Wilson Engineering Services, PC
902 Market Street
Meadville, PA 16335
(814) 337-8223

Energy · Environment · Enterprise

M E M O R A N D U M

Date: 6/11/2021

To: Kyle Walk & Greg Butler, Elizabeth Township

From: Michael Stahly & Patrick Martin, WES

CC: Heidi Kunka, PA DEP; Tom Wilson, WES; Peter Oven, WES; Ben Gesink, WES

Re: Elizabeth Township Energy Assessment

1.0 INTRODUCTION

Under the Shared Energy Manager (SEM) program administered by the Pennsylvania Department of Environmental Protection (PA DEP), Elizabeth Township is receiving technical assistance related to energy management from Wilson Engineering Services (WES). As part of this technical assistance, Elizabeth Township has requested energy assessments of three facilities which the township owns and operates. WES conducted a walkthrough of the facilities on 4/8/2021. This memorandum provides the details of the preliminary energy assessment of the Municipal Building, Municipal Garage, Community Buildings, Ballfields, and Boston Bridge based on information gathered on site and provided by Elizabeth Township.

2.0 FACILITY DESCRIPTION

2.1 MUNICIPAL BUILDINGS

2.1.1 Municipal Building

The municipal building consists of a lobby, office area, assembly hall, police station, and basement. The police station is occupied 24/7, while the rest of the building is occupied from 8 AM to 4:30 PM Monday through Friday. The building was built in 1962.

HVAC

The building is heated and cooled by a two-pipe hydronic heating system. Heat is supplied by a single 750,000 Btu/hr input Weil McClain Ultra condensing boiler. Cooling is supplied by a 15-ton air cooled chiller, model 30GT015501, which uses R-22 and dates back to 1995. The hydronic system has unit ventilators located throughout the building on exterior walls. The ventilators are grouped into several zones, and flow to each zone is controlled by a wall mounted non-programmable thermostat. Each unit ventilator has a manual switch which enables the blower, and each ventilator has a fresh air intake from the outside, although the proportion of fresh air intake is not adjustable by the occupants. The amount of fresh air relative to the overall air flow of the ventilators is assumed to be relatively small.

The main open office area is also heated and cooled by a mini split heat pump located overhead in the drop ceiling, with the remote unit at the back of the building near the chiller. The model of the outdoor unit is Fujitsu AOU36RLX. The thermostat for this mini split is located next to the hydronic zone thermostat. The mini split thermostat is programmable, but it was not confirmed whether it is programmed or used with any sort of schedule. At the time of the site visit, the mini split was providing

cooling at a setpoint of 70°F, and the hydronic system thermostat was set to 70°F for heating. The actual air temperature registered by the hydronic thermostat was 69°F, so it appeared that the system was providing unwanted heating, but the unit ventilator fans were shut off and no heat could be felt coming from the ventilators in this space.

The Township Manager's office is heated and cooled by unit ventilators controlled by the thermostat in the open office area and is also heated and cooled by a window mounted heat pump. The exact model number was not able to be determined, but based on the physical size, it is rated approximately 1 ton. The heat pump was set for heating at 65°F at the time of the site visit, but the temperature of the space was approximately 70°F, and so it was not operating.

The meeting room is heated and cooled by unit ventilators. The cooling of this space is not adequate during public assemblies and the township is contemplating installing two mini split units in this room to provide cooling. There is an exhaust fan system in the ceiling which is never used.

The code enforcement office, conference room, and police station are heated by the hydronic system and are cooled by the hydronic system as well as two rooftop air handlers. The air handlers provide the majority of the cooling for this area. The thermostats in this area are manual, non-programmable thermostats. The police station is used around the clock.

The basement has a ventilation exhaust fan which is controlled by a humidistat. Air is drawn into the basement through foundation vents when the fan is running.

DHW

DHW is provided by an AO Smith model GPV-40 200 Power Vent 40-gallon natural gas hot water heater. There is no DHW circulation system; DHW is only used for handwashing.

Lighting

The building mainly utilizes 4' T8 fluorescent lights which were installed about ten years ago as a conversion from T12. The ballast type was not verified but is assumed to be electronic.

2.1.2 Maintenance Garage

The maintenance garage consists of a small office area with a storage mezzanine above it and is otherwise high bay garage space. The building was built in three sections, which from south to north consist of 2 bays, 5 bays and the office, and 7 bays. The 7-bay section was built later.

HVAC

The 2-bay and 5-bay portions of the building are heated by a hydronic heating system. Two condensing natural gas boilers supply heat. Manual thermostats in the bays control the heat delivery from overhead unit heaters. The 7-bay portion of the building is heated by three natural gas fired unit heaters which hang overhead. Each heater is controlled by a separate manual wall thermostat. Most of the thermostats were set in the mid to upper 60's.

DHW

DHW is currently supplied by a natural gas tank type hot water heater, which is leaking water. DHW is used for handwashing and showers. The township is planning to replace this hot water heater and would prefer to replace it with a tankless natural gas hot water heater.

Lighting

The lighting is provided by high bay metal halide and T12 fluorescent fixtures. Staff mentioned that the lighting levels in the garage are inadequate for maintenance tasks and that if lighting is replaced,

consideration for brighter fixtures would be nice. Staff was happy with the lighting levels from the new LED high bay fixtures in the 2-Bay area.

2.2 COMMUNITY CENTER BUILDINGS

2.2.1 Community Center Building 1

HVAC

Building 1 is heated by two gas forced air furnaces and cooled by two A/C units. The furnaces are 96% and 80% efficient and the A/C units are 13 and 14 SEER. One system is controlled by a non-programmable thermostat, while the other one in the Sea Cadet offices is controlled by a newer programmable Honeywell Home thermostat. This building is rented 6-7 days per month, mainly on Fridays, Saturdays, and Sundays. The Sea Cadets offices and support rooms are used intermittently during the week.

DHW

DHW is supplied by a 74-gallon standing pilot natural gas hot water heater rated 75,100 Btu/hr. This unit was installed in 2004. The DHW serves showers, bathrooms, and a kitchen. This building includes a bunkroom which can sleep a dozen or more people.

Lighting

Lighting in this building is provided mainly by T12 fluorescent lighting fixtures.

2.2.2 Community Center Building 2

HVAC

Building 2 is heated by an older standard efficiency gas furnace and does not have A/C. The furnace is controlled by a non-programmable thermostat in the main room. The setpoint at the time of the visit was 60°F. The building has a bunk room which can sleep at least a dozen people, a common room, and a small kitchen area. The building hosts a few winter sleepovers but is not popular in the summer. The lack of A/C limits the ability of the township to rent this building.

DHW

DHW is supplied by a standing pilot 40-gallon natural gas hot water tank.

Lighting

Lighting in this building is mainly fluorescent T12.

2.2.3 Community Center Building 3

HVAC

Building 3 is heated by a condensing 100,000 Btu/hr natural gas furnace and is cooled by a newer 5-ton A/C unit rated 13 SEER. The building consists of a large common room with a high ceiling, a commercial kitchen, a small lobby, a storeroom, and a bathroom with a couple showers. The building does not have a bunk room, but still hosts sleepovers occasionally.

DHW

DHW is supplied by two standing pilot 75-gallon 70,000 Btu/hr natural gas hot water tanks plumbed in parallel. The tanks were installed in 2007. There is a DHW circulator pump which circulates hot water from only one of these tanks to the hot water piping system. The pump runs continuously. No insulation was observed on the hot water pipes, although access to the crawlspace was not possible for further inspection of the pipe runs.

Lighting
Lighting in this building is mainly T12.

2.2.4 Community Center Garage

HVAC
The garage is a freestanding structure near Building 2, which is heated by a high efficiency natural gas furnace. The furnace was set to 45°F.

Lighting
Lighting is provided by three 8’ T12 fixtures with two lamps per fixture, and six 8’ T17 fixtures with two Power Groove lamps per fixture. Lighting usage is estimated to be 1 hour per year.

2.3 BALLFIELDS

2.3.1 Boston Ballfield

Lighting
The Boston Ballfield has (30) 1,000W MH lamps. These lamps are used 3-4 hours per day during the sports season. Currently 9 of these lights are burned out so the township is interested in replacing them with LED if possible.

2.3.2 Municipal Ballfield

Lighting
The municipal ballfield behind the municipal building has (28) mercury vapor 1,500W lamps. These are used frequently during the sport season.

2.4 BRIDGES

2.4.1 Boston Bridge

Lighting
The township’s side of Boston Bridge is lit by (6) 250W HPS lamps. The township has obtained LED replacements for these fixtures but has not yet installed them due to the logistics of closing the bridge to allow for safe access to these lamps.

3.0 ENERGY USAGE PROFILE

3.1 ELECTRIC USAGE

Electric service to Elizabeth Township is transmitted and distributed by West Penn for the 23 months of data provided to WES. Table 1 shows the average annual consumption, cost, and unit cost from the billing data provided by the Township. The power factor of the Municipal building was investigated to determine whether reactive power was contributing to a higher electric rate but was determined to play an insignificant role in the overall electric cost.

Table 1 - Annual Electric Consumption and Cost

Facility	Electric Service Rate Class	Annual Electric Consumption (kWh/yr)	Annual Electric Cost ($/yr)	Unit Cost ($/kWh)
Municipal Building/Garage	General Service WP	265,009	$22,080	$0.083
Community Building 1[3,4]	General Service WP	27,098	$3,534	$0.130
Community Building 2[3]	General Service WP	6,078	$838	$0.138
Community Building 3[3]	General Service WP	45,099	$4,383	$0.097
Boston Bridge[3]	General Service WP	10,078	$622	$0.062
Boston Field	General Service WP	14,075	$2,418	$0.172
Municipal Field	General Service WP	15,447	$3,096	$0.200

Notes: 1) Electric data provided to WES in monthly statements from 1/2019-12/2020
2) Figures are an average of provided data, not a select historical year, and include customer charges, usage charges, and demand charges.
3) Electricity supply is contracted through Direct Energy.
4) Charges include street lighting.

3.2 NATURAL GAS

Peoples provides natural gas delivery services to Elizabeth Township for the entire time period given in the utility bills. Table 2 provides the annual consumption, cost, and unit cost of natural gas for the facility.

Table 2 - Annual Natural Gas Consumption and Cost

Location	Natural Gas Service Rate	Annual Natural Gas Consumption (MCF/yr)	Annual Natural Gas Cost ($/yr)	Unit Cost ($/MCF)
Municipal	Medium General Service[3]	1,373	$13,002	$9.47
Community	Small General Service	703	$5,658	$8.05

Notes: 1) Natural gas data provided to WES in monthly statements from 1/2019 – 12/2020.
2) Figures are an average of provided data, not a select historical year.
3) Natural Gas supply was contracted through Dominion Energy during the data period.

3.2.1 Natural Gas Consumption Model

WES utilized natural gas data to model expected consumption as a function of weather conditions. The model is used to weather-normalize the natural gas consumption to temperature data of a typical meteorological year for the region to provide an even baseline for evaluating potential energy conservation measures. Figure 1 provides the regression model derived from data provided to WES.

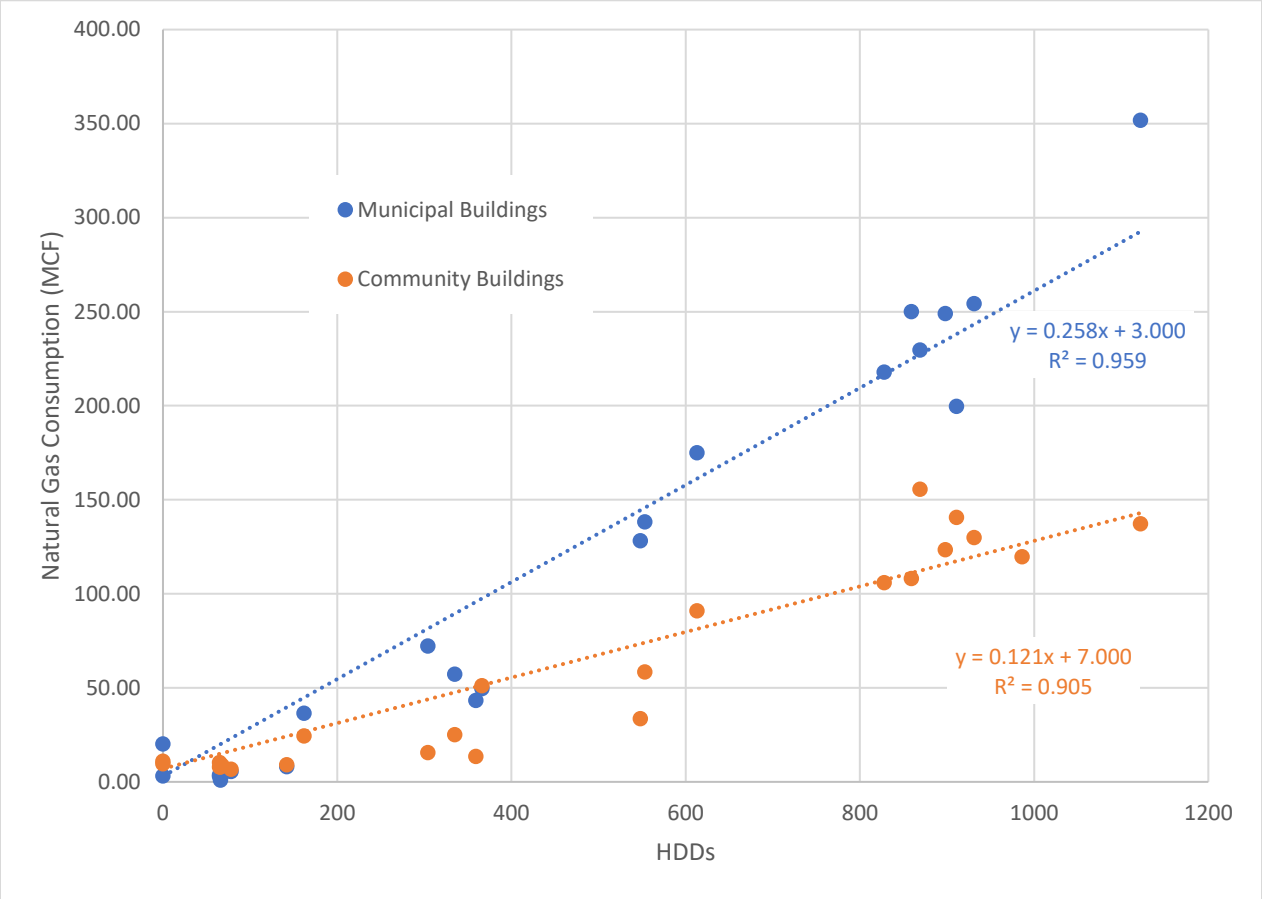

Figure 1 - Natural Gas Consumption vs Monthly HDD

Due to the facility using natural gas to provide energy for both space heating and domestic hot water functions, the model was used to assess natural gas use allocation based on a typical meteorological year. Table 3 provides the estimated consumption of natural gas for space and water heating at the Municipal Building and Community Buildings.

Table 3 – Annual Natural Gas Consumption Disaggregation Summary

Building	TMY3 HDDs	Domestic Hot Water Energy Consumption (MCF)	Space Heating Energy Consumption (MCF)	Total Consumption (MCF)
Municipal Building[1]	5,599	16	522	537
Municipal Garage[1]	5,599	28	920	948
Community Center Building 1[2]	5,599	27	242	269
Community Center Building 2[2]	5,599	20	178	198
Community Center Building 3[2,3]	5,599	54	256	310

Notes: 1) Natural gas consumption is distributed among municipal buildings proportionally by square footage.
2) Space heating energy is distributed among community center buildings proportionally by square footage.
3) Additional DHW natural gas consumption is allotted to Building 3 due to distribution system design.

3.3 WATER

Water service is offered by PA American Water with varying rate classes depending on location. Table 4 shows the average annual consumption and associated cost of water from data provided by Elizabeth Township.

Table 4 – Annual Water Consumption and Cost

Location	Water Service Rate Class	Annual Water Consumption (gal/yr)	Annual Water Cost ($/yr)	Unit Cost ($/100 gal)
Municipal	Public Authority	119,300	2,207	$1.850
Community	Residential	132,850	1,157	$0.871

Notes: 1) Water data provided to WES for the period 1/2019-12/2020.
2) Figures are an average of provided data, not a select historical year.

4.0 ENERGY CONSERVATION MEASURES

Energy conservation measures (ECMs) are strategies which can be utilized to lower energy consumption and/or cost at a facility. Based on observations during the site walkthrough, discussions with site staff, and analysis of utility billing data, several ECMs have been identified for Elizabeth Township to consider as ways to conserve energy at their properties. Table 5 provides an overview of each ECM analyzed for the Township, and further detail on the measures and savings calculations is provided in the subsequent sections.

Table 5 - Energy Conservation Measure Summary

ECM Description	Facility	Install Cost ($)	Electric Savings		Natural Gas Savings		Total Annual Savings ($)
			Consumption (kWh)	Cost ($)	Consumption (MCF)	Cost ($)	
Lighting[1]	Municipal Buildings	$11,000 - $27,500	34,812	$2,900	0	$0	$2,900
	Community Center Buildings	$3,500 - $12,500	1,142	$132	0	$0	$132
	Ballfields/ Bridge	$27,000 - $38,000	13,303	$2,011	0	$0	$2,011
Condensing Natural Gas Furnace[3]	Community Center Building 2	$3,000	0	$0	25	$201	$201
Temperature Setpoint Setback[1]	Municipal Buildings	$1,000 - $4,000	8,136	$678	34	$323	$1,001
Tankless Hot Water Heater[3]	Maintenance Garage	$1,000	0	$0	11	$106	$106
Domestic Hot Water Circulator Pump[1]	Community Center Building 3	$400 - $700	455	$44	22	$179	$223
Domestic Hot Water Tank Decommission[1]	Community Center Building 3	$0 - $150	0	$0	9	$75	$75

Notes: 1) Install costs show a range which is the estimated cost if the project is performed with in-house labor and the cost associated with hiring a contractor to complete the ECM.
2) Savings shown are for each ECM implemented independently. Implementing ECMs in tandem can produce interactions which affect potential savings.
3) Install cost represents the incremental savings of installing a condensing unit at the end of life, rather than replacing in-kind.

4.1 LIGHTING

Lighting can be a significant consumer of electricity on site. The fluorescent lighting currently installed in the Municipal Building is T8, while the Garage and Community Center Buildings primarily use T12. Additional lighting includes metal halide, compact fluorescent, and high-pressure sodium fixtures located throughout each of the buildings; a detailed analysis can be found in Appendix A with locations of all fixtures. This measure analyzes the replacement of these existing fluorescent lamps and ballasts with LED replacement tubes and ballasts and changing out the current metal halide and high-pressure sodium lamps with LED equivalents. Also analyzed is the retrofitting of HID lamps used at the ballparks and Boston Bridge. It should be noted research on LED retrofits for spotlight applications, such as those at the ball fields, yielded possible retrofit results and are assumed to be feasible at the ball fields analyzed in this memorandum; Elizabeth Township will need to determine if the aforementioned retrofits meet the necessary requirements set forth by each setting, i.e. light output, fixture compatibility, electrical

compliance, etc. This approach is considered to be more cost effective than complete fixture replacement and can typically be accomplished with in-house staff, if desired.

Table 6 - Assumed Light Hours of Operation

Location	Hours/Day
Police Emergency	24
Police Cellblock/Garage	12
Municipal Building High Bay	11
Boston Bridge	9.6
Municipal Building Offices, Bathrooms, Hallways, and Vault	8.5
Police Office and Juvenile Holding Rooms	8
Municipal Garage	8
Municipal Garage 5-Bay and 7-Bay	4
Municipal Conference Room and Police Evidence Rooms	1
Community Center Building 1[1]	0.8
Community Center Building 3[1]	0.7
Ballfields	0.6
Community Center Building 2[1]	0.5
Municipal Building Lobby, Vestibule, Basement, & Custodial Room	0

Notes: 1) Hours are representative of assumed building usage throughout year via electric data provided and being unused when unoccupied.

Table 6 shows the assumed hours of operation for lights sorted by their location, while Table 7 shows the existing and post-retrofit lighting energy profiles as well as the associated costs and savings of implementing said retrofit. The detailed lighting descriptions and savings calculations can be found in Appendix A.

Table 7 - Lighting Retrofit Analysis Summary

Parameter	Municipal Buildings	Community Center Buildings	Ballparks/ Bridges	Seldom -Used Fixtures
Number of Fixtures	219	164	64	46
Existing Demand (kW)	23	10	74	2
Post-Retrofit Demand (kW)	11	6	28	1
Existing Annual Energy Consumption (kWh/yr)	66,713	2,534	20,661	0
Post-Retrofit Energy Consumption (kWh/yr)	31,901	1,393	7,358	0
Annual Energy Demand Savings (kW)	12	5	46	1
Annual Energy Consumption Savings (kWh/yr)	34,812	1,142	13,303	0
Combined Annual Savings	$5,043			
Estimated Capital Cost with Labor	$78,000			
Estimated Capital Cost without Labor	$41,500			

It should be noted the estimated install costs assumes replacement of all fixtures, including those presumed to be off. Replacing fixtures currently in use and foregoing a retrofit on fixtures that are not in use would reduce install costs and associated payback period. Furthermore, due to the lack of kWh being

saved with a retrofit, it is unlikely to receive any form of incentive which would normally be expected from a fixture assumed to be currently in use.

Conversion of the facility from linear fluorescent, high-pressure sodium and metal halide to LED has the potential to reduce maintenance costs and increase staff safety due to the longer expected lifetime of the LED lamps. The increase in lifespan, especially over the current metal halides at the ballfield, would require less staff time needed to replace defunct bulbs. The height of the fixtures in the ballfield and position of the fluorescent lighting in the Community Building 3 is a safety hazard and would be mitigated proportional to the increased lamp lifetime of the LED replacements. Even fixtures which are rarely used, such as the T8 lamps in the Municipal Building lobby, could be replaced with LED as they burn out, in order to benefit from the longer lifespan of these lamps and thus reduce the maintenance burden and fall risk over time.

4.2 CONDENSING NATURAL GAS FURNACE

The Community Building 2 is heated by a standard efficiency gas furnace. This ECM analyzes replacing the current furnace at the end of its useful life with a high efficiency condensing natural gas replacement rather than a standard efficiency model. Condensing natural gas furnaces are highly efficient due to the furnace being able to extract a larger portion of heat from the flue gas inside the heat exchanger. It should be noted that the capture of latent heat in the flue gas stream also produces a condensate stream which must be neutralized and disposed of in a sanitary sewer. Additionally, when the furnace system is ready for replacement, it is recommended to accurately model the building heat load and "right-size" the replacement furnace for better operation and best-case installation costs. The proposed efficiency, savings, and incremental cost of this ECM are provided in Table 8.

Table 8 - Current and Proposed Furnace Efficiency and Savings

Parameter	Value	Unit
Existing Natural Gas Consumption	178	MCF/yr
Existing Efficiency	80%	$
Proposed Natural Gas Consumption	153	MCF/yr
Proposed Efficiency	93%	%
Estimated Cost Savings	$201	$/yr
Estimated Incremental Cost	$3,000	$

Notes: 1) The natural gas consumption is the estimated portion of the onsite natural gas consumed by the furnace based on the square footage of Building 2 to the combined square footage of all three buildings.

4.3 TEMPERATURE SETPOINT SETBACK

Heat loss through a building envelope is directly related to the temperature at which the internal space is maintained. Reducing the temperature setpoint for a space during unoccupied times can reduce the associated heat loss, thus lowering energy consumption. It was noted during the WES site visit that most thermostats currently installed do not have the option of a programmable schedule. This measure analyzes installing thermostats in the Municipal Building to implement a heating schedule, thus controlling temperature setpoints at both occupied and unoccupied times. It should be noted capital cost estimates include Wi-Fi enabled thermostats for the Community Buildings for convenience and to maintain current setpoint setbacks. Table 9 provides the analyzed setback parameters and annual cost savings. While a 3°F temperature setback was used for this analysis, if a 5°F setback or higher could be achieved the savings potential would be increased.

Table 9 - Temperature Setpoint Setback Summary

Parameter	Value	Unit
Occupied Setpoint	70	°F
Unoccupied Setpoint	67	°F
Occupied Setpoint Schedule	8:00am - 5:00pm	
Existing Natural Gas Consumption	1,442	MCF/yr
Existing Electric Consumption	93,754	kWh/yr
Post-Retrofit Natural Gas Consumption	1,408	MCF/yr
Post-Retrofit Electric Consumption	85,618	kWh/yr
Cost Savings	1,001	$/yr
Estimated Capital Cost with Labor[1]	$4,000	$
Estimated Capital Cost without Labor[1]	$2,500	$
Estimated Capital Cost with Labor	$2,000	$
Estimated Capital Cost without Labor	$1,000	$

Notes: 1) Estimated capital cost includes Wi-Fi thermostats for Community Buildings.

4.4 DOMESTIC HOT WATER EQUIPMENT CHANGEOUT

Tankless water heaters, also known as instantaneous or demand type water heaters, can be retrofitted into a domestic water system to replace a tank-type heater. Currently, hot water for the Municipal Garage is provided by a leaking older tank in need of replacement. This ECM analyzes replacing the current natural gas tank system with a condensing tankless natural gas system which increases the thermal efficiency of the hot water system while also eliminating standby losses due to heat loss from the tank. It is assumed that this replacement would happen when the existing water heater reaches end of life, thus only incremental differences between replacement with condensing tankless and standard efficiency tank-type models are carried. The gas line capacity would need to be investigated as part of this; it is assumed that the overall service would not need to be upgraded if the heating and domestic hot water systems were addressed at the same time. Table 10 demonstrates the proposed efficiencies of the tankless design as well as natural gas savings, associated cost savings and estimated additional install cost.

Table 10 – Domestic Hot Water Equipment Changeout

Parameter	Current Hot Water Tank	Proposed Tankless Hot Water	Unit
Efficiency	55%	93%	%
Natural Gas Consumption	26.3	15.5	MCF/yr
Natural Gas Savings	10.7		MCF/yr
Cost Savings	$102		$/yr
Estimated Capital Install Cost	$1,000		$

4.5 DOMESTIC HOT WATER CIRCULATOR PUMP CONTROL

The domestic hot water for Community Building 3 is circulated to an auxiliary tank and through the building using a continuously running pump. This continual operation utilizes electricity constantly and allows heat loss through the DHW distribution system, even when the building is unoccupied, as is the case when not being rented. This ECM analyzes placing the circulator pump on a schedule set to run only when the building is occupied by use of a time clock. This approach will reduce both electric and natural

gas consumption as the pump will operate on a reduced schedule and the hot water heater will not use energy heating unused water traveling through the distribution system. Table 11 shows the proposed schedule, electric and natural gas savings, and the associated cost savings. If it is determined the circulator pump isn't necessary to meet the hot water standards, turning it off would provide further savings and an immediate payback.

Table 11 - Circulation Pump Control Summary

Parameter	Current Schedule	Proposed Schedule	Unit
Operating Schedule	24/7	Mon - Fri 8:00am - 5:00pm	-
Electric Consumption	526	70	kWh/yr
Heat Loss	26	4	MCF/yr
Cost Savings	$223		$/yr
Estimated Capital Cost with Labor	$700		$
Estimated Capital Cost without Labor	$400		$

Notes: 1) Proposed hours are based off assumed building usage, not a set schedule.

4.6 DOMESTIC HOT WATER TANK DECOMMISSION

It was noted that there is an extra tank in Building 3 to help supply hot water. Due to the construction of the tank and it continuously holding hot water, it inherently experiences standby losses. This ECM analyzes removing the additional hot water tank to eliminate the associated standby losses. Decommissioning one tank will leave the building with first hour rating of 130 gallons, half of the current 260-gallon rating; the first hour rating refers to the amount of water the system can provide in the first hour with a full tank. It should be noted that there are two tanks, and one is connected to the pump plumbing, thus this ECM analyzes the other tank. Table 12 details the proposed heat and cost savings if implemented.

Table 12 - Hot Water Tank Decommission Summary

Parameter	Value	Unit
Existing Hot Water Tank Efficiency	55%	%
Existing Heat Loss	9.4	MCF/yr
Proposed Cost Savings	$75	$/yr
Estimated Capital Cost with Labor	$200	$
Estimated Capital Cost without Labor	$0	$

4.7 OPERATIONAL & MAINTENANCE STRATEGIES FOR ENERGY EFFICIENCY

During typical operations of facilities, there are options for ensuring energy efficiency without compromising facility function. Some of the operational strategies can be implemented with equipment controls but may also be achieved through training and discussions with facility staff. Below is a list of operational and maintenance strategies which would assist Elizabeth Township's goals of energy efficiency.

Operational Strategies for Energy Efficiency

- Turn off lights in areas whenever they are unoccupied or not in use.

- Unplug or switch off power to devices which consume standby power during unoccupied periods or periods of extended non-use.
- Maintain space temperature setpoints only at levels required for occupant comfort – avoid over-heating or over-cooling conditioned spaces. Utilize setpoint setbacks during unoccupied periods if possible.
- Keep exterior doors to conditioned areas closed during the heating and cooling seasons.

Maintenance Strategies for Energy Efficiency

- Maintain equipment in proper working order. Avoid repairs which require overriding controls which help to maintain proper equipment shutdowns during periods of non-use.
- Maintain weatherstripping and air sealing throughout the building envelope.
- Utilize Energy Star models when replacing appliances.
- Evaluate the potential for utilizing high-efficiency models when replacing equipment that has failed or reached end of life.
- Stock energy efficient models of consumable replacement parts (i.e. lamps, showerheads, etc.) such that building energy consumption levels decrease over time.

5.0 INCENTIVES

Implementation of Energy Conservation Measures (ECMs) at the facilities analyzed provides the opportunity to utilize various incentives and financing schemes to offset the initial cost of the project. Table 13 provides a summary of incentives available for implementation of ECMs.

Table 13 - Incentive Summary

Incentive	Estimated Incentive	Incentive Timing
Act 129	$1,415	Within 180 days after installation
Guaranteed Energy Savings Act	Varies	Higher Financed Project Costs, Budget-Neutral Throughout Project Term

5.1 ACT 129

Pennsylvania Act 129 provides incentives for energy conservation which are distributed through local electric utilities. With respect to the ECMs presented in this memorandum, Act 129 rebates for a total of $1,415 are applicable based on Phase III incentive levels. It should be noted Phase III of Act 129 ended May 31, 2021, and incentive levels and inclusions may change in Phase IV. The Commercial Lighting Incentive Program (CLIP) is the Act 129 lighting rebate program through West Penn and is available for retrofit projects such as the one detailed in this memorandum with incentives provided to facilities that replace T8 fixtures with high-efficiency equipment and controls. Calculated incentives for interior and exterior LED fixtures are capped at $55/fixture when replacing fixtures with total lamp wattage of 250W or less or 50% of fixture cost for lamp wattages of 250W and greater. Table 14 provides the estimated incentive levels for the lighting retrofit analyzed for the facilities analyzed.

Table 14 - Estimated Lighting Incentives Provided by Act 129 Rebates

Facility	Fixture	Estimated Incentive ($)
Municipal Buildings	2LT8-4'	$206
	2LT12-4'	$27
	1X26W CFL	$145
	400W MH	$622
Community Center Buildings	2LT8-4'	$0
	2LT8-8'	$0
	2LT12-4'	$26
	2LT12-4'U	$0
	1X100W INC	$10
	1X26W CFL	$45
	75W HPS	$0
Ballparks & Bridges	250W HPS	$97
	1000W MH	$101
	1500W MV	$134
	Total	$1,415

5.2 PENNSYLVANIA GUARANTEED ENERGY SAVINGS ACT (GESA)

Energy Conservation Measures (ECMs) can be implemented by an Energy Services Company (ESCO) in a budget-neutral format under an Energy Savings Agreement (ESA). The Guaranteed Energy Savings Act provides for municipalities such as Elizabeth Township the option to utilize this arrangement for implementation of ECMs which will result in energy savings guaranteed by the ESCO. The annual energy savings are utilized to service debt which is taken out to finance the ECMs at the beginning of the project term. This arrangement typically will bundle ECMs with longer and shorter paybacks to an aggregate project with an acceptable term. There are additional costs associated with debt service, ESCO markups, annual Measurement & Verification (M&V), among others which are associated with this type of arrangement. Elizabeth Township would need to weigh the additional project costs against the benefits of a budget-neutral implementation if this arrangement were of interest.

6.0 GREENHOUSE GAS EMISSIONS

The equivalent CO_2 emissions from electricity and natural gas usage are calculated as an aggregation of several greenhouse gases per requirements from The Climate Registry which are used for voluntary carbon accounting. The calculation is performed assuming that all energy consumed by the Township from the electric grid matches the carbon emission intensity of the regional electric generation mix. Table 15 details the CO_2e emissions for each ECM as described.

Table 15 - Existing and Post-Retrofit Greenhouse Gas Emissions Summary

Energy Conservation Measures	Existing Scope 1 & 2 Emissions ($MTCO_2e$)	Post-Retrofit Scope 1 & 2 Emissions ($MTCO_2e$)	Percentage Offset of GHG
Lighting	250.9	234.5	7%
Condensing Natural Gas Furnace	250.9	249.5	1%
Temperature Setpoint Setback	250.9	246.3	2%
Tankless Hot Water Heater	250.9	250.3	0%
Domestic Hot Water Circulator Pump	250.9	249.5	1%
Domestic Hot Water Tank Delete	250.9	250.3	0%

Notes: 1) $MTCO_2e$ = Metric Tonnes of Carbon Dioxide Equivalent

7.0 CONCLUSIONS

This memorandum provides an analysis and summary results of the energy conservations measures (ECMs) identified during the WES site visit, interviews with facility staff, and analysis of utility billing data for the buildings and properties owned by Elizabeth Township. Table 16 provides an economic and energy performance summary of the ECMs identified using the best realistic options of implementation. Key information on ECMs is provided below:

Lighting

- **Municipal Buildings** – This ECM includes a relamp of medium base bulbs, relamp – reballast of fluorescent lighting, and relamp – bypass ballast of high bay fixtures retrofit approach throughout the Municipal Buildings. This retrofitting of lighting fixtures throughout the buildings can begin as simply as ordering replacement LED lamps and compatible ballasts. While a subcontracting approach can be utilized, the most favorable approach economically would be to implement this retrofit with site staff either in a comprehensive program or as maintenance replacements on an as-needed basis. With an estimated material cost of $11,000, potential rebate of $1,000, and annual savings of $2,900, this measure would provide a payback of approximately three years.
- **Community Buildings –** This ECM includes a relamp of medium base bulbs, relamp – reballast of fluorescent lighting, and relamp – bypass ballast of high-pressure sodium retrofit approach throughout the Community Center Buildings. This retrofitting of lighting fixtures throughout the buildings can begin as simply as ordering replacement LED lamps and compatible ballasts. With an estimated material cost of $3,500, potential rebate of $132, and annual savings of $60, this measure would not provide a reasonable payback period. However, it may still make sense to replace specific fixtures with LED replacements as they fail, in order to benefit from the longer lifetime of LED lamps.
- **Ballparks/Bridges –** This ECM includes a relamp – bypass ballast of high intensity fixtures retrofit approach throughout the ballfields and bridges. With an estimated material cost of $27,000, potential rebate of $333, and annual savings of $2,011, this measure would provide a payback of approximately thirteen years.

Condensing Natural Gas Furnace

- **Condensing Natural Gas Furnace** - This ECM evaluates the incremental cost to install a condensing natural gas furnace rather than a standard efficiency model when the current furnace reaches end of life. With an estimated additional cost of $3,000 and annual savings of $201 this measure would not provide a reasonable payback period.

Temperature Setpoint Setback

- **Municipal Buildings** – This ECM evaluates installing programmable thermostats and setting a setpoint schedule to lower energy consumption when unoccupied. The schedule will match the building's operating hours to maintain comfort while reducing consumption. With an estimated install cost of $1,000, and annual savings of $1,001, this measure would provide a payback of approximately one year.
- **Community Buildings -** Wi-Fi compatible thermostats were evaluated for the Community Buildings for remotely controlling the climate settings. It was noted that staff currently manually control the building temperatures and are very diligent in doing so, thus there would not be any energy savings associated, just convenience of being able to do so from a central location. With an install cost of $2,500, this would not provide a payback period.

Domestic Hot Water Changeout

- **Municipal Garage** – This ECM includes installing a condensing natural gas tankless water heater when the current hot water tank reaches end of life, rather than replacing it in-kind. With an estimated additional cost of $1,000 and annual savings of $102, this measure provides a payback period of approximately ten years.

Domestic Hot Water Circulator Pump Control

- **Community Building 3** – This ECM includes placing the DHW circulator pump in Community Building 3 on a timer or other control device. The schedule would save energy costs both from electricity by operating the pump less and natural gas by incurring lower heat losses from the building's distribution system. With an estimated install cost of $400, and annual savings of $201, this measure would provide a payback of approximately two years.

Domestic Hot Water Tank Decommissioning

- **Community Building 3** – This ECM includes removing the additional hot water tank located in Community Building 3 from service. Decommissioning the tank would save the facility money from the standby losses associated with the tank design and cost of keeping the pilot light lit. With an estimated cost of $0 and annual savings of $75 this measure would provide an immediate payback.

Table 16 - ECM Performance Summary

ECM Description	Facility	GHG Reduction ($MTCO_2e$)	Electric Savings (kWh)	Natural Gas Savings (MCF)	Estimated Install Cost ($)	Total Annual Savings ($)	Potential Incentive Value ($)	Simple Payback with Incentives (yr)
Lighting[1,2,3]	Municipal Buildings	11.6	34,812	-	$11,000	$2,900	$1,001	3.4
	Community Center Buildings	0.4	1,142	-	$3,500	$132	$81	26.0
	Ballfields/ Bridge	4.4	13,303	-	$27,000	$2,011	$333	13.3
Condensing Natural Gas Furnace	Community Center Building 2	1.4	-	24.9	$3,000	$201	-	14.9
Temperature Setpoint Setback[1]	Municipal Buildings	1.9	8,136	34.1	$1,000	$1,001	-	1.0
Tankless Hot Water Heater	Maintenance Garage	0.6	-	10.7	$1,000	$102	-	9.8
Domestic Hot Water Circulator Pump[1]	Community Center Building 3	1.4	455	22.2	$400	$223	-	1.8
Domestic Hot Water Tank Decommission[1]	Community Center Building 3	0.5	-	9.4	$0	$75	-	-

Notes: 1) Install costs assume self-installation and include only estimated material costs.
2) Install costs and subsequent payback period assume all lighting replaced including fixtures that are assumed to be off. Replacing only fixtures that are currently in use would decrease install cost by 4%.
3) Material cost for bridge lighting fixtures set to $0.00 due to prior purchase of LED replacements.

Implementation of the ECMs discussed would provide several high-level benefits to Elizabeth Township, including:

- A reduction of on-site energy consumption and associated utility costs.
- A reduction of the greenhouse gas footprint of the facilities of up to 24.8 metric tonnes of CO_2e per year from the measures that can be combined.
- The ability to leverage incentives or financing opportunities to lower annual operating costs.
- In the case of the Lighting ECM, better lighting levels and longer lamp lifetimes from LED lamps.

WES has also provided a list of operational and maintenance strategies for energy efficiency which can be implemented at the facility. WES is available to discuss all these ECMs further, particularly if there are any questions, concerns, or if Elizabeth Township would like to move forward with more detailed planning for any of the aforementioned measures. Additionally, the savings estimates presented here can be refined

with additional information such as detailed utility billing data, confirmation of specific light fixture information, and feedback on any assumptions included in this analysis.

8.0 ANALYSIS ASSUMPTIONS

Table 17 - Analysis Assumptions

Assumption	Value	Units	Source
Natural Gas Heating Content	10.3	therms/mcf	WES Assumption
Municipal Natural Gas Average Rate	$9.47	$/mcf	Elizabeth Township
Community Buildings Natural Gas Average Rate	$8.05	$/mcf	Elizabeth Township
Municipal Building Electric Rate	$0.083	$/kWh	Elizabeth Township
Community Building 1 Electric Rate	$0.138	$/kWh	Elizabeth Township
Community Building 2 Electric Rate	$0.130	$/kWh	Elizabeth Township
Community Building 3 Electric Rate	$0.097	$/kWh	Elizabeth Township
Boston Bridge Electric Rate	$0.062	$/kWh	Elizabeth Township
Boston Field Electric Rate	$0.172	$/kWh	Elizabeth Township
Municipal Field Electric Rate	$0.200	$/kWh	Elizabeth Township
CO_2 emitted during combustion of Natural Gas	53.06	kg/mmBtu	EPA Factors
CH_4 emitted during combustion of Natural Gas	0.001	kg/mmBtu	EPA Factors
N_2O emitted during combustion of Natural Gas	0.0001	kg/mmBtu	EPA Factors
CO_2e emitted during combustion of Natural Gas	53.11	kg/mmBtu	EPA Factors
Electric On-Site CO_2e Emissions	733.95	lb/MWh	EPA Factors
Electric CO_2 Emissions	695	lb/MWh	EPA Factors
Electric CH_4 Emissions	0.053	lb/MWh	EPA Factors
Electric N_2O Emissions	0.007	lb/MWh	EPA Factors
Electric Line Losses	5%	percent	EPA Factors
CH_4 100-year Global Warming Potential	28	*CO_2	IPCC
N_2O 100-year Global Warming Potential	265	*CO_2	IPCC
Average Indoor Temperature	70	°F	WES Assumption
Municipal Building Area	6,800	ft^2	Elizabeth Township
Municipal Garage Area	12,000	ft^2	Elizabeth Township
Community Building 1 Area	3,150	ft^2	Elizabeth Township
Community Building 2 Area	2,320	ft^2	Elizabeth Township
Community Building 3 Area	3,325	ft^2	Elizabeth Township
Domestic Hot Water Temperature	140	°F	WES Assumption
Existing Furnace Efficiency	80%	%	WES Assumption
Proposed Furnace Efficiency	93%	%	WES Assumption
Existing DHW Efficiency	55%	%	WES Assumption
Proposed DHW Efficiency	93%	%	WES Assumption
Building 3 Occupied Percentage	50%	%	WES Assumption
Design Heating Temperature - 99.6% Coverage	-15.4	°F	ASHRAE

9.0 APPENDICES

Appendix A – Detailed Lighting Analysis

Appendix A

Detailed Lighting Analysis

Lighting Retrofit Analysis

			Existing						Proposed						Annual		
Building	Space	Number of Fixtures	Fixture Type	Fixture Style	Fixture Wattage (W)	Total Wattage (kW)	Annual Operating Hours (hr)	Annual Cons. (kWh)	Fixture Type	Fixture Style	Fixture Wattage (W)	Total Wattage (kW)	Annual Operating Hours (hr)	Annual Consumption (kWh)	Demand Savings (kW)	Cons. Savings (kWh)	Cost Savings ($)
Municipal Building	Exterior	4	400W MH	High Bay	456.0	1.82	4004	7,303	160W LED	High Bay	160.0	0.64	4,004	2,563	1.18	4,741	$394.99
Municipal Building	Meeting Room	56	2LT8-4'	Troffer	59.0	3.30	364	1,203	2LTLED-4'	Troffer	37.0	2.07	364	754	1.23	448	$37.36
Municipal Building	Lobby	24	2LT8-4'	Troffer	59.0	1.42	0	0	2LTLED-4'	Troffer	37.0	0.89	0	0	0.53	0	$0.00
Municipal Building	Vestibule	4	1x26W CFL	Recessed Can	26.0	0.10	0	0	1x16W LED	Recessed Can	16.0	0.06	0	0	0.04	0	$0.00
Municipal Building	Vestibule	2	2LT8-4'	Troffer	59.0	0.12	0	0	2LTLED-4'	Troffer	37.0	0.07	0	0	0.04	0	$0.00
Municipal Building	Basement Storeroom	1	2LT8-4'	Troffer	59.0	0.06	0	0	2LTLED-4'	Troffer	37.0	0.04	0	0	0.02	0	$0.00
Municipal Building	Basement Records Room	4	2LT8-4'	Troffer	59.0	0.24	0	0	2LTLED-4'	Troffer	37.0	0.15	0	0	0.09	0	$0.00
Municipal Building	Basement Main Room	4	2LT8-4'	Troffer	59.0	0.24	0	0	2LTLED-4'	Troffer	37.0	0.15	0	0	0.09	0	$0.00
Municipal Building	Basement Hallway	1	2LT8-4'	Troffer	59.0	0.06	0	0	2LTLED-4'	Troffer	37.0	0.04	0	0	0.02	0	$0.00
Municipal Building	Basement Boiler Room	2	2LT8-4'	Troffer	59.0	0.12	0	0	2LTLED-4'	Troffer	37.0	0.07	0	0	0.04	0	$0.00
Municipal Building	Main Open Office	18	2LT8-4'	Troffer	59.0	1.06	3094	3,286	2LTLED-4'	Troffer	37.0	0.67	3,094	2,061	0.40	1,225	$102.08
Municipal Building	Vault	1	1x26W CFL	Recessed Can	26.0	0.03	3094	80	1x16W LED	Recessed Can	16.0	0.02	3,094	50	0.01	31	$2.58
Municipal Building	Vault	1	2LT8-4'	Troffer	59.0	0.06	3094	183	2LTLED-4'	Troffer	37.0	0.04	3,094	114	0.02	68	$5.67
Municipal Building	Side Office	4	2LT8-4'	Troffer	59.0	0.24	3094	730	2LTLED-4'	Troffer	37.0	0.15	3,094	458	0.09	272	$22.69
Municipal Building	Lunch Room	1	2LT8-4'	Troffer	59.0	0.06	3094	183	2LTLED-4'	Troffer	37.0	0.04	3,094	114	0.02	68	$5.67
Municipal Building	Office Bathroom	2	1x26W CFL	Recessed Can	26.0	0.05	3094	161	1x16W LED	Recessed Can	16.0	0.03	3,094	99	0.02	62	$5.16
Municipal Building	Manager Office	8	2LT8-4'	Troffer	59.0	0.47	3094	1,460	2LTLED-4'	Troffer	37.0	0.30	3,094	916	0.18	545	$45.37
Municipal Building	Code Office	4	2LT8-4'	Troffer	59.0	0.24	3094	730	2LTLED-4'	Troffer	37.0	0.15	3,094	458	0.09	272	$22.69
Municipal Building	Main Hall	9	1x26W CFL	Recessed Can	26.0	0.23	3094	724	1x16W LED	Recessed Can	16.0	0.14	3,094	446	0.09	278	$23.20
Municipal Building	Men's Bathroom	2	1x26W CFL	Recessed Can	26.0	0.05	3094	161	1x16W LED	Recessed Can	16.0	0.03	3,094	99	0.02	62	$5.16
Municipal Building	Women's Bathroom	2	1x26W CFL	Recessed Can	26.0	0.05	3094	161	1x16W LED	Recessed Can	16.0	0.03	3,094	99	0.02	62	$5.16
Municipal Building	Custodial Room	1	1x26W CFL	Recessed Can	26.0	0.03	0	0	1x16W LED	Recessed Can	16.0	0.02	0	0	0.01	0	$0.00
Municipal Building	Conference Room	6	2LT8-4'	Troffer	59.0	0.35	364	129	2LTLED-4'	Troffer	37.0	0.22	364	81	0.13	48	$4.00
Municipal Building	Police Hall	3	2LT8-4'	Troffer	59.0	0.18	8736	1,546	2LTLED-4'	Troffer	37.0	0.11	8,736	970	0.07	577	$48.04
Municipal Building	Police Interview	2	2LT8-4'	Troffer	59.0	0.12	2912	344	2LTLED-4'	Troffer	37.0	0.07	2,912	215	0.04	128	$10.68
Municipal Building	Police Juvenile	2	2LT8-4'	Troffer	59.0	0.12	2912	344	2LTLED-4'	Troffer	37.0	0.07	2,912	215	0.04	128	$10.68
Municipal Building	Police Central	6	2LT8-4'	Troffer	59.0	0.35	8736	3,093	2LTLED-4'	Troffer	37.0	0.22	8,736	1,939	0.13	1,153	$96.08
Municipal Building	Police Traffic	1	2LT8-4'	Troffer	59.0	0.06	2912	172	2LTLED-4'	Troffer	37.0	0.04	2,912	108	0.02	64	$5.34
Municipal Building	Police Bathroom	2	1x26W CFL	Recessed Can	26.0	0.05	2912	151	1x16W LED	Recessed Can	16.0	0.03	2,912	93	0.02	58	$4.85
Municipal Building	Police Cellblock	1	2LT8-4'	Troffer	59.0	0.06	4368	258	2LTLED-4'	Troffer	37.0	0.04	4,368	162	0.02	96	$8.01
Municipal Building	Police Chief	6	2LT8-4'	Troffer	59.0	0.35	2912	1,031	2LTLED-4'	Troffer	37.0	0.22	2,912	646	0.13	384	$32.03
Municipal Building	Police Gerry Office	4	2LT8-4'	Troffer	59.0	0.24	2912	687	2LTLED-4'	Troffer	37.0	0.15	2,912	431	0.09	256	$21.35
Municipal Building	Police Secretary	2	2LT8-4'	Troffer	59.0	0.12	8736	1,031	2LTLED-4'	Troffer	37.0	0.07	8,736	646	0.04	384	$32.03
Municipal Building	Police Secretary	6	2LT8-4'	Troffer	59.0	0.35	8736	3,093	2LTLED-4'	Troffer	37.0	0.22	8,736	1,939	0.13	1,153	$96.08
Municipal Building	Police File Room	2	2LT8-4'	Troffer	59.0	0.12	2912	344	2LTLED-4'	Troffer	37.0	0.07	2,912	215	0.04	128	$10.68
Municipal Building	Police Side Office	4	2LT8-4'	Troffer	59.0	0.24	2912	687	2LTLED-4'	Troffer	37.0	0.15	2,912	431	0.09	256	$21.35
Municipal Building	Police Lobby	2	2LT8-4'	Troffer	59.0	0.12	8736	1,031	2LTLED-4'	Troffer	37.0	0.07	8,736	646	0.04	384	$32.03
Municipal Building	Police Garage	2	2LT8-4'	Troffer	59.0	0.12	4368	515	2LTLED-4'	Troffer	37.0	0.07	4,368	323	0.04	192	$16.01
Municipal Building	Police Evidence	1	2LT8-4'	Troffer	59.0	0.06	364	21	2LTLED-4'	Troffer	37.0	0.04	364	13	0.02	8	$0.67
Municipal Building	Police Evidence	2	2LT8-4'	Troffer	59.0	0.12	364	43	2LTLED-4'	Troffer	37.0	0.07	364	27	0.04	16	$1.33
Municipal Garage	Exterior	1	400W MH	High Bay	456.0	0.46	4004	1,826	160W LED	High Bay	160.0	0.16	4,004	641	0.30	1,185	$98.75
Municipal Garage	Office	4	2LTLED-4'	Troffer	37.0	0.15	2912	431	2LTLED-4'	Troffer	37.0	0.15	2,912	431	0.00	0	$0.00
Municipal Garage	Shower	6	1x26W CFL	Recessed Can	26.0	0.16	364	57	1x16W LED	Recessed Can	16.0	0.10	364	35	0.06	22	$1.82
Municipal Garage	Laundry	1	2LT12-4'	Troffer	67.0	0.07	2912	195	2LTLED-4'	Troffer	37.0	0.04	2,912	108	0.03	87	$7.28
Municipal Garage	2-Bay	4	160W LED	High Bay	160.0	0.64	2912	1,864	160W LED	High Bay	160.0	0.64	2,912	1,864	0.00	0	$0.00
Municipal Garage	Mezzanine	6	2LT12-4'	Troffer	67.0	0.40	2912	1,171	2LTLED-4'	Troffer	37.0	0.22	2,912	646	0.18	524	$43.67
Municipal Garage	5-Bay	4	2LT12-4'	Troffer	67.0	0.27	1456	390	2LTLED-4'	Troffer	37.0	0.15	1,456	215	0.12	175	$14.56
Municipal Garage	5-Bay	10	400W MH	High Bay	456.0	4.56	2912	13,279	160W LED	High Bay	160.0	1.60	2,912	4,659	2.96	8,620	$718.16
Municipal Garage	7-Bay	3	2LT12-4'	Troffer	67.0	0.20	1456	293	2LTLED-4'	Troffer	37.0	0.11	1,456	162	0.09	131	$10.92
Municipal Garage	7-Bay	12	400W MH	High Bay	456.0	5.47	2912	15,934	160W LED	High Bay	160.0	1.92	2,912	5,591	3.55	10,343	$861.80
Municipal Garage	7-Bay Bathroom	2	2LT12-4'	Troffer	67.0	0.13	2912	390	2LTLED-4'	Troffer	37.0	0.07	2,912	215	0.06	175	$14.56
Municipal Ballfield	Spotlights	28	1500W MV	Spotlight	1,500.0	42.00	192	8,059	500W LED	Spotlight	500.0	14.00	192	2,686	28.00	5,373	$1,076.72
Community Center Building 1	Main Room	10	2LT12-4'	Troffer	67.0	0.67	300	201	2LTLED-4'	Troffer	37.0	0.37	300	111	0.30	90	$12.40
Community Center Building 1	Kitchen	4	2LT12-4'	Troffer	67.0	0.27	300	80	2LTLED-4'	Troffer	37.0	0.15	300	44	0.12	36	$4.96
Community Center Building 1	Stove	2	1x100W INC	Recessed Can	100.0	0.20	300	60	1x16W LED	Recessed Can	16.0	0.03	300	10	0.17	50	$6.95
Community Center Building 1	Bathroom	2	2LT12-4'	Troffer	67.0	0.13	300	40	2LTLED-4'	Troffer	37.0	0.07	300	22	0.06	18	$2.48
Community Center Building 1	Bathroom	1	2LT8-4'	Troffer	59.0	0.06	300	18	2LTLED-4'	Troffer	37.0	0.04	300	11	0.02	7	$0.91
Community Center Building 1	Bunk Room	9	2LT12-4'	Troffer	67.0	0.60	300	181	2LTLED-4'	Troffer	37.0	0.33	300	100	0.27	81	$11.16
Community Center Building 1	Hall	2	2LT12-4'U	Troffer	67.0	0.13	300	40	2LTLED-4'	Troffer	37.0	0.07	300	22	0.06	18	$2.48
Community Center Building 1	Command Offices	2	2LT12-4'	Troffer	67.0	0.13	300	40	2LTLED-4'	Troffer	37.0	0.07	300	22	0.06	18	$2.48
Community Center Building 1	Radio Room	2	2LT12-4'	Troffer	67.0	0.13	300	40	2LTLED-4'	Troffer	37.0	0.07	300	22	0.06	18	$2.48
Community Center Building 1	Uniform Room	1	2LT12-4'	Troffer	67.0	0.07	300	20	2LTLED-4'	Troffer	37.0	0.04	300	11	0.03	9	$1.24
Community Center Building 1	Hall	2	2LT12-4'	Troffer	67.0	0.13	300	40	2LTLED-4'	Troffer	37.0	0.07	300	22	0.06	18	$2.48
Community Center Building 1	Library	2	2LT12-4'	Troffer	67.0	0.13	300	40	2LTLED-4'	Troffer	37.0	0.07	300	22	0.06	18	$2.48

Lighting Retrofit Analysis

			Existing						Proposed						Annual		
Building	Space	Number of Fixtures	Fixture Type	Fixture Style	Fixture Wattage (W)	Total Wattage (kW)	Annual Operating Hours (hr)	Annual Cons. (kWh)	Fixture Type	Fixture Style	Fixture Wattage (W)	Total Wattage (kW)	Annual Operating Hours (hr)	Annual Consumption (kWh)	Demand Savings (kW)	Cons. Savings (kWh)	Cost Savings ($)
Community Center Building 1	Exterior	1	75W HPS	Wall Pack	87.0	0.09	300	26	40W LED	Wall Pack	40.0	0.04	300	12	0.05	14	$1.94
Community Center Building 2	Basement	1	2LT8-8'	Troffer	109.0	0.11	170	19	2LTLED-8'	Troffer	86.0	0.09	170	15	0.02	4	$0.51
Community Center Building 2	Basement	9	2LT12-4'	Troffer	67.0	0.60	170	103	2LTLED-4'	Troffer	37.0	0.33	170	57	0.27	46	$5.99
Community Center Building 2	Main Room	9	2LT12-4'	Troffer	67.0	0.60	170	103	2LTLED-4'	Troffer	37.0	0.33	170	57	0.27	46	$5.99
Community Center Building 2	Bathroom	2	2LT12-4'	Troffer	67.0	0.13	170	23	2LTLED-4'	Troffer	37.0	0.07	170	13	0.06	10	$1.33
Community Center Building 2	Shower	2	1x26W CFL	Recessed Can	26.0	0.05	170	9	1x16W LED	Recessed Can	16.0	0.03	170	5	0.02	3	$0.44
Community Center Building 2	Bunk Room 1	1	2LT12-4'	Troffer	67.0	0.07	170	11	2LTLED-4'	Troffer	37.0	0.04	170	6	0.03	5	$0.67
Community Center Building 2	Bunk Room 2	5	2LT12-4'	Troffer	67.0	0.34	170	57	2LTLED-4'	Troffer	37.0	0.19	170	31	0.15	26	$3.33
Community Center Building 2	Storage Room	1	1x26W CFL	Recessed Can	26.0	0.03	170	4	1x16W LED	Recessed Can	16.0	0.02	170	3	0.01	2	$0.22
Community Center Building 3	Lobby Cans	2	1x26W CFL	Recessed Can	26.0	0.05	240	12	1x16W LED	Recessed Can	16.0	0.03	240	8	0.02	5	$0.47
Community Center Building 3	Main Room Pendant	6	1x16W LED	Recessed Can	16.0	0.10	240	23	1x16W LED	Recessed Can	16.0	0.10	240	23	0.00	0	$0.00
Community Center Building 3	Main Room Trusses	60	2LT12-4'	Troffer	67.0	4.02	240	965	2LTLED-4'	Troffer	37.0	2.22	240	533	1.80	432	$41.98
Community Center Building 3	Main Room Cans	2	1x26W CFL	Recessed Can	26.0	0.05	240	12	1x16W LED	Recessed Can	16.0	0.03	240	8	0.02	5	$0.47
Community Center Building 3	Chair Storage	2	2LT12-4'	Troffer	67.0	0.13	240	32	2LTLED-4'	Troffer	37.0	0.07	240	18	0.06	14	$1.40
Community Center Building 3	Kitchen Hall Cans	2	1x26W CFL	Recessed Can	26.0	0.05	240	12	1x16W LED	Recessed Can	16.0	0.03	240	8	0.02	5	$0.47
Community Center Building 3	Kitchen	6	2LT12-4'	Troffer	67.0	0.40	240	96	2LTLED-4'	Troffer	37.0	0.22	240	53	0.18	43	$4.20
Community Center Building 3	Storerooms	4	2LT12-4'	Troffer	67.0	0.27	240	64	2LTLED-4'	Troffer	37.0	0.15	240	36	0.12	29	$2.80
Community Center Building 3	Basement	4	2LT12-4'	Troffer	67.0	0.27	240	64	2LTLED-4'	Troffer	37.0	0.15	240	36	0.12	29	$2.80
Community Center Building 3	Porch	6	2LT12-4'	Troffer	67.0	0.40	240	96	2LTLED-4'	Troffer	37.0	0.22	240	53	0.18	43	$4.20
Community Center Building 3	Porch Wall	3	Unknown				0										
Boston Ballfield	Spotlights	30	1000W MH	Spotlight	1,000.0	30.00	245	7,343	450W LED	Spotlight	450.0	13.50	245	3,305	16.50	4,039	$693.79
Boston Bridge	Pole Light	6	250W HPS	Pole Light	250.0	1.50	3505	5,258	65W LED	Pole Light	65.0	0.39	3,505	1,367	1.11	3,891	$240.03
Total		*493*				*110*		*89,908*				*47*		*40,652*	*63*	*49,257*	*$5,043*