DETAILED ENERGY STUDY

Report

University City Municipal Buildings University City, MO



August 2011

Prepared by





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EXECUTIVE SUMMARY

The purpose of this energy study is to provide the city with energy conservation measures (ECMs) to reduce energy use in their municipal buildings. Allen & Hoshall performed an on-site audit in September of 2011 to determine potential recommendations for reducing energy and water consumption at the following facilities:

Annex (Police/Fire/Print Shop) Trinity Building Heman Park Community Center Heman Park Pool Central Garage Heman Park Tennis Court, Restroom and Pavilion Transfer Station and MRF Public Works Sign Shop Park Maintenance Facility Golf Club House Golf Maintenance Facility Golf Range Shack Fire House #2 City Hall Centennial Commons Recreation Center

The report includes existing condition descriptions, utility bill analysis, ECM descriptions, energy savings, implementation costs, and description and cost estimate of measurement and verification for the proposed ECMs. Each ECM description will summarize the existing conditions related to the recommended ECM. The ECM description will also provide information regarding what is required for implementation. The appendix includes ECM calculations and other support information. Detailed ECM calculations include electrical consumption, electrical demand, natural gas consumptions, water consumption, and system maintenance savings where appropriate.

The energy conservation measures were separated into five categories: Lighting, HVAC controls, Water Conservation Improvements, HVAC Improvements, and Architectural Improvements. This report identifies ECM's in all categories except Water Conservation and Architectural. Water Conservation improvements are not feasible due to a large percentage of existing fixtures being low consumption and many of the buildings having to high of a fixture to occupant ratio. Architecturally the buildings that are fully conditioned were reasonably well insulated and the existing windows were double pane. Lighting ECMs included lighting fixture replacements, lighting fixture retrofits, and lighting system automated controls. Energy Management ECMs consisted of installing programmable thermostats in the Central Garage and installing plug load occupancy sensors in the City Hall and Annex. HVAC Improvements ECMs included replacement of inefficient HVAC equipment with high efficiency type equipment and the replacement of energy inefficient motors The projected energy savings for all ECMs are shown in the Saving Summary of the report.





Utility bills were provided by the city for 2010 and 2011. The utility usage for 2010 was analyzed with information gained from the site visit to estimate the percentage of the utility bills serving different uses. Graphs of electrical consumption, electrical demand, natural gas consumption, and water consumption are also provided to represent how the utility bills vary throughout the year. The utility bills for 2011 were omitted from this information as the year is not yet complete and having a partial year would skew the findings. This information can be found in each facility description.

There are three recommendations that do not require any renovation work and therefore are not given a separate ECM. The first is to install a city policy to regulate space temperature setpoints for municipal buildings. This would help reduce energy use in buildings where more sophisticated control systems would not be economically feasible and would not require any capital expenditures. See Table 1 Recommended Space Temperature Setpoints below.

Recommended Space Temp. Set Points								
Mode	Coc	Hea	ting					
Occupancy	Occ.	Unocc.	Occ.	Unocc.				
Office	74°F	80°F	70°F	60°F				
Shops	-	-	65°F	55°F				

Table 1 Recommended Space	Temperature Setpoints
---------------------------	-----------------------

The second recommendation is for the city to track the utility usage for each building. The current usage should be compared to the previous year's usage as well as a five year average usage. This would allow the city to notice any significant changes in usage and allow an investigation to be performed in an effort to control and minimize utility usage.

The third recommendation would be to investigate obtaining LEED Existing Buildings: Operations & Maintenance certification. This certification involves chemical use, recycling, maintenance, and system upgrades. This would assure the building is operated efficiently, maintains a excellent working conditions, and minimize the buildings negative impacts on the environment. The most applicable buildings are City Hall, Annex, Fire Station #2, and the Centennial Commons Recreation Center. Allen & Hoshall is capable of assisting with the city with assessing the modifications that would be necessary and the process of applying for LEED certifications.

INCENTIVES SUMMARY

When it comes to energy saving measures in the current economic and political climate, many utilities and government organizations offer incentives to encourage businesses to implement more efficient building systems. These incentives typically come in the form of tax deductions, tax refunds, or up-front funds to offset initial capital costs. As part of this study, potential candidates that could potentially provide incentives were explored.

University City's electric utility is Ameren Missouri. Their Energy Efficiency Incentive Programs closed on August 31, 2011. Future incentives from Ameren Missouri are uncertain. It is suggested to subscribe to their monthly electronic newsletter (http://www.ameren.com/sites/aue/Pages/home.aspx) for updates.





The Missouri Department of Natural Resources Division of Energy has an Energy Revolving Fund providing low-interest loans to governments for energy efficiency improvements. However, their offerings for 2011 have not been released. Nor is there any information available for 2012.

The Department of Energy currently offers a tax deduction incentive program known as the CBTD (Commerical Buildings Tax Deduction), which was created by the Energy Policy Act of 2005. In order to receive this deduction, a certified individual (professional engineer) will survey the building and determine the current lighting power density (LPD). The lighting power density is the sum of all fixture loads divided by the building square footage. This power density is compared to the ASHRAE 2001 90.1 guidelines concerning lighting power densities for different facility types. If the building's calculated LPD is 25-40% below the ASHRAE 90.1 standard, then the building is eligible for a tax deduction that ranges from \$0.30-\$0.60/sq.ft. This incentive requires that the lighting project be completed by January, 1 2014. Based on the data gathered from this report, the Annex, City Hall, Golf Course Pro Shop & Maintenance Facility, and the Central Garage are all potential candidates. However, all of the buildings listed that are government owned and that do not pay taxes will not receive the deduction. Instead, the principle designer of the lighting system will be eligible for the deduction.

			Energ	gy Consumption	n Savings			Energy Cost	Savings		-			
	University City		ĸw	Months	Steam klbs	Water kgal	KWh	ĸw	Steam	Water	Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB
ECM-1.1	Lighting Retrofit (Annex)	58,934	17	12	-	-	\$4,037	\$0	\$0	\$0	\$4,037	\$0	\$64,736	16.0
ECM-1.2	Lighting Retrofit (City Hall)	12,081	6	12	-	-	\$828	\$0	\$0	\$0	\$828	\$0	\$21,723	23.5
ECM-1.3	Lighting Retrofit (Community Center)	5,502	4	12	-	-	\$377	\$0	\$0	\$0	\$377	\$0	\$2,249	5.3
ECM-1.4	Lighting Retrofit (Fire Station #2)	5,448	-	12	-	-	\$373	\$0	\$0	\$0	\$373	\$0	\$5,829	14.4
ECM-1.5	Lighting Retrofit (Golf Course)	1,277	1	12	-	-	\$87	\$0	\$0	\$0	\$87	\$0	\$1,847	18.5
ECM-1.6	Lighting Retrofit (Public Works)	39,387	9	12	-	-	\$2,698	\$0	\$0	\$0	\$2,698	\$0	\$31,692	8.8
ECM-1.7	Lighting Retrofit (Recreation Center)	27,897	12	12	-	-	\$1,911	\$0	\$0	\$0	\$1,911	\$0	\$42,681	20.8
ECM-1.8	Lighting Retrofit (Trinity Building)	1,226	6	12	-	-	\$84	\$0	\$0	\$0	\$84	\$0	\$9,371	111.6
ECM-2.1	Install Programable T-stats Central Garage	27,671	3	12	-	-	\$1,895	\$0	\$0	\$0	\$1,895	\$0	\$227	0.1
ECM-2.2	Install Plug Load Occupancy Sensors City Hall	16,527	0	-	-	-	\$1,132	\$0	\$0	\$0	\$1,132	\$0	\$8,081	7.6
ECM-2.3	Install Plug Load Occupancy Sensors Annex	19,016	0	-	-	-	\$1,303	\$0	\$0	\$0	\$1,303	\$0	\$11,019	9.7
ECM-4.1	Unit Replacement Annex	55,706	11	12	-	2,173	\$3,816	\$0	\$0	\$7,040	\$10,856	\$0	\$101,983	9.5
ECM-4.2	Pump Motor Replacement Heman Park Pool	15,709	5	4	-	-	\$1,076	\$0	\$0	\$0	\$1,076	\$0	\$5,845	5.4
ECM-4.3	Unit Replacement Central Garage	23,643	8	12	-	-	\$1,620	\$0	\$0	\$0	\$1,620	\$903	\$19,718	7.8
TOTAL		310,022	81	12	-	-	\$21,237	-	-	-	\$28,276	\$903	\$327,002	11.2

SAVINGS SUMMARY

Table 2 Savings Summary

MEASUREMENT AND VERIFICATION SUMMARY

Measurement and Verification (M&V) for this project should be based upon the guidelines developed by the Department of Energy Federal Energy Management Program (FEMP). The FEMP M&V Guidelines outlines four different processes (Option A,B,C,D) that can be utilized to develop a M&V procedure. The type of process selected depends upon the ECM type and current available metering information. Due to the size of this project it is recommended that the cost of M&V be kept to a minimum.

The lighting ECM's will have a baseline and post-project energy usage calculated based upon the actual measurement process based on Option A. The calculated energy savings





of the M&V process will be compared to the estimated energy savings in the audit for both electrical demand (kW) and consumption (kWh).

The control ECMs should not be subject to M&V directly. The thermostat ECMs will be measured in conjunction with the unit replacement. M&V is not applicable to the plug load occupancy sensors.

The unit replacement ECMs will have a baseline and post-project energy usage calculated based upon the actual measurement process based on Option B. The calculated energy savings of the M&V process will be compared to the estimated energy savings in the audit for both electrical demand (kW) and consumption (kWh). The pump motor replacement at Heman Park Pool should not be subject to M&V as the only variable is the operation hours of the pool which are not subject to modification.

The semi-annual M&V report summary will include the proposed and actual kW savings, kWh savings, and energy cost savings for each ECM. The report will also include corrective actions that need to be taken to maximize savings. The M&V period should be 1 year. The cost for M&V is generally in a range of 3% to 6% of the construction costs. However, if a limited number of ECMs is implemented the costs on a percentage base can increase significantly.

ENVIRONMENTAL IMPACT

Along with the energy savings, 423,588 lbs of Greenhouse gases and other pollutants will be averted. For a complete breakdown see Table 3 Greenhouse Gases and Other Pollutants below.

Greenhouse Gasses and Other Pollutants										
Annual Electricity Saved (kWh):	310,022									
Pollutant:	CO ₂ *	NO _x *	SO ₂ *	Hg*	PM10*	*	PM2.5	VOC	CO	Sub-total (Electric)
Emission Factor (lb/kWh):	1.333	0.002258	0.005852	3.01E-08	0.02	24799	0.000139	0.000022	0.000147	
Lbs of Pollutant Saved:	413,260	700	1,814	0.01	7	7,688	43	7	46	423,558
Pollutant:	Greenhouse	Nitrogen	Sulfur	Toxic Metals	PM10 P	PM2.5	Nitrous	Volatile	Carbon	Total
Pollutant:	Greenhouse Gases (CO ₂)	Nitrogen Oxides	Sulfur Dioxide	Toxic Metals (Hg)	PM10 P	PM2.5	Nitrous Oxides	Volatile Organic	Carbon Monoxide	Total
Pollutant:		•			PM10 P	PM2.5				Total
Pollutant:		Oxides	Dioxide		PM10 P	PM2.5	Oxides	Organic	Monoxide	Total

Table 3 Greenhouse Gases and Other Pollutants





FACILITY DESCRIPTIONS

<u>Annex</u>

Building Description



This facility is a three story building originally built in 1903 located at 6801 Delmar Blvd. It is approximately 49,000 ft² and has received various renovations over the years. It currently houses the Police Station, Fire House, and Print Shop. The majority of this building is in operation 24-7 and has approximately 141 full time staff.

HVAC Description

The Annex is served by multiple types of mechanical systems. The Police Dispatch, Detectives Offices, and Fire Bunks are served by rooftop units. The Police Dispatch unit newer unit with electric heat. The Fire Bunks unit is also a newer unit but has gas heat. The unit serving the Detectives Office is an older unit and also has gas heat.

There are also several split system units that serve the Office, Fire Chief/Kitchen, Fire Office/EOC, Police Offices, Locker Rooms, and Service Support. All of the units have steam heating coils with the exception of the units serving the Locker Rooms and Service Support, which have gas heat. Also on the steam system are three heaters serving the fire truck bay. Steam is provided from the adjacent Trinity Building.

The Server Room, Telephone Room, and Basement Jail Cells are served by Water-Source units. The water for these units are provided directly from the domestic water service then passes through the unit to the sewer. This causes a large amount of fresh water usage.





Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	20%
Miscellaneous:	22%
AHU Fans & Pumps:	15%
Cooling:	42%
Totals:	100%

Estimated Natural Gas Consumption

Heating:	59%
Domestic water:	41%
Totals:	100%

The total utility cost for the Annex in 2010 was \$82,565.02. It should be noted that a portion of the heat for this building comes from the steam boilers in the adjacent Trinity building and the Annex provides the City Hall with hot water. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.

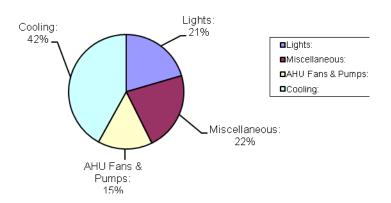


Figure 1 Electrical Usage Breakdown - Annex





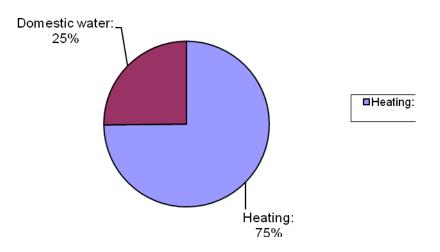


Figure 2 Natural Gas Usage Breakdown - Annex

	Utility Bill Analysis For ANNEX (Police / Fire / Print Shop)																
Period End	Electricity Consumption	Electricity Cost	Electricity Consumption		Electric			Natural Gas Consumptio		atural Gas Cost		Gas	Water Consumption	Water Cost	Water Rate	HDD	CDD
			Rate		Cos		Rate	n				Rate					
	(kWh)	(\$)	(\$/kWh)	(kW)	(\$)		(\$/kW)	(CCF)		(\$)		(\$/ccf)	(Gal.)	(\$)	(\$/kGal)		
January-10	45,360	\$ 1,761.90	\$ 0.03884	100	\$ 140	.00	\$ 1.40	7236	\$	5,540.14	\$	0.77	546,750	\$ 1,518.87	\$ 2.78	1009	0
February-10	40,080	\$ 1,595.98	\$ 0.03982	100	\$ 140	.00	\$ 1.40	6537	\$	5,027.73	\$	0.77	546,750	\$ 1,518.87	\$ 2.78	820	0
March-10	40,800	\$ 1,642.80	\$ 0.04026	100	\$ 140	.00	\$ 1.40	4678	\$	3,677.88	\$	0.79	457,250	\$ 1,841.13	\$ 4.03	350	15
April-10	48,720	\$ 1,656.77	\$ 0.03401	144	\$ 201	.60	\$ 1.40	2544	\$	2,135.04	\$	0.84	457,250	\$ 1,841.13	\$ 4.03	39	166
May-10	49,680	\$ 3,275.53	\$ 0.06593	124	\$ 469	.85	\$ 3.79	464	\$	429.78	\$	0.93	457,250	\$ 1,841.13	\$ 4.03	20	277
June-10	75,120	\$ 4,547.34	\$ 0.06053	136	\$ 527	.82	\$ 3.87	101	\$	137.45	\$	1.36	588,500	\$ 1,756.08	\$ 2.98	0	623
July-10	73,200	\$ 4,809.37	\$ 0.06570	138	\$ 573	.53	\$ 4.15	92	\$	130.40	\$	1.42	588,500	\$ 1,756.08	\$ 2.98	0	706
August-10	70,800	\$ 4,796.76	\$ 0.06775	147	\$ 609	.64	\$ 4.15	66	\$	110.00	\$	1.67	588,500	\$ 1,756.08	\$ 2.98	0	695
September-10	64,080	\$ 2,764.54	\$ 0.04314	128	\$ 196	.66	\$ 1.54	87	\$	131.03	\$	1.51	674,750	\$ 2,152.45	\$ 3.19	4	353
October-10	45,600	\$ 2,052.59	\$ 0.04501	107	\$ 164	.78	\$ 1.54	91	\$	138.13	\$	1.52	674,750	\$ 2,152.45	\$ 3.19	66	132
November-10	48,720	\$ 2,080.77	\$ 0.04271	100	\$ 154	.00	\$ 1.54	2307	\$	1,980.64	\$	0.86	674,750	\$ 2,152.45	\$ 3.19	336	9
December-10	45,600	\$ 1,943.62	\$ 0.04262	100	\$ 154	.00	\$ 1.54	5762	\$	4,443.29	\$	0.77	626,000	\$ 1,996.94	\$ 3.19	912	0
Totals:	647,760	\$32,927.97	\$ 0.05083	1,424	\$3,471	.88	\$ 2.44	29,965	\$	23,881.51	\$	0.80	6,881,000	\$22,283.66	\$ 3.24		

Electric Consumption Rate:	\$0.05083 /kWh
Electric Demand Rate	\$2.44 /kW
Natural Gas Consumption Rate	\$0.80 /ccf
Annual Cost/Sq.ft - Electricity:	\$0.743 /sqft
Annual Cost/Sq.ft - Gas.:	\$0.487 /sqft
Annual Cost/Sq.ft - Total:	\$1.230 /sqft

Annual Cost/Sq.ft - Electricity:	50
Annual Cost/Sq.ft - Gas.:	\$
Annual Cost/Sq.ft - Total:	\$

Table 4 Utility Bill Analysis - Annex





90,000 1200 80,000 1000 70.000 60,000 800 Electrical Consumption (kWh) 50,000 Degree Days 600 40,000 30,000 400 20,000 200 10,000 0 0 10 6 9 11 12 2 3 4 5 8 Month kWh

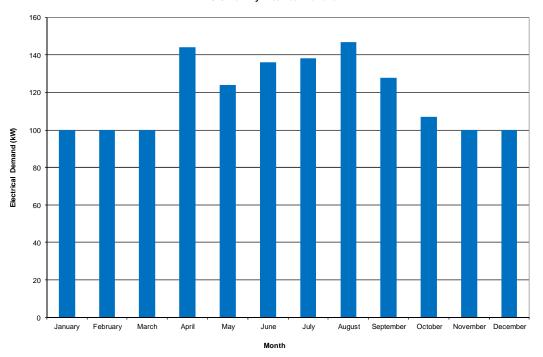
2010 Monthly Electrical Consumption

Figure 3 Monthly Electrical Consumption - Annex

Figure 3 Monthly Electrical Consumption - Annex details the electrical consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. Based on the graph, the electrical consumption peaks in June and the cooling degree days peak in July. This slight discrepancy could be due the timing of the electric billing cycle.







2010 Monthly Electrical Demand

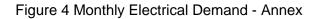
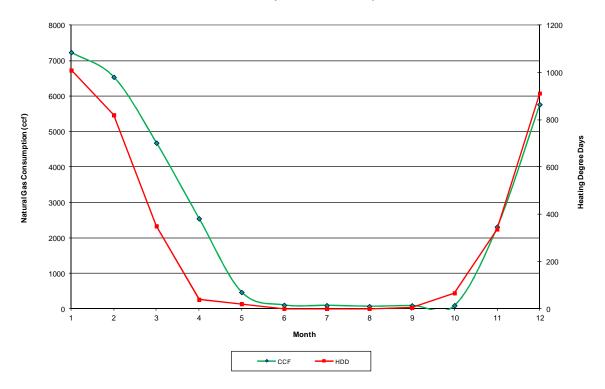


Figure 4 Monthly Electrical Demand - Annex suggests the same conclusions as the electric consumption graph. The peak months correspond to the higher cooling load required during the summer season.







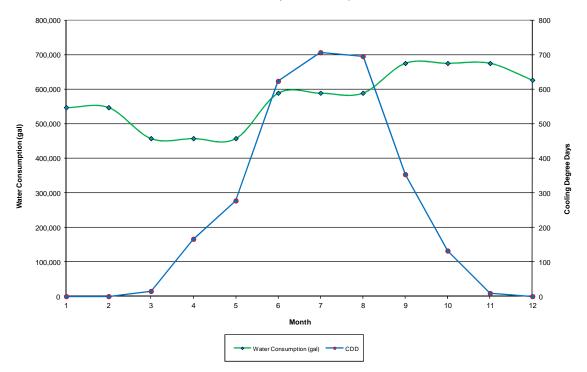
2010 Monthly Natural Gas Consumption

Figure 5 Monthly Natural Gas Consumption - Annex

Figure 5 Monthly Natural Gas Consumption - Annex details the natural gas consumption and each month's corresponding heating degree days. Heating degree days (HDD) are a measure of the severity of the heating requirements in a given locality; the more heating degree days, the cooler the winter. Based on the graph, the gas consumption and the heating degree days peak in January.







2010 Monthly Water Consumption

Figure 6 Monthly Water Consumption - Annex

Figure 6 Monthly Water Consumption - Annex details the water consumption. The water consumption is relatively flat due to the limited use of water for HVAC systems. Where water is used for HVAC systems it is used for computer room type areas that require cooling much of the year and is not as dependent on weather.





Trinity Building



Building Description

This building is a three story building of approximately 16,000 ft² built in 1939 as a library. This building is unoccupied a majority of the year. Much of the space is storage, a few small offices that are used for fair planning. When it is occupied its hours are 8am-5pm Monday through Friday and there are only a few employees.

HVAC Description

Cooling is provided by several window air-conditioners. During the audit the building was empty and was being kept warmer than an occupied building would normally be. Even with minimal conditioning humidity did not appear to be a problem. Heat was provided by steam radiators along the exterior of the building.

Two seven year old steam boilers are located in the basement and each have a capacity of 2,650 lbs/hr. These boilers provide steam to the Trinity building as well as the adjacent City Hall and Annex buildings. At the time of the audit the boilers were open awaiting yearly state inspection. The boilers were in excellent condition. It should be noted that the entire steam distribution system in all three buildings was in excellent shape. It would be difficult to find system losses while the system is not operational, however the system appeared to be well maintained and any significant system losses would not be expected.





Utility Summary

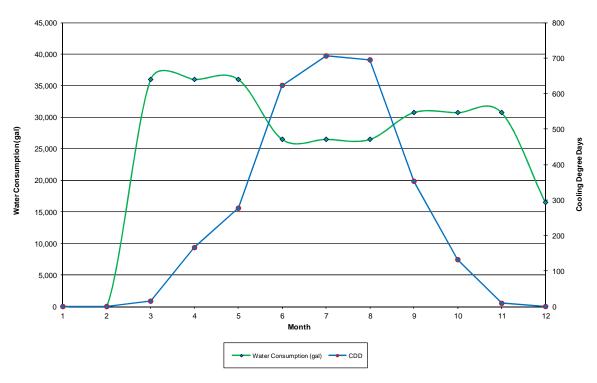
Electrical and gas bills were not available for the Trinity Building. The total utility cost for water at the Trinity Building in 2010 was \$886.48 for the past 12 months.

Utility Bill Analysis For Trinity Building												
Period End	Water	Water	Water	HDD	CDD							
	Consumption	Cost	Rate									
	(Gal.)	(\$)	(\$/kGal)									
January-10	0	\$-	\$-	1009	0							
February-10	0	\$-	\$-	820	0							
March-10	36,000	\$ 100.01	\$ 2.78	350	15							
April-10	36,000	\$ 100.01	\$ 2.78	39	166							
May-10	36,000	\$ 100.01	\$ 2.78	20	277							
June-10	26,500	\$ 79.85	\$ 3.01	0	623							
July-10	26,500	\$ 79.85	\$ 3.01	0	706							
August-10	26,500	\$ 79.85	\$ 3.01	0	695							
September-10	30,750	\$ 98.09	\$ 3.19	4	353							
October-10	30,750	\$ 98.09	\$ 3.19	66	132							
November-10	30,750	\$ 98.09	\$ 3.19	336	9							
December-10	16,500	\$ 52.64	\$ 3.19	912	0							
Totals:	296,250	\$ 886.48	\$ 2.99									

Table 5 Utility Bill Analysis - Trinity Building







2010 Monthly Water Consumption

Figure 7 Monthly Water Consumption - Trinity Building

Figure 7 Monthly Water Consumption - Trinity Buildingdetails the water consumption. The water consumption is relatively flat due to no usage of water for HVAC systems. The fluctuations are attributed entirely to building occupancy.





Heman Park Community Center



Building Description

This building is a one story 9,100 square foot facility originally built in 1958. There is one office off the main entry room with the rest of the building divided into two large multipurpose rooms. Each of which has a kitchen. The building is currently used 8am-5pm Monday through Thursday and as reserved Friday through Sunday. There is one full-time employee and an estimated thirty senior citizens occupying one of the multi-purpose rooms on the day of the audit. There was some uncertainty about the future use of the building as moving the senior citizens to another location.

HVAC Description

The building is conditioned by two packaged units with gas heat located on grade at the rear of the building in a fenced enclosure. There is also one split system to supplement the packaged units cooling capabilities.

Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	15%
Miscellaneous:	6%
AHU Fans & Pumps:	31%
Cooling:	48%
Totals:	100%

Estimated Natural Gas Consumption

Heating:	89%
Domestic water:	11%
Totals:	100%



The total utility cost for the Heman Park Community Center in 2010 was \$19,663.78. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.

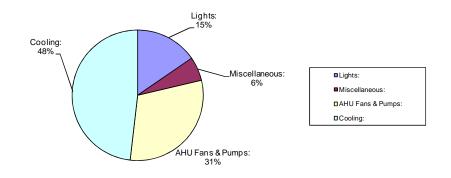


Figure 8 Electrical Usage Breakdown - Heman Park Community Center

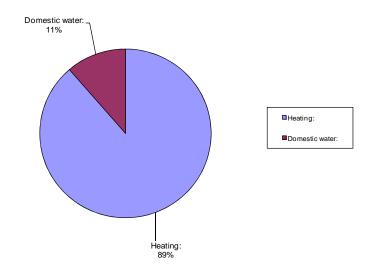


Figure 9 Natural Gas Usage Breakdown - Heman Park Community Center





	Utility Bill Analysis For Heman Park Community Center															
Period End	Electricity	E	lectricity	E	Electricity	Natural Gas	Na	tural Gas		Gas	Water	Wa	ater Cost	Water	HDD	CDD
	Consumption		Cost	Co	onsumption	Consumption		Cost	Co	onsumption	Consumption			Rate		
					Rate					Rate						
	(kWh)		(\$)		(\$/kWh)	(CCF)		(\$)		(\$/ccf)	(Gal.)		(\$)	\$/kGal)		
January-10	9,610	\$	588.13	\$	0.06120	1,682	\$	1,451.85	\$	0.86	16,000	\$	44.45	\$ 2.78	1009	0
February-10	10,560	\$	646.27	\$	0.06120	1,343	\$	1,203.49	\$	0.90	16,000	\$	44.45	\$ 2.78	820	0
March-10	8,230	\$	503.68	\$	0.06120	813	\$	817.02	\$	1.00	12,750	\$	35.41	\$ 2.78	350	15
April-10	10,090	\$	617.51	\$	0.06120	225	\$	287.22	\$	1.28	12,750	\$	35.41	\$ 2.78	39	166
May-10	11,240	\$	922.80	\$	0.08210	103	\$	117.95	\$	1.15	12,750	\$	35.41	\$ 2.78	20	277
June-10	25,350	\$	2,136.13	\$	0.08427	99	\$	114.62	\$	1.16	20,750	\$	61.92	\$ 2.98	0	623
July-10	22,780	\$	2,095.76	\$	0.09200	86	\$	104.30	\$	1.21	20,750	\$	61.92	\$ 2.98	0	706
August-10	22,470	\$	2,067.24	\$	0.09200	79	\$	98.67	\$	1.25	20,750	\$	61.92	\$ 2.98	0	695
September-10	17,700	\$	1,076.92	\$	0.06084	84	\$	106.58	\$	1.27	19,500	\$	62.21	\$ 3.19	4	353
October-10	10,100	\$	748.14	\$	0.07407	134	\$	150.12	\$	1.12	19,500	\$	62.21	\$ 3.19	66	132
November-10	8,560	\$	637.16	\$	0.07443	457	\$	571.06	\$	1.25	19,500	\$	62.21	\$ 3.19	336	9
December-10	10,230	\$	753.77	\$	0.07368	1,358	\$	1,231.22	\$	0.91	15,250	\$	48.65	\$ 3.19	912	0
Totals:	166,920	\$	12,793.51	\$	0.07664	6,463	\$	6,254.10	\$	0.97	206,250	\$	616.17	\$ 2.99		

Electric Consumption Rate: Natural Gas Consumption Rate: \$0.07664 /kWh \$0.97 /ccf

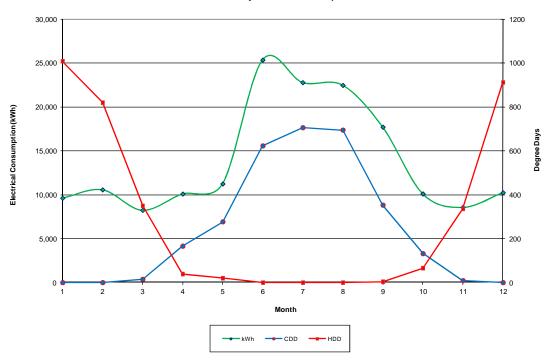
Annual Cost/Sq.ft - Electricity: Annual Cost/Sq.ft - Gas.: Annual Cost/Sq.ft - Total:

\$1.406 /sqft \$0.687 /sqft \$2.093 /sqft

Table 6 Utility Bill Analysis - Heman Park Community Center







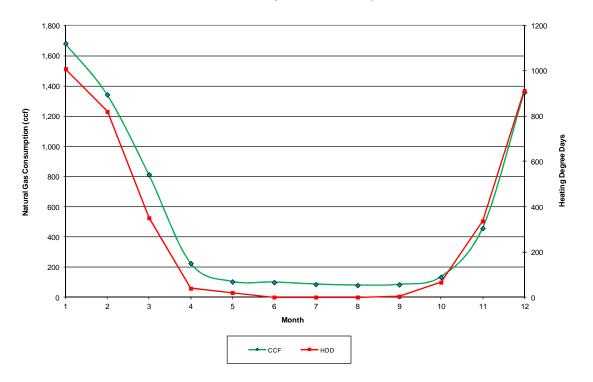
2010 Monthly Electrical Consumption

Figure 10 Monthly Electrical Consumption - Heman Park Community Center

Figure 10 Monthly Electrical Consumption - Heman Park Community Center details the electrical consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. Based on the graph, the electrical consumption peaks in June and the cooling degree days peak in July. This slight discrepancy could be due the timing of the electric billing cycle.





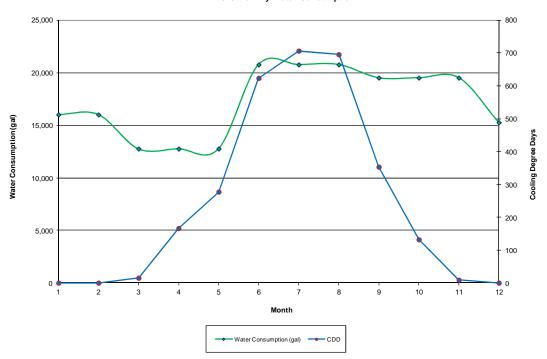


2010 Monthly Natural Gas Consumption

Figure 11 Monthly Natural Gas Consumption - Heman Park Community Center

Figure 11 Monthly Natural Gas Consumption - Heman Park Community Center details the natural gas consumption and each month's corresponding heating degree days. Heating degree days (HDD) are a measure of the severity of the heating requirements in a given locality; the more heating degree days, the cooler the winter. Based on the graph, the gas consumption and the heating degree days peak in January. The baseline consumption comes from the gas water heater and the pilot lights on the stoves. It is our understanding that the stoves are used very infrequently. Money could be saved if it is feasible to shut off these pilot lights.





2010 Monthly Water Consumption

Figure 12 Monthly Water Consumption - Heman Park Community Center

Figure 12 Monthly Water Consumption - Heman Park Community Center details the water consumption. Water Consumption at Heman Park Community Center varies entirely with occupant usage as no water is used for HVAC.





Heman Park Pool



Building Description

This pool facility is 2,800 ft² and was built in 1933. The building consists of equipment rooms for the filtration equipment, a large breezeway, locker room for the lifeguards, and a small office. Outside are two pools, on large main pool and a smaller kiddies' pool. There are approximately ten employees during the swim season which runs from late May to early September and is open from 6am through 8 pm.

HVAC Description

The only conditioned space is the small office. It has one small window air-conditioner.

Utility Summary

Utility Usage Breakdown

Estimated Natural Gas Consumption

Heating:	0%
Domestic water:	100%
Totals:	100%





Overall, the total utility cost for the Heman Park Pool is \$473.42 for the past 12 months. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel. Electric and water bills were not available. It appears that these are combined with the adjacent Centennial Commons.

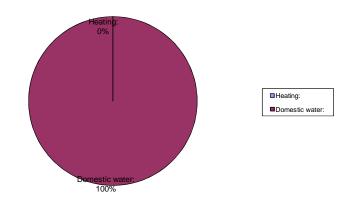


Figure 13 Natural Gas Usage Breakdown - Heman Park Pool





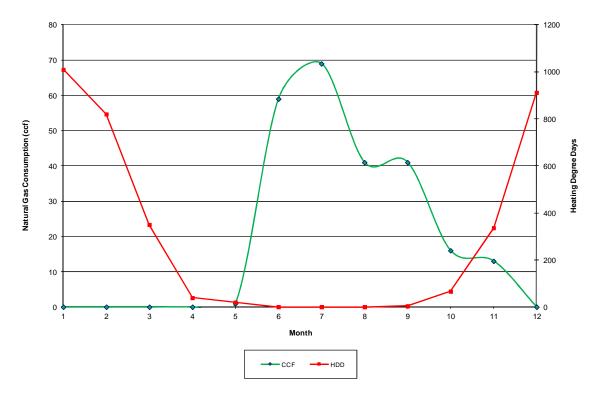
Utility Bill Analysis For Heman Park Pool												
Period End	Natural Gas	Na	tural Gas		Gas	HDD	CDD					
	Consumption		Cost	Co	nsumption							
					Rate							
	(CCF)		(\$)		(\$/ccf)							
January-10	0	\$	21.54	\$	-	1009	0					
February-10	0	\$	21.54	\$	-	820	0					
March-10	0	\$	21.54	\$	-	350	15					
April-10	0	\$	21.81	\$	-	39	166					
May-10	1	\$	22.79	\$	22.79	20	277					
June-10	59	\$	69.32	\$	1.17	0	623					
July-10	69	\$	77.27	\$	1.12	0	706					
August-10	41	\$	55.14	\$	1.34	0	695					
September-10	41	\$	56.78	\$	1.38	4	353					
October-10	16	\$	38.39	\$	2.40	66	132					
November-10	13	\$	41.80	\$	3.22	336	9					
December-10	0	\$	25.50	\$	-	912	0					
Totals:	240	\$	473.42	\$	1.97							
Natural Gas Consu	mption Rate:	\$	1.97	/cc	f		-					

•			
Annual Cost/Sq.ft -	Gas.:	\$ 0.17	/sqft
Annual Cost/Sq.ft -	Total:	\$ 0.17	/sqft

Table 7 Utility Bill Analysis - Heman Park Pool







2010 Monthly Natural Gas Consumption

Figure 14 Monthly Natural Gas Consumption - Heman Park Pool

Figure 14 Monthly Natural Gas Consumption - Heman Park Pool details the natural gas consumption and each month's corresponding heating degree days. Heating degree days (HDD) are a measure of the severity of the heating requirements in a given locality; the more heating degree days, the cooler the winter. Based on the graph, the gas usage peaks during the summer when the pool is in use, and drops off in the winter. This is due to hot water usage and the lack of heated space.



Central Garage



Building Description

The Central Garage is the vehicle maintenance facility for city vehicles, is 14,000 ft² and was built in 1970. The main office at the front of the building is approximately 620 ft². There is also an office and break room in the shop that is approximately 460 ft ². The remainder of the building is shop space. There are six full time employees and the operating hours are 6:30am-5pm Monday through Friday and 8am-Noon on Saturday.

HVAC Description

The main office and the office in the shop are conditioned by a 2.5-ton and a 3-ton split systems, respectively. The condensing unit for the main office has been replaced but the indoor unit was not. Staff reported continuing maintenance issues with this unit and the offices it served were being conditioned by window air conditioners. The shop area was heated by both gas fired low-intensity infrared heaters and gas fired unit heaters.

Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	40%
Miscellaneous:	37%
AHU Fans & Pumps:	5%
Cooling:	18%
Totals:	100%

Estimated Natural Gas Consumption

Heating:	83%
Domestic water:	17%
Totals:	100%



Overall, the total utility cost for the Central Garage is \$20,335.03 for the past 12 months. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.

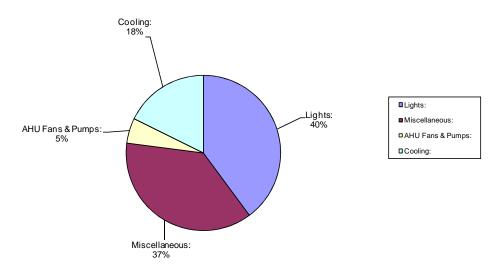


Figure 15 Electrical Usage Breakdown - Central Garage

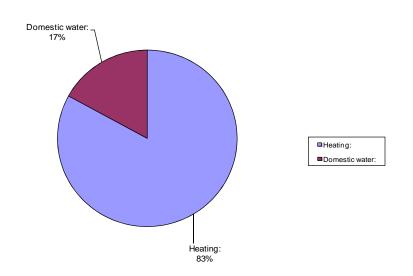


Figure 16 Natural Gas Usage Breakdown - Central Garage





	Utility Bill Analysis For Central Garage														
Period End	Electricity	Electricity Electricity		city Electricity Electricity Natural Gas Natura				atural Gas		Gas	Water	Water	Water	HDD	CDD
	Consumption		Cost	Co	nsumption	Consumption		Cost	Co	onsumption	Consumption	Cost	Rate		
					Rate					Rate					
	(kWh)		(\$)		(\$/kWh)	(CCF)		(\$)		(\$/ccf)	(Gal.)	(\$)			
January-10	5,734	\$	288.50	\$	0.05031	6,048	\$	4,638.71	\$	0.77	14,750	\$40.98	\$2.78	1009	0
February-10	5,672	\$	286.31	\$	0.05048	5,360	\$	4,132.70	\$	0.77	14,750	\$40.98	\$2.78	820	0
March-10	3,472	\$	208.43	\$	0.06003	3,677	\$	2,905.41	\$	0.79	15,000	\$41.67	\$2.78	350	15
April-10	2,518	\$	170.81	\$	0.06784	893	\$	878.30	\$	0.98	15,000	\$41.67	\$2.78	39	166
May-10	2,050	\$	185.02	\$	0.09025	77	\$	97.08	\$	1.26	15,000	\$41.67	\$2.78	20	277
June-10	2,913	\$	262.59	\$	0.09014	23	\$	53.51	\$	2.33	14,750	\$44.01	\$2.98	0	623
July-10	2,804	\$	276.58	\$	0.09864	19	\$	50.33	\$	2.65	14,750	\$44.01	\$2.98	0	706
August-10	2,744	\$	271.06	\$	0.09878	17	\$	48.75	\$	2.87	14,750	\$44.01	\$2.98	0	695
September-10	2,780	\$	201.72	\$	0.07256	20	\$	54.18	\$	2.71	15,500	\$49.45	\$3.19	4	353
October-10	2,520	\$	191.42	\$	0.07596	25	\$	60.95	\$	2.44	15,500	\$49.45	\$3.19	66	132
November-10	3,180	\$	217.56	\$	0.06842	503	\$	619.72	\$	1.23	15,500	\$49.45	\$3.19	336	9
December-10	5,360	\$	303.88	\$	0.05669	4,361	\$	3,392.32	\$	0.78	16,250	\$51.84	\$3.19	912	0
Totals:	41,747	\$ 2	2,863.88	\$	0.06860	21,023	\$	16,931.96	\$	0.81	181,500	\$539.19	\$2.97		

Electric Consumption Rate: \$0. Natural Gas Consumption Rate

\$0.06860 /kWh \$0.81 /ccf

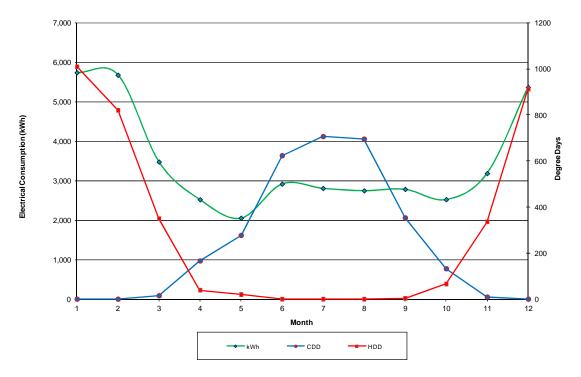
Annual Cost/Sq.ft - Electricity: Annual Cost/Sq.ft - Gas.: Annual Cost/Sq.ft - Total:

\$0.205 /sqft \$1.209 /sqft \$1.414 /sqft

Table 8 Utility Bill Analysis - Central Garage







2010 Monthly Electrical Consumption

Figure 17 Monthly Electrical Consumption - Central Garage

Figure 17 Monthly Electrical Consumption - Central Garage details the electrical consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. Based on the graph, the electrical consumption peaks in June and the cooling degree days peak in July. This slight discrepancy could be due the timing of the electric billing cycle.





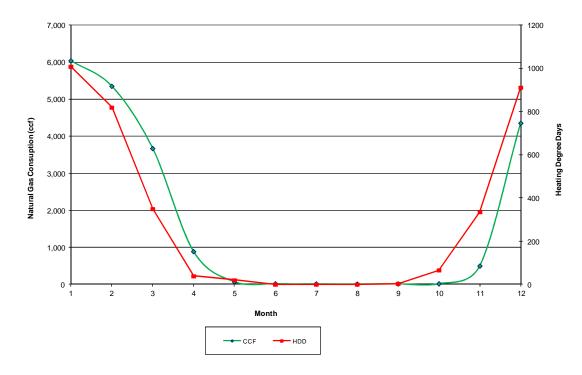
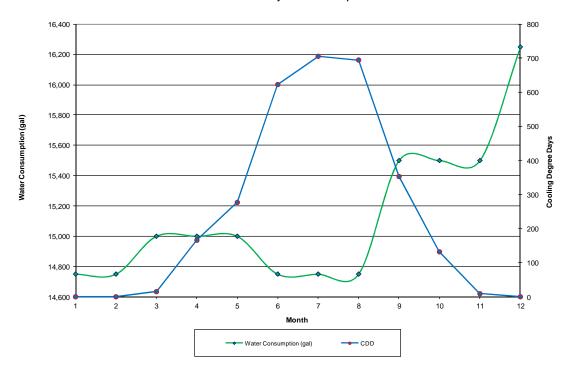


Figure 18 Monthly Natural Gas Consumption - Central Garage

Figure 18 Monthly Natural Gas Consumption - Central Garage details the natural gas consumption and each month's corresponding heating degree days. Heating degree days (HDD) are a measure of the severity of the heating requirements in a given locality; the more heating degree days, the cooler the winter. Based on the graph, the gas consumption and the heating degree days peak in January.







2010 Monthly Water Consumption

Figure 19 Monthly Water Consumption - Central Garage

Figure 19 Monthly Water Consumption - Central Garage details the water consumption. Water is not used for the Central Garage HVAC. Usage fluctuations is based solely on occupant usage.







Heman Park Tennis court, Restroom, and Pavilion

Building Description

This recreation area has approximately 850 ft² of covered facilities with no conditioned spaces. Staff noted that a renovation had been completed recently and any renovations to the tennis courts would likely draw complaints from the users. It was decided by public works staff that an audit of this facility was unnecessary.

Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	100%
Miscellaneous:	0%
AHU Fans & Pumps:	0%
Cooling:	0%
Totals:	100%

Overall, the total utility cost for the Heman Park Tennis Court, Restroom and Pavilion is \$2,510.50 for the past 12 months. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.





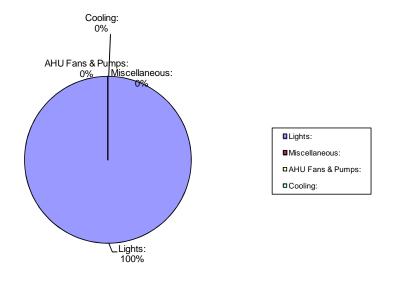


Figure 20 Electricity Usage Breakdown - Heman Park Tennis Court, Restroom and Pavilion

Utility Bill Analysis For Heman Park Tennis Court, Restroom, and Pavilion											
Period End	Electricity	E	lectricity	ectricity	HDD	CDD					
	Consumption		Cost	Cor	sumption						
			(4)		Rate						
	(kWh)		(\$)	,	\$/kWh)						
January-10	1,300	\$	87.59	\$	0.06738	1009	0				
February-10	521	\$	39.92	\$	0.07662	820	0				
March-10	2,714	\$	174.13	\$	0.06416	350	15				
April-10	3,183	\$	193.59	\$	0.06082	39	166				
May-10	2,269	\$	146.89	\$	0.06474	20	277				
June-10	3,369	\$	284.62	\$	0.08448	0	623				
July-10	3,018	\$	281.79	\$	0.09337	0	706				
August-10	3,388	\$	321.03	\$	0.09476	0	695				
September-10	3,729	\$	352.40	\$	0.09450	4	353				
October-10	3,864	\$	228.14	\$	0.05904	66	132				
November-10	3,884	\$	228.93	\$	0.05894	336	9				
December-10	2,433	\$	171.47	\$	0.07048	912	0				
Totals:	33,672	\$	2,510.50	\$	0.07456						

Electric Consumption Rate:

\$0.07456 /kWh

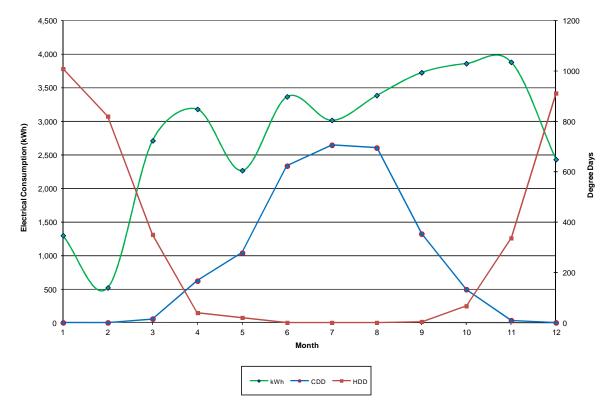
Annual Cost/Sq.ft - Electricity: Annual Cost/Sq.ft - Total:

\$2.954 /sqft \$2.954 /sqft

Table 9 Utility Bill Analysis - Heman Park Tennis Court, Restroom and Pavilion







2010 Monthly Electrical Consumption

Figure 21 Monthly Electrical Consumption - Heman Park Tennis Court, Restroom and Pavilion

Figure 21 Monthly Electrical Consumption - Heman Park Tennis Court, Restroom and Pavilion details the electrical consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. This buildings is not conditioned. All electrical use is lighting and will vary with the lighting usage.



Transfer Station and MRF



Building Description

The Transfer Station is a 9,600 ft² facility built in 1969 to transfer garbage from the route trucks to larger trucks for delivery to the landfill. The building also has a recyclables sorting machine that is no longer in use. There is also open space where other miscellaneous work is performed. There are eleven full time employees and the operating hours are 6:30am-5pm Monday through Friday and 8am-Noon on Saturday.

HVAC Description

The majority of this facility is heated only. This is provided by a 900 MBH direct fired unit. There is also a small office/break room that appears to be unoccupied that is conditioned by a PTAC unit that is inoperable. The MRF is a small shack there the route trucks unload that is conditioned by a small window unit and heated by a small electric wall heater.

Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	44%
Miscellaneous:	29%
AHU Fans & Pumps:	27%
Cooling:	0%
Totals:	100%





Estimated Natural Gas Consumption

Heating:	100%
Domestic water:	0%
Totals:	100%

Overall, the total utility cost for the Transfer Station and MRF is \$4,385.35 for the past 12 months. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.

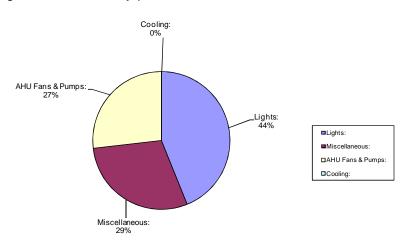


Figure 22 Electricity Usage Breakdown - Transfer Station and MRF

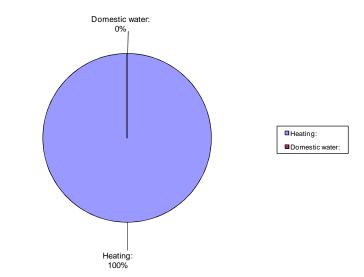


Figure 23 Natural Gas Usage Breakdown - Transfer Station and MRF





Utility Bill Analysis For Transfer Station & MRF																								
Period End	Electricity	tricity Electricity Electricity Natural Gas Natural Gas			Gas Water		V	Vater	Water	HDD	CDD													
	Consumption		Cost	Coi	nsumption	Consumption		Cost		Cost		Cost		Cost		Cost		onsumption	Consumption		Cost	Rate		
					Rate			I						Rate										
	(kWh)		(\$)	((\$/kWh)	(CCF)		(\$)		(\$/ccf)	(Gal.)		(\$)											
January-10	934	\$	65.19	\$	0.06980	1,091	\$	829.49	\$	0.76	4,250	\$	11.81	\$2.78	1009	0								
February-10	937	\$	65.37	\$	0.06977	988	\$	755.25	\$	0.76	4,250	\$	11.81	\$2.78	820	0								
March-10	660	\$	48.42	\$	0.07336	611	\$	486.12	\$	0.80	4,250	\$	11.81	\$2.78	350	15								
April-10	589	\$	44.08	\$	0.07484	87	\$	112.65	\$	1.29	4,250	\$	11.81	\$2.78	39	166								
May-10	532	\$	51.71	\$	0.09720	27	\$	43.83	\$	1.62	4,250	\$	11.81	\$2.78	20	277								
June-10	845	\$	79.51	\$	0.09409	7	\$	27.65	\$	3.95	4,250	\$	12.68	\$2.98	0	623								
July-10	784	\$	81.46	\$	0.10390	8	\$	28.45	\$	3.56	4,250	\$	12.68	\$2.98	0	706								
August-10	740	\$	77.41	\$	0.10461	7	\$	27.65	\$	3.95	4,250	\$	12.68	\$2.98	0	695								
September-10	718	\$	58.58	\$	0.08159	7	\$	29.50	\$	4.21	5,250	\$	16.75	\$3.19	4	353								
October-10	627	\$	52.34	\$	0.08348	13	\$	35.94	\$	2.76	5,250	\$	16.75	\$3.19	66	132								
November-10	771	\$	62.22	\$	0.08070	480	\$	393.88	\$	0.82	5,250	\$	16.75	\$3.19	336	9								
December-10	938	\$	73.68	\$	0.07855	899	\$	685.30	\$	0.76	7,000	\$	22.33	\$3.19	912	0								
Totals:	9,075	\$	759.97	\$	0.08374	4,225	\$	3,455.71	\$	0.82	56,750	\$	169.67	\$2.99										

Electric Consumption Rate: \$0.08374 /kWh Natural Gas Consumption Rate

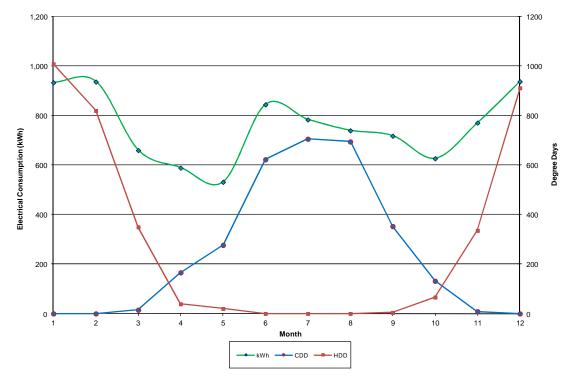
\$0.82 /ccf

Annual Cost/Sq.ft - Electricity: \$0.079 /sqft Annual Cost/Sq.ft - Gas.: \$0.360 /sqft Annual Cost/Sq.ft - Total:

\$0.439 /sqft Table 10 Utility Bill Analysis - Transfer Station and MRF







2010 Monthly Electrical Consumption

Figure 24 Monthly Electrical Consumption - Transfer Station and MRF

Figure 24 Monthly Electrical Consumption - Transfer Station and MRF details the electrical consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. Based on the graph, the electrical consumption peaks in February due to some electric heat, increased light usage due to shorter daylight hours, and the lack of cooling.



City of University City

Detailed Energy Study University City Municipal Buildings

2010 Monthly Natural Gas Consumption

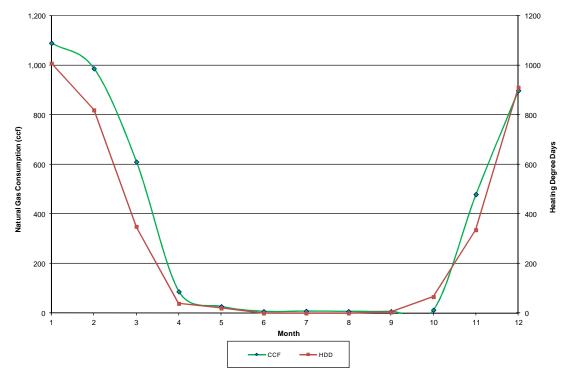


Figure 25 Monthly Gas Consumption - Transfer Station and MRF

Figure 25 Monthly Gas Consumption - Transfer Station and MRF details the natural gas consumption and each month's corresponding heating degree days. Heating degree days (HDD) are a measure of the severity of the heating requirements in a given locality; the more heating degree days, the cooler the winter. Based on the graph, the gas consumption and the heating degree days peak in January.





Public Works Sign Shop



Building Description

This building is 1,900 ft² and was built in 1970. It is set up to produce signage. There is one full time employee and the official operating hours are 6:30am-5pm Monday through Friday and 8am-Noon on Saturday. The building was unoccupied during the site visit and staff noted that the occupancy varies.

HVAC Description

The sign shop is heated only by two gas fired unit heaters. The window air conditioner was not connected to a power supply.

Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	42%
Miscellaneous:	47%
AHU Fans & Pumps:	11%
Cooling:	0%
Totals:	100%

Natural gas consumption data was not available for the Public Works Sign Shop.





Overall, the total utility cost for the Public Works Sign Shop is \$8,202.82 for the past 12 months, excluding gas and water usage. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.

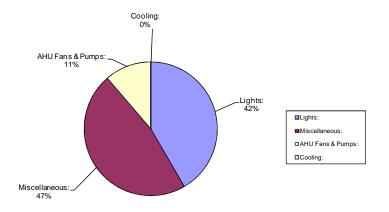


Figure 26 Electricity Usage Breakdown - Public Works Sign Shop

Utility Bill Analysis For Public Works Sign Shop										
Period End	Electricity	E	lectricity	E	ectricity	HDD	CDD			
	Consumption		Cost	Con	sumption					
					Rate					
	(kWh)		(\$)	(\$/kWh)					
January-10	8,819	\$	530.22	\$	0.06012	1009	0			
February-10	8,507	\$	519.17	\$	0.06103	820	0			
March-10	7,908	\$	497.97	\$	0.06297	350	15			
April-10	7,508	\$	476.20	\$	0.06343	39	166			
May-10	7,818	\$	658.57	\$	0.08424	20	277			
June-10	11,685	\$	1,001.76	\$	0.08573	0	623			
July-10	12,080	\$	1,129.97	\$	0.09354	0	706			
August-10	11,547	\$	1,080.93	\$	0.09361	0	695			
September-10	9,940	\$	629.97	\$	0.06338	4	353			
October-10	7,405	\$	526.59	\$	0.07111	66	132			
November-10	8,283	\$	564.35	\$	0.06813	336	9			
December-10	8,858	\$	587.12	\$	0.06628	912	0			
Totals:	110,358	\$	8,202.82	\$	0.07433					

Electric Consumption Rate:

\$0.07433 /kWh

\$4.317 /sqft

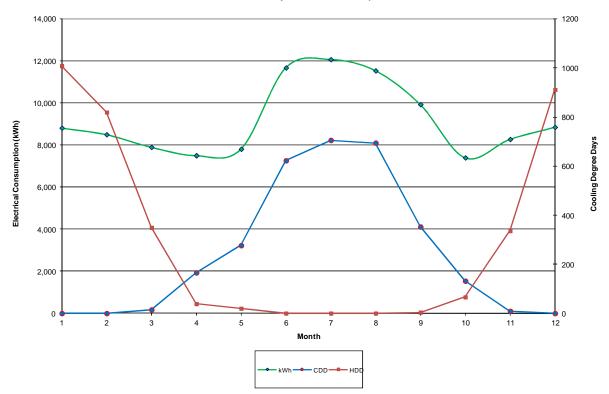
\$4.317 /sqft

Annual Cost/Sq.ft - Electricity:	
Annual Cost/Sq.ft - Total:	

Table 11 Utility Bill Analysis - Public Works Sign Shop







2010 Monthly Electrical Consumption

Figure 27 Monthly Electrical Consumption - Public Works Sign Shop

Figure 27 Monthly Electrical Consumption - Public Works Sign Shop details the electric consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. Based on the graph, the electrical consumption and the cooling degree days peak in July.





Park Maintenance Facility



Building Description

This building is a 6,300 ft² building built in 1970. The majority of the facility is a workshop and storage area with a 285 ft² office. There are two full time employees and the operating hours are 6:30am-5pm Monday through Friday and 8am-Noon on Saturday. However the occupancy varies depending on how many of the crew has come in from the field. During the site visit there were approximately 10 employees.

HVAC Description

The shop area of the building is heated only by four gas fired unit heaters and one gas fired furnace. The office is cooled by a window air conditioner unit.

Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	48%
Miscellaneous:	42%
AHU Fans & Pumps:	7%
Cooling:	4%
Totals:	100%

Estimated Natural Gas Consumption

Heating:	88%
Domestic water:	12%
Totals:	100%



Overall, the total utility cost for the Park Maintenance Facility is \$5,230.31 for the past 12 months. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.

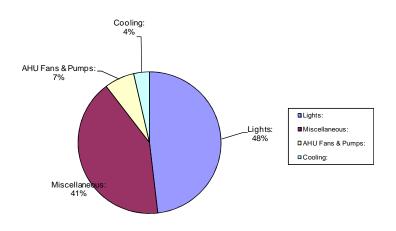


Figure 28 Electricity Usage Breakdown - Park Maintenance Facility

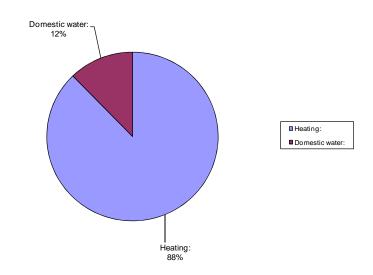


Figure 29 Natural Gas Usage Breakdown - Park Maintenance Facility





Utility Bill Analysis For Park Maintenance Facility														
Period End	Electricity	Electri	icity	Electricity	Natural Gas	Na	Natural Gas		Gas	Water	Water	Water	HDD	CDD
	Consumption	Cos	st	Consumption	Consumption		Cost	Co	onsumption	Consumption	Cost	Rate		
				Rate					Rate					
	(kWh)	(\$))	(\$/kWh)	(CCF)		(\$)		(\$/ccf)	(Gal.)	(\$)	(\$/kGal)		
January-10	75	\$ 1	2.62	\$ 0.16827	1,419	\$	1,259.00	\$	0.89	4750	\$13.20	\$2.78	1009	0
February-10	69	\$ 1	2.25	\$ 0.17754	1,250	\$	1,135.65	\$	0.91	4750	\$13.20	\$2.78	820	0
March-10	64	\$1	1.95	\$ 0.18672	651	\$	698.84	\$	1.07	6000	\$16.67	\$2.78	350	15
April-10	118	\$ 1	5.25	\$ 0.12924	195	\$	253.34	\$	1.30	6000	\$16.67	\$2.78	39	166
May-10	149	\$ 2	20.26	\$ 0.13597	59	\$	82.56	\$	1.40	6000	\$16.67	\$2.78	20	277
June-10	235	\$ 2	28.11	\$ 0.11962	30	\$	59.14	\$	1.97	14000	\$41.78	\$2.98	0	623
July-10	205	\$ 2	8.19	\$ 0.13751	0	\$	35.02	\$	-	14000	\$41.78	\$2.98	0	706
August-10	179	\$ 2	25.80	\$ 0.14413	37	\$	64.86	\$	1.75	14000	\$41.78	\$2.98	0	695
September-10	212	\$ 2	3.87	\$ 0.11259	40	\$	70.02	\$	1.75	9500	\$30.31	\$3.19	4	353
October-10	188	\$ 2	2.23	\$ 0.11824	39	\$	72.48	\$	1.86	9500	\$30.31	\$3.19	66	132
November-10	167	\$ 2	20.79	\$ 0.12449	99	\$	155.48	\$	1.57	9500	\$30.31	\$3.19	336	9
December-10	92	\$ 1	5.64	\$ 0.17000	756	\$	799.13	\$	1.06	4750	\$15.15	\$3.19	912	0
Totals:	1,753	\$ 23	6.96	\$ 0.13517	4,575	\$	4,685.52	\$	1.02	102,750	\$307.83	\$3.00		

Electric Consumption Rate:0.14 /kWhNatural Gas Consumption Rate:1.02 /ccf

Annual Cost/Sq.ft - Electricity:	\$0.038 /sqft
Annual Cost/Sq.ft - Gas.:	\$0.744 /sqft
Annual Cost/Sq.ft - Total:	\$0.781 /sqft

Table 12 Utility Bill Analysis - Park Maintenance Facility





2010 Monthly Electrical Consumption

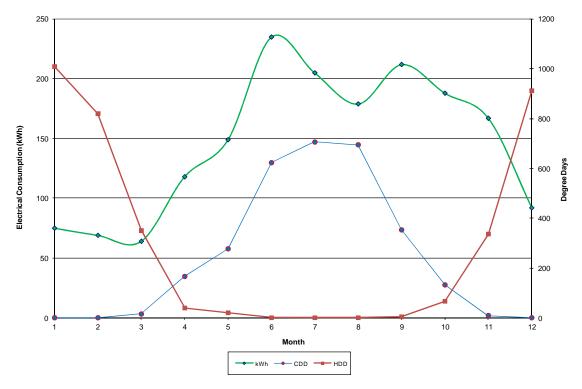
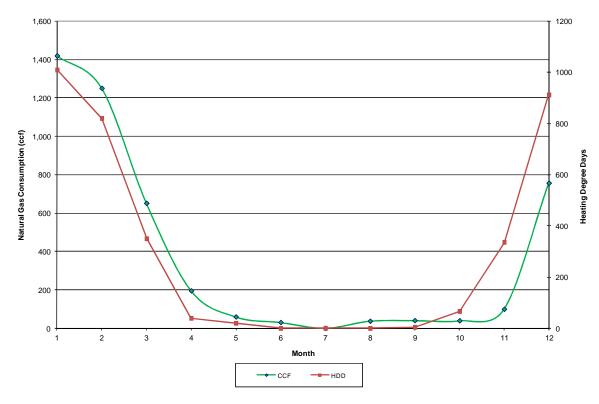


Figure 30 Monthly Electricity Consumption - Park Maintenance Facility

Figure 30 Monthly Electricity Consumption - Park Maintenance Facility details the electrical consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. Based on the graph, the electrical consumption peaks in June and the cooling degree days peak in July. This discrepancy could be due to the timing of the billing cycle.







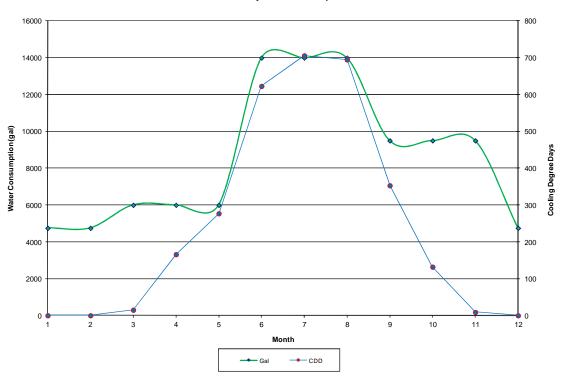
2010 Monthly Natural Gas Consumption

Figure 31 Monthly Natural Gas Consumption - Park Maintenance Facility

Figure 31 Monthly Natural Gas Consumption - Park Maintenance Facility details the natural gas consumption and each month's corresponding heating degree days. Heating degree days (HDD) are a measure of the severity of the heating requirements in a given locality; the more heating degree days, the cooler the winter. Based on the graph, the gas consumption and the heating degree days peak in January.







2010 Monthly Water Consumption

Figure 32 Monthly Water Consumption - Park Maintenance Facility

Figure 32 Monthly Water Consumption - Park Maintenance Facility details the water consumption for the Park Maintenance Facility. Although all water usage is due to occupants there is a corresponding rise in water usage during the hotter months. This is likely due to increased work load during that time of year.





Golf Course



Building Description

The Golf Course consists of three buildings; Club House, Maintenance Facility, and Range Shack. The Club House is a two story facility that is 3,500 ft² and was built in 1935. The basement of the club house is approximately half the size of the ground floor and is mainly a storage and equipment room. The ground floor is divided between the pro shop with a small office and a snack area. There is one full-time employee and the operating hours are 6am-8:30pm seven days a week.

The Golf Range Shack is 850 ft² and was built in 2009. Its only function is to house the ball dispensing machine for the driving range. This building in not occupied except to service the machine.

The Golf Maintenance Facility is 1,600 ft² and was built in 1960. There is a small office located in this building with the remainder of being a storage and workshop for the maintenance equipment.

HVAC Description

The Club House is served by two split systems. One 2.5-ton and one 5-ton. Both are less than five years old and in good condition. The Range Shack is not conditioned. The office in the Maintenance Facility is conditioned with a window air conditioner. A portion of the building is unconditioned storage while the shop is heated only by a 100-MBH gas fired unit heater.



Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	17%
Miscellaneous:	37%
AHU Fans & Pumps:	10%
Cooling:	36%
Totals:	100%

Estimated Natural Gas Consumption

Heating:	34%
Domestic water:	66%
Totals:	100%

Overall, the total utility cost for the Golf Course is \$18,461.40 for the past 12 months. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.

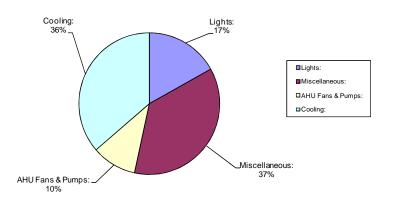


Figure 33 Electricity Usage Breakdown - Golf Course





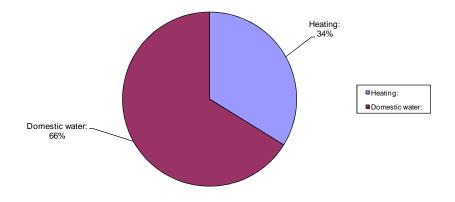


Figure 34 Natural Gas Consumption - Golf Course

Utility Bill Analysis For the Golf Course																
Period End	Electricity	Electricit	y	Electricity	Natural Gas		Natural Gas		Gas	Water	Water Cost		Water		HDD	CDD
	Consumption	Cost		Consumption	Consumption		Cost	Co	•	Consumption			F	Rate		
				Rate					Rate							
	(kWh)	(\$)		(\$/kWh)	(CCF)		(\$)		(\$/ccf)	(Gal.)		(\$)	(\$/	/kGal)		
January-10	3,960	\$ 258.4	2	\$ 0.06526	758	\$	641.59	\$	0.85	5,250	\$	14.58	\$	2.78	1009	0
February-10	3,684	\$ 241.5	52	\$ 0.06556	575	\$	510.45	\$	0.89	5,250	\$	14.58	\$	2.78	820	0
March-10	3,713	\$ 243.2	29	\$ 0.06552	381	\$	371.96	\$	0.98	139,750	\$	388.22	\$	2.78	350	15
April-10	4,344	\$ 268.4	6	\$ 0.06180	109	\$	172.94	\$	1.59	139,750	\$	388.22	\$	2.78	39	166
May-10	4,632	\$ 381.2	28	\$ 0.08231	42	\$	77.94	\$	1.86	139,750	\$	388.22	\$	2.78	20	277
June-10	8,071	\$ 696.3	88	\$ 0.08628	38	\$	74.66	\$	1.96	254,750	\$	762.51	\$	2.99	0	623
July-10	7,929	\$ 745.9	91	\$ 0.09407	32	\$	69.88	\$	2.18	254,750	\$	762.51	\$	2.99	0	706
August-10	6,649	\$ 630.3	37	\$ 0.09481	22	\$	61.83	\$	2.81	254,750	\$	762.51	\$	2.99	0	695
September-10	5,433	\$ 378.9	95	\$ 0.06975	24	\$	67.08	\$	2.80	791,000	\$	2,523.29	\$	3.19	4	353
October-10	3,798	\$ 279.2	20	\$ 0.07351	28	\$	73.54	\$	2.63	791,000	\$	2,523.29	\$	3.19	66	132
November-10	3,589	\$ 264.8	37	\$ 0.07380	101	\$	170.92	\$	1.69	791,000	\$	2,523.29	\$	3.19	336	9
December-10	4,053	\$ 296.7	'0	\$ 0.07321	421	\$	400.94	\$	0.95	9,750	\$	31.10	\$	3.19	912	0
Totals:	59,855	\$ 4,685.3	35	\$ 0.07828	2,531	\$	2,693.73	\$	1.06	3,576,750	\$	11,082.32	\$	3.10		

Electric Consumption Rate: Natural Gas Consumption Rate: \$0.07828 /kWh \$1.06 /ccf

Annual Cost/Sq.ft - Electricity: Annual Cost/Sq.ft - Gas.: Annual Cost/Sq.ft - Total: \$0.787 /sqft
\$0.453 /sqft
\$1.240 /sqft
Table 13 Utility Bill Analysis - Golf Course





2010 Monthly Electrical Consumption

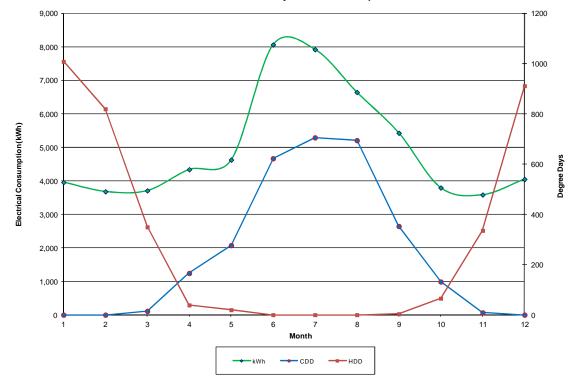


Figure 35 Monthly Electrical Consumption - Golf Course

Figure 35 Monthly Electrical Consumption - Golf Course details the electrical consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. Based on the graph, the electrical consumption peaks in June and the cooling degree days peak in July. This discrepancy could be due to the timing of the billing cycle.





2010 Monthly Natural Gas Consumption

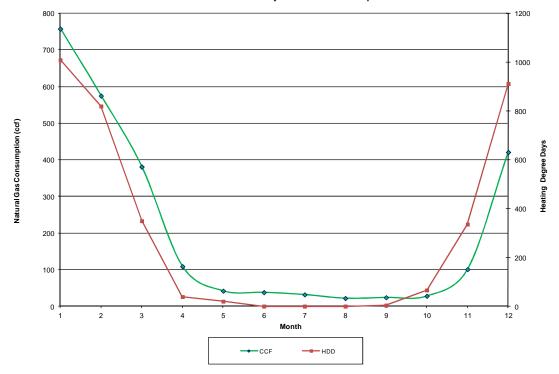


Figure 36 Monthly Natural Gas Consumption - Golf Course

Figure 36 Monthly Natural Gas Consumption - Golf Course details the natural gas consumption and each month's corresponding heating degree days. Heating degree days (HDD) are a measure of the severity of the heating requirements in a given locality; the more heating degree days, the cooler the winter. Based on the graph, the gas consumption and the heating degree days peak in January.





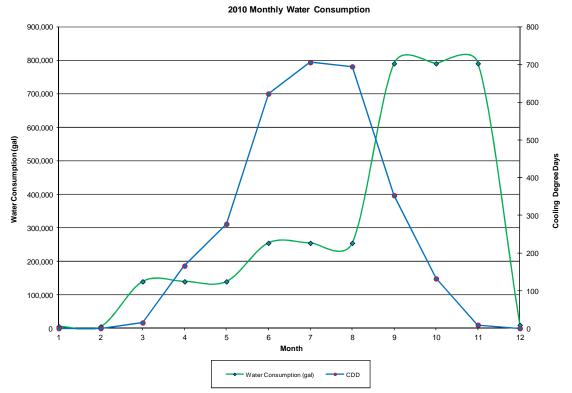


Figure 37 Monthly Water Consumption - Golf Course

Figure 37 Monthly Water Consumption - Golf Course details the water consumption for the Golf Course. Water is not used for HVAC and therefore should not follow the cooling degree days. The peak late in the year is likely due to maintenance or a leak.





Fire Station #2



Building Description

Fire Station #2 is 10,800 ft² was originally built in 1939. It received a major renovation and addition in 2006. On the first floor are the truck bays, kitchen, dining room, and entertainment room. The second floor contains the bunk rooms, exercise room, and a training room. There are sixteen full time employees divided into three shifts and the building is occupied continuously.

HVAC Description

The entire HVAC system was replaced during the 2006 renovation with new high efficiency equipment. The truck bays are heated only by four gas fired unit heaters. The reminder of the building is conditioned by five split systems totaling 23-tons. The units on the second floor were equipped with humidifiers.

Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	17%
Miscellaneous:	5%
AHU Fans & Pumps:	10%
Cooling:	34%
Heating:	34%
Totals:	100%

Estimated Natural Gas Consumption

Heating:	68%
Domestic water:	32%
Totals:	100%



Overall, the total utility cost for Fire Station #2 is \$12,422.62 for the past 12 months. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.

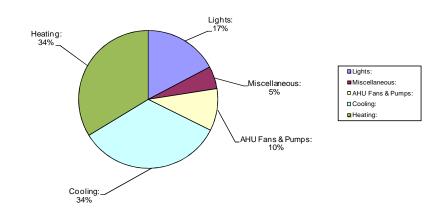


Figure 38 Electricity Usage Breakdown - Fire Station #2

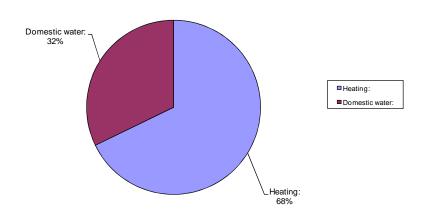


Figure 39 Natural Gas Usage Breakdown - Fire Station #2





Utility Bill Analysis For Fire Station #2															
Period End	Electricity Consumption	Electricity Cost		Electricity Consumption Rate		Natural Gas Consumption	Natural Gas Cost Consumpt Rate		onsumption	Water Consumption	Water Cost	Water Rate	HDD	CDD	
	(kWh)		(\$)		(\$/kWh)	(CCF)		(\$)		(\$/ccf)	(Gal.)	(\$)	(\$/kGal)		
January-10	11,020	\$	624.32	\$	0.05665	1,091	\$	1,020.48	\$	0.94	13,750	\$38.20	\$2.78	1009	0
February-10	10,330	\$	599.89	\$	0.05807	804	\$	810.44	\$	1.01	13,750	\$38.20	\$2.78	820	0
March-10	8,350	\$	527.73	\$	0.06320	433	\$	517.78	\$	1.20	15,000	\$41.67	\$2.78	350	15
April-10	8,990	\$	552.45	\$	0.06145	145	\$	197.30	\$	1.36	15,000	\$41.67	\$2.78	39	166
May-10	8,330	\$	700.60	\$	0.08411	55	\$	79.31	\$	1.44	15,000	\$41.67	\$2.78	20	277
June-10	11,670	\$	1,004.17	\$	0.08605	37	\$	64.70	\$	1.75	15,500	\$46.25	\$2.98	0	623
July-10	11,550	\$	1,081.21	\$	0.09361	36	\$	63.98	\$	1.78	15,500	\$46.25	\$2.98	0	706
August-10	11,540	\$	1,080.29	\$	0.09361	33	\$	61.61	\$	1.87	15,500	\$46.25	\$2.98	0	695
September-10	8,620	\$	609.94	\$	0.07076	38	\$	68.82	\$	1.81	14,250	\$45.46	\$3.19	4	353
October-10	5,800	\$	416.49	\$	0.07181	44	\$	60.86	\$	1.38	14,250	\$45.46	\$3.19	66	132
November-10	6,470	\$	462.45	\$	0.07148	154	\$	161.83	\$	1.05	14,250	\$45.46	\$3.19	336	9
December-10	8,610	\$	609.26	\$	0.07076	671	\$	524.71	\$	0.78	14,250	\$45.46	\$3.19	912	0
Totals:	111,280	\$	8,268.80	\$	0.07431	3,541	\$	3,631.82	\$	1.03	176,000	\$522.00	\$2.97		

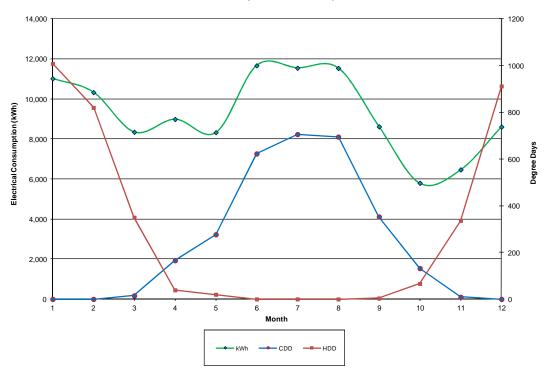
Electric Consumption Rate: Natural Gas Consumption Rate: \$0.07431 /kWh \$1.03 /ccf

Annual Cost/Sq.ft - Electricity: Annual Cost/Sq.ft - Gas.: Annual Cost/Sq.ft - Total: \$0.766 /sqft \$0.336 /sqft \$1.102 /sqft

Table 14 Utility Bill Analysis - Fire Station #2





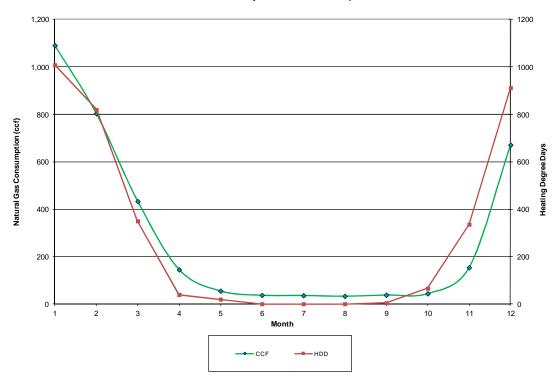


2010 Monthly Electrical Consumption

Figure 40 Monthly Electrical Consumption - Fire Station #2

Figure 40 Monthly Electrical Consumption - Fire Station #2 details the electrical consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. Based on the graph, the electrical consumption peaks when the CDDs are the highest. There is also a second peak in the winter moths attributed to a portion of the building having electric heat.





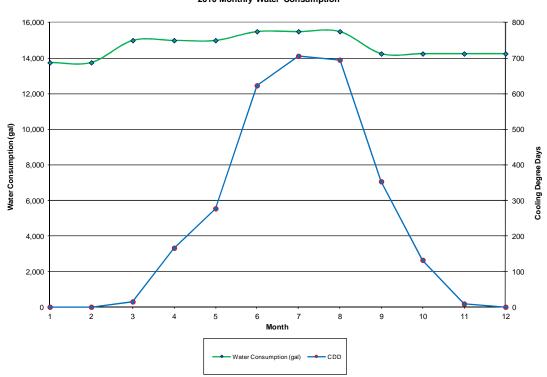
2010 Monthly Natural Gas Consumption

Figure 41 Monthly Natural Gas Consumption - Fire Station #2

Figure 41 Monthly Natural Gas Consumption - Fire Station #2 details the natural gas consumption and each month's corresponding heating degree days. Heating degree days (HDD) are a measure of the severity of the heating requirements in a given locality; the more heating degree days, the cooler the winter. Based on the graph, the gas consumption and the heating degree days peak in January.







2010 Monthly Water Consumption

Figure 42 Monthly Water Consumption - Fire Station #2

Figure 42 Monthly Water Consumption - Fire Station #2 details the water consumption for Fire Station #2. There is a slight peak in summer however, water is not used for cooling. The water use increases approximately 10% during the summer. This can be attributed to occupants using more water during the hotter portion of the year.





City Hall



Building Description

City Hall is a six story building of 39,900 ft² originally built in 1903. It was completely renovated in 2005 and became LEED certified in 2008. The basement is largely storage and mechanical space while the first through fourth floors are office space. The sixth floor is the council chambers and courtroom. There are 55 full time employees and is operated from 7am-5pm Monday through Friday.

HVAC Description

The entire HVAC system was replaced during the latest renovation in 2005. The system consists of water-source heat pumps (WSHP) with a cooling tower outside for heat rejection. In the basement there are two building loop pumps (one backup) to provide water to the WSHPs and two condenser water loop pumps (one backup) to circulate water through the cooling tower and the plate and frame heat exchanger where heat is transferred from the building loop to the condenser water loop. There is also a shell and tube heat exchanger that transfers heat from the central steam loop to the building loop during the winter. The steam is provided by the boilers in the basement of the adjacent Trinity Building. The system is controlled by a modern DDC system with night set back.





Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	14%
Miscellaneous:	18%
AHU Fans & Pumps:	34%
Cooling:	35%
Totals:	100%

Overall, the total utility cost for City Hall is \$27,975.71 for the past 12 months. It should be noted that water is supplied form the adjacent Annex building and that heating is provided by steam from the adjacent Trinity building. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.

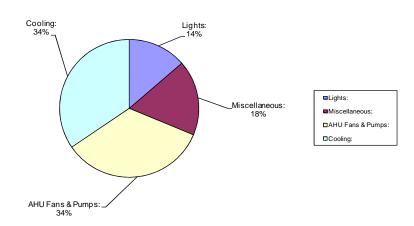


Figure 43 Electricity Usage Breakdown - City Hall



Utility Bill Analysis For City Hall																	
Period End	Electricity	Electricity	E	lectricity	Electricity	Electricity Electricity		E	lectricity	HDD	CDD						
	Consumption	Cost	Co	nsumption	Demand	Der	mand Cost		Demand								
			Rate		Rate		Rate		Rate						Rate		
	(kWh)	(\$)		(\$/kWh)	(kW)		(\$)		(\$/kW)								
January-10	46,400	\$ 1,858.08	\$	0.04004	130	\$	182.14	\$	1.40	1009	0						
February-10	39,680	\$ 1,633.57	\$	0.04117	124	\$	174.02	\$	1.40	820	0						
March-10	30,240	\$ 1,335.45	\$	0.04416	100	\$	140.00	\$	1.40	350	15						
April-10	28,480	\$ 1,227.18	\$	0.04309	125	\$	174.72	\$	1.40	39	166						
May-10	29,280	\$ 2,069.65	\$	0.07068	100	\$	378.00	\$	3.78	20	277						
June-10	42,880	\$ 2,776.49	\$	0.06475	100	\$	387.25	\$	3.87	0	623						
July-10	41,920	\$ 3,111.20	\$	0.07422	112	\$	463.56	\$	4.15	0	706						
August-10	40,640	\$ 2,902.28	\$	0.07141	100	\$	415.00	\$	4.15	0	695						
September-10	37,440	\$ 1,791.11	\$	0.04784	114	\$	174.94	\$	1.54	4	353						
October-10	27,680	\$ 1,266.32	\$	0.04575	100	\$	154.00	\$	1.54	66	132						
November-10	34,080	\$ 1,598.75	\$	0.04691	100	\$	154.00	\$	1.54	336	9						
December-10	38,880	\$ 1,760.91	\$	0.04529	125	\$	193.12	\$	1.54	912	0						
Totals:	437,600	\$23,330.99	\$	0.05332	1,330	\$	2,990.75	\$	2.25								

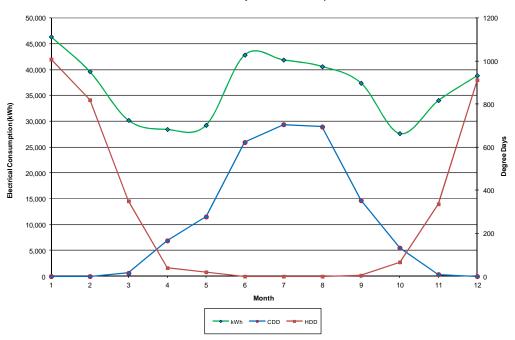
Electric Consumption Rate: Electric Demand Rate

Annual Cost/Sq.ft - Electricity: Annual Cost/Sq.ft - Total: \$0.05332 /kWh \$2.25 /kW

\$0.660 /sqft \$0.660 /sqft Table 15 Utility Bill Analysis - City Hall







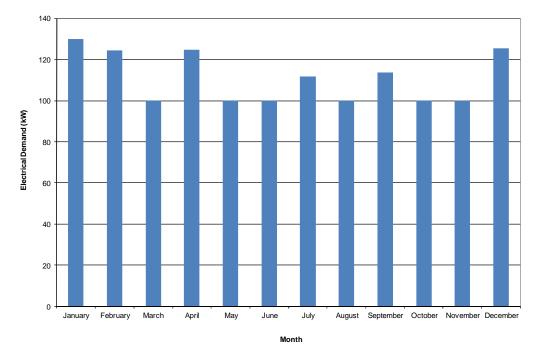
2010 Monthly Electrical Consumption

Figure 44 Monthly Electrical Consumption - City Hall

Figure 44 Monthly Electrical Consumption - City Hall details the electrical consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. Based on the graph, the electrical consumption peaks in June and the cooling degree days peak in July. This discrepancy could be due to the timing of the billing cycle. The winter peak is due to the compressors in the WSHPs running in the winter even though the hot water loop is heated with steam from a nearby building. Part of the winter increase could also be due to increased light usage since there is a day lighting controls to limit lighting usage when sun light is sufficient. Therefore, lighting usage would rise during the winter when daylight hours are shorter.







2010 Monthly Electrical Demand

Figure 45 Monthly Electrical Demand - City Hall

Figure 45 Monthly Electrical Demand - City Hall, which shows the monthly electrical demand, suggests the same conclusions as the electric consumption graph. The electric usage for the City Hall is fairly constant.





Centennial Commons Recreation Center



Building Description

This facility is a 67,000 ft² recreation facility built in 2005 adjacent to the Heman Pool. The building contains a basketball court, weight room, cardio rooms, and an indoor soccer field. The building has five full time employees but a highly variable number of occupants. The facility is open from 5:30am-10pm Monday through Friday, 8am-8pm Saturday, and 10am-6pm Sunday.

HVAC Description

The facility is conditioned by two large rooftop units, one for the basketball court and one for the exercise area. There is an energy recovery ventilator preconditioning the outside air to the rooftop unit serving the exercise spaces. These units are controlled with a modern DDC control system with night setback. The indoor soccer field is heated by gas fired forced air furnace set up for recirculation and 100% outside air.

Utility Summary

Utility Usage Breakdown

Estimated Electric Consumption

Lights:	28%
Miscellaneous:	28%
AHU Fans & Pumps:	15%
Cooling:	29%
Totals:	100%

Estimated Natural Gas Consumption

Heating:	95%
Domestic water:	5%
Totals:	100%



Overall, the total utility cost for the Centennial Commons Recreation Center is \$102,275.67 for the past 12 months. It appears from the bills that the adjacent Heman Park Pool is on the same water meter. The large spike in the June through August water bill is most likely attributed to refilling the pool for the summer season. Due to water billing once a quarter and the exact meter reading date would explain the lag time for it to show on the bill. The breakdown for each item was calculated based upon the existing equipment and the operating hours from facility personnel.

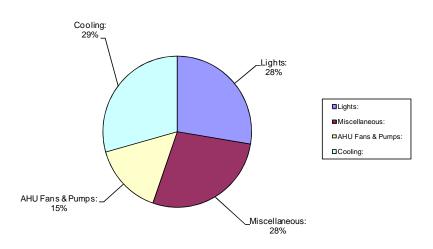


Figure 46 Electricity Usage Breakdown - Centennial Commons Recreation Center

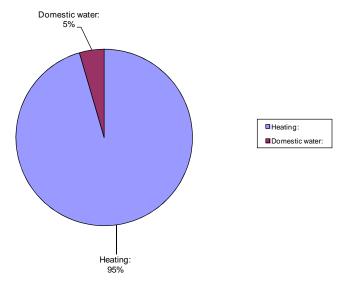


Figure 47 Natural Gas Usage Breakdown - Centennial Commons Recreation Center





Detailed Energy Study University City Municipal Buildings

Utility Bill Analysis For Centennial Commons Recreation Center																			
Period End	Electricity	Electricity	E	lectricity	Electricity	El	ectricity	El	ectricity	Natural Gas	Na	tural Gas		Gas	Water	Water	Water	HDD	CDD
	Consumption	Cost	Co	nsumption	Demand	D	emand	D	emand	Consumption		Cost	Co	nsumption	Consumption	Cost	Rate		
				Rate			Cost		Rate					Rate					
	(kWh)	(\$)		(\$/kWh)	(kW)		(\$)		(\$)	(CCF)		(\$)		(\$/ccf)	(Gal.)	(\$)	(\$/kGal)		
January-10	118,560	\$ 4,458.19	\$	0.03760	195	\$	273.28	\$	1.40	3,380	\$	2,691.30	\$	0.80	40,000	\$111.12	\$2.78	1009	0
February-10	97,920	\$ 3,778.94	\$	0.03859	181	\$	253.96	\$	1.40	2,882	\$	2,325.60	\$	0.81	40,000	\$111.12	\$2.78	820	0
March-10	90,840	\$ 3,527.39	\$	0.03883	173	\$	241.92	\$	1.40	1,577	\$	1,374.08	\$	0.87	76,250	\$211.82	\$2.78	350	15
April-10	79,080	\$ 3,157.48	\$	0.03993	169	\$	235.90	\$	1.40	381	\$	461.40	\$	1.21	76,250	\$211.82	\$2.78	39	166
May-10	77,160	\$ 3,033.74	\$	0.03932	155	\$	216.44	\$	1.40	240	\$	228.35	\$	0.95	76,250	\$211.82	\$2.78	20	277
June-10	125,040	\$ 7,872.00	\$	0.06296	276	\$	1,041.39	\$	3.78	2	\$	36.60	\$	18.30	1,344,250	\$4,011.24	\$2.98	0	623
July-10	156,240	\$10,490.08	\$	0.06714	330	\$	1,349.15	\$	4.09	1	\$	35.82	\$	35.82	1,344,250	\$4,011.24	\$2.98	0	706
August-10	168,840	\$11,225.02	\$	0.06648	331	\$	1,372.82	\$	4.15	2	\$	36.60	\$	18.30	1,344,250	\$4,011.24	\$2.98	0	695
September-10	138,480	\$10,105.54	\$	0.07297	353	\$	1,466.20	\$	4.15	1	\$	38.57	\$	38.57	400,250	\$1,276.80	\$3.19	4	353
October-10	82,080	\$ 3,413.12	\$	0.04158	282	\$	433.66	\$	1.54	53	\$	83.92	\$	1.58	400,250	\$1,276.80	\$3.19	66	132
November-10	85,800	\$ 3,588.76	\$	0.04183	259	\$	399.17	\$	1.54	192	\$	263.50	\$	1.37	400,250	\$1,276.80	\$3.19	336	9
December-10	93,120	\$ 3,818.86	\$	0.04101	261	\$	401.79	\$	1.54	2,040	\$	1,722.82	\$	0.84	31,500	\$100.49	\$3.19	912	0
Totals:	1,313,160	\$68,469.12	\$	0.05214	2,964	\$	7,685.68	\$	2.59	10,751	\$	9,298.56	\$	0.86	5,573,750	\$16,822.31	\$3.02		

Electric Consumption Rate: Electric Demand Rate Natural Gas Consumption Rate \$0.05214 /kWh \$2.59318 /kW \$0.86 /ccf

Annual Cost/Sq.ft - Electricity: Annual Cost/Sq.ft - Gas.: Annual Cost/Sq.ft - Total:

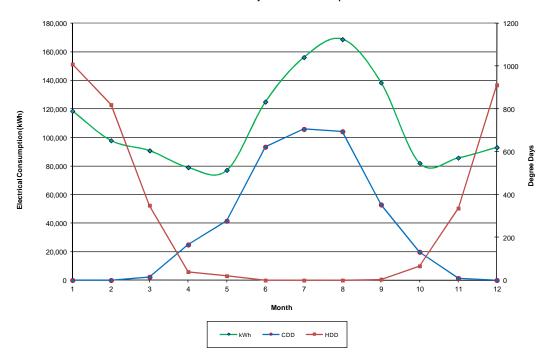
ity: \$1.137 /sqft \$0.139 /sqft \$1.275 /sqft

Table 16 Utility Bill Analysis - Centennial Commons Recreation Center





Detailed Energy Study University City Municipal Buildings



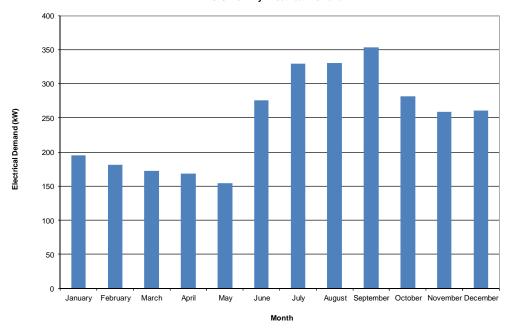
2010 Monthly Electrical Consumption

Figure 48 Monthly Electrical Consumption - Centennial Commons Recreation Center

Figure 48 Monthly Electrical Consumption - Centennial Commons Recreation Center details the electric consumption and each month's corresponding heating and cooling degree days. Cooling degree days (CDD) are a measure of the severity of the cooling requirements in a given locality; the more cooling degree days, the hotter the summer. Based on the graph, the electrical consumption peaks in August and the cooling degree days peak in July. This discrepancy could be due to the timing of the billing cycle.







2010 Monthly Electrical Demand

Figure 49 Monthly Electrical Demand - Centennial Commons Recreation Center

Figure 49 Monthly Electrical Demand - Centennial Commons Recreation Center, which shows the monthly electric demand, suggests the same conclusions as the electric consumption graph. The peak months correspond to the higher cooling load required during the summer season.





Detailed Energy Study University City Municipal Buildings

2010 Monthly Natural Gas Consumption

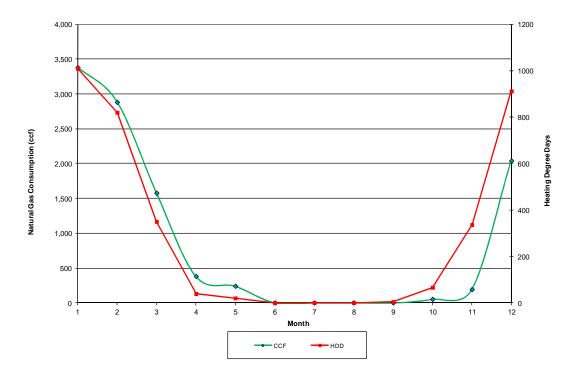


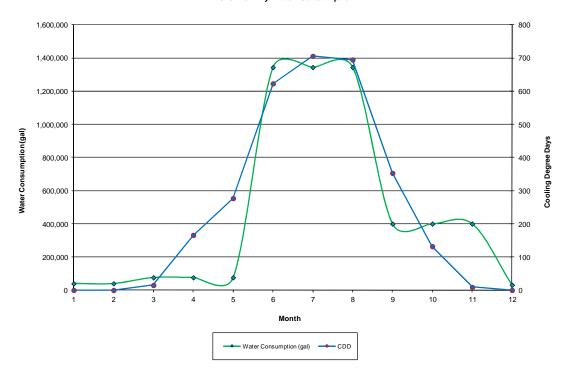
Figure 50 Monthly Natural Gas Consumption - Centennial Commons Recreation Center

Figure 50 Monthly Natural Gas Consumption - Centennial Commons Recreation Center details the natural gas consumption and each month's corresponding heating degree days. Heating degree days (HDD) are a measure of the severity of the heating requirements in a given locality; the more heating degree days, the cooler the winter. Based on the graph, the gas consumption and the heating degree days peak in January.





Detailed Energy Study University City Municipal Buildings



2010 Monthly Water Consumption

Figure 51 Monthly Water Consumption - Centennial Commons Recreation Center

Figure 51 Monthly Water Consumption - Centennial Commons Recreation Center details the water consumption. It appears from the meter that the Heman Park Pool that is adjacent to the Centennial Commons Recreation Center is on the same meter which would explain the large spike in water usage during the summer.



1.0 LIGHTING IMPROVEMENTS

ECM-1.1: Lighting Retrofit (Annex)

Existing Conditions

The University City Annex building houses the police station and one of the city's fire stations. These facilites are in operation 24/7. The lighting systems in the Annex consist exclusively of outdated linear fluorescents, high-pressure sodium low bays, halogen floods, and incandescent exit signs. All of these fixtures can be replaced or retrofitted to increase their performance, reduce energy consumption, and decrease fixture maintenance. Although the facilites are in use all day, many areas of the building do not have the lights on. This limits the practicality of installing lighting controls and retrofitting fixtures with the expectation of a reasonable payback in all portions of the building. For optimal return on investment, only the fixtures with reasonable paybacks should be considered for retrofit or replacement. All enclosed fixtures that are to remain should have their lenses cleaned and wiped down, as the photometrics and lumen output have been severely compromised due to dust collection and the presence of foreign matter in most cases.

Savings Summary

Energy Consumption Savings						Energy Cos	t Savings		Total Energy		Capital Cost	SPB
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water	Savings	Savings		
				-								
58,934	17	12	-	-	\$4,037	\$0	\$0	\$0	\$4,037	\$0	\$64,736	16.0

Table 17	' Savings Summary -	ECM-1.1 Lighting Re	trofit (Annex)

Physical Changes

To the occupant, there will be some visible changes. With current lamp technology and fixture design, occupants will notice more appropriate light levels with greater uniformity and increased color rendering. All suggested retrofit and replacement applications meet or exceed existing light levels for the applicable area. The maintenance staff will also notice several changes. As a result of changing incandescents to compact fluorescents, there will be a lower frequency of lamp replacements. Elimination of fixtures that are in poor operational condition, due to age or environmental degradation, will result in a safer work environment for the entire staff. Other positive changes include the removal of out-dated or obsolete technology, as well as a moderate amount of electrical savings for the facility.

Interface with Agency Equipment

Contractor shall provide all labor and material to inspect, test, and adjust the lighting and the electrical control systems affecting the given spaces to ensure the new lighting systems fulfill existing requirements, while offering a reduction in consumption, especially during peak hours.



Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with fixture replacement and retrofit, but will be strictly limited to the given area and the panel breakers involved. All work shall be coordinated with the administration and the maintenance staff.

Environmental Impacts

There are minimal environmental drawbacks and numerous benefits associated with the suggested retrofitting and replacement of the lighting in the areas outlined. The new lamps and fixtures will consume less energy, resulting in decreased demand from the reactor processes involved in power production. The new fluorescent lamps are far lower in mercury content, which is beneficial concerning disposal. The only negative impact is from the disposal of the existing lamps and fixtures, but this is negligible when compared to the positives. See Table 3 Greenhouse Gases and Other Pollutants

Salvage and Disposal

Existing equipment in operational condition shall be given to University City as requested. All remaining equipment will be removed and disposed of properly by the electrical contractor.





Individual Recommendations Per Location

The following is a summary of the individual floors and areas of the University City Annex facility, and the individual recommendations therein:

Police Station – Basement - Corridor

Energy Saving Opportunity:

 (15) 1x4, 2-lamp T12 recessed cove strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 60 hours/week. Re-lamp with (15) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – Basement – Break Room

Energy Saving Opportunity:

- (5) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 60 hours/week. Re-lamp with (5) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) 2x2, 2 U-lamp T12 recessed troffer. Fixture utilizes a standard magnetic ballast. Average foot candle reading for this fixture is 15-20 fc. Fixture operates 60 hours/week. Re-lamp with (1) 2, 31W T8 U-lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.
- (1) 2-lamp 60W incandescent surface round. Average foot candle reading for this fixture is 4-7 fc. Fixture operates 1 hour/week. Re-lamp with (2) 13W compact fluorescent, screw type lamps.

Police Station – Basement – Fire Chief's Office Energy Saving Opportunity:

• (10) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 40-50 fc. Fixtures operate 60 hours/week. Re-lamp with (10) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – Basement - Corridor

Energy Saving Opportunity:

• (10) 26W compact fluorescent, triple, twin tube recessed can. Average foot candle reading for these fixtures is 4-7 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain.



(3) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (3) LED Exit Sign.

Police Station – Basement – E.O.C. Room

Energy Saving Opportunity:

- (1) 26W compact fluorescent, triple, twin tube recessed can. Average foot candle reading for this fixture is 4-7 fc. Fixture operates 10 hours/week. There are no recommendations, fixture is to remain.
- (1) 1x2, 2-lamp T12 wall mount. Fixture utilizes a standard magnetic ballast. Average foot candle reading for this fixture is 15-20 fc. Fixture operates 10 hours/week. Re-lamp with (1) 2,17W 2' T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.
- (27) 1x4, 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 10 hours/week. Re-lamp with (27) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.
- (2) 1x4, 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 168 hours/week. Re-lamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

Police Station – Basement – E.O.C. Kitchen

Energy Saving Opportunity:

• (1) 2-lamp T12 strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 5 hours/week. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.

Police Station – Basement – E.O.C. Mechanical Room

Energy Saving Opportunity:

- (2) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 1 hour/week. Relamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts.
- (2) 52W exposed incandescent. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 1 hour/week. Re-lamp with (2) 13W compact fluorescent, screw type lamps.





Police Station – Basement – E.O.C.

Energy Saving Opportunity:

(2) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (2) LED Exit Sign.

Police Station – Basement – E.O.C. Communications Room

Energy Saving Opportunity:

• (3) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 1 hour/week. Relamp with (3) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

Police Station – Basement – E.O.C. Storeroom

Energy Saving Opportunity:

• (5) 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 1 hour/week. Re-lamp with (5) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

Police Station – Basement – E.O.C. Restroom

Energy Saving Opportunity:

• (2) 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 1 hour/week. Re-lamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

Police Station – Basement – Shooting Range

Energy Saving Opportunity:

- (6) PAR38 Halogen Flood. Average foot candle reading for these fixtures is 10-12 fc. Fixtures operate 5 hours/week. There are no recommendations, fixtures are to remain.
- (5) 52W exposed incandescent. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 5 hours/week. Re-lamp with (5) 13W compact fluorescent, screw type lamps.

Police Station – Basement – Shooting Range File Room

Energy Saving Opportunity:

• (4) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 1 hour/week. Relamp with (4) 2, 28W T8 lamps and high-efficiency, electronic ballasts.





Police Station – Basement – Files

Energy Saving Opportunity:

• (2) 1x8, 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 1 hour/week. Relamp with (2) 2, 59W, 8' T8 lamps and high-efficiency, electronic ballasts.

Police Station – Basement – Corridor

Energy Saving Opportunity:

• (2) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 2 hours/week. Relamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

Police Station – Basement – Closet

Energy Saving Opportunity:

• (1) 52W exposed incandescent. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 1 hour/week. Re-lamp with (1) 13W compact fluorescent, screw type lamp.

Police Station – Basement – Weapons Storage

Energy Saving Opportunity:

 (4) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 30-35 fc. Fixtures operate 5 hours/week. Relamp with (4) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

Police Station – Basement – Bike Storage

Energy Saving Opportunity:

• (14) 100W exposed incandescent. Average foot candle reading for these fixtures is 2-4 fc. Fixtures operate 1 hour/week. Re-lamp with (14) 26W compact fluorescent, screw type lamps.

Police Station – Basement – Stairs

Energy Saving Opportunity:

• (2) 2-lamp 60W incandescent surface mount. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 5 hours/week. Re-lamp with (2) 13W compact fluorescent, screw type lamps.



Police Station – 1st Floor – Print Shop

Energy Saving Opportunity:

• (6) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 50-55 fc. Fixtures operate 40 hours/week. Re-lamp with (6) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

Police Station – 1st Floor – Police Dispatch

Energy Saving Opportunity:

- (21) 2x4, 4-lamp T12 recessed volumetric. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 50-55 fc. Fixtures operate 60 hours/week. Re-lamp with (21) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.
- (10) 2x4, 4-lamp T12 recessed volumetric. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 50-55 fc. Fixtures operate 168 hours/week. Re-lamp with (10) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – 1st Floor – Entry Corridor

Energy Saving Opportunity:

(8) 1x4, 1-lamp T12 wall strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 60 hours/week. Re-lamp with (8) 1, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – Basement – Men's Cells

Energy Saving Opportunity:

- (1) 2-lamp T12, 3' strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 15-20 fc. Fixture operates 84 hours/week. Relamp with (1) 2, 25W, 3' T8 lamps and high-efficiency, electronic ballast.
- (2) 1x4, 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 84 hours/week. Relamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts.
- (2) PAR38 Halogen Flood. Average foot candle reading for these fixtures is 10-12 fc. Fixtures operate 84 hours/week. There are no recommendations, fixtures are to remain.
- (1) 1x4, 2-lamp T12 wall-mounted strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 15-20 fc. Fixture operates 84



hours/week. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballast.

Police Station – Basement – Stairs

Energy Saving Opportunity:

• (1) 1x1, 60W incandescent surface mount. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 84 hours/week. Re-lamp with (1) 13W compact fluorescent, screw type lamp.

Police Station – 1st Floor – Private Offices

Energy Saving Opportunity:

 (12) 2x4, 4-lamp T12 recessed volumetric. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 45-50 fc. Fixtures operate 60 hours/week. Re-lamp with (12) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – 1st Floor – Conference Room

Energy Saving Opportunity:

• (4) 2x4, 2-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 45-50 fc. Fixtures operate 60 hours/week. Re-lamp with (4) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

<u>Police Station – 1st Floor – Men's Locker Room</u> Energy Saving Opportunity:

• (6) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 60 hours/week. Re-lamp with (6) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – 1st Floor – Women's Locker Room

Energy Saving Opportunity:

• (4) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 60 hours/week. Re-lamp with (4) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.



Police Station – 1st Floor – Mechanical Storage

Energy Saving Opportunity:

• (3) 100W exposed incandescent. Average foot candle reading for these fixtures is 2-4 fc. Fixtures operate 1 hour/week. Re-lamp with (3) 26W compact fluorescent, screw type lamps.

Police Station – 1st Floor – Offices

Energy Saving Opportunity:

• (9) 1x4, 2-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 12-15 fc. Fixtures operate 60 hours/week. Re-lamp with (9) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – 1st Floor – Cell Entry

Energy Saving Opportunity:

- (6) 2x4, 2-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 50-55 fc. Fixtures operate 60 hours/week. Re-lamp with (6) 2, 28W T8 lamps and high-efficiency, electronic ballasts.
- (2) 40W recessed incandescent can. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 60 hours/week. Re-lamp with (2) 9W compact fluorescent, screw type lamps.

Police Station – 1st Floor – Hall Energy Saving Opportunity:

- (1) 1x1, 2-lamp 60W recessed incandescent square. Average foot candle reading for this fixture is 2-3 fc. Fixture operates 168 hours/week. Re-lamp with (1) 2, 13W compact fluorescent, screw type lamp.
- (1) PAR38 Halogen Flood. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.

Police Station – 1st Floor – Men's Restroom

Energy Saving Opportunity:

• (4) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 60 hours/week. Re-lamp with (4) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.



Police Station – 1st Floor – Women's Restroom

Energy Saving Opportunity:

- (4) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 60 hours/week. Re-lamp with (4) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) 2-lamp 60W incandescent vanity. Average foot candle reading for this fixture is 2-3 fc. Fixture operates 60 hours/week. Re-lamp with (1) 2, 13W compact fluorescent, screw type lamp.

Police Station – 1st Floor – Entry

Energy Saving Opportunity:

- (9) PAR38 Halogen Flood. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain.
- (1) 2x4, 4-lamp T12 recessed volumetric. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 45-55 fc. Fixture operates 60 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.

Police Station – 1st Floor – Field Ops Energy Saving Opportunity:

- (2) 2x4, 4-lamp T12 recessed volumetric. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 45-55 fc. Fixtures operate 60 hours/week. Re-lamp with (2) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) 2x4, 4-lamp T12 recessed troffer. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 50-70 fc. Fixture operates 60 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) 2x2, 2 U-lamp T12 recessed troffer. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 5-10 fc. Fixture operates 60 hours/week. Re-lamp with (1) 2, 31W T8 U-lamps and high-efficiency, electronic ballast. Fixtures to be controlled by dual-technology occupancy sensor.

Police Station – 1st Floor – Traffic

Energy Saving Opportunity:

• (3) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 60





hours/week. Re-lamp with (3) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

• (4) 1x4, 2-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-20 fc. Fixtures operate 60 hours/week. Re-lamp with (4) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

Police Station – 2nd Floor – Offices

Energy Saving Opportunity:

- (17) 2x4, 4-lamp T12 recessed volumetric. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 60 hours/week. Re-lamp with (17) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.
- (5) 2x4, 4-lamp T12 recessed volumetric. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 5 hours/week. Re-lamp with (5) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – 2nd Floor – Hall Energy Saving Opportunity:

• (1) 2-lamp T12 strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 60 hours/week. Relamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.

Police Station – 2nd Floor – Interrogation Room

Energy Saving Opportunity:

• (6) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 10 hours/week. Re-lamp with (6) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – 2nd Floor – Men's Restroom

Energy Saving Opportunity:

• (1) 2x4, 4-lamp T12 recessed troffer. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 20-25 fc. Fixture operates 60 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.





Police Station – 2nd Floor – Women's Restroom

Energy Saving Opportunity:

• (1) 2x4, 4-lamp T12 recessed troffer. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 20-25 fc. Fixture operates 60 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.

Police Station – 2nd Floor – Entry

Energy Saving Opportunity:

• (6) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 30-35 fc. Fixtures operate 168 hours/week. Relamp with (6) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

Police Station – 2nd Floor – Narcotics Evidence Room

Energy Saving Opportunity:

(8) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 30-35 fc. Fixtures operate 10 hours/week. Relamp with (8) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – 2nd Floor – Entry

Energy Saving Opportunity:

(2) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (2) LED Exit Sign.

Police Station – 2nd Floor – Homicide Evidence Room

Energy Saving Opportunity:

 (4) 2x4, 4-lamp T12 recessed volumetric. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 45-55 fc. Fixtures operate 10 hours/week. Re-lamp with (4) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

Police Station – 2nd Floor – Lobby

Energy Saving Opportunity:

• (5) 1x2, 2-lamp T12 wall mount. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 60



hours/week. Re-lamp with (5) 2,17W 2' T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – 3rd Floor – Offices

Energy Saving Opportunity:

• (17) 2x4, 4-lamp T12 recessed volumetric. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-50 fc. Fixtures operate 60 hours/week. Re-lamp with (17) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Police Station – 3rd Floor – Mechanical Room

Energy Saving Opportunity:

• (4) 2x4, 2-lamp T12 parabolic strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-20 fc. Fixtures operate 2 hours/week. Re-lamp with (4) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

Police Station – 3rd Floor – Offices Energy Saving Opportunity:

(2) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (2) LED Exit Sign.

Police Station – 3rd Floor – Stairs

Energy Saving Opportunity:

• (2) 1x4, 2-lamp T12 parabolic strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 1-2 fc. Fixtures operate 60 hours/week. Re-lamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

Police Station – 3rd Floor – Restroom

Energy Saving Opportunity:

• (1) 2x4, 4-lamp T12 recessed troffer. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 50-60 fc. Fixture operates 60 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixtures to be controlled by dual-technology occupancy sensor.



Police Station – 3rd Floor – Elevator Lobby

Energy Saving Opportunity:

• (1) 2x2, 2 U-lamp T12 recessed troffer. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 60 hours/week. Re-lamp with (1) 2, 31W T8 U-lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.

Police Station – Exterior Entry

Energy Saving Opportunity:

• (2) 1x1, 60W incandescent surface square. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 84 hours/week. Re-lamp with (2) 9W compact fluorescent, screw type lamps.

Fire Station – 1st Floor – Apparatus Bay

Energy Saving Opportunity:

- (6) 400W, High-Pressure Sodium low bay. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 30-35 fc. Fixtures operate 60hours/week. Fixtures to be demolished and replaced with (7) 4-lamp T5HO High-bays, with electronic ballasts. Fixtures to be controlled by integrated occupancy sensors in fixture.
- (1) 250W, Mercury Vapor wall mount. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 60 hours/week. Fixture to be demolished.
- (3) 2-lamp T8 strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 15-25 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain.

Fire Station – 1st Floor – Office

Energy Saving Opportunity:

• (4) 1x4, 2-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-20 fc. Fixtures operate 60 hours/week. Re-lamp with (4) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.





Fire Station – 1st Floor – Stairs

Energy Saving Opportunity:

• (1) 100W exposed incandescent. Average foot candle reading for this fixture is 1-2 fc. Fixture operates 1 hour/week. Re-lamp with (1) 26W compact fluorescent, screw type lamp.

Fire Station – 1st Floor – MechanicalRoom

Energy Saving Opportunity:

• (2) 100W exposed incandescent. Average foot candle reading for these fixtures is 1-2 fc. Fixtures operate 1 hour/week. Re-lamp with (2) 26W compact fluorescent, screw type lamps.

Fire Station – 1st Floor – Corridor

Energy Saving Opportunity:

• (1) 2-lamp, 60W incandescent surface square. Average foot candle reading for this fixture is 1-2 fc. Fixture operates 1 hour/week. Re-lamp with (1) 2, 13W compact fluorescent, screw type lamps.

Fire Station – 1st Floor – Store Room

Energy Saving Opportunity:

 (4) 100W exposed incandescent. Average foot candle reading for these fixtures is 1-2 fc. Fixtures operate 1 hour/week. Re-lamp with (4) 26W compact fluorescent, screw type lamps.

Fire Station – 1st Floor – Kitchen

Energy Saving Opportunity:

- (2) 2-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-25 fc. Fixtures operate 60 hours/week. Re-lamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) 1-lamp, 3' T8 strip. Fixture utilizes electronic ballast. Average foot candle reading for this fixture is 20-25 fc. Fixture operates 60 hours/week. There are no recommendations, fixture is to remain.



Fire Station – 1st Floor – Break Room

Energy Saving Opportunity:

• (2) 4-lamp 13W CFL Ceiling Fan. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 5-10 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain.

Fire Station – 2nd Floor – Restroom

Energy Saving Opportunity:

• (2) 1x1, 60W incandescent recessed square. Average foot candle reading for these fixtures is 10-12 fc. Fixtures operate 20 hours/week. Re-lamp with (2) 9W compact fluorescent, screw type lamps.

Fire Station – 2nd Floor – Showers

Energy Saving Opportunity:

• (2) 60W recessed incandescent can. Average foot candle reading for these fixtures is 5-7 fc. Fixtures operate 20 hours/week. Re-lamp with (2) 13W compact fluorescent, screw type lamps.

Fire Station – 2nd Floor – Sleep Area

Energy Saving Opportunity:

• (9) 1x2, 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 80 hours/week. Re-lamp with (9) 2,17W 2' T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Fire Station – 2nd Floor – Weight Room

Energy Saving Opportunity:

• (8) 1x4, 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 20 hours/week. Re-lamp with (8) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

Fire Station – 2nd Floor – Media Room

Energy Saving Opportunity:

• (4) 1x4, 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 10 hours/week. Re-lamp with (4) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.



Fire Station – 2nd Floor – Restroom

Energy Saving Opportunity:

- (2) 1x4, 2-lamp T12 surface vanity. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 40-45 fc. Fixtures operate 80 hours/week. Re-lamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) 2x4, 4-lamp T12 recessed troffer. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 30-35 fc. Fixture operates 80 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.

Fire Station – 2nd Floor – Storage

Energy Saving Opportunity:

• (1) 90W exposed incandescent. Average foot candle reading for this fixture is 2-5 fc. Fixture operates 1 hour/week. Re-lamp with (1) 26W compact fluorescent, screw type lamp.

Fire Station – 2nd Floor – Sleep Room Energy Saving Opportunity:

• (1) 4-lamp 52W incandescent ceiling fan. Average foot candle reading for this fixture is 5-10 fc. Fixture operates 5 hours/week. Re-lamp with (1) 4, 13W compact fluorescent, screw type lamps.

Fire Station – 2nd Floor – Stairs

Energy Saving Opportunity:

- (2) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (2) LED Exit Sign.
- (2) 2-lamp T12 wall strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 10 hours/week. Relamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts.
- (1) 1-lamp T12 wall strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 80 hours/week. Relamp with (1) 1, 28W T8 lamps and high-efficiency, electronic ballast.





ECM-1.2: Lighting Retrofit (City Hall)

Existing Conditions

The University City, City Hall building houses the mayor's office, finance department, engineering services, permits, administration, and the courthouse. The building recently underwent a substantial energy efficiency renovation in 2006. The building's lights are now controlled by a time clock that turns the lights on at 6:30 AM and turns them off at 11:30 PM, Monday through Friday. The lighting systems in City Hall consist primarily of T8 linear fluorescents, compact fluorescents, halogen track lights, and LED exit signs. The remaining T12, magnetically-ballasted fixtures, and incandescent lamps can be retrofitted to bring the building's lighting system fully up-to-date. There are also select areas and offices where occupancy sensing, lighting controls should be installed. This will save energy by turning off the lights in unoccupied spaces before the occupant arrives and after the occupant leaves the space each day. All enclosed fixtures that are to remain should have their lenses cleaned and wiped down, as the photometrics and lumen output have been severely compromised due to dust collection and the presence of foreign matter in most cases.

Savings Summary

Energy Consumption Savings						Energy Cos	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water	J-	J-		
12,081	6	12	-	-	\$828	\$0	\$0	\$0	\$828	\$0	\$21,723	23.5

Table 18 Savings	Summary - ECM-1.2	Liahtina Retrofi	t (Citv Hall)
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Physical Changes

To the occupant, there will be minimal visible changes. With current lamp technology and fixture design, occupants will notice more appropriate light levels with greater uniformity and increased color rendering in the selected retrofit areas. All suggested retrofit and replacement applications meet or exceed existing light levels for the applicable area. The maintenance staff will also notice slight changes. As a result of changing incandescents to compact fluorescents, there will be a lower frequency of lamp replacements. Elimination of fixtures that are in poor operational condition, due to age or environmental degradation, will result in a safer work environment for the entire staff. Other positive changes include the removal of out-dated or obsolete technology, as well as a moderate amount of electrical savings for the facility.

Interface with Agency Equipment

Contractor shall provide all labor and material to inspect, test, and adjust the lighting and the electrical control systems affecting the given spaces to ensure the new lighting systems fulfill existing requirements, while offering a reduction in consumption, especially during peak hours.





Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with fixture replacement and retrofit, but will be strictly limited to the given area and the panel breakers involved. All work shall be coordinated with the administration and the maintenance staff.

Environmental Impacts

There are minimal environmental drawbacks and numerous benefits associated with the suggested retrofitting and replacement of the lighting in the areas outlined. The new lamps and fixtures will consume less energy, resulting in decreased demand from the reactor processes involved in power production. The new fluorescent lamps are far lower in mercury content, which is beneficial concerning disposal. The only negative impact is from the disposal of the existing lamps and fixtures, but this is negligible when compared to the positives. See Table 3 Greenhouse Gases and Other Pollutants

Salvage and Disposal

Existing equipment in operational condition shall be given to University City as requested. All remaining equipment will be removed and disposed of properly by the electrical contractor.





Individual Recommendations Per Location

The following is a summary of the individual floors and areas of the University City, City Hall building and the individual recommendations therein:

City Hall - Elevator

Energy Saving Opportunity:

• (6) MR16 20W Halogen Can. Average foot candle reading for these fixtures is 5-8 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain.

<u>City Hall – 5th Floor - Courtroom</u>

Energy Saving Opportunity:

- (21) PAR38 Halogen Flood. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 8 hours/week. There are no recommendations, fixtures are to remain.
- (6) 26W CFL Decorative Wall Torch. Average foot candle reading for these fixtures is 5-7 fc. Fixtures operate 8 hours/week. There are no recommendations, fixtures are to remain.
- (16) 2-lamp T8 cove strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 8 hours/week. There are no recommendations, fixtures are to remain.
- (3) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (3) LED Exit Sign.

<u>City Hall – 5th Floor – Courtroom Storage</u>

Energy Saving Opportunity:

• (2) 2-lamp T8 strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 1 hour/week. There are no recommendations, fixtures are to remain.

<u> City Hall – 5th Floor - Courtroom</u>

Energy Saving Opportunity:

• (1) 16-lamp 40W incandescent decorative chandelier. Average foot candle reading for this fixture is 20-25 fc. Fixture operates 8 hours/week. Re-lamp with (16) 13W compact fluorescent, screw type lamps.



• (1) 9-lamp, 13W CFL Decorative Chandelier. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 8 hours/week. There are no recommendations, fixtures are to remain.

<u>City Hall – 5th Floor - Elevator Lobby</u>

Energy Saving Opportunity:

• (1) 100W exposed incandescent pendant. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 8 hours/week. Re-lamp with (1) 26W compact fluorescent, screw type lamp.

<u>City Hall – 5th Floor - Penthouse</u>

Energy Saving Opportunity:

- (8) 13W Exposed CFL Screw-Type Lamp. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 1 hour/week. There are no recommendations, fixtures are to remain.
- (4) 2-lamp T8 strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 30-35 fc. Fixtures operate 1 hour/week. There are no recommendations, fixtures are to remain.

<u>City Hall – 4th Floor – Women's Restroom</u> Energy Saving Opportunity:

- (3) 2-lamp T8 vanity strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 5-30 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) 13W CFL Wall Sconce. Average foot candle reading for this fixture is 5-6 fc. Fixture operates 85 hours/week. There are no recommendations, fixture is to remain.

<u>City Hall – 4th Floor - Elevator Lobby</u>

Energy Saving Opportunity:

• (1) 2-lamp, 13W Decorative CFL Wall Sconce. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 1 hour/week. There are no recommendations, fixture is to remain.





City Hall – 4th Floor – Engineering Offices

Energy Saving Opportunity:

- (21) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 60 hours/week. Re-lamp with (21) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.
- (9) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 20 hours/week. Re-lamp with (9) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.
- (19) 2x4, 4-lamp, 25W T8 recessed troffer. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 90-105 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensors.
- (5) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (5) LED Exit Sign.

<u>City Hall – 4th Floor – Engineering Office Conference Room</u>

Energy Saving Opportunity:

- (6) 2-lamp T12 above ceiling strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 5-10 fc. Fixtures operate 5 hours/week. Re-lamp with (6) 2, 28W T8 lamps and high-efficiency, electronic ballasts.
- (1) 4-lamp, 13W CFL Ceiling Fan. Average foot candle reading for this fixture is 5-10 fc. Fixture operates 5 hours/week. There are no recommendations, fixture is to remain.

<u>City Hall – 4th Floor – Engineering Office File Room</u>

Energy Saving Opportunity:

• (3) 3-lamp, T8 pendant wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 50-60 fc. Fixtures operate 5 hours/week. There are no recommendations, fixtures are to remain.

<u>City Hall – 4th Floor – Engineering Office File Room Corridor</u>

Energy Saving Opportunity:

• (1) 2-lamp, 75W T12 8' parabolic pendant. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 5-10 fc. Fixture operates 5 hours/week. Re-lamp with (1) 2, 59W, 8' T8 lamps and high-efficiency, electronic ballast.



<u>City Hall – 3rd Floor – Men's Restroom</u>

Energy Saving Opportunity:

- (3) 2-lamp T8 vanity strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 5-30 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) 13W CFL Wall Sconce. Average foot candle reading for this fixture is 5-6 fc. Fixture operates 85 hours/week. There are no recommendations, fixture is to remain.

<u>City Hall – 3rd Floor – Elevator Lobby</u>

Energy Saving Opportunity:

- (1) 2-lamp, 13W Decorative CFL Wall Sconce. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 85 hour/week. There are no recommendations, fixture is to remain.
- (1) Incandescent Exit Sign. Fixture operates 168 hours/week. Replace with new
 (1) LED Exit Sign.

<u>City Hall – 3rd Floor – Private Offices</u> Energy Saving Opportunity:

- (17) 1x4, 2-lamp T8 direct/indirect pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensors.
- (19) 1x4, 2-lamp T8 direct/indirect pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 10 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensors.

City Hall – 3rd Floor – Storage Vault

Energy Saving Opportunity:

• (1) 90W exposed incandescent pendant. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 1 hour/week. Re-lamp with (1) 26W compact fluorescent, screw type lamp.

City Hall – 3rd Floor – Conference Room

Energy Saving Opportunity:

• (6) 1x4, 2-lamp T8 direct/indirect pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 40



hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.

City Hall – 3rd Floor – Open Offices

Energy Saving Opportunity:

• (27) 1x4, 2-lamp T8 direct/indirect pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensors.

City Hall – 3rd Floor – Private Offices

Energy Saving Opportunity:

• (1) 3-lamp, 60W incandescent ceiling fan. Average foot candle reading for this fixture is 5-10 fc. Fixture operates 60 hours/week. Re-lamp with (3) 13W compact fluorescent, screw type lamps.

<u>City Hall – 3rd Floor – Open Offices</u> Energy Saving Opportunity:

• (1) LED Exit Sign. Fixture operates 168 hours/week. There are no recommendations, fixture is to remain.

City Hall – 3rd Floor – Private Offices

Energy Saving Opportunity:

- (3) 1-lamp 22W Circline Ceiling Fan. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 2 hours/week. There are no recommendations, fixtures are to remain.
- (2) LED Exit Sign. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.
- (10) 2x4, 4-lamp T8 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 35-40 fc. Fixtures operate 5 hours/week. Re-lamp with (10) 4, 25W T8 lamps and high-efficiency, electronic ballasts.

City Hall – 2nd Floor – Women's Restroom

Energy Saving Opportunity:

• (3) 2-lamp T8 vanity strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 5-30 fc. Fixtures operate 85 hours/week. There are no



recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.

• (1) 13W CFL Wall Sconce. Average foot candle reading for this fixture is 5-6 fc. Fixture operates 85 hours/week. There are no recommendations, fixture is to remain.

<u>City Hall – 2nd Floor – Elevator Lobby</u>

Energy Saving Opportunity:

• (1) 2-lamp, 13W Decorative CFL Wall Sconce. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 1 hour/week. There are no recommendations, fixture is to remain.

<u>City Hall – 2nd Floor – Center Rotunda</u>

Energy Saving Opportunity:

- (8) 9W CFL 4-lamp decorative torches. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain.
- (2) LED Exit Sign. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.
- (1) 12-lamp, 25W Incandescent Decorative Chandelier. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain.
- (1) 14-lamp, 25W Incandescent Decorative Chandelier. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain.

<u>City Hall – 2nd Floor – City Clerk</u>

Energy Saving Opportunity:

- (5) 1x4, 2-lamp T8 direct/indirect pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.
- (2) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 60 hours/week. Re-lamp with (2) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.



City Hall – 2nd Floor – Mayor

Energy Saving Opportunity:

- (2) 90W exposed incandescent pendant. Average foot candle reading for these fixtures is 2-3 fc. Fixtures operate 1 hour/week. Re-lamp with (2) 26W compact fluorescent, screw type lamps.
- (9) PAR38 Halogen Flood. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain.
- (4) 40W incandescent wall torches. Average foot candle reading for these fixtures is 8-10 fc. Fixtures operate 60 hours/week. Re-lamp with (4) 9W compact fluorescent, screw type lamps.
- (2) 2-lamp T5 task strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 3-7 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.

<u>City Hall – 2nd Floor – Mayor's Restroom</u> Energy Saving Opportunity:

- (8) 13W CFL 3-lamp decorative torches. Average foot candle reading for these fixtures is 5-10 fc. Fixtures operate 1 hour/week. There are no recommendations, fixtures are to remain.
- (1) 52W exposed incandescent. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 1 hour/week. Re-lamp with (1) 13W compact fluorescent, screw type lamps.

City Hall – 2nd Floor – Mayor's Fireplace

Energy Saving Opportunity:

(1) 4-lamp 60W decorative incandescent surface mount. Average foot candle reading for this fixture is 5-10 fc. Fixture operates 1 hour/week. Re-lamp with (1) 13W compact fluorescent, screw type lamps.

City Hall – 2nd Floor – Administrative Office 7

Energy Saving Opportunity:

• (6) 1x4, 2-lamp T8 direct/indirect pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.



City Hall – 2nd Floor – Administrative Office 8

Energy Saving Opportunity:

• (6) 1x4, 2-lamp T8 direct/indirect pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.

City Hall – 2nd Floor – Storage Closets

Energy Saving Opportunity:

• (3) 60W exposed incandescent pendant. Average foot candle reading for these fixtures is 2-3 fc. Fixtures operate 1 hour/week. Re-lamp with (3) 13W compact fluorescent, screw type lamps.

<u>City Hall – 2nd Floor – Conference Room</u> Energy Saving Opportunity:

- (3) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 30-40 fc. Fixtures operate 10 hours/week. Re-lamp with (3) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (2) 2-lamp T8 vanity strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 5-30 fc. Fixtures operate 1 hour/week. There are no recommendations, fixtures are to remain.

<u>City Hall – 1st Floor – Men's Restroom</u>

Energy Saving Opportunity:

- (3) 2-lamp T8 vanity strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 5-30 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) 13W CFL Wall Sconce. Average foot candle reading for this fixture is 5-6 fc. Fixture operates 85 hours/week. There are no recommendations, fixture is to remain.

<u>City Hall – 1st Floor – Elevator Lobby</u>

Energy Saving Opportunity:

• (1) 2-lamp, 60W decorative incandescent wall sconce. Average foot candle reading for this fixture is 2-3 fc. Fixture operates 1 hour/week. Re-lamp with (2) 13W compact fluorescent, screw type lamps.



<u>City Hall – 1st Floor – Lobby</u>

Energy Saving Opportunity:

- (36) 2-lamp, 13W CFL decorative torches. Average foot candle reading for these fixtures is 8-10 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain.
- (4) LED Exit Sign. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.
- (7) 15W Incandescent statue lights. Average foot candle reading for these fixtures is 1-2 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain.
- (4) 5-lamp, Decorative Incandescent Candleabra. Average foot candle reading for these fixtures is 2-3 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain.

<u>City Hall – 1st Floor – Offices</u>

Energy Saving Opportunity:

• (42) 1x4, 2-lamp T8 direct/indirect pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensors.

<u> City Hall – 1st Floor – Vault Closet</u>

Energy Saving Opportunity:

- (3) 90W exposed incandescent pendant. Average foot candle reading for these fixtures is 2-3 fc. Fixtures operate 1 hour/week. Re-lamp with (3) 26W compact fluorescent, screw type lamps.
- (1) 13W CFL Exposed Lamp. Average foot candle reading for this fixture is 5-6 fc. Fixture operates 1 hour/week. There are no recommendations, fixture is to remain.

<u>City Hall – 1st Floor – Offices</u>

Energy Saving Opportunity:

• (4) 1x4, 2-lamp T8 direct/indirect pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.



City Hall – 1st Floor – Sink Closet

Energy Saving Opportunity:

• (3) 52W exposed incandescent pendant. Average foot candle reading for these fixtures is 2-3 fc. Fixtures operate 1 hour/week. Re-lamp with (3) 13W compact fluorescent, screw type lamps.

City Hall – Basement - Stairs

Energy Saving Opportunity:

- (11) MR16, 50W Halogen Track Light. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 85 hours/week. There are no recommendations, fixtures are to remain.
- (2) LED Exit Sign. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.
- (1) Incandescent Exit Sign. Fixture operates 168 hours/week. Replace with new
 (1) LED Exit Sign.
- (8) 13W CFL wall sconce. Average foot candle reading for these fixtures is 5-6 fc. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.

<u> City Hall – Basement - Shops</u>

Energy Saving Opportunity:

- (2) 2-lamp T8 damp-location strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) LED Exit Sign. Fixtures operate 168 hours/week. There are no recommendations, fixture is to remain.

<u>City Hall – Basement – Mechanical Room</u>

Energy Saving Opportunity:

• (2) 2-lamp T8 damp-location pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 2 hours/week. There are no recommendations, fixtures are to remain.



City Hall – Basement – Electrical Room

Energy Saving Opportunity:

• (2) 2-lamp T8 damp-location pendant. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 2 hours/week. There are no recommendations, fixtures are to remain.

City Hall – Basement – Closet

Energy Saving Opportunity:

• (9) 90W exposed incandescent pendant. Average foot candle reading for these fixtures is 5-7 fc. Fixtures operate 1 hour/week. Re-lamp with (9) 26W compact fluorescent, screw type lamps.

City Hall – Basement – File Room

Energy Saving Opportunity:

- (7) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-30 fc. Fixtures operate 2 hours/week. Re-lamp with (7) 4, 25W T8 lamps and high-efficiency, electronic ballasts.
- (6) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 2 hours/week. Relamp with (6) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

City Hall – Basement – Shops

Energy Saving Opportunity:

- (2) 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-30 fc. Fixtures operate 60 hours/week. Re-lamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (8) 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 60 hours/week. Re-lamp with (8) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.





ECM-1.3: Lighting Retrofit (Community Center)

Existing Conditions

The University City Community Center is now in use as a senior citizen's center. The building is occupied for a limited number of hours each week. The lighting systems in the community center consist primarily of T8 and T12 linear fluorescents, compact fluorescents, exposed incandescents and incandescent exit signs. The T12, magnetically-ballasted fixtures, and incandescent lamps can be retrofitted to modernize the building's lighting system. There are also select areas and offices where occupancy sensing, lighting controls should be installed. This will save energy by turning off the lights in unoccupied spaces that are accidentally left on after the occupant leaves the space. Unfortunately, due to the limited number of fixture burn hours, these upgrades do not offer a reasonable, financial payback. All enclosed fixtures that are to remain should have their lenses cleaned and wiped down, as the photometrics and lumen output have been severely compromised due to dust collection and the presence of foreign matter in most cases.

Savings Summary

	Energy Consumption Savings						Energy Cos	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB
	KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water				
Ę	5,502	4	12	-	-	\$377	\$0	\$0	\$0	\$377	\$0	\$2,249	5.3

Table 19 Savings Summary - ECM 1.3 Lighting Retrofit (Community Center)

Physical Changes

To the occupant, there will be slight visible changes. With current lamp technology and fixture design, occupants will notice more appropriate light levels with greater uniformity and increased color rendering in the selected retrofit areas. All suggested retrofit and replacement applications meet or exceed existing light levels for the applicable area. The maintenance staff will also notice slight changes. As a result of changing incandescents to compact fluorescents, there will be a lower frequency of lamp replacements. Elimination of fixtures that are in poor operational condition, due to age or environmental degradation, will result in a safer work environment for the entire staff. Other positive changes include the removal of out-dated or obsolete technology, as well as a moderate amount of electrical savings for the facility.

Interface with Agency Equipment

Contractor shall provide all labor and material to inspect, test, and adjust the lighting and the electrical control systems affecting the given spaces to ensure the new lighting systems fulfill existing requirements, while offering a reduction in consumption, especially during peak hours.



Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with fixture replacement and retrofit, but will be strictly limited to the given area and the panel breakers involved. All work shall be coordinated with the administration and the maintenance staff.

Environmental Impacts

There are minimal environmental drawbacks and numerous benefits associated with the suggested retrofitting and replacement of the lighting in the areas outlined. The new lamps and fixtures will consume less energy, resulting in decreased demand from the reactor processes involved in power production. The new fluorescent lamps are far lower in mercury content, which is beneficial concerning disposal. The only negative impact is from the disposal of the existing lamps and fixtures, but this is negligible when compared to the positives. See Table 3 Greenhouse Gases and Other Pollutants

Salvage and Disposal

Existing equipment in operational condition shall be given to University City as requested. All remaining equipment will be removed and disposed of properly by the electrical contractor.





Individual Recommendations Per Location

The following is a summary of the individual floors and areas of the University City Community Center building and the individual recommendations therein:

Community Center – Conference Room / Stage

Energy Saving Opportunity:

- (4) 2x4, 4-lamp T8 recessed troffer. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 20 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensors.
- (16) 2x4, 4-lamp T8 recessed troffer. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 10 hours/month. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.
- (16) PAR38 Halogen Flood. Average foot candle reading for these fixtures is 1-30 fc. Fixtures operate 2 hours/week. There are no recommendations, fixtures are to remain.
- (2) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (2) LED Exit Sign.

Community Center – Store Room

Energy Saving Opportunity:

- (7) 100W recessed incandescent square. Average foot candle reading for these fixtures is 5-7 fc. Fixtures operate 1 hour/week. Re-lamp with (7) 26W compact fluorescent, screw type lamps.
- (1) 200W exposed incandescent. Average foot candle reading for this fixture is 7-9 fc. Fixture operates 2 hour/week. Re-lamp with (1) 59W compact fluorescent, screw type lamps.

Community Center – Kitchen

- Energy Saving Opportunity:
 - (3) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (3) LED Exit Sign.
 - (8) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-30 fc. Fixtures operate 5 hours/month. Re-lamp with (8) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.



Community Center - Hall

Energy Saving Opportunity:

• (2) 2-lamp, 60W incandescent surface round. Average foot candle reading for this fixture is 7-9 fc. Fixture operates 20 hours/week. Re-lamp with (4) 13W compact fluorescent, screw type lamps.

Community Center – Men's Restroom

Energy Saving Opportunity:

• (4) 2-lamp, 60W recessed incandescent square. Average foot candle reading for this fixture is 7-9 fc. Fixture operates 20 hours/week. Re-lamp with (8) 13W compact fluorescent, screw type lamps.

Community Center – Women's Restroom

Energy Saving Opportunity:

• (4) 2-lamp, 60W recessed incandescent square. Average foot candle reading for this fixture is 7-9 fc. Fixture operates 20 hours/week. Re-lamp with (8) 13W compact fluorescent, screw type lamps.

<u>Community Center – Janitor's Closet</u> Energy Saving Opportunity:

• (1) 100W exposed incandescent. Average foot candle reading for these fixtures is 5-7 fc. Fixtures operate 1 hour/month. Re-lamp with (1) 26W compact fluorescent, screw type lamps.

Community Center – Dining Hall

Energy Saving Opportunity:

• (20) 2x4, 4-lamp T8 recessed troffer. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 15-25 fc. Fixtures operate 20 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensors.

Community Center – Mechanical Room

Energy Saving Opportunity:

• (3) 200W exposed incandescent. Average foot candle reading for these fixtures is 7-9 fc. Fixtures operate 1 hour/month. Re-lamp with (3) 59W compact fluorescent, screw type lamps.





Community Center – Office / Storage

Energy Saving Opportunity:

- (1) 200W exposed incandescent. Average foot candle reading for this fixture is 7-9 fc. Fixture operates 1 hour/month. Re-lamp with (1) 59W compact fluorescent, screw type lamp.
- (1) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 5 hours/week. Relamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixture to be controlled by dual-technology occupancy sensor.
- (2) 2-lamp T8 surface wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 40-45 fc. Fixtures operate 5 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.

Community Center – Dining Hall

Energy Saving Opportunity:

- (2) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (2) LED Exit Sign.
- (16) PAR38 Halogen Flood. Average foot candle reading for these fixtures is 1-30 fc. Fixtures operate 1 hour/month. There are no recommendations, fixtures are to remain.

Community Center – Entry

Energy Saving Opportunity:

- (3) PAR38 23W CFL Flood. Average foot candle reading for these fixtures is 1-30 fc. Fixtures operate 2 hours/week. There are no recommendations, fixtures are to remain.
- (1) PAR38 Halogen Flood. Average foot candle reading for this fixture is 1-30 fc. Fixture operates 2 hours/month. There are no recommendations, fixture is to remain.

Community Center – Office

Energy Saving Opportunity:

• (1) 2x4, 4-lamp T12 recessed troffer. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 15-20 fc. Fixture operates 20 hours/month. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.



• (1) 2x4, 4-lamp T12 recessed troffer. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 15-20 fc. Fixture operates 5 hours/month. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.





ECM-1.4: Lighting Retrofit (Fire Station #2)

Existing Conditions

The University City Fire Station #2 is a combination of a building constructed in the 1930s, and an addition that occurred a few years ago. The lighting system in the building consist is completely modernized and there are no recommendations for retrofits other than the ceiling fans with incandescent lamps. Occupancy sensors are present in many areas, but should be installed in the sleep rooms for further energy savings.

Savings Summary

	Energy Consumption Savings					Energy Cos	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water				
5,448	-	-	-	-	\$373	\$0	\$0	\$0	\$373	\$0	\$5,829	14.4

 Table 20 Savings Summary - ECM-1.4 Lighting Retrofit (Fire Station #2)

Physical Changes

To the occupant, there will be no noticeable visible changes.

Interface with Agency Equipment

Contractor shall provide all labor and material to inspect, test, and adjust the lighting and the electrical control systems affecting the given spaces to ensure the new lighting systems fulfill existing requirements, while offering a reduction in consumption, especially during peak hours.

Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with fixture replacement and retrofit, but will be strictly limited to the given area and the panel breakers involved. All work shall be coordinated with the administration and the maintenance staff.

Environmental Impacts

There are minimal environmental drawbacks and numerous benefits associated with the suggested retrofitting and replacement of the lighting in the areas outlined. The new lamps and fixtures will consume less energy, resulting in decreased demand from the reactor processes involved in power production. The new fluorescent lamps are far lower in mercury content, which is beneficial concerning disposal. The only negative impact is from the disposal of the existing lamps and fixtures, but this is negligible when compared to the positives. See Table 3 Greenhouse Gases and Other Pollutants



Salvage and Disposal

Existing equipment in operational condition shall be given to University City as requested. All remaining equipment will be removed and disposed of properly by the electrical contractor.





Individual Recommendations Per Location

The following is a summary of the individual floors and areas of the University City Fire Station #2 building and the individual recommendations therein:

Fire Station #2 – 1st Floor – Movie Room

Energy Saving Opportunity:

- (4) 2x4, 2-lamp T8 surface wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 13-15 fc. Fixtures operate 5 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.
- (2) 4-lamp 60W incandescent ceiling fan. Average foot candle reading for this fixture is 5-10 fc. Fixture operates 1 hour/week. Re-lamp with (8) 13W compact fluorescent, screw type lamps.

Fire Station #2 – 1st Floor – Corridor

Energy Saving Opportunity:

- (3) LED Exit Sign. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.
- (3) 1x4, 2-lamp T8 surface wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 30-35 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.

Fire Station #2 – 1st Floor – Kitchen

Energy Saving Opportunity:

- (1) 2x4, 8-lamp T8 surface wrap. Fixture utilizes electronic ballast. Average foot candle reading for this fixture is 55-60 fc. Fixture operates 60 hours/week. There are no recommendations, fixture is to remain. Fixture to be controlled by dual-technology occupancy sensor.
- (3) 2-lamp, 13W Quad CFL recessed can. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.





Fire Station #2 – 1st Floor – Office Dispatch

Energy Saving Opportunity:

• (3) 2x4, 4-lamp T8 recessed troffer. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 30-35 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.

Fire Station #2 – 1st Floor – Garage

Energy Saving Opportunity:

• (4) 2-lamp T8 strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 15-25 fc. Fixtures operate 5 hours/week. There are no recommendations, fixtures are to remain.

Fire Station #2 – 1st Floor – Apparatus Bay

Energy Saving Opportunity:

- (15) 2-lamp T8 caged strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 13-15 fc. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dualtechnology occupancy sensors.
- (26) 2-lamp T8 caged strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 13-15 fc. Fixtures operate 10 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensors.

Fire Station #2 – 1st Floor – Electrical Room

Energy Saving Opportunity:

• (1) 1x4, 2-lamp T8 surface strip. Fixture utilizes electronic ballast. Average foot candle reading for this fixture is 22-25 fc. Fixture operates 2 hours/week. There are no recommendations, fixture is to remain.

Fire Station #2 – 1st Floor – Janitor's Closet

Energy Saving Opportunity:

- (1) 1x4, 2-lamp T8 surface strip. Fixture utilizes electronic ballast. Average foot candle reading for this fixture is 22-25 fc. Fixture operates 2 hours/week. There are no recommendations, fixture is to remain.
- (1) 1x4, 1-lamp T8 surface strip. Fixture utilizes electronic ballast. Average foot candle reading for this fixture is 22-25 fc. Fixture operates 2 hours/week. There are no recommendations, fixture is to remain.



Fire Station #2 – 1st Floor – Apparatus Bay

Energy Saving Opportunity:

• (3) LED Exit Sign. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.

Fire Station #2 – 1st Floor – Apparatus Bay Stairs

Energy Saving Opportunity:

• (3) 1x4, 2-lamp T8 surface wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 168 hours/week. There are no recommendations, fixturea are to remain.

Fire Station #2 – 1st Floor – Storage

Energy Saving Opportunity:

• (2) 1x4, 2-lamp T8 surface strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 2 hours/week. There are no recommendations, fixturea are to remain.

Fire Station #2 – 1st Floor – Restroom

Energy Saving Opportunity:

• (2) 1x4, 2-lamp T8 wall strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 5 hours/week. There are no recommendations, fixturea are to remain.

Fire Station #2 – 1st Floor – Outside

Energy Saving Opportunity:

• (1) 100W HID Wall Pack. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 5-7 fc. Fixtures operate 84 hours/week. There are no recommendations, fixturea are to remain.

Fire Station #2 – 2nd Floor – Stairs

Energy Saving Opportunity:

• (2) 2-lamp, 26W CFL surface round. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.



Fire Station #2 – 2nd Floor – Corridors Energy Saving Opportunity:

- (5) LED Exit Sign. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.
- (5) 26W CFL step light. Average foot candle reading for these fixtures is 1-2 fc. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.

Fire Station #2 – 2nd Floor – Mechanical Room

Energy Saving Opportunity:

• (1) 2-lamp, 26W CFL surface round. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 2 hours/week. There are no recommendations, fixture is to remain.

Fire Station #2 – 2nd Floor – Corridors

Energy Saving Opportunity:

• (11) 1x4, 2-lamp T8 surface wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 10 hours/week. There are no recommendations, fixturea are to remain.

Fire Station #2 – 2nd Floor – Restrooms

Energy Saving Opportunity:

- (3) 1x4, 2-lamp T8 surface wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 5 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.
- (3) 1x4, 2-lamp T8 vanity. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 5 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.
- (3) 26W CFL surface round shower light. Average foot candle reading for these fixtures is 1-2 fc. Fixtures operate 5 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.





Fire Station #2 – 2nd Floor – Bedrooms

Energy Saving Opportunity:

• (14) 1x4, 2-lamp T8 surface wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 5 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensors.

Fire Station #2 – 2nd Floor – Closet

Energy Saving Opportunity:

• (2) 1x4, 1-lamp T8 surface strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 1 hour/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.

Fire Station #2 – 2nd Floor – Laundry

Energy Saving Opportunity:

• (2) 1x4, 2-lamp T8 surface wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 15 hours/week. There are no recommendations, fixtures are to remain.

Fire Station #2 – 2nd Floor – Mechanical Room / Janitor's Closet

Energy Saving Opportunity:

• (2) 1x4, 2-lamp T8 surface wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 1 hour/week. There are no recommendations, fixtures are to remain.

Fire Station #2 – 2nd Floor – Conference Briefing Room

Energy Saving Opportunity:

• (11) 2x4, 4-lamp T8 recessed troffer. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 30-35 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.

Fire Station #2 – 2nd Floor – Weight Room

Energy Saving Opportunity:

• (3) 1x4, 2-lamp T8 surface wrap. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 22-25 fc. Fixtures operate 1 hour/week. There



are no recommendations, fixtures are to remain. Fixtures to be controlled by dualtechnology occupancy sensor.





ECM-1.5: Lighting Retrofit (Golf Course)

Existing Conditions

The University City Golf Course audit focuses on two main buildings: the pro shop and the maintenance garage. The pro shop is occupied approximately 15 hours per day. There are several outdated T12 fixtures in use in the building. These should all be retrofitted with T8 lamps and high-efficiency, electronic ballasts for a substantial payback. These fixtures should also be controlled by dual-technology occupancy sensors to further increase savings by reducing burn hours. The maintenance garage has the same recommendations as well as replacing exposed incandescent lamps with compact fluorescents. All enclosed fixtures that are to remain should have their lenses cleaned and wiped down, as the photometrics and lumen output have been severely compromised due to dust collection and the presence of foreign matter in most cases.

Savings Summary

Energy Consumption Savings					Energy Cos	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB	
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water				
1,277	1	12	-	-	\$87	\$0	\$0	\$0	\$87	\$0	\$1,847	18.5

Table 21 Savings Summary - ECM-1.5 Lighting Retrofit (Golf Course)

Physical Changes

To the occupant, there will be slight visible changes. With current lamp technology and fixture design, occupants will notice more appropriate light levels with greater uniformity and increased color rendering in the selected retrofit areas. All suggested retrofit and replacement applications meet or exceed existing light levels for the applicable area. The maintenance staff will also notice slight changes. As a result of changing incandescents to compact fluorescents, there will be a lower frequency of lamp replacements. Elimination of fixtures that are in poor operational condition, due to age or environmental degradation, will result in a safer work environment for the entire staff. Other positive changes include the removal of out-dated or obsolete technology, as well as a moderate amount of electrical savings for the facility.

Interface with Agency Equipment

Contractor shall provide all labor and material to inspect, test, and adjust the lighting and the electrical control systems affecting the given spaces to ensure the new lighting systems fulfill existing requirements, while offering a reduction in consumption, especially during peak hours.





Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with fixture replacement and retrofit, but will be strictly limited to the given area and the panel breakers involved. All work shall be coordinated with the administration and the maintenance staff.

Environmental Impacts

There are minimal environmental drawbacks and numerous benefits associated with the suggested retrofitting and replacement of the lighting in the areas outlined. The new lamps and fixtures will consume less energy, resulting in decreased demand from the reactor processes involved in power production. The new fluorescent lamps are far lower in mercury content, which is beneficial concerning disposal. The only negative impact is from the disposal of the existing lamps and fixtures, but this is negligible when compared to the positives. See Table 3 Greenhouse Gases and Other Pollutants

Salvage and Disposal

Existing equipment in operational condition shall be given to University City as requested. All remaining equipment will be removed and disposed of properly by the electrical contractor.





Individual Recommendations Per Location

The following is a summary of the individual floors and areas of the University City Golf Course building and the individual recommendations therein:

<u>Golf Course – Pro Shop</u>

Energy Saving Opportunity:

- (4) 1x4, 2-lamp T12 wall-mounted strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 105 hours/week. Re-lamp with (4) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (8) R40 Halogen Flood Track Light. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 105 hours/month. There are no recommendations, fixtures are to remain.
- (8) 2x4, 4-lamp T8 recessed troffer. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 80-100 fc. Fixtures operate 105 hours/week. Re-lamp with (8) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (1) 2x4, 4-lamp T8 surface wrap. Fixture utilizes electronic ballast. Average foot candle reading for this fixture is 60-80 fc. Fixture operates 105 hours/week. Relamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.

Golf Course – Pro Shop - Office

Energy Saving Opportunity:

• (1) 1x4, 4-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 35-40 fc. Fixtures operate 60 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixture to be controlled by dual-technology occupancy sensor.

Golf Course – Pro Shop – Men's Restroom

Energy Saving Opportunity:

• (1) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-30 fc. Fixtures operate 60 hours/week. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixture to be controlled by dual-technology occupancy sensor.



Golf Course – Pro Shop – Women's Restroom

Energy Saving Opportunity:

• (1) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-30 fc. Fixtures operate 10 hours/week. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixture to be controlled by dual-technology occupancy sensor.

Golf Course - Pro Shop - Stairs

Energy Saving Opportunity:

• (4) 100W recessed incandescent square. Average foot candle reading for these fixtures is 5-7 fc. Fixtures operate 5 hours/week. Re-lamp with (4) 26W compact fluorescent, screw type lamps.

Golf Course – Pro Shop – Basement

Energy Saving Opportunity:

• (1) 2-lamp T12 strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 20-25 fc. Fixture operates 5 hours/week. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballast.

<u> Golf Course – Pro Shop – Kitchen</u>

Energy Saving Opportunity:

- (1) 2-lamp T12 strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 20-25 fc. Fixture operates 5 hours/week. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballast.
- (1) 100W incandescent globe. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 5 hours/week. Re-lamp with (1) 26W compact fluorescent, screw type lamp.

Golf Course – Pro Shop – Ball Shack

Energy Saving Opportunity:

• (1) 1x4, 2-lamp T8 surface wrap. Fixture utilizes electronic ballast. Average foot candle reading for this fixture is 12-15 fc. Fixture operates 20 hours/week. There are no recommendations, fixtures are to remain.





Golf Course – Grounds Maintenance Building - Storage

Energy Saving Opportunity:

• (1) 100W incandescent globe. Average foot candle reading for this fixture is 2-3 fc. Fixture operates 2 hours/year. Re-lamp with (1) 26W compact fluorescent, screw type lamp.

Golf Course – Grounds Maintenance Building - Garage

Energy Saving Opportunity:

- (1) 60W incandescent globe. Average foot candle reading for this fixture is 2-3 fc. Fixture operates 60 hours/week. Re-lamp with (1) 13W compact fluorescent, screw type lamp.
- (5) 60W incandescent globe. Average foot candle reading for this fixture is 2-3 fc. Fixture operates 2 hours/year. Re-lamp with (5) 13W compact fluorescent, screw type lamp.
- (2) 13W Exposed CFL screw type lamp. Average foot candle reading for these fixtures is 3-5 fc. Fixtures operate 60 hours/week. There are no recommendations, fixtures are to remain.
- (5) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 120 hours/week. Relamp with (5) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

Golf Course – Grounds Maintenance Building – Garage Office

Energy Saving Opportunity:

(2) 2x4, 4-lamp T8 recessed troffer. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 55-60 fc. Fixtures operate 60 hours/week. Re-lamp with (2) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

<u>Golf Course – Grounds Maintenance Building – Exterior</u> Energy Saving Opportunity:

• (2) PAR38 Halogen Flood. Average foot candle reading for this fixture is 5-10 fc. Fixture operates 10 hours/week. There are no recommendations, fixture is to remain.





ECM-1.6: Lighting Retrofit (Public Works)

Existing Conditions

The University City Public Works site consists of several buildings: the central garage, recycling center, sign shop, and grounds maintenance storage and shops. All of these buildings use antiquated T12 strips and recessed troffers with magnetic ballast. All of these fixtures should be retrofitted with T8 lamps and low-power, electronic ballasts. The garage fixtures should be replaced with high-bay, T8 fixtures that will drastically increase light levels, while reducing the total numbers of fixtures and saving significant energy. These fixtures will be equipped with integral occupancy sensors to further increase energy savings. Other upgraded fixtures should also be controlled by new, dual-technology, occupancy sensors for a reduction in burn hours. Although many of these upgrades offer a slightly less than ideal payback, the improvements in light quality and worker productivity make these upgrades a wise investment. All enclosed fixtures that are to remain should have their lenses cleaned and wiped down, as the photometrics and lumen output have been severely compromised due to dust collection and the presence of foreign matter in most cases.

Savings Summary

Energy Consumption Savings					Energy Cos	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB	
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water				
39,387	9	12	-	-	\$2,698	\$0	\$0	\$0	\$2,698	\$0	\$31,692	8.8

Table 22 Savings Summary - ECM-1.6 Lighting Retrofit (Public Works)

Physical Changes

To the occupant, there will be slight visible changes. With current lamp technology and fixture design, occupants will notice more appropriate light levels with greater uniformity and increased color rendering in the selected retrofit areas. All suggested retrofit and replacement applications meet or exceed existing light levels for the applicable area. The maintenance staff will also notice slight changes. As a result of changing incandescents to compact fluorescents, there will be a lower frequency of lamp replacements. Elimination of fixtures that are in poor operational condition, due to age or environmental degradation, will result in a safer work environment for the entire staff. Other positive changes include the removal of out-dated or obsolete technology, as well as a moderate amount of electrical savings for the facility.

Interface with Agency Equipment

Contractor shall provide all labor and material to inspect, test, and adjust the lighting and the electrical control systems affecting the given spaces to ensure the new lighting systems fulfill existing requirements, while offering a reduction in consumption, especially during peak hours.



Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with fixture replacement and retrofit, but will be strictly limited to the given area and the panel breakers involved. All work shall be coordinated with the administration and the maintenance staff.

Environmental Impacts

There are minimal environmental drawbacks and numerous benefits associated with the suggested retrofitting and replacement of the lighting in the areas outlined. The new lamps and fixtures will consume less energy, resulting in decreased demand from the reactor processes involved in power production. The new fluorescent lamps are far lower in mercury content, which is beneficial concerning disposal. The only negative impact is from the disposal of the existing lamps and fixtures, but this is negligible when compared to the positives. See Table 3 Greenhouse Gases and Other Pollutants

Salvage and Disposal

Existing equipment in operational condition shall be given to University City as requested. All remaining equipment will be removed and disposed of properly by the electrical contractor.





Individual Recommendations Per Location

The following is a summary of the individual floors and areas of the University City Central Garage building and the individual recommendations therein:

<u>Central Garage – Vehicle Workshop</u>

Energy Saving Opportunity:

- (41) 1x8, 2-lamp 75W T12 surface strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-25 fc. Fixtures operate 55 hours/week. Fixtures to be demolished and replaced with (25) 4-lamp T8 High-bays, with electronic ballasts. Fixtures to be controlled by integrated occupancy sensors in fixtures.
- (13) 1x4, 2-lamp T12 surface strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-25 fc. Fixtures operate 55 hours/week. Fixtures to be demolished and replaced with (7) 4-lamp T8 Highbays, with electronic ballasts. Fixtures to be controlled by integrated occupancy sensors in fixtures.
- (4) 1x4, 2-lamp T12 pendant industrial task. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-25 fc. Fixtures operate 55 hours/week. Re-lamp with (4) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

Central Garage – High-Bay Garage

Energy Saving Opportunity:

- (21) 1x8, 2-lamp 75W T12 surface strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 40-60 fc. Fixtures operate 55 hours/week. Fixtures to be demolished and replaced with (8) 4-lamp T5HO High-bays, with electronic ballasts. Fixtures to be controlled by integrated occupancy sensors in fixtures.
- (3) 1x4, 2-lamp T12 industrial strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 55 hours/week. All fixtures to be demolished.

<u> Central Garage – Garage</u>

Energy Saving Opportunity:

(1) Incandescent Exit Sign. Fixture operates 168 hours/week. Replace with new
 (1) LED Exit Sign.



Central Garage – Tool/Compressor Room

Energy Saving Opportunity:

• (1) 1x8, 2-lamp 75W T12 industrial strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 10-12 fc. Fixture operates 55 hours/week. Re-lamp with (1) 2, 59W 8', T8 lamps and high-efficiency, electronic ballasts. Fixture to be controlled by dual-technology occupancy sensor.

Central Garage – Parts Supply Room

Energy Saving Opportunity:

- (5) 1x4, 2-lamp T12 industrial strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-22 fc. Fixtures operate 55 hours/week. Re-lamp with (5) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (2) 1x4, 1-lamp T12 industrial strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 18-20 fc. Fixtures operate 55 hours/week. Re-lamp with (2) 1, 28W T8 lamp and high-efficiency, electronic ballast. Fixtures to be controlled by dual-technology occupancy sensor.

Central Garage – Print Room

Energy Saving Opportunity:

• (1) 2x4, 4-lamp T12 recessed troffer. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 25-30 fc. Fixture operates 55 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.

Central Garage – Offices

Energy Saving Opportunity:

- (2) 2x4, 4-lamp T12 surface wrap. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 55 hours/week. Re-lamp with (2) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.
- (3) 1x4, 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-20 fc. Fixtures operate 55 hours/week. Re-lamp with (3) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.



Central Garage – Break Room

Energy Saving Opportunity:

• (1) 1x4, 2-lamp T12 industrial strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 15-20 fc. Fixture operates 55 hours/week. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.

Central Garage – Men's Locker & Restroom

Energy Saving Opportunity:

- (14) 1x4, 2-lamp T12 industrial strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 55 hours/week. Re-lamp with (14) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.
- (1) 1x4, 2-lamp T8 industrial strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 15-20 fc. Fixture operates 55 hours/week. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.
- (1) 1x4, 1-lamp T12 vanity strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 10-12 fc. Fixture operates 55 hours/week. Re-lamp with (1) 1, 28W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.
- (2) 1x4, 2-lamp T8 strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixture operates 55 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensor.

<u>Central Garage – Offices</u> Energy Saving Opportunity:

• (15) 1x4, 2-lamp T12 industrial strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 15-20 fc. Fixtures operate 55 hours/week. Re-lamp with (15) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Central Garage – Women's Restroom

Energy Saving Opportunity:

• (1) 1x4, 2-lamp T12 industrial strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 55 hours/week. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.



Central Garage – Fuel Station

Energy Saving Opportunity:

• (2) 175W Metal Halide Class 1, Division 1 surface mount. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 8-10 fc. Fixtures operate 84 hours/week. There are no recommendations, fixtures are to remain.

Materials Recycling Facility - Storage

Energy Saving Opportunity:

- (6) 1x4, 2-lamp T8 surface strip. Fixture utilizes electronic ballast. Average foot candle reading for this fixture is 20-22 fc. Fixture operates 40 hours/week. There are no recommendations, fixtures are to remain. Fixtures to be controlled by dual-technology occupancy sensors.
- (10) 1x4, 2-lamp T12 surface strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-22 fc. Fixtures operate 40 hours/week. Re-lamp with (10) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensors.

Materials Recycling Facility - Break

Energy Saving Opportunity:

• (3) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 20-30 fc. Fixtures operate 2 hours/week. Re-lamp with (3) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures to be controlled by dual-technology occupancy sensor.

Materials Recycling Facility - Restroom

Energy Saving Opportunity:

• (1) 2x4, 4-lamp T12 recessed troffer. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 20-25 fc. Fixture operates 40 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.

<u>Materials Recycling Facility – Janitor's Closet</u> Energy Saving Opportunity:

• (1) 1x4, 2-lamp T8 industrial strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 25-30 fc. Fixture operates 40 hours/week. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixture to be controlled by dual-technology occupancy sensor.



Materials Recycling Facility – Storage

Energy Saving Opportunity:

(2) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (2) LED Exit Sign.

Materials Recycling Facility – Trash Sorting

Energy Saving Opportunity:

- (3) 100W Metal Halide Wall Flood. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 3-7 fc. Fixtures operate 84 hours/week. There are no recommendations, fixtures are to remain.
- (2) 150W High-Pressure Sodium Wall Pack. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 4-7 fc. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.

Materials Recycling Facility – Break Shack

Energy Saving Opportunity:

• (2) 1x4, 2-lamp T12 surface wrap. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 10-20 fc. Fixtures operate 2 hours/week. Re-lamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

Parks Storage and Shops - Storage

Energy Saving Opportunity:

- (19) 1x4, 2-lamp T12 pendant strip. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 11-15 fc. Fixtures operate 168 hours/week. Re-lamp with (19) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures shall be controlled by dual-technology occupancy sensors.
- (1) 1x4, 4-lamp T12 pendant strip. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 21-25 fc. Fixture operates 168 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture shall be controlled by dual-technology occupancy sensor.

Parks Storage and Shops – Break Area

Energy Saving Opportunity:

• (27) 1x4, 2-lamp T12 pendant strip. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 20-22 fc. Fixture operates 168 hours/week. Re-lamp with (27) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixtures shall be controlled by dual-technology occupancy sensors.



• (1) 2x4, 4-lamp T12 pendant strip. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 21-25 fc. Fixture operates 168 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixtures shall be controlled by dual-technology occupancy sensor.

Parks Storage and Shops - Storage

Energy Saving Opportunity:

• (5) 26W CFL Pendant Globe. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 4-6 fc. Fixtures operate 50 hours/week. There are no recommendations, fixtures are to remain.

Parks Storage and Shops – Back Garage

Energy Saving Opportunity:

• (6) 1x4, 2-lamp T12 pendant strip. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 15-20 fc. Fixture operates 168 hours/week. Re-lamp with (6) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixtures shall be controlled by dual-technology occupancy sensor.

Parks Storage and Shops – Machine Shop

Energy Saving Opportunity:

• (20) 1x4, 2-lamp T12 pendant strip. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 15-20 fc. Fixture operates 168 hours/week. Re-lamp with (20) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixtures shall be controlled by dual-technology occupancy sensors.

Parks Storage and Shops – Entry Hall

Energy Saving Opportunity:

• (3) 1x4, 2-lamp T12 surface wrap. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 23-25 fc. Fixture operates 50 hours/week. Re-lamp with (3) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixtures shall be controlled by dual-technology occupancy sensor.

Parks Storage and Shops – Locker Energy Saving Opportunity:

- (3) 1x4, 2-lamp T12 surface wrap. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 23-25 fc. Fixture operates 50 hours/week. Re-lamp with (3) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixtures shall be controlled by dual-technology occupancy sensor.
- (2) 1x8, 2-lamp 75W T12 industrial strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 40-50 fc. Fixtures



operate 50 hours/week. Re-lamp with (2) 2, 59W 8', T8 lamps and high-efficiency, electronic ballasts. Fixtures shall be controlled by dual-technology occupancy sensor.

Parks Storage and Shops – Restroom

Energy Saving Opportunity:

- (2) 100W exposed incandescent pendant. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 50 hours/year. Re-lamp with (2) 26W compact fluorescent, screw type lamp.
- (1) 2-lamp 60W incandescent vanity. Average foot candle reading for this fixture is 9-11 fc. Fixture operates 50 hours/year. Re-lamp with (2) 13W compact fluorescent, screw type lamp.

Parks Storage and Shops – Office

Energy Saving Opportunity:

- (3) 2x4, 4-lamp T8 recessed troffer. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 90-110 fc. Fixtures operate 50 hours/week. Fixtures shall be demolished and replaced with 2-lamp, T8 recessed volumetric fixtures with high-efficiency, electronic ballasts. Fixtures shall be controlled by dual-technology occupancy sensor.
- (3) 2-lamp T12 strip above lay-in lens. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 50 hours/week. Re-lamp with (3) 2, 28W T8 lamps and high-efficiency, electronic ballast. Fixtures shall be controlled by dual-technology occupancy sensor.

Lawn Equipment Storage - Garage

Energy Saving Opportunity:

- (4) PAR38 Halogen Flood. Average foot candle reading for these fixtures is 5-10 fc. Fixtures operate 5 hours/month. There are no recommendations, fixtures are to remain.
- (1) 26W Exposed CFL. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 4-6 fc. Fixture operates 5 hours/month. There are no recommendations, fixture is to remain.
- (1) 1x4, 1-lamp T12 surface strip. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 5 hours/month. Re-lamp with (1) 1, 28W T8 lamp and high-efficiency, electronic ballast.



Sign Shop - Storage

Energy Saving Opportunity:

 (20) 1x4, 2-lamp T12 surface industrial strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-25 fc. Fixtures operate 45 hours/week. Fixtures to be demolished and replaced with (8) 4-lamp T8 High-bays, with electronic ballasts. Fixtures to be controlled by integrated occupancy sensors in fixtures.

Sign Shop - Office

Energy Saving Opportunity:

• (1) 1x8, 2-lamp 75W T12 industrial strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 10-25 fc. Fixture operates 45 hours/week. Re-lamp with (1) 2, 59W 8', T8 lamps and high-efficiency, electronic ballast. Fixture shall be controlled by dual-technology occupancy sensor.

Sign Shop - Restroom

Energy Saving Opportunity:

• (1) 1x4, 1-lamp T12 industrial strip. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 45 hours/week. Re-lamp with (1) 1, 28W T8 lamp and high-efficiency, electronic ballast. Fixture shall be controlled by dual-technology occupancy sensor.

<u> Sign Shop - Storage</u>

Energy Saving Opportunity:

(1) Incandescent Exit Sign. Fixture operates 168 hours/week. Replace with new
 (1) LED Exit Sign.



ECM-1.7: Lighting Retrofit (Recreation Center)

Existing Conditions

The University City Recreation Center houses a gym, basketball court, indoor soccer field, offices, and a pool. Many portions of the gym were added in in the mid-2000s and do not require any upgrades. The basketball court and indoor soccer field currently use metal halide high-bay fixtures for illumination. By replacing these T5HO high-bay fixtures, the overall number of fixtures will be significantly reduced, the lighting will improve, energy will be saved, and controllability and safety will be increased due to "instant on" technology. These fixtures shall be installed with integral occupancy sensors to avoid wasted burn hours when the areas are not in use. The weight rooms as well as the pool house still use T12 lamps with magnetic ballasts. These should be retrofitted with T8 lamps and highefficiency, electronic ballasts to save energy and improve all aspects of the existing fixtures. Controls should also be implemented in these areas to reduce unnecessary burn time. Unfortunately, most of the suggested upgrades are for quality and productivity as well as increased control; but they do not offer a reasonable payback in most cases. All enclosed fixtures that are to remain should have their lenses cleaned and wiped down, as the photometrics and lumen output have been severely compromised due to dust collection and the presence of foreign matter in most cases.

Savings Summary

Energy Consumption Savings					Energy Cost	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB	
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water				
27,897	12	12	-	-	\$1,911	\$0	\$0	\$0	\$1,911	\$0	\$42,681	20.8

Table 23 Savings Summary - ECM-1.7 Lighting Retrofit (Recreation Center)

Physical Changes

To the occupant, there will be moderate visible changes. With current lamp technology and fixture design, occupants will notice more appropriate light levels with greater uniformity and increased color rendering in the selected retrofit areas. All suggested retrofit and replacement applications meet or exceed existing light levels for the applicable area. The maintenance staff will also notice slight changes. As a result of changing incandescents to compact fluorescents, there will be a lower frequency of lamp replacements. Elimination of fixtures that are in poor operational condition, due to age or environmental degradation, will result in a safer work environment for the entire staff. Other positive changes include the removal of out-dated or obsolete technology, as well as a moderate amount of electrical savings for the facility.

Interface with Agency Equipment

Contractor shall provide all labor and material to inspect, test, and adjust the lighting and the electrical control systems affecting the given spaces to ensure the new lighting systems fulfill existing requirements, while offering a reduction in consumption, especially during peak hours.





Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with fixture replacement and retrofit, but will be strictly limited to the given area and the panel breakers involved. All work shall be coordinated with the administration and the maintenance staff.

Environmental Impacts

There are minimal environmental drawbacks and numerous benefits associated with the suggested retrofitting and replacement of the lighting in the areas outlined. The new lamps and fixtures will consume less energy, resulting in decreased demand from the reactor processes involved in power production. The new fluorescent lamps are far lower in mercury content, which is beneficial concerning disposal. The only negative impact is from the disposal of the existing lamps and fixtures, but this is negligible when compared to the positives. See Table 3 Greenhouse Gases and Other Pollutants

Salvage and Disposal

Existing equipment in operational condition shall be given to University City as requested. All remaining equipment will be removed and disposed of properly by the electrical contractor.





Individual Recommendations Per Location

The following is a summary of the individual floors and areas of the University City Recreation Center building and the individual recommendations therein:

Recreation Center – Weight Room

Energy Saving Opportunity:

- (22) 2x4, 4-lamp T8 recessed troffer. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 45-50 fc. Fixtures operate 103 hours/week. There are no recommendations, fixtures are to remain. Fixtures shall be controlled by dual-technology occupancy sensors.
- (2) LED Exit Sign. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.
- (8) PAR38 CFL Flood. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 103 hours/week. There are no recommendations, fixtures are to remain.

Recreation Center – Restroom Corridor

Energy Saving Opportunity:

- (2) 2x4, 4-lamp T12 surface wrap. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 35-40 fc. Fixtures operate 103 hours/week. Re-lamp with (2) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures shall be controlled by dual-technology occupancy sensor.
- (1) 2x4, 4-lamp T12 recessed troffer. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 20-25 fc. Fixture operates 103 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast. Fixture shall be controlled by dual-technology occupancy sensor.

Recreation Center – Men's Restroom

Energy Saving Opportunity:

• (3) 2x4, 4-lamp T12 surface wrap. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 103 hours/week. Re-lamp with (3) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures shall be controlled by dual-technology occupancy sensor.

Recreation Center – Women's Restroom

Energy Saving Opportunity:

• (5) 2x4, 4-lamp T12 surface wrap. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 103



hours/week. Re-lamp with (5) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures shall be controlled by dual-technology occupancy sensor.

Recreation Center – Rock Wall

Energy Saving Opportunity:

• (4) 250W, Metal Halide low bay. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 5-12 fc. Fixtures operate 103 hours/week. Fixtures to be demolished and replaced with (4) 4-lamp T5HO Highbays, with electronic ballasts. Fixtures to be controlled by integrated occupancy sensors in fixtures.

Recreation Center – Indoor Soccer

Energy Saving Opportunity:

- (11) 250W, Metal Halide low bay. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 1-16 fc. Fixtures operate 103 hours/week. Fixtures to be demolished and replaced with (21) 4-lamp T5HO Highbays, with electronic ballasts. Fixtures to be controlled by integrated occupancy sensors in fixtures.
- (32) 250W, Metal Halide low bay. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 1-16 fc. Fixtures operate 10 hours/week. Fixtures to be demolished.
- (4) LED Exit Sign. Fixtures operate 168 hours/week. There are no recommendations, fixtures are to remain.

Recreation Center – Basketball Court

Energy Saving Opportunity:

 (20) 250W, Metal Halide low bay. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 8-10 fc. Fixtures operate 103 hours/week. Fixtures to be demolished and replaced with (15) 4-lamp T5HO Highbays, with electronic ballasts. Fixtures to be controlled by integrated occupancy sensors in fixtures.

Recreation Center – Pool Entry

Energy Saving Opportunity:

• (10) 26W CFL Recessed Can. Fixture utilizes standard, magnetic ballast. Average foot candle reading for this fixture is 4-6 fc. Fixture operates 2 hours/week. There are no recommendations, fixture is to remain.



Recreation Center – Pool House

Energy Saving Opportunity:

- (3) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (3) LED Exit Sign.
- (59) 1-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 11-13 fc. Fixtures operate 66 hours/week. Relamp with (59) 1, 28W T8 lamp and high-efficiency, electronic ballasts. Fixtures shall be controlled by dual-technology occupancy sensors.
- (17) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 66 hours/week. Relamp with (17) 2, 28W T8 lamps and high-efficiency, electronic ballasts. Fixtures shall be controlled by dual-technology occupancy sensors.
- (7) 2-lamp T12 strip. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 20-25 fc. Fixtures operate 5 hours/week. Relamp with (7) 2, 28W T8 lamps and high-efficiency, electronic ballasts.
- (4) 2x4, 4-lamp T12 surface wrap. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 66 hours/week. Re-lamp with (4) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixtures shall be controlled by dual-technology occupancy sensor.

Recreation Center – Pool Electrical / Pump Room

Energy Saving Opportunity:

• (11) 2-lamp T8 damp-location strip. Fixtures utilize electronic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 66 hours/week. There are no recommendations, fixtures are to remain. Fixtures shall be controlled by dual-technology occupancy sensors.

Recreation Center – Pool Office

Energy Saving Opportunity:

• (1) 2x4, 4-lamp T12 surface wrap. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 35-40 fc. Fixtures operate 60 hours/week. Re-lamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballasts. Fixture shall be controlled by dual-technology occupancy sensor.

Recreation Center – Pool Storage

Energy Saving Opportunity:

• (1) 100W exposed incandescent pendant. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 1 hour/year. Re-lamp with (1) 26W compact fluorescent, screw type lamp.



ECM-1.8: Lighting Retrofit (Trinity Building)

Existing Conditions

The University City Trinity Building was a former library that is now used for storage. The building is rarely occupied, thus no upgrades will offer a reasonable payback. Therefore, there are no recommendations for the Trinity Building although there are potential upgrades listed if payback was not a factor or the building occupancy increases.

Savings Summary

Energy Consumption Savings				Energy Cost Savings				Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB	
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water				
1,226	6	12	-	-	\$84	\$0	\$0	\$0	\$84	\$0	\$9,371	111.6

Table 24 Savings Summa	rv - FCM-1 8 Liahtina F	Retrofit (Trinity Building)
		(ou one (i milly Danaing)

Physical Changes

To the occupant, there will be moderate visible changes. With current lamp technology and fixture design, occupants will notice more appropriate light levels with greater uniformity and increased color rendering in the selected retrofit areas. All suggested retrofit and replacement applications meet or exceed existing light levels for the applicable area. The maintenance staff will also notice slight changes. As a result of changing incandescents to compact fluorescents, there will be a lower frequency of lamp replacements. Elimination of fixtures that are in poor operational condition, due to age or environmental degradation, will result in a safer work environment for the entire staff. Other positive changes include the removal of out-dated or obsolete technology, as well as a moderate amount of electrical savings for the facility.

Interface with Agency Equipment

Contractor shall provide all labor and material to inspect, test, and adjust the lighting and the electrical control systems affecting the given spaces to ensure the new lighting systems fulfill existing requirements, while offering a reduction in consumption, especially during peak hours.

Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with fixture replacement and retrofit, but will be strictly limited to the given area and the panel breakers involved. All work shall be coordinated with the administration and the maintenance staff.



Environmental Impacts

There are minimal environmental drawbacks and numerous benefits associated with the suggested retrofitting and replacement of the lighting in the areas outlined. The new lamps and fixtures will consume less energy, resulting in decreased demand from the reactor processes involved in power production. The new fluorescent lamps are far lower in mercury content, which is beneficial concerning disposal. The only negative impact is from the disposal of the existing lamps and fixtures, but this is negligible when compared to the positives. See Table 3 Greenhouse Gases and Other Pollutants

Salvage and Disposal

Existing equipment in operational condition shall be given to University City as requested. All remaining equipment will be removed and disposed of properly by the electrical contractor.

Individual Recommendations Per Location

The following is a summary of the individual floors and areas of the University City Trinity Building and the individual recommendations therein:

Trinity Building – 1st Floor - Storage

Energy Saving Opportunity:

- (11) 2x4, 4-lamp T12 surface wrap. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 20 hours/year. Re-lamp with (11) 4, 25W T8 lamps and high-efficiency, electronic ballasts.
- (3) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (3) LED Exit Sign.

Trinity Building – 1st Floor - Offices

Energy Saving Opportunity:

• (2) 2x4, 4-lamp T12 recessed troffer. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 25-30 fc. Fixtures operate 10 hours/year. Re-lamp with (2) 4, 25W T8 lamps and high-efficiency, electronic ballasts.

<u>Trinity Building – 1st Floor - Kitchen</u>

Energy Saving Opportunity:

• (1) 2-lamp T12 strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 10-15 fc. Fixture operates 10 hours/year. Re-lamp with (1) 2, 28W T8 lamps and high-efficiency, electronic ballast.



Trinity Building – 1st Floor – Stage / Mechanical

Energy Saving Opportunity:

• (15) 90W exposed incandescent pendant. Average foot candle reading for these fixtures is 2-3 fc. Fixtures operate 5 hours/year. Re-lamp with (15) 26W compact fluorescent, screw type lamps.

<u>Trinity Building – 1st Floor – Stairs</u>

Energy Saving Opportunity:

• (2) 26W CFL Pendant. Fixtures utilize standard, magnetic ballasts. Average foot candle reading for these fixtures is 2-3 fc. Fixtures operate 40 hours/week. There are no recommendations, fixtures are to remain.

<u> Trinity Building – 1st Floor – Men's Restroom</u>

Energy Saving Opportunity:

• (1) 90W exposed incandescent pendant. Average foot candle reading for this fixture is 2-3 fc. Fixture operates 5 hours/year. Re-lamp with (1) 26W compact fluorescent, screw type lamp.

Trinity Building – 1st Floor – Women's Restroom

Energy Saving Opportunity:

- (1) 90W exposed incandescent pendant. Average foot candle reading for this fixture is 2-3 fc. Fixture operates 5 hours/year. Re-lamp with (1) 26W compact fluorescent, screw type lamp.
- (1) 1x4, 1-lamp T12 wall strip. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 5-10 fc. Fixture operates 40 hours/week. Relamp with (1) 1, 28W T8 lamp and high-efficiency, electronic ballast.

Trinity Building – 1st Floor – Storage

Energy Saving Opportunity:

• (4) 100W exposed incandescent. Average foot candle reading for these fixtures is 2-3 fc. Fixtures operate 1 hour/year. Re-lamp with (4) 26W compact fluorescent, screw type lamps.

Trinity Building – 2nd Floor – Hall

Energy Saving Opportunity:

• (1) 2-lamp, 40W recessed incandescent square. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 1 hour/year. Re-lamp with (2) 9W compact fluorescent, screw type lamp.



Trinity Building – 2nd Floor – Storage

Energy Saving Opportunity:

• (18) 60W exposed incandescent. Average foot candle reading for these fixtures is 2-3 fc. Fixtures operate 1 hour/year. Re-lamp with (18) 13W compact fluorescent, screw type lamps.

Trinity Building – 2nd Floor – Stairs

Energy Saving Opportunity:

- (2) 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 1-2 fc. Fixtures operate 20 hours/week. Re-lamp with (2) 2, 28W T8 lamps and high-efficiency, electronic ballasts.
- (1) 4-lamp T12 surface wrap. Fixture utilizes standard magnetic ballast. Average foot candle reading for this fixture is 1-2 fc. Fixture operates 20 hours/week. Relamp with (1) 4, 25W T8 lamps and high-efficiency, electronic ballast.

<u>Trinity Building – 2nd Floor – Storage</u>

Energy Saving Opportunity:

- (1) Incandescent Exit Sign. Fixture operates 168 hours/week. Replace with new
 (1) LED Exit Sign.
- (39) 34W exposed incandescent. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 1 hour/year. Re-lamp with (39) 9W compact fluorescent, screw type lamp.
- (5) 2-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 10-15 fc. Fixtures operate 20 hours/week. Re-lamp with (5) 2, 28W T8 lamps and high-efficiency, electronic ballasts.

<u> Trinity Building – 2nd Floor – Old Library</u>

Energy Saving Opportunity:

- (9) 4-lamp T12 surface wrap. Fixtures utilize standard magnetic ballasts. Average foot candle reading for these fixtures is 5-10 fc. Fixtures operate 60 hours/year. Re-lamp with (9) 4, 25W T8 lamps and high-efficiency, electronic ballasts.
- (2) Incandescent Exit Sign. Fixtures operate 168 hours/week. Replace with new
 (2) LED Exit Sign.





Trinity Building – 2nd Floor – Stairs

Energy Saving Opportunity:

• (2) 5-lamp, Decorative Incandescent Candleabra. Average foot candle reading for these fixtures is 2-3 fc. Fixtures operate 1 hour/month. There are no recommendations, fixtures are to remain.

Trinity Building – 2nd Floor – Entry

Energy Saving Opportunity:

• (1) 2-lamp, 40W decorative incandescent surface mount. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 1 hour/month. Re-lamp with (2) 13W compact fluorescent, screw type lamp.

Trinity Building – 3rd Floor – Storage

Energy Saving Opportunity:

• (19) 34W exposed incandescent. Average foot candle reading for this fixture is 3-5 fc. Fixture operates 1 hour/year. Re-lamp with (19) 9W compact fluorescent, screw type lamp.





2.0 ENERGY MANAGEMENT SYSTEM / CONTROL IMPROVEMENTS

ECM-2.1: Install Programmable Tstats & Locking Covers - Central Garage (Assumes ECM-4.3 Implemented)

The Central Garage offices are conditioned by two split systems as described in the HVAC description. These units are controlled by standard thermostats. The set points for these spaces can be modified to reduce energy use.

This ECM recommends the installation of new programmable thermostats with locking covers to control the unit. See

Table 25 Office Set Point Schedule - Central Garage below for space temperature setpoints.

Existing	Space Temp. S	et Points	Recommend	ded Space Tem	p.SetPoints
Mode	Occupied	Unoccupied	Mode	Occupied	Unoccupied
Hours	0630-1700	1700-0630	Hours	0630-1700	1700-0630
Cooling	72°F	72°F	Cooling	74°F	80°F
Heating	72°F	72°F	Heating	70°F	60°F

Table 25 Office Set Point Schedule - Central Garage

Savings Summary

	Energ	gy Consumption	Savings			Energy Cost	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water				
27,671	3	12	-	0	\$1,895	\$0	\$0	\$0	\$1,895	\$0	\$227	0.1

Table 26 Savings Summary - ECM-2.1 Office Setpoint Schedule (Central Garage)

Physical Changes

To the occupant, there will be virtually no visible changes.

Interface with Agency Equipment

Contractor will provide all labor and material to inspect, test, and adjust the mechanical and control systems affecting the given spaces to ensure the HVAC systems are performing in a manner to adequately condition the spaces served.

Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some time when the space temperatures may fluctuate as the system operation is tested. These will be coordinated with the facility administration.





Environmental Impacts

The environmental impact from this project will only be positive. By reducing electrical consumption, pollution from power generating plants will also be reduced. Please see Table 3 Greenhouse Gases and Other Pollutants.

Salvage and Disposal

There is no equipment that will be removed.





ECM-2.2: Install Plug Load Occupancy Sensors - City Hall

The City Hall has workstations using various office appliances. These spaces have a total of approximately fifty-five (55) computers that can be retrofitted with a plug load occupancy sensor. The plug load sensor will turn off accessory plug loads (not the computer itself) which includes the associated monitor, personal printers, and task lighting that are used approximately 12 hours a day, however most remain on the majority of the day.

This ECM recommends the installation of a plug load occupancy sensor power strip that will reduce energy consumption by turning plug loads on and off based on occupancy.

Savings Summary

	Energ	gy Consumption	Savings			Energy Cos	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water				
16,527						\$0	\$0	\$0	\$1,132	\$0	\$8,081	7.6

Table 27 Savings Summary - ECM-2.2 Install Plug Load Occupancy Sensors (City Hall)

Physical Changes

To the occupant, there will be virtually no visible changes. The worker will have to be educated on how the plug load occupancy sensor works in order to understand how it may affect them during the workday. For instance, if the worker leaves for lunch and the occupancy sensor will shut off outlets that are connected after the present time delay expires. When the worker returns they will notice that as they approach their desk, the equipment connected to the power strip will turn on.

Interface with Agency Equipment

The facility manager should coordinate which workstations will be allowed to have the plug load occupancy sensor power strip installed on.

Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be minimal downtime associated with each plug load occupancy sensor power strip installation. These will be coordinated with the facility administration.

Environmental Impacts

The environmental impact from this project will only be positive. By reducing electrical consumption, pollution from power generating plants will also be reduced. By reducing the plug loads associated with unoccupied workstation energy will be conserved. Please see Table 3 Greenhouse Gases and Other Pollutants.

Salvage and Disposal

There is no equipment that will be removed.



ECM-2.3: Install Plug Load Occupancy Sensors - Annex

The Annex has workstations using various office appliances. These spaces have a total of approximately seventy-five (75) computers that can be retrofitted with a plug load occupancy sensor. The plug load sensor will turn off accessory plug loads (not the computer itself) which includes the associated monitor, personal printers, and task lighting that are used approximately 12 hours a day, however most remain on the majority of the day.

This ECM recommends the installation of a plug load occupancy sensor power strip that will reduce energy consumption by turning plug loads on and off based on occupancy.

Savings Summary

		Ener	gy Consumption	Savings			Energy Cos	st Sa	avings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB
	KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	97	Steam	Water				
C	19,016	-	-	-	-	\$1,303	\$0	Γ	\$0	\$0	\$1,303	\$0	\$11,019	9.7

Table 28 Savings Summary - ECM-2.3 Install Plug Load Occupancy Sensors (Annex)

Physical Changes

To the occupant, there will be virtually no visible changes. The worker will have to be educated on how the plug load occupancy sensor works in order to understand how it may affect them during the workday. For instance, if the worker leaves for lunch and the occupancy sensor will shut off outlets that are connected after the present time delay expires. When the worker returns they will notice that as they approach their desk, the equipment connected to the power strip will turn on.

Interface with Agency Equipment

The facility manager should coordinate which workstations will be allowed to have the plug load occupancy sensor power strip installed on.

Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be minimal downtime associated with each plug load occupancy sensor power strip installation. These will be coordinated with the facility administration.

Environmental Impacts

The environmental impact from this project will only be positive. By reducing electrical consumption, pollution from power generating plants will also be reduced. By reducing the plug loads associated with unoccupied workstation energy will be conserved. Please see Table 3 Greenhouse Gases and Other Pollutants.



Salvage and Disposal

There is no equipment that will be removed.





4.0 HEATING, VENTILATING, & AIR CONDITIONING IMPROVEMENTS

ECM-4.1: Unit Replacement – Annex

The Annex is conditioned by multiple systems as was previously detailed in the HVAC description. There are several pieces of equipment that are nearing the end of their useful life and consume higher quantities of energy than newer equipment. Also the water source units consume large quantities of domestic water.

This ECM recommends replacing the condensing unit, cooling coil, and refrigerant lines for the existing split systems. The existing gas furnace or steam coils for these units would remain. This ECM also recommends replacing the water source units with new split systems. The units serving the server and telephone room would not require heat while the unit serving the basement cells shall be a heat pump unit. The new split system units shall have a higher cooling efficiency EER rating ranging from 12.0 and a higher heating efficiency COP of 3.5. The new heat pump unit will still have supplemental auxiliary electric heat; but this would only occur when the heat pump could not maintain set temperature. New equipment shall be installed in the same location as existing equipment. SeeTable 29 Existing HVAC Recommended Replacement Schedule - Annex. It should be noted that cooling would not be possible below 0°F ambient for the computer room and telephone room. Design temperature for this area is 2°F, however there can be times when ambient temperatures are below this. Also, the cost estimate does not include any code issues that may arise.

Existi	ng HVAC Recommended Rep	lacement	Schedule)		
Area Served	Unit Type	Quantity	SA cfm	Tons	Clg type	Htg Type
Detectives	DX/Gas RTU	1	2,000	5.0	DX	Gas
Office	DX/Gas Split	1	1,200	3.0	DX	Gas
Fire Chief/Kitchen	DX/Steam Split	1	1,200	3.0	DX	Steam
Server Rm	Vert. Water Source	1	1,200	3.0	WS	WSHP
Telephone Rm	Horiz. Water Source	1	1,200	3.0	WS	WSHP
Basement Cells	Vert. Water Source	1	1,200	3.0	WS	WSHP

Table 29 Existing HVAC Recommended Replacement Schedule - Annex

Savings Summary

	Ener	gy Consumption	Savings			Energy Cost	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB
KWh	KW	Months	Water kgal	KWh	KW	Steam	Water					
55,706	11	12	-	2,173	\$3,816	\$0	\$0	\$7,040	\$10,856	\$0	\$101,983	9.5

Table 30 Savings Summary - ECM-4.1 Unit Replacement Annex Physical Changes

To the occupant, there will be virtually no visible changes. In many locations where the system has not been operating effectively, building occupants will now have a more comfortable working environment.





Interface with Agency Equipment

Contractor will provide all labor and material to inspect, test, and adjust the mechanical and control systems affecting the given spaces to ensure the HVAC systems are performing in a manner to adequately condition the spaces served.

Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with each unit replacement. Any electricity curtailment will be limited to an individual breaker serving an air handler or other HVAC equipment. In some instances, a sub panel may be momentarily interrupted. These will be coordinated with the facility manager.

Environmental Impacts

The environmental impact from this project will only be positive. By reducing electrical consumption, pollution from power generating plants will also be reduced. By increasing the efficiency of the equipment, cooling and heating energy will be conserved. Please see Table 3 Greenhouse Gases and Other Pollutants.

Salvage and Disposal

Existing equipment is not believed to hold any salvage value. It will be removed and disposed of properly.





ECM-4.2: Pump Motor Replacement – Heman Park Pool

There are two pumps located in a mechanical room at Heman Park Pool to serve the main filtration system. Each of these pumps has a 40 hp motor. One has been replaced recently while the other is an older less efficient model.

This ECM recommends replacing the older pump motor with a new 40 hp motor The new motor with a minimum efficiency of 93%.

Savings Summary

	Ener	gy Consumption	Savings			Energy Cos	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water				
15,709	5	4	-	-	\$1,076	\$0	\$0	\$0	\$1,076	\$0	\$5,845	5.4

Table 31 Savings Summary - ECM-4.2 Pump Motor Replacement (Heman Park Pool)

Physical Changes

To the occupant, there will be virtually no visible changes. The equipment will operate at the same level of performance.

Interface with Agency Equipment

Contractor will provide all labor and material to inspect, test, and adjust the mechanical and control systems affecting the given pumps to ensure the systems are performing as near to the original design as possible.

Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with each motor replacement. Any electricity curtailment will be limited to an individual breaker serving the HVAC equipment. In some instances, a sub panel may be momentarily interrupted. These will be coordinated with the facility manager.

Environmental Impacts

The environmental impact from this project will only be positive. By reducing electrical consumption, pollution from power generating plants will also be reduced. By increasing the efficiency of the equipment fan energy will be conserved. See Table 3 Greenhouse Gases and Other Pollutants.

Salvage and Disposal

Existing equipment is not believed to hold any salvage value. It will be removed and disposed of properly.





ECM-4.3: Unit Replacement – Central Garage (Assumes ECM-2.1 Implemented)

The central Garage has two office areas that are conditioned by split systems. The condensing unit and indoor unit for the office in the shop is older and can be replaced with a newer unit. The indoor unit serving the front office has been replaced while the condensing unit is original. This system is not functioning properly and needs to be replaced. This would allow the window units to be removed.

This ECM recommends replacing these units with heat pumps and units of the same configuration. The new split system units with capacities of 5-tons or lesser shall have a higher cooling efficiency EER rating ranging from 13.5 and a higher heating efficiency COP of 4.0. The new heat pump will still have supplemental auxiliary electric heat; however, the electric heat would only be used when the heat pump could not maintain set temperature. New equipment shall be in the same location as existing equipment. SeeTable 32 Existing HVAC Recommended Replacement Schedule - Central Garage.

Existi	ng HVAC Recommended Rep	lacement	Schedul	e		
Area Served	Unit Type	Quantity	SA cfm	Tons	Clg type	Htg Type
Front Office	DX/Elec Split	1	1,000	2.5	DX	Elec
Shop Office	DX/Elec Split	1	1,200	3.0	DX	Elec

Table 32 Existing HVAC Recommended Replacement Schedule - Central Garage

Savings Summary

	Enerç	y Consumption	Savings			Energy Cost	t Savings		Total Energy Savings	Avoided Maint. Savings	Capital Cost	SPB
KWh	KW	Months	Steam klbs	Water kgal	KWh	KW	Steam	Water				
23,643	8	12	-	-	\$1,620	\$0	\$0	\$0	\$1,620	\$903	\$19.718	7.8

Table 33 Savings Summary - ECM-4.3 Existing HVAC Replacement - Central Garage

Physical Changes

To the occupant, there will be virtually no visible changes. The equipment will operate at the same level of performance.

Interface with Agency Equipment

Contractor will provide all labor and material to inspect, test, and adjust the mechanical and control systems affecting the given spaces to ensure the HVAC systems are performing in a manner to adequately condition the spaces served.





Utility Interruptions and Site Coordination

There will be no significant utility interruptions. There will be some downtime associated with each motor replacement. Any electricity curtailment will be limited to an individual breaker serving the HVAC equipment. In some instances, a sub panel may be momentarily interrupted. These will be coordinated with the facility manager.

Environmental Impacts

The environmental impact from this project will only be positive. By reducing electrical consumption, pollution from power generating plants will also be reduced. By increasing the efficiency of the equipment fan energy will be conserved. Please see Table 3 Greenhouse Gases and Other Pollutants.

Salvage and Disposal

Existing equipment is not believed to hold any salvage value. It will be removed and disposed of properly.





Appendix A

Lighting Improvements Calculations (Annex) – ECM-1.1





Detailed Energy Study University City Municipal Buildings

Fixture ECM Totals:

				Existing						Energy	Avg.	kWh	Energy	Unit	Unit	Unit	Tetel	Simple
			Input Watts /	Wattage	kWh Existing			Input Watts /		Savings	Hours /	Savings /	Savings /	Material	Labor	Disposal	Total Cost (\$)	Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	<u>(W)</u>	(kWh)	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)			Year (kWh)		Cost (\$)	Cost (\$)	Cost (\$)		<u>(Yr.)</u>
	-	la		•	•	-	• •	-	-		-					-	••	
Police Station -	1x4, 2L T12 recessed cove strip					Re-lamp w/2 28W T8 lamps w/high-efficiency,												
Basement - Corridor	w/standard ballast	1	5 7	3 1095		electronic ballast	15	51	765	330	3120	1.029.60	61.64	3	7 .	45	2 1.26	0 20.44
					01101			0.			0.20	1,020.00	01.01				.,	20111
Police Station -						Re-lamp w/4 25W T8												
Basement - Break	2x4, 4L T12 recessed troffer					lamps w/high-efficiency,												
Room	w/standard ballast	ŧ	5 14	4 720	2246.4	electronic ballast	5	86	430	290	3120	904.80	54.17	42	2 :	50	2 47	0 8.68
Police Station -						Re-lamp w/2 31W T8 U-												
Basement - Break Room	2x2, 2 U-lamp T12 recessed troffer w/standard ballast		1 7	3 73	007.70	lamps w/high-efficiency, electronic ballast		60	60		3120	40.56	2.43	3	7	45	2 8	4 34.59
Room	troffer W/standard Dallast		1 7.	3 73	227.70	electronic dallast	1	60	60	13	5 3120	40.56	2.43	5 3	/ 4	45	2 84	4 34.59
Police Station -						Re-lamp w/2 13W												
	2-lamp 60W Incandescent					compact fluorescent												
Room	Surface Round		1 12	0 120	6.24	screw-type lamps	1	26	26	94	52	4.89	0.29) (5	15	1 2	1 71.76
Police Station -						Re-lamp w/4 25W T8												
	s 2x4, 4L T12 recessed troffer					lamps w/high-efficiency,												
Office	w/standard ballast	10	0 14	4 1440	4492.8	electronic ballast	10	86	860	580	3120	1,809.60	108.34	42	2 :	50	2 94	0 8.68
Police Station -						Do Nothing - Fixture To												
Basement - Corridor	26W TTT CFL Recessed Can	1	2	6 260	811.2	Remain	10	26	260	0	3120	0.00	0.00					
Police Station -						Replace with LED Exit												
Basement - Corridor	Incandescent Exit Sign		3 2	0 60	525.6	Sign	3	3	9	51	8760	446.76	26.75	5 55	5 (65	5 37	5 14.02
Police Station - Basement - E.O.C.						Do Nothing - Fixture To												
Room	26W TTT CFL Recessed Can		1 2	6 26	13.53	Remain	4	26	26		520	0.00	0.00					
NUM			·	20	10.02	memalii		20	20		, J20	, 0.00	0.00	, 				-
Police Station -						Re-lamp w/2 17W T8												
Basement - E.O.C.	1x2, 2L T12 wall mount					lamps w/high-efficiency,												
Room	w/standard ballast	· ·	1 4	8 48	24.96	electronic ballast	1	34	34	14	520	7.28	0.44	37	7 4	45	2 8	4 192.73
Police Station -						Re-lamp w/2 28W T8												
Basement - E.O.C.	1x4, 2L T12 surface wrap					lamps w/high-efficiency,						000 00			_			
Room	w/standard ballast	27	7 7	3 1971	1024.92	electronic ballast	27	51	1377	594	520	308.88	18.49	37	(45	2 2,26	8 122.64





			Input Watts /	Existing Wattage	kWh Existing		Proposed	Input Watts /	Proposed	<u>Energy</u> Savings		<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	<u>Total</u> Cost (\$)	<u>Simple</u> Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	<u>(W)</u>	<u>(kWh)</u>	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)	<u>(W)</u>	Year	Year (kWh)	Year (\$)	Cost (\$)	Cost (\$)	Cost (\$)	0031 (\$)	<u>(Yr.)</u>
Police Station - Basement - E.O.C. Room	1x4, 2L T12 surface wrap w/standard ballast		2 7	3 14	6 1278.96	Re-lamp w/2 28W T8 lamps w/high-efficiency, 6 electronic ballast	2	2 51	102	44	8760	385.44	23.08	3 3	7 4	5 2	2 16	8 7.28
Police Station - Basement - E.O.C. Kitchen	2L T12 strip w/standard ballast		1 7	3 7	3 18.96	Re-lamp w/2 28W T8 lamps w/high-efficiency, 8 electronic ballast	1	51	51	22	2 260	5.72	2 0.34	4 3	7 4	5 2	2 8	4 245.29
Police Station - Basement - E.O.C. Mechanical Room	2L T12 strip w/standard ballast		2 7	_		Re-lamp w/2 28W T8 lamps w/high-efficiency, 2 electronic ballast	2	2 51	102							_		
Police Station - Basement - E.O.C. Mechanical Room	52W Exposed Incandescent		2 5	2 10	4 5.408	Re-lamp w/13W compact fluorescent 8 screw-type lamps	2	2 13	26	78	3 52	4.06	0.24	1 .	5 1:	5 -	4	2 172.96
Police Station - Basement - E.O.C.	Incandescent Exit Sign		2 2	0 4	0 350.4	Replace with LED Exit 4 Sign	2	2	6	34	8760	297.84	17.83	3 5	5 6	5 5	5 25	0 14.02
Police Station - Basement - E.O.C.Communication s Room	2L T12 strip w/standard ballast		3 7	3 21	9 11.388	Re-lamp w/2 28W T8 lamps w/high-efficiency, 8 electronic ballast	3	51	153	66	5 52	3.43	0.21	1 3	7 4	5 2	2 25	2 1226.43
Police Station - Basement - E.O.C.Storeroom	2L T12 surface wrap w/standard ballast		5 7	3 36	5 18.98	Re-lamp w/2 28W T8 lamps w/high-efficiency, 8 electronic ballast	5	51	255	110) 52	5.72	. 0.34	4 3	7 4	5 2	2 42	0 1226.43
Police Station - Basement - E.O.C.Restroom	2L T12 surface wrap w/standard ballast		2 7	3 14	6 7.592	Re-lamp w/2 28W T8 lamps w/high-efficiency, 2 electronic ballast	2	2 51	102	44	52	2.29	0.14	4 3	7 4	5 2	2 16	8 1226.43
Police Station - Basement - Shooting Range	PAR 38 Halogen Flood		6 7	5 45	0 117	Do Nothing - Fixture To 7 Remain	6	3 75	450) 260	0.00	0.00)				
Police Station - Basement - Shooting Range	52W Exposed Incandescent		5 5	2 26	0 67.6	Re-lamp w/13W compact fluorescent 6 screw-type lamps	5	5 13	65	195	5 260	50.70	3.04	1	5 1:	5	10	5 34.59





			Input Watts /		kWh Existing		Proposed	Input Watts /		<u>Energy</u> Savings	Hours/	<u>kWh</u> Savings /	<u>Energy</u> Savings/	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	<u>Total</u> Cost (\$)	Simple Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	<u>(W)</u>	<u>(kWh)</u>	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)	<u>(W)</u>	Year	Year (kWh)	Year (\$)	Cost (\$)	Cost (\$)	Cost (\$)		<u>(Yr.)</u>
Police Station - Basement - Shooting						Re-lamp w/2 28W T8 lamps w/high-efficiency,												
Range File Room	2L T12 strip w/standard ballast		4 7	3 292	2 15.184	4 electronic ballast	4	51	204	88	52	4.58	0.27	7 3	87 4	5 2	336	6 1226.43
Police Station - Basement - Files	1x8, 2L 75W T12 strip w/standard ballast		2 15	8 316	5 16.432	Re-lamp w/2 59W T8 8' lamps w/high-efficiency, 2 electronic ballast	2	2 112	224	92	2 52	4.78	0.29	9 3	87 4	5 2	168	3 586.56
Police Station - Basement - Corridor	2L T12 strip w/standard ballast		2 7	3 146	5 15.184	Re-lamp w/2 28W T8 lamps w/high-efficiency, 4 electronic ballast	2	2	102	44	104	4.58	0.27	7 3	87 4	5 2	168	613.22
Police Station - Basement - Closet	52W Exposed Incandescent		1 5	2 52	2 2.704	Re-lamp w/13W compact fluorescent 4 screw-type lamps	1	13	13	39	52	2.03	0.12	2	5 1	51	21	172.96
Police Station - Basement - Weapons Storage	2L T12 strip w/standard ballast		4 7	3 292	75.92	Re-lamp w/2 28W T8 lamps w/high-efficiency, 2 electronic ballast	4	51	204	88	3 260	22.85	1.37	7 3	57 4	5 2	336	3 245.29
Police Station - Basement - Bike Storage	100W Exposed Incandescent		14 10			Re-lamp w/26W compact fluorescent 8 screw-type lamps	14								5 1	_	294	
Police Station - Basement - Stairs	2-lamp 60W Incandescent Surface		2 12			Re-lamp w/2 13W compact fluorescent 4 screw-type lamps	2								0 2	_	72	
Police Station - 1st Floor - Print Shop	2x4, 4L T12 recessed troffer w/standard ballast		6 14	4 864	4 1797.12	Re-lamp w/4 25W T8 lamps w/high-efficiency, 2 electronic ballast	6	86	516	348	3 2080	723.84	43.34	4 4	12 5	0 2	564	4 13.01
Police Station - 1st	2x4, 4L T12 recessed volumetric w/standard ballast		21 14			Re-lamp w/4 25W T8 lamps w/high-efficiency, 8 electronic ballast	21								12 5	_		
Police Station - 1st	2x4, 4L T12 recessed volumetric w/standard ballast		10 14	4 1440) 12614.4	Re-lamp w/4 25W T8 lamps w/high-efficiency, 4 electronic ballast	10	86	860	580				9 4	12 5	0 2	940	





			Input Watts /		kWh Existing		Proposed	Input Watts /	Proposed	Energy Savings	Hours/	<u>kWh</u> Savings /	Energy Savings /	<u>Unit</u> Material Cost (\$)	<u>Unit</u> Labor Cost (\$)	<u>Unit</u> Disposal Cost (\$)	<u>Total</u> Cost (\$)	<u>Simple</u> Payback (Yr.)
Location	Existing Fixture	Existing Qty.	Fixture (W)	<u>(W)</u>	<u>(kWh)</u>	Proposed Fixture	<u>Qty.</u>	Fixture (W)	Wattage (W)	<u>(vv)</u>	Year	Year (kWh)	Year (\$)	<u>COSI (\$)</u>	<u>COSI (\$)</u>	<u>COSI (\$)</u>		<u>(11.)</u>
Police Station - 1st	1x4, 1L T12 wall strip					Re-lamp w/1 28W T8 lamp w/high-efficiency,												
Floor - Entry Corridor	w/standard ballast		8 4	2 336	5 1048.32	2 electronic ballast	8	3 26	208	128	3120	399.36	23.91	3	7 4	5 2	672	28.11
Police Station - Basement - Men's Cell	2L 3', T12 strip w/standard Is ballast		1 6	5 65	5 284.7	Re-lamp w/2 3', 25W T8 lamps w/high-efficiency, 7 electronic ballast	1	45	45	20	4380	87.60) 5.24	4 3	7 4	5 2	84	16.02
Police Station - Basement - Men's Cell	1x4, 2L T12 strip w/standard Is ballast		2 7	3 146	639.4	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	2	2 51	102	44	4380	192.72	2 11.54	4 3	7 4	5 2	168	14.56
Police Station - Basement - Men's Cell	ls PAR 38 Halogen Flood		2 7	5 15() 65	Do Nothing - Fixture To 7 Remain		2 75	150	0	4380	0.00				_		
Police Station - Basement - Men's Cell	1x4, 2L T12 wall-mounted strip		1 7			Re-lamp w/2 28W T8 lamps w/high-efficiency, 4 electronic ballast	1	51		22					7 4	5 2	84	14.56
Police Station - Basement - Stairs	1x1, 60W Incandescent Surface		1 6	0 60) 262.8	Re-lamp w/1 13W compact fluorescent 3 screw-type lamps	1	13	13	47	4380	205.86	5 12.32	2	5 1:	5 1	21	1.70
Police Station - 1st Floor - Private Offices	2x4, 4L T12 recessed volumetric w/standard ballast		12 14	4 1728	3 5391.36	Re-lamp w/4 25W T8 lamps w/high-efficiency, 6 electronic ballast	12	2 86	1032	696	3120	2,171.52	130.01	4	2 5	0 2	1,128	8.68
Police Station - 1st Floor - Conference Room	2x4, 2L T12 recessed troffer w/standard ballast		4 7	3292	2 911.04	Re-lamp w/2 28W T8 lamps w/high-efficiency, 4 electronic ballast	4	4 51	204	88	3120	274.56	5 16.44	4 3	7 4	5 2	336	20.44
Police Station - 1st Floor - Men's Locker Room	2x4, 4L T12 recessed troffer w/standard ballast		6 14	4864	4 2695.68	Re-lamp w/4 25W T8 lamps w/high-efficiency, 3 electronic ballast	6	86	516	348	3120	1,085.76	65.00) 4	2 5	0 2	564	8.68
Police Station - 1st Floor - Women's Locker Room	2x4, 4L T12 recessed troffer w/standard ballast		4 14	4 576	5 1797.12	Re-lamp w/4 25W T8 lamps w/high-efficiency, 2 electronic ballast	4	4 86	344	232	3120	723.84	43.34	4 4	2 5	0 2	376	8.68





			Input Watts /	Existing	kWh Existing		Proposed	Input Watts /	Proposed	<u>Energy</u> Savings	<u>Avg.</u> Hours/	<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total	<u>Simple</u> Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	(W)	(kWh)	Proposed Fixture	Qty.		Wattage (W)		Year	Year (kWh)		Cost (\$)	Cost (\$)	Cost (\$)	<u>Cost (\$)</u>	(Yr.)
Police Station - 1st Floor - Mechanical						Re-lamp w/26W compact fluorescent												
Storage	100W Exposed Incandescent		3 10	0 300) 15.6	6 screw-type lamps	3	3 26	78	222	52	11.54	0.69	9	5 1	5	6	91.15
Police Station - 1st Floor - Offices	1x4, 2L T12 recessed troffer w/standard ballast		9 7	3 657	7 2049.84	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	g	51	459	198	3120	617.76	36.99) 3	37 4:	5 2	2 756	3 20.44
Police Station - 1st Floor - Cell Entry	2x4, 2L T12 recessed troffer w/standard ballast		6 7	3 438	3 1366.56	Re-lamp w/2 28W T8 lamps w/high-efficiency, 6 electronic ballast	6	51	306	132	3120	411.84	24.66	3 3	87 4:	5 2	2 504	20.44
Police Station - 1st Floor - Cell Entry	40W Recessed Incandescent		2 4	0 80	249.6	Re-lamp w/9W compact fluorescent screw-type 6 lamps	2	, c	18	62	3120	193.44	11.58	2	5 1	5	4:	2 3.63
Police Station - 1st Floor - Hall	1x1, 2-lamp 60W Recessed Incandescent Square		1 12			Re-lamp w/2 13W compact fluorescent 2 screw-type lamps	1	26							0 2		3	
Police Station - 1st Floor - Hall	PAR 38 Halogen Flood		1 7	5 75	5 657	Do Nothing - Fixture To 7 Remain	1	75	75	0	8760	0.00	0.00)				
Police Station - 1st Floor - Men's Restroom	2x4, 4L T12 recessed troffer w/standard ballast		4 14	4 576	6 1797.12	Re-lamp w/4 25W T8 lamps w/high-efficiency, 2 electronic ballast	4	86	344	232	3120	723.84	43.34	4 4	12 51	0 2	2 376	8.68
Police Station - 1st Floor - Women's Restroom	2x4, 4L T12 recessed troffer w/standard ballast		4 14	4 576	5 1797.12	Re-lamp w/4 25W T8 lamps w/high-efficiency, 2 electronic ballast	4	86	344	232	3120	723.84	43.34	4 4	12 51	0 2	2 376	8.68
Police Station - 1st Floor - Women's Restroom	2-lamp 60W Incandescent Vanity		1 12	0 120) 374.4	Re-lamp w/2 13W compact fluorescent screw-type lamps	1	26	26	94	3120	293.28	17.56	5 1	0 2	5	36	3 2.05
Police Station - 1st Floor - Entry	PAR 38 Halogen Flood Cans		9 7	5 675	5 2106	Do Nothing - Fixture To	g) 75	675	0	3120	0.00) 0.00)				





			Input Watts /		kWh Existing		Proposed	Input Watts /		<u>Energy</u> Savings		<u>kWh</u> Savings/	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	<u>Total</u> Cost (\$)	<u>Simple</u> Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	<u>(W)</u>	<u>(kWh)</u>	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)	<u>(W)</u>	Year	Year (kWh)	Year (\$)	Cost (\$)	Cost (\$)	Cost (\$)	0000(0)	<u>(Yr.)</u>
Police Station - 1st	2x4, 4L T12 recessed					Re-lamp w/4 25W T8 lamps w/high-efficiency,												
Floor - Entry	volumetric w/standard ballast		1 14	4 144	4 449.2	8 electronic ballast	1	86	86	58	3120	180.96	6 10.83	3 4	2 5	0 2	94	8.68
Police Station - 1st Floor - Field Ops	2x4, 4L T12 recessed volumetric w/standard ballast		2 14	4 288	3 898.5	Re-lamp w/4 25W T8 lamps w/high-efficiency, 6 electronic ballast	2	2 86	172	116	3120	361.92	2 21.67	7 4.	2 5	0 2	188	8.68
Police Station - 1st Floor - Field Ops	2x4, 4L T12 recessed troffer w/standard ballast		1 14	4 14	449.2	Re-lamp w/4 25W T8 lamps w/high-efficiency, 8 electronic ballast	1	86	86	58	3120	180.96	10.83	3 4	2 5	0 2		8.68
Police Station - 1st Floor - Field Ops	2x2, 2 U-lamp T12 recessed troffer w/standard ballast		1 7	3 73	3 227.70	Re-lamp w/2 31W T8 U- lamps w/high-efficiency, 6 electronic ballast	1	60	60	13	3120	40.56	5 2.43	3 3	7 4	5 2	84	34.59
Police Station - 1st Floor - Traffic	2x4, 4L T12 recessed troffer w/standard ballast		3 14	4 432	2 1347.8	Re-lamp w/4 25W T8 lamps w/high-efficiency, 4 electronic ballast	3	8 86	258	174	3120	542.88	32.50) 4	2 5	0 2	282	8.68
Police Station - 1st Floor - Traffic	1x4, 2L T12 recessed troffer w/standard ballast		4 7	3 292	2 911.04	Re-lamp w/2 28W T8 lamps w/high-efficiency, 4 electronic ballast	4	51	204	88	3120	274.56	6 16.44	4 3	7 4	5 2	336	20.44
Police Station - 2nd Floor - Offices	2x4, 4L T12 recessed volumetric w/standard ballast		17 14	4 2448	3 7637.70	Re-lamp w/4 25W T8 lamps w/high-efficiency, 6 electronic ballast	17	. 86	1462	986	3120	3,076.32	2 184.18	3 4	2 5	0 2	1,598	8.68
Police Station - 2nd Floor - Offices	2x4, 4L T12 recessed volumetric w/standard ballast		514	4 720	0 187.:	Re-lamp w/4 25W T8 lamps w/high-efficiency, 2 electronic ballast	5	86	430	290	260	75.40) 4.51	4	2 5	0 2	470) 104.12
Police Station - 2nd Floor - Hall	2L T12 strip w/standard ballast		1 7	3 7:	3 227.7	Re-lamp w/2 28W T8 lamps w/high-efficiency, 6 electronic ballast	1	51	51	22	3120	68.64	4.11	3	7 4	5 2	84	20.44
Police Station - 2nd Floor - Interrogation Room	2x4, 4L T12 recessed troffer w/standard ballast		6 14	4 864	4 449.20	Re-lamp w/4 25W T8 lamps w/high-efficiency, 8 electronic ballast	6	86 86	516	348	520	180.96	5 10.83	3 4	2 5	0 2	564	52.06





				Existing						Energy	Avg.	<u>kWh</u>		<u>Unit</u>	<u>Unit</u>	<u>Unit</u>	Total	Simple
			Input Watts /		kWh Existing		Proposed	Input Watts /		Savings			ourningo,	Material Cost (\$)	Labor Cost (\$)	Disposal Cost (\$)	Cost (\$)	Payback (Yr.)
Location	Existing Fixture	Existing Qty.	Fixture (W)	<u>(W)</u>	<u>(kWh)</u>	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)	<u>(W)</u>	Year	Year (kWh)	Year (\$)	<u>Cost (\$)</u>	COSt (\$)	<u>COSt (\$)</u>		<u>(fr.)</u>
Police Station - 2nd	2x4, 4L T12 recessed troffer					Re-lamp w/4 25W T8 lamps w/high-efficiency,												
Floor - Men's Restroom			1 14	4 14	1 1/0 20	electronic ballast		1 86	86	5	3 3120	180.96	10.83	4	2 5) 2	94	8.68
FIDDI - MEITS RESTIDUIT			1 14	+ 144	+ 449.20				00	0 30	5 3120	100.90	0 10.03	9 42	2 5	J 2	. 94	0.00
Police Station - 2nd						Re-lamp w/4 25W T8												
Floor - Women's	2x4, 4L T12 recessed troffer					lamps w/high-efficiency,												
Restroom	w/standard ballast		1 14	4 144	1 1/0 28	electronic ballast		1 86	86	58	3 3120	180.96	10.83	4	2 5) 2	94	8.68
Realion	w/stariation bailast		1 17	т I т	1 110.20			1 00	,	,	5 5120	100.30	10.00	, <u> </u>		2		0.00
						Re-lamp w/2 28W T8												
Police Station - 2nd						lamps w/high-efficiency,												
Floor - Entry	2L T12 strip w/standard ballast		6 7	3 438	3836.89	electronic ballast		6 51	306	132	2 8760	1.156.32	69.23	3	7 4	5 2	504	7.28
		· · · · ·	0 7.	J 7J	5 5050.00			5 51	500	102	0/00	1,100.02	. 00.20	, 5,	·	2		1.20
Police Station - 2nd						Re-lamp w/2 28W T8												
Floor - Narcotics						lamps w/high-efficiency,												
Evidence Room	2L T12 strip w/standard ballast		8 7	3 584	1 303 68	electronic ballast		8 51	408	176	520	91.52	5.48	3	7 4	5 2	672	122.64
				00							020	0.101				-	0.2	122101
Police Station - 2nd						Replace with LED Exit												
Floor - Entry	Incandescent Exit Sign		2 2	0 40	350.4	Sian		2 3	6	34	1 8760	297.84	17.83	5	5 6	5 5	250	14.02
	j																	
Police Station - 2nd						Re-lamp w/4 25W T8												
Floor - Homicide	2x4. 4L T12 recessed					lamps w/high-efficiency,												
Evidence Room	volumetric w/standard ballast		4 14	4 576	6 299.52	electronic ballast		4 86	344	232	2 520	120.64	7.22	42	2 5) 2	376	52.06
						Re-lamp w/2 17W T8												
Police Station - 2nd	1x2, 2L T12 pendant strip					lamps w/high-efficiency,												
Floor - Lobby	w/standard ballast		5 4	B 240	748.8	electronic ballast	4	5 34	170	70	3120	218.40	13.08	3	7 4	5 2	420	32.12
						Re-lamp w/4 25W T8												
Police Station - 3rd	2x4, 4L T12 recessed					lamps w/high-efficiency,												
Floor - Offices	volumetric w/standard ballast	1	7 14	4 2448	3 7637.76	electronic ballast	1	7 86	1462	986	3120	3,076.32	184.18	42	2 5) 2	1,598	8.68
Police Station - 3rd						Re-lamp w/2 28W T8												
Floor - Mechanical	2x4, 2L T12 parabolic strip					lamps w/high-efficiency,												
Room	w/standard ballast		4 7	3 292	2 30.368	B electronic ballast		4 51	204	88	3 104	9.15	0.55	5 37	7 4	5 2	336	613.22
Police Station - 3rd						Replace with LED Exit												
Floor - Offices	Incandescent Exit Sign	:	2 2	0 40	350.4	I Sign		2 3	6	34	4 8760	297.84	17.83	55	5 6	5 5	250	14.02





				Existing						Energy	Avg.	<u>kWh</u>		<u>Unit</u>	<u>Unit</u>	<u>Unit</u>	Total	Simple_
Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Wattage (W)	<u>kWh Existing</u> (kWh)	Proposed Fixture	Proposed Qty.	Input Watts / Fixture (W)	Proposed Wattage (W)	Savings	<u>Hours /</u> Year	<u>Savings /</u> Year (kWh)			Labor Cost (\$)	Disposal Cost (\$)	Cost (\$)	Payback (Yr.)
Location		Existing ety.	I IXIUI E (W)	(11)	(KVVII)	rioposed rixture	<u>uty.</u>	I IXCUTE (VV)	wallage (w)	(**)	Ical			<u></u>	<u></u>	<u></u>		<u></u>
						Re-lamp w/2 28W T8												
Police Station - 3rd	1x4, 2L T12 surface wrap		_			lamps w/high-efficiency,										_		
Floor - Stairs	w/standard ballast		2 73	3 146	6 455.52	electronic ballast	2	2 0	C	146	3120	455.52	27.27	37	7 4	5 2	168	6.16
						Re-lamp w/4 25W T8												
Police Station - 3rd	2x4. 4L T12 recessed troffer					lamps w/high-efficiency,												
Floor - Restroom	w/standard ballast		1 14	144	449.28	electronic ballast	1	86	86	58	3120	180.96	10.83	42	2 50	0 2	94	8.68
						Re-lamp w/2 31W T8 U-												
Police Station - 3rd	2x2, 2 U-lamp T12 recessed					lamps w/high-efficiency,												
Floor - Elevator Lobby	troffer w/standard ballast		1 7:	3 73	3 227.76	electronic ballast	1	60	60	13	3120	40.56	5 2.43	37	7 4	5 2	84	34.59
						Re-lamp w/ 13W												
Police Station - Exterior	1x1, 60W Incandescent Surface					compact fluorescent												
Entry	Square		2 60	120	525.6	S screw-type lamps	2	13	26	94	4380	411.72	24.65	5	5 1	5 1	42	1.70
						T5HO High Bay												
						w/electronic ballast and												
	- 400W, High-Pressure Sodium					integral occupancy												
Apparatus Bay	Low Bay w/standard ballast		6 460	2760	12088.8	3 sensor	7	258	1806	954	4380	4,178.52	2 250.17	313	3 73	3 25	2,877	11.50
Fire Station - 1st Floor	- 250W, Mercury Vapor Wall																	
Apparatus Bay	Mount w/standard ballast		1 29	5 295	1292.1	Fixture to be Removed	1	0	0	295	4380	1.292.10	77.36		2	5 25	50	0.65
									-			.,						
Fire Station - 1st Floor -	-					Do Nothing - Fixture To												
Apparatus Bay	2L T8 strip w/electronic ballast		3 59	9 177	552.24	Remain	3	59	177	' (3120	0.00	0.00					
						D /0.0014/T0												
Fire Station 1 at Elect	- 1x4, 2L T12 recessed troffer					Re-lamp w/2 28W T8 lamps w/high-efficiency,												
Office	w/standard ballast		4 7;	3 292	911.04	electronic ballast		51	204	88	3120	274.56	16.44	37	7 4	5 2	336	20.44
Onice	W/Standard ballast		<u> </u>	2.52	. 311.0-	Cicculorito ballast		r 51	201		5 5120	214.50	, 10.44	51	· •	5 2		20.44
						Re-lamp w/26W												
Fire Station - 1st Floor	-					compact fluorescent												
Stairs	100W Incandescent Pendant		1 100	0 100) 5.2	screw-type lamps	1	26	26	i 74	52	3.85	0.23	5	5 1	5 1	21	91.15
Fire Otation dat Flags						Re-lamp w/26W												
Fire Station - 1st Floor - Mechanical Room	100W Exposed Incandescent		2 100	200	10/	compact fluorescent screw-type lamps		26	52	148	52	7.70	0.46		5 1:	5 1	42	91.15
	TOOM EXPOSED Incandescent		2 100	200	10.4	sciew-type tattips	4	. 20	<u> </u>	. 140	52	1.70	0.40	<u> </u>	ו ו	J	42	91.15





			Input Watts / Wa	isting_	kWh Existing		Barris		Deserved	Energy	<u>Avg.</u>	<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total	<u>Simple</u> Payback
Location	Existing Fixture	Existing Qty.	Fixture (W) (W		(kWh)	Proposed Fixture	Proposed Qty.	Input Watts / Fixture (W)	Wattage (W)	Savings (W)	<u>Hours /</u> Year	Savings / Year (kWh)			Cost (\$)	Cost (\$)	Cost (\$)	(Yr.)
				_														
Fire Station 1 at Floor	2-lamp 60W Incandescent					Re-lamp w/2 13W compact fluorescent												
	Surface Square	1	1 120	120	6.24	screw-type lamps	1	26	26	94	52	4.89	0.29	9 10	2	5 -	3	6 123.02
						··· ,												
						Re-lamp w/26W												
Fire Station - 1st Floor - Store Room	100W Exposed Incandescent		100	400	20.0	compact fluorescent screw-type lamps		26	104	296	52	15.39	0.92	2 5	5 1	, ,	8	4 91.15
SIDIE ROOM	TOUW Exposed incandescent	2	+ 100	400	20.0	screw-type lamps	4	20	104	290	0 52	10.35	0.92	<u> </u>		5	0	4 91.10
						Re-lamp w/2 28W T8												
Fire Station - 1st Floor -						lamps w/high-efficiency,												
Kitchen	2L T12 strip w/standard ballast	2	2 73	146	6 455.52	electronic ballast	2	51	102	2 44	3120	137.28	8.22	2 37	7 4	5 2	2 16	8 20.44
Fire Station - 1st Floor -	1L 3' T8 strip w/electronic					Do Nothing - Fixture To												
Kitchen	ballast	1	1 24	24	4 74.88	Remain	1	24	24	<u>ا</u> (3120	0.00	0.00)				
Fire Station - 1st Floor -						Do Nothing - Fixture To												
	4-lamp 13W CFL Ceiling Fan	2	2 52	104	324.48	Remain	2	52	104	ч (3120	0.00	0.00)				
Fire Otation and Floor	1x1, 60W Incandescent					Re-lamp w/ 13W compact fluorescent												
	Recessed Square		2 60	120	124.8	screw-type lamps	2	13	26	94	1040	97.76	5.85	5 5	5 1	5	4	2 7.18
																-		
						Re-lamp w/ 13W												
	60W Incandescent Recessed		2 60	4.00	404.0	compact fluorescent		13			1040	97.76	5.05					7.40
Showers	Can		2 60	120	/ 124.0	screw-type lamps	2	13	26	6 94	1040	97.70	5.85		5 1	2	4	2 7.18
						Re-lamp w/2 17W, 2' T8												
	1x2, 2L T12 surface wrap					lamps w/high-efficiency,												
Sleep Area	w/standard ballast	9	9 42	378	3 1572.48	electronic ballast	9	26	234	144	4160	599.04	4 35.86	6 37	7 4	5 2	2 75	6 21.08
						Re-lamp w/2 28W T8												
Fire Station - 2nd Floor -	1x4, 2L T12 surface wrap					lamps w/high-efficiency,												
Weight Room	w/standard ballast	6	3 73	584	607.36	electronic ballast	8	51	408	176	5 1040	183.04	10.96	6 3 7	7 4	5 2	2 67	2 61.32
Fire Station - 2nd Floor	1x4, 2L T12 surface wrap					Re-lamp w/2 28W T8 lamps w/high-efficiency,												
Fire Station - 2nd Floor - Media Room	w/standard ballast		4 73	292	151.84	electronic ballast	4	51	204	88	520	45.76	2.74	37	7 4	5 3	33	6 122.64





			Input Watts		kWh Existing		Proposed	Input Watts /		<u>Energy</u> Savings	<u>Avq.</u> Hours/	<u>kWh</u> Savings/	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	<u>Total</u> Cost (\$)	Simple Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	<u>(W)</u>	<u>(kWh)</u>	Proposed Fixture	<u>Qty.</u>	Fixture (W)	Wattage (W	<u>(W)</u>	Year	Year (kWh)	Year (\$)	<u>Cost (\$)</u>	Cost (\$)	Cost (\$)		<u>(Yr.)</u>
						Re-lamp w/2 28W T8												
Fire Station - 2nd Floor -	1x4, 2L T12 surface vanity					lamps w/high-efficiency,												
	w/standard ballast		2 7	3 14	6 607.36	electronic ballast	2	2 51	102	2 4	4 4160	183.04	10.96	6 3	37 4	5 2	2 16	8 15.33
	0.4.41 T10					Re-lamp w/4 25W T8												
	- 2x4, 4L T12 recessed troffer w/standard ballast		1 14	4 14	1 500 0/	lamps w/high-efficiency, electronic ballast	1	86	86	5 5	8 4160	241.28	14.45	5	2 5	0 2	9	4 6.51
Restroom	w/stariaara bailast		1 17		+ 000.04					, ,		241.20	, 14.4	,	12 31	0 2		+ 0.51
						Re-lamp w/26W												
Fire Station - 2nd Floor -						compact fluorescent												
Storage	90W Exposed Incandescent		1 9	90 90	0 4.68	screw-type lamps	1	26	26	6 6	4 52	2 3.33	3 0.20)	5 2	0 1	2	6 130.49
						Re-lamp w/4 13W												
Fire Station - 2nd Floor -	4-lamp 52W Incandescent					compact fluorescent												
	Ceiling Fan		1 20	8 20	8 54.08	screw-type lamps	1	52	52	2 15	6 260	40.56	6 2.43	3 2	20 2	5 4	4	9 20.18
First Obsting and Flass						Dealers with LED Full												
Fire Station - 2nd Floor - Stairs	Incandescent Exit Sign		2 2	20 40	0 350.4	Replace with LED Exit	2		F	3 3	4 8760	297.84	17.83	2 F	5 6	5 6	5 25	0 14.02
				.0 1	0000.	loigh				, <u> </u>	1 0/0	201.0	1 11.00		.0 0	<u> </u>	20	14.02
						Re-lamp w/2 28 T8												
	-2L T12 wall strip w/standard					lamps w/high-efficiency,												
Stairs	ballast		2 4	2 8	4 43.68	electronic ballast	2	2 26	52	2 3	2 520	16.64	1.00) 3	37 4	5 2	2 16	8 168.63
						Re-lamp w/1 28W T8												
Fire Station - 2nd Floor -	1L T12 wall strip w/standard					lamp w/high-efficiency,												
	ballast		1 4	2 42	2 174.72	electronic ballast	1	26	26	6 1	6 4160	66.56	3.98	3 3	37 4	5 2	2 8	4 21.08





	Lighting Retrofit:	Controls Totals:	Total
Total Annual Demand Savings (kW):	17	-	17
Total Energy Consumption Savings (kWh/yr)	43,582	15,353	58,934
Total Energy Savings / Year (\$)	\$2,609	\$919	\$3,528
Total Cost of Material and Labor (\$)	\$32,731	\$11,154	\$43,885
St. Louis Price Adjustment (\$)	\$33,582	\$11,444	\$45,026
Total Tax, Overhead & Profit, and Contingency (\$)	\$11,754	\$4,005	\$15,759
Total Installed Cost (\$)	\$45,336	\$15,449	\$60,785
Total Simple Payback (Years)	17.38	16.81	17.23





Controls Totals:

				Input Watts		Proposed	Avg. Hours		Energy	<u>Unit</u>	<u>Unit</u>	Total	Simple
	Existing Fixture	Proposed Fixture	Proposed		Proposed Wattage (W)	Control	Saved /	<u>Savings /</u> Year (kWh)	Savings /	Material Cost (\$)		Cost (\$)	Payback (Yr.)
Location			Qty.			Qty.	Year -			_			
	1x4. 2L T12 recessed	Re-lamp w/2 28W T8 lamps											
Police Station -	cove strip w/standard	w/high-efficiency, electronic											
Basement - Corridor	ballast	ballast	15	51	765	4	780	596.70	35.72	90	53	572	16.01
Police Station -		Re-lamp w/4 25W T8 lamps											
Basement - Break	2x4, 4L T12 recessed	w/high-efficiency, electronic											
Room	troffer w/standard ballast	ballast	5	86	430	1	780	335.40	20.08	90	53	143	7.12
Police Station -	2x2, 2 U-lamp T12	Re-lamp w/2 31W T8 U-											
Basement - Break	recessed troffer	lamps w/high-efficiency,											
Room	w/standard ballast	electronic ballast	1	60	60	1	780	46.80	2.80	90	53	143	51.04
Police Station -		Re-lamp w/4 25W T8 lamps											
Basement - Fire	2x4, 4L T12 recessed	w/high-efficiency, electronic											
Chief's Office	troffer w/standard ballast	ballast	10	86	860	4	780	670.80	40.16	90	53	572	14.24
Police Station -		Re-lamp w/2 17W T8 lamps											
Basement - E.O.C.	1x2, 2L T12 wall mount	w/high-efficiency, electronic											
Room	w/standard ballast	ballast	1	34	34	1	130	4.42	0.26	90	53	143	540.39
Police Station -		Re-lamp w/2 28W T8 lamps											
Basement - E.O.C.	1x4, 2L T12 surface wrap	w/high-efficiency, electronic											
Room	w/standard ballast	ballast	27	51	1377	2	130	179.01	10.72	90	53	286	26.69
Police Station -		Re-lamp w/2 28W T8 lamps											
Basement - E.O.C.		w/high-efficiency, electronic											
Room	w/standard ballast	ballast	2	51	102	1	2190	223.38	13.37	90	53	143	10.69
Police Station -		Re-lamp w/2 28W T8 lamps											
Basement - E.O.C.	2L T12 strip w/standard	w/high-efficiency, electronic											
Kitchen	ballast	ballast	1	51	51	1	65	3.32	0.20	90	53	143	720.52
Police Station -		Re-lamp w/2 28W T8 lamps											
Basement - Weapons		w/high-efficiency, electronic											
Storage	ballast	ballast	4	51	204	1	65	13.26	0.79	90	53	143	180.13
		Re-lamp w/4 25W T8 lamps											
Police Station - 1st	2x4, 4L T12 recessed	w/high-efficiency, electronic											
Floor - Print Shop	troffer w/standard ballast	ballast	6	86	516	ij 1	520	268.32	16.06	90	53	143	8.90





			Proposed	Input Watts Saved /	Proposed	Proposed Control	<u>Avg. Hours</u> Saved /	<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	Total	<u>Simple</u> Payback
Location	Existing Fixture	Proposed Fixture	Qty.			Qty.	Year	Year (kWh)		Cost (\$)		<u>Cost (\$)</u>	(Yr.)
Police Station - 1st Floor - Police Dispatch	2x4, 4L T12 recessed volumetric w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	21	86	1806	3	780	1408.68	84.34	90	53	429	5.09
Police Station - 1st Floor - Police Dispatch	2x4, 4L T12 recessed volumetric w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	10			2	2190	1883.40	112.76	90	53	286	2.54
Police Station - 1st Floor - Entry Corridor	1x4, 1L T12 wall strip w/standard ballast	Re-lamp w/1 28W T8 lamp w/high-efficiency, electronic ballast	8	26	208	2	780	162.24	9.71	90	53	286	29.44
Police Station - 1st Floor - Private Offices	2x4, 4L T12 recessed volumetric w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	12	86	1032	3	780	804.96	48.19	90	53	429	8.90
Police Station - 1st Floor - Conference Room	2x4, 2L T12 recessed troffer w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	4	51	204	1	780	159.12	9.53	90	53	143	15.01
Police Station - 1st Floor - Men's Locker Room	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	6	86	516	2	780	402.48	24.10	90	53	286	11.87
Police Station - 1st Floor - Women's Locker Room	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	4	86	344	1	780	268.32	16.06	90	53	143	8.90
Police Station - 1st Floor - Offices	1x4, 2L T12 recessed troffer w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	9	51	459	3	780	358.02	21.43	90	53	429	20.01
Police Station - 1st Floor - Men's Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	4	86	344	1	780	268.32	16.06	90	53	143	8.90
Police Station - 1st Floor - Women's Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	4	86	344	1	780	268.32	16.06	90	53	143	8.90





			Proposed	Input Watts Saved /	Proposed	Proposed Control	<u>Avg. Hours</u> Saved /	<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	Total	<u>Simple</u> Payback
Location	Existing Fixture	Proposed Fixture	Qty.		Wattage (W)	Qty.	Year	Year (kWh)		Cost (\$)		<u>Cost (\$)</u>	<u>(Yr.)</u>
Police Station - 1st Floor - Entry	2x4, 4L T12 recessed volumetric w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1	86	86	1	780	67.08	4.02	90	53	143	35.61
Police Station - 1st Floor - Field Ops	2x4, 4L T12 recessed volumetric w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	2	86	172	1	780	134.16	8.03	90	53	143	17.80
Police Station - 1st Floor - Field Ops	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1	86	86	1	780	67.08	4.02	90	53	143	35.61
Police Station - 1st Floor - Field Ops	2x2, 2 U-lamp T12 recessed troffer w/standard ballast	Re-lamp w/2 31W T8 U- lamps w/high-efficiency, electronic ballast	1	60	60	1	780	46.80	2.80	90	53	143	51.04
Police Station - 1st Floor - Traffic	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	3	86	258	1	780	201.24	12.05	90	53	143	11.87
Police Station - 1st Floor - Traffic	1x4, 2L T12 recessed troffer w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	4	51	204	1	780	159.12	9.53	90	53	143	15.01
Police Station - 2nd Floor - Offices	2x4, 4L T12 recessed volumetric w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	17	. 86	1462	. 5	; 780	1140.36	68.27	90	53	715	10.47
Police Station - 2nd Floor - Offices	2x4, 4L T12 recessed volumetric w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	5	86	430	2	: 65	27.95	1.67	90	53	286	170.91
Police Station - 2nd Floor - Hall	2L T12 strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51	51	1	780	39.78	2.38	90	53	143	60.04
Police Station - 2nd Floor - Interrogation Room	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	6	86	516	2	. 130	67.08	4.02	90	53	286	71.21





			Proposed	Input Watts Saved /	Proposed	Proposed Control	<u>Avg. Hours</u> Saved /	Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material		<u>Total</u> Cost (\$)	<u>Simple</u> Payback
Location	Existing Fixture	Proposed Fixture	<u>Qty.</u>	Fixture (W)	Wattage (W)	Qty.	Year	<u>Year (kWh)</u>	<u>Year (\$)</u>	<u>Cost (\$)</u>	<u>Cost (\$)</u>		<u>(Yr.)</u>
Police Station - 2nd Floor - Men's Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1	86	86	i 1	780	67.08	4.02	90	53	143	35.61
Police Station - 2nd Floor - Women's Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1	86	86	1	780	67.08	4.02	90	53	143	35.61
Police Station - 2nd Floor - Entry	2L T12 strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	6	51	306	2	2190	670.14	40.12	90	53	286	7.13
Police Station - 2nd Floor - Narcotics Evidence Room	2L T12 strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast		51	408	2	130	53.04	3.18	90	53	286	90.06
Police Station - 2nd Floor - Homicide Evidence Room	2x4, 4L T12 recessed volumetric w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	4	86	344	1	130	44.72	2.68	90	53	143	53.41
Police Station - 2nd Floor - Lobby	1x2, 2L T12 pendant strip w/standard ballast	Re-lamp w/2 17W T8 lamps w/high-efficiency, electronic ballast	5	34	170	2	780	132.60	7.94	90	53	286	36.03
Police Station - 3rd Floor - Offices	2x4, 4L T12 recessed volumetric w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	17	86	1462	5	780	1140.36	68.27	90	53	715	10.47
Police Station - 3rd Floor - Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1	86	86	1	780	67.08	4.02	90	53	143	35.61
Police Station - 3rd Floor - Elevator Lobby	2x2, 2 U-lamp T12 recessed troffer w/standard ballast	Re-lamp w/2 31W T8 U- lamps w/high-efficiency, electronic ballast	1	60	60	1	780	46.80	2.80	90	53	143	51.04
Fire Station - 1st Floor Apparatus Bay	400W, High-Pressure Sodium Low Bay w/standard ballast	Replace with 4-lamp T5HO High Bay w/electronic ballast and integral occupancy sensor	7	258	1806	7	1095	1977.57	118.40	0	0	0	0.00





Location	Existing Fixture		Proposed Qty.		Proposed Wattage (W)	Proposed Control Qty.	<u>Avg. Hours</u> <u>Saved /</u> Year	<u>kWh</u> <u>Savings /</u> Year (kWh)	<u>Energy</u> Savings /	<u>Unit</u> Material Cost (\$)		<u>Total</u> Cost (\$)	<u>Simple</u> Payback (Yr.)
		rioposed lixidie	<u>aty.</u>		wattage (w)	<u>uty.</u>	1001		<u>rear (\$)</u>	<u></u>	<u></u>		<u></u>
Fire Station - 1st Floor - Office	,	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	4	51	204	1	780	159.12	9.53	90	53	143	15.01
Fire Station - 1st Floor - Kitchen	2L T12 strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	2	51	102	1	780	79.56	4.76	90	53	143	30.02
Fire Station - 2nd Floor - Sleep Area	1x2, 2L T12 surface wrap w/standard ballast	Re-lamp w/2 17W, 2' T8 lamps w/high-efficiency, electronic ballast	9	26	234	4	1040	243.36	14.57	90	53	572	39.26
Fire Station - 2nd Floor - Weight Room	1x4, 2L T12 surface wrap w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	8	51	408	1	260	106.08	6.35	90	53	143	22.52
Fire Station - 2nd Floor - Media Room	1x4, 2L T12 surface wrap w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	4	51	204	1	130	26.52	1.59	90	53	143	90.06
Fire Station - 2nd Floor - Restroom	1x4, 2L T12 surface vanity w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	2	51	102	1	1040	106.08	6.35	90	53	143	22.52
Fire Station - 2nd Floor - Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1	86	86	1	1040	89.44	5.35	90	53	143	26.71





Appendix B

Lighting Improvements Calculations (City Hall) – ECM-1.2





Detailed Energy Study University City Municipal Buildings

Fixture ECM Totals:

				Existing						Energy	<u>Avg.</u>	<u>kWh</u>	Energy	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total	Simple Payback
Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Wattage (W)	<u>kWh Existing</u> (kWh)	Proposed Fixture	Proposed Qty.	Input Watts / Fixture (W)	Proposed Wattage (W)	Savings	<u>Hours/</u> Year	Savings / Year (kWh)	Savings / Year (\$)	Cost (\$)	Cost (\$)		Cost (\$)	(Yr.)
							<u>ury.</u>			-							- 6	• •
						Do Nothing - Fixture To												
City Hall - Elevator	MR16 20W Halogen Can	(6 20) 120	530.4	Remain	6	6 20	120	0 () 4420	0.00	0.00	0				
City Hall - 5th Floor -						Do Nothing - Fixture To												
Courtroom	PAR 38 Halogen Flood	2	1 75	5 1575	655.2	Remain	21	75	1575	i () 416	6 0.00	0.00)				
City Hall - 5th Floor - Courtroom	26W CFL Decorative Wall Torch		6 26	6 156	64.896	Do Nothing - Fixture To Remain	6	5 26	156	i (416	6 0.00	0.00)				
City Hall - 5th Floor - Courtroom	2L T8 cove strip w/electronic ballast	10	6 59	944	302 70/	Do Nothing - Fixture To Remain	16	59	944) 416	6 0.00	0.00	1				
Countoon	Deneist		<u> </u>	, ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	002.10-	riterian					, 410	0.00	0.00	, 				
City Hall - 5th Floor -						Replace with LED Exit												
Courtroom	Incandescent Exit Sign		3 20	0 60	525.6	Sign	3	3	9	51	8760	446.76	22.34	1 5	5 0	65	5 37	5 16.79
City Hall - 5th Floor -						Do Nothing - Fixture To												
	2L T8 strip w/electronic ballast	:	2 59	9 118	6.136	Remain	2	2 59	118	(() 52	2 0.00	0.00)				
City Hall - 5th Floor -	Decorative Chandelier (40W					Re-lamp w/13W compact fluorescent												
Courtroom	Incandescent Lamps)	10	6 40	640	266.24	screw-type lamps	16	i 13	208	432	2 416	6 179.71	8.99	9	5	15	1 33	6 37.39
City Hall - 5th Floor - Courtroom	Decorative Chandelier (13W Compact Fluorescent Lamps)		9 1:	3 117	48.672	Do Nothing - Fixture To Remain	g	13	117) 416	6 0.00	0.00)				
						Re-lamp w/26W												
City Hall - 5th Floor - Elevator Lobby	100W Exposed Incandescent Pendant		1 100	100	41.6	compact fluorescent screw-type lamps	1	26	26	74	416	30.78	1.54	1	5	15	1 2	1 13.64
,						A CONTRACTOR OF							110			-		
City Hall - 5th Floor -						Do Nothing - Fixture To												
Penthouse	Lamp	1	8 13	3 104	5.408	8 Remain	8	8 13	104	0) 52	2 0.00	0.00)				





			Input Watts /	Existing Wattage	kWh Existing		Proposed	Input Watts /	Proposed	Energy Savings	<u>Avg.</u> Hours/	<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total	Simple Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	(W)	(kWh)	Proposed Fixture	Qty.		Wattage (W		Year		Year (\$)	Cost (\$)	Cost (\$)	Cost (\$)	Cost (\$)	(Yr.)
City Hall - 5th Floor -						Do Nothing - Fixture To												
Penthouse	2L T8 strip w/electronic ballast		4 59	236	6 12.272	Remain	4	4 59	236	6 C	52	2 0.00	0.00)				
City Hall - 4th Floor -	2L T8 vanity strip w/electronic					Do Nothing - Fixture To												
Women's Restroom		:	3 59	9 177	7 782.34	Remain	3	3 59	9 177	′ (4420	0.00	0.00)				
City Hall - 4th Floor -						Do Nothing - Fixture To												
Women's Restroom	13W CFL Wall Sconce	· · ·	1 1:	3 13	3 57.46	Remain	1	1 13	3 13	8 (4420	0.00	0.00)				
City Hall - 4th Floor -	2-lamp 13W CFL Decorative					Do Nothing - Fixture To												
Elevator Lobby	Wall Sconce	· · · ·	1 26	6 26	6 (Remain	1	1 26	6 26	6 C) (0.00	0.00)				
						Re-lamp w/4 25W T8												
	2x4, 4L T12 recessed troffer					lamps w/high-efficiency,												
Engineering Offices	w/standard ballast	2	1 144	3024	1 9434.88	electronic ballast	21	1 86	6 1806	5 1218	3120	3,800.16	190.01	1 4:	2 5	0 :	2 1,974	4 10.39
						Re-lamp w/4 25W T8												
	2x4, 4L T12 recessed troffer					lamps w/high-efficiency,												
Engineering Offices	w/standard ballast		9 144	1296	5 1347.84	electronic ballast	ę	9 86	6 774	522	2 1040	542.88	27.14	4:	2 5	0 2	2 84	6 31.17
	2x4, 4L, 25W T8 recessed					Do Nothing - Fixture To												
Engineering Offices	troffer w/electronic ballast	1	9 86	6 1634 	4 5098.08	Remain	19	9 86	6 1634	l (3120	0.00	0.00)				
City Hall - 4th Floor -	Incandescent Exit Sign		5 20	100	070	Replace with LED Exit	f	5 3	3 15	5 85	8760	744.6	37.23	3 5	5 6	-	5 62	5 16.79
Engineering Onices	Incandescent Exit Sign		5 20	/ 100	5 670	Sign		j		0 00	0/00	/44.0	51.23	5 0	-0 -0	5 .	5 02;	10.79
City Hall - 4th Floor -						Re-lamp w/2 28W T8												
Engineering Office Conference Room	2L T12 above ceiling strip w/standard ballast		6 73	438	112.90	lamps w/high-efficiency, electronic ballast	F	5 51	306	5 132	2 260	34.32	1.72	2 3	7 4	5	2 50	4 293.71
Condicince (COOIII	W/ Stanual U Dallast			, 430	, 113.00			, J	300	, 132	200	, 34.32	1.72	. 3	4	5 1	U	233.71
City Hall - 4th Floor -																		
Engineering Office Conference Room	4-lamp 13W CFL Ceiling Fan		1 52	2 52	12.50	Do Nothing - Fixture To Remain		1 52	2 52	2 (260	0.00	0.00					
Completice NU0III	Thamp TOW OF L COUNTY Fall		ij 04	- 34	10.02	Nomalii	_	ij	- 34	. L	/ 200	0.00	0.00	/				1





				Existing						Energy	<u>Avg.</u>	<u>kWh</u>	Energy	<u>Unit</u>	<u>Unit</u>	<u>Unit</u>	Total	Simple
Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Wattage (W)	<u>kWh Existing</u> (kWh)	Proposed Fixture	Proposed Qty.		Proposed Wattage (W	Savings (W)	<u>Hours /</u> Year	<u>Savings /</u> Year (kWh)	<u>Savings /</u> Year (\$)	Material Cost (\$)	Labor Cost (\$)	Disposal Cost (\$)	Cost (\$)	Payback (Yr.)
City Hall - 4th Floor - Engineering Office	3L T8 pendant wrap					Do Nothing - Fixture To												
File Room	w/electronic ballast		3 87	7 261	67.8	Remain		3 87	26		260	0.00	0.00	n				
		,	5 01	20	07.00			3 07	20		200	0.00	0.00	J				
City Hall - 4th Floor -						Re-lamp w/2 59W T8 8'												
Engineering Office	2L 75W T12 8' parabolic					lamps w/high-efficiency,												
File Room Corridor	pendant w/standard ballast		1 158	3 158	3 41.08	electronic ballast		1 112	11:	2 4	6 260	11.96	0.60	n a	37 4	5	2 8	4 140.47
	portaant injotanaara banaot										200							
City Hall - 3rd Floor -	2L T8 vanity strip w/electronic					Do Nothing - Fixture To												
Men's Restroom	ballast	:	3 59	9 177	7 782.34	Remain		3 59	17	7 1) 4420	0.00	0.00	D				
City Hall - 3rd Floor -						Do Nothing - Fixture To												
Men's Restroom	13W CFL Wall Sconce		1 13	3 13	3 57.46	Remain		1 13	1:	3 1) 4420	0.00	0.00	0				
						5 N.0. 5 . 5												
City Hall - 3rd Floor - Elevator Lobby	2-lamp 13W CFL Decorative Wall Sconce		1 26		444.00	Do Nothing - Fixture To Remain		1 26	26) 4420	0.00	0.00					
Elevator Lobby	Waii Sconce		1 20	6 26	114.92	Remain		1 20	20) 442(0.00	0.00	J				
City Hall - 3rd Floor -						Replace with LED Exit												
Elevator Lobby	Incandescent Exit Sign		1 20	20	175.2	Sign		1 3		3 1	7 8760	148.92	7.4	5 5	5 6	5	5 12	5 16.79
															-			
City Hall - 3rd Floor -	1x4, 2L T8 D/I pendant					Do Nothing - Fixture To												
Private Offices	w/electronic ballast	1	7 59	9 1003	3 3129.36	Remain	1	7 59	1003	3 (3120	0.00	0.00	0				
City Hall - 3rd Floor -						Do Nothing - Fixture To		_			_			_				
Private Offices	w/electronic ballast	19	9 59	9 1121	582.92	Remain	1	9 59	112	1 1) 520	0.00	0.00	U				
						De lesse (0014/												
City Hall - 3rd Eleor	90W Exposed Incandescent					Re-lamp w/26W compact fluorescent												
Storage Vault	Pendant		1 90	90	1.65	screw-type lamps		1 26	20	6 6	4 52	3.33	0.17	7	5 1	5	1 2	1 126.20
otorage vauit	r onduitt		. 50	, 50	, 4.00	oorow-type tampa		. 20		5 0		. 3.33	, 0.11		<u> </u>		. 2	1 120.20
City Hall - 3rd Floor -	1x4, 2L T8 D/l pendant					Do Nothing - Fixture To												
	w/electronic ballast		6 59	354	1 736.32	Remain		6 59	354	4 (2080	0.00	0.00	b				





				Existing						Energy	Avg.	<u>kWh</u>	Energy	<u>Unit</u>	<u>Unit</u>	<u>Unit</u>	Total	Simple
			Input Watts /		kWh Existing		Proposed	Input Watts /		Savings			Savings /	Material	Labor	Disposal	Cost (\$)	Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	<u>(W)</u>	<u>(kWh)</u>	Proposed Fixture	<u>Qty.</u>	Fixture (W)	Wattage (W)	<u>(W)</u>	Year	Year (kWh)	<u>Year (\$)</u>	Cost (\$)	Cost (\$)	Cost (\$)		<u>(Yr.)</u>
City Hall - 3rd Floor -						Do Nothing - Fixture To												
Open Offices	w/electronic ballast	2	7 59	9 1593	3 4970.16	Remain	27	' 59	1593	(3120	0.00	0.00)				
						Re-lamp w/3 13W												
City Hall - 3rd Floor -	3-lamp 60W Incandescent					compact fluorescent												
Private Offices	Ceiling Fan		1 180	180	561.6	screw-type lamps	1	39	39	141	1 3120	439.92	22.00	0 15	5 25	5 1	4	1 1.86
City Hall - 3rd Floor -						Do Nothing - Fixture To												
Open Offices	LED Exit Sign		1 :	3 3	3 26.28	Remain	1	3	3	(8760	0.00	0.00)				
City Hall - 3rd Floor -	1-lamp 22W Circline Ceiling					Do Nothing - Fixture To												
Private Offices	Fan	:	3 24	1 72	2 7.488	Remain		3 24	72	(0 104	0.00	0.00)				
City Hall - 3rd Floor -						Do Nothing - Fixture To												
Private Offices	LED Exit Sign		2 3	3 6	6 52.56	Remain	2	2 3	6	(8760	0.00	0.00)				
	2x4, 4L, 32W T8 recessed					Re-lamp w/4 25W T8												
Private Offices	troffer w/electronic ballast	1	0 114	1140) 296.4	lamps	10	86	860	280	260	72.80	4.65	5 12	2 20) 2	2 34	0 73.05
	- 2L T8 vanity strip w/electronic					Do Nothing - Fixture To												
Women's Restroom	ballast		3 59) 177	782.34	Remain	2	59	177	() 4420	0.00	0.00)				
City Hall - 2nd Floor -					57.40	Do Nothing - Fixture To					4400							
women's Restroom	13W CFL Wall Sconce		1 1:	3 13	57.4t	Remain		13	13	() 4420	0.00	0.00) 				
City Hall - 2nd Floor - Elevator Lobby	- 2-lamp 13W CFL Decorative Wall Sconce		1 26	5 26		Do Nothing - Fixture To Remain		26	26			0.00	0.00					
LIEVALUI LUUUY			20	, 20				20	20			0.00	0.00	, 				
City Hall - 2nd Floor - Center Rotunda	 9W CFL 4-lamp decorative torches 		8 9	72	240.0	Do Nothing - Fixture To Remain			72		4420	0.00	0.00					
Center Rotunua	luiches			1 12	s 18.24	rtemain	č) <u> </u>	<u>ا ا</u>	. (J <u>44</u> 20	0.00	0.00	/		-		





				Existing						Energy	Avg.	<u>kWh</u>	Energy	<u>Unit</u>	<u>Unit</u>	<u>Unit</u>	Total	Simple
Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Wattage (W)	<u>kWh Existing</u> (kWh)	Proposed Fixture	Proposed Qty.		Proposed Wattage (W	Savings	<u>Hours /</u> Year	<u>Savings /</u> Year (kWh)	<u>Savings /</u> Year (\$)	Material Cost (\$)	Labor Cost (\$)	Disposal Cost (\$)	Cost (\$)	Payback (Yr.)
Location		Existing ety.		<u>,</u>	(KHII)	Toposed Tixture	<u>uty.</u>		manage (m	<u>, (11)</u>	Tear		<u>1001 (ψ)</u>					1
City Hall - 2nd Floor -	_					Do Nothing - Fixture To												
Center Rotunda	LED Exit Sign		2	3	6 52.56	8 Remain		2 3	3 6	6	0 8760	0.00	0.00	0				
City Hall - 2nd Floor -	- Decorative Chandelier (25W					Do Nothing - Fixture To												
Center Rotunda	Incandescent Lamps)	1	2 2	5 30	0 132	Remain	1	12 25	5 300)	0 4420	0.00	0.00	0				
	Decorative Chandelier (25W																	
City Hall - 2nd Floor -						Do Nothing - Fixture To												
Center Rotunda	Lamps)	1	4 2	5 35	0 154	7 Remain	1	4 25	5 350) (0 4420	0.00	0.00	0				
	- 1x4, 2L T8 D/I pendant					Do Nothing - Fixture To												
City Clerk	w/electronic ballast		5 5	9 29	5 920.4	Remain		5 59) 295		0 3120	0.00	0.00	0				
						Re-lamp w/4 25W T8												
	- 2x4, 4L T12 recessed troffer					lamps w/high-efficiency,												
City Clerk	w/standard ballast	·	2 14	4 28	5 898.5	6 electronic ballast		2 86	6 172	2 11	6 3120	361.92	23.14	4 4	2 5		2 18	8 8.13
						Re-lamp w/26W												
City Hall - 2nd Floor -			2 9	10		compact fluorescent		2 26		10			0.4		5 1	-	1 4	2 98.70
Mayor	90W Exposed Incandescent		2 9	0 18	9.3	S screw-type lamps		2 26	6 52	2 12	8 52	2 6.66	6 0.43	3	5 1	5	1 4.	2 98.70
City Hall - 2nd Floor -						Do Nothing - Fixture To												
Mayor	- PAR 38 Halogen Can		9 7	5 67	5 210	8 Remain		9 75	5 675	5	0 3120	0.00	0.00	0				
City Hall - 2nd Floor	- 40W Incandescent Wall					Re-lamp w/9W compact fluorescent screw-type												
Mayor	Torches		4 4	0 16	0 499.2	2 lamps		4 9	36	6 12	4 3120	386.88	24.73	3	5 1	5	1 8	4 3.40
City Hall - 2nd Floor -	- 2L T5 task light strips					Do Nothing - Fixture To												
Mayor	w/electronic ballast		2 5	3 10	6 330.72	2 Remain		2 53	3 106	6	0 3120	0.00	0.00	0				
City Hall - 2nd Floor -					40.04	Do Nothing - Fixture To												
Mayor's Restroom	torches		8 2	6 20	8 10.816	8 Remain		8 26	6 208	5 1	0 52	2 0.00	0.00	U				





			Input Watts /	Existing Wattage	kWh Existing		Proposed	Input Watts /	Pronosed	<u>Energy</u> Savings	<u>Avg.</u> Hours	<u>kWh</u> / Savings/	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total	Simple Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	(W)	(kWh)	Proposed Fixture	Qty.		Wattage (W)		Year	Year (kWh)		Cost (\$)	Cost (\$)	Cost (\$)	Cost (\$)	(Yr.)
						Re-lamp w/13W												
City Hall - 2nd Floor - Mayor's Restroom	- 52W Exposed Incandescent	1	52	2 52	2 70/	compact fluorescent screw-type lamps	1	13	13	39	a #	52 2.0	3 0.13	2 1	5 1	5	2	161.97
Wayor a realfoorn	52W Exposed meandescent		J 52		2.70	screw-type lamps		10				2.0	0.10	, <u> </u>	5 1	5	. 2	101.37
						Re-lamp w/13W												
	- 4-lamp Decorative 60W					compact fluorescent							_					
Mayor's Fireplace	Incandescent Surface Mount	1	1 240	240	12.48	screw-type lamps	1	52	52	188	8 5	52 9.7	8 0.62	2 (5 1	5	1 2'	33.60
City Hall - 2nd Floor -	_																	
	a 1x4, 2L T8 D/I pendant					Do Nothing - Fixture To												
7	w/electronic ballast	6	6 59	9 354	1104.48	Remain	6	59	354	(0 312	20 0.0	0.00)				
City Hall - 2nd Floor - Administrative Office	- a 1x4, 2L T8 D/I pendant					Do Nothing - Fixture To												
8	w/electronic ballast	6	5 59	354	1104.48	Remain	6	59	354	. (0 312	20 0.0	0.00)				
						Re-lamp w/13W												
City Hall - 2nd Floor - Storage Closets	- 60W Exposed Incandescent	3	3 60	180	9.36	compact fluorescent screw-type lamps	3	13	39	141	1 5	52 7.3	3 0.47	, ,	5 1	5 .	6	3 134.40
ciologo ciocolo					0.00	coron type lampe						.2 110						10 11 10
	- 2x4, 4L, 32W T8 recessed					Re-lamp w/4 25W T8												
Conference Room	troffer w/electronic ballast	2	3 114	1 342	177.84	lamps	3	8 86	258	84	4 52	20 43.6	8 2.79	9 12	2 2	0 2	2 102	36.53
City Hall - 2nd Floor -	-					Do Nothing - Fixture To												
Conference Room	2L T8 vanity w/electronic ballast	2	2 59	9 118	6.136	Remain	2	2 59	118	(0 5	52 0.0	0.00)				
City Hall - 1st Floor -	2L T8 vanity strip w/electronic					Do Nothing - Fixture To												
Men's Restroom	ballast	3	3 59	9 177	782.34	Remain	3	59	177	. (0 442	20 0.0	0.00)				
City Hall - 1st Floor -						Do Nothing - Fixture To												
Men's Restroom	13W CFL Wall Sconce	1	13	3 13	57.46	Remain	1	13	13		0 442	20 0.0	0.00)				
						Re-lamp w/2 13W												
				100		compact fluorescent		00				-			-	-		67.00
Elevator Lobby	Sconce	1	1 120	120	6.24	screw-type lamps	11	26	26	i 94	4 5	52 4.8	9 0.31	ų ;	5 1	ວ <u></u>	1 2'	67.20





				Existing			L .		L .	Energy	<u>Avg.</u>	<u>kWh</u>	Energy	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total	Simple Payback
Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Wattage (W)	<u>kWh Existing</u> (kWh)	Proposed Fixture	Proposed Qty.		Proposed Wattage (W	Savings (W)	<u>Hours /</u> Year		Savings / Year (\$)	Cost (\$)	Cost (\$)	Cost (\$)	Cost (\$)	(Yr.)
City Hall - 1st Floor -	13W CFL 2-lamp decorative					Do Nothing - Fixture To												
Lobby	torches	3	6 20	6 936	6 4137.12	2 Remain	3	6 26	930	6	0 4420	0.00	0.0	0				
City Hall - 1st Floor -						Do Nothing - Fixture To												
Lobby	LED Exit Sign		4 :	3 12	2 105.12	2 Remain		4 3	1:	2	0 8760	0.00	0.0	0				
Other Line Land Floore	4 FIM Is and a sout Olation					De Nathier, Eistern Te												
City Hall - 1st Floor - Lobby	15W Incandescent Statue Lights		7 1:	5 105	5 464.	Do Nothing - Fixture To Remain	· · ·	7 15	10	5 1	0 4420	0.00	0.0	0				
	5-lamp Decorative Candelabra																	
City Hall - 1st Floor - Lobby	(25W Incandescent Candelabra Lamps)	4	4 12	5 500) 221(Do Nothing - Fixture To Remain		4 125	500)	0 4420	0.00	0.0	0				
City Hall - 1st Floor - Offices	1x4, 2L T8 D/l pendant w/electronic ballast	4	2 5	9 2478	3 7731.3	Do Nothing - Fixture To Remain	4	2 59	2478	3	0 3120	0.00	0.0	0				
						Re-lamp w/26W												
City Hall - 1st Floor - Vault Closet	90W Exposed Incandescent		3 90	270	14.0	compact fluorescent screw-type lamps		3 26	5 78	3 19:	2 52	2 9.98	0.6	4	5 1	5 .	1 6	3 98.70
Vault Closel	90W Exposed incandescent		3 91	5 270	J 14.04	screw-type lamps		3 20		5 19.	2 34	2 9.90	0.04	4	<u>o i</u>	5	1 0	3 90.70
City Hall - 1st Floor -						Do Nothing - Fixture To												
Vault Closet	13W CFL Exposed Lamp		1 1:	3 13	3 0.670	Remain		1 13	s <u>1</u> ;	3	0 52	2 0.00	0.0	0				
City Hall - 1st Floor -	1x4, 2L T8 D/l pendant					Do Nothing - Fixture To												
Offices	w/electronic ballast		4 59	9 236	5 736.3	2 Remain		4 59	230	6 (0 3120	0.00	0.0	0				
City Hall - 1st Floor -						Re-lamp w/13W compact fluorescent												
Sink Closet	52W Exposed Incandescent	:	3 52	2 156	8.112	2 screw-type lamps	:	3 13	39	9 11	7 52	2 6.08	0.3	9	5 2	0	1 7	8 200.54
City Hall - Basement						Do Nothing - Fixture To												
Stairs	50W MR16 Track Light	1	1 50	550	243	Remain	1	1 50	550		0 4420	0.00	0.0	0				





				Existing						Energy	Avg.	kWh	Energy	<u>Unit</u>	<u>Unit</u>	<u>Unit</u>	Total	Simple_
Location	Eviating Fisture	Eviating Otu	Input Watts /		<u>kWh Existing</u> (kWh)	Proposed Fixture	Proposed	Input Watts / Fixture (W)		Savings		Savings / Year (kWh)	Savings /	Material Cost (\$)	Labor Cost (\$)	Disposal Cost (\$)	Cost (\$)	Payback (Yr.)
	Existing Fixture	Existing Qty.	Fixture (W)	<u>(W)</u>	<u>(Kvvn)</u>	Proposed Fixture	<u>Qty.</u>	Fixture (W)	vvattage (vv	<u>(vv)</u>	Year	<u>tear (Kvvn)</u>	<u>Year (\$)</u>	0031 (ψ)	<u>0031 (ψ)</u>	0031 (ψ)		(11.)
City Hall - Basement	-					Do Nothing - Fixture To								_				
Stairs	LED Exit Sign		2 3	3 (52.50	Remain	`	2 3	<u>ن</u> د) 	0 8760	0.00	0.00	0				
City Hall - Basement						Replace with LED Exit												
Stairs	Incandescent Exit Sign		1 20	0 20	175.2	Sign		1 3	. 3	3 1	7 8760	148.92	9.52	2 5	5 6	5 4	5 125	5 13.13
						- 3												
City Hall - Basement						Do Nothing - Fixture To												
Stairs	13W CFL Wall Sconce	-	8 1:	3 104	4 911.04	Remain	8	B 13	104	1	0 8760	0.00	0.00	0				
City Hall - Basement	-2L T8 damp-location pendant					Do Nothing - Fixture To												
Shops	w/electronic ballast		2 59	9 118	368.16	Remain	2	2 59	118	3	0 3120	0.00	0.00	0				
City Hall - Basement						Do Nothing - Fixture To												
Shops	LED Exit Sign	-	1 :	3 :	3 26.28	Remain		1 3	3	3	0 8760	0.00	0.00	0				
	-2L T8 damp-location pendant					Do Nothing - Fixture To												
Mechanical Room	w/electronic ballast	:	2 59	9 118	3 12.272	Remain	2	2 59	118	3	0 104	4 0.00	0.00	0				
	-2L T8 damp-location pendant					Do Nothing - Fixture To								_				
Electrical Room	w/electronic ballast		2 59	9 118	3 12.272	Remain	1	2 59	118	3	0 104	4 0.00	0.00	0				
						Re-lamp w/26W												
City Hall - Basement						compact fluorescent										_		
Closet	90W Exposed Incandescent		9 90	0 810) 42.12	screw-type lamps	9	9 26	234	1 57	6 52	2 29.95	1.91	1	5 1	5	1 189	9 98.70
						Re-lamp w/4 25W T8												
City Hall - Basement File Room	-2x4, 4L T12 recessed troffer w/standard ballast		7 14	4 1008	101.02	lamps w/high-efficiency, electronic ballast		7 86	602	2 40	104	42.22	2.70		2 5		2 658	8 243.76
	w/stanudiu UdildSt		1 144	+ 1000	104.032		· · · ·	00	002	40	0 104	+ 42.22	2.70	4	- <u> </u>		. 000	, 243.70
						Re-lamp w/2 28W T8												
City Hall - Basement			0 7/		45 55	lamps w/high-efficiency,			000			40.70	0.00		7 4			4 574.07
File Room	2L T12 strip w/standard ballast		6 73	3 438	45.552	electronic ballast		6 51	306	6 13	2 104	13.73	0.88	8 3	7 4	5 C	2 504	4 574.27





Location	Existing Fixture		Input Watts / Fixture (W)	Existing Wattage (W)	<u>kWh Existing</u> (kWh)	Proposed Fixture	Proposed Qty.	Input Watts / Fixture (W)			<u>Avq.</u> Hours/ Year	<u>kWh</u> Savings / Year (kWh)	<u>Energy</u> Savings / Year (\$)	<u>Unit</u> Material Cost (\$)	<u>Unit</u> Labor Cost (\$)	<u>Unit</u> Disposal Cost (\$)	<u>Total</u> Cost (\$)	Simple Payback (Yr.)
	-2L T12 surface wrap w/standard ballast	2	2 73	3 14		Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast		2 51	102	44	3120	137.28	8.78	3 3	7 45	5 2	2 168	3 19.14
City Hall - Basement Shops	-2L T12 industrial strip w/standard ballast	8	73	3 58-	4 1822.08	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast		8 51	408	176	3120	549.12	35.11	3	7 45	5 2	2 672	2 19.14

	Lighting Retrofit:	Controls Totals:	Total
Total Annual Demand Savings (kW):	6	-	6
Total Energy Consumption Savings (kWh/yr)	8,217	3,864	12,081
Total Energy Savings / Year (\$)	\$436	\$247	\$683
Total Cost of Material and Labor (\$)	\$8,291	\$6,435	\$14,726
St. Louis Price Adjustment (\$)	\$8,507	\$6,602	\$15,109
Total Tax, Overhead & Profit, and Contingency (\$)	\$2,977	\$2,311	\$5,288
Total Installed Cost (\$)	\$11,484	\$8,913	\$20,397
Total Simple Payback (Years)	26.32	36.08	29.85





				Input Watts					<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u>	Total	Simple Pavback
1 4	Existing Fixture	Deserves d Fisteres		Saved /	Proposed Wattage (W)	Control	Saved /	<u>Savings /</u> Year (kWh)		Cost (\$)	Labor	Cost (\$)	Payback (Yr.)
Location		Proposed Fixture	Qty.			Qty.	Year -					1 🕞	
City Hall - 4th Floor - Women's Restroom	2L T8 vanity strip w/electronic ballast	Do Nothing - Fixture To Remain	3	59	177	, 4	442	78.23	5.00	90	53	143	8 28.59
women's Restroom	w/electronic ballast	Remain	3	59	177		442	10.23	5.00	90	53	143	20.09
City Hall - 4th Floor - Engineering Offices	2x4, 2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	21	86	1806	6 5	5 312	563.47	36.02	90	53	715	5 19.85
City Hall - 4th Floor - Engineering Offices	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	9	86	774	4 2	2 104	80.50	5.15	90	53	286	55.58
3													
City Hall - 4th Floor - Engineering Offices	2x4, 4L, 25W T8 recessed troffer w/electronic ballast	Do Nothing - Fixture To Remain	19	86	1634	1 4	312	509.81	32.59	90	53	572	2 17.55
City Hall - 3rd Floor - Men's Restroom	2L T8 vanity strip w/electronic ballast	Do Nothing - Fixture To Remain	3	59	177	71	442	78.23	5.00	90	53	143	8 28.59
City Hall - 3rd Floor - Private Offices	1x4, 2L T8 D/I pendant w/electronic ballast	Do Nothing - Fixture To Remain	17	59	1003	3 4	312	312.94	20.01	90	53	572	2 28.59
City Hall - 3rd Floor - Private Offices	1x4, 2L T8 D/l pendant w/electronic ballast	Do Nothing - Fixture To Remain	19	59	1121		52	58.29	3.73	90	53	572	2 153.49
City Hall - 3rd Floor - Conference Room	1x4, 2L T8 D/l pendant w/electronic ballast	Do Nothing - Fixture To Remain	6	59	354	1 1	208	73.63	4.71	90	53	143	30.38
City Hall - 3rd Floor - Open Offices	1x4, 2L T8 D/l pendant w/electronic ballast	Do Nothing - Fixture To Remain	27	59	1593	3 4	I 312	497.02	31.77	. 90	53	572	2 18.00
City Hall - 2nd Floor - Women's Restroom	2L T8 vanity strip w/electronic ballast	Do Nothing - Fixture To Remain	3	59	177	7 1	442	78.23	5.00	90	53	143	8 28.59





Controls Totals (Continued):

				<u>Input Watts</u> Saved /	Proposed	Proposed Control	<u>Avg. Hours</u> Saved /	<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material		<u>Total</u> Cost (\$)	<u>Simple</u> Payback
Location	Existing Fixture	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)	Qty.	Year	Year (kWh)	<u>Year (\$)</u>	Cost (\$)	Cost (\$)	<u>COSI (\$)</u>	<u>(Yr.)</u>
City Hall - 2nd Floor -	1x4, 2L T8 D/I pendant	Do Nothing - Fixture To											
City Clerk	w/electronic ballast	Remain	5	59	295	1	312	92.04	5.88	90	53	143	24.30
	2x4, 2x4, 4L T12	Re-lamp w/4 25W T8 lamps											
City Hall - 2nd Floor -	recessed troffer	w/high-efficiency, electronic											
City Clerk	w/standard ballast	ballast	2	86	172	1	312	53.66	3.43	90	53	143	41.68
City Hall - 2nd Floor - Mayor	2L T5 task light strips w/electronic ballast	Do Nothing - Fixture To Remain	2	53	106	1	312	33.07	2.11	90	53	143	67.63
IMayOI		Remain	2		100		312	33.07	2.11	90	55	143	07.03
	Aut of TO D// seadout	De Nething Eisture Te											
City Hall - 2nd Floor - Administrative Office 7		Do Nothing - Fixture To Remain	6	59	354	1	312	110.45	7.06	90	53	143	20.25
City Hall - 2nd Floor -	1v1 2L T8 D/Lpendant	Do Nothing - Fixture To											
Administrative Office 8		Remain	6	59	354	1	312	110.45	7.06	90	53	143	20.25
	2x4, 4L, 32W T8												
City Hall - 2nd Floor -	recessed troffer												
Conference Room	w/electronic ballast	Re-lamp w/4 25W T8 lamps	3	86	258	1	52	13.42	0.86	6 90	53	143	166.73
City Hall - 1st Floor -	2L T8 vanity strip	Do Nothing - Fixture To											
Men's Restroom	w/electronic ballast	Remain	3	59	177	1	442	78.23	5.00	90	53	143	28.59
City Hall - 1st Floor - Offices	1x4, 2L T8 D/I pendant w/electronic ballast	Do Nothing - Fixture To Remain	42	59	2478	ε ε	312	773.14	49.43	90	53	858	17.36
Onces	W/electronic ballast		42		2470		5 512	113.14	49.43	30		0.00	17.50
	4v4 OL TO D// pendent	De Nething - Fisture Te											
City Hall - 1st Floor - Offices	w/electronic ballast	Do Nothing - Fixture To Remain	4	59	236	1	312	73.63	4.71	90	53	143	30.38
City Hall - Basement -	2L T8 damp-location pendant w/electronic	Do Nothing - Fixture To											
Shops	ballast	Remain	2	59	118	1	312	36.82	2.35	90	53	143	60.76





Controls Totals (Continued):

Location	Existing Fixture	Dramond Firther	Proposed	Input Watts Saved /	Proposed	Proposed Control	<u>Avg. Hours</u> Saved /	<u>kWh</u> <u>Savings /</u> Year (kWh)	<u>Energy</u> Savings/	<u>Unit</u> <u>Material</u> Cost (\$)			<u>Simple</u> Payback (Yr.)
Location	Existing Fixture	Proposed Fixture	<u>Qty.</u>	Fixture (W)	Wattage (W)	<u>Qty.</u>	Year	rear (kvvn)	<u>rear (\$)</u>	<u>003((ψ)</u>	<u>003((ψ)</u>		<u></u>
City Hall - Basement - Shops	2L T12 surface wrap w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast		51		1	312	31.82	2.03	90	53	143	70.29
City Hall - Basement - Shops	2L T12 industrial strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast		51	408	2	312	127.30	8.14	90	53	286	35.14





Appendix C

Lighting Improvements Calculations (Community Center)– ECM-1.3





Detailed Energy Study University City Municipal Buildings

Fixture ECM Totals:

										Energy	Avg.	<u>kWh</u>	Energy	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total Cost	t Payback
	Fuinting Finture	Enderline Office	Input Watts /		kWh Existing	Proposed Fixture		Input Watts / Fixture (W)		Savings		<u>Savings /</u> Year (kWh)	Savings /	Cost (\$)	Cost (\$)	Cost (\$)	(\$)	(Yr.)
Location	Existing Fixture	Existing Qty.	Fixture (W)	Wattage (W) <u>(KVVN)</u>		Qty.		Wattage (W)		Year		Year (\$)			_	-	• •
																		-
Community Center -																		
Conference Room /	2x4, 4L T8 recessed troffer					Do Nothing - Fixture To												
Stage	w/electronic ballast	4	4 114	456	6 474.24	Remain	4	86	344	¥ 11:	2 1040	116.48	5.82	2				
Community Center -																		
Conference Room /	2x4, 4L T8 recessed troffer			400		Do Nothing - Fixture To	10		4070			50.70						
Stage	w/electronic ballast	16	6 114	1824	4 218.88	Remain	16	86	1376	6 44	8 120) 53.76	6 2.69	•				
Community Center -																		
Conference Room /						Do Nothing - Fixture To												
Stage	PAR 38 Halogen Flood	16	6 75	5 1200	124.8	Remain	16	75	1200)	0 104	0.00	0.00					
Community Center -																		
Conference Room /						Replace with LED Exit												
Stage	Incandescent Exit Sign	2	2 20) 40	350.4	Sign	2	3	6	6 3	4 8760	297.84	17.83	5	5 6	5	5 250	0 14.02
						D - I												
Community Center -	100W Recessed Incandescent					Re-lamp w/26W compact fluorescent												
Store Room	Square		7 100	700	72 8	screw-type lamps	7	26	182	2 51	8 104	53.87	3.23		5 1	5	1 147	7 45.5
	oquaro								102				0.20					10.0.
						Re-lamp w/59W												
Community Center -						compact fluorescent												
Store Room	200W Exposed Incandescent	1	1 200	200	20.8	screw-type lamps	1	59	59	9 14	1 104	14.66	6 0.88	3 1	0 2	5	1 36	6 41.0
Community Center -						Replace with LED Exit												
Kitchen	Incandescent Exit Sign		3 20	60	525 6	Sign	3	3	c	9 5	1 8760	446.76	26.75	5 5	5 6	5	5 375	5 14.02
Ritorion	Indundosoonik Exik olgin			, 00	020.0	loigh				, 0	1 0/00		20.70	, 0,			5 0/0	/ 14.04
						Re-lamp w/4 25W T8												
Community Center -	2x4, 4L T12 recessed troffer					lamps w/high-efficiency,												
Kitchen	w/standard ballast	8	в 144	1152	2 69.12	electronic ballast	8	86	688	3 46	4 60	27.84	1.67	4:	2 5	0 :	2 752	2 451.17
	0.1 001111					Re-lamp w/2 13W												
,	2-lamp 60W Incandescent Surface Round		2 120	240	240.6	compact fluorescent screw-type lamps	2	26	52	2 18	8 1040) 195.52	2 11.71		5 1	5	1 4	2 3.5
Hall	Surrace Kound	2	2 120	240	J 249.6	screw-type lamps	2	26	52	2 18	0 1040	195.52	11./1	-	ວ <u>1</u>	5 ⁻	1 42	2 3.5
						Re-lamp w/2 13W												
Community Center -	2-lamp 60W Recessed					compact fluorescent												
Men's Restroom	Incandescent Square	4	4 120	480	499.2	screw-type lamps	4	26	104	1 37	6 1040	391.04	23.41		5 1	5	1 84	4 3.5





							L .			Energy	Avg.	<u>kWh</u>	Energy	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total Cos	<u>Simple</u>
Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Existing Wattage (W)	kWh Existing	Proposed Fixture	Proposed Qty.	Input Watts / Fixture (W)	Proposed Wattage (W)	Savings (W)	<u>Hours /</u> Year	<u>Savings /</u> Year (kWh)	<u>Savings /</u> Year (\$)		Cost (\$)	Cost (\$)	<u>(\$)</u>	(Yr.)
0						Re-lamp w/2 13W												
	2-lamp 60W Recessed Incandescent Square		4 120	480	0 499.2	compact fluorescent screw-type lamps	4	26	104	4 376	1040	391.04	23.41	Ę	5 1:	5 1	84	3.59
						···· 31 · · · 1 ·												
						Re-lamp w/26W												
Community Center - Janitor's Closet	1-lamp 100W Exposed Incandescent		1 100	100	0 1.2	compact fluorescent screw-type lamps	1	26	26	6 74	12	0.89	0.05	; f	5 1:	5 1	2	395.00
						ooron type tampe							0.00					
O	2x4, 4L T8 recessed troffer					De Nethine - Eistern Te												
Community Center - Dining Hall	w/electronic ballast	20	0 114	2280	0 2371.2	Do Nothing - Fixture To Remain	20	114	2280) 0	1040	0.00	0.00)				
0						Re-lamp w/59W												
Community Center - Mechanical Room	200W Exposed Incandescent		3 200	600	0 7.2	compact fluorescent screw-type lamps	3	59	177	423	12	5.08	0.30	10	2	5 1	108	355.38
	·																	
						Re-lamp w/59W												
Community Center - Office / Storage	200W Exposed Incandescent		1 200	200	0 52	compact fluorescent screw-type lamps	1	59	59	9 141	260	36.66	2.19	10	2	5 1	36	16.40
	·																	
Community Center -						Re-lamp w/2 28W T8												
	2L T12 strip w/standard ballast		1 73	3 73	3 18.98	lamps w/high-efficiency, electronic ballast	1	51	51	1 22	260	5.72	0.34	37	7 4	5 2	2 84	245.29
Community Center -	2L T8 surface wrap					Do Nothing - Fixture To												
Office / Storage	w/electronic ballast		2 59	9 118	8 30.68	Remain	2	2 59	118	3 0	260	0.00	0.00)				
0						Danlage with LED Fuit												
Community Center - Dining Hall	Incandescent Exit Sign		2 20	40	0 350.4	Replace with LED Exit	2	. 3	6	6 34	8760	297.84	17.83	55	5 6	5 5	5 250	14.02
	J					- 5												
Community Center -						Do Nothing - Fixture To												
Dining Hall	PAR38 Halogen Flood	16	6 75	5 1200	0 14.4	Remain	16	5 75	1200) O	12	.0.00	0.00)				
	Ŭ																	
Community Center -						Do Nothing - Fixture To												
Entry	PAR38 23W CFL		3 23	69	9 7.176	Remain	3	23	69	e o	104	0.00	0.00					





Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Existing Wattage (W)	<u>kWh Existing</u> (kWh)	Proposed Fixture	_	Input Watts / Fixture (W)		Savings		Savings /	<u>Energy</u> <u>Savings /</u> Year (\$)		<u>Unit</u> Labor Cost (\$)	<u>Unit</u> Disposal Cost (\$)	<u>Total Cost</u> (\$)	Simple Payback (Yr.)
Community Center -						Do Nothing - Fixture To												
Entry	PAR38 Halogen Flood	1	1 75	i 75	5 7.8	Remain	1	75	75	5 0	104	0.00	0.00)				
Community Center -	2x4, 4L T12 recessed troffer					Re-lamp w/4 25W T8 lamps w/high-efficiency,												
Office	w/standard ballast	1	1 144	144	149.76	electronic ballast	1	86	86	5 58	1040	60.32	3.61	42	2 50	2	2 94	26.03
Community Center -	2x4, 4L T12 recessed troffer					Re-lamp w/4 25W T8 lamps w/high-efficiency,												
Office	w/standard ballast	1	1 144	144	4 37.44	electronic ballast	1	86	86	5 58	260	15.08	0.90	42	2 50	2	94	104.12

	Lighting Retrofit:	Controls Totals:	Total:
Total Annual Demand Savings (kW):	4	-	4
Total Energy Consumption Savings (kWh/yr)	2,410	3,091	5,502
Total Energy Savings / Year (\$)	\$143	\$185	\$328
Total Cost of Material and Labor (\$)	\$2,457	\$1,716	\$4,173
St. Louis Price Adjustment (\$)	\$2,521	\$1,761	\$4,281
Total Tax, Overhead & Profit, and Contingency (\$)	\$882	\$616	\$1,499
Total Installed Cost (\$)	\$3,403	\$2,377	\$5,780
Total Simple Payback (Years)	23.86	12.84	17.64





			Proposed	Input Watts Saved /	Proposed	Proposed Control	Avg. Hours Saved /	Savings /	<u>Energy</u> Savings /			<u>Total</u> Cost (\$)	<u>Simple</u> Payback
Location	Existing Fixture	Proposed Fixture	<u>Qty.</u>	Fixture (W)	Wattage (W)	Qty.	Year	Year (kWh)	<u>Year (\$)</u>	Cost (\$)	Cost (\$)	<u> </u>	<u>(Yr.)</u>
	•		-		-	-	-	-		-	-		-
Community Center -	2x4, 4L T8 recessed												
Conference Room /	troffer w/electronic	Do Nothing - Fixture To											
Stage	ballast	Remain	4	86	344	. 1	1 1040	357.76	21.42	90	53	143	6.68
Community Center -	2x4. 4L T8 recessed												
Conference Room /	troffer w/electronic	Do Nothing - Fixture To											
Stage	ballast	Remain	16	86	1376	1	1 120	165.12	9.89	90	53	143	14.47
elage									0.00				
		Re-lamp w/4 25W T8 lamps											
Community Center -	2x4, 4L T12 recessed	w/high-efficiency, electronic											
Kitchen	troffer w/standard ballast	ballast	8	86	688	2	2 60	41.28	2.47	90	53	286	115.72
	2x4, 4L T8 recessed												
Community Center -	troffer w/electronic	Do Nothing - Fixture To											
Dining Hall	ballast	Remain	20	114	2280	4	4 1040	2371.20	141.96	90	53	572	4.03
O and the O and an		Re-lamp w/2 28W T8 lamps											
Community Center - Office / Storage	2L T12 strip w/standard ballast	w/high-efficiency, electronic ballast		51	51		260	13.26	0.79	90	53	143	180.13
Office / Storage	Dallast	Dallast	1	51	51		1 200	13.20	0.79	90		143	160.13
Community Center -	2L T8 surface wrap	Do Nothing - Fixture To											
Office / Storage	w/electronic ballast	Remain	2	59	118	1	1 260	30.68	1.84	90	53	143	77.85
		Re-lamp w/4 25W T8 lamps											
Community Center -	2x4. 4L T12 recessed	w/high-efficiency, electronic											
Office	troffer w/standard ballast		1	86	86	. 1	1040	89.44	5.35	90	53	143	26.71
01100				00			. 1040	05.44	0.00	. 50		143	20.71
		Re-lamp w/4 25W T8 lamps											
Community Center -	2x4, 4L T12 recessed	w/high-efficiency, electronic											
Office	troffer w/standard ballast		1	86	86	1	260	22.36	1.34	90	53	143	106.82





Appendix D

Lighting Improvements Calculations (Fire Station #2)– ECM-1.4





Detailed Energy Study University City Municipal Buildings

Fixture ECM Totals:

			In most Martin 1	Fuistin a	1.140 5-1-1-1		Deserves	In much Martin 1	Brances	Energy	<u>Avg.</u>	<u>kWh</u>	Energy	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total Cost (\$)	Simple Paybacl
_ocation	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Existing Wattage (W	<u>kWh Existing</u>	Proposed Fixture	Proposed Qty.	Input Watts / Fixture (W)		<u>Savings</u> (W)	<u>Hours /</u> Year	<u>Savings /</u> Year (kWh)	<u>Savings /</u> Year (\$)	Cost (\$)		Cost (\$)	Cost (\$)	(Yr.)
		▼		/ Indiage (II	- <u></u>		• •		-									•
						De Nethine - Fisture Te												
-ire Station #2 - 1st Floor- Movie Room	2x4, 2L T8 surface wrap w/electronic ballast		4 5	9 23	6 61 36	Do Nothing - Fixture To Remain	4	59	236		0 260	0.00	0.0					
					01.00		-		200		200	0.00	0.0					
						Re-lamp w/4 13W												
	4-lamp 60W Incandescent					compact fluorescent												
loor- Movie Room	Ceiling Fan		2 24	0 48	0 24.96	Screw-type lamps	2	52	104	4 37	6 52	19.55	5 0.9	3 20	25	5	1 9	2 9
Fire Station #2 - 1st						Do Nothing - Fixture To												
Floor- Corridor	LED Exit Sign		3	3 !	9 78.84	Remain	3		9	9	0 8760	0.00	0.0	0				
Fire Station #2 - 1st	1x4, 2L T8 surface wrap					Do Nothing - Fixture To												
Floor- Corridor	w/electronic ballast		3 5	9 17	7 552.24	Remain	3	59	177	7	0 3120	0.00	0.0	D				
Tito Station #2 4 at	2x4, 8L T8 surface wrap					Do Nothing - Fixture To												
Fire Station #2 - 1st Floor- Kitchen	w/electronic ballast		1 23	6 23	6 736.32	2 Remain	1	236	236	5	0 3120	0.00	0.0)				
Fire Station #2 - 1st Floor- Kitchen	2-lamp 13W Quad CFL Recessed Can		3 2	6 7	0 040.00	Do Nothing - Fixture To Remain		26	78		0 3120	0.00	0.0					
-IOOI- MICHEN	Recessed Call		3 2		0 243.30		3	20	10	· د	0 3120	0.00	J 0.0	J				
Fire Station #2 - 1st																		
Floor- Office	2x4, 4L T8 recessed troffer					Do Nothing - Fixture To												
Dispatch	w/electronic ballast		3 11	4 34:	2 1067.04	Remain	3	114	342	2	0 3120	0.00	0.0	0				
Fire Station #2 - 1st						Do Nothing - Fixture To												
Floor- Garage	2L T8 strip w/electronic ballas	t	4 5	9 23	6 61.36	Remain	4	59	236	6	0 260	0.00	0.0	0				
Fire Station #2 - 1st	2L T8 caged strip w/electronic					Do Nothing - Fixture To												
Floor- Apparatus Bay			15 5	9 88	5 7752.6	Remain	15	59	885	5	0 8760	0.00	0.0	0				
Tire Otation #0 4-4	OL TO append atting what attention					Do Nothing - Fisters To												
-ire Station #2 - 1st Floor- Apparatus Bay	2L T8 caged strip w/electronic		26 5	9 153	4 797.68	Do Nothing - Fixture To	26	59	1534		0 520	0.00	0.0					





							L .			Energy	Avg.	<u>kWh</u>	Energy	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total	Simple Payback
Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Existing Wattage (W)	<u>kWh Existing</u> (kWh)	Proposed Fixture	Proposed Qty.	Input Watts / Fixture (W)	Proposed Wattage (W)	Savings (W)	<u>Hours/</u> Year	<u>Savings /</u> Year (kWh)	<u>Savings /</u> Year (\$)		Cost (\$)	Cost (\$)	Cost (\$)	(Yr.)
Fire Station #2 - 1st																		
Floor- Electrical	1x4, 2L T8 surface strip w/electronic ballast		1 5	9 59		Do Nothing - Fixture To Remain		59	9 5		0 104	0.00	0.0					
Room	W/electronic ballast		1 5	9 55	6.130	Remain	1	55	1 5	9	0 104	F 0.00	0.0					
Fire Station #2 - 1st																		
Floor- Janitor's	1x4, 2L T8 surface strip					Do Nothing - Fixture To												
Closet	w/electronic ballast		1 5	9 59	6.136	Remain	1	59	5	9	0 104	0.00	0.0	0				
Fire Station #2 - 1st																		
Floor- Janitor's	1x4, 1L T8 surface strip					Do Nothing - Fixture To												
Closet	w/electronic ballast		1 3	0 30		Remain	1	30) 3	0	0 104	0.00	0.0	0				
Tito Station #2 . 1 at						De Nething - Fisture Te												
Fire Station #2 - 1st Floor- Apparatus Bay	v LED Evit Sign		3	3 0		Do Nothing - Fixture To Remain	3			0	0 8760	0.00	0.0	n				
ioor-Apparatus Da			J		70.04	Kentain		,			0,00	, 0.00	0.0					
Fire Station #2 - 1st																		
	y 1x4, 2L T8 surface wrap		-			Do Nothing - Fixture To				_				_				
Stairs	w/electronic ballast		3 5	9 177	1550.52	Remain	3	3 59	17	/ /	0 8760	0.00	0.0					
	1x4, 2L T8 surface strip					Do Nothing - Fixture To												
Floor- Storage	w/electronic ballast		2 5	9 118	3 12.272	Remain	2	2 59	11	8	0 104	0.00	0.0	0				
	1x4, 2L T8 wall strip					Do Nothing - Fixture To												
Floor- Restroom	w/electronic ballast		1 5	9 59	9 15.34	Remain	1	59	5	9 1	0 260	0.00	0.0	0				
Fire Station #2 - 1st						Do Nothing - Fixture To												
Floor- Outside	100W Wall Pack HID		1 12	9 129	9 565.02	Remain	1	129	12	9 1	0 4380	0.00	0.0	0				
	2-lamp 26W CFL Surface					Do Nothing - Fixture To												
Floor- Stairs	Round		2 5	2 104	911.04	Remain	2	2 52	2 10	4 1	0 8760	0.00	0.0	0				
ire Station #2 - 2nd						Do Nothing - Fixture To												
loor- Corridors	LED Exit Sign		5	3 15	5 131.4	Remain	5	i 3	1	5	0 8760	0.00	0.00	0				





										Energy	Avg.	<u>kWh</u>	Energy	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Dispessel	Total	Simple Paybac
	Endeding Firstone	Enderline Otor	Input Watts /		kWh Existing	Proposed Fixture		Input Watts		Savings	Hours /	Savings /	Savings /	Cost (\$)	Labor Cost (\$)	Disposal Cost (\$)	Cost (\$)	(Yr.)
ocation	Existing Fixture	Existing Qty.	Fixture (W)	Wattage (W)	(KVVN)	Proposed Fixture	<u>Qty.</u>	Fixture (W)	Wattage (W)	<u>(W)</u>	<u>Year</u>	Year (kWh)	<u>Year (\$)</u>	0031 (ψ)	003((#)	<u>003((#)</u>		<u>(11.)</u>
Fire Station #2 - 2n	d					Do Nothing - Fixture To												
Floor- Corridors	26W CFL Step Lights		5 2	6 130) 1138.8	Remain	5	5 2	6 13	0	0 8760	0.00	0.0	0				
Fire Station #2 - 2n Floor- Mechanical	d 2-lamp 26W CFL Surface					Do Nothing - Fixture To												
Room	Round		1 5	2 52		Remain	1	5	2 5	2	0 104	0.00	0.0	n				
toom										-		0.00	, 0.0					
-ire Station #2 - 2n Floor- Corridors	d 1x4, 2L T8 surface wrap w/electronic ballast		11 5	9 649		Do Nothing - Fixture To Remain	11	5	9 64		0 520	0.00	0.0	n				
	W/electronic ballast		<u>11 J</u>	5 042	557.40	Remain		J	5 04	5	0 520	/ 0.00	0.0					
	d 1x4, 2L T8 surface wrap					Do Nothing - Fixture To	3			_								
Floor- Restroom	w/electronic ballast		3 5	9 177	40.02	Remain		5	9 17	<u>/</u>	0 260	0.00) 0.0					
Fire Station #2 - 2n Floor- Restroom	d 1x4, 2L T8 vanity w/electronic ballast		3 5	9 177		Do Nothing - Fixture To Remain		3 5	9 17	-	0 260	0.00	0.0	n				
	Danast		<u> </u>	5 177	40.02	Remain		<u>,</u>	5 17	/ ·	0 200	0.00	0.0					
Fire Station #2 - 2n Floor- Restroom	d 26W CFL Surface Round Shower Light		3 2	6 78		Do Nothing - Fixture To Remain		3 2	6 7		0 260	0.00	0.0	n				
FIDDI- RESUDDITI			3 2		20.20	Remain		2			0 200	0.00	0.0					
Fire Station #2 - 2n Floor- Bedrooms	d 1x4, 2L T8 surface wrap w/electronic ballast		14 5	9 826		Do Nothing - Fixture To Remain	14	5	9 82		0 260	0.00	0.0	n				
1001- Deuloonis	W/electronic ballast		14 0	9 020	214.70	Remain	14	+ J	9 02		0 200	0.00	0.0					
-ire Station #2 - 2n Floor- Closet	d 1x4, 1L T8 surface strip w/electronic ballast		2 3	0 60		Do Nothing - Fixture To Remain	2	3	0 6	0	0 52	0.00	0.0	n				
			<u> </u>		, J. 12	INGINAIII	2	. 3			0 02	. 0.00	, 0.0					
Tire Station #2	d 1x4, 2L T8 surface wrap					Do Nothing - Fixture To												
Floor- Laundry	w/electronic ballast		2 5	9 118		Remain	2	2 5	9 11	8	0 780	0.00	0.0	D				
Fire Station #2 - 2n					52101							5.00	0.0					
loor- Mechanical																		
Room / Janitor's	1x4, 2L T8 surface wrap					Do Nothing - Fixture To												
Closet	w/electronic ballast		2 5	9 118	6.136	Remain	2	2 5	9 11	8	0 52	2 0.00	0.0	0				





Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Existing Wattage (W)	<u>kWh Existing</u> (kWh)	Proposed Fixture		Input Watts / Fixture (W)		Energy Savings (W)	<u>Avg.</u> Hours/ Year	<u>kWh</u> Savings / Year (kWh)	<u>Energy</u> Savings / Year (\$)	<u>Unit</u> Material Cost (\$)	 <u>Unit</u> Disposal Cost (\$)	<u>Total</u> Cost (\$)	Simple Payback (Yr.)
	2x4, 4L T8 recessed troffer w/electronic ballast		11 1	14 12	54 3912.	Do Nothing - Fixture 1 18 Remain	Го	11	114	1254	0	3120	0.00	0.00			
Fire Station #2 - 2nd Floor- Weight Room	1x4, 2L T8 surface wrap w/electronic ballast		3	59 1	77 9.2	Do Nothing - Fixture 1 04 Remain	Го	3	59	177	0	52	0.00	0.00			

	Lighting Retrofits:	Controls Totals:	Total
Total Annual Demand Savings (kW):	0	-	0
Total Energy Consumption Savings (kWh/yr)	20	5,428	5,448
Total Energy Savings / Year (\$)	\$1	\$347	\$348
Total Cost of Material and Labor (\$)	\$92	\$3,575	\$3,667
St. Louis Price Adjustment (\$)	\$94	\$3,668	\$3,762
Total Tax, Overhead & Profit, and Contingency (\$)	\$33	\$1,284	\$1,317
Total Installed Cost (\$)	\$127	\$4,952	\$5,079
Total Simple Payback (Years)	130.35	14.27	14.60





				Input Watts Saved /		Proposed	Avg. Hours		<u>Energy</u> Savings /	Unit Motorial	<u>Unit</u> Labor	Total	<u>Simple</u> Payback
Location	Existing Fixture	Proposed Fixture	Proposed Qty.		Proposed Wattage (W)	Control Qty.	<u>Saved /</u> Year	<u>Savings /</u> Year (kWh)		Cost (\$)		Cost (\$)	(Yr.)
		r	v		<u> </u>								
-	2x4, 2L T8 surface												
Fire Station #2 - 1st	wrap w/electronic	Do Nothing - Fixture To					1 52	40.07	0.78	3 90	53		400.07
Floor- Movie Room	ballast	Remain	4	59	236		1 52	12.27	0.78	s 90	53	3 143	182.27
	1x4. 2L T8 surface												
Fire Station #2 - 1st	wrap w/electronic	Do Nothing - Fixture To											
Floor- Corridor	ballast	Remain	3	59	177	1	1 624	110.45	7.06	90	53	143	20.25
	2x4, 8L T8 surface												
Fire Station #2 - 1st Floor- Kitchen	wrap w/electronic ballast	Do Nothing - Fixture To Remain	1	236	236		624	147.26	9.41	90	53	143	15.19
	Dallast	Kemain	I	230	230		1 024	147.20	9.41	90	0 33	0 143	15.19
Fire Station #2 - 1st	2-lamp 13W Quad	Do Nothing - Fixture To											
Floor- Kitchen	CFL Recessed Can	Remain	3	26	78	3 1	1 624	48.67	3.11	90	53	3 143	45.96
	2x4. 4L T8 recessed												
Fire Station #2 - 1st	troffer w/electronic	Do Nothing - Fixture To											
Floor- Office Dispatch		Remain	3	114	342		1 624	213.41	13.64	90	53	143	10.48
Fire Station #2 - 1st	2L T8 caged strip	Do Nothing - Fixture To											4 70
Floor- Apparatus Bay	w/electronic ballast	Remain	15	59	885	5 3	3 4380	3876.30	247.81	90	53	429	1.73
Fire Station #2 - 1st	2L T8 caged strip	Do Nothing - Fixture To											
Floor- Apparatus Bay	w/electronic ballast	Remain	26	59	1534	4	104	159.54	10.20	90	53	3 572	56.08
	1x4, 2L T8 surface												
Fire Station #2 - 2nd	wrap w/electronic	Do Nothing - Fixture To											
Floor- Restroom	ballast	Remain	3	59	177		1 52	9.20	0.59	90	53	143	243.03
								0.20					2.0.00
Fire Station #2 - 2nd		De Nething - Fisture T-											
Fire Station #2 - 2nd Floor- Restroom	1x4, 2L T8 vanity w/electronic ballast	Do Nothing - Fixture To Remain	3	59	177		1 52	9.20	0.59	90	53	143	243.03
	Wrelectronic Dallast						JZ	9.20	0.58	, 30	, 30	, 143	2-+3.03
		De Nething Fisture T											
Fire Station #2 - 2nd	26W CFL Surface Round Shower Light	Do Nothing - Fixture To			78			4.00	0.00	90	-	140	EE1 40
Floor- Restroom	Round Shower Light	Remain	3	26	/8	N 1	1 52	4.06	0.26	sj 90	53	3 143	551.48





Controls Totals (Continued):

			Proposed		Proposed	Proposed Control	Avg. Hours Saved /	Savings /	Energy Savings /	<u>Unit</u> Material Cost (\$)		<u>Total</u> Cost (\$)	<u>Simple</u> Payback (Yr.)
Location	Existing Fixture	Proposed Fixture	<u>Qty.</u>	Fixture (W)	Wattage (W)	<u>Qty.</u>	Year	Year (kWh)	<u>Year (\$)</u>	<u>COSL (#)</u>	<u>COSL (#)</u>		<u>uu</u>
	1x4, 2L T8 surface												
Fire Station #2 - 2nd	wrap w/electronic	Do Nothing - Fixture To											
Floor- Bedrooms	ballast	Remain	14	59	826	7	7 52	42.95	2.75	90	53	1001	364.54
								1					
	1x4, 1L T8 surface												
Fire Station #2 - 2nd	strip w/electronic	Do Nothing - Fixture To											
Floor- Closet	ballast	Remain	2	2 30	60	1	52	3.12	0.20	90	53	143	716.93
Fire Station #2 - 2nd	2x4, 4L T8 recessed												
Floor- Conference	troffer w/electronic	Do Nothing - Fixture To											
Briefing Room	ballast	Remain	11	114	1254	1	624	782.50	50.02	90	53	143	2.86
Briening Room	DalldSt	Remain		114	1204		024	102.00	50.02	. 90	53	143	2.00
	1x4, 2L T8 surface												
Fire Station #2 - 2nd	wrap w/electronic	Do Nothing - Fixture To											
Floor- Weight Room	ballast	Remain	3	59	177	1	52	9.20	0.59	90	53	143	243.03





Appendix E

Lighting Improvements Calculations (Golf Course)– ECM-1.5





Preliminary Energy Study University City Municipal Buildings

Fixture ECM Totals:

										Energy	Avg.	<u>kWh</u>	Energy	<u>Unit</u>	<u>Unit</u>	<u>Unit</u>	Total	Simple
l a catlan	Existing Electron		Input Watts /	Existing Wattage (W)	kWh Existing	Deserves of Firsterry		Input Watts /	Proposed Wattage (W)	Savings			Savings / Year (\$)	Material Cost (\$)	Labor Cost (\$)	Disposal Cost (\$)	Cost (\$)	Payback (Yr.)
ocation	Existing Fixture	Existing Qty.	Fixture (W)	wattage (w)		Proposed Fixture	Qty.											+ ·
																		4
						Re-lamp w/2 28W T8												
Golf Course - Pro	1x4, 2L T12 wall-mounted					lamps w/high-efficiency,												
Shop	strip w/standard ballast		4 7	3 292	1594.32	electronic ballast	4	51	204	88	5460	480.48	37.12	2 3	7 4	5 2	2 33	6 9.0
Golf Course - Pro						Do Nothing - Fixture To												
Shop	R40 Flood Track Light		8 4	0 320) 1747.2	Remain	8	3 4(320) (5460	0.00	0.00)				
	2x4, 4L T8 recessed troffer					Re-lamp w/4 25W T8									_			
Shop	w/electronic ballast		8 11	4 912	4979.52	lamps	8	8 86	688	3 224	5460	1,223.04	94.49	9 1	2 2	5 4	1 32	8 3.4
0-# 0 D	0.4.41 T0																	
Goir Course - Pro Shop	2x4, 4L T8 surface wrap w/electronic ballast		1 11	4 114	622.4/	Re-lamp w/4 25W T8 lamps	1	86	86	5 28	5460	152.88	11.8 [.]	1 1	2 2		4	1 3.4
бпор	Wrelectionic Danast		<u> </u>	4 114	022.4-	lamps		00		20	5 5400	152.00	5 11.0		2 2,	-	- 4	1 3.4
Golf Course - Pro	1x4, 4L T12 surface wrap					Re-lamp w/4 25W T8												
Shop - Office	w/standard ballast		1 11	4 114	355.68	lamps	1	86	86	6 28	3120	87.36	6.75	5 1	2 2	5 4	4	1 6.0
Golf Course - Pro						Re-lamp w/2 28W T8												
Shop - Men's	2x4, 4L T12 recessed					lamps w/high-efficiency,												
Restroom	troffer w/standard ballast		1 14	4 144	449.28	electronic ballast	1	51	51	93	3120	290.16	5 22.42	2 3	7 4	5 2	2 8	4 3.7
Golf Course - Pro						Re-lamp w/2 28W T8												
Shop - Women's	2x4, 4L T12 recessed					lamps w/high-efficiency,												
Restroom	troffer w/standard ballast		1 14	4 144	74.88	electronic ballast	1	51	51	93	3 520	48.36	3.74	4 3	7 4	5 2	2 8	4 22.4
						Re-lamp w/26W compac												
Golf Course - Pro	100W Exposed					fluorescent screw-type												
Shop - Stairs	Incandescent		4 10	0 400	104	lamps	4	1 26	5 104	1 296	6 260	76.96	5.95	5	5 1	5 1	8	4 14.1
Golf Course - Pro	2L T12 strip w/standard					Re-lamp w/2 28W T8 lamps w/high-efficiency,												
Shop - Basement			1 7	3 73	18.98	electronic ballast	1	51	51	22	2 260	5.72	0.44	4 3	7 4	5 2	2 8	4 190.0
Golf Course - Pro	2L T12 strip w/standard					Re-lamp w/2 28W T8 lamps w/high-efficiency,												
	ballast		1 7	3 73	18.98	electronic ballast	1	51	51	22	2 260	5.72	0.44	4 3	7 4	5 2	2 8	4 190.0





Location	Existing Fixture	Input Watts / Fixture (W)	Existing Wattage (W)	<u>kWh Existing</u> (kWh)	Proposed Fixture	 Input Watts / Fixture (W)	Proposed Wattage (W)	<u>Energy</u> <u>Savings</u> (<u>W)</u>		<u>kWh</u> Savings/ Year (kWh)	Savings /	<u>Unit</u> Material Cost (\$)	<u>Unit</u> Labor Cost (\$)	<u>Unit</u> Disposal Cost (\$)	<u>Total</u> Cost (\$)	Simple Paybac (Yr.)	
Golf Course - Pro Shop - Kitchen	100W Incandescent Globe	1 10	00 1	00 2	Re-lamp w/26W compa fluorescent screw-type 6 lamps	1	26	26	74	260	19.24	1.49	5	15	1	21	14.13
Golf Course - Ball Shack	1x4, 2L T8 surface wrap w/electronic ballast	1 4	59	59 61.3	Do Nothing - Fixture To 6 Remain	1	59	59	0	1040	0.00	0.00					

	Lighting Retrofit:	Controls Totals:	Total:
Total Annual Demand Savings (kW):	1	-	1
Total Energy Consumption Savings	2,390	1,448	3,838
Total Energy Savings / Year (\$)	\$185	\$112	\$297
Total Cost of Material and Labor (\$)	\$1,187	\$858	\$2,045
St. Louis Price Adjustment (\$)	\$1,218	\$880	\$2,098
Total Tax, Overhead & Profit, and	\$426	\$308	\$734
Total Installed Cost (\$)	\$1,644	\$1,188	\$2,833
Total Simple Payback (Years)	8.90	10.62	9.55





			Proposed	Input Watts Saved /	Proposed	Proposed Control	<u>Avg. Hours</u> Saved /	<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	Total	<u>Simple</u> Payback
Location	Existing Fixture	Proposed Fixture	Qty.	Fixture (W)		Qty.	Year	Year (kWh)		Cost (\$)		<u>Cost (\$)</u>	(Yr.)
										-	-	-	
Golf Course - Pro Shop	1x4, 2L T12 wall- mounted strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	4	51	204	1	1365	278.46	21.51	90	53	143	6.65
Golf Course - Pro Shop	2x4, 4L T8 recessed troffer w/electronic ballast	Re-lamp w/4 25W T8 lamps		86	688	1	1365	939.12	72.56	90	53	143	1.97
Golf Course - Pro Shop	2x4, 4L T8 surface wrap w/electronic ballast	Re-lamp w/4 25W T8 lamps	1	86	86	1	1365	117.39	9.07	90	53	143	15.77
Golf Course - Pro Shop - Office	1x4, 4L T12 surface wrap w/standard ballast	Re-lamp w/4 25W T8 lamps	1		86	1	780	67.08	5.18	90	53	143	27.59
Golf Course - Pro Shop - Men's Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51		1	780	39.78	3.07	90	53	143	46.53
Golf Course - Pro Shop - Women's Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51	51	1	130	6.63	0.51	90	53	143	279.17





Fixture ECM Totals:

			Input Watts /		kWh Existing		Proposed			Energy Savings	<u>Avg.</u> Hours/	kWh Savings	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	<u>Total</u> Cost (\$)	<u>Simple</u> Payback
Location		Existing Qty.	Fixture (W)	Wattage (W)	(kWh)	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)		Year	/ Year (kWh)	Year (\$)	Cost (\$)	Cost (\$)	Cost (\$)		<u>(Yr.)</u>
	•					•		• · · · · ·		•	-			ii	•		<u> </u>	• •
Golf Course - Grounds Maintenance Building -						Re-lamp w/26W compact fluorescent												
Storage	100W Exposed Incandescent		1 100	100	0.2	screw-type lamps		1 2	6 20	6 74	1 2	2 0.15	0.01	l :	5 15	5 1	2	1 1698.49
Golf Course - Grounds Maintenance Building - Garage	60W Exposed Incandescent		60	60	187.2	Re-lamp w/13W compact fluorescent screw-type lamps		1 1	3 1:	3 4	7 3120) 146.64	12.25	5	5 15	5 1	2	1 1.71
Golf Course - Grounds Maintenance Building - Garage	60W Exposed Incandescent		5 60) 300	0.6	Re-lamp w/13W compact fluorescent screw-type lamps		5 1	3 6	5 23	5 2	2 0.47	0.04	1 .	5 15	5 1	10	5 2674.22
Golf Course - Grounds Maintenance Building - Garage	13W Exposed CFL Screw Type		2 13	3 26	; 81.12	Do Nothing - Fixture To Remain		2 1	3 20	6 () 312(0.00	0.00)				
Golf Course - Grounds Maintenance Building - Garage	2L T12 strip w/standard ballast		5 73	3 365	2277.6	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	,	5 5	1 25	5 110	0 6240	0 686.40	57.34	4 3	7 4	5 2	2 42	0 7.32
Golf Course - Grounds Maintenance Building - Garage Office	2x4, 4L T8 surface wrap w/electronic ballast		2 114	228	5 711.36	Re-lamp w/4 25W T8 lamps		2 8	6 172	2 51	6 3120) 174.72	14.60) 1:	2 25	5 4	8	2 5.62
Golf Course - Grounds Maintenance Building - Exterior	PAR38 Flood on motion sensor		2 75	5 150	78	Do Nothing - Fixture To Remain		2 7	5 15) () 52(0.00	0.00)				

	Lighting Retrofit:	Controls Totals:	Total:
Total Annual Demand Savings (kW):	1	-	1
Total Energy Consumption Savings (kWh/yr)	1,008	268	1,277
Total Energy Savings / Year (\$)	\$84	\$22	\$107
Total Cost of Material and Labor (\$)	\$649	\$143	\$792
St. Louis Price Adjustment (\$)	\$666	\$147	\$813
Total Tax, Overhead & Profit, and Contingency (\$)	\$233	\$51	\$284
Total Installed Cost (\$)	\$899	\$198	\$1,097
Total Simple Payback (Years)	10.67	8.84	10.29

Allen&Hoshall engineering since 1915



Preliminary Energy Study University City Municipal Buildings

Location	Existing Fixture	Proposed Fixture	Proposed Qty.	Input Watts Saved / Fixture (W)	Proposed	Proposed Control Qtv.	<u>Avg. Hours</u> Saved / Year		<u>Energy</u> Savings / Year (\$)	<u>Unit</u> Material Cost (\$)		<u>Total</u> Cost (\$)	Simple Payback (Yr.)
-							•] 📃 📼] 🖛] –	
Golf Course - Grounds													
Maintenance Building -	2x4, 4L T8 surface wrap												
Garage Office	w/electronic ballast	Re-lamp w/4 25W T8 lamps	2	86	172	1	1560	268.32	22.42	90	53	143	6.38





Appendix F

Lighting Improvements Calculations (Public Works)- ECM-1.6





Fixture ECM Totals:

										Energy	Avg.		Energy		<u>Unit</u>	<u>Unit</u>	Total	Simple
			Input Watts /		kWh Existing		Proposed			Savings		kWh Savings /			Labor Cost (\$)	Disposal Cost (\$)	Cost (\$)	Payback (Yr.)
Location	Existing Fixture	Existing Qty.	Fixture (W)	Wattage (W		Proposed Fixture	<u>Qty.</u>	Fixture (W)	Wattage (W)	_			100.107					• •
						Replace with 4-lamp T8												
						High Bay w/electronic												
Central Garage -	1x8, 2L 75W T12 surface strip					ballast and integral												
Vehicle Workshop	w/standard ballast	4	1 15	8 6478	8 18527.08	occupancy sensor	2	5 114	2850	3628	2860	10,376.08	711.80	278	7	73 2	5 9,40	0 13.21
						Replace with 4-lamp T8												
						High Bay w/electronic												
Central Garage -	1x4, 2L T12 surface strip				07444	ballast and integral			700		0000	404.00	00.00	070	-		5 2,63	
Vehicle Workshop	w/standard ballast	1:	3 7	3 949	9 2714.14	occupancy sensor		7 114	798	3 151	2860	431.86	29.63	278		73 2	5 2,63	88.84
						Re-lamp w/2 28W T8												
Central Garage -	1x4, 2L T12 pendant industrial					lamps w/high-efficiency,												
Vehicle Workshop	task w/standard ballast		4 7	3 292	2 835.12	electronic ballast		4 51	204	88	2860	251.68	17.27	37	2	15	2 33	19.46
						Replace with 4-lamp T5HC)											
						High Bay w/electronic												
Central Garage - High-						ballast and integral												
Bay Garage	w/standard ballast	2	1 15	8 3318	8 9489.48	occupancy sensor		8 258	2064	1254	2860	3,586.44	246.03	313	7	73 2	5 3,28	13.36
Central Garage - High-	1x4. 2L T12 industrial strip																	
Bay Garage	w/standard ballast		3 7	3 219	9 626.34	Fixtures to be Demolished		3 () (219	2860	626.34	42.97	, o	2	25	5 9	2.09
Central Garage -						Replace with LED Exit												
Garage	Incandescent Exit Sign		1 2	0 20	0 175.2	Sign		1 3	3	3 17	8760	148.92	10.22	2 55	e	65	5 12	25 12.24
O antral O and an																		
Central Garage - Tool/Compressor	1x8, 2L 75W T12 industrial strip					Re-lamp w/2 59W T8 8' lamps w/high-efficiency,												
Room	w/standard ballast	· .	1 15	8 158	8 451.88	electronic ballast		1 112	112	46	2860	131.56	9.03	37	4	15	2 8	9.31
						Re-lamp w/2 28W T8												
Central Garage - Parts						lamps w/high-efficiency,												
Supply Room	w/standard ballast		5 7	3 365	5 1043.9	electronic ballast		5 51	255	5 110	2860	314.60	21.58	37	4	15	2 42	19.46
Central Garage - Parts	1x4, 1L T12 industrial strip					Re-lamp w/1 28W T8 lamp w/high-efficiency,												
Supply Room	w/standard ballast	.	2 4	2 84	4 240.24	electronic ballast		2 26	52	32	2860	91.52	6.28	35	4	12	2 15	8 25.17
coppy room				0	. 240.24				. 52	. 52	2000	01.02				-		
						Re-lamp w/4 25W T8												
Central Garage - Print	2x4, 4L T12 recessed troffer					lamps w/high-efficiency,												
Room	w/standard ballast		1 14	4 14	4 411.84	electronic ballast		1 86	86	5 58	2860	165.88	11.38	42	5	50	2 9	4 8.26





			Input Watts /	Existing	kWh Existing		Proposed	Input Watts /	Proposed	Energy Savings	<u>Avg.</u> Hours/	kWh Savings /	<u>Energy</u> Savings /		<u>Unit</u> Labor	<u>Unit</u> Disposal	Total Cost (\$)	Simple Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	Wattage (W)	<u>(kWh)</u>	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)	<u>(W)</u>	Year	<u>Year (kWh)</u>	<u>Year (\$)</u>	<u>Cost (\$)</u>	Cost (\$)	Cost (\$)	0031 (9)	<u>(Yr.)</u>
Central Garage -	2x4. 4L T12 surface wrap					Re-lamp w/4 25W T8 lamps w/high-efficiency,												
Offices	w/standard ballast	2	2 144	288	823.68	electronic ballast	2	2 86	172	2 116	2860	331.76	22.76	6 42	2 50) :	2 188	8.26
Central Garage - Offices	1x4, 2L T12 surface wrap w/standard ballast		3 73	219	626.34	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	3	3 51	153	3 66	3 2860	188.76	12.95	5 37	4	5 3	2 252	19.46
Central Garage - Break Room	1x4, 2L T12 industrial strip w/standard ballast	1	1 73	73	208.78	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51	51	22	2 2860	62.92	4.32	2 37	4	5	2 84	19.46
Central Garage - Men's Locker & Restroom	1x4, 2L T12 industrial strip w/standard ballast	14	4 73	1022	2922.92	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	14	4 51	714	4 308	3 2860	880.88	60.43	3 37	4	5 3	2 1,176	19.46
Central Garage - Men's Locker & Restroom	1x4, 2L T8 industrial strip w/standard ballast	1	1 69	69	197.34	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51	51	18	3 2860	51.48	3.53	3 37	4	5	2 84	23.79
Central Garage - Men's Locker & Restroom	1x4, 1L T12 vanity strip w/standard ballast	1	1 42	42		Re-lamp w/1 28W T8 lamp w/high-efficiency, electronic ballast	1	26	26	5 16	3 2860	45.76	3.14	4 35	5 42	2 2	2 79	25.17
Central Garage - Men's Locker & Restroom	1x4, 2L T8 strip w/electronic ballast	2	2 59	118	337.48	Do Nothing - Fixture To Remain	2	2 59	118	3 () 2860	0.00	0.00)				
Central Garage - Offices	1x4, 2L T12 industrial strip w/standard ballast	15	5 73	1095	3131.7	Re-lamp w/2 28W T8 lamps w/high-efficiency, / electronic ballast	15	5 51	765	5 330) 2860	943.80	64.74	4 37	. 4	5 :	2 1,260	19.46
Central Garage - Women's Restroom	1x4, 2L T12 industrial strip w/standard ballast		1 73	73	208.78	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51	51	22	2 2860	62.92	4.32	2 37	4	5 2	2 84	19.46
Central Garage - Fuel Station	175W Metal Halide Class 1, surface mount with standard ballast		4 213	852	3731 76	Do Nothing - Fixture To	4	4 213	852) 4380	0.00	0.00					





	Lighting Retrofit:	Controls Totals:	Total:
Total Annual Demand Savings (kW):	7	-	7
Total Energy Consumption Savings (kWh/yr)	18,693	5,290	23,983
Total Energy Savings / Year (\$)	\$1,282	\$317	\$1,599
Total Cost of Material and Labor (\$)	\$19,834	\$2,145	\$21,979
St. Louis Price Adjustment (\$)	\$20,350	\$2,201	\$22,550
Total Tax, Overhead & Profit, and Contingency (\$)	\$7,122	\$770	\$7,893
Total Installed Cost (\$)	\$27,472	\$2,971	\$30,443
Total Simple Payback (Years)	21.42	9.38	19.04





			Proposed	Input Watts Saved /	Proposed	Proposed Control	<u>Avg. Hours</u> Saved /	Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Total</u> Cost (\$)	<u>Simple</u> Payback
Location	Existing Fixture	Proposed Fixture	Qty.		Wattage (W)	Qty.	Year	Year (kWh)		Cost (\$)			<u>(Yr.)</u>
												–	
Central Garage - Vehicle Workshop	1x8, 2L 75W T12 surface strip w/standard ballast	Replace with 4-lamp T8 High Bay w/electronic ballast and integral occupancy sensor	25	114	2850) 25	572	1630.20	97.60	0	0	o	0.00
Central Garage -	1x4, 2L T12 surface strip	Replace with 4-lamp T8 High Bay w/electronic ballast and integral											
Vehicle Workshop	w/standard ballast	occupancy sensor	7	114	798	8 7	572	456.46	27.33	0	0	0	0.00
Central Garage - High- Bay Garage	1x8, 2L 75W T12 industrial strip w/standard ballast	Replace with 4-lamp T5HO High Bay w/electronic ballast and integral occupancy sensor	8	258	2064	8	572	1180.61	70.68	0	0	0	0.00
Central Garage - Tool/Compressor Room	1x8, 2L 75W T12 industrial strip w/standard ballast	Re-lamp w/2 59W T8 8' lamps w/high-efficiency, electronic ballast	1	112	112	2 1	1430	160.16	9.59	90	53	143	14.91
Central Garage - Parts Supply Room	1x4, 2L T12 industrial strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	5	51	255	5 1	1144	291.72	17.47	90	53	143	8.19
Central Garage - Parts Supply Room	1x4, 1L T12 industrial strip w/standard ballast	Re-lamp w/1 28W T8 lamp w/high-efficiency, electronic ballast	2	26	52	2 1	1144	59.49	3.56	90	53	143	40.15
Central Garage - Print Room	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1	86	86	5 1	572	49.19	2.95	90	53	143	48.55
Central Garage - Offices	2x4, 4L T12 surface wrap w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	2	86	172	2 1	572	98.38	5.89	90	53	143	24.28
Central Garage - Offices	1x4, 2L T12 surface wrap w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	3	51	153	1	572	87.52	5.24	90	53	143	27.29
Central Garage - Break Room	1x4, 2L T12 industrial strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51	51	1	572	29.17	1.75	90	53	143	81.88





Controls Totals (Continued):

Location	Existing Fixture	Proposed Fixture	Proposed		Proposed	Proposed Control	<u>Avg. Hours</u> <u>Saved /</u> Year	<u>kWh</u> <u>Savings /</u> Year (kWh)	<u>Energy</u> Savings /	<u>Unit</u> Material Cost (\$)	<u>Unit</u> Labor Cost (\$)	<u>Total</u> Cost (\$)	<u>Simple</u> Payback (Yr.)
Location	Existing Fixture	Proposed Fixture	<u>Qtv.</u>	Fixture (VV)	Wattage (W)	<u>Qty.</u>	rear	<u>rear (kvvn)</u>	<u>rear (\$)</u>	<u>0000 (ψ)</u>	<u>00031 (ψ)</u>		<u></u>
Central Garage - Men's Locker & Restroom	1x4, 2L T12 industrial strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	14	51	714	2	2 858	612.61	36.68	90	53	286	7.80
	1x4, 2L T8 industrial strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51	51	1	858	43.76	2.62	90	53	143	54.58
	1x4, 1L T12 vanity strip w/standard ballast	Re-lamp w/1 28W T8 lamp w/high-efficiency, electronic ballast	1	26	26	5 1	858	22.31	1.34	90	53	143	107.07
Central Garage - Men's Locker & Restroom	1x4, 2L T8 strip w/electronic ballast	Do Nothing - Fixture To Remain	2	59	118	s C) 858	101.24	6.06	90	53	0	0.00
Central Garage - Offices	1x4, 2L T12 industrial strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	15	51	765	; з	3 572	437.58	26.20	90	53	429	16.38
Central Garage - Women's Restroom	1x4, 2L T12 industrial strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51	51	1	572	29.17	1.75	90	53	143	81.88





Fixture ECM Totals:

Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	<u>Existing</u> Wattage (W)	kWh Existing	Proposed Fixture	Proposed Qty.	Input Watts / Fixture (W)	Proposed Wattage (W)	Energy Savings (W)	<u>Avg.</u> Hours/ Year	<u>kWh</u> Savings/ Year (kWh)	<u>Energy</u> Savings / Year (\$)	Unit Material Cost (\$)	<u>Unit</u> Labor Cost (\$)	Unit Disposal Cost (\$)	<u>Total</u> Cost (\$)	Simple Payback (Yr.)
Location									_		<u>rear</u>		<u></u>					• • •
Materials Recycling	1x4, 2L T8 surface strip					Do Nothing - Fixture To												
Facility - Storage	w/electronic ballast		6 59	354	736.32	Remain	6	5 5	9 35	4 (2080	0.00	0.00)				_
Materials Recycling	1x4. 2L T12 surface strip					Re-lamp w/2 28W T8 lamps w/high-efficiency,												
Facility - Storage	w/standard ballast	10	0 73	730	1518 /	electronic ballast	10	5	1 51	22	2080	457.60	31.39	9 37	7 45		2 84	0 26.76
r achity - Storage	W/Stariuaru Dailast		1.	/ //	/ 1510.4			5 5	1 30	5 22	2000	457.00	/ 31.33	5 31	4	, ,	2 04	20.70
						Re-lamp w/4 25W T8												
Materials Recycling	2x4, 4L T12 recessed					lamps w/high-efficiency,												
Facility - Break	troffer w/standard ballast		3 144	432	44.928	electronic ballast	3	3 8	6 25	3 17-	1 104	18.10	1.24	4 42	2 50		2 28	2 227.17
						Re-lamp w/4 25W T8												
Materials Recycling	2x4, 4L T12 recessed					lamps w/high-efficiency,												
Facility - Restroom	troffer w/standard ballast	· · ·	1 144	144	299.52	electronic ballast	1	1 8	6 8	6 5	3 2080	120.64	8.28	3 42	2 50) :	2 9	4 11.36
Materials Recycling						Re-lamp w/2 28W T8												
Facility - Janitor's Closet	1x4, 2L T8 industrial strip w/standard ballast		1 69	69	1/3 53	lamps w/high-efficiency, electronic ballast		1 5	1 5	1 14	3 2080	37.44	2.57	7 37	7 45		2 8	4 32.71
Closel	W/Stariuaru Dallast		1 08	03	140.02			i J	1 J		5 2000	57.44	- 2.5	1 31		, ,		4 32.71
Materials Recycling						Replace with LED Exit												
Facility - Storage	Incandescent Exit Sign		2 20	40	350.4	Sign	2	2	3 (5 3	4 8760	297.84	20.43	3 55	5 65	5 (5 25	0 12.24
Materials Recycling	100W Metal Halide Wall					Do Nothing - Fixture To			-									
Facility - Trash Sorting	Flood w/standard ballast		3 125	5 375	1642.5	Remain	2	3 12	5 37		4380	0.00	0.00)				
	150W High-Pressure																	
Materials Recycling	Sodium Wall Pack					Do Nothing - Fixture To												
Facility - Trash Sorting	w/standard ballast		2 188	376		Remain	2	2 18	B 37	6 (8760	0.00	0.00	0				
, if the second s													5.00					
						Re-lamp w/2 28W T8												
Materials Recycling	1x4, 2L T12 surface wrap					lamps w/high-efficiency,												
Facility - Break Shack	w/standard ballast		2 73	146	5 15.184	electronic ballast	2	2 5	1 10	2 4	4 104	4.58	8 0.31	1 37	7 45	5 2	2 16	8 535.18





Fixture ECM Totals:

	Lighting Retrofit:	Controls Totals:	Total:
Total Annual Demand Savings (kW):	1	-	1
Total Energy Consumption Savings (kWh/yr)	936	422	1,358
Total Energy Savings / Year (\$)	\$64	\$25	\$89
Total Cost of Material and Labor (\$)	\$1,718	\$1,001	\$2,719
St. Louis Price Adjustment (\$)	\$1,763	\$1,027	\$2,790
Total Tax, Overhead & Profit, and Contingency	\$617	\$359	\$976
Total Installed Cost (\$)	\$2,380	\$1,386	\$3,766
Total Simple Payback (Years)	37.05	54.91	42.09





Location	Existing Fixture	Proposed Fixture	Proposed Qty.	Input Watts Saved / Fixture (W)	Proposed Wattage (W)	Proposed Control Qty.	<u>Avg. Hours</u> Saved / Year	<u>kWh</u> Savings / Year (kWh)		<u>Unit</u> Material Cost (\$)		<u>Total</u> Cost (\$)	<u>Simple</u> Payback (Yr.)
					<u></u> ▼	<u>aty.</u>			<u>rear(</u> ↓			•	
Materials Recycling Facility - Storage	1x4, 2L T8 surface strip w/electronic ballast	Do Nothing - Fixture To Remain	6	59	354	2	. 416	147.26	8.82	90	53	286	32.44
Materials Recycling Facility - Storage	1x4, 2L T12 surface strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	10	51	510	2	. 416	212.16	12.70	90	53	286	22.52
Materials Recycling Facility - Break	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	3		258	1	21	5.37	0.32	90	53	143	445.09
Materials Recycling Facility - Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1		86	1	416	35.78	2.14	90	53	143	66.76
Materials Recycling Facility - Janitor's Closet	1x4, 2L T8 industrial strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51	51	1	416	21.22	1.27	90	53	143	112.58





Fixture ECM Totals:

			Input Watts /		kWh Existing		Proposed	Input Watts /		Energy Savings	_		ournigo/	<u>Unit</u> Material Cost (\$)		<u>Unit</u> Disposal Cost (\$)	<u>Total</u> Cost (\$)	Simple Payback (Yr.)
Location	Existing Fixture	Existing Qty.	Fixture (W)	Wattage (W)		Proposed Fixture	Qty.		Wattage (W		Year		<u>Year (\$)</u>					<u>(11.)</u>
						Re-lamp w/2 28W T8												
Park Storage and	1x4, 2L T12 pendant strip			4007	40450.44	lamps w/high-efficiency,			000		0700	0.004.00	054.40				4 500	0.05
Shops - Storage	w/standard ballast	1	9 73	3 1387	12150.12	2 electronic ballast	19	9 51	969	418	8 8760	3,661.68	251.19	37	45	2	2 1,596	6.35
Park Storage and Shops - Storage	1x4, 4L T12 pendant strip w/standard ballast		1 144	4 144	1261.44	Re-lamp w/4 25W T8 lamps w/high-efficiency, 4 electronic ballast	1	1 86	86	55	8 8760	508.08	34.85	i 42	2	2	294	2.70
Park Storage and Shops - Break Area	1x4, 2L T12 pendant strip w/standard ballast	2	27 7:	3 1971	17265.96	Re-lamp w/2 28W T8 lamps w/high-efficiency, 6 electronic ballast	27	7 51	1377	594	8760	5,203.44	356.96	37	45	2	22,268	6.35
Park Storage and Shops - Break Area	2x4, 4L T12 pendant strip w/standard ballast		1 14	4 144	1261.44	Re-lamp w/4 25W T8 lamps w/high-efficiency, 4 electronic ballast	1	1 86	86 86	5 58	8 8760	508.08	34.85	5 42	2 50	2	2 94	2.70
Park Storage and Shops - Storage	26W CFL Pendant Globe		5 26	6 130) 338	Do Nothing - Fixture To Remain		5 26	<u>i 130</u>) (2600	0.00	0.00)				
Park Storage and Shops - Back Garage	1x4, 2L T12 pendant strip w/standard ballast		6 7:	3 438	3 3836.88	Re-lamp w/2 28W T8 lamps w/high-efficiency, 8 electronic ballast	6	5 51	306	3 132	8760	1,156.32	79.32	2 37	45	2	2 504	6.35
Park Storage and Shops - Machine Shop	1x4, 2L T12 pendant strip w/standard ballast	2	20 7:	3 1460) 12789.6	Re-lamp w/2 28W T8 lamps w/high-efficiency, 6 electronic ballast	20	0 51	1020) 440	8760	3,854.40	264.41	37	45	2	21,680	6.35
Park Storage and Shops - Entry Hall	1x4, 2L T12 surface wrap w/standard ballast		3 7:	3 219	569.4	Re-lamp w/2 28W T8 lamps w/high-efficiency, 4 electronic ballast	3	3 51	153	3 66	6 2600	171.60	11.77	37	45	2	2 252	21.41
Park Storage and Shops - Locker	1x4, 2L T12 surface wrap w/standard ballast		3 7:	3 219	569.4	Re-lamp w/2 28W T8 lamps w/high-efficiency, 4 electronic ballast	3	3 51	153	3 66	6 2600	171.60	11.77	37	45	2	2 252	21.41
Park Storage and Shops - Locker	1x8, 2L 75W T12 surface wrap w/standard ballast		2 158	3 316	821.6	Re-lamp w/2 59W 8', T8 lamps w/high-efficiency, 6 electronic ballast	2	2 112	2 224	92	2 2600	239.20	16.41	40	52	2	2 188	11.46





			Input Watts /	Existing	kWh Existing		Proposed	Input Watts /	Proposed	<u>Energy</u> Savings		<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total	Simple Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	Wattage (W)		Proposed Fixture	Qty.		Wattage (W			Year (kWh)		Cost (\$)	Cost (\$)	Cost (\$)	<u>Cost (\$)</u>	<u>(Yr.)</u>
Park Storage and Shops - Restroom	100W Exposed Incandescent Pendant		2 100	200	520	Re-lamp w/26W compact fluorescent screw-type lamps	2	26	52	: 148	3 2600	384.80) 19.24		5 15	5 1	42	2 2.18
Park Storage and Shops - Restroom	2-lamp 60W Incandescent Vanity		1 120	120	312	Re-lamp w/2 13W compact fluorescent screw 2 type lamps	1	26	26	; 9 [,]	4 2600	244.40) 12.22	2 10	0 20	1	31	2.54
Park Storage and Shops - Office	2x4, 4L T8 recessed troffer w/electronic ballast		3 114	342	889.2	Provide new 2-lamp T8 recessed volumetric w/high-efficiency electronic ballast	3	59	177	16	5 2600	429.00) 29.43	125	5 55	10	570) 19.37
Park Storage and Shops - Office	2L T12 strip above lay-in lens w/standard ballast		3 73	219	569.4	Re-lamp w/2 28W T8 lamps w/high-efficiency, lelectronic ballast	3	51	153	6	6 2600	171.60) 11.77	37	7 45	2	252	2 21.41

	Lighting Retrofit:	Controls Totals:	Total:
Total Annual Demand Savings (kW):	2	-	2
Total Energy Consumption Savings (kWh/yr)	16,704	17,284	33,988
Total Energy Savings / Year (\$)	\$1,134	\$1,035	\$2,169
Total Cost of Material and Labor (\$)	\$7,823	\$1,573	\$9,396
St. Louis Price Adjustment (\$)	\$8,026	\$1,614	\$9,640
Total Tax, Overhead & Profit, and	\$2,809	\$565	\$3,374
Total Installed Cost (\$)	\$10,836	\$2,179	\$13,014
Total Simple Payback (Years)	9.55	2.11	6.00





Location	Existing Fixture	Proposed Fixture	Proposed Qty.		Proposed	Proposed Control Qty.	<u>Avg. Hours</u> <u>Saved /</u> Year	<u>kWh</u> Savings / Year (kWh)	<u>Energy</u> Savings / Year (\$)	<u>Unit</u> <u>Material</u> Cost (\$)	<u>Unit</u> Labor Cost (\$)	<u>Total</u> Cost (\$)	<u>Simple</u> Payback (Yr.)
v		<u>▼10p0seu l ixture</u>	<u>uery.</u>	-	vvallage (vv)	<u>uty.</u>			<u>rear (\$)</u>		<u>++++(+)</u>	-	<u></u>
Park Storage and Shops - Storage	1x4, 2L T12 pendant strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	19	51	969	2	4380	4244.22	254.10	90	53	286	1.13
Park Storage and Shops - Storage	1x4, 4L T12 pendant strip w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1	86	86	c	4380	376.68	22.55	90	53	0	0.00
Park Storage and Shops - Break Area	1x4, 2L T12 pendant strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	27	51	1377	2	4380	6031.26	361.09	90	53	286	0.79
Park Storage and Shops - Break Area	2x4, 4L T12 pendant strip w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1	86	86	c	4380	376.68	22.55	90	53	0	0.00
Park Storage and Shops - Back Garage	1x4, 2L T12 pendant strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	6	51	306	1	4380	1340.28	80.24	90	53	143	1.78
Park Storage and Shops - Machine Shop		Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	20	51	1020	2	4380	4467.60	267.48	90	53	286	1.07
Park Storage and Shops - Entry Hall		Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	3		153	1	520						
Park Storage and	1x4, 2L T12 surface wrap	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic											
Shops - Locker Park Storage and Shops - Locker	w/standard ballast 1x8, 2L 75W T12 surface wrap w/standard ballast	ballast Re-lamp w/2 59W 8', T8 lamps w/high-efficiency, electronic ballast	3				520						
Park Storage and Shops - Office	2x4, 4L T8 recessed troffer w/electronic ballast	Provide new 2-lamp T8 recessed volumetric w/high- efficiency electronic ballast	3										
Park Storage and Shops - Office	2L T12 strip above lay-in lens w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	3	51	153	1	520	79.56	4.76	90	53	143	30.02



Location	Existing Fixture	Existing Oty		Input Watts / Fixture (W)	<u>Existing</u> Wattage (W	<u>kWh</u> Existing	Proposed Fixture	Proposed Qty.	<u>Input Watts /</u> Fixture (W)	<u>Proposed</u> Wattage (W	Energy Savings (V	Avg. Hours/	<u>kWh</u> <u>Savings /</u> Year (kWh)		<u>Unit</u> Material Cost (\$)	<u>Unit Labor</u> Cost (\$)	Unit Disposal Cost (\$)	<u>Total Cost</u> (\$)	Simple Payback (Yr.)
Location		Existing aty.			Mallage (W	r (KVIII)	<u>I IALUIC</u>	<u>etty.</u>		Tallage (II	r Davings (*	v ical			<u></u>	1	-		<u> </u>
Lawn Equipment Storage - Garage	PAR 38 Halogen Flood		4		5 300) 18	Do Nothing - Fixture To Remain		4 7	5 30)	0 6	0 0.00	0.00					
Lawn Equipment Storage - Garage	26W Exposed CFL		1	26	6 20	6 1.56	Do Nothing - Fixture To Remain	1	1 2	6 2	6	0 6	0 0.00	0.00					
Lawn Equipment Storage - Garage	1x4, 1L T12 surface strip w/standard ballast		1	42	2 42		28W T8 lamp w/high- efficiency, electronic		1 2	6 2	5 ·	16 6	0 0.96	6 0.07	35	5 42	2 :	2 79	1199.59

	Lighting Retrofit:
Total Annual Demand Savings	0
Total Energy Consumption	1
Total Energy Savings / Year (\$)	\$0
Total Cost of Material and	\$79
St. Louis Price Adjustment (\$)	\$81
Total Tax, Overhead & Profit,	\$28
Total Installed Cost (\$)	\$109
Total Simple Payback (Years)	1661.55





			Input Watts /		kWh Existing			Input Watts /		Energy Savings		Savings /	Energy Savings /	Material	Labor	<u>Unit</u> Disposal Cost (\$)	<u>Total</u> Cost (\$)	Simple Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	Wattage (W)	(kWh)	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)	<u>(W)</u>	Year	Year (kWh)	<u>Year (\$)</u>	Cost (\$)	<u>COSt (\$)</u>	<u>COSt (\$)</u>		<u>(Yr.)</u>
Sign Shop - Storage	1x4, 2L T12 surface industrial strip	20	0 73	3 1460	3416.4	Replace with 4-lamp T8 High Bay w/electronic ballast and integral occupancy sensor		3 114	91	2 54	8 2340	1,282.32	87.97	278	73	25	3,008	34.19
Sign Shop - Office	1x8, 2L 75W T12 industrial strip w/standard ballast		1 158			Re-lamp w/2 59W 8', T8 lamps w/high-efficiency, electronic ballast		112							52	23	94	
Sign Shop - Restroom	1x4, 1L T12 industrial strip w/standard ballast		1 42	2 42	98.28	Re-lamp w/1 28W T8 lamp w/high-efficiency, electronic ballast		26	2	6 1	6 2340	37.44	2.57	35	42	2	79	30.76
Sign Shop - Storage	Incandescent Exit Sign		1 20) 20		Replace with LED Exit Sign		3		3 1	7 8760	148.92	10.22	2 55	65	5	125	12.24

	Lighting Retrofit:	Controls Totals:	Total:
Total Annual Demand Savings (kW):	1	-	1
Total Energy Consumption Savings (kWh/yr)	1,576	2,457	4,033
Total Energy Savings / Year (\$)	\$108	\$147	\$255
Total Cost of Material and Labor (\$)	\$3,306	\$286	\$3,592
St. Louis Price Adjustment (\$)	\$3,392	\$293	\$3,685
Total Tax, Overhead & Profit, and Contingency (\$)	\$1,187	\$103	\$1,290
Total Installed Cost (\$)	\$4,579	\$396	\$4,975
Total Simple Payback (Years)	42.35	2.69	19.49





Controls Totals:

				Input Watts Saved /	Proposed	Proposed Control	<u>Avg. Hours</u> Saved /	<u>kWh</u> Savings /	ouvingo/	<u>Unit</u> Material		<u>Total</u> Cost (\$)	<u>Simple</u> Payback
Location	Existing Fixture	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)	Qty.	Year	Year (kWh)	Year (\$)	Cost (\$)	Cost (\$)		<u>(Yr.)</u>
		·	-	•			-	-		•	-	-	-
		Replace with 4-lamp T8											
	1x4, 2L T12 surface	High Bay w/electronic											
	industrial strip	ballast and integral											
Sign Shop - Storage	w/standard ballast	occupancy sensor	8	114	912	8	2340	2134.08	127.77	0	0	0	0.00
Sign Shop - Office	1x8, 2L 75W T12 industrial strip w/standard ballast	Re-lamp w/2 59W 8', T8 lamps w/high-efficiency, electronic ballast	1	112	112	1	2340	262.08	15.69	90	53	143	9.11
	1x4. 1L T12 industrial	Re-lamp w/1 28W T8 lamp w/high-efficiency, electronic											
Sign Shop - Restroom	strip w/standard ballast	ballast	1	26	26	1	2340	60.84	3.64	90	53	143	39.26





Appendix G

Lighting Improvements Calculations (Recreation Center)– ECM-1.7





Detailed Energy Study University City Municipal Buildings

				Enterting					Proposed	Energy	<u>Avg.</u>	<u>kWh</u>	Energy	<u>Unit</u> Material		<u>Unit</u> Disposal		Simple Payback
Location	Existing Fixture	Existing Qtv.	Input Watts / Fixture (W)	Wattage (W)	kWh Existing	Proposed Fixture	Proposed Qtv.	Input Watts Fixture (W)		Savings (W)	<u>Hours/</u> Year	Savings / Year (kWh)	<u>Savings /</u> Year (\$)			Cost (\$)		(Yr.)
							<u>u uy.</u>		T T									
Recreation Center -	2x4, 4L, T8 recessed troffer					Do Nothing - Fixture To												
Weight Room	w/electronic ballast	2	2 114	4 2508	3 13432.848	Remain	22	2 11	4 2508	3 () 5356	5 0.00	0.0	0				
Recreation Center -						Do Nothing - Fixture To												
Weight Room	LED Exit Sign		2 3	<u>s</u> t	52.50	Remain		2	3 6	5 () 8760	0.00) 0.0					
Recreation Center -	23W CFL PAR38 Recessed Can			10	005 50	Do Nothing - Fixture To			184) 5356) 0.0					
Weight Room	23W CFL PAR38 Recessed Can		8 23	3 184	985.504	Remain		5 2	(3 184	+ () 5356	6 0.00) 0.0	J				
Recreation Center - Restroom Corridor	2x4, 4L T12 surface wrap w/standard ballast		2 144	1 288	4540.50	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast			6 172		5356	621.30) 31.0	6 42	2 50		188	0.05
Restroom Corridor	W/standard ballast		2 144	4 280	3 1542.520		4	2 8	io 172	2 110	5350	0 621.3	31.0	0 42	: 50		188	6.05
Recreation Center - Restroom Corridor	2x4, 4L T12 recessed troffer w/standard ballast		1 144	1 142	774.00	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast			6 86	5 58	3 5356	310.6	5 15.5	3 42	2 50		94	6.05
Restroom Corndor	W/standard Dallast		1 144	144	+ //1.204			i c	0 00	0 00	5 3330	5 310.03	0 10.0	3 42	: 50	2	94	6.05
Recreation Center - Restroom Corridor	1x4, 2L T12 recessed troffer w/standard ballast		1 73	3 73	300 08	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast		1 5	i1 51	2	2 5356	6 117.8	3 5.8	9 37	45		. 84	14.26
Restroom Comdo	W/Standard Balast				5 550.500				1 5			, 117.00	5.0.	5 51	~~~			14.20
Recreation Center - Men's Restroom	2x4, 4L T12 recessed troffer w/standard ballast		3 144	432	2313 792	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast		3 8	6 258	3 174	1 5356	§ 931.94	46.6	0 42	. 50	2	282	6.05
						Re-lamp w/4 25W T8												
Recreation Center - Women's Restroom	,		5 144	1 720	3856 3	lamps w/high-efficiency, electronic ballast		5 8	6 430	290	5356	1.553.24	4 77.6	6 42	50		470	6.05
Women's Resuborn	wysteindalu ballast		<u> </u>	r /20	1 3030.34	Replace with 4-lamp T5HO High Bay w/electronic		, d	430	, 290	,	1,303.24	, 11.0	- 42	. 50		470	0.05
Recreation Center - Rock Wall	250W, Metal Halide Low Bay w/standard ballast		4 295	5 1180	6320.08	ballast, cage and integral 3 occupancy sensor		4 25	i8 1032	2 148	3 5356	5 792.69	9 47.4	6 313	123	25	5 1,844	38.86
Recreation Center -	250W, Metal Halide Low Bay					Replace with 4-lamp T5HO High Bay w/electronic ballast, cage and integral												
Indoor Soccer	w/standard ballast	1	1 295	5 3245	17380.22	2 occupancy sensor	2	1 25	8 5418	3 -2173	5356	-11,638.59	-696.8	313	123	25	9,681	-13.89





Location	Existing Fixture	Existing Qty.	Input Watts / Fixture (W)	Existing Wattage (W)	<u>kWh Existing</u> (<u>kWh)</u>	Proposed Fixture	Proposed Qty.	Input Watts / Fixture (W)		<u>Energy</u> Savings (W)		<u>kWh</u> Savings / Year (kWh)	<u>Energy</u> Savings / Year (\$)	<u>Unit</u> Material Cost (\$)		<u>Unit</u> Disposal Cost (\$)	<u>Total</u> Cost (\$)	<u>Simple</u> Payback (Yr.)
Recreation Center - Indoor Soccer	250W, Metal Halide Low Bay	20	295	5 9440	4008.6	All fixtures shall be removed				9440) 520	4,908.80) 293.89					0 0.00
Indoor Soccer	W/Stariuaru Dallast	32	290	9440	4900.0	All lixiules shall be removed	l (, () (9440	520	4,900.00	293.05		0	U	(5 0.00
Recreation Center - Indoor Soccer	LED Exit Sign	4		3 12	2 105.12	Do Nothing - Fixture To Remain	4		3 12	2 (8760	0.00) 0.00)				
Recreation Center -	250W, Metal Halide Indirect Round					Replace with 4-lamp T5HO High Bay w/electronic ballast, cage and integral												
Basketball Court	w/standard ballast	20	295	5 5900	31600.4	occupancy sensor	15	5 258	3870	2030	5356	10,872.68	650.95	5 313	73	25	6,165	5 9.47

	Lighting Retrofit:	Controls Totals:	Total:
Total Annual Demand Savings (kW):	10	-	10
Total Energy Consumption Savings (kWh/yr)	8,471	11,757	20,228
Total Energy Savings / Year (\$)	\$472	\$752	\$1,224
Total Cost of Material and Labor (\$)	\$18,808	\$858	\$19,666
St. Louis Price Adjustment (\$)	\$19,297	\$880	\$20,177
Total Tax, Overhead & Profit, and Contingency (\$)	\$6,754	\$308	\$7,062
Total Installed Cost (\$)	\$26,051	\$1,188	\$27,239
Total Simple Payback (Years)	55.16	1.58	22.26





Controls Totals:

			Durant	Input Watts		Proposed	Avg. Hours		Energy	Unit Material	<u>Unit</u> Labor	Total	Simple Payback
Location	Existing Fixture	Proposed Fixture	Proposed		Proposed Wattage (W)	Control	<u>Saved /</u> Year	Savings / Year (kWh)	Savings /		Cost (\$)	Cost (\$)	(Yr.)
Location			Qty.			Qty.							
Recreation Center -	2x4, 4L, T8 recessed	Do Nothing - Fixture To											
Weight Room	troffer w/electronic ballast	Remain	22	114	2508	8 3	3 536	1343.28	85.88	90	53	429	5.0
Recreation Center - Restroom Corridor	2x4, 4L T12 surface wrap w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	2	86	172	2 1	536	92.12	5.89	90) 53	143	24.28
Recreation Center - Restroom Corridor	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	1	86	86	5 () 536	46.06	2.94	90) 53	s C	0.0
Recreation Center - Restroom Corridor	1x4, 2L T12 recessed troffer w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	1	51	51) 536	27.32	. 1.75	90) 53	c C	0.00
Recreation Center - Men's Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	3	86	258	3 1	536	138.18	8.83	90) 53	143	16.1
Recreation Center - Women's Restroom	2x4, 4L T12 recessed troffer w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	5	86	430) 1	536	230.31	14.72	. 90) 53	143	9.7
Recreation Center - Rock Wall	250W, Metal Halide Low Bay w/standard ballast	Replace with 4-lamp T5HO High Bay w/electronic ballast, cage and integral occupancy sensor	4	258	1032	2 2	4 536	552.74	35.34	u o) C) C	0.00
Recreation Center - Indoor Soccer	250W, Metal Halide Low Bay w/standard ballast	Replace with 4-lamp T5HO High Bay w/electronic ballast, cage and integral occupancy sensor	21	258	5418	21	1339	7254.70	463.79	0 0) C) C	0.0
Recreation Center - Basketball Court	250W, Metal Halide Indirect	Replace with 4-lamp T5HO High Bay w/electronic	15	258	3870) 15	5 536	2072.77	132.51	C) (0.00



			Input Watts /	Existing	kWh Existing		Proposed	Input Watts /	Proposed	Energy Savings	<u>Avg.</u> Hours /	<u>kWh</u> Savings/	Energy Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total	<u>Simple</u> Payback
Location	Existing Fixture	Existing Qty.		Wattage (W)		Proposed Fixture	Qty.	Fixture (W)	Wattage (W		Year	Year (kWh)	Year (\$)	Cost (\$)	Cost (\$)	Cost (\$)	Cost (\$)	(Yr.)
	-		-								-					1	• •	
Description Operators						De Nething - Fisture Te												
Recreation Center - Pool Entry	26W CFL Recessed Can	10	26	260	27.0/	Do Nothing - Fixture To Remain	10	26	6 260		0 104	0.00	0.00					
roorEnay			20	200	21.0-	T C T C T C T C T C T C T C T C T C T C		. 20	200		0 10	.00	/ 0.00	/				
Recreation Center -						Replace with LED Exit												
Pool House	Incandescent Exit Sign	:	3 20	60	525.6	Sign	3	3	3 9	9 5	1 8760	446.76	3 22.34	4 55	5 65	5	5 375	5 16.79
Description Operators						Re-lamp w/1 28W T8												
Recreation Center - Pool House	1L T12 strip w/standard ballast	59	9 42	2478	8504 494	lamp w/high-efficiency, electronic ballast	59	26	5 1534	1 94	4 3432	3,239.81	161.99	37	4	5	2 4,956	30.59
1 doi 1 louse				. 2410	0304.430	ciecti onic ballast		20	, 135-	- 54	4 3432	. 0,200.01	101.50	, 51		5	,330	00.00
						Re-lamp w/2 28W T8												
Recreation Center -						lamps w/high-efficiency,												
Pool House	2L T12 strip w/standard ballast	17	7 73	1241	4259.112	electronic ballast	17	51	867	7 37	4 3432	1,283.57	64.18	3 37	4	5	2 1,428	3 22.25
						Re-lamp w/2 28W T8												
Recreation Center - Pool House	2L T12 strip w/standard ballast	-	7 73	511	132.86	lamps w/high-efficiency, electronic ballast	7	51	357	7 15	4 260	40.04	2.00	37	4	5	2 588	3 293.71
r oorriouse		· · · · ·	1 13	5 511	152.00			J	1 331	15	4 200	40.04	F 2.00	5 51	4	5	2 300	233.11
						Re-lamp w/4 25W T8												
Recreation Center -	2x4, 4L T12 surface wrap w/standard					lamps w/high-efficiency,												
Pool House	ballast	4	4 144	576	1976.832	electronic ballast	4	86	6 34	1 23	2 3432	2 796.22	39.81	1 42	2 50	DC	2 376	6 9.44
Recreation Center - Electrical / Pump	2L T8 damp-location strip w/electronic					Do Nothing - Fixture To												
Room	ballast	1.	1 59	649	2227.368		11	59	649		0 3432	2 0.00	0.00					
				010	2227.000						0 0102	. 0.00	, 0.00					
						Re-lamp w/4 25W T8												
Recreation Center -	2x4, 4L T12 surface wrap w/standard					lamps w/high-efficiency,												
Office	ballast		1 144	144	449.28	electronic ballast	1	86	8 86	6 5	8 3120	180.96	9.05	5 42	2 50	0	2 94	4 10.39
Description Operators						Re-lamp w/26W compact												
Recreation Center - Storage	100W Exposed Incandescent Pendant		1 100	100	5.0	fluorescent screw-type lamps	1	26	5 26	6 7	4 52	3.85	0.19	9 5	5 15	5	1 21	1 109.15
ololage	Troom Exposed meandescent Fendant		100	100	3.2	lampa		2	20		- J2	. 3.00	0.18	, J		J	<u> </u>	103.13



	Lighting Retrofit:	Controls Totals:	Total:
Total Annual Demand Savings (kW):	2	-	2
Total Energy Consumption Savings (kWh/yr)	5,991	1,677	7,669
Total Energy Savings / Year (\$)	\$300	\$107	\$407
Total Cost of Material and Labor (\$)	\$7,838	\$1,430	\$9,268
St. Louis Price Adjustment (\$)	\$8,042	\$1,467	\$9,509
Total Tax, Overhead & Profit, and Contingency (\$)	\$2,815	\$514	\$3,328
Total Installed Cost (\$)	\$10,856	\$1,981	\$12,837
Total Simple Payback (Years)	36.24	18.47	31.56





Controls Totals:

			Proposed	Input Watts Saved /	Proposed	Proposed Control	<u>Avg. Hours</u> Saved /	<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Total</u>	<u>Simple</u> Payback
Location	Existing Fixture	Proposed Fixture	Qty.	Fixture (W)	Wattage (W)	Qty.	Year	Year (kWh)		Cost (\$)	Cost (\$)	<u>Cost (\$)</u>	(Yr.)
	-] [-		[-	-	-	-
Recreation Center - Pool House	1L T12 strip w/standard ballast	Re-lamp w/1 28W T8 lamp w/high-efficiency, electronic ballast	59	26	1534		343	526.47	33.66	90	53	572	16.99
Recreation Center - Pool House	2L T12 strip w/standard ballast	Re-lamp w/2 28W T8 lamps w/high-efficiency, electronic ballast	17	51		2	2343	297.55	i 19.02	90	53	286	15.03
Recreation Center - Pool House	2x4, 4L T12 surface wrap w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast	4	86	344	1	343	118.06	7.55	90	53	143	18.95
Recreation Center - Electrical / Pump Room	2L T8 damp-location strip w/electronic ballast	Do Nothing - Fixture To Remain	11	59	649	2	2 1030	668.21	42.72	90	53	286	6.69
Recreation Center - Office	2x4, 4L T12 surface wrap w/standard ballast	Re-lamp w/4 25W T8 lamps w/high-efficiency, electronic ballast		86	86	1	780	67.08	4.29	90	53	143	33.35





Appendix H

Lighting Improvements Calculations (Trinity Building)– ECM-1.8





Detailed Energy Study University City Municipal Buildings

				Existing	<u>kWh</u>		L .		Proposed		<u>Avg.</u>	<u>kWh</u>	Energy	<u>Unit</u>	<u>Unit</u>	<u>Unit</u>	Total	Simple
			Input Watts /		Existing			Input Watts /		Savings		Savings /	Savings /	Material Cost (\$)	Labor Cost (\$)	Disposal Cost (\$)	Cost (\$)	Payback (Yr.)
Location	Existing Fixture	Existing Qty.	Fixture (W)	<u>(W)</u>	<u>(kWh)</u>	Proposed Fixture	Qty.	Fixture (W)	<u>(W)</u>	<u>(W)</u>	Year	Year (kWh)	Year (\$)					
						Re-lamp w/4 25W T8												
Trinity Building - 1st	2x4, 4L T12 surface wrap w/standard					lamps w/high-efficiency,												
Floor - Storage	ballast	1	1 144	1584	31.68	electronic ballast	11	86	6 94	6 63	8 20	12.76	6 0.76	6 42	50	2	1,034	1353.
Trinity Building - 1st						Replace with LED Exit			_							_	075	
Floor - Storage	Incandescent Exit Sign		3 20	0 60) 525.6	Sign	3	3	3	9 5	1 8760	446.76	6 26.75	5 55	65	5	375	5 14.0
						Re-lamp w/4 25W T8												
Trinity Building - 1st	2x4, 4L T12 recessed troffer					lamps w/high-efficiency,												
Floor - Offices	w/standard ballast		2 144	288	2.88	electronic ballast	2	86	6 17	2 11	6 10	1.16	6 0.07	7 42	50	2	188	3 2707.0
						Re-lamp w/2 28W T8												
Trinity Building - 1st						lamps w/high-efficiency,												
Floor - Kitchen	2L T12 strip w/standard ballast		1 73	3 73	3 0.73	electronic ballast	1	5	1 5	1 2	2 10	0.22	2 0.01	1 37	45	2	84	4 6377.4
Trinity Building - 1st						Re-lamp w/26W												
Floor - Stage /						compact fluorescent												
Mechanical	90W Exposed Incandescent	1	5 90	1350	6.7	screw-type lamps	15	20	6 39	0 96	0 5	5 4.80	0.29	9 5	15	1	315	5 1096.1
Trinity Building - 1st						Do Nothing - Fixture To												
Floor - Stairs	26W TTT CFL Pendant		2 26	6 52	2 108.16	Remain	2	2 20	6 5	2	0 2080	0.00	0.00)				
						Re-lamp w/26W												
Trinity Building - 1st						compact fluorescent												
	90W Exposed Incandescent		1 90	90	0.4	screw-type lamps	1	20	6 2	6 6	4 5	5 0.32	2 0.02	2 5	15	1	21	1096.1
Trinity Building - 1st						Re-lamp w/26W												
Floor - Women's						compact fluorescent												
Restroom	90W Exposed Incandescent		1 90	90 90	0.4	screw-type lamps	1	20	6 2	6 6	4 5	5 0.32	2 0.02	2 5	5 15	1	21	1096.1
Trinity Building - 1st						Re-lamp w/1 28W T8												
Floor - Women's	1x4, 1L T12 wall strip w/standard					lamp w/high-efficiency,												
Restroom	ballast		1 42	2 42	87.36	electronic ballast	1	20	6 2	6 1	6 2080	33.28	3 1.99	9 37	45	2	84	42.1
						Re-lamp w/26W												
Trinity Building - 1st						compact fluorescent												
Floor - Storage	100W Exposed Incandescent	· · · · · ·	4 100	400	<u>ا</u> 0.4	screw-type lamps	4	26	6 10	4 29	b 1	0.30	0.02	2 5	5 15	<u> </u> 1	84	4740.





Detailed Energy Study University City Municipal Buildings

Fixture ECM Totals (Continued):

			Input Watts /	Existing Wattage	<u>kWh</u> Existing		Proposed	Input Watts /	Proposed Wattage	Energy Savings	<u>Avg.</u> Hours/	<u>kWh</u> Savings /	<u>Energy</u> Savings /	<u>Unit</u> Material	<u>Unit</u> Labor	<u>Unit</u> Disposal	Total	Simple Payback
Location	Existing Fixture	Existing Qty.	Fixture (W)	(W)	<u>(kWh)</u>	Proposed Fixture	Qty.		<u>(W)</u>	(W)	Year		Year (\$)	Cost (\$)	Cost (\$)	Cost (\$)	Cost (\$)	<u>(Yr.)</u>
Trinity Building - 1st	2-lamp 40W Recessed Incandescen	t				Re-lamp w/2 9W compact fluorescent												
Floor - Hall	Square		1 80	80	0.0	8 screw-type lamps	1	18	8 1	3 62	2 1	0.06	0.00	5	5 15		1 21	1 5657.42
Trinity Building - 1st Floor - Storage	60W Exposed Incandescent	11	8 60	1080	1.0	Re-lamp w/13W compact fluorescent 8 screw-type lamps	18	13	3 23	4 84(6 1	0.85	0.05	5	15		1 378	8 7462.98
Trinity Building - 2nd Floor - Stairs	2L T12 wall strip w/standard ballast		1 73	5 73	75.9	Re-lamp w/2 28W T8 lamps w/high-efficiency, 2 electronic ballast	1	51	5	1 2:	2 1040	22.88	1.37	37	45		2 84	4 61.32
Trinity Building - 2nd Floor - Storage	60W Exposed Incandescent	11	в 60	1080	1.0	Re-lamp w/13W compact fluorescent 8 screw-type lamps	18	13	23	4 84	6 1	0.85	0.05	5	15		1 378	8 7462.98
Trinity Building - 2nd Floor - Stairs	2L T12 surface wrap w/standard ballast		2 73	3 146	151.8	Re-lamp w/2 28W T8 lamps w/high-efficiency, 4 electronic ballast	2	51	10	2 44	1040	45.76	2.74	37	45	. 1	2 168	8 61.32
Trinity Building - 2nd Floor - Stairs	4L T12 surface wrap w/standard ballast		1 144	144	149.7	Re-lamp w/4 25W T8 lamps w/high-efficiency, 6 electronic ballast	1	86	8	6 51	3 1040	60.32	3.61	42	50		2 94	4 26.03
Trinity Building - 2nd Floor - Storage	Incandescent Exit Sign		1 20	20	175.:	Replace with LED Exit 2 Sign	1	3	8	3 1	7 8760	148.92	8.92	55	65		5 125	5 14.02
Trinity Building - 2nd Floor - Storage	34W Exposed Incandescent	3:	9 34	1326	1.32	Re-lamp w/ 9W compact fluorescent 6 screw-type lamps	39	e e	35	1 97:	5 1	0.98	0.06	5	5 15		1 819	9 14030.40
Trinity Building - 2nd Floor - Storage	2L T12 strip w/standard ballast		5 73	365	379.1	Re-lamp w/2 28W T8 lamps w/high-efficiency, 6 electronic ballast	5	51	25	5 11() 1040	114.40	6.85	37	45		2 420	0 61.32
Trinity Building - 2nd Floor - Old Library	4L T12 surface wrap w/standard ballast		9 144	1296	5 77.7	Re-lamp w/4 25W T8 lamps w/high-efficiency, 6 electronic ballast	9	86	5 77	4 52:	2 60	31.32	1.88	42	50		2 846	6 451.17





Fixture ECM Totals (Continued):

Location	Existing Fixture	Existing Qty.		Existing Wattage (W)	<u>kWh</u> Existing (kWh)	Proposed Fixture	Proposed Qty.	Input Watts / Fixture (W)		<u>Energy</u> <u>Savings</u> (W)	<u>Avg.</u> Hours/ Year	<u>kWh</u> Savings / Year (kWh)	<u>Energy</u> Savings / Year (\$)	<u>Unit</u> Material Cost (\$)	<u>Unit</u> Labor Cost (\$)	<u>Unit</u> Disposal Cost (\$)	<u>Total</u> Cost (\$)	<u>Simple</u> Payback (Yr.)
Trinity Building - 2nd						Replace with LED Exit												
Floor - Old Library	Incandescent Exit Sign		2 20	40	350.4	1 Sign	2	2 3	8 6	34	8760	297.84	17.83	5	5 65	5 5	5 25	14.02
Trinity Building - 2nd	5-lamp Decorative Candelabra (25W					Do Nothing - Fixture To												
Floor - Stairs	Incandescent Candelabra Lamps)	:	2 25	5 100) 442	2 Remain	2	2 25	5 100) () 12	2 0.00	0.00)				
Trinity Building - 2nd	2-lamp 40W Decorative					Re-lamp w/2 13W compact fluorescent												
Floor - Entry	Incandescent Surface Mount		1 120) 120	1.44	screw-type lamps	1	26	26	6 94	12	2 1.13	0.07	1 10	0 25	5 1	3	533.07
Trinity Building - 3rd						Re-lamp w/ 9W compact fluorescent												
Floor - Storage	34W Exposed Incandescent	1	9 34	646	0.646	screw-type lamps	19	9 9	17	475	5 1	0.48	0.03		5 15	5 1	39	9 14030.40

	Lighting Retrofit:
Total Annual Demand Savings (kW):	6
Total Energy Consumption Savings (kWh/yr)	1,226
Total Energy Savings / Year (\$)	\$73
Total Cost of Material and Labor (\$)	\$6,224
St. Louis Price Adjustment (\$)	\$6,386
Total Tax, Overhead & Profit, and Contingency (\$)	\$2,235
Total Installed Cost (\$)	\$8,621
Total Simple Payback (Years)	117.48





Appendix I

Energy Management / Control Improvements- ECM-2





ECM-2.2: Install Progrmable Tstats & Locking Covers - Central Garage:

Cooling - Electrical Consumption

Existing Cooling	Eectrical Co	nsump	tion	12												
Front Office			.5	tons	х		868 Fl				kW/to				kWh/yr	
Shop Office		3	.0	tons	х	: 18	868 Fl	LH	х	1.40	kW/to	n =	7,8	47	kWh/yr	
Total Existing Cool	ing Electrical Co	onsumpt	tion:									=	15,7	88	kWh/yr	
Recommended	Cooling Elect	rical Co	onsi	umpt	ior	ı:										
Front Office			2.5	tons	х	: 15	602 Fl	LH	х	0.08	kW/to	n =	3	00	kWh/yr	
Shop Office			3.0	tons	х	15	602 FI	LH	x	80.0	kW/to	n =	3	61	kWh/yr	
Total Recommende	ed Cooling Elect	trical Co	nsur	mptio	n:							=	6	61	kWh/yr	
Total Cooling Elect	rical Consumpti	ion Savi	ngs:									=	15,1	27	kWh/yr	
Cooling - Electric Existing Cooling		mand:														
Front Office		2.										kW/ton			kW/mo	
Shop Office		3.	0 t	ons	х	70%	Dem.	. Div	ersit	ух	1.40	kW/ton	=	2.9	kW/mo	
Total Existing Cooli	ing Electrical De	emand:											=	5.9	kW/mo	
Recommended Front Office	Cooling Electr			nd: ons	v	70%	Dem	Div	orsit	. .	0.08	kW/ton	_	0 1	kW/mo	
Shop Office												kW/ton			kW/mo	
Total Recommende	d Cooling Floot					10%	Dem	. Div	ersi	y X	0.08	KVV/IOII			kW/mo	
			man	u.												
Total Monthly Cooli Assumes 7 mon	ths per year us		Savin	igs:									=	5.6	kW/mo	
-	nths per year us	sage:	avin	igs:									=	5.6	kvv/mo	
Assumes 7 mon	nths per year us I <u>mption</u> I Consumptio 25,000	sage: <u>n:</u> Btu/hr		_	F	x 14	16,380	0 hr-	۰F	x	0.292	2 kW/kE			kvv/mo 14,841	kWh/y
Assumes 7 mon ting - Electrical Consu ting Heating Electrical t Office o Office	I Consumption 25,000 30,000	sage: n: Btu/hr Btu/hr	÷	72 °			16,380 16,380					2 kW/kE 2 kW/kE	3tu =	=		
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Office Existing Heating Electric	Inthis per year us Internation I Consumption 25,000 30,000 cal Consumption	n: Btu/hr Btu/hr Btu/hr	÷	72 °									Stu = Stu =	=	14,841	kWh/y
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Office Existing Heating Electric ommended Heating E	Imption Consumption 25,000 30,000 cal Consumption Lectrical Cons	sage: n: Btu/hr Btu/hr n: sumptic	÷ ÷	72 ° 72 °	F	x 14	16,380) hr-	°F	x	0.292	2 kW/kE	3tu = 3tu =	=	14,841 17,810 32,651	kWh/
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Office Existing Heating Electric ommended Heating Electric t Office	Inthis per year us Inthis per year us I Consumption 25,000 30,000 cal Consumption Intectrical Cons 25,000	sage: n: Btu/hr Btu/hr n: sumptic Btu/hr	÷ ÷ 5n:	72 ° 72 °	F	x 14	7,923	0 hr- 3 hr-	°F	x ÷	0.292	2 kW/kE	3tu = 3tu = 3tu =	=	14,841 17,810 32,651 6,961	kWh/ kWh/
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Office Existing Heating Electric tommended Heating Electric office Office	Inthis per year us Internet in the second s	n: Btu/hr Btu/hr n: sumptic Btu/hr Btu/hr Btu/hr	÷ · · · · · · · · · · · · · · · · · · ·	72 ° 72 °	F	x 14	7,923	0 hr- 3 hr-	°F	x ÷	0.292	2 kW/kE	Btu = Btu = Btu = Btu =	=	14,841 17,810 32,651 6,961 8,353	kWh/ kWh/ kWh/ kWh/
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Office Existing Heating Electric ommended Heating Electric t Office	Inthis per year us Inthis per year us I Consumption 25,000 30,000 Cal Consumption Internal Consumption 25,000 30,000 Electrical Cons	n: Btu/hr Btu/hr n: Btu/hr Btu/hr Btu/hr umption	÷ · · · · · · · · · · · · · · · · · · ·	72 ° 72 °	F	x 14	7,923	0 hr- 3 hr-	°F	x ÷	0.292	2 kW/kE	3tu = 3tu = 3tu = 3tu =	=	14,841 17,810 32,651 6,961	kWh/y kWh/y kWh/y kWh/y
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Office Existing Heating Electric ommended Heating Electric office Office Office Office	Inthis per year us Inthis per year us I Consumption 25,000 30,000 Cal Consumption Cal Consumption 25,000 30,000 Electrical Consumption Saving:	n: Btu/hr Btu/hr n: Btu/hr Btu/hr Btu/hr umption	÷ · · · · · · · · · · · · · · · · · · ·	72 ° 72 °	F	x 14	7,923	0 hr- 3 hr-	°F	x ÷	0.292	2 kW/kE	3tu = 3tu = 3tu = 3tu =	=	14,841 17,810 32,651 6,961 8,353 15,314	kWh/y kWh/y kWh/y kWh/y
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Existing Heating Electric ommended Heating Electrical Coffice Office Office Office Recommended Heating Heating Electrical Consul-	Inthis per year us Inthis per year us I Consumption 25,000 30,000 cal Consumption Electrical Cons 30,000 Electrical Cons umption Saving rical Demand	sage: n: Btu/hr Btu/hr btu/hr Btu/hr Btu/hr umption s:	÷ ÷ ÷	72 ° 72 °	F	x 14	7,923	0 hr- 3 hr-	°F	x ÷	0.292	2 kW/kE	3tu = 3tu = 3tu = 3tu =	=	14,841 17,810 32,651 6,961 8,353 15,314	kWh/y kWh/y kWh/y kWh/y
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Existing Heating Electric ommended Heating Electric office Office Recommended Heating Heating Electrical Consu- Heating - Electric	Inthis per year us Inthis per year us I Consumption 25,000 30,000 cal Consumption Electrical Cons 30,000 Electrical Cons umption Saving rical Demand	sage: n: Btu/hr Btu/hr btu/hr Btu/hr Btu/hr umption s:	÷ ÷ ÷	72 ° 72 ° 72 °	F	x 14 x 11 x 11	16,380 7,923 7,923	0 hr- 3 hr- 3 hr-	°F	×	0.292	2 kW/kE) kW/kE) kW/kE	3tu = 3tu = : : : : : : : :	=	14,841 17,810 32,651 6,961 8,353 15,314	kWh/y kWh/y kWh/y kWh/y
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Defice Existing Heating Electrical t Office Office Office Recommended Heating Heating Electrical Consu- Heating - Electrical Existing Heating	Inthis per year us Inthis per year us I Consumption 25,000 30,000 cal Consumption Electrical Cons 30,000 Electrical Cons umption Saving rical Demand	n: Btu/hr Btu/hr n: Btu/hr Btu/hr umption s: emand:	÷ ÷ ÷ : :	72 ° 72 ° 72 ° 72 °	F F X	x 14 x 11 x 11 80%	7,923 7,923 7,923	0 hr- 3 hr- 3 hr-	°F °F °F	x ÷	0.292 0.170 0.170	2 kW/kB) kW/kB) kW/kB	Btu = 3tu = 9tu = 9tu = 75.8	= = = = = 3 kV	14,841 17,810 32,651 6,961 8,353 15,314 17,337	kWh/y kWh/y kWh/y kWh/y
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Defice Existing Heating Electric ommended Heating Electric Office Recommended Heating Heating Electrical Consu- Heating - Electric Existing Heating Front Office	Inthis per year us Internet and the second	n: Btu/hr Btu/hr n: Btu/hr Btu/hr Btu/hr umption s: 25,000 30,000	÷ ÷ ÷ : : : : : : : :	72 ° 72 ° 72 ° 72 °	F F X	x 14 x 11 x 11 80%	7,923 7,923 7,923	0 hr- 3 hr- 3 hr-	°F °F °F	x ÷	0.292 0.170 0.170	2 kW/kB) kW/kB) kW/kB	3tu = 3tu = 3tu = 3tu = 5.8 7.0	= = = = = = = = = = = = = = = = = = =	14,841 17,810 32,651 6,961 8,353 15,314 17,337 V/mo	kWh/ kWh/ kWh/ kWh/
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Diffice Existing Heating Electric ommended Heating Electric Office Recommended Heating Heating Electrical Consu- Heating Electrical Consu- Existing Heatin Front Office Shop Office	Interpretation and a series of the series of	n: Btu/hr Btu/hr n: Btu/hr Btu/hr umption s: 25,000 30,000 Demand	÷ ÷ ÷ : : : : : : : : : : : : : : : : :	72 ° 72 ° 72 ° 72 °	F F X	x 14 x 11 x 11 80%	7,923 7,923 7,923	0 hr- 3 hr- 3 hr-	°F °F °F	× ÷	0.292 0.170 0.170	2 kW/kB) kW/kB) kW/kB kW/kB kBtu =	3tu = 3tu = 3tu = 3tu = 5.8 7.0	= = = = = = = = = = = = = = = = = = =	14,841 17,810 32,651 6,961 8,353 15,314 17,337 V/mo V/mo	kWh/y kWh/y kWh/y kWh/y
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Existing Heating Electric ommended Heating Electric Coffice Recommended Heating Heating Electrical Consu- Heating Electrical Consu- Existing Heating Front Office Shop Office Total Existing Heating	Interpretation and a series of the series of	n: Btu/hr Btu/hr n: Btu/hr Btu/hr umption s: 25,000 30,000 Demand	÷ ÷ ÷ : : : : : : : : : : : : : : : : :	72 ° 72 ° 72 ° 72 °	F F X X	x 14 x 11 x 11 80% 80%	6,380 7,923 7,923 Dem.) hr- 3 hr- 3 hr- . Div. . Div.	°F °F ×	x ÷ ÷	0.292 0.17(0.17(0.17(2. kW///	2 kW/kE 0 kW/kE 0 kW/kE 0 kW/kE cBtu = =	3tu = 3tu = 3tu = 5.8 7.0 5.8	= = = = = = = = = = = = = = = = = = =	14,841 17,810 32,651 6,961 8,353 15,314 17,337 V/mo V/mo	kWh/y kWh/y kWh/y kWh/y
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Defice Existing Heating Electric ommended Heating Electric Office Recommended Heating Heating Electrical Consu- Heating Electrical Consu- Existing Heating Front Office Shop Office Total Existing Heating Heating Heating Heating Total Existing Heating	Interpretation and a series of the series of	n: Btu/hr Btu/hr btu/hr Btu/hr Btu/hr Btu/hr amption s: 25,000 25,000 20,000 Demance	÷ ÷ ÷ ÷ ÷ : : : : : : : : : : : : :	72 ° 72 ° 72 ° 72 ° 72 °	F F X X X	x 14 x 11 x 11 80% 80%	7,923 7,923 7,923 Dem. Dem.	0 hr- 3 hr- 3 hr- 3 hr- 1 Div. . Div.	°F °F °F × x	x ÷ ÷ 0.292 0.292 0.170	0.292 0.170 0.170 2 kW///	2 kW/kE 0 k	3tu = 3tu = 3tu = 3tu = 5.8 7.0 5.8	= = = = = = = = = = = = = = = = = = =	14,841 17,810 32,651 6,961 8,353 15,314 17,337 V/mo V/mo V/mo	kWh/y kWh/y kWh/y kWh/y
Assumes 7 mon ting - Electrical Consu- ting Heating Electrical t Office Defice Existing Heating Electrical t Office Defice Defice Tecommended Heating Electrical Recommended Heating Heating Electrical Consu- Existing Heating Front Office Total Existing Heating Recommended Front Office	Inthis per year us Internet in the series of the series o	n: Btu/hr Btu/hr Btu/hr btu/hr Btu/hr umption s: 25,000 30,000 ctrical D 25,000 30,000	÷ ÷ ÷ ÷ ÷ : : : : : : : : : : : : :	72 ° 72 ° 72 ° 72 ° 72 °	F F X X X	x 14 x 11 x 11 80% 80%	7,923 7,923 7,923 Dem. Dem.	0 hr- 3 hr- 3 hr- 3 hr- 1 Div. . Div.	°F °F °F × x	x ÷ ÷ 0.292 0.292 0.170	0.292 0.170 0.170 2 kW///	2 kW/kE 0 k	3tu = 3tu = 3tu = 3tu = 5.8 7.0 5.8 3.4 4.1	= = = = = = = = = = = = = = = = = = =	14,841 17,810 32,651 6,961 8,353 15,314 17,337 V/mo V/mo V/mo	kWh/y kWh/y kWh/y kWh/y

Assumes 5 months per year usage:





ECM-2.2: Install Progrmable Tstats & Locking Covers - Central Garage (Continued):

Supply Fan Motors - Electrical Consumption

cuppi) an motore		
Existing Supply Fan	Motor Electrical Consumption:	
Front Office	0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 7,586 hrs/yr =	1,603 kWh/yr
Shop Office	0.33 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 7,586 hrs/yr =	2,138 kWh/yr
Total Existing Supply I	Fan Motor Electrical Consumption: =	3,741 kWh/yr
Recommended Sup	pply Fan Motor Electrical Consumption:	
Front Office	0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 93% Motor Eff. x 6,502 hrs/yr =	1,108 kWh/yr
Shop Office	0.33 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 93% Motor Eff. x 6,502 hrs/yr =	1,478 kWh/yr
Total Recommended S	Supply Fan Motor Electrical Consumption: =	2,586 kWh/yr
Total Supply Fan Moto	pr Electrical Consumption Savings: =	1,155 kWh/yr
	rs - Electrical Demand	
Existing Supply F	an Motor Bectrical Demand:	
Front Office	0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. =	0.2 kw/mo
Shop Office	0.33 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. =	0.2 kw/mo
Total Existing Suppl	ly Fan Motor Electrical Demand: =	0.4 kW/mo
Recommended S	Supply Fan Motor Electrical Demand:	
Front Office	0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 93% Motor Eff. x 80% Dem. Div. =	0.1 kw/mo
Shop Office	0.33 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 93% Motor Eff. x 80% Dem. Div. =	0.2 kw/mo
Total Recommende	d Supply Fan Motor Electrical Demand: =	0.3 kW/mo
Total Supply Fan M	btor Electrical Demand Savings: =	0.1 kW/mo
,		

Assumes 12 months per year usage:





ECM-2.2: Install Plug Load Occupancy Sensors - City Hall:

Office Equipment - Electrcial Consumption

Existing Electrical Consumption: In-Use (24 hrs/day * 7 days/w k) 55 Qty. x 40 Accessory Watts/desktop * x 24 hrs/day x 7 days/w k = 19,282,032 Watts ÷ 1,000 W/kW = 19,282 kWh/yr Accessories In-Use (24 hrs/da Total Existing Electrical Consumption: 19,282 kWh/yr

Recommended Electrical Consumption:

Total Electrcial Consumption Savings:

ECM-2.3: Install Plug Load Occupancy Sensors - Annex:

Office Equipment - Electrcial Consumption

Existing Electrical Consumption: In-Use (24 hrs/day * 7 days/w k) 75 Qty. x 40 Accessory Watts/desktop * x 24 hrs/day x 7 days/w k = 26,293,680 Watts ÷ 1,000 W/kW = 26,294 kWh/yr Accessories

Total Existing Electrical Consumption: 26,294 kWh/yr

Recommended Electrical Consumption:

Accessories In-Use (12 hrs/day * 5 days/w k) 75 Oty. x 40 Accessory Watts/desktop * x 12 hrs/day x 5 days/w k = 9,390,600 Watts ÷ 1,000 W/kW = 9,391 kWh/yr Total Recommended Electrical Consumption: 9,391 kWh/yr

Total Electrcial Consumption Savings:

= 16,903 kWh/yr

= 14,691 kWh/yr





Appendix J

Heating, Ventilation, & Air Conditioning Improvements – ECM-4





ECM-4.1: Unit Replacement - Annex:

Cooling - Electrical Consumption

Existing Cooling Electrical Consumption:												
Detectives	5.0	tons	х	2012 FLH	х	1.40 kW/ton	=	14,083 kWh/yr				
Office	3.0	tons	х	2012 FLH	х	1.40 kW/ton	=	8,450 kWh/yr				
Fire Chief/Kitchen	3.0	tons	х	2012 FLH	х	1.40 kW/ton	=	8,450 kWh/yr				
Server Rm	3.0	tons	х	2012 FLH	х	1.40 kW/ton	=	8,450 kWh/yr				
Telephone Rm	3.0	tons	х	2012 FLH	х	1.40 kW/ton	=	8,450 kWh/yr				
Basement Cells	3.0	tons	х	2012 FLH	х	1.40 kW/ton	=	8,450 kWh/yr				
Total Existing Cooling Electrical Consumption: = 56,332 kWh/yr												

Recommended Cooling Electrical Consumption:

	-						
Detectives	5.0 tons	х	2012 FLH	х	0.08 kW/ton	=	805 kWh/yr
Office	3.0 tons	х	2012 FLH	х	0.08 kW/ton	=	483 kWh/yr
Fire Chief/Kitchen	3.0 tons	х	2012 FLH	х	0.08 kW/ton	=	483 kWh/yr
Server Rm	3.0 tons	х	2012 FLH	х	0.08 kW/ton	=	483 kWh/yr
Telephone Rm	3.0 tons	х	2012 FLH	х	0.08 kW/ton	=	483 kWh/yr
Basement Cells	3.0 tons	х	2012 FLH	х	0.08 kW/ton	=	483 kWh/yr
Total Recommended Cooling Electrical C	onsumptior	n:				=	3,219 kWh/yr
Total Cooling Electrical Consumption Sav	vings:					=	53,113 kWh/yr

Cooling - Electrical Demand Savings - 4 :-inter F

Existing Cooling Electrical Demand:												
Detectives	5.0	tons x	70% Dem. Diversity	х	1.40 kW/ton =	4.9 kW/mo						
Office	3.0	tons x	70% Dem. Diversity	х	1.40 kW/ton =	2.9 kW/mo						
Fire Chief/Kitchen	3.0	tons x	70% Dem. Diversity	х	1.40 kW/ton =	2.9 kW/mo						
Server Rm	3.0	tons x	70% Dem. Diversity	х	1.40 kW/ton =	2.9 kW/mo						
Telephone Rm	3.0	tons x	70% Dem. Diversity	х	1.40 kW/ton =	2.9 kW/mo						
Basement Cells	3.0	tons x	70% Dem. Diversity	х	1.40 kW/ton =	2.9 kW/mo						
Total Existing Cooling Electrical Dema	nd:				=	19.6 kW/mo						

Recommended Cooling Electrical Demand:

Detectives	5.0 tons x	70% Dem. Diversity	х	0.08 kW/ton	=	0.3 kW/mo
Office	3.0 tons x	70% Dem. Diversity	х	0.08 kW/ton =	=	0.2 kW/mo
Fire Chief/Kitchen	3.0 tons x	70% Dem. Diversity	х	0.08 kW/ton =	=	0.2 kW/mo
Server Rm	3.0 tons x	70% Dem. Diversity	х	0.08 kW/ton =	=	0.2 kW/mo
Telephone Rm	3.0 tons x	70% Dem. Diversity	х	0.08 kW/ton =	=	0.2 kW/mo
Basement Cells	3.0 tons x	70% Dem. Diversity	х	0.08 kW/ton =	=	0.2 kW/mo
Total Recommended Cooling Electrical	Demand:			:	=	1.1 kW/mo
Total Monthly Cooling Electrical Demand	Savings:			:	=	18.5 kW/mo

Total Monthly Cooling Electrical Demand Savings:

Heating - Electrical Consumption

Existing Heating Electrical Consumption:												
Basement Cells	30,000 Btu/hr	÷	72	٥F	х	146,380 hr- °F x	0.213 kW/kBtu =	12,961 kWh/yr				
Total Existing Heating Elec	Total Existing Heating Electrical Consumption: = 12,961 kWh/yr											

Recommended Heating Electrical Consumption:

Detectives	30,000 Btu/hr ÷ 72	2°F>	146,380 hr- °F ÷	- 0.170 kW/kBtu =	10,369 kWh/yr
Total Recommended H	eating Electrical Consump	tion:		=	10,369 kWh/yr



2,172.82 kgal

ECM-4.1: Unit Replacement - Annex (Continued):

Heating - Electrical Demand

Basement Cells	30,000 Btu/hr x 80% Dem. Div. x 0.213 kW/kBtu =	5.1 kW/ma
Total Existing Heating Elect	rical Demand: =	5.1 kW/ma
Recommended Heating	Electrical Demand:	
Recommended Heating Detectives	Electrical Demand: 30,000 Btu/hr x 80% Dem. Div. ÷ 0.170 kW/kBtu =	4.1 kW/ma
0	30,000 Btu/hr x 80% Dem. Div. ÷ 0.170 kW/kBtu =	4.1 kW/ma 4.1 kW/ma

Water-Source Heat Pump Water Consumption

Existing WSHP Con	sumption:				
Server Rm	3 tons x	12,000 Btu/ton	= 36,000	0 Btu ÷ 500 ÷ 12 °F∆T = 6 GPM = 360 GPH x 2012 FLH = 724.27 kg	gal
Telephone Rm	3 tons x	12,000 Btu/ton	= 36,000	0 Btu ÷ 500 ÷ 12 °F $_{\Delta}$ T = 6 GPM = 360 GPH x 2012 FLH = 724.27 kg	gal
Basement Cells	3 tons x	12,000 Btu/ton	= 36,000	0 Btu ÷ 500 ÷ 12 °F∆T = 6 GPM = 360 GPH x 2012 FLH = 724.27 kg	gal

Total Existing WSHP Water Consumption Savings:

Avoided Maintenance Costs

Assume HVAC System Replacement is avoided maintenance.

Assume replacement happens in 1 years.

Assume estimated life of new equipment is 15 years.

Future Value of:	\$10,675 (F/P	4.00% 1) =	\$11,102
Annual Value of:	\$11,102 (A/P	4.00% 15) =	\$999



ECM-4.2: Pump Motor Replacement - Heman Park Pool:

Pump Motors - Electrical Consumption

Existing Pump Motor Electrical Consumption:

Main Pool Filtration	40 hp x	0.746 kW/bhp	x 0.85	bhp/hp	÷ 75%	Motor Eff.	x 2,4	400 hrs/yr	=	81,165 kWh/y
Total Existing Pump Motor Elec	trical Consumption:								=	81,165 kWh/y
Recommended Pump Mot	or Electrical Consun	ption:								
Aain Pool Filtration	40 hp x	0.746 kW/bhp	x 0.85	bhp/hp	÷ 93%	Motor Eff.	x 2,4	400 hrs/yr	=	65,455 kWh/y
Fotal Recommended Pump Mo	tor Electrical Consumpt	ion:							=	65,455 kWh/y
otal Pump Motor Electrical Co	insumption Savings:								=	15,709 kWh/y
Pump Motors - Electrical										
Existing Pump Motor Elec										
Main Pool Filtration	40 hp x	0.746 kW/bhp >	(0.85 b	bhp/hp ÷	75% M	otor Eff. x	80%	Dem. Div.	=	27.1 kw/mo
Total Existing Pump Motor Ele	ectrical Demand:								=	27.1 kW/mo
Recommended Pump Mo	otor Electrical Demar	nd:								
Main Pool Filtration	40 hp x	0.746 kW/bhp >	0.85 b	bhp/hp ÷	93% M	otor Eff. x	80%	Dem. Div.	=	21.8 kw/mo
Total Recommended Pump M	Notor Electrical Demand	:							=	21.8 kW/mo
Total Pump Motor Electrical D	Demand Savings:								=	5.2 kW/mo
	-									
	Avoided	Maintenance Co	osts							
	Assume	NAC System Rep	blacemen	nt is avoide	d mainter	ance.				
		eplacement happe								
		stimated life of ne			vears					
					•					

 Future Value of:
 \$6,550 (F/P
 4.00%
 5)
 =
 \$7,969

 Annual Value of:
 \$7,969 (A/P
 4.00%
 15)
 =
 \$717





ECM-4.3: Unit Replacement - Central Garage:

Cooling - Electrical Consumption

Front Office		2	2.5	tons	х	1868	FLH	х	1.70	kW/ton	=	7,941	kWh/yr	
Shop Office		3	8.0	tons	х	1868	FLH	х	1.40	kW/ton	=	7,847	kWh/yr	
Total Existing Coolir	ng Electrical Co	nsump	tion:								=	15,788	kWh/yr	
Recommended C	Cooling Electr	ical Co	วทรเ	umpt	ion:									
Front Office			2.5	tons	х		FLH		0.08	kW/ton	=	374	kWh/yr	
Shop Office			3.0	tons	х	1868	FLH	х	0.08	kW/ton	=	448	kWh/yr	
Total Recommende	d Cooling Elect	rical Co	onsu	mptio	า:						=	822	kWh/yr	
Total Cooling Electri	cal Consumpti	on Savi	ings:	:							=	14,966	kWh/yr	
Cooling - Electrica														
Existing Cooling I	lectrical Den									1 70 11				
Front Office		2.							•	1.70 k) kW/mo	
Shop Office		3.	0 t	ions	x /	0% D	em. Dr	versi	ty x	1.40 k) kW/mo	
Total Existing Coolin	ig Electrical De	mand:										= 5.9) kW/mo	
Recommended C	ooling Electr													
Front Office										0.08 k			l kW/mo	
Shop Office					x 7	'0% D	em. Dr	versi	ty x	0.08 k	N/ton		2 kW/mo	
		1 CALL 12 P										= 0.3	3 kW/mo	
Total Recommended Total Monthly Coolin ating - Electrical Consur	g Electrical De												3 kW/mo	
Total Monthly Coolin ating - Electrical Consur	g Electrical De	mand S												
Total Monthly Coolin ating - Electrical Consur sting Heating Electrical	g Electrical De	mand S n:	Savin	ngs:	= x	146,3	380 h	r- °F	x	0.292	kW/kB1	= 5.0	∂ kW/mo	kWh/y
Total Monthly Coolin ating - Electrical Consur sting Heating Electrical ant Office up Office	g Electrical De nption Consumption 25,000 30,000	mand S n: Btu/hr Btu/hr	Savin ÷	ngs: 72 이		,						= 5.6	6 kW/mo 14,841	
Total Monthly Coolin ating - Electrical Consur sting Heating Electrical int Office op Office	g Electrical De nption Consumption 25,000 30,000	mand S n: Btu/hr Btu/hr	Savin ÷	ngs: 72 °		,					kW/kB1	= 5.6	6 kW/mo 14,841 17,810	kWh/y
Total Monthly Coolin ating - Electrical Consur sting Heating Electrical nt Office ap Office al Existing Heating Electrica commended Heating Electrica	g Electrical De nption Consumption 25,000 30,000 al Consumption actrical Cons	mand S n: Btu/hr Btu/hr : u m pti e	Savin ÷ ÷ on:	ngs: 72 이 72 이	= x	146,	380 h	r- ⁰F	x	0.292	kW/kBt	= 5.6 tu = tu = =	5 kW/mo 14,841 17,810 32,651	kWh/y kWh/y
Total Monthly Coolin ating - Electrical Consur sting Heating Electrical Int Office al Existing Heating Electrica commended Heating Electrica	g Electrical De nption Consumption 25,000 30,000 al Consumption ectrical Cons 25,000	mand S n: Btu/hr Btu/hr : um ptie Btu/hr	Savin ÷ ÷ on:	ngs: 72 이 72 이 72 이	= x = x	146,	380 h 380 h	r- ∘F r- ∘F	×	0.292	kW/kBi kW/kBi	= 5.6 tu = tu = = tu =	5 kW/mo 14,841 17,810 32,651	kWh/y kWh/y
Total Monthly Coolin ating - Electrical Consur sting Heating Electrical Int Office al Existing Heating Electrica commended Heating Electrica nt Office po Office	g Electrical De nption Consumption 25,000 30,000 al Consumption ectrical Cons 25,000 30,000	mand S n: Btu/hr Btu/hr : umptie Btu/hr Btu/hr	Savin ÷ ÷ ÷	ngs: 72 이 72 이 72 이	= x = x	146,	380 h 380 h	r- ∘F r- ∘F	×	0.292	kW/kBt	= 5.6 tu = tu = = tu =	5 kW/mo 14,841 17,810 32,651 8,640 10,369	kWh/y kWh/y kWh/y kWh/y
Total Monthly Coolin ating - Electrical Consur sting Heating Electrical Int Office al Existing Heating Electrica commended Heating Electrica nt Office po Office	g Electrical De nption Consumption 25,000 30,000 al Consumption ectrical Cons 25,000 30,000	mand S n: Btu/hr Btu/hr : umptie Btu/hr Btu/hr	Savin ÷ ÷ ÷	ngs: 72 이 72 이 72 이	= x = x	146,	380 h 380 h	r- ∘F r- ∘F	×	0.292	kW/kBi kW/kBi	= 5.6 tu = tu = = tu =	5 kW/mo 14,841 17,810 32,651 8,640 10,369	kWh/y kWh/y kWh/y kWh/y
Total Monthly Coolin ating - Electrical Consur sting Heating Electrical nt Office pp Office al Existing Heating Electrica commended Heating Electrica pp Office al Recommended Heating Electrica	g Electrical De nption Consumption 25,000 30,000 al Consumption ectrical Cons 25,000 30,000 Electrical Consumption	mand S n: Btu/hr Btu/hr : Btu/hr Btu/hr umption	Savin ÷ ÷ ÷	ngs: 72 이 72 이 72 이	= x = x	146,	380 h 380 h	r- ∘F r- ∘F	×	0.292	kW/kBi kW/kBi	$= 5.6$ $\frac{tu =}{=}$ $tu =$ $tu =$	5 kW/mo 14,841 17,810 32,651 8,640 10,365 19,005	kWh/y kWh/y kWh/y kWh/y kWh/y
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Total Monthly Coolin ating - Electrical Consur sting Heating Electrical int Office al Existing Heating Electrical commended Heating Electrical op Office al Recommended Heating Electrical consur Heating Electrical Consur Heating - Electrical Existing Heating	g Electrical De nption Consumption 25,000 30,000 al Consumption ectrical Cons 25,000 30,000 Electrical Consumption Savings cal Dem and	mand S n: Btu/hr Btu/hr : Btu/hr Btu/hr umption s:	÷ ÷ ÷	ngs: 72 이 72 이 72 이	= x = x	146,	380 h 380 h	r- ∘F r- ∘F	×	0.292	kW/kBi kW/kBi	= 5.6 $tu = tu =$	5 kW/mo 14,841 17,810 32,651 8,640 10,365 19,005	kWh/y kWh/y kWh/y kWh/y kWh/y
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Total Monthly Coolin ating - Electrical Consur sting Heating Electrical nt Office al Existing Heating Electrical commended Heating Electrical commended Heating Electrical al Recommended Heating Electrical al Heating Electrical Consur <u>Heating - Electrical</u> Existing Heating	g Electrical De nption Consumption 25,000 30,000 al Consumption ectrical Cons 25,000 30,000 Electrical Consumption Savings cal Dem and	mand S h: Btu/hr Btu/hr Btu/hr Btu/hr Btu/hr umption S: mand 25,000	÷ ÷ ÷ ÷ : 0 Btr	ngs: 72 이 72 이 72 이 72 이	= x = x = x = x	146,; 146,; 146,; 146,;	380 h 380 h 380 h	r- °F r- °F r- °F v. x	× ÷	0.292	kW/kBi kW/kBi kW/kBi kW/kBi	$= 5.6$ $\frac{tu =}{tu =}$ $= \frac{tu =}{tu =}$	14,841 17,810 32,651 8,640 10,369 13,642	kWh/y kWh/y kWh/y kWh/y kWh/y
Total Monthly Coolin ating - Electrical Consur sting Heating Electrical p Office al Existing Heating Electrica commended Heating Electrica al Recommended Heating Electrical al Heating Electrical Consur Heating - Electrical Existing Heating Front Office	g Electrical De nption Consumption 25,000 30,000 al Consumption ectrical Cons 25,000 30,000 Electrical Consumption Savings cal Dem and g Electrical De	mand S n: Btu/hr Btu/hr Btu/hr Btu/hr Btu/hr umption s: mand 25,000 30,000	÷ ÷ ÷ ; ; 0 Btr 0 Btr	ngs: 72 이 72 이 72 이 72 이	= x = x = x = x	146,; 146,; 146,; 146,;	380 h 380 h 380 h	r- °F r- °F r- °F v. x	× ÷	0.292 0.170 0.170 2 kW/kE	kW/kBi kW/kBi kW/kBi kW/kBi	$= 5.6$ $\frac{tu =}{=}$ $= 5.8 k$ 7.0 k	14,841 17,810 32,651 8,640 10,369 13,642 W/mo	kWh/y kWh/y kWh/y kWh/y kWh/y
Total Monthly Coolin ating - Electrical Consur sting Heating Electrical on Office al Existing Heating Electrica commended Heating Electrica al Recommended Heating Electrical consur Heating Electrical Consur Heating Heating Front Office Shop Office Total Existing Heating Recommended	g Electrical De <u>nption</u> <u>25,000</u> <u>30,000</u> al Consumption <u>ectrical Cons</u> <u>25,000</u> <u>30,000</u> Electrical Consumption Savings <u>cal Dem and</u> <u>5 Electrical De</u> ting Electrical I	mand S Btu/hr Btu/hr Btu/hr Btu/hr Btu/hr Btu/hr amption 30,000 Demand trical E	÷ ÷ ÷ ÷ : 0 Btr 0 Btr 0 Btr 1: 2 Dem	72 ° 72 ° 72 ° 72 ° 72 ° 72 ° 72 ° 72 °	= x = x = x x 80 x 80	146,; 146,; 146,; 0% De 0% De	380 h 380 h 380 h 380 h	r- °F r- °F r- °F v. x v. x	× ÷ ;	0.292 0.170 0.170 2 kW/kE 2 kW/kE	kW/kB kW/kB kW/kB kW/kB stu = =	tu = tu = tu = = 5.8 k 7.0 k	14,841 17,810 32,651 8,640 10,365 19,005 13,642 W/mo W/mo	kWh/y kWh/y kWh/y kWh/y kWh/y
Total Monthly Coolin ating - Electrical Consur- sting Heating Electrical th Office al Existing Heating Electrica commended Heating Ele- th Office al Recommended Heating Ele- al Recommended Heating Ele- al Heating Electrical Consur- Heating - Electric Existing Heating Front Office Shop Office Total Existing Heating	g Electrical De <u>nption</u> <u>25,000</u> <u>30,000</u> al Consumption <u>ectrical Cons</u> <u>25,000</u> <u>30,000</u> Electrical Consumption Savings <u>cal Dem and</u> <u>5 Electrical De</u> ting Electrical I	mand S Btu/hr Btu/hr Btu/hr Btu/hr Btu/hr Btu/hr amption 30,000 Demand trical E	÷ ÷ ÷ ÷ : 0 Btr 0 Btr 0 Btr 1: 2 Dem	72 ° 72 ° 72 ° 72 ° 72 ° 72 ° 72 ° 72 °	= x = x = x x 80 x 80	146,; 146,; 146,; 0% De 0% De	380 h 380 h 380 h 380 h	r- °F r- °F r- °F v. x v. x	× ÷ ;	0.292 0.170 0.170 2 kW/kE	kW/kB kW/kB kW/kB kW/kB stu = =	tu = tu = tu = = 5.8 k 7.0 k	14,841 17,810 32,651 8,640 10,369 13,642 W/mo W/mo	kWh/y kWh/y kWh/y kWh/y kWh/y
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Total Monthly Coolin ating - Electrical Consur sting Heating Electrical on Office al Existing Heating Electrica commended Heating Electrica al Recommended Heating Ele al Recommended Heating Electrical Consur Heating Electrical Consur Heating Heating Heating Front Office Shop Office Total Existing Heating Front Office Shop Office Total Existing Heating Front Office	g Electrical De nption 25,000 30,000 al Consumption actrical Cons 25,000 30,000 Electrical Consumption Savings cal Demand g Electrical De ting Electrical I Heating Elec	mand S h: Btu/hr Btu/hr Btu/hr Btu/hr Btu/hr amption 30,000 brical E 25,000 30,000 brical E 25,000 30,000	÷ ÷ • ÷ •	ngs: مرا 72 ۹ 72 ۹ 72 ۹ 72 ۹ 72 ۹ 72 ۹ 72 ۹	= x = x = x = x = x x 80 x 80 x 80	146,; 146,; 146,; 0% De 0% De	380 h 380 h 380 h 380 h 380 h em. Div em. Div	r- °F r- °F r- °F v. x v. x v. x	x ÷ ÷ 0.292 0.292 0.170	0.292 0.170 0.170 2 kW/kE 2 kW/kE	kW/kBi kW/kBi kW/kBi kW/kBi stu = = =	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	14,841 17,810 32,651 8,640 10,365 19,005 13,642 W/mo W/mo W/mo	kWh/y kWh/y kWh/y kWh/y kWh/y





ECM-4.3: Unit Replacement - Central Garage (Continued):

Supply Fan Motors - Electrical Consumption

xisting Supply Fan		
ront Office	0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 2,400 hrs/yr =	507 kWh/y
hop Office	0.33 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 2,400 hrs/yr =	676 kWh/y
otal Existing Supply	Fan Motor Electrical Consumption: =	1,184 kWh/y
ecommended Su	oply Fan Motor Electrical Consumption:	
ront Office	0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 93% Motor Eff. x 2,400 hrs/yr =	409 kWh/y
hop Office	0.33 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 93% Motor Eff. x 2,400 hrs/yr =	545 kWh/y
otal Recommended S	Supply Fan Motor Electrical Consumption: =	955 kWh/y
Supply Fan Motor	rs - Bectrical Demand	229 kWh/y
Supply Fan Motor	rs - Bectrical Demand an Motor Bectrical Demand:	229 kWh/y
Supply Fan Motor Existing Supply F	rs - Electrical Demand	
Supply Fan Motor Existing Supply F Front Office Shop Office	r <u>s-Electrical Demand</u> an Motor Electrical Demand: 0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. =	0.2 kw/mo
Supply Fan Motor Existing Supply F Front Office Shop Office Total Existing Supp	rs - Electrical Demand an Motor Electrical Demand: 0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. = 0.33 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. =	0.2 kw/mo 0.2 kw/mo
Supply Fan Motor Existing Supply F Front Office Shop Office Total Existing Supp	rs - Electrical Demand an Motor Electrical Demand: 0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. = 0.33 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. = by Fan Motor Electrical Demand:	0.2 kw/mo 0.2 kw/mo
Supply Fan Motor Existing Supply F Front Office Shop Office Total Existing Supp Recommended S	rs - Electrical Demand an Motor Electrical Demand: 0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. = 0.33 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. = by Fan Motor Electrical Demand: Supply Fan Motor Electrical Demand:	0.2 kw/mo 0.2 kw/mo 0.4 kW/mo
Supply Fan Motor Existing Supply F Front Office Shop Office Total Existing Supp Recommended S Front Office Shop Office	rs - Electrical Demand an Motor Electrical Demand: 0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. = 0.33 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 75% Motor Eff. x 80% Dem. Div. = by Fan Motor Electrical Demand: 0.25 hp x 0.746 kW/bhp x 0.85 bhp/hp ÷ 93% Motor Eff. x 80% Dem. Div. =	0.2 kw /mo 0.4 kW/mo 0.1 kw /mo

Avoided Maintenance Costs

Assume HVAC System Replacement is avoided maintenance. Assume replacement happens in 1 years. Assume estimated life of new equipment is 15 years. Future Value of: 10,675 (F/P 4.00% 1) = 11,102Annual Value of: 11,102 (A/P 4.00% 15) = 999





Appendix K

Mechanical Inventory





Detailed Energy Study University City Municipal Buildings

Mechanical Equipment Inventory															
Elevation:	Quantity:	Area Served:	Туре:	Manufacturer.	Model #:	Serial #:	Capacity:	Fan HP:	RLA:	FLA:	V oltage:	Phase:	Condition:	Date of Manufacture:	
×.	*		¥ ¥	*	*	*	*	v	v	¥		· ·			*
Annex			D)/(0, 0, 1/)												
3rd / Roof Roof	1	Office Detectives	DX/Gas Split DX/Gas RTU	Carrier York	38TKB036 D4CG060	0600E09480 NHBM060332	3-tons 5-tons	-	15.3 16.7	- 2.6	208	3	Fair Poor	2000	
Roof	1	Fire Bunks	DX/Gas RTU	Carrier	58TDJ016	5004F1973	5-tons 15-tons	4	2@25.6	10.5	208	3	Good	2004	Has Economizer
3rd / Roof	1	Office	DX/Gas Split	Carrier	38VE004	B954678	3-tons	-	17.8	-	208	3	Poor	1986	has continued
1st	3	Fire Truck Bay	Steam UH	-	-	-	-	-	-	-	-	-	-	-	
Basement/Grade	1	Fire Chief/Kitchen	DX/Steam Split	Carrier	38CKB036	2096E06509	3-tons		15.7		208	1	Poor	1996	
Grade	1	Police Offices	CU	Carrier	24ABB360	0809E0964	5-tons	-	26.4		208	1	Good	2009	
Grade	1	Police Offices	CU	Carrier	24ABR360	0206E19627	5-tons	-	25.3	-	208	1	Good	2006	
Grade 1st	1	Fire Office/EOC Fire Office/EOC	AHU (DX/Steam)	Carrier	38AUZ16A065A 40RM-016	0910U03949 3806U24297	13-tons 13-tons	1 4	2@25	- 10.6	208	1	Good	2008	Has Economizer
1st	1	Server Rm	Vert. Water Source CRU	Kold-wave	40KW-016		-	-	-	-	- 200	-	Fair	- 2000	Uses domestic water in a single pass-through
1st	1	Telephone Rm	Horiz. Water Source CRU	Carrier	50HQ033511	x200781	3-tons	-	13.8	2.5	208	3	Fair	-	Uses domestic water in a single pass-through
Basement	1	Firing Range	Gas Heat Horz. AHU	Applied Air	DFS-15 hrs	76-DFS-229 F01321	378,00 BTUH	1	-	-	208	3	Good	-	Heating Only
Basement	1	Cells	Vert. Water Source CRU	Kold-wave	3RC31D12	-	3-tons	1/2	18	2.86	208	3	Poor	-	Uses domestic water in a single pass-through
1st	1	Police Offices	AHU (DX/Gas)	Carrier	40RM012	3806U24391	10-tons	3	-	5.8	208	3	Good	2006	
1st 2nd	1	Locker Rooms Service Support	Split System (DX/Gas) Split System (DX/Gas)	Carrier Comfort Maker	38BRC030 AA1BJ036	2100E21912 4994E05577	2.5-tons 3-tons	-	15 16.1	-	208	3	Fair Poor	2000	
Roof	1	Police Dispatch	RTU (DX/Elec)	Comfort Maker	50TFF006	1407G10298	3-tons 5-tons		16.1	5.2	208	3	Good	2000	1
								1				1			
City Hall															
Basement	1	Condensate	Duplex condensate pump	B&G	23CBE22-20	QE1672-SA0590904	22 gpm	1/2	-	19.2	115	1	Good	2005	
Basement	2	Cooling Tower	End Suction Pump	B&G	1510 3AC BF 6.5	-	311 gpm @ 31 ft	5	-	-	208	3	Good	2005	
Basement Grade	2	Bldg. Condenser Water Condenser Water	End Suction Pump Cooling Tower	B&G Evapco	1510 3BC BF 8.125 ICT 4-612		311 @ 60 ft	10	-	-	208	3	Good Good	2005 2005	Induced Draft Counter Flow with VFD
Basement	1	Condenser Water	Plate & Frame Heat Exchanger	Evapco ITT - B&G	BY5409	- 953899-03	- 296 GPM			-	-	-	Good	2005	Induced Drait Counter Flow with VFD
Basement	1	Condenser Water	Shell & Tube Heat Exchanger	B&G	BQSU10 2+2	-	296 GPM	-		-	-	-	Good	2005	
Various	40	Conditioned Space	Water Source Heat Pumps	Trane	GEH/GEC		100 tons total	-	-	-	115	1	Good	2005	
Herman Park Pool		5 1.0%		- 1.c.											
1st 1st	1	Pool Office Main Pool	WAC Pump Motor	Zenith Emerson	- T661		1-ton	- 40	-	-	- 460	- 3	Fair Good		93% Eff.
1st	1	Main Pool	Pump Motor Pump Motor	Ellieison	1001			40		-	460	3	Poor	1	93% Eff. Near the end of its useful life
1st	1	Kid Pool	Pump Motor	Marathon Elec			-	7 1/2	-	-	-	-	Good	New	87.50%
1st	1	Kid Pool	Pump Motor	Magnetek	H492	-	-	3/4			-	-	Fair	-	3450 RPM
1st	1	Domestic Hot Water	Natural Gas Fired Water Heater	A. O. Smith	BTR 154 104	ML990886210	154 MBH	-		-	-	-	Good	-	149 Gal/hr recovery
Oraclassial Oracas															
Centennial Commons 1st	2	Domestic Hot Water	Electric Water Heater	State	CSB12027SFEB	J05M007606	119 Gal / 27 kW				460	3	Good	2005	
1st	2	Indoor Soccer Field	Gas Fired Forced Air Furnace	Reznor	-	-		-	-	-	-	-	-		
Roof	1	Exercise Area	RTU Cooling Only (RTU-1)	Trane	TCD600	-	50-tons	-	-	-	460	3	Good	2005	
1st	1	RTU-1	Energy Recovery Ventilator	SEMCO	FB-7500TS	-	5600 CFM	-	-	-	460	3	Good	2005	
Roof	1	Gymnasium	RTU (DX/Gas)	Trane	YCD480		40-ton	-	-	-	460	3		2005	
Roof	9	Varies	Exhaust Fan	Cook	Varies		-	Fractional	-	-	Varies		Good	2005	
Fire House #2															
1 ne 1 1003e #2	1	Domestic Hot Water	Gas Water Heater	A.O.Smith	BTH 199 970	MD040013130	100 Gal / 200 MBH	-		•	120	1	Good	2004	
1st	?	Truck Bays	Gas Unit Heater	Reznor			-	-	-	-	-	-		-	
2nd	1	Workout Room	PTAC	Carrier			1-ton	-	-	-	-	-	Good	2005	
Roof	6		Exhaust Fans	-			-	-	-	-	-	-		-	
Roof	1	Training Room	Split DX / Elec	Lennox	XC21-060-230-02 XC21-060-230-02	5806C09081 5806B44235	5-ton	-	25.7	-	208	1	Good	2006	Humidifier
Roof	1	South Bedrooms North Bedrooms	Split DX / Elec Split DX / Elec	Lennox Lennox	XC21-060-230-02 XC21-060-230-02	5806B44235 5806C09077	5-ton 5-ton	-	25.7 25.7	-	208	1	Good Good	2006	Humidifier Humidifier
Roof		North Bedrooms		Cook	012012 GI 12X12GI AL	180S884444	5-ton		25.7		208	-	Good	2006	numumer
Roof	1		Exhaust Fan Exhaust Fan			180S884444		-		-	-	-		2006	
			Exhaust Fan Exhaust Fan Split DX / Elec Split DX / Elec	Cook	024024 GR 24x24 GI AL XC21-036-130-02				- 16.7	-	- 208	- 1	Good Good	2006 2006	





Detailed Energy Study University City Municipal Buildings

					Me	chanical Equipment Inve	antory								
														ifacture:	
Elevation	Quantity:	Area Served:	Type:	Manufacturer	# Model #	Serial #	Capacity:	Fan HP:	RLA:	FLA:	V oltage:	Phase:	Condition:	Date of Manu	Notes:
Herman Park C. C.															
1st	1	Storage	Electric Unite Heater	Qmark	MUH-03-2	07-88-322	2-2/3 kW		-		208	1	Good		
1st	1	Domestic Hot Water	Gas Water Heater	A. O. Smith	FSG 75	GM96-3403752	230 gal / 75 MBH		-		-	-	Good	-	
Grade	1	Conditioned Space	PKU (DX/Gas)	Carrier	48LJD024	-	20-tons	5	-	-		-	Fair	-	242 MBH
Grade	1	Conditioned Space Conditioned Space	PKU (DX/Gas) Split	American Std. Carrier	YCH181 38EN036320	928100451D	15-ton 3-ton	v	29.5/17.6 21	10.6	308 208	3	Good Poor	2009	High Efficiency
Grade	1	Conditioned Space	Split	Carrier	38EIN036320		3-ton	-	21		208	3	Poor	1987	
Central Garage	_														
Basement	1	Front Office	Vertical Fan Coil Unit (DX)	Bryant	FA4ANF030	0697A12546	2.5-ton	1/4	-	1.8	208/230	1	Poor	2006	Maintenance Issue. Offices have window units
Roof	1	Front Office	CU	Carrier	38CKC030	2497E07006	2.5-ton	-	14.8	-	208/230	1	Poor	1997	Maintenance Issue, Offices have window units
Mezznine	1	Shop Office	Horizontal Fan Coil Unit (DX)	Bryant	FA4NF036	1497A10931	3-ton	1/3		2.4	208/230	1	Poor	1997	
Roof	1	Shop Office	CU	Carrier	38CKC036	1697F11812	3-ton	-	15	-	208/230	1	Poor	1997	
1st	10	Shop	Infrared Heater	Re-verber-ray	DTH S100	-	100 MBH		-		-	-	Good	-	
1st	2	Shop	Gas Unit Heater	Reznor	-	-	-		-		-	-	Fair	-	
1st	1	Shop	Gas Unit Heater	Sterling	-	-		-	-	-	-	-	Fair	-	
1st	3	Front Office	Window Air Conditioner	Various	-		3-ton total	-	-		-	-	Fair	-	
Transfer Station	_														
1st	1	Office	PTAC				1-ton		-				Poor		inoperable
1st	1	Building Heat	Direct Fired MAU	AbsolutAire	AA-3U	14261	8000 CFM/ 900 MBH	7 1/2	-	23	230	3	Fair		99.7% eff.
2nd	1	MRF Shack	WAC	AbsolutAlle	-	14201	1-ton	1 1/2		25	230	5	Fair		33.776 611.
2nd 2nd	1	MRF Shack	Elec, Wall Heater			-	1.5 kW		-		-	-	Fair		
Sign Shop															
1st	1	Sign Shop	Gas Unit Heater	Reznor	-	-	-		-		-	-	Fair	-	
1st	1	Sign Shop	Gas Unit Heater	Bryant	-	-	-	-	-	-	-	-	Fair	-	
Golf Course		Ohth Library	Madical Fee Oall Halt	Carrier	FX4CNF030	00001.00040	2.5-ton	4/0	-	0.0	000/000	4	Ored	2006	
1st Basement	1	Club House Snack Bar	Vertical Fan Coil Unit Vertical Fan Coil Unit (DX/Gas)	Carrier	EX4CNE030 CNPVP6024A	3606A69849 3806X25447	2.5-ton 5-ton	1/3	-	2.8	208/230 208/230	1	Good	2006	
Grade	1	Shack Bar	CU	Carrier	24ACA360A300	0407E23612	5-ton		26.4		208/230	1	Good	2008	
Roof	1	Club House	CU	Carrier	24ACA330A300	1306E36180	2.5-ton		12.8		208/230	1	Good	2007	
												1			
Golf Maintenance															
1st	2	Shop	Gas Unit Heater	Dayton	3E228A	C8842301	65 MBH	-	-	-	120	1	Good	1988	
1st	1	Office	Window Air Conditioner	LG		-	1-ton		-		120	1	Good	-	
MILL IN														-	
Trinity		0: 0 ·			115 0050									0001	
Basement 1st Florr	2	Steam System Building	Steam Boiler Window Air Conditioner	Aldrich	HF-2650	04F-1620	2650 lbs/hr 1-ton	2 1/4	-	6.4	208	3	Good Fair	2004	
IST FIOIT	2	Building	window Air Conditioner			-	1-ton	1/4	<u> </u>		-	<u> </u>	Fair	+ -	
Park Maintenance														1	
1st	1	Shop	Gas Unit Heater	Reznor	F50		50 MBH Input				115	1	Good	1989	
1st	1	Shop	Gas Unit Heater	Dayton	3E243D		150 MBH Input		-		115	1	Good	2008	
1st	1	Shop	Horiz. Gas Furnace	Lennox	GS6-130	-	130 MBH Input		-		-	-	Good	-	80% eff.
1st	1	Office	Window Air Conditioner			-	1-ton	-	-	-	115	1	Fair	-	
1st	1	Shop	Gas Unit Heater				50 MBH Input		-		115	1	Good	-	
1st	1	Shop	Gas Unit Heater			-	100 MBH	-	-	-	115	1	Good	-	
							1					1		1	





Appendix L

Cost Estimate



	ESTIMAT	E OF P	ROBABL	E COST				
Project Name			Status of Desig	n			Date	
University City Municipal Buildings DES							2/2	1/2012
Building		Estimated by				Last Modified:		
Annex		ALLEN & HOS	HALL			2/2	1/2012	
Project Number								
ECM-1.1: Lighting Retrofit								
	Qua	antity	Material/E	Equip. Cost	Labor	Cost	Engin	eering Est
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total
DEMOLITION		•		•				
TOTAL DEMOLITION				\$0		\$0		\$0

Lighting Retrofit	1	LS	60785.11	\$60,785	0.00	\$0	1.00	\$60,785
TOTAL Lighting				\$60,785		\$0		\$60,785

ELECTRICAL				
TOTAL ELECTRICAL		\$0	\$0	\$0

Sub-total				
Tax (Material @ 9.5%)				
Overhead & Profit (20%)				
Contingency (5%)				
TOTAL				\$60,785

	ESTIMAT	E OF P	ROBABL	E COST					
Project Name			Status of Desig	n			Date		
University City Municipal Buildings DES	1		3				2/21/2012		
Building							Last Modified:		
City Hall			ALLEN & HOS	HALL			2/2	1/2012	
Project Number									
ECM-1.2: Lighting Retrofit									
			•						
	Qua	intity Material/Equip. Cost		Labor	Cost	Engin	eering Est		
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total	
DEMOLITION		•		•					
TOTAL DEMOLITION			1	\$0		\$0		\$0	

Lighting Retrofit	1	LS	20396.98	\$20,397	0.00	\$0	1.00	\$20,397
			1 1	. ,				
			İ					
							1.25	
TOTAL Lighting				\$20,397		\$0		\$20,397

ELECTRICAL										
TOTAL ELECTRICAL				\$0		\$0		\$0		

Sub-total				
Tax (Material @ 9.5%)				
Overhead & Profit (20%)				
Contingency (5%)				
TOTAL				\$20,397

E	STIMAT	E OF P	ROBABL	E COST				
Project Name			Status of Desig	'n			Date	
University City Municipal Buildings DES			Glatus of Desig					1/2012
Building			Estimated by				Last Modified:	
Community Center			ALLEN & HOS	HALL			2/2	1/2012
Project Number								
ECM-1.3: Lighting Retrofit								
	Qua	antity	Material/E	Equip. Cost	Labor	Cost	Engine	eering Est
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total
DEMOLITION								
TOTAL DEMOLITION				\$0		\$0		\$0

Lighting Retrofit	1	LS	5780.02	\$5,780	0.00	\$0	1.00	\$5,780
	1	L3	5760.02	\$3,780	0.00	φU	1.00	43,760
		-						
			1					
TOTAL Lighting				\$5,780		\$0		\$5,780

ELECTRICAL										
TOTAL ELECTRICAL				\$0		\$0		\$0		

Sub-total				
Tax (Material @ 9.5%)				
Overhead & Profit (20%)				
Contingency (5%)				
TOTAL				\$5,780

	ESTIMATI	E OF P	ROBABL	E COST				
Project Name			Status of Desi	a 0			Date	
University City Municipal Buildings D	DES		Status of Desi	gn				1/2012
Building	ng		Estimated by				Last Modified:	
Fire Station #2			ALLEN & HO	SHALL			2/2	1/2012
Project Number								
ECM-1.4: Lighting Retrofit								
	Qua	antity	Material/I	Equip. Cost	Labor Cost		Engineering Est	
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total
DEMOLITION	·							
	1							
TOTAL DEMOLITION	·			\$0		\$0		\$0

Lighting Retrofit	4	EA	5079.16	\$5,079	12.50	\$13	1.00	\$5,092
	1	EA	5079.10	\$5,079	12.30	φıs	1.00	\$ 5,092
TOTAL Electrical				\$5,079		\$13		\$5,092

ELECTRICAL				
TOTAL ELECTRICAL		\$0	\$0	\$0

Sub-total				
Tax (Material @ 9.5%)				
Overhead & Profit (20%)				
Contingency (15%)				
TOTAL				\$5,092

	ESTIMATI	E OF P	ROBABL	E COST				
Project Name			Status of Desi	ian			Date	
University City Municipal Buildings D	ES		Status of Desi	ign				21/2012
Building		E					Last Modified	:
Golf Course				SHALL			2/2	21/2012
Project Number								
ECM-1.5 Lighting Retrofit								
	Qua	antity	Material/	Equip. Cost	Labor	Cost	Engin	eering Est
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total
DEMOLITION	•	•	•	•		•		
		1						
TOTAL DEMOLITION	·	Ì		\$0		\$0		\$0

Lighting Retrofit	1	EA	1097.00	\$1,097	12.50	\$13	1.00	\$1,109
	1	LA	1097.00	φ1,0 <i>91</i>	12.30	\$13	1.00	φ1,109
TOTAL Electrical				\$1,097		\$13		\$1,109

ELECTRICAL									
TOTAL ELECTRICAL				\$0		\$0		\$0	

Sub-total				
Tax (Material @ 9.5%)				
Overhead & Profit (20%)				
Contingency (15%)				
TOTAL				\$1,109

	ESTIMAT	E OF PF	ROBABL	E COST				
Project Name			Status of Desi	ian			Date	
University City Municipal Buildings DES	6			9				21/2012
Building			Estimated by				Last Modified	:
Public Works			ALLEN & HO	SHALL			2/2	21/2012
Project Number								
ECM-1.6 Lighting Retrofit								
	Qua	antity	Material/	Equip. Cost	Labor Cost		Engin	eering Est
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total
DEMOLITION	-							
TOTAL DEMOLITION				\$0		\$0		\$0

Lighting		1						
Lighting Retrofit	1	EA	29757.85	\$29,758	12.50	\$13	1.00	\$29,770
TOTAL Electrical				\$29,758		\$13		\$29,770

ELECTRICAL									
TOTAL ELECTRICAL				\$0		\$0		\$0	

Sub-total				
Tax (Material @ 9.5%)				
Overhead & Profit (20%)				
Contingency (15%)				
TOTAL				\$29,770

	ESTIMATI	E OF P	ROBABL	E COST				
Project Name			Status of Desi	gn			Date	
University City Municipal Buildings	DES						2/2	1/2012
Building			Estimated by				Last Modified:	
Recreation Center			ALLEN & HO	SHALL			2/2	1/2012
Project Number								
ECM-1.7 Lighting Retrofit								
							1	
	Qua	antity	Material/I	Equip. Cost	Labor	Cost	Engine	eering Est
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total
DEMOLITION	•		•			•		
TOTAL DEMOLITION				\$0		\$0		\$0

Linkting Detrofit	4		40070 40	¢ 40.070	40.50	¢40	4.00	¢ 40.000
Lighting Retrofit	1	EA	40076.48	\$40,076	12.50	\$13	1.00	\$40,089
TOTAL Electrical				\$40,076		\$13		\$40,089

ELECTRICAL				
TOTAL ELECTRICAL		\$0	\$0	\$0

Sub-total				
Tax (Material @ 9.5%)				
Overhead & Profit (20%)				
Contingency (15%)				
TOTAL				\$40,089

E	STIMAT	E OF PF	ROBABL	E COST				
Project Name			Status of Des	ign			Date	
University City Municipal Buildings DES							2/2	1/2012
Building			Estimated by				Last Modified	
rinity Building			ALLEN & HO	SHALL			2/2	1/2012
Project Number								
ECM-1.8 Lighting Retrofit								
	Qu	antity	Material/	Equip. Cost	Labor	Cost	Engin	eering Est
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total
DEMOLITION			•	•			•	•
TOTAL DEMOLITION				\$0		\$0		\$0

Lighting Retrofit	1	EA	8620.86	\$8,621	12.50	\$13	1.00	\$8,633
Lighting reading	-	L7	0020.00	ψ 0,02 Ι	12.30	ψīJ	1.00	40,000
TOTAL Electrical				\$8,621		\$13		\$8,633

ELECTRICAL										
TOTAL ELECTRICAL				\$0		\$0		\$0		

Sub-total				
Tax (Material @ 9.5%)				
Overhead & Profit (20%)				
Contingency (15%)				
TOTAL				\$8,633

	ESTIMATI	E OF P	ROBABL	E COST					
Project Name University City Municipal Buildings DES			Status of Desig	gn			Date 2/2	21/2012	
Building Central Garage			Estimated by ALLEN & HOS	SHALL			Last Modified: 2/21/2012		
Project Number ECM-2.1: Install Programable T-stats &	Locking Co	over							
	Qua	antity	Material/E	ALLEN & HOSHALL Material/Equip. Cost Labor Cost			Engin	eering Est	
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total	
DEMOLITION		1							
TOTAL DEMOLITION				\$0		\$0		\$0	
				ΨŪ		ψŪ		ψU	
MECHANICAL									
Install Programable T-stat & Locking Cover	1	EA	120.00	\$120	40.00	\$40	1.00	\$160	
				¢400		¢ 40		¢400	
TOTAL MECHANICAL				\$120		\$40		\$160	
ELECTRICAL									
TOTAL ELECTRICAL				\$0		\$0		\$0	
Sub-total								\$160	
Tax (Material @ 9.5%)								\$11	
Overhead & Profit (20%)								\$32	
Contingency (15%)								\$24	
TOTAL								\$227	

	ESTIMATE	E OF P	ROBABLI	E COST					
Project Name			Status of Desig	jn			Date	10040	
University City Municipal Buildings DES Building)		Estimated by				2/21/2012 Last Modified:		
City Hall			ALLEN & HOS				2/21/2012		
Project Number									
ECM-2.2: Install Plug Load Occupancy	Sensors								
	0		Matarial/F	quip. Cost	Labor	Cont	Engine	ering Est	
	Qua	-	-		1				
Item Description	Number	Unit Unit Cost		Total	Unit Cost	Total	Escalation	Total	
DEMOLITION									
TOTAL DEMOLITION				\$0		\$0		\$0	
			I						
MECHANICAL									
Install Plug Load Occupancy Sensors	55	EA	90.00	\$4,950	12.50	\$688	1.00	\$5,638	
TOTAL MECHANICAL				\$4,950		\$688		\$5,638	
		L	4 4	÷.,000		÷:00	L	<i>40,000</i>	
ELECTRICAL									

TOTAL ELECTRICAL				\$0		\$0		\$0		

Sub-total				\$5,638
Tax (Material @ 9.5%)				\$470
Overhead & Profit (20%)				\$1,128
Contingency (15%)				\$846
TOTAL				\$8,081

E	STIMAT	E OF PI	ROBABL	E COST					
Project Name			Status of Desig	gn			Date		
University City Municipal Buildings DES			.				2/21/2012		
Building Annex			Estimated by ALLEN & HOS				Last Modified: 2/21/2012		
Project Number			ALLEN & HUS	SHALL		2/2	1/2012		
ECM-2.3: Install Plug Load Occupancy Se	ensors								
	Qua	antity	Material/E	Equip. Cost	Labor	Cost	Engine	eering Est	
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total	
DEMOLITION									
				-					
TOTAL DEMOLITION				\$0		\$0		\$0	
	1	1					11		
MECHANICAL									
Install Plug Load Occupancy Sensors	75	EA	90.00	\$6,750	12.50	\$938	1.00	\$7,688	
		1	1						
TOTAL MECHANICAL	1	1		\$6,750		\$938		\$7,688	

ELECTRICAL										
TOTAL ELECTRICAL				\$0		\$0		\$0		

Sub-total				\$7,688
Tax (Material @ 9.5%)				\$641
Overhead & Profit (20%)				\$1,538
Contingency (15%)				\$1,153
TOTAL				\$11,019

EST		F PRO	BABLE CO	OST					
Project Name			Status of Desig	20			Date		
University City Municipal Buildings DES			Status of Desig	911				21/2012	
Building			Estimated by				Last Modified		
Annex			ALLEN & HOS	HALL				21/2012	
Project Number ECM-4.1: Unit Replacement									
	0	antity	Material/E	quin Cost	Lab	or Cost	Engineering Est		
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total	
DEMOLITION									
Demo 5-ton Condensing Unit and Evaporator Coil	1	EA	0.00	\$0	700.00	\$700	1.25	\$875	
Demo 3-ton Condensing Unit and Evaporator Coil	2	EA	0.00	\$0	700.00	\$1,400		\$1,750	
Demo 3-ton WSHP	3	EA	0.00	\$0	830.00	\$2,490		\$3,113	
TOTAL DEMOLITION				\$0		\$4,590		\$5,738	
-									
MECHANICAL									
Install 5-ton Condensing Unit & Evaporator Coil	1	EA	3450.00	\$3,450	1499.00	\$1,499	1.25	\$6,186	
Install 3-ton Condensing Unit & Evaporator Coil	2	EA	2310.00	\$4,620	772.00	\$1,544	1.25	\$7,705	
Install 3-ton Computer Room Unit with remote Condenser	2	EA	16100.00	\$32,200	1500.00	\$3,000	1.25	\$44,000	
Install 3-ton Split System HP	1	EA	3635.00	\$3,635	822.00	\$822	1.25	\$5,571	
TOTAL MECHANICAL				\$43,905		\$6,865		\$63,463	
ELECTRICAL									
Electrical Connection								r	
							<u> </u>		
TOTAL ELECTRICAL				\$0		\$0		\$0	
Sub-total			<u> </u>					\$60,200	

Sub-total				\$69,200
Tax (Material @ 9.5%)				\$4,171
Overhead & Profit (20%)				\$13,840
Contingency (15%)				\$10,380
TOTAL				\$97,591

E	STIMAT	e of Pi	ROBABL	E COST				
Project Name			Status of Desi	gn			Date	
University City Municipal Buildings DES							2/2	1/2012
Building			Estimated by				Last Modified:	
Heman Park Pool			ALLEN & HO	SHALL			2/2	1/2012
ECM-4.2: Pump Motor Replacement	0	antity	Material/	Equip. Cost	Labor	Cost	Engine	eering Est
Item Description	Number	Unit	Unit Cost	Total	Unit Cost	Total	Escalation	Total
DEMOLITION	1							
Remove Pump Motor	1	EA	0.00	\$0	150.00	\$150	1.25	\$188

MECHANICAL								
Install 40 hp pump motor	1	EA	2400.00	\$2,400	201.00	\$201	1.25	\$3,251
TOTAL MECHANICAL	1			\$2,400		\$201		\$3,251

ELECTRICAL									
TOTAL ELECTRICAL				\$0		\$0		\$0	
Sub-total								\$3,439	
Tax (Material @ 9.5%)								\$228	

Tax (Material @ 9.5%)				\$228
Overhead & Profit (20%)				\$688
Contingency (15%)				\$516
TOTAL				\$4.870

	ESTIM	ATE OF	PROBABL	E COST				
Project Name			Status of Design				Date	
University City Municipal Buildings D	DES						2/21/	2012
Building			Estimated by			Last Modified:		
Central Garage			ALLEN & HOSHA	LL			2/21/	2012
Project Number ECM-4.3: Unit Replacement								
	0		Material/Equ	vin Coot	Labor C	`aat	Enginee	ring Fot
Item Description	Number	antity Unit	Unit Cost	Total	Labor Cost Unit Cost Total		Engineering Est Escalation Total	
DEMOLITION	Number	Unit	Unit Cost	Total	Unit Cost	TOLAI	Escalation	Totai
Remove 2.5-ton Split System	1	EA	0.00	\$0	I	\$0	1.25	\$0
Remove 3-ton Split System	1	EA	0.00	\$0		\$0	1.25	\$0
TOTAL DEMOLITION				\$0		\$0		\$0
MECHANICAL								
Install 2.5-ton HP Split System	1	EA	3875.00	\$3,875	81.00	\$614	1.25	\$5,611
Install 3-ton HP Split System	1	EA	4375.00	\$4,375	520.00	\$812	1.25	\$6,484
TOTAL MECHANICAL				\$8,250		\$1,426		\$12,095
ELECTRICAL								
Electrical Connection								
TOTAL ELECTRICAL				\$0		\$0		\$0
Sub-total								\$12,095
Tax (Material @ 9.5%)								\$784
Overhead & Profit (20%)						-		\$2,419
Contingency (20%)								\$2,419
TOTAL								\$17,717