

ICF Marbek
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Energy Assessment

Public Archives and National Library Building

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A handwritten signature in black ink, appearing to read 'R. Patterson'.

Richard Patterson, P. Eng.

Executive Summary

SNC-Lavalin O&M (SNCLOM) retained ICF Marbek to conduct comprehensive energy assessments of two facilities for which SNCLOM provides building maintenance services under contract to Public Works and Government Services Canada:

- Public Archives and National Library Building (395 Wellington Street)
- St. Andrew's Tower (275 Sparks Street)

This report pertains to the Public Archives and National Library Building.

The objectives of the assessment were to assess the current energy performance of the facility, identify and evaluate potential energy and water reduction opportunities, and to develop recommendations for energy performance improvements. This study was carried out in support of the Canadian Government's Federal Sustainable Development Strategy as well as to satisfy requirements set out by the Building Owners and Managers Association (BOMA) for entry into their building certification program, BOMA BESt. The results provide SNCLOM with the information needed to plan and implement energy and cost reduction improvements in their facility operations as well as satisfy the energy audit requirement of the BOMA BESt program.

The results of the assessment indicate that there are significant opportunities for energy and cost savings in the areas of lighting retrofits, controls optimisation, and improved operations and maintenance.

Exhibit ES.1 overleaf provides a summary of the three recommended energy reduction measures evaluated in this study. As shown, the total cost savings for the measures are estimated to be \$175,000 per year, with an estimated implementation cost of \$560,000. The simple payback is 3.1 years, and the resulting GHG emissions reductions are 344 tonnes of eCO₂ per year.

The total savings represent a 24% reduction in electricity, a 13% decrease in steam, a 1% reduction in chilled water consumption, and a 5% decrease in water consumption. The implementation of these measures would decrease the energy intensity from the current baseline of 31.5 ekWh/ft²/year to a post-retrofit intensity of 27.1 ekWh/ft²/year, representing a 14% decrease in overall energy use and a 15% decrease in operating costs.

Exhibit ES.1 Measure Summary

Energy Reduction Measure	Electricity			Annual Savings				Water	Total	Estimated Total Cost	Simple Payback	GHG Reduction	
	[kWh/yr]	[kW]	[\$]	Steam	Chilled Water	Water	Total						
				[GJ/yr]	[\$]	[GJ/yr]	[\$]	[m ³ /yr]	[\$]	[\$]	[\$]	[years]	[teCO ₂]
Lighting Retrofit	598,262	190	\$77,205	0	\$0	0	\$0	0	\$0	\$77,205	\$474,578	6.1	83.5
Controls Optimisation	150,616	0	\$15,188	3,000	\$66,631	0	\$0	0	\$0	\$81,820	\$51,250	0.6	216.0
O&M Measures	0	0	\$0	675	\$14,995	60	\$1,400	314	\$1,092	\$17,487	\$30,000	1.7	44.7
Total	748,878	190	\$749,067	3,675	\$81,626	60	\$1,400	314	\$1,092	\$176,512	\$555,828	3.1	344.2
Baseline Consumption	3,098,255			27,485		6,044		5,940					2,297
Estimated Savings	24%			13%		1%		5%					15%
Post-Retrofit Target	2,349,377			23,810		5,984		5,626					1,953

Table of Contents

Executive Summary	i
1 Introduction	1
1.1 Background	1
1.2 Scope and Methodology	1
1.3 Acknowledgements	2
1.4 This Report	2
2 Facility Description	3
2.1 General	3
2.2 Space Utilization	3
2.3 Space Occupancy	3
3 Utility Data Analysis	4
3.1 Baseline Energy Use	4
3.2 Utility Rates	13
3.3 Energy End Use Breakdown	15
4 Mechanical and Electrical Systems	18
4.1 Heating and Cooling	18
4.2 Ventilation Systems	19
4.3 Lighting	21
4.4 Building Automation	23
4.5 Water	24
5 Energy Conservation Measures	25
5.1 Lighting Retrofit	25
5.2 Controls Optimisation	27
5.3 O&M Measures	28
Appendix A EAR Templates	A-1
Appendix B Measure Worksheets	B-1
Appendix C Energy Balance Reports	C-1

List of Exhibits

- Exhibit 1 Space Utilization Table3
- Exhibit 2 Baseline Energy Consumption5
- Exhibit 3 Historical Electricity Consumption Profile.....6
- Exhibit 4 Baseline Electricity Use Profile7
- Exhibit 5 Baseline Electricity Demand Profile8
- Exhibit 6 Historical Steam Use Profile9
- Exhibit 7 Baseline Steam Use Profile10
- Exhibit 8 Historical Chilled Water Use Profile10
- Exhibit 9 Baseline Chilled Water Use Profile.....11
- Exhibit 10 Historical Water Use Profile11
- Exhibit 11 Baseline Water Use Profile12
- Exhibit 12 Electrical End-Use Breakdown15
- Exhibit 13 Steam End-Use Breakdown.....16
- Exhibit 14 Water End-Use Breakdown17
- Exhibit 15 Main AHU Schedule19
- Exhibit 16 Lighting Fixture Breakdown.....21
- Exhibit 17 Water Fixture Schedule24
- Exhibit 18 Lighting Retrofit Measure Summary25
- Exhibit 19 Controls Optimisation Measure Summary27
- Exhibit 20 O&M Measure Summary28

1 Introduction

1.1 Background

SNC-Lavalin O&M (SNCLOM) retained ICF Marbek to conduct a detailed energy assessment of the Public Archives and National Library Building located at 395 Wellington Street, Ottawa. The objectives of this assessment are to assist SNCLOM in making asset investment decisions as part of the Canadian Government's Sustainable Development Strategy. This involves completing an evaluation of current energy use and potential energy and water reduction opportunities as well as the development of a set of recommendations for energy performance improvements.

These results provide SNCLOM with the information needed to plan and implement energy and cost reduction improvements in their facility operations.

1.2 Scope and Methodology

The scope and structure of this report is closely tied to the requirements set forward by SNCLOM in the original request for proposal. This methodology encompasses the following task areas and activities:

Facility Information

- Collection and review of facility information including available building documentation, drawings and maintenance logs
- Collection and review of electricity, steam, chilled water, and domestic water utility information over a five year period.

Site Audit

- Site visit to conduct walk-through audit of mechanical, electrical and architectural systems
- Lights-out audit to determine equipment runtime and occupant behaviours
- Interviews and discussions with facility personnel regarding operation and maintenance (O&M) practices and energy-efficiency issues

Analysis and Findings

- Utility data analysis
- Identification and evaluation of energy reduction measures, including estimates of project cost and associated energy savings
- Preparation of an energy model to verify calculations
- Preparation of a report to document the findings

1.3 Acknowledgements

ICF Marbek gratefully acknowledges the assistance of the following people in carrying out this study:

- Phil Berman, Project Manager, SNCLM
- Corey Reynolds, Energy Manager, SNCLM
- Eric Labbé, Technician, SNCLM

1.4 This Report

The remainder of this report is structured as follows:

- **Section 2 Facility Description** provides an overview of the facility's demographics including building type, age, size and construction.
- **Section 3 Utility Data Analysis** presents the results of the analysis of utility data including historical consumption, energy end-use analysis, and a utility billing overview.
- **Section 4 Mechanical and Electrical Systems** presents a summary of the mechanical and electrical systems within the building including building envelope, lighting, HVAC, DHW and plug loads.
- **Section 5 Energy Conservation Measures** presents a summary of the financial justification for each proposed measure including the total project cost, energy cost savings, simple payback period and reduction in GHG emissions.

2 Facility Description

2.1 General

The Public Archives and National Library building was purpose built between 1963 and 1967 to serve as a library, office and storage space for the National Library, as well as Public Archives Canada. PANL consists of a nine storey tower central tower, five mezzanine levels, two four storey wings which flank the building on the east and west sides, and a fan shaped auditorium and loading dock on the west side. The gross area of the building is 47,691 m² and the rentable area is 31,959 m². The facility is Crown-owned and managed by SNC-Lavalin O&M under contract to Public Works and Government Services Canada.

2.2 Space Utilization

Overall space utilization is described in Exhibit 1 below and descriptions of each main area are included below the table.

Exhibit 1 Space Utilization Table

Space Category	Floor(s)	% of Space
General Office Areas	G, 2, 3, 4	24%
Storage	B3, B2, B1, 6, 7, 8	66%
Lab	4	4%
Mechanical	Basement, Penthouse	5%
Other	All	1%

- General Office Areas
 - This includes office space and administrative areas.
- Storage
 - These spaces are used for the storage of various media including paper, audiotape, and videotape.
- Labs
 - Includes spaces for specialised equipment.
- Mechanical
 - Includes spaces for mechanical and electrical equipment.
- Other
 - Miscellaneous spaces.

2.3 Space Occupancy

The ground floor and floors 2, 3, 4, and 5, are accessible to the public. Hours of operation vary by collection with the longest schedule being from 8 am to 11 pm on weekdays and 10 am to 6 pm on Saturdays. There are 274 full time equivalent employees in the building, mostly occupying floors ground to 5. The basement levels and floors 6 to 8 are used for storage.

3 Utility Data Analysis

This section presents the results of the analysis of electricity, steam, chilled water and water consumption data over the most recent full year of data and includes the following:

- Baseline energy use
- Energy end-use estimates
- Utility rates

The results of these analyses yielded valuable insights into all aspects of building energy performance and efficiency and helped to identify and inform the proposed energy-efficiency measures.

3.1 Baseline Energy Use

The baseline energy profile is typically selected using the most recent full year with available utility data. For PANL, this is the 2013 calendar year.

This baseline was used to calibrate energy end-use estimates and as the reference case for calculating energy savings. All costs shown in the baseline are actual; all savings calculations are generated using the current rates identified in Section 3.2. Exhibit 2 presents the baseline energy use and costs; Exhibits 3 presents the historical electricity consumption profile, Exhibits 4 and 5 present the baseline electricity consumption and demand profiles; Exhibits 6 and 7 present the historical steam and baseline steam use profiles; Exhibits 8 and 9 present the historical chilled water and baseline chilled water use profiles; Exhibits 10 and 11 present the historical water and baseline water use profiles.

Key Observations

A review of the baseline energy and water cost profiles reveals that:

- The total annual utility costs for the site are approximately \$1,165,000. Electricity costs amount to \$348,646 (30% of total costs), steam accounts for \$652,528 (56% of total costs), chilled water accounts for \$145,040 (12% of total costs), and water accounts for \$19,055 (2% of total costs).
- The annual electrical consumption is 3,098 MWh, the annual steam consumption is 7,635 eMWh, and the annual chilled water consumption is 1,679 eMWh, resulting in a total site energy intensity of 31.5 ekWh/ ft²/yr. This is better than the Canadian average energy intensity for office buildings of 36.7 ekWh/ ft²/yr by 14%, as reported by Natural Resources Canada¹.
- The annual water consumption is 5,940 m³ which results in an intensity of 15.1 L/ft²/yr. This is lower than the Canadian average of 188.7 L/ft²/yr by 92%, as reported by Sustainable Development Technology Canada².

¹ 2010 BOMA BEST Energy and Environmental Report, p. 33

² 2010 BOMA BEST Energy and Environmental Report, p. 46

Exhibit 2 Baseline Energy Consumption

2013	Electricity				Steam				Chilled Water				Water			Total			
	Usage [kWh]	Intensity [kWh/ft ²]	GHG Emissions [teCO ₂]	Cost [\$]	Usage GJ	Intensity [ekWh/ft ²]	GHG Emissions [teCO ₂]	Cost [\$]	Usage GJ	Intensity [ekWh/ft ²]	GHG Emissions [teCO ₂]	Cost [\$]	Usage [m ³]	Intensity [L/ft ²]	Cost [\$]	Usage [ekWh]	Intensity [ekWh/ft ²]	GHG Emissions [teCO ₂]	Cost [\$]
Jan	289,791	0.7	40.5	\$27,792	4,071	2.9	264.6	\$100,139	0	0.0	0.0	\$0	350	0.9	\$669	1,420,714	3.6	305.0	\$128,600
Feb	263,385	0.7	36.8	\$30,128	3,609	2.5	234.5	\$88,789	0	0.0	0.0	\$0	371	0.9	\$1,177	1,265,965	3.2	271.3	\$120,094
Mar	281,331	0.7	39.3	\$28,139	3,168	2.2	205.9	\$77,940	0	0.0	0.0	\$0	419	1.1	\$1,319	1,161,401	2.9	245.2	\$107,398
Apr	257,321	0.7	35.9	\$29,416	2,602	1.8	169.1	\$60,323	0	0.0	0.0	\$0	413	1.0	\$1,319	980,156	2.5	205.0	\$91,058
May	261,644	0.7	36.5	\$27,288	1,857	1.3	120.7	\$43,055	848	0.6	11.0	\$20,345	357	0.9	\$1,214	1,013,093	2.6	168.2	\$91,901
Jun	242,328	0.6	33.8	\$27,801	1,104	0.8	71.7	\$25,583	972	0.7	12.6	\$23,330	1,315	3.3	\$4,161	819,040	2.1	118.2	\$80,875
Jul	236,968	0.6	33.1	\$31,206	1,019	0.7	66.2	\$23,618	1,685	1.2	21.8	\$40,431	675	1.7	\$2,311	988,139	2.5	121.1	\$97,565
Aug	232,716	0.6	32.5	\$20,999	1,166	0.8	75.8	\$27,036	1,543	1.1	20.0	\$37,022	147	0.4	\$502	985,276	2.5	128.2	\$85,558
Sep	223,425	0.6	31.2	\$30,632	1,269	0.9	82.5	\$29,411	935	0.7	12.1	\$22,442	619	1.6	\$2,046	835,696	2.1	125.8	\$84,531
Oct	251,227	0.6	35.1	\$26,963	1,436	1.0	93.3	\$33,276	61	0.0	0.8	\$1,470	539	1.4	\$1,816	667,094	1.7	129.2	\$63,525
Nov	247,441	0.6	34.6	\$26,511	2,386	1.7	155.1	\$55,315	0	0.0	0.0	\$0	351	0.9	\$1,186	910,272	2.3	189.6	\$83,011
Dec	310,680	0.8	43.4	\$41,771	3,798	2.7	246.8	\$88,044	0	0.0	0.0	\$0	384	1.0	\$1,336	1,365,764	3.5	290.2	\$131,151
Total	3,098,255	7.9	432.7	\$348,646	27,485	19.4	1,786.2	\$652,528	6,044	4.3	78.1	\$145,040	5,940	15.1	\$19,055	12,412,611	31.5	2,297.0	\$1,165,269

Exhibit 3 shows the historical electricity consumption from May 2005 to July 2014. Consumption dropped significantly between October 2008 and June 2009 as a major retrofit project was completed. There was a significant spike in consumption in the winter of 2009 due to the temporary installation of electric boilers to provide heating while the output of the central steam plant was reduced due to repairs. The boilers have since been decommissioned and removed. Annual consumption continued to decline from 2011 onwards, but has begun to increase in the first part of 2014.

Exhibit 3 Historical Electricity Consumption Profile

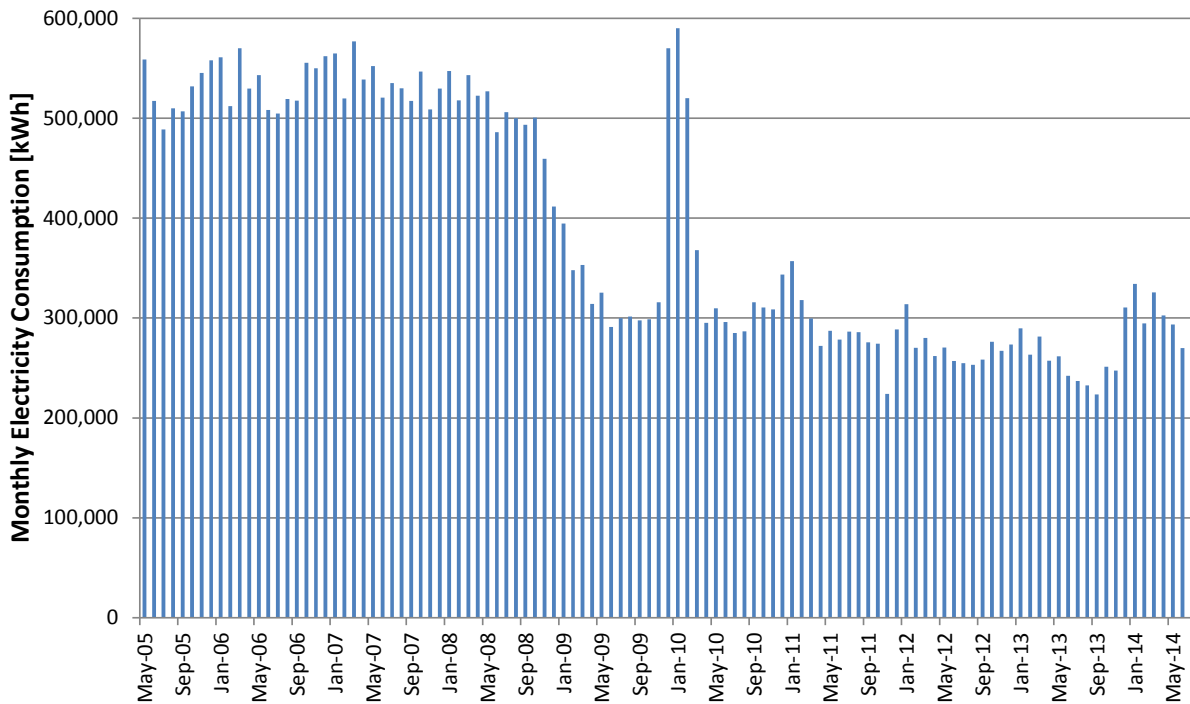


Exhibit 4 shows the monthly electricity use profile for 2013. The building has a fairly constant baseload throughout the year, with an increase in the winter months that is mainly due to pumping energy for the hydronic heating systems.

Exhibit 4 Baseline Electricity Use Profile

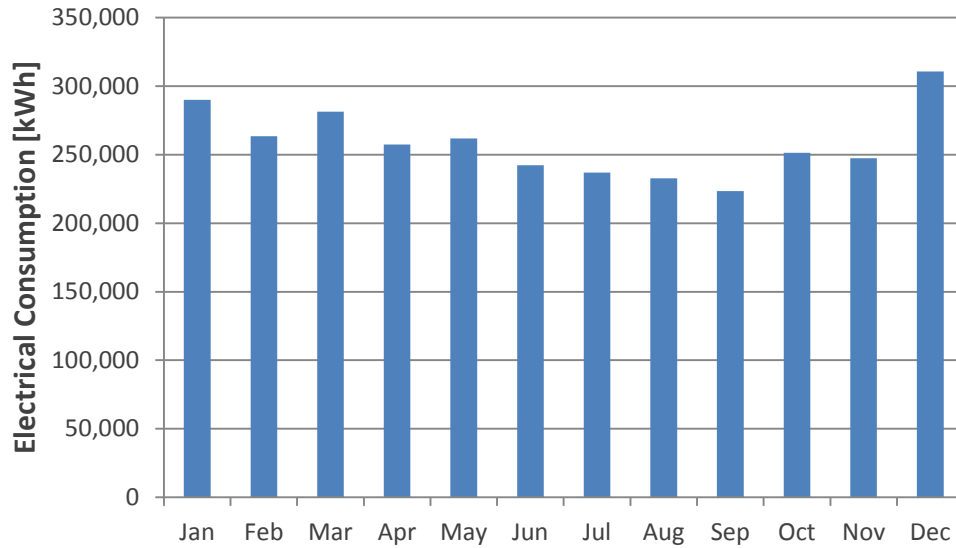


Exhibit 5 shows the daily maximum and minimum electricity demand profile from September 1, 2013 to August 30, 2014. The building has a daytime baseload of approximately 475 kW and a nighttime baseload of approximately 275 kW.

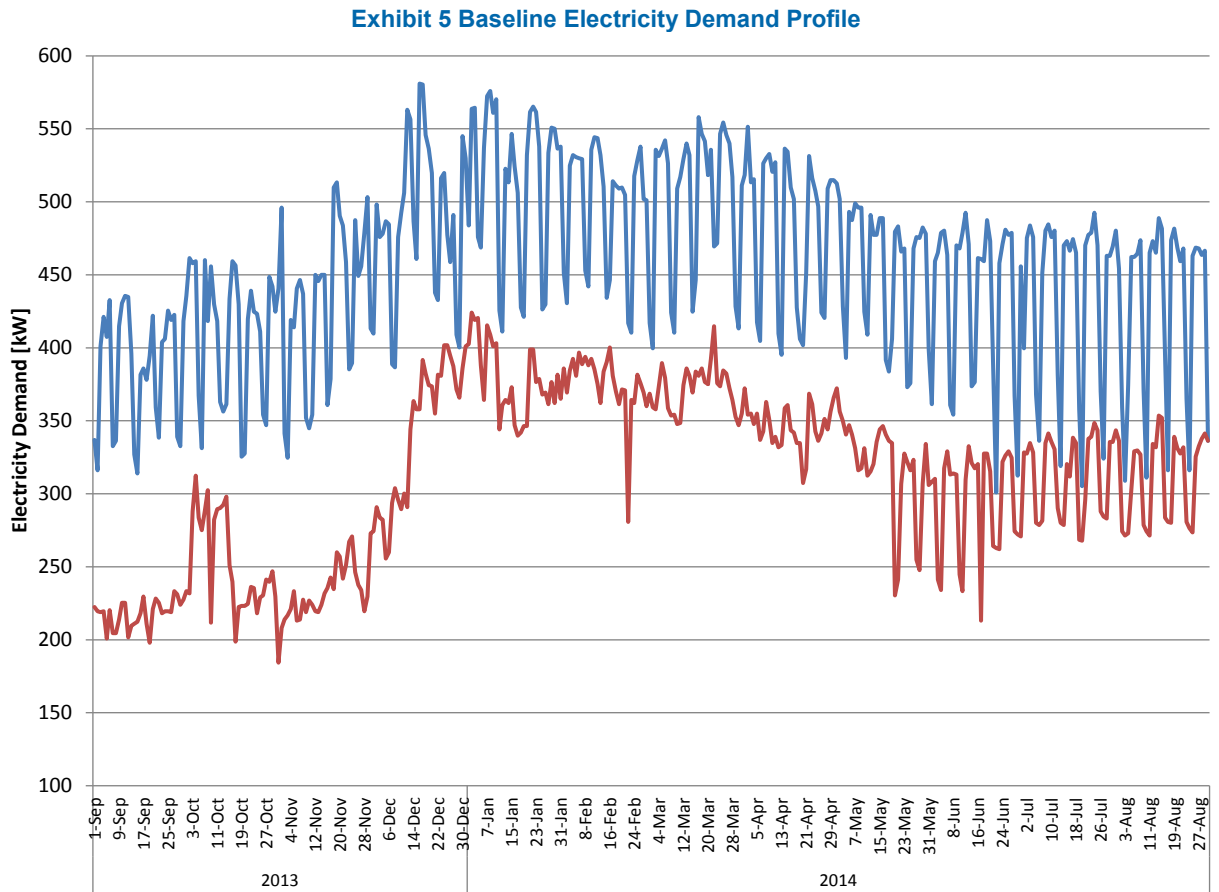


Exhibit 6 shows the historical steam use profile from May 2005 to July 2014. Annual steam use dropped in 2009, coinciding with the reduced output of the central steam plant. Normal steam production resumed the following winter, but consumption remained lower due to the completion of a retrofit project in 2009. Steam consumption correlates well with heating degree days, indicating a good control strategy.

Exhibit 6 Historical Steam Use Profile

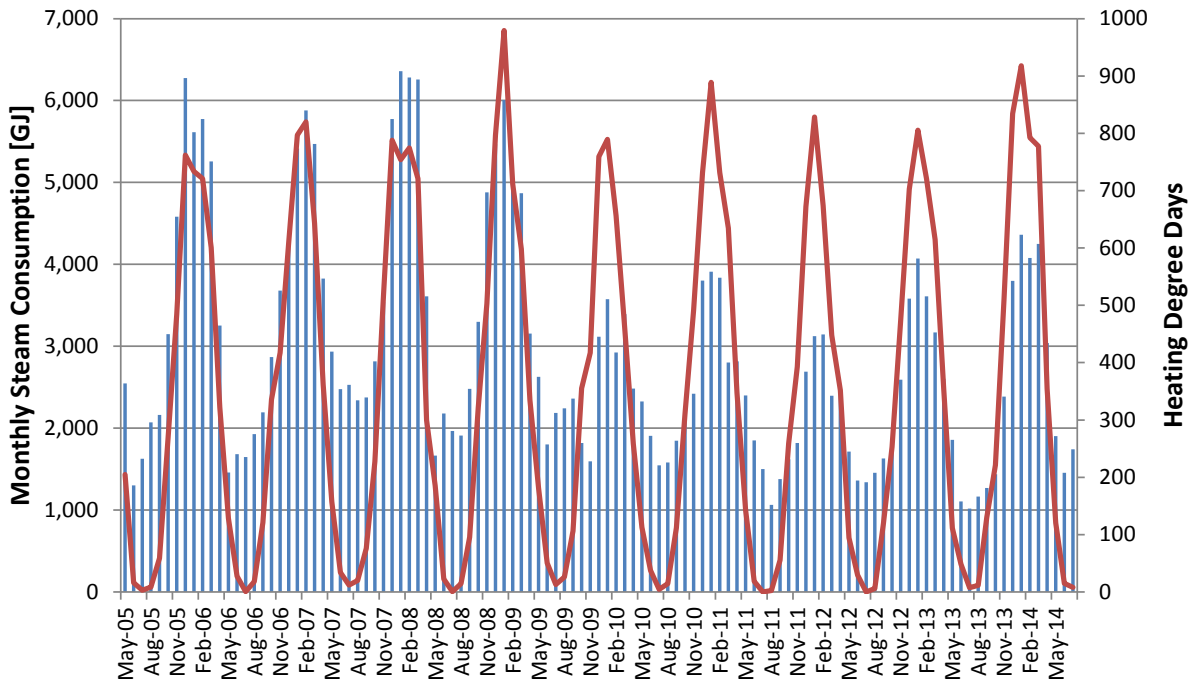


Exhibit 7 shows the monthly steam use profile for 2013. There is a baseload that serves domestic hot water production and terminal reheat in the VAV boxes. There is a predictable increase in the winter months due to space heating loads.

Exhibit 7 Baseline Steam Use Profile

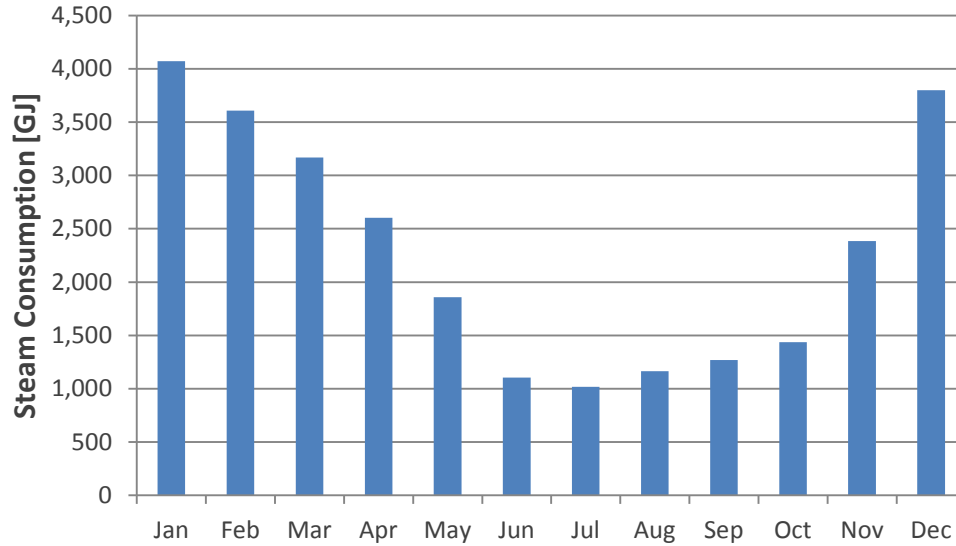


Exhibit 8 shows the historical chilled water use profile from May 2005 to July 2014. Consumption as a function of cooling degree days has decreased since the completion of a retrofit project in 2009.

Exhibit 8 Historical Chilled Water Use Profile

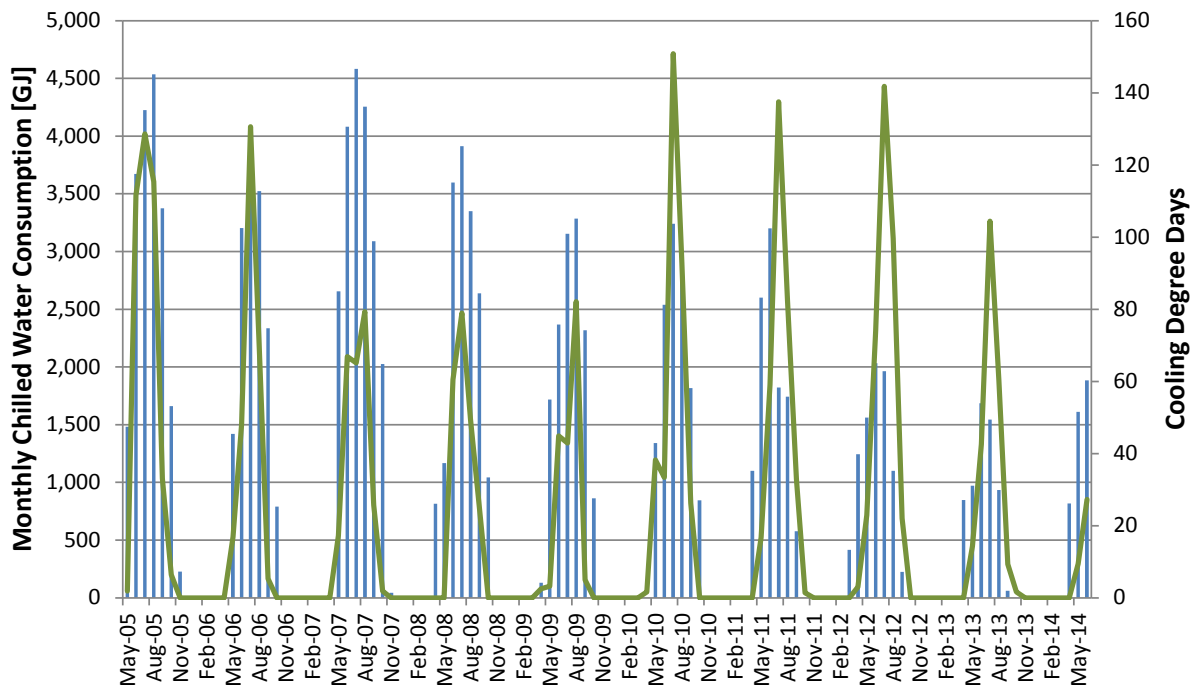


Exhibit 9 shows the monthly chilled water use profile for 2013. Consumption correlates well with the space cooling load on the building, and there are no baseload cooling demands served by chilled water.

Exhibit 9 Baseline Chilled Water Use Profile

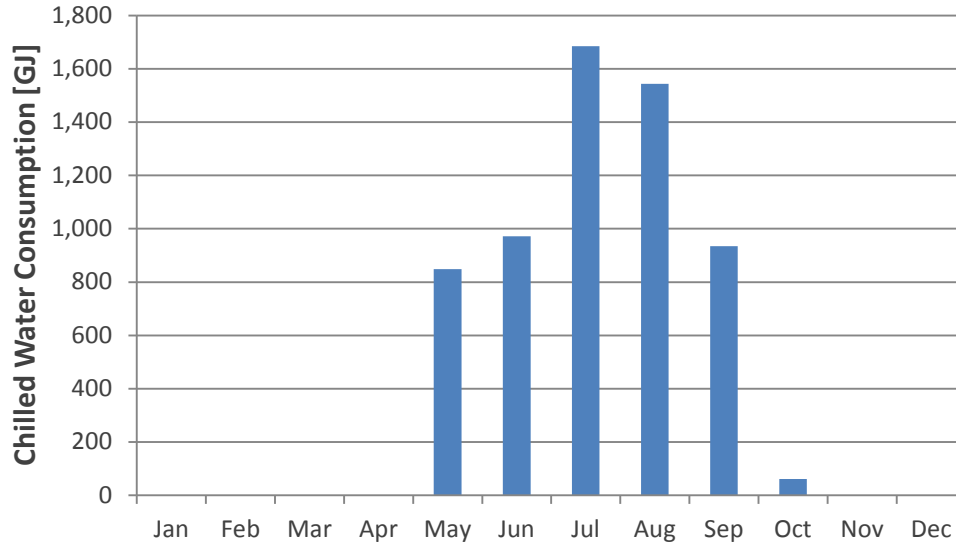


Exhibit 10 shows the historical water use profile from May 2005 to July 2014. Annual water consumption drops significantly from 2010 to 2011, a result of a water fixture retrofit.

Exhibit 10 Historical Water Use Profile

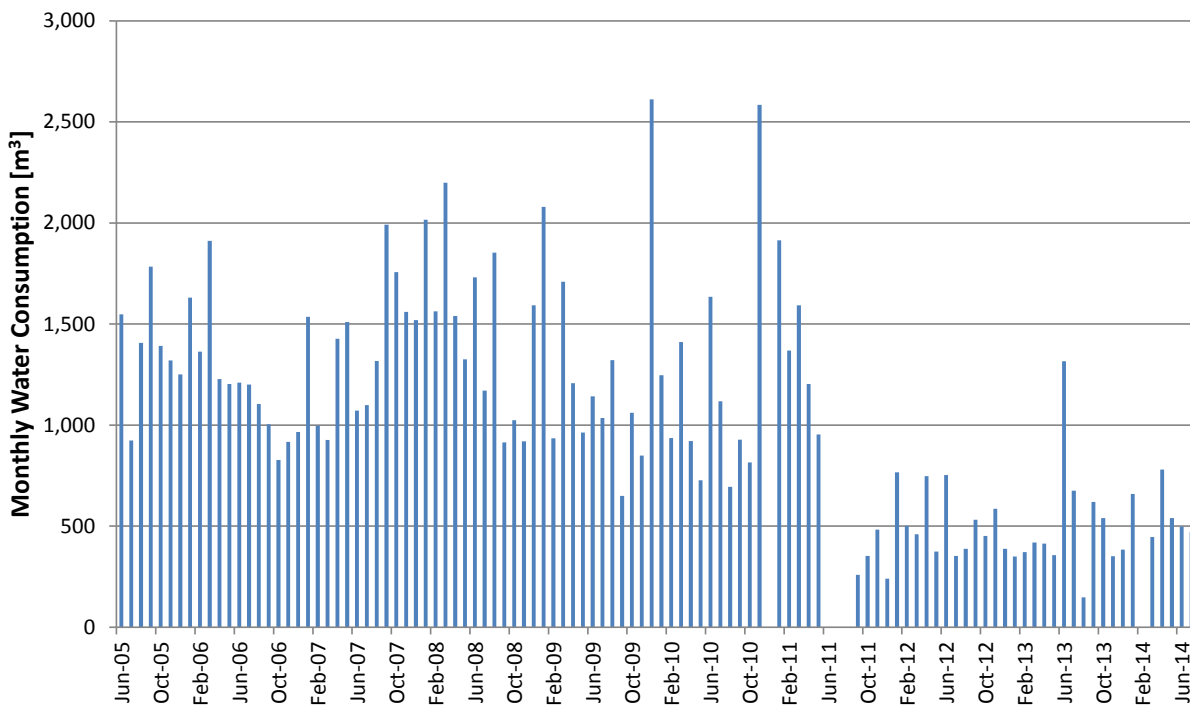
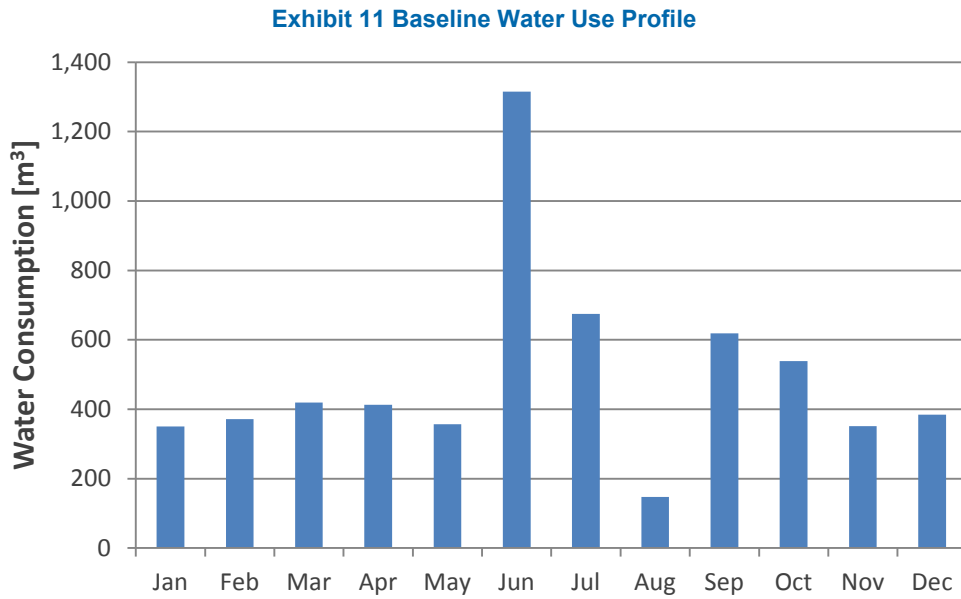


Exhibit 11 shows the monthly water use profile for 2013. Water bills are typically regarded as the least reliable for identifying trends due to infrequent meter reading, so the spike in June consumption is likely due to a billing correction as water use for irrigation is not significant, and there is no water cooled equipment in the facility.



3.2 Utility Rates

This sub section presents an overview of utility services and rates for electricity, steam, chilled water, and water. The utility costs were used in this study for the purposes of calculating marginal costs to accurately assess savings. Avoided costs are based on the current marginal rates sourced from the utility's billing structure.

3.2.1 Electricity

Electricity is provided to PANL by Hydro Ottawa through their C4 (1,500-5,000 kW) rate for commercial customers. The rate is structured as follows:

- Static Charges
 - Monthly Charge: \$4,140.11/month
- Consumption Charges
 - Regulatory Charge: 0.57 cents/kWh
 - Debt Retirement Charge: 0.694 cents/kWh
- Demand Charges
 - Transmission Network Charge: \$3.142/kW
 - Transmission Connection Charge: \$1.7223/kW
 - Hydro Ottawa Delivery Charge: \$2.5925/kW
 - Global Adjustment: -\$0.05363/kW
 - Low Voltage Services Charge: \$0.02516/kW

In addition, there are consumption charges set by the Independent Electricity System Operator. These are adjusted monthly, so the average cost to date for 2014 has been used. At the time of this report, the most recent data available was for August 2014.

- Consumption Charges
 - Average Weighted Hourly Price: 4.57 cents/kWh
 - Global Adjustment (Class B): 4.25 cents/kWh

Using this rate structure, the marginal electrical rates used for this study are **10.08 cents per kWh and \$7.41 per kW**.

3.2.2 Steam

Steam is provided by the Cliff Street Central Heating Plant. The rate appears to have been adjusted in April 2014, and the current price is \$22.21/GJ. For the purposes of this study, the marginal steam rate used is **\$22.21 per GJ**.

3.2.3 Chilled Water

Chilled Water is provided by the Cliff Street Central Heating Plant. The average rate for 2014 is \$23.17/GJ. For the purposes of this study, the marginal chilled water rate used is **\$23.17 per GJ**.

3.2.4 Water

Water is supplied to the PANL by the City of Ottawa at the following rates:

- Water Rate: \$1.603 per m³
- Sewer Rate: \$1.876 per m³ (117% of water charge)

Therefore, the marginal rate for avoided water costs is **\$3.479 per m³**.

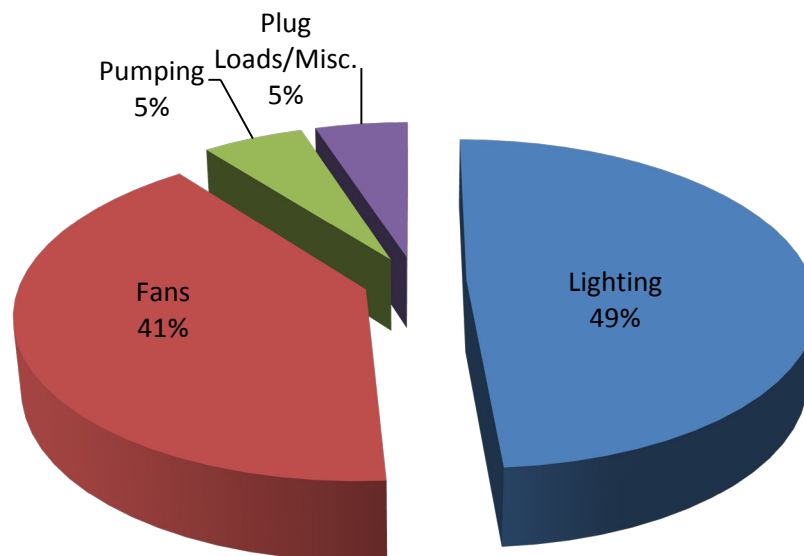
3.3 Energy End Use Breakdown

Estimates of energy end-use consumption were carried out for electricity, steam, chilled water and water. End-use estimates were calculated using spreadsheet-based tools in conjunction with a review of utility profiles. Specific energy uses that may overlap several categories are explained in their respective sections. Please see [Appendix C](#) for the original ICF Marbek energy balance reports.

3.3.1 Electricity

Exhibit 12 illustrates the electrical energy end-use distribution. The approach used was to develop a ground-up estimate of each electricity user in the building, calibrated to utility data. The following four end uses shown below were identified to have an electrical impact.

Exhibit 12 Electrical End-Use Breakdown

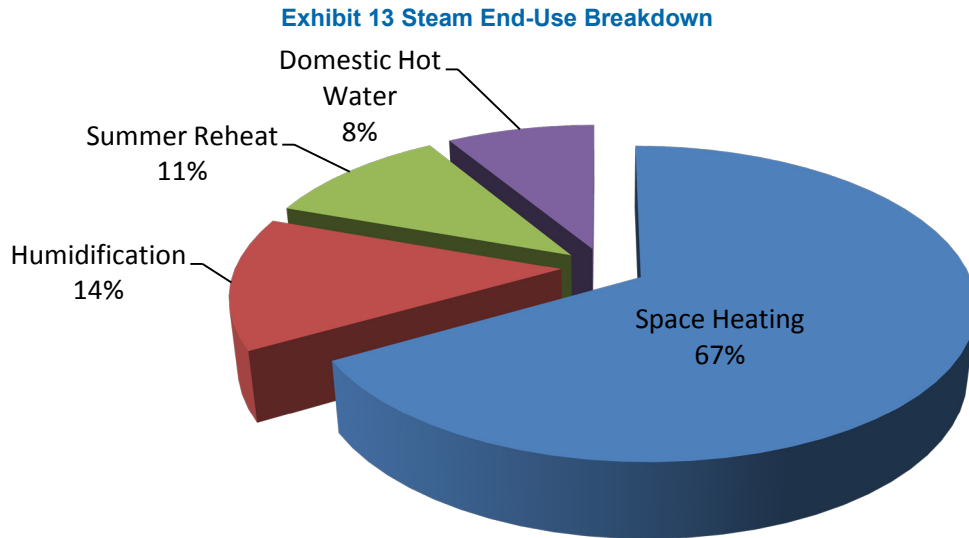


Observations on Electrical End-Use Breakdown:

- Lighting: 49%
 - The lighting energy consumption makes up a larger portion of the electrical energy consumption than is typical due to the fact that the building has no electrical heating or cooling loads. The lighting power density and energy consumption is within the expected range.
- Fans: 40%
 - The facility has several major air handling systems which operate on a long schedule.
- Pumping: 5%
 - Pumping energy is higher than expected due to the terminal reheat loop operating all year round.
- Plug Loads/Misc.: 5%
 - The energy consumption in this category is low because many areas are used for document storage and have no significant plug load.

3.3.2 Steam

Exhibit 14 illustrates the steam end use distribution for PANL, created using collected data in conjunction with the utility bills. We have found that there are four distinct end uses as shown below.



Observations on Steam End-Use Breakdown:

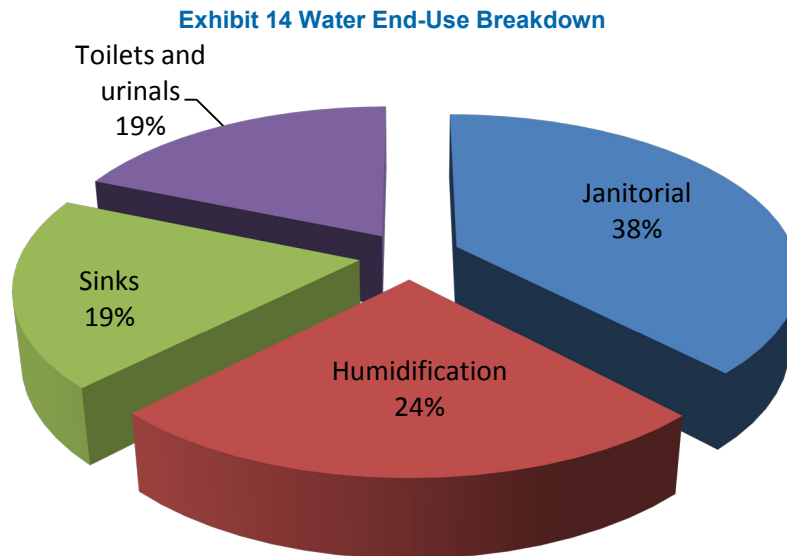
- Space Heating: 67%
 - This is within the expected range considering that all space heating is provided by steam.
- Air Handler Humidification: 14%
 - This value is within the expected range as humidification for ventilation air is provided exclusively by steam.
- Summer Reheat: 11%
 - This represents the load on the terminal reheat coils in the summer months.
- Domestic Hot Water: 8%
 - This value is within the expected range.

3.3.3 Chilled Water

The entirety of the chilled water consumption at PANL is used for space cooling loads.

3.3.4 Water

Exhibit 14 illustrates the water end use distribution for PANL, created using collected data in conjunction with the utility bills. We have found that there are four distinct end uses as shown below.



Observations on Water End-Use Breakdown:

- Janitorial: 38%
 - This category is proportionally higher as the water fixtures are more efficient than average.
- Humidification: 24%
 - This represents the water consumed by the steam to steam humidifiers.
- Sinks: 19%
 - This falls within the expected range.
- Toilets and Urinals: 19%
 - Most toilets and urinals were replaced with low flow models in a 2011 retrofit.

4 Mechanical and Electrical Systems

This section provides a concise description of PANL's energy consuming systems. Refer to Section 5 for details of recommended energy conservation measures.

4.1 Heating and Cooling

System Description

The Cliff Street Central Heating and Cooling Plant (CHP) supplies steam and chilled water to PANL. The steam pressure is reduced in the penthouse mechanical room from 23 psi to 9 psi for space heating, domestic hot water, and humidification. All condensate is collected and then supplied back to the CHP.

The main air handling units are equipped with heating coils, and VAV boxes provide terminal reheat. Space heating is provided by perimeter radiation units.

Humidification is supplied by steam to steam generators supplying the main air handling units.

Most space cooling is provided by chilled water coils in the main air handling units, but there are a few dedicated cooling systems such as a Liebert unit serving a mechanical room office and lunch room. There are no base loads in the building that require year round cooling. The pressure of the chilled water supply is sufficient to provide circulation and there are no additional chilled water pumps located within the building.

Audit Findings

- There is uninsulated steam piping in some of the mechanical rooms in the facility, as well as uninsulated steam traps.
- There is not a significant amount of electric heating in the building.
- The terminal reheat loop operates year round, adding a significant amount of steam to the baseload energy consumption.



From Left: Pressure reducing valves for central steam supply, perimeter radiant heater on the ground floor, perimeter heating loop pumps

4.2 Ventilation Systems

System Description

Ventilation is provided by six main air handling units serving ten zones within the building. Additional smaller units serve specific areas such as the auditorium and cafeteria. The largest units are listed in Exhibit 15 below. This section is intended to provide an overview of the systems as well as general recommendations; specific details on measures are included in Section 5.

Exhibit 15 Main AHU Schedule

AHU #	Serving	Type	Volume	Motor	Heating Coil	Cooling Coil	Humidification	Hours of Operation
			[cfm]	Supply/Return [HP]				
S1	Stack Area West	VAV	36,300	40 / none	Hot Water	Chilled Water	Steam	Constant
S2	Stack Area East	VAV	42,995	40 / none	Hot Water	Chilled Water	Steam	Constant
S3	West End West Zone	VAV	43,709	40 / none	Hot Water	Chilled Water	Steam	6am-11pm
S3A	West End Interior Zone	VAV	20,472	20 / none	Hot Water	Chilled Water	Steam	6am-11pm
S4	West End Interior Zone	VAV	18,166	15 / none	Hot Water	Chilled Water	Steam	6am-11pm
S4A	West End North Zone	VAV	23,320	25 / none	Hot Water	Chilled Water	Steam	6am-11pm
S5	East End East Zone	VAV	48,600	50 / none	Hot Water	Chilled Water	Steam	Constant
S5A	East End South Zone	VAV	11,384	10 / none	Hot Water	Chilled Water	Steam	Constant
S6	East End Interior Zone	VAV	8,570	10 / none	Hot Water	Chilled Water	Steam	6am-11pm
S6A	East End North Zone	VAV	50,235	50 / none	Hot Water	Chilled Water	Steam	6am-11pm
S7	Cafeteria	CV		5 / none	Hot Water	Chilled Water	Steam	Constant
S8	9th Floor Mech. Rm.	CV	6,000	2 / none	-	-	-	Constant
	Ehibition Room C	CV	5,300	7.5 / none	Hot Water	Chilled Water	Steam	Constant
S11	Auditorium	CV	12,100	10 / none	Hot Water	Chilled Water	Steam	Constant
S13	Basement Mech. Rm.	CV	8,200	15 / none	-	-	-	Constant
R1	Stack Area West	VAV	22,500	none / 10	-	-	-	Constant
R2	Stack Area East	VAV	26,500	none / 10	-	-	-	Constant
R3	West End	VAV	65,150	none / 25	-	-	-	Constant
R4	East End	VAV	74,150	none / 30	-	-	-	Constant
R7	Auditorium	VAV	8,000	none / 3	-	-	-	Constant
R8	Basement Mech. Rm.	CV	8,200	none / 3	-	-	-	Constant

Exhaust Fans

There is a network of exhaust fans located throughout the building, the largest of which serve the washrooms and the cafeteria.

Audit Findings

- Facility staff were not able to access the schedules for the main ventilation fans. The fan schedules used in this report were based on information provided by the facility staff.
- Most of the main ventilation fans were equipped with VFDs during a recently completed ESCO project. Staff report that there have been issues with pressurisation by some of the relief fans since then. In particular, R3 was operating at 32.5% speed and the air was observed to be flowing in the wrong direction at low speed during the audit. This issue needs to be rectified through air balancing, but it is unlikely to result in any energy savings.
- Approximately 25% of the VAV boxes have lost communication with the BAS due to poor signal strength or low battery power.
- Several of the exhaust fans are not included on the BAS, and are not scheduled.



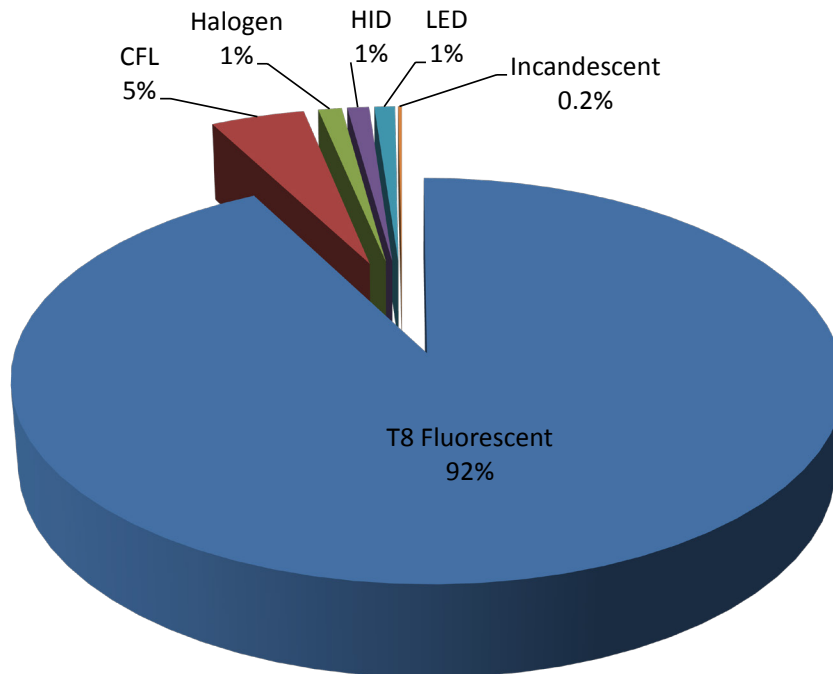
From Left: Supply fan S6-A, VFD on ventilation fan, smoke exhaust fans

4.3 Lighting

System Description

Exhibit 16 below shows the breakdown of lamps found in the PANL building. For more detailed information as well as a line-by-line summary of replacement recommendations, please see [Appendix A](#) for the lighting spreadsheet included in the set of EAR templates.

Exhibit 16 Lighting Fixture Breakdown

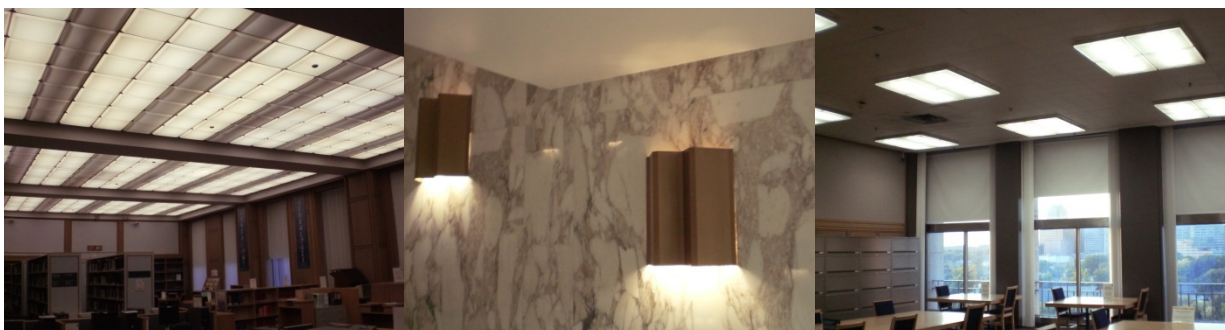


Observations on Lighting Breakdown:

- T8 Fluorescent: 92%
 - The majority of the general area and office lighting is provided by 4' T8 fluorescent fixtures utilising electronic ballasts. Lamps are a mixture of 32W, 28W, and 25W models. There is a smaller quantity of T8 U-bend fixtures and 2' 17W T8 fixtures.
- Compact Fluorescent: 5%
 - The majority of these lights are architectural pot lights in the public areas.
- Halogen: 1%
 - These are used as general area lighting in the 5th floor cafeteria.
- HID: 1%
 - The main lobby contains recessed mercury vapour lamps. The remaining HID fixtures make up the majority of the outdoor lighting fixtures, and are photocell controlled.
- LED: 1%
 - These are used primarily in the architectural wall sconces in the main stairwell, and there is a small quantity of exterior floodlight fixtures.
- Incandescent: 0.2%
 - All of the incandescent lights are used on the exterior of the building.

Audit Findings

- Almost all general area lighting consists of T8 fluorescent lamps coupled with electronic ballasts. The fixtures were retrofitted from T12 in a recently completed ESCO project.
- Only 28W T8 lamps were found in stock, but most spaces have a variety of lamp types including 25W, 28W, and 32W lamps.
- The lights out audit revealed that most of the lights were on in the public spaces even when rooms were unoccupied.
- Building operators report that there have been issues with the lighting control system shutting lights off unexpectedly.
- A review of the hourly electricity demand profile indicates that the lighting control system appears to be turning the lights on in the morning automatically at around 3 am every day. This scheduled point can be removed from the programming as staff can turn on the lights if and when they enter the building. It may also be possible that the load increase is due to fans operating outside of their desired schedule, but based on the loads involved, the lighting appears to be the more likely explanation.
- Illuminance levels as measured with a photometer were found to be meet IESNA recommended guidelines.



From Left: Lighting recessed above ceiling panels, wall sconces along staircase, typical recessed fixtures

4.4 Building Automation

System Description

The facility utilizes a Siemens Apogee BAS to control the major ventilation systems, and the heating and cooling systems.

There is a Douglas Lighting control system which controls the lights on the ground floor, 2nd floor, 3rd floor, and 4th floor.

A number of smaller systems, particularly the exhaust fans, are not included on the BAS and do not have any standalone controllers.

Audit Findings

- Facility staff report that they are not able to access setpoints for many of the operating parameters, including temperature and VFD speeds.
- Approximately 25% of the VAV boxes have lost communication with the BAS due to poor signal strength or low battery power. Staff report that the battery life on several VAV boxes is significantly shortened because of low signal strength in certain areas of the building.
- The lighting control system appears to be turning the lights on in the morning automatically at around 3 am every day. This scheduled point can be removed from the programming as staff can turn on the lights if and when they enter the building.

4.5 Water

System Description

Domestic Hot Water

The main domestic hot water system consists of two steam to hot water heat exchangers which are supplied by the central steam connection. There is one decommissioned electric hot water tanks that was installed when the Cliff Street plant was operating at reduced capacity.

Plumbing Fixtures

Exhibit 17 below shows schedule of water consuming fixtures in the facility.

Exhibit 17 Water Fixture Schedule

Type	Fixture Mounting	Supply	Quantity	Flow Rate
Toilet	Floor	Tank	22	13 LPF
Toilet	Floor	Valve	80	6 LPF
Urinal	Wall	Valve	28	0.5 LPF
Sink	Wall	Valve	54	7.6 LPM
Sink	Wall	Valve	85	3.8 LPM
Shower	Wall	Valve	2	12 LPM

Audit Findings

- New 1.0 gpm faucet aerators were meant to be installed on all of the sinks in the building during a prior retrofit, but a few sinks still have 2.0 gpm aerators and a few are missing aerators.



From Left: Domestic hot water heat exchanger, typical sink arrangement, motion sensor controlled urinals

5 Energy Conservation Measures

This section summarizes the potential energy efficiency measures. It includes a discussion of each measure, a description of the existing system, and the results of the financial analysis. Further information, including internal rate of return (IRR), net present value (NPV), and a list of assumptions made for each measure can be found in [Appendix B](#).

5.1 Lighting Retrofit

Description of Existing System

Most office and general area lighting is provided by 4' T8 fluorescents. Lamps are a mixture of 25W, 28W, and 32W models. There are also a number of halogen fixtures used for architectural and general area lighting. Exterior lighting is incandescent and HID.

Proposed Energy Efficiency Measures

The following lighting measures are proposed:

- Relamp all 4' T8 fixtures with 16.5W LED lamps.
- Relamp all T8-U fixtures with 16.5W LED lamps.
- Relamp all 2' T8 fixtures with 8.5W LED lamps.
- Relamp all halogen fixtures in the 5th floor cafeteria with LED lamps.
- Relamp all MR16 halogen fixtures on the ground floor with LED lamps.
- Replace all exterior HID fixtures with LED fixtures.
- Replace all incandescent fixtures with LED fixtures.

Exhibit 18 below presents a summary of the financial justification for the measure including total project cost, energy cost savings, simple payback period, and GHG emissions reduction. Refer to [Appendix B](#) for details of costs and savings.

Exhibit 18 Lighting Retrofit Measure Summary

Energy Reduction Measure	Electricity			Total Savings [\$]	Estimated Cost [\$]	Simple Payback [Years]	GHG Reduction [teCO ₂]
	[kW]	[kWh]	[\$]				
Lighting Retrofit	190	598,262	\$77,205	\$77,205	\$474,578	6.1	83.5

Impact on Operations and Maintenance

The frequency of lamp replacements will be reduced as the lifetime of the LED lamps is greater than that of the fluorescent lamps.

Estimated Service Life

- LED lamps – 50,000 hours.

Implementation Guidelines

- It is important that this retrofit results in light levels that are within the guidelines of the IESNA. It is recommended to carry out a full lighting photometric study and/or a pilot project before proceeding with the full implementation of this measure in order to ensure that the resulting light levels are within the applicable guidelines for all of the spaces.
- The proposed LED lamps are designed to be compatible with most electronic ballasts. Ballast compatibility should be confirmed before the retrofit takes place.

Available Incentives

The Ontario Power Authority offers incentives for energy savings projects through the saveONenergy program. It is estimated that this lighting retrofit may qualify for \$60,000 of incentive financing, which would have the effect of reducing the project's simple payback time from 6.1 years to 5.4 years. Please note that the project costs shown in Exhibit 18 do not include the potential incentive payments. Hydro Ottawa should be consulted for details of the requirements and payments for incentive programs. The website for this program can be found at <https://www.saveonenergy.ca>, and provides details on the types of incentives available.

5.2 Controls Optimisation

Description of Existing Systems

A review of the HVAC and lighting system controls and operations has identified several opportunities for optimization of energy performance including HVAC upgrades, improved control strategies, and re-commissioning.

Energy Efficiency Measure

This proposed measure involves undertaking HVAC and lighting control upgrades and operational improvements including re-commissioning of the BAS controls and improving the control strategies to achieve the energy savings. A description of each identified opportunity is outlined below:

- Add the washroom and cafeteria exhaust fans to the BAS and schedule base on building occupancy.
- Eliminate the operation of the terminal reheat loop during the summer months.
- Program the lighting control system to remove the automatic event which turns the lights on at 3 am every morning. If the lighting control system is determined to not be the cause of the load increase, the fan schedules should be investigated.

Exhibit 19 below presents a summary of the financial justification for the measure including total project cost, energy cost savings, simple payback period, and GHG emissions reduction. Refer to [Appendix B](#) for details of costs and savings.

Exhibit 19 Controls Optimisation Measure Summary

Energy Reduction Measure	Electricity			Steam		Total Savings	Estimated Cost	Simple Payback	GHG Reduction
	[kW]	[kWh]	[\$]	[GJ]	[\$]	[\$]	[\$]	[Years]	[teCO ₂]
Controls Optimisation	0	150,616	\$15,188	3,000	\$66,631	\$81,820	\$51,250	0.6	216.0

Impact on Operations and Maintenance

- New controls will require periodic maintenance including calibration as per manufacturers' guidelines.
- Reducing the run time of equipment will reduce the maintenance requirements and extend equipment lifetimes.
- It is expected that operations and maintenance staff will assist and participate in the recommissioning process.

Estimated Service Life

- New controls – 10 to 15 years.
- Re-commissioning – 5 years.

A recommissioning process of some form should take place approximately every 5 years.

5.3 O&M Measures

Description of Existing System

The audit identified various opportunities to improve the energy performance of the facility through improved O&M practices and low-cost measures.

Energy Efficiency Measure

The following O&M measures are proposed:

- Test and repair leaking steam traps.
- Insulate exposed steam pipes in the mechanical rooms.
- Install weather stripping around leaky exterior doors.
- Install low flow 1 gpm aerators on sinks that have no aerators or higher flow aerators.
- Replace the batteries on the VAV boxes that have lost communication with the BAS, and implement a strategy to replace the batteries as soon as possible after they fail. A long term solution to the signal strength problem should be sought.
- The building operators would benefit from improved documentation and BAS training to fully exploit the benefits of the recently undertaken ESCO project.

Exhibit 20 presents a summary of the financial justification for the measure including total project cost, cost savings, simple payback period, and GHG emissions reduction. Refer to [Appendix B](#) for details of costs and savings.

Exhibit 20 O&M Measure Summary

Energy Reduction Measure	Steam		Chilled Water		Water		Total Savings	Estimated Cost	Simple Payback	GHG Reduction
	[GJ]	[\$]	[GJ]	[\$]	[m ³]	[\$]				
O&M Measures	535	\$11,886	60	\$1,400	314	\$1,092	\$14,377	\$30,000	2.1	35.6

Impact on Operations and Maintenance

- It is anticipated that the measures identified above would be implemented by the present maintenance staff as part of their routine maintenance activities.

Estimated Service Life

- 5 years.

Appendix A EAR Templates

- Table 1: Description of Facility
- Table 2: Space Occupancy
- Table 3: Existing Drawing References
- Table 4: Lighting Template
- Table 5: AHU & Fan Summary
- Table 6: Pump Summary
- Table 7: Water Audit
- Table 8: Utility Usage Summary

Table 1: Description of Facility

Name of Facility		Address	395 Wellington St., Ottawa
Owner (if not PWGSC)		Address	
Building Management	PWGSC / SNC Lavalin Profac	Address	
Building Name	PANL Building	Building #	
Address (Street or P.O. Box)	395 Wellington St., Ottawa	City, Province/Territory, Postal Code	Ottawa, ON K1A 0N4
Building Manager (administrator responsible)	Eric Labbe	Bldg. Manager's Phone	613-223-0981
Date of Audit	Type of Facility Office <input checked="" type="checkbox"/> Laboratory <input checked="" type="checkbox"/> Other <input type="checkbox"/> Date of construction: <u>1962</u> Population of Facility: <u>274 FTE</u>		
Original Architects (if known)		Original Engineers (if known)	
Building Modifications or Changes In Use Anticipated in the next 15 years:		Remaining Useful life of the building:	
Building recently refitted, no modifications or changes anticipated.		At least 20 Years	
Does the Facility have an ongoing energy management program?			<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Previous Energy Audits Completed? (if yes, give dates) <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No Any other audits which may exist were not provided for this project. Since the building has recently undergone a significant refit, it is unlikely that any previous energy audit would encompass the building as it currently exists.			
Previous Architectural/Engineering Studies Undertaken? (if Yes, Specify) <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No			
Name of Utility Suppliers	Electricity: Hydro Ottawa Steam: Central Heating Plant Chilled Water: Central Heating Plant Water: City of Ottawa		

Table 2: Space Occupancy

Space Category	Floor(s)	% of Space
General Office Areas	G, 2, 3, 4	24%
Storage	B3, B2, B1, 6, 7, 8	66%
Lab	4	4%
Mechanical	Basement, Penthouse	5%
Other	All	1%

Table 3: Existing Drawing References

Project / Drawing #	Rev	Title/Description	Date	Location Where Stored
N/A	N/A	Floor Plans	N/A	PWGSC

Table 4: Lighting Template

Area	Description	Existing System							Proposed System						Costs					Savings							
		Fixture	Lamp	Qty.	Watts	Hours	kWh	kW	Measure	Lamp	Watts	Occ. Sensor	Hours	kWh	kW	Unit Matl.	Unit Labour	Sensor Cost	Material	Labour	Total Cost	Project Costs	Total Project	kWh Savings	kW Savings	Cost Savings	Simple Payback
BD2225	Corridor	Troffer	T8	38	28	130	138	1.06	Relamp	LED	16.5	0	130	82	0.63	\$20	\$2	\$0	\$760	\$57	\$817	\$204	\$1,021	57	0.44	\$45	22.9
BD2225	Corridor	Troffer	T8	38	28	8,736	9,295	1.06	Relamp	LED	16.5	0	8,736	5,477	0.63	\$20	\$2	\$0	\$760	\$57	\$817	\$204	\$1,021	3,818	0.44	\$424	2.4
BD2225	Corridor	Troffer	T8	1	52	130	7	0.05	Relamp	LED	33	0	130	4	0.03	\$40	\$3	\$0	\$40	\$3	\$43	\$11	\$54	2	0.02	\$2	27.7
DE1025	Corridor	Troffer	T8	17	28	130	62	0.48	Relamp	LED	16.5	0	130	36	0.28	\$20	\$2	\$0	\$340	\$26	\$366	\$91	\$457	25	0.20	\$20	22.9
DE1025	Corridor	Troffer	T8	16	28	8,736	3,914	0.45	Relamp	LED	16.5	0	8,736	2,306	0.26	\$20	\$2	\$0	\$320	\$24	\$344	\$86	\$430	1,607	0.18	\$178	2.4
DE1025	Corridor	Troffer	T8	21	52	130	142	1.09	Relamp	LED	33	0	130	90	0.69	\$40	\$3	\$0	\$840	\$63	\$903	\$226	\$1,129	52	0.40	\$41	27.7
EF1025	Corridor	Troffer	T8	76	28	130	277	2.13	Relamp	LED	16.5	0	130	163	1.25	\$20	\$2	\$0	\$1,520	\$114	\$1,634	\$409	\$2,043	114	0.87	\$89	22.9
EF1025	Corridor	Troffer	T8	76	28	8,736	18,590	2.13	Relamp	LED	16.5	0	8,736	10,955	1.25	\$20	\$2	\$0	\$1,520	\$114	\$1,634	\$409	\$2,043	7,635	0.87	\$848	2.4
EF1025	Corridor	Troffer	T8	23	52	130	155	1.20	Relamp	LED	33	0	130	99	0.76	\$40	\$3	\$0	\$920	\$69	\$989	\$247	\$1,236	57	0.44	\$45	27.7
FG225	Corridor	Troffer	T8	82	28	130	298	2.30	Relamp	LED	16.5	0	130	176	1.35	\$20	\$2	\$0	\$1,640	\$123	\$1,763	\$441	\$2,204	123	0.94	\$96	22.9
FG225	Corridor	Troffer	T8	82	28	8,736	20,058	2.30	Relamp	LED	16.5	0	8,736	11,820	1.35	\$20	\$2	\$0	\$1,640	\$123	\$1,763	\$441	\$2,204	8,238	0.94	\$915	2.4
FG225	Corridor	Troffer	T8	18	52	130	122	0.94	Relamp	LED	33	0	130	77	0.59	\$40	\$3	\$0	\$720	\$54	\$774	\$194	\$968	44	0.34	\$35	27.7
GH225	Corridor	Troffer	T8	93	28	130	339	2.60	Relamp	LED	16.5	0	130	199	1.53	\$20	\$2	\$0	\$1,860	\$140	\$2,000	\$500	\$2,499	139	1.07	\$109	22.9
GH225	Corridor	Troffer	T8	57	52	130	385	2.96	Relamp	LED	33	0	130	245	1.88	\$40	\$3	\$0	\$2,280	\$171	\$2,451	\$613	\$3,064	141	1.08	\$111	27.7
GH225	Corridor	Pot	CFL	4	32	130	17	0.13	None	CFL	32	0	130	17	0.13	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HJ125	Corridor	Troffer	T8	6	28	130	22	0.17	Relamp	LED	16.5	0	130	13	0.10	\$20	\$2	\$0	\$120	\$9	\$129	\$32	\$161	9	0.07	\$7	22.9
HJ125	Corridor	Troffer	T8	5	28	8,736	1,223	0.14	Relamp	LED	16.5	0	8,736	721	0.08	\$20	\$2	\$0	\$100	\$8	\$108	\$27	\$134	502	0.06	\$56	2.4
HJ125	Corridor	Troffer	T8	75	52	130	507	3.90	Relamp	LED	33	0	130	322	2.48	\$40	\$3	\$0	\$3,000	\$225	\$3,225	\$806	\$4,031	185	1.43	\$145	27.7
HJ125	Corridor	Pot	CFL	7	32	130	29	0.22	None	CFL	32	0	130	29	0.22	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HJ125	Corridor	Troffer	F17T8	1	15	130	2	0.02	Relamp	LED	8.5	0	130	1	0.01	\$21	\$2	\$0	\$21	\$2	\$22	\$6	\$28	1	0.01	\$1	41.5
JK1025	Corridor	Pot	CFL	4	32	130	17	0.13	None	CFL	32	0	130	17	0.13	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JK1025	Corridor	Troffer	T8	73	52	130	493	3.80	Relamp	LED	33	0	130	313	2.41	\$40	\$3	\$0	\$2,920	\$219	\$3,139	\$785	\$3,924	180	1.39	\$142	27.7
KL1025	Corridor	Troffer	T8	90	52	130	608	4.68	Relamp	LED	33	0	130	386	2.97	\$40	\$3	\$0	\$3,600	\$270	\$3,870	\$968	\$4,838	222	1.71	\$174	27.7
KL1025	Corridor	Pot	CFL	21	32	130	87	0.67	None	CFL	32	0	130	87	0.67	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
KL1025	Corridor	Troffer	T8-U	4	30	130	16	0.12	Relamp	LED	16.5	0	130	9	0.07	\$23	\$2	\$0	\$90	\$6	\$96	\$24	\$120	7	0.05	\$6	21.8
LM1025	Corridor	Troffer	T8	83	52	130	561	4.32	Relamp	LED	33	0	130	356	2.74	\$40	\$3	\$0	\$3,320	\$249	\$3,569	\$892	\$4,461	205	1.58	\$161	27.7
AyE726	Corridor	Pot	CFL	8	32	130	33	0.26	None	CFL	32	0	130	33	0.26	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
AyE726	Corridor	Troffer	T8	25	28	130	91	0.70	Relamp	LED	16.5	0	130	54	0.41	\$20	\$2	\$0	\$500	\$38	\$538	\$134	\$672	37	0.29	\$29	22.9
AyE726	Corridor	Troffer	T8	26	28	8,736	6,360	0.73	Relamp	LED	16.5	0	8,736	3,748	0.43	\$20	\$2	\$0	\$520	\$39	\$559	\$140	\$699	2,612	0.30	\$290	2.4
AyE726	Corridor	Troffer	T8	27	52	130	183	1.40	Relamp	LED	33	0	130	116	0.89	\$40	\$3	\$0	\$1,080	\$81	\$1,161	\$290	\$1,451	67	0.51	\$52	27.7
EF1025	Corridor	Troffer	T8	28	28	130	102	0.78	Relamp	LED	16.5	0	130	60	0.46	\$20	\$2	\$0	\$560	\$42	\$602	\$151	\$753	42	0.32	\$33	22.9
EF1025	Corridor	Troffer	T8	29	28	8,736	7,094	0.81	Relamp	LED	16.5	0	8,736	4,180	0.48	\$20	\$2	\$0	\$580	\$44	\$624	\$156	\$779	2,913	0.33	\$323	2.4
FG1025	Corridor	Troffer	T8	30	28	130	109	0.84	Relamp	LED	16.5	0	130	64	0.50	\$20	\$2	\$0	\$600	\$45	\$645	\$161	\$806	45	0.35	\$35	22.9
FG1025	Corridor	Troffer	T8	31	28	8,736	7,583	0.87	Relamp	LED	16.5	0	8,736	4,468	0.51	\$20	\$2	\$0	\$620	\$47	\$667	\$167	\$833	3,114	0.36	\$346	2.4
GH1025	Corridor	Troffer	T8	32	28	130	116	0.90	Relamp	LED	16.5	0	130	69	0.53	\$20	\$2	\$0	\$640	\$48	\$688	\$172	\$860	48	0.37	\$38	22.9
GH1025	Corridor	Troffer	T8	33	28	8,736	8,072	0.92	Relamp	LED	16.5	0	8,736	4,757	0.54	\$20	\$2	\$0	\$660	\$50	\$710	\$177	\$887	3,315	0.38	\$368	2.4
GH1025	Corridor	Pot	CFL	34	32	130	141	1.09	None	CFL	32	0	130	141	1.09	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HJ1025	Corridor	Troffer	T8	35	28	130	127	0.98	Relamp	LED	16.5	0	130	75	0.58	\$20	\$2	\$0	\$700	\$53	\$753	\$188	\$941	52	0.40	\$41	22.9
HJ1025	Corridor	Troffer	T8	36	28	8,736	8,806	1.01	Relamp	LED	16.5	0	8,736	5,189	0.59	\$20	\$2	\$0	\$720	\$54	\$774	\$194	\$968	3,617	0.41	\$402	2.4
HJ1025	Corridor	Troffer	T8	37	52	130	250	1.92	Relamp	LED	33	0	130	159	1.22	\$40	\$3	\$0	\$1,480	\$111	\$1,591	\$398	\$1,989	91	0.70	\$72	27.7
JK1025	Corridor	Troffer	T8	38	28	130	138	1.06	Relamp	LED	16.5	0	130	82	0.63	\$20	\$2	\$0	\$760	\$57	\$817	\$204	\$1,021	57	0.44	\$45	22.9
JK1025	Corridor	Troffer	T8	39	28	8,736	9,540	1.09	Relamp	LED	16.5	0	8,736	5,622	0.64	\$20	\$2	\$0	\$780	\$59	\$839	\$210	\$1,048	3,918	0.45	\$435	2.4
JK1025	Corridor	Pot	CFL	40	32	130	166	1.28	None	CFL	32	0	130	166	1.28	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JK1025	Corridor	Troffer	T8	41	52	130	277	2.13	Relamp	LED	33	0	130	176	1.35	\$40	\$3	\$0	\$1,640	\$123	\$1,763	\$441	\$2,204	101	0.78	\$79	27.7
KL1025	Corridor	Troffer	T8	42	28	130	153	1.18	Relamp	LED	16.5	0	130	90	0.69	\$20	\$2	\$0	\$840	\$63	\$903	\$226	\$1,129	63	0.48	\$49	22.9
KL1025	Corridor	Troffer	T8	43	28	8,736	10,518	1.20	Relamp	LED	16.5	0	8,736	6,198	0.71	\$20	\$2	\$0	\$860	\$65	\$925	\$231	\$1,156	4,320	0.49	\$480	2.4
KL1025	Corridor	Pot	CFL	44	32	130	183	1.41	None	CFL	32	0	130	183	1.41	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
KL1025	Corridor	Troffer	T8	45	52	130	304	2.34	Relamp	LED	33	0	130	193	1.49	\$40	\$3	\$0	\$1,800	\$135	\$1,935	\$484	\$2,419	111	0.86	\$87	27.7
KL1025	Corridor	Troffer	T8-U	46	30	130	179	1.38	Relamp	LED	16.5	0	130	99	0.76	\$23	\$2	\$0	\$1,035	\$69	\$1,104	\$276	\$1,380	81	0.62	\$63	21.8
LM1025	Corridor	Troffer	T8	47	28	130	171	1.32	Relamp	LED	16.5	0	130	101	0.78	\$20	\$2	\$0	\$940	\$71	\$1,011	\$253	\$1,263	70	0.54	\$55	22.9
LM1025	Corridor	Troffer	T8	48	28	8,736	11,741	1.34	Relamp	LED	16.5	0	8,736	6,919	0.79	\$20	\$2	\$0	\$960	\$72	\$1,032	\$258	\$1,290	4,822	0.55	\$535	2.4
LM1025	Corridor	Pot	CFL	49	32	130	204	1.57	None	CFL	32	0	130	204	1.57	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
LM1025	Corridor	Troffer	T8	50	52	130	338	2.60	Relamp	LED	33	0	130	215	1.65	\$40	\$3	\$0	\$2,000	\$150	\$2,150	\$538	\$2,688	124	0.95	\$97	27.7
LM1025	Corridor	Troffer	T8-U	4	30	130	16	0.12	Relamp	LED	16.5	0	130	9	0.07	\$23	\$2	\$0	\$90	\$6	\$96	\$24	\$120	7	0.05	\$6	21.8
EF1025	Corridor	Troffer	T8	201	28	130	732	5.63	Relamp	LED	16.5	0	130	431	3.32	\$20	\$2	\$0	\$4,020	\$302	\$4,322	\$1,080	\$5,402	300	2.31	\$236	22.9
FG725	Corridor	Troffer	T8	199	28	130	724	5.57	Relamp	LED	16.																

Table 4: Lighting Template

		Existing System							Proposed System							Costs					Savings							
Area	Description	Fixture	Lamp	Qty.	Watts	Hours	kWh	kW	Measure	Lamp	Watts	Occ. Sensor	Hours	kWh	kW	Unit Matl.	Unit Labour	Sensor Cost	Material	Labour	Total Cost	Project Costs	Total Project	kWh Savings	kW Savings	Cost Savings	Simple Payback	
QM1218	Generator Room (B401)	Troffer	T8	4	28	260	29	0.11	Relamp	LED	16.5	0	260	17	0.07	\$20	\$2	\$0	\$80	\$6	\$86	\$22	\$108	12	0.05	\$5	20.3	
QM1218	Mechanical Room (B401)	Troffer	T8	27	28	4,368	3,302	0.76	Relamp	LED	16.5	0	4,368	1,946	0.45	\$20	\$2	\$0	\$540	\$41	\$581	\$145	\$726	1,356	0.31	\$164	4.4	
QM1218	Storage Room	Troffer	T8	1	28	260	7	0.03	Relamp	LED	16.5	0	260	4	0.02	\$20	\$2	\$0	\$20	\$2	\$22	\$5	\$27	3	0.01	\$1	20.3	
BE1023	Corridor	Troffer	T8	51	52	3,640	9,653	2.65	Relamp	LED	33	0	3,640	6,126	1.68	\$40	\$3	\$0	\$2,040	\$153	\$2,193	\$548	\$2,741	3,577	0.97	\$442	6.2	
BE1023	Corridor	Troffer	T8	4	52	3,640	757	0.21	Relamp	LED	33	0	3,640	480	0.13	\$40	\$3	\$0	\$160	\$12	\$172	\$43	\$215	272	0.08	\$35	6.2	
BE1023	Corridor	Pot	HID	112	57.5	0	0	6.44	None	HID	57.5	0	0	0	6.44	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0		
BE1023	Corridor	Pot	CFL	7	32	3,640	815	0.22	None	CFL	32	0	3,640	815	0.22	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
BE1023	Corridor	Wall Sconce	LED	79	12	3,640	3,451	0.95	None	LED	12	0	3,640	3,451	0.95	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
BE1023	Corridor	Troffer	T8-U	4	30	3,640	437	0.12	Relamp	LED	16.5	0	3,640	240	0.07	\$23	\$2	\$0	\$90	\$6	\$96	\$24	\$120	197	0.05	\$25	4.9	
BC2324	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
BC2425	Corridor	Troffer	T8	28	52	3,640	5,300	1.46	Relamp	LED	33	0	3,640	3,363	0.92	\$40	\$3	\$0	\$1,120	\$84	\$1,204	\$301	\$1,505	1,936	0.53	\$243	6.2	
CD2324	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
CD2425	Corridor	Troffer	T8	28	52	3,640	5,300	1.46	Relamp	LED	33	0	3,640	3,363	0.92	\$40	\$3	\$0	\$1,120	\$84	\$1,204	\$301	\$1,505	1,936	0.53	\$243	6.2	
DE2324	Corridor	Troffer	T8	28	52	3,640	5,300	1.46	Relamp	LED	33	0	3,640	3,363	0.92	\$40	\$3	\$0	\$1,120	\$84	\$1,204	\$301	\$1,505	1,936	0.53	\$243	6.2	
DE2425	Corridor	Troffer	T8	28	52	3,640	5,300	1.46	Relamp	LED	33	0	3,640	3,363	0.92	\$40	\$3	\$0	\$1,120	\$84	\$1,204	\$301	\$1,505	1,936	0.53	\$243	6.2	
EF14	Corridor	Pot	CFL	3	32	3,640	349	0.10	None	CFL	32	0	3,640	349	0.10	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
EF1011	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2	
EF1112	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2	
EF1213	Corridor	Troffer	T8	28	52	3,640	5,300	1.46	Relamp	LED	33	0	3,640	3,363	0.92	\$40	\$3	\$0	\$1,120	\$84	\$1,204	\$301	\$1,505	1,936	0.53	\$243	6.2	
EF1314	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
EF1415	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
EF1516	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
EF1617	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
EF1718	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
EF1819	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
EF1920	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
EF2021	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
EF2122	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
EF2223	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
EF2324	Corridor	Troffer	T8	28	52	3,640	5,300	1.46	Relamp	LED	33	0	3,640	3,363	0.92	\$40	\$3	\$0	\$1,120	\$84	\$1,204	\$301	\$1,505	1,936	0.53	\$243	6.2	
EF2425	Corridor	Troffer	T8	28	52	3,640	5,300	1.46	Relamp	LED	33	0	3,640	3,363	0.92	\$40	\$3	\$0	\$1,120	\$84	\$1,204	\$301	\$1,505	1,936	0.53	\$243	6.2	
EF1025	Corridor	Wall Sconce	LED	16	12	3,640	699	0.19	None	LED	12	0	3,640	699	0.19	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
FG110	Corridor	Pot	CFL	14	32	3,640	1,631	0.45	None	CFL	32	0	3,640	1,631	0.45	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
FG1011	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2	
FG1112	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2	
FG1216	Corridor	Pot	CFL	21	32	3,640	2,446	0.67	None	CFL	32	0	3,640	2,446	0.67	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
FG1216	Corridor	Troffer	T8-U	7	30	3,640	764	0.21	Relamp	LED	16.5	0	3,640	420	0.12	\$23	\$2	\$0	\$158	\$11	\$168	\$42	\$210	344	0.09	\$43	4.9	
FG1216	Corridor	Troffer	T8	4	52	3,640	757	0.21	Relamp	LED	33	0	3,640	480	0.13	\$40	\$3	\$0	\$160	\$12	\$172	\$43	\$215	277	0.08	\$35	6.2	
FG1216	Corridor	Troffer	T8	6	28	3,640	612	0.17	Relamp	LED	16.5	0	3,640	360	0.10	\$20	\$2	\$0	\$120	\$9	\$129	\$32	\$161	251	0.07	\$31	5.1	
FG1216	Corridor	Troffer	F17T8	4	15	3,640	218	0.06	Relamp	LED	8.5	0	3,640	124	0.03	\$21	\$2	\$0	\$82	\$6	\$88	\$22	\$110	95	0.03	\$12	9.3	
FG1617	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2	
FG1718	Corridor	Troffer	T8	42	52	3,640	7,950	2.18	Relamp	LED	33	0	3,640	5,045	1.39	\$40	\$3	\$0	\$1,680	\$126	\$1,806	\$452	\$2,258	2,905	0.80	\$364	6.2	
FG1819	Corridor	Troffer	T8	42	52	3,640	7,950	2.18	Relamp	LED	33	0	3,640	5,045	1.39	\$40	\$3	\$0	\$1,680	\$126	\$1,806	\$452	\$2,258	2,905	0.80	\$364	6.2	
FG1925	Corridor	Troffer	T8	9	52	3,640	1,704	0.47	Relamp	LED	33	0	3,640	1,081	0.30	\$40	\$3	\$0	\$360	\$27	\$387	\$97	\$484	622	0.17	\$78	6.2	
FG1925	Corridor	Troffer	T8	21	52	3,640	3,975	1.09	Relamp	LED	33	0	3,640	2,523	0.69	\$40	\$3	\$0	\$840	\$63	\$903	\$226	\$1,129	1,452	0.40	\$182	6.2	
FG1925	Corridor	Track Lighting	MR16	10	50	3,640	1,820	0.50	Relamp	LED	7	0	3,640	255	0.07	\$15	\$2	\$0	\$150	\$15	\$165	\$41	\$206	1,565	0.43	\$196	1.1	
FG1925	Corridor	Troffer	T8	22	28	3,640	2,242	0.62	Relamp	LED	16.5	0	3,640	1,321	0.36	\$20	\$2	\$0	\$440	\$33	\$473	\$118	\$591	921	0.25	\$115	5.1	
GH110	Corridor	Pot																										

Table 4: Lighting Template

Area	Description	Existing System							Proposed System							Costs						Savings					
		Fixture	Lamp	Qty.	Watts	Hours	kWh	kW	Measure	Lamp	Watts	Occ. Sensor	Hours	kWh	kW	Unit Matl.	Unit Labour	Sensor Cost	Material	Labour	Total Cost	Project Costs	Total Project	kWh Savings	kW Savings	Cost Savings	Simple Payback
HJ1216	Corridor	Troffer	T8	1	52	3,640	189	0.05	Relamp	LED	33	0	3,640	120	0.03	\$40	\$3	\$0	\$40	\$3	\$43	\$11	\$54	69	0.02	\$9	6.2
HJ1216	Corridor	Troffer	T8-U	3	30	3,640	328	0.09	Relamp	LED	16.5	0	3,640	180	0.05	\$23	\$2	\$0	\$68	\$5	\$72	\$18	\$90	147	0.04	\$18	4.9
HJ1617	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
HJ1718	Corridor	Troffer	T8	42	52	3,640	7,950	2.18	Relamp	LED	33	0	3,640	5,045	1.39	\$40	\$3	\$0	\$1,680	\$126	\$1,806	\$452	\$2,258	2,905	0.80	\$364	6.2
HJ1819	Corridor	Troffer	T8	42	52	3,640	7,950	2.18	Relamp	LED	33	0	3,640	5,045	1.39	\$40	\$3	\$0	\$1,680	\$126	\$1,806	\$452	\$2,258	2,905	0.80	\$364	6.2
HJ1925	Corridor	Troffer	T8	28	28	3,640	2,854	0.78	Relamp	LED	16.5	0	3,640	1,682	0.46	\$20	\$2	\$0	\$560	\$42	\$602	\$151	\$753	1,172	0.32	\$147	5.1
HJ1925	Corridor	Troffer	T8	6	52	3,640	1,136	0.31	Relamp	LED	33	0	3,640	721	0.20	\$40	\$3	\$0	\$240	\$18	\$258	\$65	\$323	415	0.11	\$52	6.2
HJ1925	Corridor	Troffer	T8	4	52	3,640	757	0.21	Relamp	LED	33	0	3,640	480	0.13	\$40	\$3	\$0	\$160	\$12	\$172	\$43	\$215	277	0.08	\$35	6.2
HJ1925	Corridor	Pot	CFL	1	32	3,640	116	0.03	None	CFL	32	0	3,640	116	0.03	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HJ1925	Corridor	Troffer	F17T8	1	15	3,640	55	0.02	Relamp	LED	8.5	0	3,640	31	0.01	\$21	\$2	\$0	\$21	\$2	\$22	\$6	\$28	24	0.01	\$3	9.3
JK110	Corridor	Pot	CFL	3	32	3,640	349	0.10	None	CFL	32	0	3,640	349	0.10	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JK1016	Corridor	Pot	CFL	9	32	3,640	1,048	0.29	None	CFL	32	0	3,640	1,048	0.29	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JK1016	Corridor	Troffer	T8-U	22	30	3,640	2,402	0.66	Relamp	LED	16.5	0	3,640	1,321	0.36	\$23	\$2	\$0	\$495	\$33	\$528	\$132	\$660	1,081	0.30	\$135	4.9
JK1016	Corridor	Troffer	T8	1	52	3,640	189	0.05	Relamp	LED	33	0	3,640	120	0.03	\$40	\$3	\$0	\$40	\$3	\$43	\$11	\$54	69	0.02	\$9	6.2
JK1016	Corridor	Troffer	T8	1	28	3,640	102	0.03	Relamp	LED	16.5	0	3,640	60	0.02	\$20	\$2	\$0	\$20	\$2	\$22	\$5	\$27	42	0.01	\$5	5.1
JK1016	Corridor	Troffer	T8	10	52	3,640	1,893	0.52	Relamp	LED	33	0	3,640	1,201	0.33	\$40	\$3	\$0	\$400	\$30	\$430	\$108	\$538	692	0.19	\$87	6.2
JK1016	Corridor	Troffer	F17T8	1	15	3,640	55	0.02	Relamp	LED	8.5	0	3,640	31	0.01	\$21	\$2	\$0	\$21	\$2	\$22	\$6	\$28	24	0.01	\$3	9.3
JK1617	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
JK1718	Corridor	Troffer	T8	42	52	3,640	7,950	2.18	Relamp	LED	33	0	3,640	5,045	1.39	\$40	\$3	\$0	\$1,680	\$126	\$1,806	\$452	\$2,258	2,905	0.80	\$364	6.2
JK1819	Corridor	Troffer	T8	42	52	3,640	7,950	2.18	Relamp	LED	33	0	3,640	5,045	1.39	\$40	\$3	\$0	\$1,680	\$126	\$1,806	\$452	\$2,258	2,905	0.80	\$364	6.2
JK1925	Corridor	Troffer	T8	47	28	3,640	4,790	1.32	Relamp	LED	16.5	0	3,640	2,823	0.78	\$20	\$2	\$0	\$940	\$71	\$1,011	\$253	\$1,263	1,967	0.54	\$246	5.1
JK1925	Corridor	Troffer	T8	5	52	3,640	946	0.26	Relamp	LED	33	0	3,640	601	0.17	\$40	\$3	\$0	\$200	\$15	\$215	\$54	\$269	346	0.10	\$43	6.2
JK1925	Corridor	Troffer	T8	2	52	3,640	379	0.10	Relamp	LED	33	0	3,640	240	0.07	\$40	\$3	\$0	\$80	\$6	\$86	\$22	\$108	138	0.04	\$17	6.2
KL1016	Corridor	Troffer	T8-U	16	30	3,640	1,747	0.48	Relamp	LED	16.5	0	3,640	961	0.26	\$23	\$2	\$0	\$360	\$24	\$384	\$96	\$480	786	0.22	\$98	4.9
KL1016	Corridor	Troffer	T8	37	52	3,640	7,003	1.92	Relamp	LED	33	0	3,640	4,444	1.22	\$40	\$3	\$0	\$1,480	\$111	\$1,591	\$398	\$1,989	2,559	0.70	\$321	6.2
KL1617	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
KL1718	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
KL1819	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
KL1920	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
KL2021	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
KL2122	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
KL2223	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
KL2324	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
KL2425	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
LM1016	Corridor	Troffer	T8-U	16	30	3,640	1,747	0.48	Relamp	LED	16.5	0	3,640	961	0.26	\$23	\$2	\$0	\$360	\$24	\$384	\$96	\$480	786	0.22	\$98	4.9
LM1016	Corridor	Troffer	T8	24	52	3,640	4,543	1.25	Relamp	LED	33	0	3,640	2,883	0.79	\$40	\$3	\$0	\$960	\$72	\$1,032	\$258	\$1,290	1,660	0.46	\$208	6.2
LM1617	Corridor	Troffer	T8	36	52	3,640	6,814	1.87	Relamp	LED	33	0	3,640	4,324	1.19	\$40	\$3	\$0	\$1,440	\$108	\$1,548	\$387	\$1,935	2,490	0.68	\$312	6.2
LM1718	Corridor	Troffer	T8	36	52	3,640	6,814	1.87	Relamp	LED	33	0	3,640	4,324	1.19	\$40	\$3	\$0	\$1,440	\$108	\$1,548	\$387	\$1,935	2,490	0.68	\$312	6.2
LM1819	Corridor	Troffer	T8	36	52	3,640	6,814	1.87	Relamp	LED	33	0	3,640	4,324	1.19	\$40	\$3	\$0	\$1,440	\$108	\$1,548	\$387	\$1,935	2,490	0.68	\$312	6.2
LM1920	Corridor	Troffer	T8	36	52	3,640	6,814	1.87	Relamp	LED	33	0	3,640	4,324	1.19	\$40	\$3	\$0	\$1,440	\$108	\$1,548	\$387	\$1,935	2,490	0.68	\$312	6.2
LM2021	Corridor	Troffer	T8	36	52	3,640	6,814	1.87	Relamp	LED	33	0	3,640	4,324	1.19	\$40	\$3	\$0	\$1,440	\$108	\$1,548	\$387	\$1,935	2,490	0.68	\$312	6.2
LM2122	Corridor	Troffer	T8	36	52	3,640	6,814	1.87	Relamp	LED	33	0	3,640	4,324	1.19	\$40	\$3	\$0	\$1,440	\$108	\$1,548	\$387	\$1,935	2,490	0.68	\$312	6.2
LM2223	Corridor	Troffer	T8	36	52	3,640	6,814	1.87	Relamp	LED	33	0	3,640	4,324	1.19	\$40	\$3	\$0	\$1,440	\$108	\$1,548	\$387	\$1,935	2,490	0.68	\$312	6.2
LM2324	Corridor	Troffer	T8	36	52	3,640	6,814	1.87	Relamp	LED	33	0	3,640	4,324	1.19	\$40	\$3	\$0	\$1,440	\$108	\$1,548	\$387	\$1,935	2,490	0.68	\$312	6.2
LM2425	Corridor	Troffer	T8	36	52	3,640	6,814	1.87	Relamp	LED	33	0	3,640	4,324	1.19	\$40	\$3	\$0	\$1,440	\$108	\$1,548	\$387	\$1,935	2,490	0.68	\$312	6.2
KJ1224	Corridor	Troffer	T8	45	28	3,640	4,586	1.26	Relamp	LED	16.5	0	3,640	2,703	0.74	\$20	\$2	\$0	\$900	\$68	\$968	\$242	\$1,209	1,884	0.52	\$236	5.1
KJ1224	Corridor	Troffer	T8	2	52	3,640	379	0.10	Relamp	LED	33	0	3,640	240	0.07	\$40	\$3	\$0	\$80	\$6	\$86	\$22	\$108	138	0.04	\$17	6.2
JH1224	Corridor	Troffer	T8	35	28	3,640	3,567	0.98	Relamp	LED	16.5	0	3,640	2,102	0.58	\$20	\$2	\$0	\$700	\$53	\$753	\$188	\$941	1,465	0.40	\$184	5.1
JH1224	Corridor	Troffer	T8	6	52	3,640	1,136	0.31	Relamp	LED	33	0	3,640	721	0.20	\$40	\$3	\$0	\$240	\$18	\$258	\$65	\$323	415	0.11	\$52	6.2
JH1224	Corridor	Troffer	F17T8	1	15	3,640	55	0.02	Relamp	LED	8.5	0	3,640	31	0.01	\$21	\$2	\$0	\$21	\$2	\$22	\$6	\$28	24	0.01	\$3	9.3
HG1224	Corridor	Troffer	T8	64	28	3,640	5,523	1.79	Relamp	LED	16.5	0	3,640	3,844	1.06	\$20	\$2	\$0	\$1,280	\$96	\$1,376	\$344	\$1,720	2,679	0.74	\$336	5.1
HG1224	Corridor	Pot	CFL	9	32	3,640	1,048	0.29	None	CFL	32	0	3,640	1,048	0.29	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HG1224	Corridor	Troffer	T8	2	52	3,640	379	0.10	Relamp	LED	33	0	3,640	240	0.07	\$40	\$3	\$0	\$80	\$6	\$86	\$22	\$108	138	0.04	\$17	6.2
GF1224	Corridor	Troffer	T8	65	28	3,640	6,625	1.82	Relamp	LED	16.5	0	3,640														

Table 4: Lighting Template

Area	Description	Existing System							Proposed System						Costs					Savings							
		Fixture	Lamp	Qty.	Watts	Hours	kWh	kW	Measure	Lamp	Watts	Occ. Sensor	Hours	kWh	kW	Unit Matl.	Unit Labour	Sensor Cost	Material	Labour	Total Cost	Project Costs	Total Project	kWh Savings	kW Savings	Cost Savings	Simple Payback
EF1516	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
EF1617	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
EF1718	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
EF1819	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
EF1920	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
EF2021	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
FG1014	Corridor	Troffer	T8	25	28	3,640	2,548	0.70	Relamp	LED	16.5	0	3,640	1,502	0.41	\$20	\$2	\$0	\$500	\$38	\$538	\$134	\$672	1,047	0.29	\$131	5.1
FG1014	Corridor	Troffer	T8	12	52	3,640	2,271	0.62	Relamp	LED	33	0	3,640	1,441	0.40	\$40	\$3	\$0	\$480	\$36	\$516	\$129	\$645	830	0.23	\$104	6.2
FG2125	Corridor	Pot	CFL	6	32	3,640	699	0.19	None	CFL	32	0	3,640	699	0.19	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0.00	\$0	
FG2125	Corridor	Troffer	T8-U	43	30	3,640	4,696	1.29	Relamp	LED	16.5	0	3,640	2,583	0.71	\$23	\$2	\$0	\$968	\$65	\$1,032	\$258	\$1,290	2,113	0.58	\$265	4.9
FG2125	Corridor	Troffer	T8	6	52	3,640	1,136	0.31	Relamp	LED	33	0	3,640	721	0.20	\$40	\$3	\$0	\$240	\$18	\$258	\$65	\$323	415	0.11	\$52	6.2
FG1415	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2
FG1516	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2
FG1617	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2
FG1718	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2
FG1819	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2
FG1920	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2
FG2021	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2
GH1016	Corridor	Troffer	T8	12	52	3,640	2,271	0.62	Relamp	LED	33	0	3,640	1,441	0.40	\$40	\$3	\$0	\$480	\$36	\$516	\$129	\$645	830	0.23	\$104	6.2
GH1016	Corridor	Troffer	T8	2	52	3,640	379	0.10	Relamp	LED	33	0	3,640	240	0.07	\$40	\$3	\$0	\$80	\$6	\$86	\$22	\$108	138	0.04	\$17	6.2
GH1016	Corridor	Troffer	T8	49	28	3,640	4,994	1.37	Relamp	LED	16.5	0	3,640	2,943	0.81	\$20	\$2	\$0	\$980	\$74	\$1,054	\$263	\$1,317	2,051	0.56	\$257	5.1
GH1725	Corridor	Troffer	T8	4	52	3,640	757	0.21	Relamp	LED	33	0	3,640	480	0.13	\$40	\$3	\$0	\$160	\$12	\$172	\$43	\$215	277	0.08	\$35	6.2
GH1725	Corridor	Troffer	T8	14	52	3,640	2,650	0.73	Relamp	LED	33	0	3,640	1,682	0.46	\$40	\$3	\$0	\$560	\$42	\$602	\$151	\$753	968	0.27	\$121	6.2
GH1725	Corridor	Troffer	T8	64	28	3,640	6,523	1.79	Relamp	LED	16.5	0	3,640	3,844	1.06	\$20	\$2	\$0	\$1,280	\$96	\$1,376	\$344	\$1,720	2,679	0.74	\$336	5.1
GH1617	Corridor	Troffer	T8	28	52	3,640	5,300	1.46	Relamp	LED	33	0	3,640	3,363	0.92	\$40	\$3	\$0	\$1,120	\$84	\$1,204	\$301	\$1,505	1,936	0.53	\$243	6.2
HJ1016	Corridor	Troffer	T8	6	52	3,640	1,136	0.31	Relamp	LED	33	0	3,640	721	0.20	\$40	\$3	\$0	\$240	\$18	\$258	\$65	\$323	415	0.11	\$52	6.2
HJ1016	Corridor	Troffer	T8	7	52	3,640	1,325	0.36	Relamp	LED	33	0	3,640	841	0.23	\$40	\$3	\$0	\$280	\$21	\$301	\$75	\$376	484	0.13	\$61	6.2
HJ1016	Corridor	Troffer	T8	2	28	3,640	204	0.06	Relamp	LED	16.5	0	3,640	120	0.03	\$20	\$2	\$0	\$40	\$3	\$43	\$11	\$54	84	0.02	\$10	5.1
HJ1016	Corridor	Pot	CFL	12	32	3,640	1,398	0.38	None	CFL	32	0	3,640	1,398	0.38	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0.00	\$0	
HJ1016	Corridor	Troffer	T8-U	8	30	3,640	874	0.24	Relamp	LED	16.5	0	3,640	480	0.13	\$23	\$2	\$0	\$180	\$12	\$192	\$48	\$240	393	0.11	\$49	4.9
HJ1725	Corridor	Troffer	T8	4	52	3,640	757	0.21	Relamp	LED	33	0	3,640	480	0.13	\$40	\$3	\$0	\$160	\$12	\$172	\$43	\$215	277	0.08	\$35	6.2
HJ1725	Corridor	Troffer	T8	12	52	3,640	2,271	0.62	Relamp	LED	33	0	3,640	1,441	0.40	\$40	\$3	\$0	\$480	\$36	\$516	\$129	\$645	830	0.23	\$104	6.2
HJ1725	Corridor	Troffer	T8	33	28	3,640	3,363	0.92	Relamp	LED	16.5	0	3,640	1,982	0.54	\$20	\$2	\$0	\$660	\$50	\$710	\$177	\$887	1,381	0.38	\$173	5.1
HJ1725	Corridor	Troffer	F17T8	1	15	3,640	55	0.02	Relamp	LED	8.5	0	3,640	31	0.01	\$21	\$2	\$0	\$21	\$2	\$22	\$6	\$28	24	0.01	\$3	9.3
HJ1725	Corridor	Troffer	T8-U	12	30	3,640	1,310	0.36	Relamp	LED	16.5	0	3,640	721	0.20	\$23	\$2	\$0	\$270	\$18	\$288	\$72	\$360	590	0.16	\$74	4.9
HJ1617	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
KJ1224	Corridor	Troffer	T8	107	28	3,640	10,905	3.00	Relamp	LED	16.5	0	3,640	6,426	1.77	\$20	\$2	\$0	\$2,140	\$161	\$2,301	\$575	\$2,876	4,479	1.23	\$561	5.1
JH1224	Corridor	Troffer	T8	78	28	3,640	7,950	2.18	Relamp	LED	16.5	0	3,640	4,685	1.29	\$20	\$2	\$0	\$1,560	\$117	\$1,677	\$419	\$2,096	3,265	0.90	\$409	5.1
JH1224	Corridor	Troffer	F17T8	1	15	3,640	55	0.02	Relamp	LED	8.5	0	3,640	31	0.01	\$21	\$2	\$0	\$21	\$2	\$22	\$6	\$28	24	0.01	\$3	9.3
HG1224	Corridor	Troffer	T8	139	28	3,640	14,167	3.89	Relamp	LED	16.5	0	3,640	8,348	2.29	\$20	\$2	\$0	\$2,780	\$209	\$2,989	\$747	\$3,736	5,819	1.60	\$729	5.1
HG1224	Corridor	Troffer	T8	4	52	3,640	757	0.21	Relamp	LED	33	0	3,640	480	0.13	\$40	\$3	\$0	\$160	\$12	\$172	\$43	\$215	277	0.08	\$35	6.2
GF1224	Corridor	Troffer	T8	64	28	3,640	6,523	1.79	Relamp	LED	16.5	0	3,640	3,844	1.06	\$20	\$2	\$0	\$1,280	\$96	\$1,376	\$344	\$1,720	2,679	0.74	\$336	5.1
FE1224	Corridor	Troffer	T8	68	28	3,640	6,931	1.90	Relamp	LED	16.5	0	3,640	4,084	1.12	\$20	\$2	\$0	\$1,360	\$102	\$1,462	\$366	\$1,828	2,846	0.78	\$357	5.1
FE1224	Corridor	Pot	CFL	1	32	3,640	116	0.03	None	CFL	32	0	3,640	116	0.03	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0.00	\$0	
BE1025	Corridor	Troffer	T8	99	52	3,640	18,739	5.15	Relamp	LED	33	0	3,640	11,892	3.27	\$40	\$3	\$0	\$3,960	\$297	\$4,257	\$1,064	\$5,321	6,847	1.88	\$858	6.2
BE1025	Corridor	Troffer	T8	4	28	3,640	408	0.11	Relamp	LED	16.5	0	3,640	240	0.07	\$20	\$2	\$0	\$80	\$6	\$86	\$22	\$108	167	0.05	\$21	5.1
BE1025	Corridor	Troffer	T8-U	2	30	3,640	218	0.06	Relamp	LED	16.5	0	3,640	120	0.03	\$23	\$2	\$0	\$45	\$3	\$48	\$12	\$60	98	0.03	\$12	4.9
EF1015	Corridor	Pot	CFL	2	32	3,640	233	0.06	None	CFL	32	0	3,640	233	0.06	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0.00	\$0	
EF1015	Corridor	Troffer	T8-U	9	30	3,640	983	0.27	Relamp	LED	16.5	0	3,640	541	0.15	\$23	\$2	\$0	\$203	\$14	\$216	\$54	\$270	442	0.12	\$55	4.9
EF1015	Corridor	Troffer	F17T8	3	15	3,640	164	0.05	Relamp	LED	8.5	0	3,640	93	0.03	\$21	\$2	\$0	\$62	\$5	\$66	\$17	\$83	71	0.02	\$9	9.3
EF1015	Corridor	Troffer	T8	18	52	3,640	3,407	0.94	Relamp	LED	33	0	3,640	2,162	0.59	\$40	\$3	\$0	\$720	\$54	\$774	\$194	\$968	1,245	0.34	\$156	6.2
EF2025	Corridor	Pot	CFL	4	32	3,640	466	0.13	None	CFL	32	0	3,640	466	0.13	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0.00	\$0	
EF2025	Corridor	Troffer	T8-U	7	30	3,640	764	0.21	Relamp	LED	16.5	0	3,640	420	0.12	\$23	\$2	\$0	\$158	\$11	\$168	\$42	\$210	344	0.09	\$43	4.9
EF2025	Corridor	Troffer	T8	1	28	3,640	102	0.03	Relamp	LED	16.5	0	3,640	60	0.02	\$20	\$2	\$0	\$20	\$2	\$2						

Table 4: Lighting Template

Area	Description	Existing System							Proposed System							Costs					Savings						
		Fixture	Lamp	Qty.	Watts	Hours	kWh	kW	Measure	Lamp	Watts	Occ. Sensor	Hours	kWh	kW	Unit Matl.	Unit Labour	Sensor Cost	Material	Labour	Total Cost	Project Costs	Total Project	kWh Savings	kW Savings	Cost Savings	Simple Payback
FG1718	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2
FG1819	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2
FG1920	Corridor	Troffer	T8	44	52	3,640	8,328	2.29	Relamp	LED	33	0	3,640	5,285	1.45	\$40	\$3	\$0	\$1,760	\$132	\$1,892	\$473	\$2,365	3,043	0.84	\$381	6.2
GH1016	Corridor	Troffer	T8	10	52	3,640	1,893	0.52	Relamp	LED	33	0	3,640	1,201	0.33	\$40	\$3	\$0	\$400	\$30	\$430	\$108	\$538	692	0.19	\$87	6.2
GH1016	Corridor	Troffer	T8	36	52	3,640	6,814	1.87	Relamp	LED	33	0	3,640	4,324	1.19	\$40	\$3	\$0	\$1,440	\$108	\$1,548	\$387	\$1,935	2,490	0.68	\$312	6.2
GH1016	Corridor	Troffer	T8-U	1	30	3,640	109	0.03	Relamp	LED	16.5	0	3,640	60	0.02	\$23	\$2	\$0	\$23	\$2	\$24	\$6	\$30	49	0.01	\$6	4.9
GH1725	Corridor	Troffer	T8	12	52	3,640	2,271	0.62	Relamp	LED	33	0	3,640	1,441	0.40	\$40	\$3	\$0	\$480	\$36	\$516	\$129	\$645	830	0.23	\$104	6.2
GH1725	Corridor	Troffer	T8	1	52	3,640	189	0.05	Relamp	LED	33	0	3,640	120	0.03	\$40	\$3	\$0	\$40	\$3	\$43	\$11	\$54	69	0.02	\$9	6.2
GH1725	Corridor	Troffer	T8	78	28	3,640	7,950	2.18	Relamp	LED	16.5	0	3,640	4,685	1.29	\$20	\$2	\$0	\$1,560	\$117	\$1,677	\$419	\$2,096	3,265	0.90	\$409	5.1
GH1617	Corridor	Troffer	T8	28	52	3,640	5,300	1.46	Relamp	LED	33	0	3,640	3,363	0.92	\$40	\$3	\$0	\$1,120	\$84	\$1,204	\$301	\$1,505	1,936	0.53	\$243	6.2
HJ1016	Corridor	Troffer	T8	10	52	3,640	1,893	0.52	Relamp	LED	33	0	3,640	1,201	0.33	\$40	\$3	\$0	\$400	\$30	\$430	\$108	\$538	692	0.19	\$87	6.2
HJ1016	Corridor	Troffer	T8	12	52	3,640	2,271	0.62	Relamp	LED	33	0	3,640	1,441	0.40	\$40	\$3	\$0	\$480	\$36	\$516	\$129	\$645	830	0.23	\$104	6.2
HJ1016	Corridor	Pot	CFL	10	32	3,640	1,165	0.32	None	CFL	32	0	3,640	1,165	0.32	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HJ1016	Corridor	Wall Sconce	LED	12	12	3,640	524	0.14	None	LED	12	0	3,640	524	0.14	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HJ1725	Corridor	Troffer	T8	12	52	3,640	2,271	0.62	Relamp	LED	33	0	3,640	1,441	0.40	\$40	\$3	\$0	\$480	\$36	\$516	\$129	\$645	830	0.23	\$104	6.2
HJ1725	Corridor	Troffer	T8	4	52	3,640	757	0.21	Relamp	LED	33	0	3,640	480	0.13	\$40	\$3	\$0	\$160	\$12	\$172	\$43	\$215	277	0.08	\$35	6.2
HJ1725	Corridor	Troffer	T8	50	28	3,640	5,096	1.40	Relamp	LED	16.5	0	3,640	3,003	0.83	\$20	\$2	\$0	\$1,000	\$75	\$1,075	\$269	\$1,344	2,093	0.58	\$262	5.1
HJ1725	Corridor	Troffer	F17T8	1	15	3,640	55	0.02	Relamp	LED	8.5	0	3,640	31	0.01	\$21	\$2	\$0	\$21	\$2	\$22	\$6	\$28	24	0.01	\$3	9.3
HJ1617	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
JK1016	Corridor	Troffer	T8	11	52	3,640	2,082	0.57	Relamp	LED	33	0	3,640	1,321	0.36	\$40	\$3	\$0	\$440	\$33	\$473	\$118	\$591	761	0.21	\$95	6.2
JK1016	Corridor	Troffer	T8	13	52	3,640	2,461	0.68	Relamp	LED	33	0	3,640	1,562	0.43	\$40	\$3	\$0	\$520	\$39	\$559	\$140	\$699	899	0.25	\$113	6.2
JK1016	Corridor	Troffer	T8	12	28	3,640	1,223	0.34	Relamp	LED	16.5	0	3,640	721	0.20	\$20	\$2	\$0	\$240	\$18	\$258	\$65	\$323	502	0.14	\$63	5.1
JK1725	Corridor	Troffer	T8	14	52	3,640	2,650	0.73	Relamp	LED	33	0	3,640	1,682	0.46	\$40	\$3	\$0	\$560	\$42	\$602	\$151	\$753	968	0.27	\$121	6.2
JK1725	Corridor	Troffer	T8	2	52	3,640	379	0.10	Relamp	LED	33	0	3,640	240	0.07	\$40	\$3	\$0	\$80	\$6	\$86	\$22	\$108	138	0.04	\$17	6.2
JK1725	Corridor	Troffer	T8	43	28	3,640	4,383	1.20	Relamp	LED	16.5	0	3,640	2,583	0.71	\$20	\$2	\$0	\$860	\$65	\$925	\$231	\$1,156	1,800	0.49	\$225	5.1
JK1725	Corridor	Troffer	F17T8	2	15	3,640	109	0.03	Relamp	LED	8.5	0	3,640	62	0.02	\$21	\$2	\$0	\$41	\$3	\$44	\$11	\$55	47	0.01	\$6	9.3
JK1725	Corridor	Troffer	T8-U	3	30	3,640	328	0.09	Relamp	LED	16.5	0	3,640	180	0.05	\$23	\$2	\$0	\$68	\$5	\$72	\$18	\$90	147	0.04	\$18	4.9
JK1725	Corridor	Pot	CFL	5	32	3,640	582	0.16	None	CFL	32	0	3,640	582	0.16	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JK1617	Corridor	Troffer	T8	35	52	3,640	6,625	1.82	Relamp	LED	33	0	3,640	4,204	1.16	\$40	\$3	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	2,421	0.67	\$303	6.2
KL1016	Corridor	Troffer	T8-U	52	30	3,640	5,678	1.56	Relamp	LED	16.5	0	3,640	3,123	0.86	\$23	\$2	\$0	\$1,170	\$78	\$1,248	\$312	\$1,560	2,555	0.70	\$320	4.9
KL1016	Corridor	Troffer	T8	4	52	3,640	757	0.21	Relamp	LED	33	0	3,640	480	0.13	\$40	\$3	\$0	\$160	\$12	\$172	\$43	\$215	277	0.08	\$35	6.2
KL1016	Corridor	Troffer	T8	8	52	3,640	1,514	0.42	Relamp	LED	33	0	3,640	961	0.26	\$40	\$3	\$0	\$320	\$24	\$344	\$86	\$430	553	0.15	\$69	6.2
KL2025	Corridor	Troffer	T8	31	52	3,640	5,868	1.61	Relamp	LED	33	0	3,640	3,724	1.02	\$40	\$3	\$0	\$1,240	\$93	\$1,333	\$333	\$1,666	2,144	0.59	\$269	6.2
KL1617	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
KL1718	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
KL1819	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
KL1920	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
LM1016	Corridor	Troffer	T8-U	96	30	3,640	10,483	2.88	Relamp	LED	16.5	0	3,640	5,766	1.58	\$23	\$2	\$0	\$2,160	\$144	\$2,304	\$576	\$2,880	4,717	1.30	\$591	4.9
LM2025	Corridor	Troffer	T8	30	52	3,640	5,678	1.56	Relamp	LED	33	0	3,640	3,604	0.99	\$40	\$3	\$0	\$1,200	\$90	\$1,290	\$323	\$1,613	2,075	0.57	\$260	6.2
LM1617	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
LM1718	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
LM1819	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
LM1920	Corridor	Troffer	T8	26	52	3,640	4,921	1.35	Relamp	LED	33	0	3,640	3,123	0.86	\$40	\$3	\$0	\$1,040	\$78	\$1,118	\$280	\$1,398	1,798	0.49	\$225	6.2
KL1223	Corridor	Troffer	T8	53	28	3,640	5,402	1.48	Relamp	LED	16.5	0	3,640	3,183	0.87	\$20	\$2	\$0	\$1,060	\$80	\$1,140	\$285	\$1,424	2,219	0.61	\$278	5.1
JH1223	Corridor	Troffer	T8	58	28	3,640	5,911	1.62	Relamp	LED	16.5	0	3,640	3,483	0.96	\$20	\$2	\$0	\$1,160	\$87	\$1,247	\$312	\$1,559	2,428	0.67	\$304	5.1
JH1223	Corridor	Pot	CFL	1	32	3,640	116	0.03	None	CFL	32	0	3,640	116	0.03	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JH1224	Corridor	Troffer	T8	6	52	3,640	1,136	0.31	Relamp	LED	33	0	3,640	721	0.20	\$40	\$3	\$0	\$240	\$18	\$258	\$65	\$323	415	0.11	\$52	6.2
HG1223	Corridor	Troffer	T8	118	28	3,640	12,027	3.30	Relamp	LED	16.5	0	3,640	7,087	1.95	\$20	\$2	\$0	\$2,360	\$177	\$2,537	\$634	\$3,171	4,939	1.36	\$619	5.1
HG1223	Corridor	Troffer	T8	1	52	3,640	189	0.05	Relamp	LED	33	0	3,640	120	0.03	\$40	\$3	\$0	\$40	\$3	\$43	\$11	\$54	69	0.02	\$9	6.2
GF1223	Corridor	Troffer	T8	66	28	3,640	6,727	1.85	Relamp	LED	16.5	0	3,640	3,964	1.09	\$20	\$2	\$0	\$1,320	\$99	\$1,419	\$355	\$1,774	2,763	0.76	\$346	5.1
FE1223	Corridor	Troffer	T8	28	28	3,640	2,854	0.78	Relamp	LED	16.5	0	3,640	1,682	0.46	\$20	\$2	\$0	\$560	\$42	\$602	\$151	\$753	1,172	0.32	\$147	5.1
FE1223	Corridor	Pot	CFL	8	32	3,640	932	0.26	None	CFL	32	0	3,640	932	0.26	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
FE1223	Corridor	Troffer	T8	14	52	3,640	2,650	0.73	Relamp	LED	33	0	3,640	1,682	0.46	\$40	\$3	\$0	\$560	\$42	\$602	\$151	\$753	968	0.27	\$121	6.2
FE1223	Corridor	Troffer	T8-U	2	30	3,640	218	0.06	Relamp	LED	16.5	0	3,640	120	0.03	\$23	\$2										

Table 4: Lighting Template

Area	Description	Existing System						Proposed System						Costs					Savings								
		Fixture	Lamp	Qty.	Watts	Hours	kWh	kW	Measure	Lamp	Watts	Occ. Sensor	Hours	kWh	kW	Unit Matl.	Unit Labour	Sensor Cost	Material	Labour	Total Cost	Project Costs	Total Project	kWh Savings	kW Savings	Cost Savings	Simple Payback
HJ1025	Corridor	Troffer	T8	9	52	3,640	1,704	0.47	Relamp	LED	33	0	3,640	1,081	0.30	\$40	\$3	\$0	\$360	\$27	\$387	\$97	\$484	622	0.17	\$78	6.2
HJ1025	Corridor	Troffer	T8	57	28	3,640	5,809	1.60	Relamp	LED	16.5	0	3,640	3,423	0.94	\$20	\$2	\$0	\$1,140	\$86	\$1,226	\$306	\$1,532	2,386	0.66	\$299	5.1
HJ1025	Corridor	Troffer	T8	20	52	3,640	3,786	1.04	Relamp	LED	33	0	3,640	2,402	0.66	\$40	\$3	\$0	\$800	\$60	\$860	\$215	\$1,075	1,383	0.38	\$173	6.2
HJ1025	Corridor	Troffer	T8-U	8	30	3,640	874	0.24	Relamp	LED	16.5	0	3,640	480	0.13	\$23	\$2	\$0	\$180	\$12	\$192	\$48	\$240	393	0.11	\$49	4.9
HJ1025	Corridor	Troffer	F17T8	1	15	3,640	55	0.02	Relamp	LED	8.5	0	3,640	31	0.01	\$21	\$2	\$0	\$21	\$2	\$22	\$6	\$28	24	0.01	\$3	9.3
JK1025	Corridor	Pot	CFL	14	32	3,640	1,631	0.45	None	CFL	32	0	3,640	1,631	0.45	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JK1025	Corridor	Troffer	T8	68	28	3,640	6,931	1.90	Relamp	LED	16.5	0	3,640	4,084	1.12	\$20	\$2	\$0	\$1,360	\$102	\$1,462	\$366	\$1,828	2,846	0.78	\$357	5.1
JK1025	Corridor	Troffer	T8-U	11	30	3,640	1,201	0.33	Relamp	LED	16.5	0	3,640	661	0.18	\$23	\$2	\$0	\$248	\$17	\$264	\$66	\$330	541	0.15	\$68	4.9
JK1025	Corridor	Troffer	T8	24	52	3,640	4,543	1.25	Relamp	LED	33	0	3,640	2,883	0.79	\$40	\$3	\$0	\$960	\$72	\$1,032	\$258	\$1,290	1,660	0.46	\$208	6.2
JK1025	Corridor	Troffer	T8	3	52	3,640	568	0.16	Relamp	LED	33	0	3,640	360	0.10	\$40	\$3	\$0	\$120	\$9	\$129	\$32	\$161	207	0.06	\$26	6.2
KL1025	Corridor	Troffer	T8	88	52	3,640	16,657	4.58	Relamp	LED	33	0	3,640	10,571	2.90	\$40	\$3	\$0	\$3,520	\$264	\$3,784	\$946	\$4,730	6,086	1.67	\$762	6.2
LM1025	Corridor	Troffer	T8	88	52	3,640	16,657	4.58	Relamp	LED	33	0	3,640	10,571	2.90	\$40	\$3	\$0	\$3,520	\$264	\$3,784	\$946	\$4,730	6,086	1.67	\$762	6.2
LM1025	Corridor	Track Lighting	MR16	10	50	3,640	1,820	0.50	Relamp	LED	7	0	3,640	255	0.07	\$15	\$2	\$0	\$150	\$15	\$165	\$41	\$206	1,565	0.43	\$196	1.1
KJx1223	Corridor	Pot	CFL	8	32	3,640	932	0.26	None	CFL	32	0	3,640	932	0.26	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
KJx1223	Corridor	Troffer	T8	3	28	3,640	306	0.08	Relamp	LED	16.5	0	3,640	180	0.05	\$20	\$2	\$0	\$60	\$5	\$65	\$16	\$81	126	0.03	\$16	5.1
Jx1223	Corridor	Pot	CFL	8	32	3,640	932	0.26	None	CFL	32	0	3,640	932	0.26	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JHx1223	Corridor	Pot	CFL	5	32	3,640	582	0.16	None	CFL	32	0	3,640	582	0.16	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JHx1223	Corridor	Troffer	T8	7	28	3,640	713	0.20	Relamp	LED	16.5	0	3,640	420	0.12	\$20	\$2	\$0	\$140	\$11	\$151	\$38	\$188	293	0.08	\$37	5.1
HxH1223	Corridor	Pot	CFL	9	32	3,640	1,048	0.29	None	CFL	32	0	3,640	1,048	0.29	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HxH1223	Corridor	Troffer	T8	7	28	3,640	713	0.20	Relamp	LED	16.5	0	3,640	420	0.12	\$20	\$2	\$0	\$140	\$11	\$151	\$38	\$188	293	0.08	\$37	5.1
HGx1223	Corridor	Pot	CFL	10	32	3,640	1,165	0.32	None	CFL	32	0	3,640	1,165	0.32	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HGx1223	Corridor	Troffer	T8	6	28	3,640	612	0.17	Relamp	LED	16.5	0	3,640	360	0.10	\$20	\$2	\$0	\$120	\$9	\$129	\$32	\$161	251	0.07	\$31	5.1
GxG1223	Corridor	Pot	CFL	11	32	3,640	1,281	0.35	None	CFL	32	0	3,640	1,281	0.35	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
GxG1223	Corridor	Troffer	T8	5	28	3,640	510	0.14	Relamp	LED	16.5	0	3,640	300	0.08	\$20	\$2	\$0	\$100	\$8	\$108	\$27	\$134	209	0.06	\$26	5.1
GfX1223	Corridor	Pot	CFL	16	32	3,640	1,864	0.51	None	CFL	32	0	3,640	1,864	0.51	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
GfX1223	Corridor	Troffer	T8	7	28	3,640	713	0.20	Relamp	LED	16.5	0	3,640	420	0.12	\$20	\$2	\$0	\$140	\$11	\$151	\$38	\$188	293	0.08	\$37	5.1
FxF1223	Corridor	Pot	CFL	17	32	3,640	1,980	0.54	None	CFL	32	0	3,640	1,980	0.54	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
FxF1223	Corridor	Troffer	T8	2	28	3,640	204	0.06	Relamp	LED	16.5	0	3,640	120	0.03	\$20	\$2	\$0	\$40	\$3	\$43	\$11	\$54	84	0.02	\$10	5.1
FEx1223	Corridor	Pot	CFL	15	32	3,640	1,747	0.48	None	CFL	32	0	3,640	1,747	0.48	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
FEx1223	Corridor	Troffer	T8	7	28	3,640	713	0.20	Relamp	LED	16.5	0	3,640	420	0.12	\$20	\$2	\$0	\$140	\$11	\$151	\$38	\$188	293	0.08	\$37	5.1
ExE1223	Corridor	Pot	CFL	17	32	3,640	1,980	0.54	None	CFL	32	0	3,640	1,980	0.54	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
ExE1223	Corridor	Troffer	T8	10	28	3,640	1,019	0.28	Relamp	LED	16.5	0	3,640	601	0.17	\$20	\$2	\$0	\$200	\$15	\$215	\$54	\$269	419	0.12	\$52	5.1
JH1223	Storage	Troffer	F17T8	2	15	130	4	0.03	Relamp	LED	8.5	0	130	2	0.02	\$21	\$2	\$0	\$41	\$3	\$44	\$11	\$55	2	0.01	\$1	41.5
JH1223	Staircase	Troffer	T8	6	52	4,368	1,363	0.31	Relamp	LED	33	0	4,368	865	0.20	\$40	\$3	\$0	\$240	\$18	\$258	\$65	\$323	498	0.11	\$60	5.3
JH1223	Storage	Troffer	T8	2	28	130	7	0.06	Relamp	LED	16.5	0	130	4	0.03	\$20	\$2	\$0	\$40	\$3	\$43	\$11	\$54	3	0.02	\$2	22.9
JH1223	Corridor	Troffer	T8	22	28	4,368	2,691	0.62	Relamp	LED	16.5	0	4,368	1,586	0.36	\$20	\$2	\$0	\$440	\$33	\$473	\$118	\$591	1,105	0.25	\$134	4.4
JH1223	Corridor	Troffer	T8	10	52	4,368	2,271	0.52	Relamp	LED	33	0	4,368	1,441	0.33	\$40	\$3	\$0	\$400	\$30	\$430	\$108	\$538	800	0.19	\$101	5.3
JH1223	Cafeteria	Pot	Halogen	40	50	4,368	8,736	2.00	Relamp	LED	5	0	4,368	874	0.20	\$15	\$2	\$0	\$600	\$60	\$660	\$165	\$825	7,862	1.80	\$953	0.9
JH1223	Storage	Troffer	T8-U	1	30	130	4	0.03	Relamp	LED	16.5	0	130	2	0.02	\$23	\$2	\$0	\$23	\$2	\$24	\$6	\$30	2	0.01	\$1	21.8
HG1223	Office	Troffer	T8	5	52	1,820	473	0.26	Relamp	LED	33	0	1,820	300	0.17	\$40	\$3	\$0	\$200	\$15	\$215	\$54	\$269	173	0.10	\$26	10.4
HG1223	Office	Troffer	T8	8	28	1,820	408	0.22	Relamp	LED	16.5	0	1,820	240	0.13	\$20	\$2	\$0	\$160	\$12	\$172	\$43	\$215	167	0.09	\$25	8.6
HG1223	Cafeteria	Pot	Halogen	24	50	1,820	2,184	1.20	Relamp	LED	5	0	1,820	218	0.12	\$15	\$2	\$0	\$360	\$36	\$396	\$99	\$495	1,966	1.08	\$294	1.7
HG1223	Washrooms	Pot	CFL	14	32	1,820	815	0.45	None	CFL	32	0	1,820	815	0.45	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HG1223	Corridor	Troffer	T8-U	5	30	4,368	655	0.15	Relamp	LED	16.5	0	4,368	360	0.08	\$23	\$2	\$0	\$113	\$8	\$120	\$30	\$150	295	0.07	\$36	4.2
HG1223	Corridor	Troffer	T8	51	28	4,368	6,238	1.43	Relamp	LED	16.5	0	4,368	3,676	0.84	\$20	\$2	\$0	\$1,020	\$77	\$1,097	\$274	\$1,371	2,562	0.59	\$310	4.4
GF1223	Office	Troffer	T8	4	52	1,820	379	0.21	Relamp	LED	33	0	1,820	240	0.13	\$40	\$3	\$0	\$160	\$12	\$172	\$43	\$215	138	0.08	\$21	10.4
GF1223	Storage	Troffer	T8	3	52	130	20	0.16	Relamp	LED	33	0	130	13	0.10	\$40	\$3	\$0	\$120	\$9	\$129	\$32	\$161	7	0.06	\$6	27.7
GF1223	Corridor	Troffer	T8	94	28	4,368	11,497	2.63	Relamp	LED	16.5	0	4,368	6,775	1.55	\$20	\$2	\$0	\$1,880	\$141	\$2,021	\$505	\$2,526	4,722	1.08	\$572	4.4
GF1223	Cafeteria	Pot	Halogen	34	50	1,820	3,094	1.70	Relamp	LED	5	0	1,820	309	0.17	\$15	\$2	\$0	\$510	\$51	\$561	\$140	\$701	2,785	1.53	\$417	1.7
FE1223	Corridor	Troffer	T8	99	28	4,368	12,108	2.77	Relamp	LED	16.5	0	4,368	7,135	1.63	\$20	\$2	\$0	\$1,980	\$149	\$2,129	\$532	\$2,661	4,973	1.14	\$603	4.4
JH1223	Storage	Troffer	F17T8	2	15	130	4	0.03	Relamp	LED	8.5	0	130	2	0.02	\$21	\$2	\$0	\$41	\$3	\$44	\$11	\$55	2	0.01	\$1	41.5
JH1223	Staircase	Troffer	T8	6	52	8,736	2,726	0.31	Relamp	LED	33	0	8,736	1,730	0.20	\$40	\$3	\$0	\$240	\$18	\$258	\$65	\$323	996	0.11	\$111	2.9
JH1223	Storage	Troffer	T8	2	28	130	7	0.06	Relamp	LED	16.5	0	130	4	0.03	\$20	\$2	\$0	\$40	\$3	\$43	\$11	\$54	3	0.02	\$2	22.9
JH1223	Storage	Troffer	T8	2	28	8,736	489	0.06	Relamp	LED	16.5	0	8,736	288	0.03	\$20	\$2	\$0	\$40	\$3	\$43	\$11	\$54	201	0.02	\$22	2.4
JH1223	Corridor	Troffer	T8	35	28	130	127	0.98	Relamp	LED	16.5	0	130	75	0.58	\$20	\$2	\$0	\$700	\$53	\$753	\$188	\$941	52	0.40	\$41	22.9
JH1223	Corridor	Troffer	T8	35	28	8,736	8,561	0.98	Relamp	LED	16.5	0	8,73														

Table 4: Lighting Template

Area	Description	Existing System							Proposed System							Costs					Savings						
		Fixture	Lamp	Qty.	Watts	Hours	kWh	kW	Measure	Lamp	Watts	Occ. Sensor	Hours	kWh	kW	Unit Matl.	Unit Labour	Sensor Cost	Material	Labour	Total Cost	Project Costs	Total Project	kWh Savings	kW Savings	Cost Savings	Simple Payback
JH1223	Corridor	Troffer	T8	29	28	130	106	0.81	Relamp	LED	16.5	0	130	62	0.48	\$20	\$2	\$0	\$580	\$44	\$624	\$156	\$779	43	0.33	\$34	22.9
JH1223	Corridor	Troffer	T8	28	28	8,736	6,849	0.78	Relamp	LED	16.5	0	8,736	4,036	0.46	\$20	\$2	\$0	\$560	\$42	\$602	\$151	\$753	2,813	0.32	\$312	2.4
JH1223	Corridor	Troffer	T8	13	52	130	88	0.68	Relamp	LED	33	0	130	56	0.43	\$40	\$3	\$0	\$520	\$39	\$559	\$140	\$699	32	0.25	\$25	27.7
JH1223	Storage	Troffer	T8-U	1	30	130	4	0.03	Relamp	LED	16.5	0	130	2	0.02	\$23	\$2	\$0	\$23	\$2	\$24	\$6	\$30	2	0.01	\$1	21.8
HG1223	Corridor	Troffer	T8	130	28	130	473	3.64	Relamp	LED	16.5	0	130	279	2.15	\$20	\$2	\$0	\$2,600	\$195	\$2,795	\$699	\$3,494	194	1.50	\$153	22.9
HG1223	Storage	Troffer	T8	1	28	130	4	0.03	Relamp	LED	16.5	0	130	2	0.02	\$20	\$2	\$0	\$20	\$2	\$22	\$5	\$27	1	0.01	\$1	22.9
HG1223	Storage	Troffer	T8	1	28	8,736	245	0.03	Relamp	LED	16.5	0	8,736	144	0.02	\$20	\$2	\$0	\$20	\$2	\$22	\$5	\$27	100	0.01	\$11	2.4
GF1223	Corridor	Troffer	T8	69	28	130	251	1.93	Relamp	LED	16.5	0	130	148	1.14	\$20	\$2	\$0	\$1,380	\$104	\$1,484	\$371	\$1,854	103	0.79	\$81	22.9
GF1223	Corridor	Troffer	T8	69	28	8,736	16,878	1.93	Relamp	LED	16.5	0	8,736	9,946	1.14	\$20	\$2	\$0	\$1,380	\$104	\$1,484	\$371	\$1,854	6,932	0.79	\$770	2.4
FE1223	Corridor	Troffer	T8	47	28	130	171	1.32	Relamp	LED	16.5	0	130	101	0.78	\$20	\$2	\$0	\$940	\$71	\$1,011	\$253	\$1,263	70	0.54	\$55	22.9
FE1223	Corridor	Troffer	T8	47	28	8,736	11,497	1.32	Relamp	LED	16.5	0	8,736	6,775	0.78	\$20	\$2	\$0	\$940	\$71	\$1,011	\$253	\$1,263	4,722	0.54	\$524	2.4
JH1223	Storage	Troffer	F17T8	2	15	130	4	0.03	Relamp	LED	8.5	0	130	2	0.02	\$21	\$2	\$0	\$41	\$3	\$44	\$11	\$55	2	0.01	\$1	41.5
JH1223	Staircase	Troffer	T8	6	52	8,736	2,726	0.31	Relamp	LED	33	0	8,736	1,730	0.20	\$40	\$3	\$0	\$240	\$18	\$258	\$65	\$323	996	0.11	\$111	2.9
JH1223	Staircase	Troffer	T8	3	28	8,736	734	0.08	Relamp	LED	16.5	0	8,736	432	0.05	\$20	\$2	\$0	\$60	\$5	\$65	\$16	\$81	301	0.03	\$33	2.4
JH1223	Storage	Troffer	T8	2	28	130	7	0.06	Relamp	LED	16.5	0	130	4	0.03	\$20	\$2	\$0	\$40	\$3	\$43	\$11	\$54	3	0.02	\$2	22.9
JH1223	Corridor	Troffer	T8	27	28	130	98	0.76	Relamp	LED	16.5	0	130	58	0.45	\$20	\$2	\$0	\$540	\$41	\$581	\$145	\$726	40	0.31	\$32	22.9
JH1223	Corridor	Troffer	T8	26	28	8,736	6,360	0.73	Relamp	LED	16.5	0	8,736	3,748	0.43	\$20	\$2	\$0	\$520	\$39	\$559	\$140	\$699	2,612	0.30	\$290	2.4
JH1223	Corridor	Troffer	T8	13	52	130	88	0.68	Relamp	LED	33	0	130	56	0.43	\$40	\$3	\$0	\$520	\$39	\$559	\$140	\$699	32	0.25	\$25	27.7
JH1223	Storage	Troffer	T8-U	1	30	130	4	0.03	Relamp	LED	16.5	0	130	2	0.02	\$23	\$2	\$0	\$23	\$2	\$24	\$6	\$30	2	0.01	\$1	21.8
HG1223	Corridor	Pot	CFL	6	32	130	25	0.19	None	CFL	32	0	130	25	0.19	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
HG1223	Corridor	Troffer	T8	64	28	130	233	1.79	Relamp	LED	16.5	0	130	137	1.06	\$20	\$2	\$0	\$1,280	\$96	\$1,376	\$344	\$1,720	96	0.74	\$75	22.9
HG1223	Corridor	Troffer	T8	63	28	8,736	15,410	1.76	Relamp	LED	16.5	0	8,736	9,081	1.04	\$20	\$2	\$0	\$1,260	\$95	\$1,355	\$339	\$1,693	6,329	0.72	\$703	2.4
HG1223	Storage	Troffer	T8	1	28	130	4	0.03	Relamp	LED	16.5	0	130	2	0.02	\$20	\$2	\$0	\$20	\$2	\$22	\$5	\$27	1	0.01	\$1	22.9
GF1223	Corridor	Troffer	T8	70	28	130	255	1.96	Relamp	LED	16.5	0	130	150	1.16	\$20	\$2	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	105	0.81	\$82	22.9
GF1223	Corridor	Troffer	T8	70	28	8,736	17,123	1.96	Relamp	LED	16.5	0	8,736	10,090	1.16	\$20	\$2	\$0	\$1,400	\$105	\$1,505	\$376	\$1,881	7,032	0.81	\$781	2.4
FE1223	Corridor	Troffer	T8	48	28	130	175	1.34	Relamp	LED	16.5	0	130	103	0.79	\$20	\$2	\$0	\$960	\$72	\$1,032	\$258	\$1,290	72	0.55	\$56	22.9
FE1223	Corridor	Troffer	T8	48	28	8,736	11,741	1.34	Relamp	LED	16.5	0	8,736	6,919	0.79	\$20	\$2	\$0	\$960	\$72	\$1,032	\$258	\$1,290	4,822	0.55	\$535	2.4
JE1216	Mechanical Room 1	Troffer	T8	12	28	260	87	0.34	Relamp	LED	16.5	0	260	51	0.20	\$20	\$2	\$0	\$240	\$18	\$258	\$65	\$323	36	0.14	\$16	20.3
JE1216	Mechanical Room 1	Pot	CFL	3	32	260	25	0.10	None	CFL	32	0	260	25	0.10	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JE1619	Mechanical Room 2	Troffer	T8	47	28	260	342	1.32	Relamp	LED	16.5	0	260	202	0.78	\$20	\$2	\$0	\$940	\$71	\$1,011	\$253	\$1,263	141	0.54	\$62	20.3
JE1619	Mechanical Room 2	Pot	CFL	1	32	260	8	0.03	None	CFL	32	0	260	8	0.03	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JE1619	Mechanical Room 2	Troffer	T8	4	52	260	54	0.21	Relamp	LED	33	0	260	34	0.13	\$40	\$3	\$0	\$160	\$12	\$172	\$43	\$215	20	0.08	\$9	24.6
JE1923	Mechanical Room 3	Pot	CFL	2	32	260	17	0.06	None	CFL	32	0	260	17	0.06	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JE1923	Mechanical Room 3	Troffer	T8	15	28	260	109	0.42	Relamp	LED	16.5	0	260	64	0.25	\$20	\$2	\$0	\$300	\$23	\$323	\$81	\$403	45	0.17	\$20	20.3
1618	Corridor	Troffer	T8	2	28	4,368	245	0.06	Relamp	LED	16.5	0	4,368	144	0.03	\$20	\$2	\$0	\$40	\$3	\$43	\$11	\$54	100	0.02	\$12	4.4
JH2223	Corridor	Pot	CFL	5	32	4,368	699	0.16	None	CFL	32	0	4,368	699	0.16	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
JH1213	Corridor	Pot	CFL	5	32	4,368	699	0.16	None	CFL	32	0	4,368	699	0.16	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	
Exterior	Exterior	Globe	Incan	8	400	4,368	13,978	3.20	Relamp	LED	16.5	0	4,368	577	0.13	\$60	\$6	\$0	\$480	\$48	\$528	\$132	\$660	13,401	3.07	\$1,624	0.4
Exterior	Exterior	Flood	HID	10	115	4,368	5,023	1.15	Retrofit	LED	50	0	4,368	2,184	0.50	\$115	\$60	\$0	\$1,150	\$600	\$1,750	\$438	\$2,188	2,839	0.65	\$344	6.4
Exterior	Exterior	Globe	Incan	14	100	4,368	6,115	1.40	Relamp	LED	16.5	0	4,368	1,009	0.23	\$15	\$2	\$0	\$210	\$21	\$231	\$58	\$289	5,106	1.17	\$619	0.5
Exterior	Exterior	Flood	HID	6	115	4,368	3,014	0.69	Retrofit	LED	50	0	4,368	1,310	0.30	\$115	\$60	\$0	\$690	\$360	\$1,050	\$263	\$1,313	1,704	0.39	\$206	6.4
Exterior	Exterior	Flood	LED	6	20	4,368	524	0.12	None	LED	20	0	4,368	524	0.12	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	0	0.00	\$0	

Table 5: Fan Schedule

AHU #	Serving	Type	Volume [cfm]	Motor Supply/Return [HP]	Heating Coil	Cooling Coil	Humidification	Hours of Operation
S1	Stack Area West	VAV	36,300	40 / none	Hot Water	Chilled Water	Steam	Constant
S2	Stack Area East	VAV	42,995	40 / none	Hot Water	Chilled Water	Steam	Constant
S3	West End West Zone	VAV	43,709	40 / none	Hot Water	Chilled Water	Steam	6am-11pm
S3A	West End Interior Zone	VAV	20,472	20 / none	Hot Water	Chilled Water	Steam	6am-11pm
S4	West End Interior Zone	VAV	18,166	15 / none	Hot Water	Chilled Water	Steam	6am-11pm
S4A	West End North Zone	VAV	23,320	25 / none	Hot Water	Chilled Water	Steam	6am-11pm
S5	East End East Zone	VAV	48,600	50 / none	Hot Water	Chilled Water	Steam	Constant
S5A	East End South Zone	VAV	11,384	10 / none	Hot Water	Chilled Water	Steam	Constant
S6	East End Interior Zone	VAV	8,570	10 / none	Hot Water	Chilled Water	Steam	6am-11pm
S6A	East End North Zone	VAV	50,235	50 / none	Hot Water	Chilled Water	Steam	6am-11pm
S7	Cafeteria	CV		5 / none	Hot Water	Chilled Water	Steam	Constant
S8	9th Floor Mech. Rm.	CV	6,000	2 / none	-	-	-	Constant
	Ehibition Room C	CV	5,300	7.5 / none	Hot Water	Chilled Water	Steam	Constant
S11	Auditorium	CV	12,100	10 / none	Hot Water	Chilled Water	Steam	Constant
S13	Basement Mech. Rm.	CV	8,200	15 / none	-	-	-	Constant
R1	Stack Area West	VAV	22,500	none / 10	-	-	-	Constant
R2	Stack Area East	VAV	26,500	none / 10	-	-	-	Constant
R3	West End	VAV	65,150	none / 25	-	-	-	Constant
R4	East End	VAV	74,150	none / 30	-	-	-	Constant
R7	Auditorium	VAV	8,000	none / 3	-	-	-	Constant
R8	Basement Mech. Rm.	CV	8,200	none / 3	-	-	-	Constant

Table 6: Pump Summary

Pump ID	Service	Motor Power [HP]	Flow Rate [gpm]	Head [ft]	Operation
P2	North Zone Perimeter Heating	1.5	68	39	Winter
P3	North Zone Perimeter Heating	1.5	68	39	Winter
P6	South Zone Perimeter Heating	1.5	68	39	Winter
P7	South Zone Perimeter Heating	1.5	68	39	Winter
P8	West Zone Perimeter Heating	1.5	68	39	Winter
P9	West Zone Perimeter Heating	1.5	68	39	Winter
P4	East Zone Perimeter Heating	1.5	68	39	Winter
P5	East Zone Perimeter Heating	1.5	68	39	Winter
	Main Heating	25.0	750	88	Constant
	Main Heating	25.0	750	88	Standby
	Fire Pump	35.5	500	80	On Demand
	Sump	10.0	-	-	On Demand
	Sump	10.0	-	-	On Demand
	Condensate Return	3.0	-	-	On Demand
	Condensate Return	3.0	-	-	On Demand
	Vestibule Heater Circulation	1.5	-	-	Winter
	Domestic Cold Water	10.0	80	185	Constant
	Domestic Cold Water	10.0	80	185	Standby

Table 7: Water Audit

Type	Fixture Mounting	Supply	Quantity	Flow Rate
Toilet	Floor	Tank	22	13 LPF
Toilet	Floor	Valve	80	6 LPF
Urinal	Wall	Valve	28	0.5 LPF
Sink	Wall	Valve	54	7.6 LPM
Sink	Wall	Valve	85	3.8 LPM
Shower	Wall	Valve	2	12 LPM

Table 8: Utility Data

Month	Electricity				Steam				Chilled Water				Water		Total			Weather Data			
	Usage	Cost	Usage Intensity	Cost Intensity	Usage		Cost	Usage Intensity	Cost Intensity	Usage		Cost	Usage Intensity	Cost Intensity	Usage	Cost	Usage	Cost	Cost Intensity	HDD	CDD
	[kWh]	[\$]	[kWh/m ²]	[\$/m ²]	[GJ]	[ekWh]	[\$]	[ekWh/m ²]	[\$/m ²]	[GJ]	[ekWh]	[\$]	[ekWh/m ²]	[\$/m ²]	[m ³]	[\$]	[ekWh]	[\$]	[\$/m ²]	[@18°C]	[@18°C]
January	289,791	\$27,792	7.9	\$0.76	4,071	1,130,924	\$100,139	30.9	\$2.74	0	0	\$0	0.0	\$0.00	350	\$669	1,420,714	\$128,600	\$3.51	805.4	0
February	263,385	\$30,128	7.2	\$0.82	3,609	1,002,580	\$88,789	27.4	\$2.43	0	0	\$0	0.0	\$0.00	371	\$1,177	1,265,965	\$120,094	\$3.28	721	0
March	281,331	\$28,139	7.7	\$0.77	3,168	880,070	\$77,940	24.0	\$2.13	0	0	\$0	0.0	\$0.00	419	\$1,319	1,161,401	\$107,398	\$2.93	614.6	0
April	257,321	\$29,416	7.0	\$0.80	2,602	722,836	\$60,323	19.7	\$1.65	0	0	\$0	0.0	\$0.00	413	\$1,319	980,156	\$91,058	\$2.49	353.6	0
May	261,644	\$27,288	7.1	\$0.75	1,857	515,875	\$43,055	14.1	\$1.18	848	235,574	\$20,345	6.4	\$0.56	357	\$1,214	1,013,093	\$91,901	\$2.51	111.6	14.3
June	242,328	\$27,801	6.6	\$0.76	1,104	306,691	\$25,583	8.4	\$0.70	972	270,022	\$23,330	7.4	\$0.64	1,315	\$4,161	819,040	\$80,875	\$2.21	48.3	42.6
July	236,968	\$31,206	6.5	\$0.85	1,019	283,078	\$23,618	7.7	\$0.65	1,685	468,093	\$40,431	12.8	\$1.10	675	\$2,311	988,139	\$97,565	\$2.67	7.4	104.4
August	232,716	\$20,999	6.4	\$0.57	1,166	323,915	\$27,036	8.8	\$0.74	1,543	428,645	\$37,022	11.7	\$1.01	147	\$502	985,276	\$85,558	\$2.34	11.3	60.3
September	223,425	\$30,632	6.1	\$0.84	1,269	352,528	\$29,411	9.6	\$0.80	935	259,743	\$22,442	7.1	\$0.61	619	\$2,046	835,696	\$84,531	\$2.31	130.6	9.3
October	251,227	\$26,963	6.9	\$0.74	1,436	398,921	\$33,276	10.9	\$0.91	61	16,946	\$1,470	0.5	\$0.04	539	\$1,816	667,094	\$63,525	\$1.74	221.6	1.6
November	247,441	\$26,511	6.8	\$0.72	2,386	662,831	\$55,315	18.1	\$1.51	0	0	\$0	0.0	\$0.00	351	\$1,186	910,272	\$83,011	\$2.27	511.3	0
December	310,680	\$41,771	8.5	\$1.14	3,798	1,055,084	\$88,044	28.8	\$2.41	0	0	\$0	0.0	\$0.00	384	\$1,336	1,365,764	\$131,151	\$3.58	834.6	0
Total	3,098,255	\$348,646	84.6	\$9.52	27,485	7,635,333	\$652,528	208.6	\$17.83	6,044	1,679,023	\$145,040	45.9	\$3.96	5,940	\$19,055	12,412,611	\$1,165,269	\$31.83	4,371.3	232.5

Table 9: Measure Summary

Measure Description	Total Utility [\$]	Electrical		Annual Utility Savings				CO ₂ e [MT/yr]	Total Cost [\$]	Simple Payback [yrs]
		[kW]	[kWh/yr]	Chilled Water [GJ/yr]	Steam [GJ/yr]	Water [m ³ /yr]	Total [GJ/yr]			
Controls Optimisation	\$81,820	0	150,616	0	3,000	0	3,542	216.0	\$51,250	0.6
O&M Measures	\$17,487	0	0	60	675	314	736	44.7	\$30,000	1.7
Measure Totals (< 6 year Simple Payback)	\$99,306	0	150,616	60	3,675	314	4,278	260.7	\$81,250	0.8
Measure Description	Total Utility [\$]	Electrical		Annual Utility Savings				CO ₂ e [MT/yr]	Total Cost [\$]	Simple Payback [yrs]
		[kW]	[kWh/yr]	Chilled Water [GJ/yr]	Steam [GJ/yr]	Water [m ³ /yr]	Total [GJ/yr]			
Lighting Retrofit	\$77,205	190	598,262	0	0	0	2,154	83.5	\$474,578	6.1
Measure Totals (> 6 year Simple Payback)	\$77,205	190	598,262	0	0	0	2,154	83.5	\$474,578	6.1
Measure Totals (All Measures)	\$176,512	190	748,878	60	3,675	314	6,432	344.2	\$555,828	3.1

Appendix B Measure Worksheets

Measure Cost and Savings Work-Up Sheet

Facility: Public Archives and National Library

Measure: Lighting Retrofit

Existing:

The facility is currently illuminated by:

- T8 4' fixtures in most areas. Lamps are a mixture of 25W, 28W, and 32W
- T8 2' fixtures in common areas
- Halogen pot lights in the 5th floor cafeteria
- Halogen MR16 track lights on the ground floor
- Incandescent and HID fixtures on the exterior of the building

Proposed:

The following lighting measures are proposed:

- Relamp all 4' T8 fixtures with 16.5W LED lamps
- Relamp all T8-U fixtures with 16.5W LED lamps
- Relamp all 2' T8 fixtures with 8.5W LED lamps
- Relamp all halogen fixtures in the 5th floor cafeteria with LED lamps
- Relamp all MR16 halogen fixtures on the ground floor with LED lamps
- Replace all exterior HID fixtures with LED fixtures
- Replace all incandescent fixtures with LED fixtures

Cost:

	Material:	\$352,425
	Labour:	\$27,237
	Sub-Total:	\$379,662
	(15%) Eng. & Proj. Man.:	\$56,949
	(10%) Contingency:	\$37,966
	Total Cost:	\$474,578

Annual Savings: \$77,205

Service Life (Years):	5
Simple Payback:	6.15
Net Present Value:	-\$149,361
ROI:	-7%

Assumptions:

- Cost of LED 4' tube: \$20, relamp assumed to take 1/12 hour/lamp relamping technician time
- Cost of LED U-tube: \$22.50, relamp assumed to take 1/12 hour/lamp relamping technician time
- Cost of LED 2' tube: \$20.50, relamp assumed to take 1/12 hour/lamp relamping technician time
- Cost of LED MR16 lamp: \$15, relamp assumed to take 1/12 hour/lamp relamping technician time
- Cost of LED pot light lamp (50W halogen replacement): \$15, relamp assumed to take 1/12 hour/lamp relamping technician time
- Cost of LED 12W lamp (100W incandescent replacement): \$15, relamp assumed to take 1/12 hour/lamp relamping technician time
- Cost of 50W LED floodlight: \$115, installation assumed to take 1 hour/fixture electrician time
- Labour rates set as follows:
 - relamping technician at \$18/hour
 - electrician at \$60/hour
- Incentives are based on saveONenergy Engineered rates of \$400/kW or \$0.05/kWh

Savings:

Energy Reduction Measure	Electricity			Total Savings	Estimated Cost	Simple Payback	GHG Reduction
	[kW]	[kWh]	[\$]				
Lighting Retrofit	190	598,262	\$77,205	\$77,205	\$474,578	6.1	83.5

Notes:

Approximately \$60,000 may be available in incentive funding from the Ontario Power Authority's saveonenergy Retrofit program. See <http://saveonenergy.ca> for details.

Measure Cost and Savings Work-Up Sheet

Facility: Public Archives and National Library

Measure: Controls Optimisation

Existing:

A review of the HVAC and lighting system controls and operations has identified several opportunities for optimization of energy performance including HVAC upgrades, improved control strategies, and re-commissioning.

Proposed:

The following measures are proposed:

- Add the washroom and cafeteria exhaust fans to the BAS and schedule base on building occupancy.
- Eliminate the operation of the terminal reheat loop during the summer months.
- Program the lighting control system to remove the automatic event which turns the lights on at 3 am every morning. If the lighting control system is determined to not be the cause of the load increase, the fan schedules should be investigated.

Cost:

Material: \$20,000
Labour: \$21,000
Sub-Total: \$41,000
(15%) Eng. & Proj. Man.: \$6,150
(10%) Contingency: \$4,100
Total Cost: \$51,250

Annual Savings: \$81,820

Service Life (Years): 5
Simple Payback: 0.6
Net Present Value: \$293,404
ROI: 158%

Assumptions:

- 10 exhaust fans added to the BAS and scheduled
- 100 hours to eliminate summer reheat
- 10 hours to reprogram lighting control system
- \$10,000 in miscellaneous materials costs

- Labour rate: \$100/hour
- BAS Points: \$2,000/point

Savings:

Energy Reduction Measure	Electricity			Steam		Total Savings [\$]	Estimated Cost [\$]	Simple Payback [Years]	GHG Reduction [teCO ₂]
	[kW]	[kWh]	[\$]	[GJ]	[\$]				
Controls Optimisation	0	150,616	\$15,188	3,000	\$66,631	\$81,820	\$51,250	0.6	216.0

Notes:

Measure Cost and Savings Work-Up Sheet

Facility: Public Archives and National Library

Measure: O&M Measures

Existing:

The audit identified various opportunities to improve the energy performance of the facility through improved O&M practices and low-cost measures.

Proposed:

The following O&M measures are proposed:

- Test and repair leaking steam traps.
- Insulate exposed steam pipes in the mechanical rooms.
- Install weather stripping around leaky exterior doors.
- Install low flow 1 gpm aerators on sinks that have no aerators or higher flow aerators.
- Replace the batteries on the VAV boxes that have lost communication with the BAS, and implement a strategy to replace the batteries as soon as possible after they fail. A long term solution to the signal strength problem should be sought.
- The building operators would benefit from improved documentation and BAS training to fully exploit the benefits of the recently undertaken ESCO project.

Cost:

Material: \$12,000
Labour: \$12,000
Sub-Total: \$24,000
(15%) Eng. & Proj. Man.: \$3,600
(10%) Contingency: \$2,400
Total Cost: \$30,000

Annual Savings: \$17,487

Service Life (Years): 5
Simple Payback: 1.72
Net Present Value: \$43,661
ROI: 51%

Assumptions:

- Faucet aerators: \$5/aerator, 1/12 hours/aerator installation time
- Labour rate: \$60/hour

Savings:

Energy Reduction Measure	Steam		Chilled Water		Water		Total Savings	Estimated Cost	Simple Payback	GHG Reduction
	[GJ]	[\$]	[GJ]	[\$]	[m ³]	[\$]				
O&M Measures	675	\$14,995	60	\$1,400	314	\$1,092	\$17,487	\$30,000	1.7	44.7

Notes:

Appendix C Energy Balance Reports

Building: Public Archives and National Library
Date: Oct-14
Purpose: Electrical End-Use Estimates and Energy Balance

Area = 393,827 sq.ft.

End-Use Estimates	Base				Winter Extra				Total		
	[kW]	[kWh]	[kWh/ft ²]	[\$]	[kW]	[kWh]	[kWh/ft ²]	[\$]	[kWh]	[kWh/ft ²]	[\$]
Lighting											
Interior Lighting	497.0	1,516,044	3.8	\$197,077					1,516,044	3.8	\$197,077
Exterior Lighting	6.6	28,654	0.1	\$3,473					28,654	0.1	\$3,473
Plug Loads/Miscellaneous											
Computer Equipment and Plug Loads	78.8	78,765	0.2	\$14,947					78,765	0.2	\$14,947
Compressors	7.5	13,070	0.0	\$1,981					13,070	0.0	\$1,981
Elevators	20.1	67,033	0.2	\$8,551					67,033	0.2	\$8,551
Air Handling Systems											
East End Stack	13.9	86,090	0.2	\$9,916					86,090	0.2	\$9,916
West End Stack	27.3	169,030	0.4	\$19,469					169,030	0.4	\$19,469
East End	69.8	367,806	0.9	\$43,293					367,806	0.9	\$43,293
West End	77.2	366,618	0.9	\$43,833					366,618	0.9	\$43,833
Auditorium	3.0	19,017	0.0	\$2,189					19,017	0.0	\$2,189
Exhibition Room C	5.6	34,913	0.1	\$4,018					34,913	0.1	\$4,018
Basement Mechanical Room	13.4	83,791	0.2	\$9,644					83,791	0.2	\$9,644
9th Floor Mechanical Room	1.5	9,310	0.0	\$1,072					9,310	0.0	\$1,072
Exhaust Fans	16.8	147,037	0.4	\$16,320					147,037	0.4	\$16,320
Pumping											
Terminal Reheat Coil	13.7	120,047	0.3	\$13,324					120,047	0.3	\$13,324
DCW Booster	1.6	13,959	0.0	\$1,549					13,959	0.0	\$1,549
Perimeter Heat					10.1	39,700	0.1	\$4,899	39,700	0.1	\$4,899
Totals	854	3,121,183	7.9	\$390,655	10.1	39,700	0.1	\$4,899	3,160,883	8.0	\$395,554
Baseline	854	3,060,000	7.8	\$384,485	10	38,255	0.1	\$4,753	3,098,255	7.9	\$156,771
Difference		2.0%				3.8%			2.0%		

Notes:

Building: Public Archives and National Library
Date: Oct-14
Purpose: Steam End-Use Estimate and Energy Balance

Floor Area 393,827 sq.ft.
Marginal Rate \$22.21 /GJ
Average Rate \$23.74 /GJ

System Estimates	Base Load			Winter Extra			Total		
	[GJ]	[ekWh/sq.ft.]	[\$]	[GJ]	[ekWh/sq.ft.]	[\$]	[GJ]	[ekWh/sq.ft.]	[\$]
DHW									
Hot Water	2,390	1.69	\$56,743				2,390	1.69	\$56,743
Space Heating									
Summer Reheat	3,000	2.12	\$71,224				3,000	2.12	\$71,224
Space Heating			\$0	18,438		\$437,729	18,438	13.01	\$437,729
Humidification			\$0	3,813		\$90,513	3,813	2.69	\$90,513
Total	5,390	3.80	\$127,967	22,250	0.00	\$528,243	27,640	19.50	\$656,209
Baseline	5,500	3.88	\$130,577	21,985	15.51	\$521,951	27,485	19.39	\$652,528
Difference	-2.0%			1.2%			0.6%		

Notes:

Building: Public Archives and National Library
Date: Oct-14
Purpose: Chilled Water End-Use Estimate and Energy Balance

Floor Area 393,827 sq.ft.
Marginal Rate \$23.17 /GJ
Average Rate \$24.00 /GJ

System Estimates	[GJ]	Base Load [ekWh/sq.ft.]	[\$]	[GJ]	Summer Extra [ekWh/sq.ft.]	[\$]	[GJ]	Total [ekWh/sq.ft.]	[\$]
Stack Area West				671	0.47	\$16,108	671	0.47	\$16,108
Stack Area East				795	0.56	\$19,079	795	0.56	\$19,079
West End West Zone				808	0.57	\$19,396	808	0.57	\$19,396
West End Interior Zone				379	0.27	\$9,084	379	0.27	\$9,084
West End Interior Zone				336	0.24	\$8,061	336	0.24	\$8,061
West End North Zone				431	0.30	\$10,348	431	0.30	\$10,348
East End East Zone				899	0.63	\$21,566	899	0.63	\$21,566
East End South Zone				211	0.15	\$5,052	211	0.15	\$5,052
East End Interior Zone				158	0.11	\$3,803	158	0.11	\$3,803
East End North Zone				929	0.66	\$22,292	929	0.66	\$22,292
Cafeteria				92	0.07	\$2,219	92	0.07	\$2,219
9th Floor Mech. Rm.				111	0.08	\$2,663	111	0.08	\$2,663
Auditorium				224	0.16	\$5,369	224	0.16	\$5,369
Total	0	0.00	\$0	6,044	4.26	\$145,040	6,044	4.26	\$145,040
Baseline	0	0.00	\$0	6,044	4.26	\$145,040	6,044	4.26	\$145,040
Difference	0.0%			0.0%			0.0%		

Notes:

Building: Public Archives and National Library
Date: Oct-14
Purpose: Water End-Use Estimate

Water Rate: \$3.48 /m³

System Estimates	Base Load [m³]	Cost [\$]
Toilets and urinals	1,106	\$3,547
Sinks	1,124	\$3,605
Showers	25	\$80
Janitorial	2,245	\$7,201
Humidification	1,448	\$4,644
Total	5,947	\$19,077
Baseline	5,940	\$19,055
Difference	0%	0%