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Local Government Energy Program
Energy Audit Final Report

For

The Public Works Garage
Township of Hopewell
Titusville, NJ 08560

Project Number: LGEA16

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INTRODUCTION

On July 9th, August 6th and 7th Steven Winter Associates, Inc. (SWA) performed an energy audit and assessment for the Township of Hopewell municipal buildings. The audit included a review of the Public Works Garage, the Athletic Complex, the Union Fire and Rescue building, the Municipal building, the Princeton Farms Pump Station, and the Brandon Farms Pump Station. The buildings are located in Titusville and Pennington, NJ. A separate energy audit report is issued for each of the referenced buildings.

This report addresses the Public Works Garage building located at 203 Washington Crossing - Pennington Rd., Titusville, NJ 08560. Current conditions and energy-related information were collected in order to analyze and facilitate the implementation of energy conservation measures for the building.

The Public Works Garage building was built in 1993 and houses the Public Works administrative offices, tax assessor offices, and 24 double dump truck size bays. The building consists of 31,631 square feet, 7,800 square feet of which is conditioned space. The building houses approximately 33 day staff employees.

The building is operated Monday through Friday 5:00 am to 4:30 pm and utilized on weekends and evenings for emergencies.

The goal of this energy audit is to provide sufficient information to the Township of Hopewell to make decisions regarding the implementation of the most appropriate and most cost effective energy conservation measures for the DPW building.

EXECUTIVE SUMMARY

The energy audit performed by Steven Winter Associates (SWA) encompasses The Public Works Garage building located at 203 Washington Crossing - Pennington Rd, Titusville, NJ 08560. The Public Works Garage building is a one story building (with mezzanine areas) with a combined floor area of 31,631 square feet, built in 1993.

Based on the field visits performed by the SWA staff on July 9th, August 6th and 7th, 2009 and the results of a comprehensive energy analysis, this report describes the site's current conditions and recommendations for improvements. Suggestions for measures related to energy conservation and improved comfort are provided in the scope of work. Energy and resource savings are estimated for each measure that results in a reduction of heating, cooling, and electric usage.

In 2008, the most recent year, the Public Works Garage consumed 173,850 kWh or $27,858 worth of electricity and 12,323 therms or $22,087 worth of natural gas. The joint energy consumption for the building, including both electricity and natural gas, was 1,386 MM-Btus of energy that cost a total of $49,945.

SWA has entered energy information about the Public Works Garage in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. This Vehicle Repair / Service facility is comprised of non-eligible (Other) space type. SWA encourages the Township of Hopewell to continue entering utility data in *Energy Star Portfolio Manager* in order to track weather normalized source energy use over time. EPA is continually working to expand the available space types.

Based on the assessment of the Public Works Garage, SWA has separated the recommendations into three categories. These are summarized as follows:

Category I Recommendations: Capital Improvements

- New DHW heater - The existing DHW heater was installed 1993 and is now operating past its expected useful life. SWA recommends replacing the DHW heater with an AO Smith Vertex model unit or equivalent that has a thermal efficiency of 90% or higher or an Efficiency Factor (EF) value of 0.82 or higher. The overall replacement installed cost for this DHW heater with a similar size tank is estimated to cost $10,000. The NJ Clean Energy rebate program incentive could be as high as $400 for installing a high efficiency unit.
- Upgrade Roof Insulation - SWA recommends as part of a capital improvement plan to increase insulation levels throughout the roof assembly for a consistent R value. There isn't any insulation in the roof above six of the garage bays.

Category II Recommendations: Operations and Maintenance

- Controls Optimization - SWA recommends that the schedules for all air handling, cooling and heating equipment serving key public spaces be reviewed and optimized. During periods when the spaces are not occupied, the equipment may be shut-off or controlled to minimize the amount of fresh air conditioned by the equipment. The cost and effort associated with implementation of this recommendation will depend upon the capabilities of the existing automation control system. Energy and cost savings associated with this recommendation will vary, depending upon the current occupancy schedules and means of control utilized.
- Roof insulation - There are roof areas where the membrane is not well sealed to the wall surface. Extra precautions and care should be taken to avoid excess moisture entrapment within the building ceiling and wall cavities, because insulation looses thermal protective properties when wet.
- SWA recommends installing window tinting to windows missing film.

- Weather Stripping / Air Sealing - SWA observed that exterior door weather-stripping in places was beginning to deteriorate. Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. Garage overhead door bottom rubber whether strips should be filling any gap at the bottom of the doors when they are fully down and closed. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.
- Water Efficient Fixtures & Controls - There are many retrofit options, which can be installed now or incorporated as equipment is replaced. Routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy. Retrofitting with more efficient water-consumption fixtures / appliances will save both energy and money through reduced energy consumption for water heating, while also decreasing water / sewer bills.
- Energy Star labeled appliances such as refrigerators should replace older energy inefficient equipment.
- Smart power electric strips with occupancy sensors should be used to power down computer equipment when left unattended for extended periods of time.
- Create an educational program that teaches maintenance personnel how to minimize the energy use in the buildings. The US Department of Energy offers free information for hosting energy efficiency educational programs and for more information please visit: http://www1.eere.energy.gov/education/

Category III Recommendations: Energy Conservation Measures - Upgrades with associated energy savings

At this time, SWA recommends a total of **3** Energy Conservation Measures (ECMs) for the Public Works Garage that are summarized in the following table. The total investment cost for these ECMs with incentives is **$41,874**. SWA estimates a first year savings of **$5,849** with a simple payback of **7.2 years**. SWA estimates that implementing the recommended ECMs will reduce the carbon footprint of the Public Works Garage by **45,612 lbs of CO_2.**

There are various incentives that the Township of Hopewell could apply for that could also help lower the cost of installing the ECMs. SWA recommends that the Public Works Garage apply for the NJ SmartStart program through the New Jersey Office of Clean Energy. This incentive can help provide technical assistance for the building in the implementation phase of any energy conservation project. A new NJ Clean Power program, Direct Install, to be rolled out soon, could also assist to cover 80% of the capital investment.

Specifically, the building could qualify for $460 incentives for installing the recommended wall-mounted occupancy sensors.

The following tables summarize the proposed Energy Conservation Measures (ECM) and their economic relevance.

PROPOSED													
ECM #	ECM description	Installed Cost		1st year energy savings					SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
		Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $			Cost Savings $		
1	Install Drinks Vending machine miser	$265	www.usatech.com	2,496	kWh	0.7	-	399	0.7	12	3,928	115.2	3,420
2.1	install 23 occupancy sensors with INCENTIVES	$2,070	RS Means, Lit Search, NJ Clean Energy Program	2,891	kWh	0.8	kW	463	4.5	12	4,549	10.0	3,960
3	Retro-Commission-ing	$39,539	Similar Projects	17,385	kWh	5.1	kW	4,987	7.9	12	49,052	2.0	38,232
				1,232	therms	-	-						
	Total Proposed	**$41,874**	-	-	-	**7.0**	**kW**	**$5,849**	**7.2**	**12**	**57,529**	**3.1**	**45,612**

Definitions:
SPP – Simple Payback (years)
LoM: Life of Measure (years)
ROI: Return on Investment (%)
Assumptions:
Discount Rate: 3.2% per DOE FEMP Guidelines
Energy Price Escalation Rate: 0% per DOE FEMP Guidelines

CONSIDERED													
ECM #	ECM description	Installed Cost		1st year energy savings					SPP	LoM	Lifetime	ROI, %	Annual Carbon Reduced (lbs of CO2)
		Estimate $	Source	Use	Unit	Demand	Unit	Savings / year $			Cost Savings $		
4	Install CO2 sensors for demand control ventilation	$4,000	Similar Projects, RS Means, Lit Search	664	kWh	0.2	kW	343	11.7	12	3,369	-1.3	2,454
				132	therms	-	-						
2.2	replace building internal lights: T12s to T8s with INCENTIVES (incl. 75% labor)	$47,545	RS Means, Lit Search, NJ Clean Energy Program	12,702	kWh	3.7	kW	2,032	23.4	12	19,991	-4.8	17,402

1. HISTORIC ENERGY CONSUMPTION

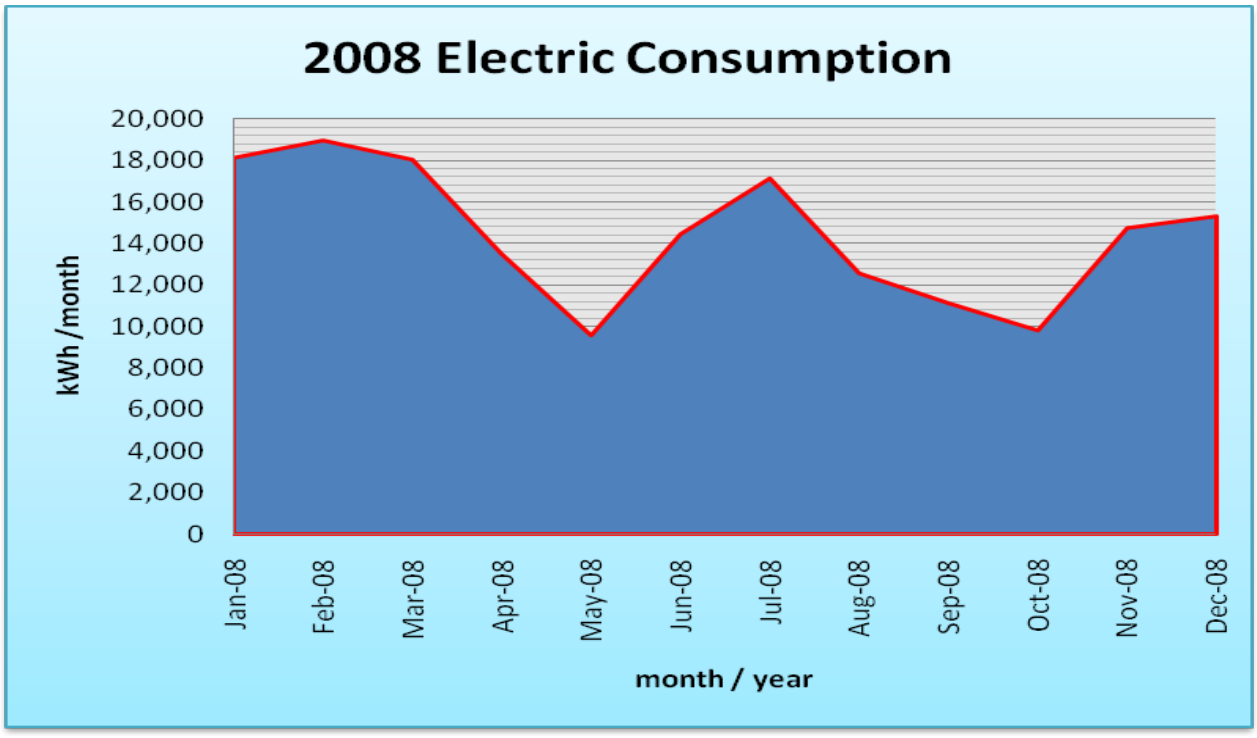
1.1. Energy usage and cost analysis

SWA analyzed utility bills from September 2007 through August 2009 that were received from the utilities supplying the Public Works Garage with electric and natural gas.

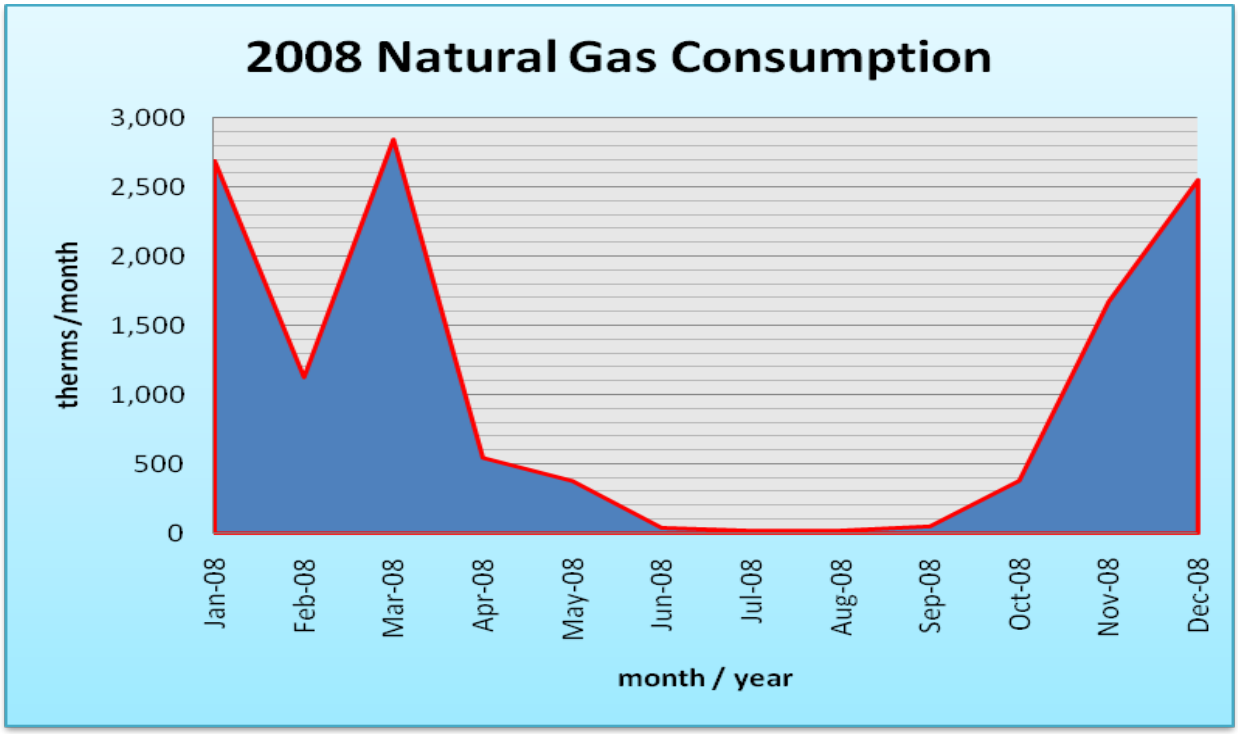
Electricity - The Public Works Garage is currently served by one electric meter. The Public Works Garage currently buys electricity from PSE&G at **an average rate of $0.160/kWh** based on 12 months of utility bills for 2008. The Public Works Garage purchased **approximately 173,850 kWh or $27,858 worth of electricity** in the previous year. The average monthly demand was 50 kW.

Natural Gas - The Public Works Garage is currently served by one meter for natural gas. The Public Works Garage currently buys natural gas from Elizabethtown Gas Co. at **an average aggregated rate of $1.79/therm** based on 12 months of utility bills for 2008. The Public Works Garage purchased **approximately 12,323 therms or $22,087 worth of natural gas** in the previous year.

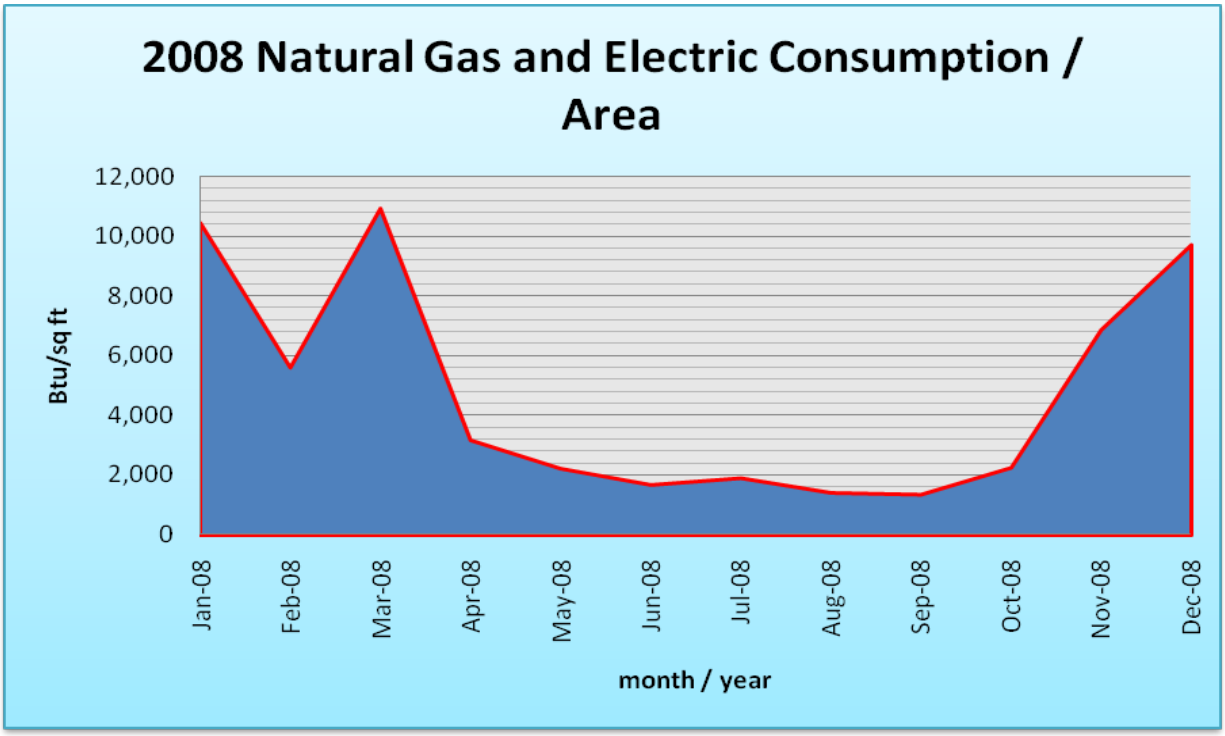
The following chart shows electricity use for the Public Works Garage based on utility bills for the 12 month period of January 2008 - December 2008.



The following chart shows the natural gas consumption for the Public Works Garage based on utility bills for the 12 month period of January 2008 - December 2008.

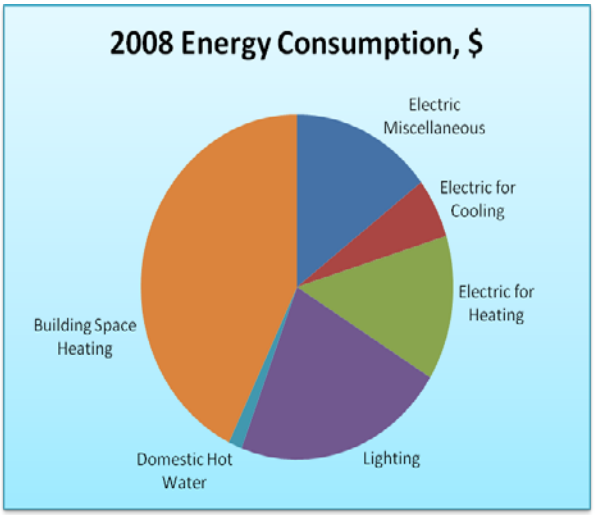


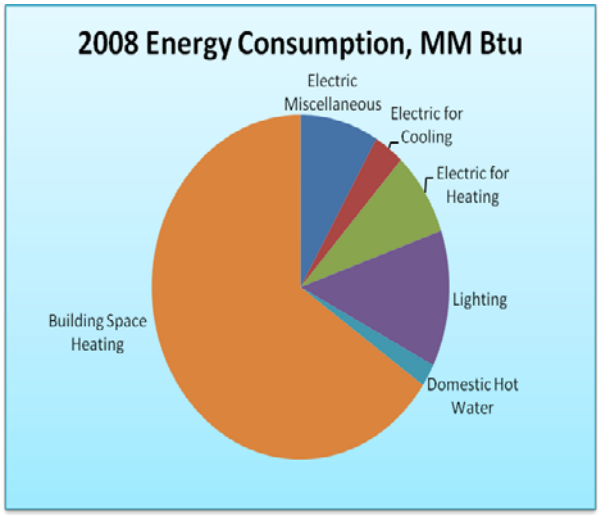
The following chart shows combined natural gas and electric consumption in Btu/ft2 for the Public Works Garage, based on utility bills for the 12 month period of January 2008 - December 2008.



The following table and chart pies show energy use for the Public Works Garage based on utility bills for the 12 month period of January 2008 - December 2008. Note electrical cost at $47/MM-Btu of energy is 2.5 times as expensive to use as natural gas at $18/MM-Btu.

2008 Annual Energy Consumption / Costs					
	MM-Btu	% MM Btu	$	% $	$/MM Btu
Electric Miscellaneous	155	8%	$7,284	15%	$47
Electric for Cooling	60	3%	$2,811	6%	$47
Electric for Heating	144	8%	$6,780	14%	$47
Lighting	234	13%	$10,983	22%	$47
Domestic Hot Water	39	2%	$696	1%	$18
Building Space Heating	1,194	65%	$21,391	43%	$18
Totals	1,826	100%	$49,945	100%	$27
Total Electric Usage	593	32%	$27,858	56%	$47
Total Natural Gas Usage	1,232	68%	$22,087	44%	$18
Totals	1,826	100%	$49,945	100%	$27





1.2. Utility rate

The Public Works Garage currently purchases electricity from PSE&G at a general service market rate for electricity use (kWh) with a separate (kW) demand charge. The Public Works Garage currently pays an average rate of approximately $0.160/kWh based on 12 months of utility bills for 2008.

The Public Works Garage currently purchases natural gas supply from Elizabethtown Gas Co. at a general service market rate for natural gas (therms). Elizabethtown Gas Co. acts also as the transport company. There is one gas meters that provides natural gas service to the Public Works Garage currently. The average aggregated rate (supply and transport) for the meter is approximately of $1.79/therm based on 12 months of utility bills for 2008.

Some of the minor unusual utility fluctuations that showed up for a couple of months on the utility bills may be due to adjustments between estimated and actual meter readings.

1.3. Energy benchmarking

SWA has entered energy information about the Public Works Garage in the U.S. Environmental Protection Agency's (EPA) *Energy Star Portfolio Manager* Energy benchmarking system. This Vehicle Repair / Service facility is comprised of non-eligible (Other) space type. The Vehicle Repair / Service space or "Other" can be used to classify a facility or a portion of a facility where the primary activity does not fall into any of the available space types. Consequently, the Public Works Garage is not eligible to receive a national energy performance rating at this time. SWA encourages the Township of Hopewell to continue entering utility data in *Energy Star Portfolio Manager* in order to track weather normalized source energy use over time. EPA is continually working to expand the available space types. As new space types become available, the Township of Hopewell will be able to reclassify spaces accordingly if they have previously been entered as "Other".

Per the LGEA program requirements, SWA has assisted the Township of Hopewell to create an *Energy Star Portfolio Manager* account and share the Public Works Garage facilities information to allow future data to be added and tracked using the benchmarking tool. SWA has shared this Portfolio Manager site information with the Township of Hopewell (user name of "hopewelladmin" with a password of "hopewelltwp1") and TRC Energy Services (user name of TRC-LGEA).

2. FACILITY AND SYSTEMS DESCRIPTION

2.1. Building Characteristics

The Public Works Garage is a one level building with mezzanine areas in various locations. The building consists of 31,631 square feet of space. The Public Works Garage was built in 1993 and it houses the following function areas: administrative offices, tax assessor offices, and 24 double dump truck size bays. The administrative offices include approximately 6,800 square feet and the tax assessor offices include approximately 1,000 square feet.

2.2. Building occupancy profiles

The peak occupancy for the Public Works Garage is approximately 33 employees. The building is generally operated from 5:00 am to 4:30pm Monday through Friday. The building may be utilized during nights and weekends for emergencies.

2.3. Building envelope

2.3.1. Exterior Walls

The exterior walls consist of 12" CMU block with 1-½" rigid insulation on the exterior side of the wall assembly with either a 4" brick veneer or EIFS (Exterior Insulated Finishing System) façade. Exterior walls appear to be in good condition with proper drainage including weep holes and flashing.

Due to warm temperature conditions at the time of the field visit, insulation levels could not be verified with help of infrared technology. If desired, the Municipality could contract a separate envelope inspection during cooler months.

2.3.2. Roof

There are three different roofing materials: a standing-seam metal pitched roof, a black rubber membrane roof painted white, and a black rubber membrane. The black rubber membrane roof section was installed in 2000 and the section painted white was installed in 2006. There were obvious soft spots detected in the white painted membrane. There appeared to be a few areas where water has pooled due to insufficient slope. SWA suggests verifying the terms of the roof warranty and contacting the roofing installer to correct areas with insufficient slope. There are other areas (as seen in the image below) where the membrane is not sealed to the wall surface. Extra attention should be provided to these areas, as water may be entering the wall assemblies, leading to future mold and mildew issues. SWA noted a dehumidifier in use in the administrative offices. Extra precautions and care should be taken to avoid excess moisture entrapment within the building ceiling and wall cavities, because insulation looses thermal protective properties when wet.

According to the building drawings, the roof insulation varied from 1 ½" to 3" in different roof sections. Roof insulation could not be verified at the time of the inspection without the help of infrared technology. SWA recommends as part of a capital improvement plan to increase insulation levels throughout the roof assembly for a consistent R value. As noted during the kickoff meeting, there isn't any insulation in the roof above six of the garage bays. As these areas are heated throughout the winter, SWA suggests a continuous insulation layer be added with any roof improvements or upgrades.

2.3.3. Base

The building's base is a 4" concrete slab-on grade with a perimeter footing. There weren't any obvious or reported signs of moisture or water damage. The slab edge or perimeter insulation could not be verified and should be confirmed at the time of the above recommended insulation inspection during cooler months for usable infrared data evaluation.

2.3.4. Windows

The building contains fixed and casement aluminum-framed windows with double-glazing. The windows appeared to be in good condition. Certain windows were missing tinted glazing allowing those areas to receive additional solar heat gain. SWA recommends installing window tinting to windows missing film. When replacement of windows is needed, SWA suggests insulated, low-e windows.

2.3.5. Exterior doors

The aluminum framed exterior door and metal doors were observed to be in good condition except for some missing or worn weather-stripping. SWA also recommends checking the weather-stripping of each door (including garage doors) on a regular basis and replacing any broken seals immediately. Tight seals around the doors will help ensure that the building is kept continuously tight and insulated.

2.3.6. Building air tightness

Based on a visual inspection, the Public Works Garage could benefit from additional air sealing around ductwork, plumbing, wire penetrations, and verifying weather-stripping around all exterior doors. Any water damage due to condensing un-insulated pipes, condensate lines dripping, plumbing leaks, or roof leaks should be repaired immediately and ceiling tiles should be replaced. Ceiling tiles act as an air barrier containing expensive conditioned air from leaking into ceiling or wall cavities.

2.4. HVAC Systems

2.4.1. Heating

Heating is provided to the office area, the locker room and the lunch room of the building by a gas fired rooftop unit through a ductwork distribution system. The rooftop unit installed is a model

48DKD028, manufactured by Carrier. The heating input capacity is 185MBH, and its thermal efficiency is 80%.

The garage area is heated by 18 gas fired, ceiling mounted radiant.

The mechanic's office and shop area are heated by a packaged unit (heating and ventilation) installed on the mezzanine with a ductwork distribution system. This unit is a model DHE 301 SFM, manufactured by Modine, with input capacity of 300 MBH and an output capacity of 240 MBH.

The mechanic's office and the outer walls of the Administrative offices are also provided with perimeter electric baseboard heat set at a low setting.

2.4.2. Cooling

Cooling is provided to the office area of the building by the Carrier rooftop unit through a ductwork system. The mechanic's office is cooled by a 1-Ton Trane through-the-wall unit, manufactured by Carrier.

2.4.3. Ventilation

Outside air is supplied to the office area from the rooftop unit.

Outside air is provided to the mechanic's office and the shop area from the heating and ventilation unit.

The garages are provided with a fume exhaust system. The exhaust fan is installed at the garage ceiling.

2.4.4. Domestic Hot Water

The domestic hot water heater (DHW) is produced by a natural gas fired hot water heater, manufactured by AO Smith, with a storage capacity of 100 gallons. This DHW heater was installed 1993 and is now operating past its expected useful life. Rather than wait for a catastrophic failure, SWA recommends replacing the DHW heater with an AO Smith Vertex model unit or equivalent that has a thermal efficiency of 90% or higher or an Efficiency Factor (EF) value of 0.82 or higher. The Township of Hopewell may first want to measure the daily and instantaneous amount of hot water consumed in order to determine the appropriate storage tank capacity required, now that the building has been in operation for 16 years. The overall replacement installed cost for this DHW heater with a similar size unit is estimated to cost $10,000. The NJ Clean Energy rebate program incentive could be as high as $400 for installing a high efficiency unit.

More efficient water-consuming fixtures and appliances save both energy and money through reduced energy consumption for water heating and decreased water and sewer bills. SWA recommends adding controlled on- / off- timers on all lavatory faucets to reduce both cold and domestic hot water consumption. Building staff can also easily install faucet aerators and / or low-flow fixtures to reduce hot water consumption. In addition, routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy.

2.5. Electrical systems

2.5.1. Lighting

Interior Lighting - The Public Works Garage currently consists of mostly T12 fluorescent fixtures with magnetic ballasts with a few areas retrofitted from T12 to T8 fixtures. Based on measurements of lighting levels for each space, there are not any vastly over-lighted areas. SWA recommends replacing T12 lighting including magnetic ballasts whenever possible with T8 lighting and electronic ballasts. As this option may not be very cost effective, the changeover could take place as fixtures break down and are taken out of service. SWA also recommends installing occupancy sensors in bathrooms, offices and areas that are occupied only part of the day. Since bathrooms are used sporadically throughout the day and lighting is commonly left on far beyond the necessary hours of operation, SWA recommends installing occupancy sensors with time delay and acoustic capabilities. Typically, occupancy sensors have an adjustable time delay that shuts down the lights automatically if no motion or sound is detected within a set time period. The building also has a few lights with incandescent bulbs. SWA recommends replacing all incandescent bulbs with CFLs. See attached lighting schedule in Appendix A for a complete inventory of lighting throughout the building and estimated power consumption.

Exit Lights - The building has mostly LED exit signs installed. These are low energy users. SWA recommends that any newly installed exit signs be LED type exit signs.

Exterior Lighting - The exterior lighting was surveyed during the building audit, and it is a mix of 70 and 100 Watt metal halide lamps and 70 Watt high pressure sodium lamps. Since this lighting is mainly for Safety as well as for Security, SWA has deemed it not cost effective to replace exterior metal halide lamp lighting at this time. The majority of exterior lighting is controlled by timers. There is not any immediate need to upgrade exterior lighting fixtures or timers.

2.5.2. Appliances and process

Appliances, such as refrigerators, that are over 10 years of age should be replaced with newer efficient models with the Energy Star label. For example, Energy Star refrigerators use as little as 315 kWh / yr. When compared to the average electrical consumption of older equipment, Energy Star equipment results in large savings. Look for the Energy Star label when replacing appliances and equipment, including: refrigerators, printers, computers, copy machines, etc. More information can be found in the "Products" section of the Energy Star website at: http://www.energystar.gov. Also, energy vending miser devices are now available for conserving energy usage by Drinks and Snacks vending machines. When equipped with the vending miser devices, vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines.

Computers left on in the building consume a lot of energy. A typical desk top computer uses 65 to 250 watts and uses the same amount of energy when the screen saver is left on. Televisions in meeting areas use approximately 3-5 watts of electricity when turned off. SWA recommends all computers and all appliances (i.e. fridges, coffee makers, televisions, etc) be plugged in to power strips and turned off each evening just as the lights are turned off. The Public Works Garage computers are generally programmed for the power save mode, to shut down after a period non use.

2.5.3. Elevators

The Public Works Garage is a single story building and therefore does not contain any elevator equipment.

2.5.4. Others electrical systems

There isn't any emergency generator serving the Public Works Garage. There are not currently any other electrical systems installed at the Public Works Garage.

3. EQUIPMENT LIST

Inventory

The Public Works Garage						
Building System	**Description**	**Location**	**Model#**	**Fuel**	**Space served**	**Estimated Remaining useful life %**
Heating, cooling and ventilation	1 RTU (2 compressors) with DX coil - 15 Ton, heating input capacity: 185 MBH	rooftop	Carrier, model 48DKD028	Natural Gas / Electric	Office area, locker room and lunch room	45%
Heating, cooling and ventilation	Modine heating and ventilation unit, input capacity of 300 MBH and output capacity of 240 MBH	mezzanine in garage	DHE 301 SFM	Natural Gas / Electric	Mechanic's office and shop area	45%
Heating	exterior offices and conf room have electrical radiant heaters	room perimeters	IR	Electric	Public Works offices	45%
Heating	mechanic's office has electric baseboard heat	room perimeter	IR	Electric	Garage area	45%
Cooling	1 wall A/C unit - 1 Ton for the mechanic's office	mechanic's office	Trane	Electric	Garage area	45%
Heating	18 garage heaters	garage	Zonex (Honeywell)	Natural Gas	Garage area	45%
Ventilation	9 exhaust fans on manual control	rooftop	-	Electric	Garage area	45%
Domestic Hot water heater	100 gal tank	southeast corner loft - mechanic's bay	A.O. Smith	Natural Gas	Public Works Garage Bldg.	0% and operating past it's expected useful life
PV Installation	40 kW PV Solar Panels	front lawn	-	Electric	Outside Public Works Garage Bldg.	100%
Lighting	See details - Appendix A	See details - Appendix A	-	Electric	Union Fire & Rescue House	varies, average 60%

Note:

The remaining useful life of a system (in %) is an estimate based on the system date of built and existing conditions derived from visual inspection.

4. ENERGY CONSERVATION MEASURES

Based on the assessment of the Public Works Garage, SWA has separated the investment opportunities into three recommended categories:

1. Capital Improvements - Upgrades not directly associated with energy savings
2. Operations and Maintenance - Low Cost / No Cost Measures
3. Energy Conservation Measures - Higher cost upgrades with associated energy savings

Category I Recommendations: Capital Improvements

- New DHW heater - The existing DHW heater was installed 1993 and is now operating past its expected useful life. Rather than wait for a catastrophic failure, SWA recommends replacing the DHW heater with an AO Smith Vertex model unit or equivalent that has a thermal efficiency of 90% or higher or an Efficiency Factor (EF) value of 0.82 or higher. The Township of Hopewell may first want to measure the daily and instantaneous amount of hot water consumed in order to determine the appropriate storage tank capacity required, now that the building has been in operation for 16 years. The overall replacement installed cost for this DHW heater with a similar size tank is estimated to cost $10,000. The NJ Clean Energy rebate program incentive could be as high as $400 for installing a high efficiency unit.
- Upgrade Roof Insulation - SWA recommends as part of a capital improvement plan to increase insulation levels throughout the roof assembly for a consistent R value. There isn't any insulation in the roof above six of the garage bays. As these areas are heated throughout the winter, SWA suggests a continuous insulation layer be added with any roof improvements or upgrades.

Category II Recommendations: Operations and Maintenance

- Controls Optimization - SWA recommends that the schedules for all air handling, cooling and heating equipment serving key public spaces be reviewed and optimized. During periods when the spaces are not occupied, the equipment may be shut-off or controlled to minimize the amount of fresh air conditioned by the equipment. The cost and effort associated with implementation of this recommendation will depend upon the capabilities of the existing automation control system. Energy and cost savings associated with this recommendation will vary, depending upon the current occupancy schedules and means of control utilized.
- Roof insulation - There are roof areas where the membrane is not well sealed to the wall surface. Extra precautions and care should be taken to avoid excess moisture entrapment within the building ceiling and wall cavities, because insulation looses thermal protective properties when wet.
- SWA recommends installing window tinting to windows missing film. When replacement of windows is needed, SWA suggests insulated, low-e windows.
- Weather Stripping / Air Sealing - SWA observed that exterior door weather-stripping in places was beginning to deteriorate. Doors and vestibules should be observed annually for deficient weather-stripping and replaced as needed. Garage overhead door bottom rubber whether strips should be filling any gap at the bottom of the doors when they are fully down and closed. The perimeter of all window frames should also be regularly inspected and any missing or deteriorated caulking should be re-caulked to provide an unbroken seal around the window frames. Any other accessible gaps or penetrations in the thermal envelope penetrations should also be sealed with caulk or spray foam.
- Water Efficient Fixtures & Controls - Adding controlled on / off timers on all lavatory faucets is a cost-effective way to reduce domestic hot water demand and save water. Building staff can also easily install faucet aerators and / or low-flow fixtures to reduce water consumption. There are many retrofit options, which can be installed now or incorporated as equipment is replaced. Routine maintenance practices that identify and quickly address water leaks are a low-cost way to save water and energy. Retrofitting with

more efficient water-consumption fixtures / appliances will save both energy and money through reduced energy consumption for water heating, while also decreasing water / sewer bills.

- Energy Star labeled appliances such as refrigerators should replace older energy inefficient equipment.
- Smart power electric strips with occupancy sensors should be used to power down computer equipment when left unattended for extended periods of time.
- Create an educational program that teaches maintenance personnel how to minimize the energy use in the buildings. The US Department of Energy offers free information for hosting energy efficiency educational programs and for more information please visit: http://www1.eere.energy.gov/education/

Category III Recommendations: Energy Conservation Measures

Summary table

ECM#	Description
1	**Install Drinks Vending machine misers**
2	**Upgrade building lighting: incandescent to CFLs, occupancy sensors for some offices, Exit fluorescents to LED and T12 magnetic fixtures to T8 electronic fixtures**
3	**Undertake retro-commissioning of building systems and controls to optimize performance**
4	**Install Carbon Dioxide sensors to control and improve Indoor Air Quality in the office area, as well as reduce energy costs**

ECM#1: *Install Vending Misers*

Description:

The Public Works Garage has one Drinks vending machine outside the locker room. Energy vending miser devices are now available for conserving energy with these vending machines. There isn't a need to purchase new machines to reduce operating costs and greenhouse gas emissions. When equipped with the vending miser devices, refrigerated beverage vending machines use less energy and are comparable in daily energy performance to new ENERGY STAR qualified machines. Vending miser devices incorporate innovative energy-saving technology into small plug-and-play devices that installs in minutes, either on the wall or on the vending machine. Vending miser devices use a Passive Infrared Sensor (PIR) to: Power down the machine when the surrounding area is vacant; Monitor the room's temperature; Automatically repower the cooling system at one- to three-hour intervals, independent of sales; Ensure the product stays cold.

Should the Public Works Garage decide to install a Snacks vending machines in the future, there are also snacks vending miser devices, where maximum energy savings can be achieved, that result in reduced operating costs and decreased greenhouse gas emissions with existing machines. Snacks vending miser devices also use a Passive Infrared Sensor (PIR) to determine if there is anyone within 25 feet of the machine. It waits for 15 minutes of vacancy, then powers down the machine. If a customer approaches the machine while powered down, the snacks vending miser will sense the presence and immediately power up.

Installation cost:

Estimated installed cost: $265
Source of cost estimate: www.usatech.com *and established costs*

Economics (without incentives):

ECM description	Installed Cost		1st year energy savings					SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand / mo	Unit	Savings / year $			Cost Savings $		
Install Drinks Vending machine miser	$265	www.usatech.com	2,496	kWh	0.7	-	399	0.7	12	3,928	115.2	3,420

Assumptions: SWA assumes energy savings based modeling calculator found at www.usatech.com. or http://www.usatech.com/energy_management/energy_calculator.php

Rebates/financial incentives: *This measure does not qualify for a rebate or financial incentive at this time.*

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#2: *Upgrade Existing Lighting*

Description:

On the day of the site visit, SWA completed a lighting inventory of the Public Works Garage (see Appendix A). The existing lighting consists of many T12 fluorescent fixtures with magnetic ballasts, and a few incandescent lights and T8s. A few of the lights in the Public Works Garage appear to have been upgraded to T8 fixtures and LED lighted Exit signs. SWA has performed an evaluation of upgrading all the T12 magnetic ballast fixtures to T8 electronic ballast fixtures, incandescent bulbs to CFLs and installing occupancy sensors in offices and bathrooms that may be left unoccupied a considerable amount of time throughout the day. The labor in all these installations was evaluated using prevailing electrical contractor wages. The Public Works Garage may decide to perform this work with in-house resources from its Maintenance Department on a scheduled, longer timeline than otherwise performed by a contractor, to obtain savings. SWA recommends at a minimum that the incandescent bulbs be replaced with CFLs, occupancy sensors be installed in a number of offices and bathrooms. See Appendix A for recommendations.

Installation cost:

Estimated installed cost: $2,070
Source of cost estimate: RS *Means; Published and established costs*

Economics (Some of the options considered with incentives):

ECM description	Installed Cost		1st year energy savings					SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $			Cost Savings $		
install 23 occupancy sensors with INCENTIVES	$2,070	RS Means, Lit Search, NJ Clean Energy Program	2,891	kWh	0.8	kW	463	4.5	12	4,549	10.0	3,960

Economics (Option with incentives considered that do not appear cost effective):

ECM description	Installed Cost		1st year energy savings					SPP	LoM	Lifetime	ROI, %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $			Cost Savings $		
replace building internal lights: T12s to T8s with INCENTIVES (incl. 75% labor)	$47,545	RS Means, Lit Search, NJ Clean Energy Program	12,702	kWh	3.7	kW	2,032	23.4	12	19,991	-4.8	17,402

Assumptions: SWA calculated the savings for this measure using measurements taken the day of the field visit and using the billing analysis.

Rebates/financial incentives:

NJ Clean Energy - Wall Mounted occupancy sensors ($20 per control)
Maximum incentive amount is $460.

NJ Clean Energy - Prescriptive Lighting Incentive, Incentive based on installing T5 or T8 lamps with electronic ballasts in existing facilities ($10-$30 per fixture, depending on quantity of lamps). Maximum incentive amount is $7,710.

Options for funding the Lighting ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#3: *Retro-Commissioning*

Description:

Retro-commissioning is a process that seeks to improve how building equipment and systems function together. Depending on the age of the building, retro-commissioning can often resolve problems that occurred during design or construction and / or address problems that have developed throughout the building's life. Owners often undertake retro-commissioning to optimize building systems, reduce operating costs, and address comfort complaints from building occupants.

Since the systems at the Public Works Garage have undergone some renovations in the last ten years, and the building has concerns with thermal comfort control, SWA recommends undertaking retro-commissioning to optimize system operation as a follow-up to completion of the upgrades. There have been concerns from the Maintenance Department that the control systems are not operating as designed. The retro-commissioning process should include a review of existing operational parameters for both newer and older installed equipment. In particular, SWA observed potential energy savings associated with optimizing the scheduled operating hours and outdoor air fraction of rooftop equipment serving large public areas, as well as best heating scheme for the garage. During retro-commissioning, the individual loop temperatures should also be reviewed to identify opportunities for optimizing system performance.

Installation cost:

Estimated installed cost: $15,284
Source of cost estimate: Similar projects

Economics (without incentives):

ECM description	Installed Cost		1st year energy savings					SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $			Cost Savings $		
Retro-Commission-ing	$39,539	Similar Projects	17,385	kWh	5.1	kW	4,987	7.9	12	49,052	2.0	38,232
			1,232	therms	-	-						

Assumptions: Since the utility bills have some accounting fluctuations, it is difficult to determine the amount of energy used for heating and cooling the Public Works Garage. Based on experience with similar buildings, SWA estimated the heating and cooling energy consumption. Typical savings for retro-commissioning range from 5-20%, as a percentage of the total space conditioning consumption. SWA assumed 10% savings. Estimated costs for retro-commissioning range from $0.50-$2.00 per square foot. SWA assumed $1.25 per square foot of a total square footage of 31,631.

Rebates / financial incentives: *There are currently no incentives for this measure at this time.*

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.

http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

ECM#4: *Carbon Dioxide Controls in the Public Works Garage Officer Area*

Description:

On the day of the site visit, SWA observed that there were not any air flow controls for the Public Works Garage office area based on occupancy. SWA recommends that a carbon dioxide sensor be installed (in the return air duct) in the Public Works Garage to sense occupancy and improve Indoor Air Quality (IAQ). Signals from this sensor need to be taken back to the HVAC air flow controls for programming to regulate the amount of cooling and heating for the Public Works Garage and vary air flows according to occupancy. Thus, many a time when the Public Works Garage offices are sparsely occupied, savings will be realized in the heating and cooling of these spaces, by bringing into the spaces the right amount of fresh air (rather than too much unconditioned air). This measure is to optimize the amount of outdoor air entering the building based on occupancy. Typical applications are theaters, meeting rooms and anywhere when occupancy can vary significantly. For predetermined schedules and repeatable occupancy levels, such as offices or classrooms, a timer based control would be sufficient.

Installation cost:

Estimated installed cost: $4,000
Source of cost estimate: RS *Means; Published and established costs*

Economics (without incentives):

ECM description	Installed Cost		1st year energy savings					SPP	LoM	Lifetime	ROI %	Annual Carbon Reduced (lbs of CO2)
	Estimate $	Source	Use	Unit	Demand /mo	Unit	Savings / year $			Cost Savings $		
Install CO2 sensors for demand control ventilation	$4,000	Similar Projects, RS Means, Lit Search	664	kWh	0.2	kW	343	11.7	12	3,369	-1.3	2,454
			132	therms	-	-						

Assumptions: SWA assumes thermal savings based on heating and cooling loads calculated using modeling and by conducting the billing analysis. In order to estimate savings for this measure, SWA assumed in the model an occupancy reduction equivalent to a conservative 5% (in view that the space is seldom used at the full designed capacity) of the total heating and cooling used for the Public Works Garage offices based on the described use schedules. This estimate also does not overlap retro-commissioning assumptions.

Rebates/financial incentives:

This measure does not qualify for a rebate or financial incentive at this time.

Options for funding ECM:

This project may benefit from enrolling in NJ SmartStart program with Technical Assistance to offset a portion of the cost of implementation.
http://www.njcleanenergy.com/commercial-industrial/programs/nj-smartstart-buildings/nj-smartstart-buildings

5. RENEWABLE AND DISTRIBUTED ENERGY MEASURES

5.1. Existing systems

The Township of Hopewell is commissioning a 40 kW photovoltaic system located on the lawn of the Public Works Garage.

5.2. Wind

Description:

The Township of Hopewell should experiment first with the new photovoltaic installation and observe how it impacts kW demand at the Public Works Garage before implementing other renewable sources of energy.

5.3. Solar Photovoltaic

Description:

Expansion discussions of the new 40 kW photovoltaic system should be taken up after the full impacts of the newly installed photovoltaic system are understood.

5.4. Solar Thermal Collectors

The solar thermal collector applicability review for the Public Works Garage location should be postponed until the full impacts of the newly installed photovoltaic system are understood.

5.5. Combined Heat and Power

Description:

CHP is not applicable for this building because there isn't a good source to use the exhaust heat produced effectively.

5.6. Geothermal

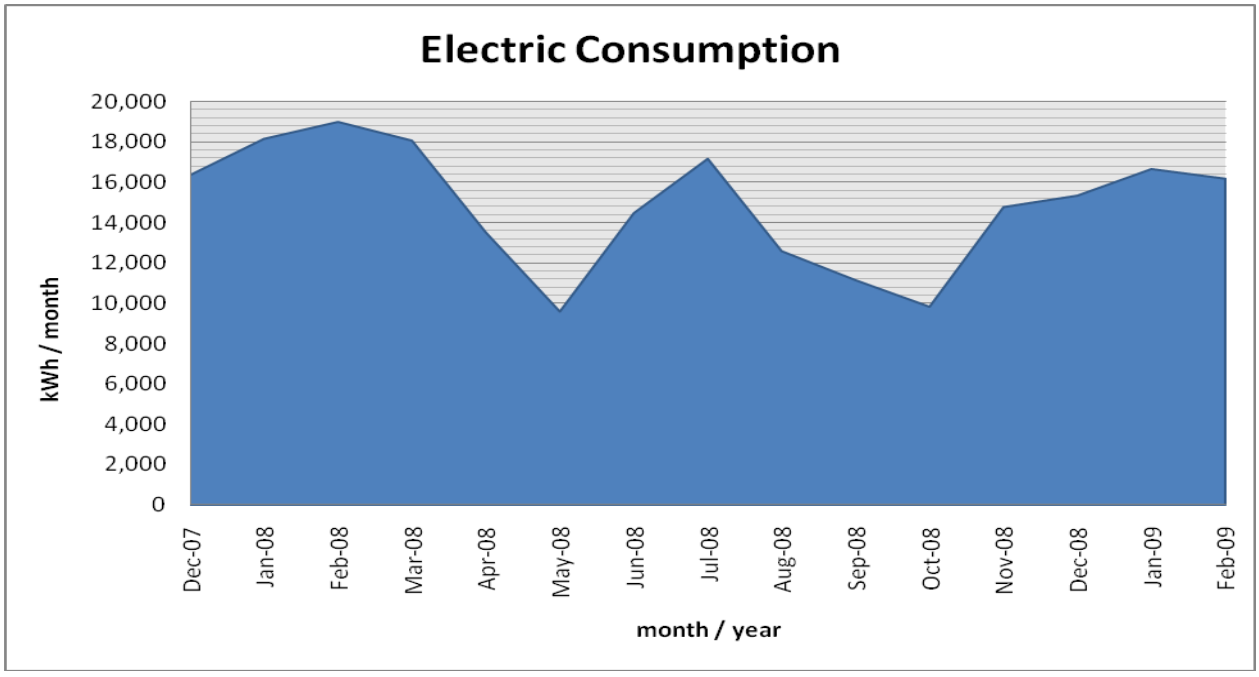
Description:

Geothermal is not applicable for this building because it would not be cost effective to change to a geothermal system at this location.

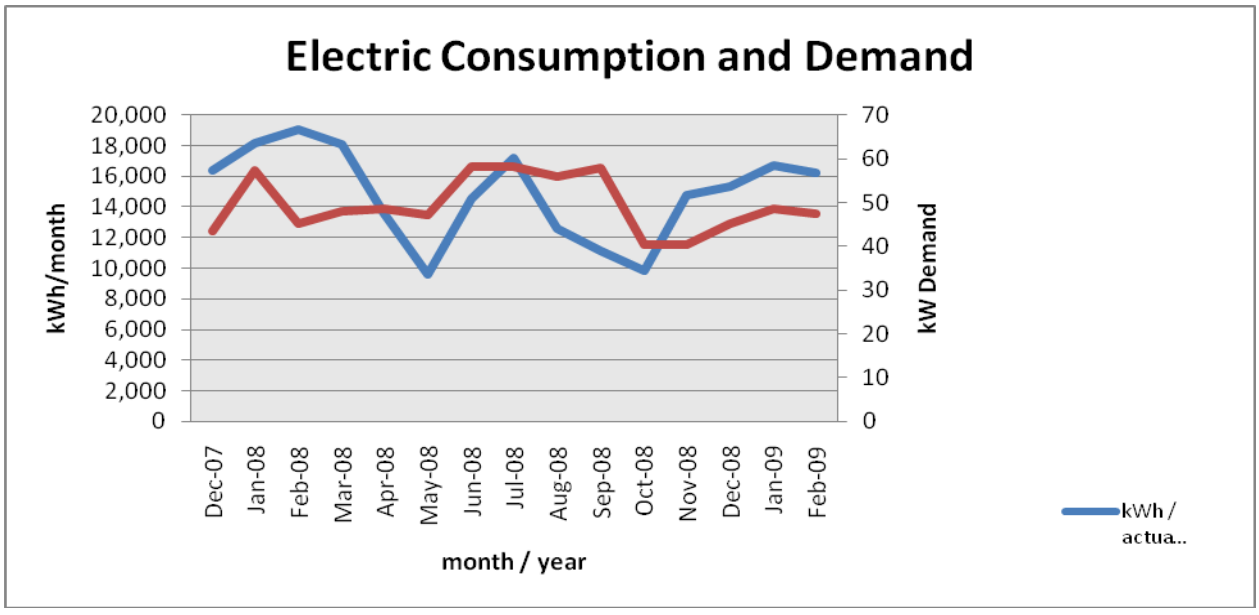
6. ENERGY PURCHASING AND PROCUREMENT STRATEGIES

6.1. Load profiles

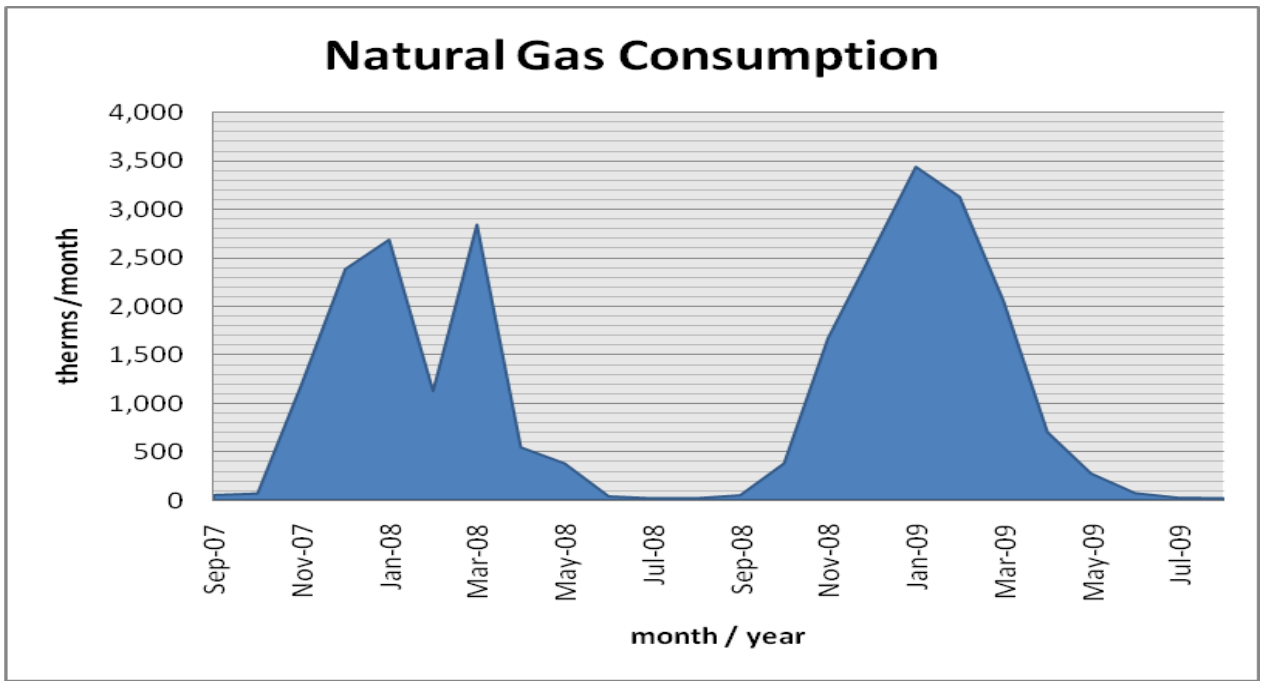
The following are charts that show the annual electric and natural gas load profiles for the Public Works Garage.

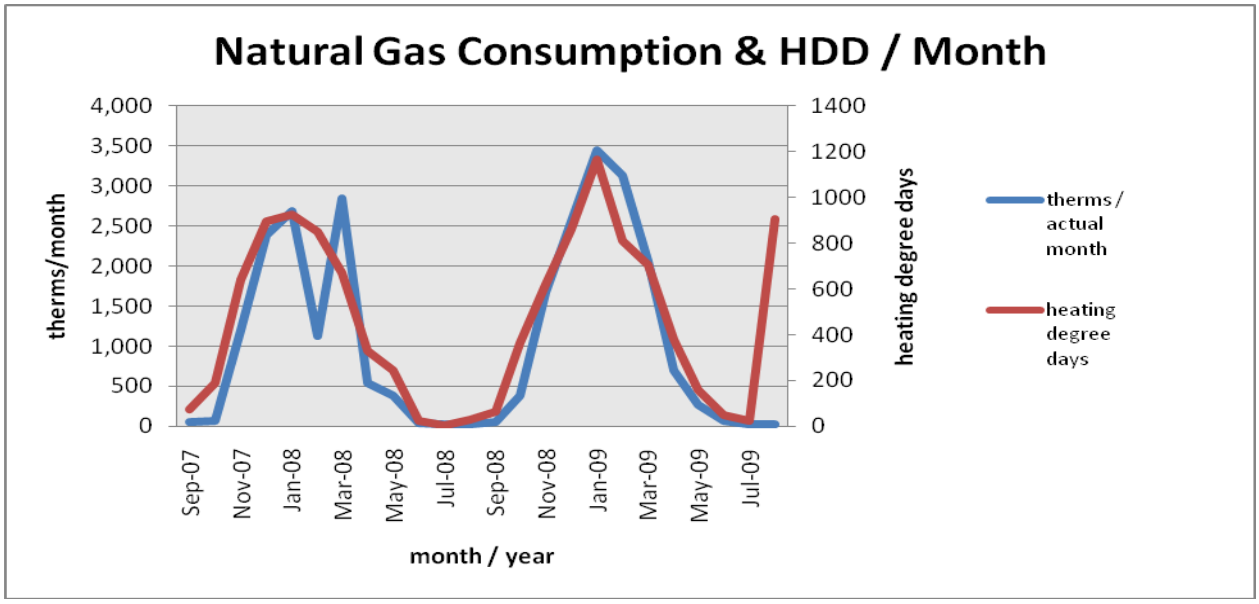


Some minor unusual electric fluctuations shown may be due to adjustments between estimated and actual meter readings. Also, note on the following chart how the electrical Demand peaks (except for a few unusual fluctuation anomalies) follow the electrical consumption peaks.



The following is a chart of the natural gas annual load profile for the building, peaking in the coldest months of the year and a chart showing gas consumption following the “heating degree days” curve.

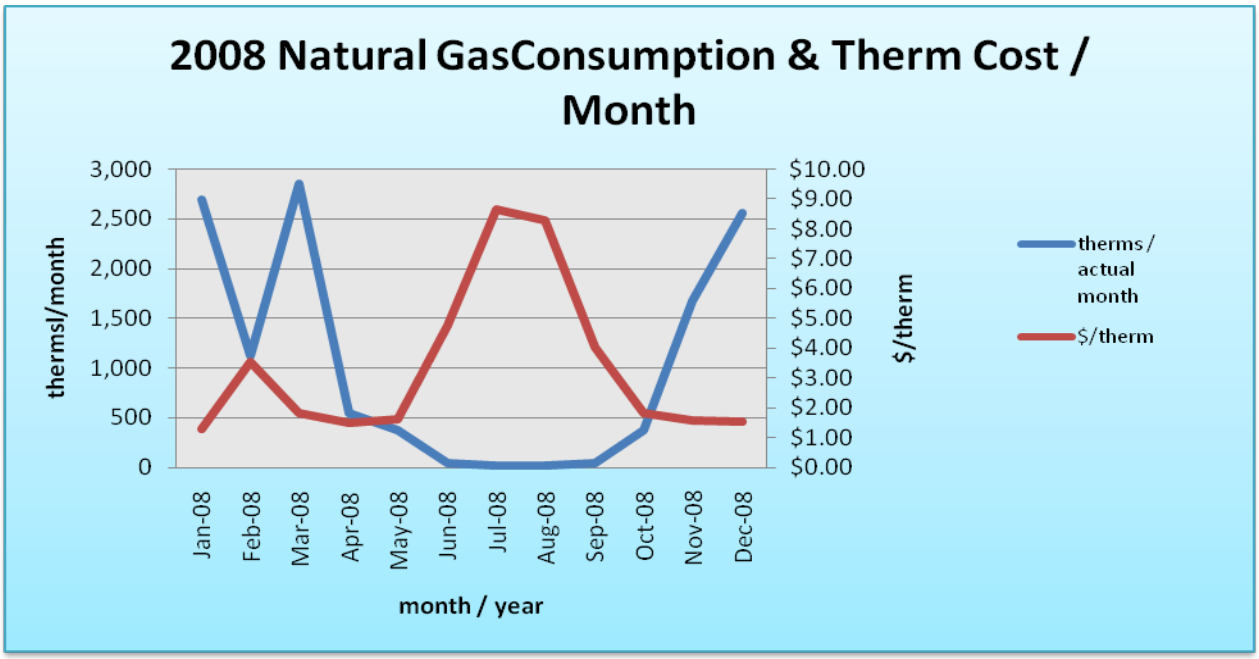




6.2. Tariff analysis

Currently, natural gas is provided to the Public Works Garage via one gas meter with Elizabethtown Gas Co. acting as the supply and transport company. Gas is provided by Elizabethtown Gas Co. at a general service rate. The suppliers' general service rate for natural gas charges a market-rate price based on use and the Public Works Garage billing does not breakdown demand costs for all periods. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the natural gas prices increase during the heating months when natural gas is used by the hot air heating units. The high gas price per therm fluctuations shown on the following chart may be due to

high energy costs that occurred in 2008 and low use caps for the non-heating months. Thus the building pays for fixed costs such as meter reading charges during the summer months.

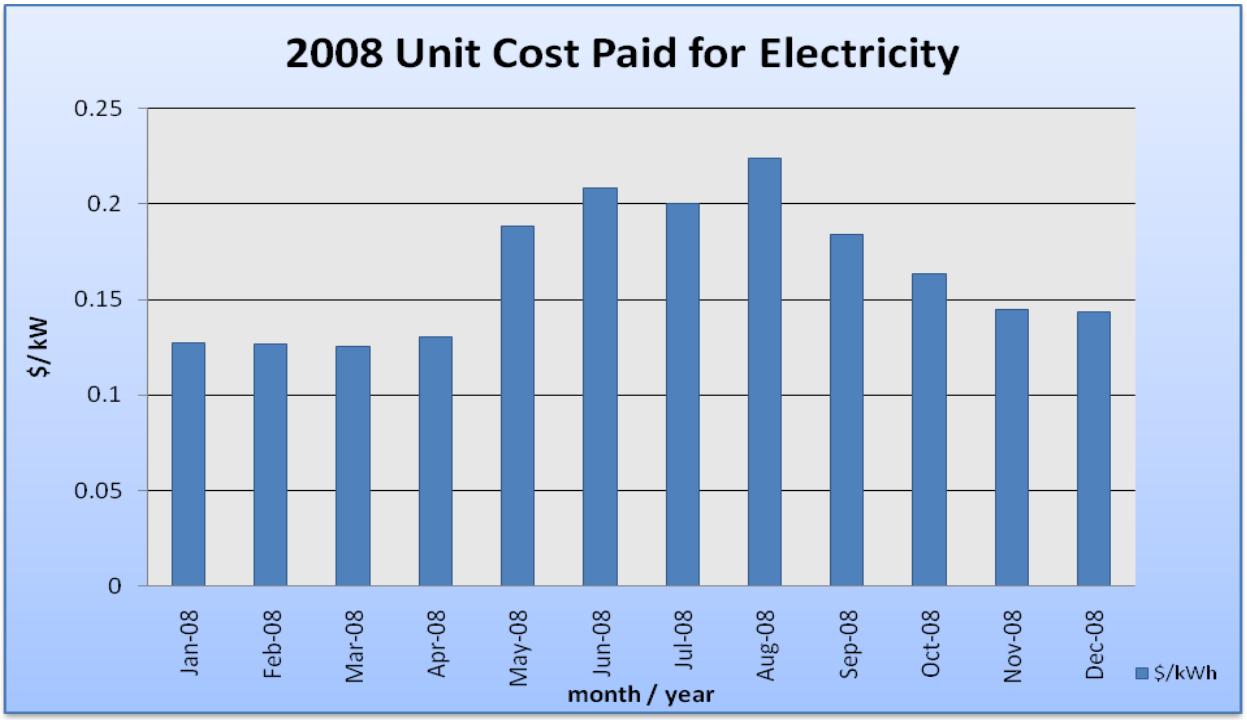


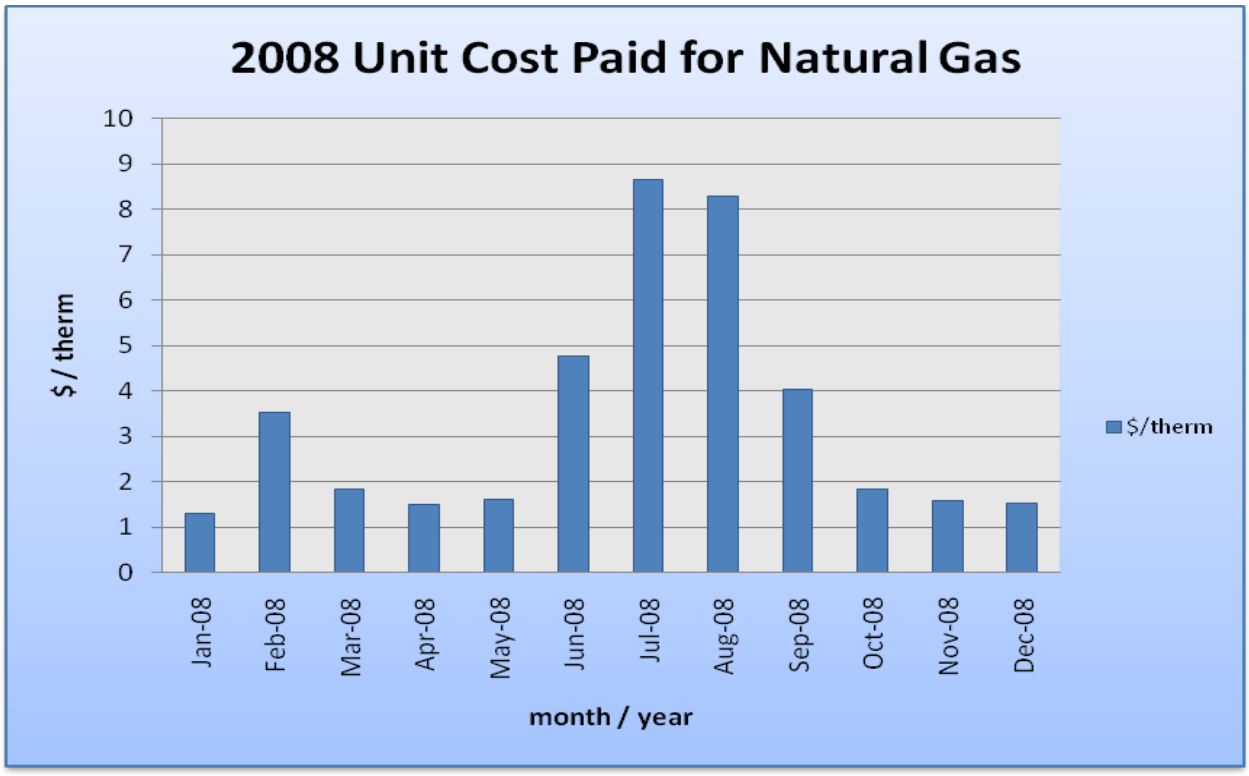
The Public Works Garage is direct-metered (via one main meter) and currently purchases electricity from PSE&G at a general service rate. The general service rate for electric charges are market-rate based on use and the Public Works Garage billing does show a breakdown of demand costs. Demand prices are reflected in the utility bills and can be verified by observing the price fluctuations throughout the year. Typically, the electricity prices increase during the cooling months when electricity is used by the rooftop air-handling unit.

6.3. Energy Procurement strategies

The Public Works Garage receives natural gas via one incoming meter. The Elizabethtown Gas Co. supplies the gas and transports it. There is not and ESCO engaged in the process. An Energy Services Company (ESCO) is a consultancy group that engages in a performance based contract with a client firm to implement measures which reduce energy consumption and costs in a technically and financially viable manner. Electricity is also purchased via one incoming meter directly for the Public Works Garage from PSE&G without an ESCO. SWA analyzed the utility rate for natural gas and electricity supply over an extended period. Electric bill analysis shows fluctuations up to 44% over the most recent 12 month period. Natural gas bill analysis shows fluctuations in excess of 80% over the most recent 12 month period. Some of these fluctuations may have been caused by adjustments between estimated and actual meter readings, others may be due to unusual high and escalating energy costs in 2008. SWA recommends that the Township of Hopewell further explore opportunities of purchasing both natural gas and electricity from ESCOs in order to reduce rate fluctuation and ultimately reduce the annual cost of energy for the Public Works Garage. Appendix B contains a complete list of third party energy suppliers for the Hopewell service area. The Township of Hopewell may want to consider partnering with school districts, municipalities, townships and communities to aggregate a substantial electric and natural gas use for better leveraging in negotiations with ESCOs and of improving the pricing structures. This sort of activity is happening in many parts of the country and in New Jersey. Also, the Public Works Garage building would not be eligible for enrollment in a Demand Response Program, because there isn't the

capability at this time to shed a minimum of 100 kW electric demand when requested by the utility during peak demand periods, which is the typical threshold for considering this option. The following charts show the Public Works Garage monthly spending per unit of energy in 2008.





7. METHOD OF ANALYSIS

7.1. Assumptions and tools

Energy modeling tool:	established / standard industry assumptions
Cost estimates:	RS Means 2009 (Facilities Maintenance & Repair Cost Data) RS Means 2009 (Building Construction Cost Data) RS Means 2009 (Mechanical Cost Data) Published and established specialized equipment material and labor costs Cost estimates also based on utility bill analysis and prior experience with similar projects

7.2. Disclaimer

This engineering audit was prepared using the most current and accurate fuel consumption data available for the site. The estimates that it projects are intended to help guide the owner toward best energy choices. The costs and savings are subject to fluctuations in weather, variations in quality of maintenance, changes in prices of fuel, materials, and labor, and other factors. Although we cannot guarantee savings or costs, we suggest that you use this report for economic analysis of the building and as a means to estimate future cash flow.

THE RECOMMENDATIONS PRESENTED IN THIS REPORT ARE BASED ON THE RESULTS OF ANALYSIS, INSPECTION, AND PERFORMANCE TESTING OF A SAMPLE OF COMPONENTS OF THE BUILDING SITE. ALTHOUGH CODE-RELATED ISSUES MAY BE NOTED, SWA STAFF HAVE NOT COMPLETED A COMPREHENSIVE EVALUATION FOR CODE-COMPLIANCE OR HEALTH AND SAFETY ISSUES. THE OWNER(S) AND MANAGER(S) OF THE BUILDING(S) CONTAINED IN THIS REPORT ARE REMINDED THAT ANY IMPROVEMENTS SUGGESTED IN THIS SCOPE OF WORK MUST BE PERFORMED IN ACCORDANCE WITH ALL LOCAL, STATE, AND FEDERAL LAWS AND REGULATIONS THAT APPLY TO SAID WORK. PARTICULAR ATTENTION MUST BE PAID TO ANY WORK WHICH INVOLVES HEATING AND AIR MOVEMENT SYSTEMS, AND ANY WORK WHICH WILL INVOLVE THE DISTURBANCE OF PRODUCTS CONTAINING MOLD, ASBESTOS, OR LEAD.

Appendix A: Lighting Study

Public Works Garage Existing Lighting Conditions															Proposed Lighting										
#	Bldg	Flr	Location in Building	Measured Lighting Level in Foot-candles	Fixture Type	Ballast Type	No. of Fixtures	No. of Lamps	Type of Lamp	Watts /Lamp	Hrs/ Day	Energy Use (Watt hours / day)	Con-trols	Day-lighting possible?	Fixture Type	Ballast Type	No. of Fixtures	No. of Lamps	Type of Lamp	Watts/ Lamp	Hrs/ Day	Energy Use (Watt hours/ day)	Con-trols	Total Power (Watts)	further W-hr/day reduction with occupancy sensors
1	PWG	Grd	Office Tax Ass. 1	-	T12 4'	M	4	3	F	34	8	3264	S	no	T8 4'	E	4	3	F	32	8	2448	S	384	612
2	PWG	Grd	Office Tax Ass 2	-	T12 4'	M	3	3	F	34	8	2448	S	no	T8 4'	E	3	3	F	32	8	1836	S	288	459
3	PWG	Grd	Office Tax Ass 3	-	T8 4'	E	1	3	F	32	8	768	S	no	T8 4'	E	1	3	F	32	8	768	S	96	192
4	PWG	Grd	Office Tax Ass Storage	-	T8 4'	E	7	3	F	32	8	5376	S	Yes	T8 4'	E	7	3	F	32	8	5376	S	672	1,344
5	PWG	Grd	Office	-	T12 4'	M	10	3	F	34	8	8160	S	no	T8 4'	E	10	3	F	32	8	6120	S	960	1,530
6	PWG	Grd	Office	-	T12 U	M	7	3	F	34	8	5712	S	no	T8 U	E	7	3	F	32	8	4284	S	672	1,071
7	PWG	Grd	Office General Foreman	-	T12 U	M	4	2	F	34	8	2176	S	no	T8 U	E	4	2	F	32	8	1632	S	256	408
8	PWG	Grd	Office Director	-	T12 U	M	5	3	F	34	8	4080	S	no	T8 U	E	5	3	F	32	8	3060	S	480	765
9	PWG	Grd	Office Director	-	T12 U	M	1	2	F	34	8	544	S	no	T8 U	E	1	2	F	32	8	408	S	64	102
10	PWG	Grd	Meeting Rm	-	T12 4'	M	1	6	F	34	8	1632	S	no	T8 4'	E	1	6	F	32	8	1224	S	192	306
11	PWG	Grd	Meeting Rm	-	CFL 13W	-	11	1	CFL	13	4	572	S	no	CFL 13W	-	11	1	CFL	13	4	572	S	143	143
12	PWG	Grd	Office Foreman	-	T12 U	M	8	2	F	34	1	544	S	Yes	T8 U	E	8	2	F	32	1	408	S	512	
13	PWG	Grd	Foreman	-	CFL 13W	-	2	1	CFL	13	1	26	S	no	CFL 13W	-	2	1	CFL	13	1	26	S	26	
14	PWG	Grd	Utility Rm	-	T12 U	M	3	2	F	32	1	192	OC	no	T8 U	E	3	2	F	32	1	144	OC	192	
15	PWG	Grd	Janitor's Closet	-	T12 4'	M	3	1	F	34	2	204	S	no	T8 4'	E	3	1	F	32	2	153	S	96	
16	PWG	Grd	Foyer	-	T8 4'	E	6	2	F	32	10	3840	S	no	T8 4'	E	6	2	F	32	10	3840	S	384	
17	PWG	Grd	Hallway	-	CFL 13W	-	2	1	CFL	13	10	260	S	no	CFL 13W	-	2	1	CFL	13	10	260	S	26	
18	PWG	Grd	Hallway	-	CFL 13W	-	4	2	CFL	13	10	1040	S	no	CFL 13W	-	4	2	CFL	13	10	1040	S	104	
19	PWG	Grd	Bathroom Women Locker	-	T12 4'	M	1	3	F	34	8	816	S	no	T8 4'	E	1	3	F	32	8	612	S	96	153
20	PWG	Grd	Bathroom Women Locker	-	T12 U	M	2	2	F	34	8	1088	S	no	T8 U	E	2	2	F	32	8	816	S	128	204
21	PWG	Grd	Bathroom Women Locker	-	T12 4'	M	2	1	F	34	8	544	S	no	T8 4'	E	2	1	F	32	8	408	S	64	102
22	PWG	Grd	Bathroom Women	-	T12 4'	M	2	1	F	34	8	544	S	no	T8 4'	E	2	1	F	32	8	408	S	64	102
23	PWG	Grd	Bathroom Women	-	T12 4'	M	3	1	F	34	8	816	S	no	T8 4'	E	3	1	F	32	8	612	S	96	153
24	PWG	Grd	Bathroom Men	-	T12 4'	M	3	1	F	34	8	816	S	no	T8 4'	E	3	1	F	32	8	612	S	96	153
25	PWG	Grd	Bathroom Men	-	T12 4'	M	2	1	F	34	8	544	S	no	T8 4'	E	2	1	F	32	8	408	S	64	102
26	PWG	Grd	Lunch Rm	-	T12 4'	M	12	1	F	34	8	3264	S	no	T8 4'	E	12	1	F	32	8	2448	S	384	612
27	PWG	Grd	Bathroom Men Locker	-	T12 4'	M	14	3	F	34	8	11424	S	no	T8 4'	E	14	3	F	32	8	8568	S	1344	2,142
28	PWG	Grd	Bathroom Men Locker	-	CFL 13W	CFL	8	1	CFL	13	8	832	S	no	CFL 13W	-	8	1	CFL	13	8	832	S	104	208
29	PWG	Grd	Bathroom Men Locker	-	T12 4'	M	1	2	F	34	8	544	S	no	T8 4'	E	1	2	F	32	8	408	S	64	102
30	PWG	Grd	Bathroom Men Locker	-	T12 4'	M	1	3	F	34	8	816	S	no	T8 4'	E	1	3	F	32	8	612	S	96	153
31	PWG	Grd	Mechanic Bays	-	T12 8'	M	34	2	F	68	8	36992	S	no	T8 4'	E	68	2	F	32	8	27744	S	4352	
32	PWG	Grd	Mechanic Bays	-	T12 4'	M	3	2	F	34	8	1632	S	no	T8 4'	E	3	2	F	32	8	1224	S	192	
33	PWG	Grd	Mechanic Bays	-	T12 4'	M	3	2	F	34	8	1632	S	no	T8 4'	E	3	2	F	32	8	1224	S	192	
34	PWG	Grd	Office Mechanic	-	T12 4'	M	3	2	F	34	8	1632	S	no	T8 4'	E	3	2	F	32	8	1224	S	192	
35	PWG	Grd	Office Mechanic	-	LED Exit	NA	4	1	LED	5	24	480	None	no	Exit LED	-	4	1	LED	5	24	480	None	20	
36	PWG	Grd	Mezzanine	-	T12 4'	M	7	2	F	34	4	1904	S	no	T8 4'	E	7	2	F	32	4	1428	S	448	
37	PWG	Grd	Mezzanine	-	T12 4'	M	2	2	F	34	4	544	S	no	T8 4'	E	2	2	F	32	4	408	S	128	
38	PWG	Grd	Mezzanine	-	LED Exit	LED	2	1	LED	5	24	240	None	no	Exit LED	-	2	1	LED	5	24	240	None	10	
39	PWG	Grd	Mezzanine	-	T12 4'	M	9	2	F	34	4	2448	S	no	T8 4'	E	9	2	F	32	4	1836	S	576	
40	PWG	Grd	Mezzanine	-	LED Exit	LED	1	1	LED	5	24	120	None	no	Exit LED	-	1	1	LED	5	24	120	None	5	
41	PWG	Grd	Small Truck Bay	-	CFL 13W	-	3	1	F	13	8	312	S	no	CFL 13W	-	3	1	F	13	8	312	S	39	
42	PWG	Grd	Small Truck Bay	-	T12 8'	M	24	2	F	68	8	26112	S	no	T8 4'	E	48	2	F	32	8	19584	S	3072	
43	PWG	Grd	Small Truck Bay	-	LED Exit	NA	1	2	LED	5	24	240	None	no	Exit LED	-	1	2	LED	5	24	240	None	10	
44	PWG	Grd	Carpentry Shop	-	T12 8'	M	8	2	F	68	1	1088	S	no	T8 4'	E	16	2	F	32	1	816	S	1024	
45	PWG	Grd	Carpentry Shop	-	LED Exit	NA	1	1	LED	5	24	120	None	no	Exit LED	-	1	1	LED	5	24	120	None	5	
46	PWG	Grd	Sign Shop	-	T12 8'	M	4	2	F	68	2	1088	S	no	T8 4'	E	8	2	F	32	2	816	S	512	
47	PWG	Grd	Large Truck Bays	-	T12 8'	M	64	2	F	68	8	69632	S	no	T8 4'	E	128	2	F	32	8	52224	S	8192	
48	PWG	Grd	Large Truck Bays	-	LED Exit	NA	2	1	LED	5	24	240	None	no	Exit LED	-	2	1	LED	5	24	240	None	10	

Public Works Garage Existing Lighting Conditions															Proposed Lighting										
#	Bldg	Flr	Location in Building	Measured Lighting Level in Foot-candles	Fixture Type	Ballast Type	No. of Fixtures	No. of Lamps	Type of Lamp	Watts /Lamp	Hrs/ Day	Energy Use (Watt hours / day)	Con-trols	Day-lighting possible?	Fixture Type	Ballast Type	No. of Fixtures	No. of Lamps	Type of Lamp	Watts/ Lamp	Hrs/ Day	Energy Use (Watt hours/ day)	Con-trols	Total Power (Watts)	further W-hr/day reduction with occupancy sensors
49	PWG	Grd	Power Tool Cage	-	T12 4'	M	2	2	F	34	2	272	S	no	**T8 4'**	**E**	**2**	**2**	**F**	**32**	**2**	**204**	**S**	**128**	
50	PWG	Grd	Hand Tool Cage	-	T12 4'	M	2	2	F	34	2	272	S	no	**T8 4'**	**E**	**2**	**2**	**F**	**32**	**2**	**204**	**S**	**128**	
51	PWG	Ext	Pole Lights	NA	Metal Halide	NA	10	1	MH	70	12	8400	astro timer	NA	Metal Halide	NA	10	1	MH	70	12	8400	astro timer	700	
52	PWG	Ext	Wall Packs	NA	Metal Halide	NA	20	1	MH	100	12	24000	astro timer	NA	Metal Halide	NA	20	1	MH	100	12	24000	astro timer	2000	
53	PWG	Ext	Spot Ground Lights	NA	High Press Sodium	NA	7	1	HPS	70	12	5880	astro timer	NA	High Press Sodium	NA	7	1	HPS	70	12	5880	astro timer	490	
				TOTALS exterior								38,280										38,280			
				TOTALS interior								209,886										161,031		30,572	11,118
annual consumption (kWh)												68,543										52,950	includes occupancy sensors		
estimated cost ($/year)												$10,967										$8,472			
Public Works Garage total light power (Watt)												32,168										30,572			
Public Works Garage light power density (Watt/sq ft)												1.02										0.97			
Proposed Annual Savings (kWh)												15,593													
Proposed Annual Cost Savings ($)												$2,495													
Proposed Investment ($)												$49,615													
surface area (sq ft)												31,631										31,631			
Legend: PWG - Public Works Garage; M - magnetic; E - electronic; F - fluorescent; incand - incandescent; CFL - compact fluorescent lamp; HPS - high pressure sodium; MH - Metal Halide; S - on/off switch																									
OC - occupancy sensor; Grd - Ground Floor																									

Note: Last table column shows additional electrical savings if the decision is to change out switches to occupancy sensors.

Appendix B: Third Party Energy Suppliers (ESCOs)
http://www.state.nj.us/bpu/commercial/shopping.html

PSE&G ELECTRICAL SERVICE TERRITORY Last Updated: 06/15/09		
Hess Corporation 1 Hess Plaza Woodbridge, NJ 07095 (800) 437-7872 www.hess.com	**BOC Energy Services, Inc.** 575 Mountain Avenue Murray Hill, NJ 07974 (800) 247-2644 www.boc.com	**Commerce Energy, Inc.** 4400 Route 9 South, Suite 100 Freehold, NJ 07728 (800) 556-8457 www.commerceenergy.com
Constellation NewEnergy, Inc. 900A Lake Street, Suite 2 Ramsey, NJ 07446 (888) 635-0827 www.newenergy.com	**Direct Energy Services, LLC** 120 Wood Avenue Suite 611 Iselin, NJ 08830 (866) 547-2722 www.directenergy.com	**FirstEnergy Solutions Corp.** 300 Madison Avenue Morristown, NJ 07962 (800) 977-0500 www.fes.com
Glacial Energy of New Jersey, Inc. 207 LaRoche Avenue Harrington Park, NJ 07640 (877) 569-2841 www.glacialenergy.com	**Integrys Energy Services, Inc.** 99 Wood Ave, South, Suite 802 Iselin, NJ 08830 (877) 763-9977 www.integrysenergy.com	**Strategic Energy, LLC** 55 Madison Avenue, Suite 400 Morristown, NJ 07960 (888) 925-9115, www.sel.com
Liberty Power Holdings, LLC Park 80 West, Plaza II, Suite 200 Saddle Brook, NJ 07663 (866) 769-3799 www.libertypowercorp.com	**Pepco Energy Services, Inc.** 112 Main St. Lebanon, NJ 08833 (800) ENERGY-9 (363-7499) www.pepco-services.com	**PPL EnergyPlus, LLC** 811 Church Road Cherry Hill, NJ 08002 (800) 281-2000 www.pplenergyplus.com
Sempra Energy Solutions The Mac-Cali Building 581 Main Street, 8th Floor Woodbridge, NJ 07095 (877) 273-6772 www.semprasolutions.com	**South Jersey Energy Company** One South Jersey Plaza Route 54 Folsom, NJ 08037 (800) 800-756-3749 www.south jerseyenergy.com	**Suez Energy Resources NA, Inc.** 333 Thornall Street 6th Floor Edison, NJ 08837 (888) 644-1014 www.suezenergyresources.com
UGI Energy Services, Inc. 704 East Main Street, Suite 1 Moorestown, NJ 08057 (856) 273-9995 www.ugienergyservices.com	**American Powernet Management, LP** 437 North Grove St. Berlin, NJ 08009 (800) 437-7872 www.hess.com	**ConEdison Solutions** Cherry Tree, Corporate Center 535 State Highway 38 Cherry Hill, NJ 08002 (888) 665-0955 www.conedsolutions.com
Credit Suisse, (USA) Inc. 700 College Road East Princeton, NJ 08450 212-538-3124 www.creditsuisse.com	**Sprague Energy Corp.** 12 Ridge Road Chatham Township NJ 07928 (800) 225-1560 www.spragueenergy.com	

ELIZABETHTOWN GAS COMPANY NATURAL GAS SERVICE TERRITORY Last Updated: 06/15/09		
Cooperative Industries 412-420 Washington Avenue Belleville, NJ 07109 800-6BUYGAS (6-289427) www.cooperativenet.com	**Direct Energy Services, LLP** 120 Wood Avenue, Suite 611 Iselin, NJ 08830 866-547-2722 www.directenergy.com	**Glacial Energy of New Jersey, Inc.** 207 LaRoche Avenue Harrington Park, NJ 07640 1-877-569-2841 www.glacialenergy.com
Gateway Energy Services Corp. 44 Whispering Pines Lane Lakewood, NJ 08701 800-805-8586 www.gesc.com	**UGI Energy Services, Inc. d/b/a GASMARK** 704 East Main Street, Suite 1 Moorestown, NJ 08057 856-273-9995 www.ugienergyservices.com	**Great Eastern Energy** 116 Village Riva, Suite 200 Princeton, NJ 08540 888-651-4121 www.greateastern.com
Hess Energy, Inc. One Hess Plaza Woodbridge, NJ 07095 800-437-7872 www.hess.com	**Metromedia Energy, Inc.** 6 Industrial Way Eatontown, NJ 07724 877-750-7046 www.metromediaenergy.com	**Intelligent Energy** 2050 Center Avenue, Suite 500 Fort Lee, NJ 07024 800-724-1880 www.intelligentenergy.org
MxEnergy, Inc. 510 Thornall Street, Suite 270 Edison, NJ 088327 800-375-1277 www.mxenergy.com	**NATGASCO (Mitchell Supreme)** 532 Freeman Street Orange, NJ 07050 800-840-4GAS www.natgasco.com	**Metro Energy Group, LLC** 14 Washington Place Hackensack, NJ 07601 888-53-Metro www.metroenergy.com
PPL EnergyPlus, LLC 811 Church Road - Office 105 Cherry Hill, NJ 08002 800-281-2000 www.pplenergyplus.com	**Stuyvesant Energy LLC** 10 West Ivy Lane, Suite 4 Englewood, NJ 07631 800-646-6457 www.stuyfuel.com	**Pepco Energy Services, Inc.** 112 Main Street Lebanon, NJ 08833 800-363-7499 www.pepco-services.com
Sprague Energy Corp. 12 Ridge Road Chatham Township, NJ 07928 800-225-1560 www.spragueenergy.com	**South Jersey Energy Company** One South Jersey Plaza, Route 54 Folsom, NJ 08037 800-756-3749 www.sjindustries.com/sje.htm	**Woodruff Energy** 73 Water Street Bridgeton, NJ 08302 800-557-1121 www.woodruffenergy.com