



# **ENERGY AUDIT – FINAL REPORT**

## **HILLSBOROUGH MUA SUNNYMEAD PUMP STATION**

**220 TRIANGLE ROAD**

**SUITE #234**

**HILLSBOROUGH, NJ 08844**

**ATTN: MR. GARY NUCERA,  
EXECUTIVE DIRECTOR**

**CEG PROJECT No. 9C09101**

## **CONCORD ENGINEERING GROUP**



**520 SOUTH BURNT MILL ROAD**

**VOORHEES, NJ 08043**

**TELEPHONE: (856) 427-0200**

**FACSIMILE: (856) 427-6529**

**[WWW.CEG-INC.NET](http://WWW.CEG-INC.NET)**

**CONTACT: JOHN MARCHIAFAVA PE, PROGRAM MANAGER  
EMAIL: [jmarchiafava@ceg-inc.net](mailto:jmarchiafava@ceg-inc.net)**

**Table of Contents**

I. EXECUTIVE SUMMARY ..... 3

II. INTRODUCTION ..... 6

III. METHOD OF ANALYSIS..... 7

IV. HISTORIC ENERGY CONSUMPTION/COST..... 11

    A. Energy Usage/Tariffs ..... 11

    B. Energy Use Index (EUI)..... 13

    C. EPA Energy Benchmarking System ..... 15

VI. MAJOR EQUIPMENT LIST ..... 17

VII. ENERGY CONSERVATION MEASURES..... 18

XI. ENERGY PURCHASING AND PROCUREMENT STRATEGY ..... 27

X. INSTALLATION FUNDING OPTIONS..... 29

XI. ADDITIONAL RECOMMENDATIONS ..... 31

Appendix A – Detailed Cost Breakdown per ECM

Appendix B – New Jersey Smart Start<sup>®</sup> Program Incentives

Appendix C – Portfolio Manager “Statement of Energy Performance”

Appendix D – Major Equipment List

Appendix E – Investment Grade Lighting Audit

Appendix F – Renewable / Distributed Energy Measures Calculations

**REPORT DISCLAIMER**

The information contained within this report, including any attachment(s), is intended solely for use by the named addressee(s). If you are not the intended recipient, or a person designated as responsible for delivering such messages to the intended recipient, you are not authorized to disclose, copy, distribute or retain this report, in whole or in part, without written authorization from Concord Engineering Group, Inc., 520 S. Burnt Mill Road, Voorhees, NJ 08043.

This report may contain proprietary, confidential or privileged information. If you have received this report in error, please notify the sender immediately. Thank you for your anticipated cooperation.

## I. EXECUTIVE SUMMARY

This report presents the findings of the energy audit conducted for:

Hillsborough Township Municipal Utilities Authority  
220 Triangle Road  
Suite #234  
Hillsborough, NJ 08844

Authority Contact Person: Gary R. Nucera, Executive Director  
Facility Contact Person: Leonard S. Jacakowicz

This audit is performed in connection with the New Jersey Clean Energy - Local Government Energy Audit Program. The energy audit is conducted to promote the mission of the office of Clean Energy, which is to use innovation and technology to solve energy and environmental problems in a way that improves the State's economy. This can be achieved through the wiser and more efficient use of energy.

The annual energy costs at this facility are as follows:

Electricity	\$81,396
Diesel Fuel	\$520
<hr/>	
Total	\$81,916

The potential annual energy cost savings for each energy conservation measure (ECM) are shown below in Table 1. Be aware that the ECM's are not additive because of the interrelation of some of the measures. This audit is consistent with an ASHRAE level 2 audit. The cost and savings for each measure is  $\pm 20\%$ . The evaluations are based on engineering estimations and industry standard calculation methods. More detailed analyses would require engineering simulation models, hard equipment specifications, and contractor bid pricing.

**Table 1**  
**Energy Conservation Measures (ECM's)**

<b>ENERGY CONSERVATION MEASURES (ECM's)</b>					
<b>ECM NO.</b>	<b>DESCRIPTION</b>	<b>NET INSTALLATION COST<sup>A</sup></b>	<b>ANNUAL SAVINGS<sup>B</sup></b>	<b>SIMPLE PAYBACK (Yrs)</b>	<b>SIMPLE LIFETIME ROI</b>
ECM #1	Lighting Upgrade - General	\$1,168	\$66	17.6	-14.6%
ECM #2	Lighting Controls	\$573	\$16	35.8	-58.1%
ECM #3	Pump and Motor System Upgrade <sup>C</sup>	\$157,388	\$30,576	5.1	288.5%
ECM #4	Solar PV Direct Purchase	\$552,690	\$35,772	15.5	61.8%

**Notes:** A. Cost takes into consideration applicable NJ Smart Start<sup>TM</sup> incentives.  
 B. Savings takes into consideration applicable maintenance savings.  
 C. Cost based upon 5 year remaining life.

The estimated demand and energy savings for each ECM is shown below in Table 2. The information in this table corresponds to the ECM's in Table 1.

**Table 2**  
**Estimated Energy Savings**

<b>ENERGY CONSERVATION MEASURES (ECM's)</b>				
<b>ECM NO.</b>	<b>DESCRIPTION</b>	<b>ANNUAL UTILITY REDUCTION</b>		
		<b>ELECTRIC DEMAND (KW)</b>	<b>ELECTRIC CONSUMPTION (KWH)</b>	<b>NATURAL GAS (THERMS)</b>
ECM #1	Lighting Upgrade - General	2.4	394	0.0
ECM #2	Lighting Controls	0.6	105	0.0
ECM #3	Pump and Motor System Upgrade	67.3	128,010	0.0
ECM #4	Solar PV Direct Purchase	0.0	70,951	0.0

\*Elec. Demand Savings are calculated for peak month only. Elec. consumption savings are totaled annually.

Concord Engineering Group (CEG) recommends proceeding with the implementation of all ECM's that provide a calculated simple payback at or under seven (7) years. The following Energy Conservation Measures are recommended for the facility:

- **ECM #3: Pump and Motor System Upgrades**

Although ECMs #1 and #2 do not provide a payback less than 7 years, it is recommended to proceed with the installation of both ECMs as a part of a comprehensive pump station upgrade if ECM #3 is expanded to completely upgrade the pump station.

In addition to the ECMs, there are maintenance and operational measures that can provide energy savings and provide immediate benefits. The ECMs listed above represent investments that can be made to the facility which are justified by the savings seen overtime. However, the maintenance items and small operational improvements below are typically achievable with on site staff or maintenance contractors and in turn have the potential to provide operational savings compared to the costs associated. The following are recommendations which should be considered a priority in achieving an energy efficient building:

1. Maintain all weather stripping on entrance doors.
2. Clean all light fixtures to maximize light output.
3. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.
4. The new dry pit submersible pumps, VFDs and communicator should become a part of a larger pump station upgrade. The additional items are considered moderately extensive since the structures, generator and chemical feed equipment appear serviceable for many years to come. We recommend HVAC systems be upgraded, the lighting be improved, the instrumentation and communications be improved, emergency lighting be improved, refinish the building exterior and replace the roofing system.
5. Retro-commissioning – in addition to the recommendations above, implementing Retro-Commissioning would be beneficial for this facility. Retro-Commissioning is a means to verify your current equipment is operating in its designed mechanical efficiency range, hydraulic flow capacity, designed motor efficiency and overall performance. Retro-Commissioning provides valuable insight into systems or components not performing correctly or efficiently. The commissioning process defines the original system design parameters and recommends revisions to the current system operating characteristics.

## II. INTRODUCTION

This comprehensive energy audit covers the 551 square feet Sunnymeade Pumping Station which includes the wet well, dry well, super structure and the generator.

Electrical and diesel fuel utility information is collected and analyzed for one full year's energy use of the building. The utility information allows for analysis of the building's operational characteristics; calculate energy benchmarks for comparison to industry averages, estimated savings potential, and baseline usage/cost to monitor the effectiveness of implemented measures. A computer spreadsheet is used to calculate benchmarks and to graph utility information (see Figure 1 for electricity usage profile).

The Energy Use Index (EUI) is established for the building. Energy Use Index (EUI) is expressed in British Thermal Units/square foot/year (BTU/ft<sup>2</sup>/yr), which is used to compare energy consumption to similar building types or to track consumption from year to year in the same building. The EUI is calculated by converting the annual consumption of all energy sources to BTUs and dividing by the area (gross square footage) of the building. Blueprints (where available) are utilized to verify the gross area of the facility. The EUI is a good indicator of the relative potential for energy savings. A low EUI indicates less potential for energy savings, while a high EUI indicates poor building performance therefore a high potential for energy savings.

Existing building architectural and engineering drawings (where available) are utilized for additional background information. The building envelope, lighting systems, HVAC equipment, process equipment and controls information gathered from building drawings allow for a more accurate and detailed review of the building. The information is compared to the energy usage profiles developed from utility data. Through the review of the architectural and engineering drawings a building profile can be defined that documents building age, type, usage, major energy consuming equipment or systems, etc.

The preliminary audit information is gathered in preparation for the site survey. The site survey provides critical information in deciphering where energy is spent and opportunities exist within a facility. The entire site is surveyed to inventory the following to gain an understanding of how each facility operates:

- Building envelope (roof, windows, etc.)
- Heating, ventilation, and air conditioning equipment (HVAC)
- Lighting systems and controls
- Facility-specific equipment

The building site visit is performed to survey all major building components and systems. The site visit includes detailed inspection of energy consuming components. Summary of building occupancy schedules, operating and maintenance practices, and energy management programs provided by the facility manager are collected along with the system and components to determine a more accurate impact on energy consumption.

### III. METHOD OF ANALYSIS

#### General

Post site visit work includes evaluation of the information gathered, researching possible conservation opportunities, organizing the audit into a comprehensive report, and making recommendations on HVAC, lighting, process equipment and building envelope improvements. Data collected is processed using energy engineering calculations to anticipate energy usage for each of the proposed energy conservation measures (ECMs). The actual building's energy usage is entered directly from the utility bills provided by the owner. The anticipated energy usage is compared to the historical data to determine energy savings for the proposed ECMs.

It is pertinent to note, that the savings noted in this report are not additive. The savings for each recommendation is calculated as standalone energy conservation measures. Implementation of more than one ECM may in some cases affect the savings of each ECM. The savings may in some cases be relatively higher if an individual ECM is implemented in lieu of multiple recommended ECMs. For example implementing reduced operating schedules for inefficient lighting will result in a greater relative savings. Implementing reduced operating schedules for newly installed efficient lighting will result in a lower relative savings, because there is less energy to be saved. If multiple ECM's are recommended to be implemented, the combined savings is calculated and identified appropriately.

ECMs are determined by identifying the building's unique properties and deciphering the most beneficial energy saving measures available that meet the specific needs of the facility. The building construction type, function, operational schedule, existing conditions, and foreseen future plans are critical in the evaluation and final recommendations. Energy savings are calculated base on industry standard methods and engineering estimations. Energy consumption is calculated based on manufacturer's cataloged information when new equipment is proposed.

#### Specific Process Equipment Energy Method of Analysis

Dramatic increases in energy prices have made the water and wastewater industry aware of the significance of energy costs. Energy plays an important role in decisions that pertain to equipment replacement and design and operation of water and wastewater treatment plants and pump stations.

An energy audit is an inspection, survey and analysis of energy flows in a process or system with the objective of understanding the energy dynamics of the system and study.

An energy audit is conducted to seek opportunities to reduce the amount of energy input into the system without negatively affecting the output. It is a survey of major areas of energy usage in treatment plants and pump stations followed by a cost effectiveness analysis of methods that can be used to reduce energy usage.

The greatest energy consumers in water and wastewater treatment facilities and pump stations are the motors that drive pumping equipment.

Overall wire-to-water efficiency is calculated by the following equation:

$$e = \frac{H \times Q}{hp \times 3,960}$$

Where:

- H: differential head across the pump, ft.  
Q: flow rate, gpm  
hp: horse power (wire into motor)

The wire-to-water efficiency can also be calculated as follows:

$e = \text{pump eff.} \times \text{drive eff.} \times \text{motor eff.}$

To minimize energy consumption each of the efficiency components of the above efficiency equation must be examined and maximized.

The overall wire-to-water efficiency formula reveals that the efficiency of the pump can be maximized by operating the pump at design flows and total dynamic head that coincides with the pumps most efficient operation range. In other words, pumps with highest flow per kwh should be operated where there is more than one pump available. It should be noted that pump wear can have a significant effect on pump performance.

The next element in the overall efficiency equation is electric motor. Two approaches are used to improve efficiency in existing systems:

- use of more efficient motors
- operation of motors at or near the nameplate rating

Motors can be loosely categorized as premium efficiency motors and standard motors. Premium efficiency motors generally cost more than comparable standard efficiency motors. These motors offer exceptional value if they are operated more than 50% of the time.

The last major element affecting overall efficiency is the drive. The constant speed drive with simple on-off control is the most efficient overall drive unit when it is operated at or near the most efficient point on the pump curve. However, most pumping applications require more flexibility in pump output. One of the most efficient methods of varying the pump output is using variable speed drives and one of the most efficient variable speed drives is a variable frequency drive.

There are number of other factors that may be considered in an energy audit in addition to equipment selection. They are as follows:

- power factor
- demand
- time of use

The demand and time-of-use factors can be defined for each specific process application.

It is worthwhile to add a few comments regarding the potential of a low power factor at the Authority's facilities and the resultant inefficient operation of the facilities. A review of the Authority's Public Service Electric and Gas Company (PSE&G) electric bills reveals the Authority is billed for kw used and not kva used. This type of billing is typical of power companies in New Jersey. However, if the ratio of kw/kva (power factor) droops below 0.85 PSE&G may impose penalties upon the Authority unless corrective action is taken. PSE&G will give notice before imposing dollar penalties. The energy efficiency improvement methods described above, i.e. premium motors, operating equipment in an efficient range, variable frequency drives, will all serve to raise the ratio closer to 1.0. A quick method to improve the power factor is to add capacitor banks to lower the total reactive kvar.

The New Jersey Board of Public Utilities (BPU) regulates the fee structure of PSE&G and the other New Jersey power companies. BPU allows power factor management by penalties and not by incentives. In the absence of incentives the least cost approach for the Authority is to monitor any change in regulation by the BPU and to install power factor correction devices when utility penalties are imposed.

An effective method to take all of the factors into account is to periodically run equipment performance tests. For motors and pumps new equipment is typically tested during the startup to determine compliance with procurement specifications. Subsequent testing can be compared to establish efficiency trends of motor and pump combinations. Small pumps and motors typically receive very little testing whereas larger pieces of equipment receive increased levels of attention.

For situations where test results are available a reasonably reliable increased cost of energy can be calculated for a loss of efficiency.

For situations where test results are not available the energy audit engineer must estimate loss of efficiency based upon other equipment factors, data that may be available, maintenance records and personal experiences. Confirmation performance testing may be conducted during a subsequent design phase.

Confirmation performance testing can also be useful as a retrocommissioning procedure. In retrocommissioning the original design efficiencies or equipment startup performance test results are compared to efficiencies calculated from test results of current conditions. A third consideration is the potential for improved efficiencies by upgrading mechanical equipment and

motors to models with enhanced efficiencies over original new equipment. The table below presents the efficiencies to be included in the analysis.

<b>Retro-Commissioning Analysis</b>			
<b>Type</b>	<b>Original Installation Efficiencies</b>	<b>Current Equipment Efficiencies</b>	<b>Upgrade Equipment Efficiencies</b>
Pump Capacity	USGPM	USGPM	USGPM
TDH	Feet	Feet	Feet
Water HP	Q*H/3960	Q*H/3960	Q*H/3960
Pump Efficiency	Range	Range	Range
Motor Efficiency	Manufacturer	Manufacturer	Manufacturer
Drive Efficiency	Manufacturer	Manufacturer	Manufacturer
Transformer Efficiency	Manufacturer	Manufacturer	Manufacturer
Switchgear Efficiency	Manufacturer	Manufacturer	Manufacturer

Cost savings are calculated based on the actual historical energy costs for the facility. Installation costs include labor and equipment costs to estimate the full up-front investment required to implement a change. Costs are derived from Means Cost Data, industry publications, and local contractors and equipment suppliers. The NJ Smart Start Building® program incentives savings (where applicable) are included for the appropriate ECM's and subtracted from the installed cost. Maintenance savings are calculated where applicable and added to the energy savings for each ECM. The life-time for each ECM is estimated based on the typical life of the equipment being replaced or altered. The costs and savings are applied and a simple payback, simple lifetime savings, and simple return on investment are calculated. See below for calculation methods:

ECM Calculation Equations:

$$\text{Simple Payback} = \left( \frac{\text{Net Cost}}{\text{Yearly Savings}} \right)$$

$$\text{Simple Lifetime Savings} = (\text{Yearly Savings} \times \text{ECM Lifetime})$$

$$\text{Simple Lifetime ROI} = \frac{(\text{Simple Lifetime Savings} - \text{Net Cost})}{\text{Net Cost}}$$

$$\text{Lifetime Maintenance Savings} = (\text{Yearly Maintenance Savings} \times \text{ECM Lifetime})$$

$$\text{Internal Rate of Return} = \sum_{n=0}^N \left( \frac{\text{Cash Flow of Period}}{(1 + \text{IRR})^n} \right)$$

$$\text{Net Present Value} = \sum_{n=0}^N \left( \frac{\text{Cash Flow of Period}}{(1 + \text{DR})^n} \right)$$

Net Present Value calculations based on Interest Rate of 3%.

## IV. HISTORIC ENERGY CONSUMPTION/COST

### A. Energy Usage/Tariffs

The electric usage profile (below) represents the actual electrical usage for the facility. Public Service Electric and Gas (PSE&G) provides electricity to the facility under their Commercial and Industrial Customer Accounts Three-Phase rate structure. The electric utility measures consumption in kilowatt-hours (KWH) and maximum demand in kilowatts (KW). One KWH usage is equivalent to 1000 watts running for one hour. One KW of electric demand is equivalent to 1000 watts running at any given time. The basic usage charges are shown as supply service and delivery charges along with several non-utility generation charges. Rates used in this report reflect the historical data received for the facility.

The facility uses no natural gas. The standby power generator uses diesel fuel.

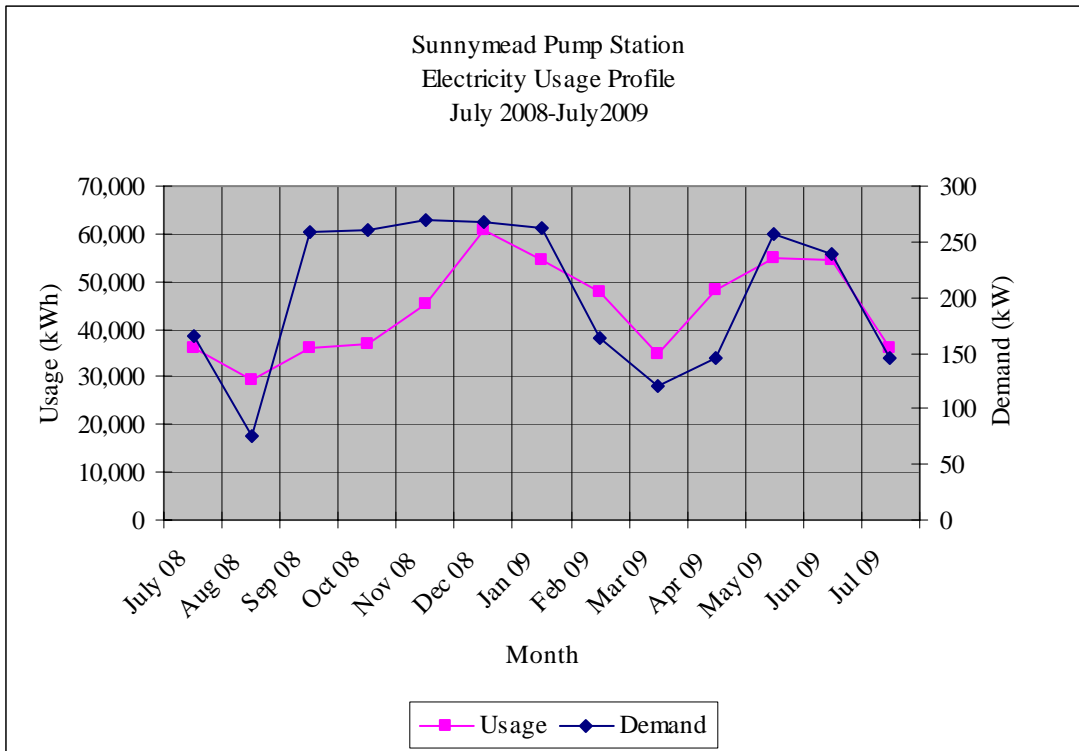
The overall cost for utilities is calculated by dividing the total cost by the total usage. Based on the utility history provide, the average cost for utilities at this facility is as follows:

<u>Description</u>	<u>Average</u>
Electricity	15.10¢ / kWh
Diesel Fuel	\$520 / Yr

**Table 3**  
**Electricity Billing Data**

<b>Utility Provider: PSE&amp;G 3 Phase Rate Structure (Meter # 286004664)</b>			
<b>MONTH OF USE</b>	<b>CONSUMPTION KWH</b>	<b>DEMAND</b>	<b>TOTAL BILL</b>
Jul-08	35,852	166	\$6,872.89
Aug-08	29,491	76.2	\$5,354.79
Sep-08	36,015	258.7	\$7,091.65
Oct-08	37,080	259.7	\$5,588.31
Nov-08	45,383	269.1	\$6,288.41
Dec-08	60,845	267	\$7,853.22
Jan-09	54,309	262.1	\$7,400.87
Feb-09	47,630	163.3	\$6,562.44
Mar-09	34,793	121	\$4,965.36
Apr-09	48,211	145.5	\$6,413.83
May-09	54,759	257.7	\$7,511.53
Jun-09	54,625	238.1	\$9,392.30
<b>Totals</b>	<b>538,993</b>	<b>269.1 Max</b>	<b>\$81,395.60</b>
<b>AVERAGE DEMAND</b>		<b>207 KW average</b>	
<b>AVERAGE RATE</b>		<b>15.10¢/kWh</b>	

**Figure 1**  
**Electric Usage Profile**



## B. Energy Use Index (EUI)

Energy Use Index (EUI) is a measure of a building's annual energy utilization per square foot of building. This calculation is completed by converting all utility usage consumed by a building for one year, to British Thermal Units (BTU) and dividing this number by the building square footage. EUI is a good measure of a building's energy use and is utilized regularly for comparison of energy performance for similar building types. The Oak Ridge National Laboratory (ORNL) Buildings Technology Center under a contract with the U.S. Department of Energy maintains a Benchmarking Building Energy Performance Program. The ORNL website determines how a building's energy use compares with similar facilities throughout the U.S. and in a specific region or state.

Source use differs from site usage when comparing a building's energy consumption with the national average. Site energy use is the energy consumed by the building at the building site only. Source energy use includes the site energy use as well as all of the losses to create and distribute the energy to the building. Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses, which allows for a complete assessment of energy efficiency in a building. The type of utility purchased has a substantial impact on the source energy use of a building. The EPA has determined that source energy is the most comparable unit for evaluation purposes and overall global impact. Both the site and source EUI ratings for the building are provided to understand and compare the differences in energy use.

The site and source EUI for this facility is calculated as follows. (See Table 5 for details):

$$\text{Building Site EUI} = \frac{(\text{Electric Usage in kBtu} + \text{Diesel Usage in kBtu})}{\text{Building Square Footage}}$$

$$\text{Building Source EUI} = \frac{(\text{Electric Usage in kBtu} \times \text{SS Ratio} + \text{Diesel Fuel Usage in kBtu} \times \text{SS Ratio})}{\text{Building Square Footage}}$$

**Table 4**  
**Sunnymead Pumping Station Building EUI Calculations**

ENERGY TYPE	BUILDING USE			SITE ENERGY	SITE-SOURCE	SOURCE ENERGY
	kWh	Therms	Gallons	kBtu	RATIO	kBtu
ELECTRIC	538,993			1,800,776	3.340	6,014,591
FUEL OIL			208.00	28,725	1.010	29,012
TOTAL				1,829,500		6,043,603
*Site - Source Ratio data is provided by the Energy Star Performance Rating Methodology for Incorporating Source Energy Use document issued Dec 2007.						
<b>BUILDING AREA</b>	550		<b>SQUARE FEET</b>			
<b>BUILDING SITE EUI</b>	3326.00		<b>kBtu/SF/YR</b>			
<b>BUILDING SOURCE EUI</b>	10988.00		<b>kBtu/SF/YR</b>			

### C. EPA Energy Benchmarking System

The United States Environmental Protection Agency (EPA) in an effort to promote energy management has created a system for benchmarking energy use amongst various end users. The benchmarking tool utilized for this analysis is entitled Portfolio Manager. The Portfolio Manager tool allows tracking and assessment of energy consumption via the template forms located on the ENERGY STAR website ([www.energystar.gov](http://www.energystar.gov)). The importance of benchmarking for local government municipalities is becoming more important as utility costs continue to increase and emphasis is being placed on carbon reduction, greenhouse gas emissions and other environmental impacts.

Based on information gathered from the ENERGY STAR website, Government agencies spend more than \$10 billion a year on energy to provide public services and meet constituent needs. Furthermore, energy use in commercial buildings and industrial facilities is responsible for more than 50 percent of U.S. carbon dioxide emissions. It is vital that local government municipalities assess facility energy usage, benchmark energy usage utilizing Portfolio Manager, set priorities and goals to lessen energy usage and move forward with priorities and goals.

At the present time Portfolio Manager has benchmarking tools for wastewater treatment plants but does not have benchmarking tools for water treatment plants and water and wastewater pumping stations.

In accordance with the Local Government Energy Audit Program, CEG has created an ENERGY STAR account for the municipality to access and monitor the facility's yearly energy usage as it compares to facilities of similar type. The login page for the account can be accessed at the following web address; the username and password are also listed below:

User Name: Hillsborough TMUA  
 Password: lgeaceg2009  
 Security Question: What city were you born in?  
 Security Answer: hillsborough

The utility bills and other information gathered during the energy audit process are entered into the Portfolio Manager. The following is a summary of the results for the facility:

**Table 5**  
**ENERGY STAR Performance Rating**

<b>FACILITY DESCRIPTION</b>	<b>ENERGY PERFORMANCE RATING</b>	<b>NATIONAL AVERAGE</b>
Sunnymead Pumping Station	N/A	N/A

**Statement of Energy Performance Appendix** for the detailed energy summary is not applicable.

## V. FACILITY DESCRIPTION

The pumping station is located on the site of the Harrison Street maintenance garage. Approximately ½ acre is reserved for pumping facility usage. The Sunnymeade Pumping Station consists of two energy consuming structures. The smaller structure is a Kohler prefabricated power system 600 generator in a sound attenuating enclosure with an integral fuel tank base occupying about 200 square feet. The main pumping station is a 550 square feet structure with a below grade wet well, a below grade dry well, and an above grade superstructure. The main pumping station houses three pump and motor combinations, three variable frequency drives, a motor control center, a pump controller, ventilation equipment, unit heaters, air conditioning and lights. The station is visited on average 1 hour per day by Authority personnel and/or Authority contractors, and as needed by the regulators. Public access is denied. The generator enclosure is a weather enclosure with insulated vertical walls and an insulated flat roof. The enclosure has a door and ventilation louvers, but no windows. The generator was installed in 1999. The main pump station has cast in place concrete walls below grade, a masonry brick and block superstructure, and a flat roof over precast concrete planks. The roofing is a 4 ply built up roof over 1-inch rigid insulation. Decorative copper sheets extend the masonry walls to conceal the ventilation and exhaust equipment. The building was constructed in 1973.

### HVAC Systems

The superstructure has two 5-kw unit heaters. The heaters are occasionally used only on the coldest days and typically when long duration maintenance or repairs are required.

The inefficient pump motors generate so much heat that a 15,000 BTU air conditioner has been installed to reduce hot weather temperature. Reportedly the pump room dehumidifier has been removed.

### Exhaust System

The generator enclosure has an exhaust fan, the wet well, dry well and motor room have power ventilators.

### Lighting

Typical lighting in the generator building, wet well and dry well is fluorescent tube, drop fixtures with T-12 lamps and magnetic ballasts. Access tubes, the wet well and the dry well are lit with incandescent lamps. The exterior of the building is lit with incandescent flood lights. There is no area lighting.

## VI. MAJOR EQUIPMENT LIST

The equipment list describes the major energy consuming equipment, which through energy conservation measures could yield substantial energy savings. The list shows the major equipment in the facility and all pertinent information utilized in energy savings calculations. An approximate age was assigned to the equipment in some cases if a manufactures date was not shown on the equipment's nameplate. The ASHRAE service life for the equipment along with the remaining useful life is also shown in the **Major Equipment List Appendix**.

National studies show that by far the largest consumption of energy at water and wastewater facilities occurs from the transfer of fluids by pumping equipment. The handbook of Public Water Systems by Robert William and Gordon Culp, Van Nostrand Reinhold, 1986 presents data that justifies that pumping consumes about 80% of the electric consumption at water treatment facilities. The energy consumption by electric motor driven pumps at pumping stations is probably closer to 95% of all electric power consumed at the pumping station motor.

Refer to the **Major Equipment List Appendix** for this facility.

## VII. ENERGY CONSERVATION MEASURES

### ECM #1: Lighting Upgrade – Office / Courts

#### Description:

The lighting in the pumping station building and generator enclosure is primarily made up of fluorescent fixtures with T-12 lamps and magnetic ballasts. The dry well, wet well and exterior areas have incandescent lighting fixtures.

This ECM includes replacement of the existing fixtures containing T12 lamps and magnetic ballasts with fixtures containing T8 lamps and electronic ballasts. The new energy efficient, T8 fixtures will provide adequate lighting and will save the owner on electrical costs due to the better performance of the lamp and ballasts. This ECM will also provide maintenance savings through the reduced number of lamps replaced per year. The expected lamp life of a T8 lamp is approximately 30,000 burn-hours, in comparison to the existing T12 lamps which is approximately 20,000 burn-hours. The facility will need 33% less lamps replaced per year.

This ECM also includes replacement of all incandescent fixtures to compact fluorescent fixtures. The energy usage of an incandescent compared to a compact fluorescent is approximately 3 to 4 times greater. In addition to the energy savings, compact fluorescent fixtures burn-hours are 8 to 15 times longer than incandescent fixtures ranging from 6,000 to 15,000 burn-hours compared to incandescent fixtures ranging from 750 to 1000 burn-hours.

#### Energy Savings Calculations:

The **Investment Grade Lighting Audit Appendix** outlines the proposed retrofits, costs, savings, and payback periods.

NJ Smart Start<sup>®</sup> Program Incentives are calculated as follows:

From the **Smart Start Incentive Appendix**, the replacement of a T-12 fixture to a T-5 or T-8 fixture warrants the following incentive: T-5 or T-8 (1-2 lamp) = \$10 per fixture; T-5 or T-8 (3-4 lamp) = \$20 per fixture.

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (\# \text{ of } 1-2 \text{ lamp fixtures} \times \$10) + (\# \text{ of } 3-4 \text{ lamp fixtures} \times \$20)$$

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (10 \times \$10) + (0 \times \$20) = \underline{\$100}$$

Replacement and Maintenance Savings are calculated as follows:

$$\text{Savings} = (\text{reduction in lamps replaced per year}) \times (\text{repackment } \$ \text{ per lamp} + \text{Labor } \$ \text{ per lamp})$$

$$\text{Savings} = (1.0 \text{ lamps per year}) \times (\$2.00 + \$5.00) = \underline{\$7}$$

**Energy Savings Summary:**

<b>ECM #1 - ENERGY SAVINGS SUMMARY</b>	
<b>Installation Cost (\$):</b>	\$1,268
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$100
<b>Net Installation Cost (\$):</b>	\$1,168
<b>Maintenance Savings (\$/Yr):</b>	\$7
<b>Energy Savings (\$/Yr):</b>	\$59
<b>Total Yearly Savings (\$/Yr):</b>	\$66
<b>Estimated ECM Lifetime (Yr):</b>	15
<b>Simple Payback</b>	17.6
<b>Simple Lifetime ROI</b>	-14.6%
<b>Simple Lifetime Maintenance Savings</b>	\$105
<b>Simple Lifetime Savings</b>	\$997
<b>Internal Rate of Return (IRR)</b>	-2%
<b>Net Present Value (NPV)</b>	(\$374.60)

## ECM #2: Lighting Controls

### Description:

Authority policy requires all lights to be off when the building is unoccupied; however, in some areas the lighting may be left on unnecessarily. In many cases the lights are left on because of the inconvenience to manually switch lights off when a room is left or on when a pump station is first occupied. This is possible in lower floor rooms that are occupied for only short periods and only a few times per day. In some instances lights are left on due to the misconception that that it is better to keep the lights on rather to continuously switch lights on and off. Although increased switching reduces lamp life, the energy savings outweigh the lamp replacement costs. The payback timeframe for when to turn the lights off is approximately 2 minutes. If the lights are off for a least a two minute interval, then it pays to shut them off.

Lighting controls come in many forms. Sometimes an additional switch is adequate to provide reduced lighting levels when full light output is not needed. Occupancy sensors detect motion and will switch the lights on when the room is occupied. Occupancy sensors can either be mounted in place or a current wall switch, or on the ceiling to cover large areas. Photocell control senses light levels and turn off or reduce lights when there is adequate daylight. Photocells are mostly used outside, but are becoming more popular in energy-efficient interior lighting designs as well.

ASHRAE Standard 90.1-2004, **Appendix G** is a reference standard for modeling building efficiency. The standard estimates that lighting controls provide a 10% reduction in lighting power usage for daytime occupancies in buildings over 5,000 SF, and 15% reduction in buildings under 5,000 SF. This ECM includes occupancy sensors in the pump room, generator building, and wet well and drywell as well as a dual technology motion and photocell daylight sensor controlling the exterior lighting.

The ECM includes replacement of standard wall switches with sensor wall switches for individual areas and photocell sensors for the exterior lighting. Sensors shall be manufactured by Sensorswitch, Watt Stopper or equivalent. See the **“Investment Grade Lighting Audit” Appendix** for details.

The **“Investment Grade Lighting Audit”** Appendix of this report includes the summary of lighting controls implemented in this ECM and outlines the proposed controls, costs, savings, and payback periods. The calculations adjust the lighting power usage by 15% for all areas that include occupancy sensor lighting controls and 20% for areas that include photocell daylight sensors.

Light Energy                   = 520 kWh/Yr. occupancy sensor controlled lighting  
  and  
  = 135 kWh/Yr. daylight sensor controlled lighting

**Energy Savings Calculations:**

$$\text{Energy Savings} = 15\% \times 520 \text{ (kWh)} + 20\% \times 135 \text{ (kWh)} = 105 \text{ (kWh)}$$

$$\text{Savings} = \text{Energy Savings (kWh)} \times \text{Ave Elec Cost} \left( \frac{\$}{\text{kWh}} \right)$$

$$\text{Savings} = 105 \text{ (kWh)} \times 0.151 \left( \frac{\$}{\text{kWh}} \right) = \$16$$

Installation cost per occupancy sensor (Basis: Sensorswitch or equivalent) is \$110/unit including material and labor. Installation cost per daylight sensor with dual motion sensor technology is \$238/unit

$$\text{Installation Cost} = \$110 \times 4 \text{ motion sensors} + \$238 \times 1 \text{ Daylight Sensors} = \underline{\$678}$$

From the **NJ Smart Start Appendix**, the installation of a lighting control device warrants the following incentive: occupancy = \$20 per fixture, daylight = \$25 per fixture.

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (\# \text{ of wall mount devices} \times \$20) = (4 \times \$20) = \$80$$

$$\text{Smart Start}^{\circledR} \text{ Incentive} = (\# \text{ of day light devices} \times \$25) = (1 \times \$25) = \$25$$

$$\text{Smart Start}^{\circledR} \text{ Incentive} = \$105 \text{ Total}$$

**Energy Savings Summary:**

<b>ECM #2 - ENERGY SAVINGS SUMMARY</b>	
<b>Installation Cost (\$):</b>	\$678
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$105
<b>Net Installation Cost (\$):</b>	\$573
<b>Maintenance Savings (\$/Yr):</b>	\$0
<b>Energy Savings (\$/Yr):</b>	\$16
<b>Total Yearly Savings (\$/Yr):</b>	\$16
<b>Estimated ECM Lifetime (Yr):</b>	15
<b>Simple Payback</b>	35.8
<b>Simple Lifetime ROI</b>	-58.1%
<b>Simple Lifetime Maintenance Savings</b>	\$0
<b>Simple Lifetime Savings</b>	\$240
<b>Internal Rate of Return (IRR)</b>	-9%
<b>Net Present Value (NPV)</b>	<b>(\$381.99)</b>

\*ECM#2 Calculations DO NOT include lighting changes implemented in ECM #1. If ECM #1 and #2 are implemented together the savings will be relatively lower than shown above.

## ECM #3: Pump and Motor System Upgrade

### Description:

The pump station was designed and built in 1974 as a cast-in-place concrete substructure and a masonry superstructure with a masonry roof. The substructure is divided into two compartments. A wet well is fitted with a bar screen but no grinding equipment. A dry well contains three Fairbanks Morse centrifugal pumps.

As a consequence of the wet well design, considerable difficult effort is devoted to cleaning the trash basket and unclogging pump impellers.

The superstructure originally housed the motor controls, motors and standby generator. In the late 1990's the generator was removed being replaced by a new generator installed near the pump station within its own weather enclosure. The three pumps have Safronics brand VFDs without a bypass.

This ECM #3 includes removal of the pump drive shafts, motors and Safronics drives. The wet well is proposed to have the bar screen removed and replaced with a JWC brand "Muffin Monster" 5 hp channel grinders with bypass capability. The grinder is proposed to be installed mounted on the incoming pipe wall. The existing dry well is to be used for placement of three 200 hp Flygt brand high efficiency motor submersible pumps suitable for dry pit operations.

The controls are to be replaced by Danfoss brand 200 hp variable frequency drivers on each pump, with a bypass, and a flow matching controller to vary the speed. The existing generator building, automatic transfer switch and generator are to be retained in the ECM. The existing magnetic flow meter is to be refurbished or replaced. The ECM does not provide a complete pumping system upgrade, which is addressed in Section XI Additional Recommendations.

### Energy Savings Calculations:

The **Major Equipment List Audit Appendix** outlines the proposed retrofits, costs, and savings.

NJ Smart® program incentives are calculated as follows:

From this **Smart Start® Incentive Appendix**, the use of variable frequency drives for the new pumps greater than 200 hp and premium motors over 25 hp warrants an incentive of \$0.16 per kWh saved provided at least 25,000 kWh are saved each year.

$$\begin{aligned} \text{Smart Start® Incentive} &= 128,011 \times \$0.16 \\ &= \$20,482 \end{aligned}$$

Operations and maintenance savings are calculated as follows:

Savings cleaning = weekly cleaning of bar rack in wet well, 5 manhours each week x 52 weeks/year x \$31.50 ave. labor rate for HMUA = \$8,190 per year.

Savings clogging = 12 times per year (reduction to 3 times per year = net of 9) at 16 mahours per event x \$31.50 ave. Labor rate for HMUA = \$4,536

Total O&M savings = \$12,726

### Energy Savings Summary:

<b>ECM #3 - ENERGY SAVINGS SUMMARY</b>	
<b>Installation Cost (\$):</b>	\$177,870
<b>NJ Smart Start Equipment Incentive (\$):</b>	\$20,482
<b>Net Installation Cost (\$):</b>	\$157,388
<b>Maintenance Savings (\$/Yr):</b>	\$12,726
<b>Energy Savings (\$/Yr):</b>	\$17,850
<b>Total Yearly Savings (\$/Yr):</b>	\$30,576
<b>Estimated ECM Lifetime (Yr):</b>	20
<b>Simple Payback</b>	5.1
<b>Simple Lifetime ROI</b>	288.5%
<b>Simple Lifetime Maintenance Savings</b>	\$254,520
<b>Simple Lifetime Savings</b>	\$611,520
<b>Internal Rate of Return (IRR)</b>	19%
<b>Net Present Value (NPV)</b>	\$297,505.67

\* ECM#3 Calculations are based upon a pumping system replacement with implementation of premium motor submersible pumps, VFDs, grinder equipment and a replacement magnetic flow meter together as one project.

## VIII. RENEWABLE/DISTRIBUTED ENERGY MEASURES

Globally, renewable energy has become a priority affecting international and domestic energy policies. The State of New Jersey has taken a proactive approach, and has recently adopted in its Energy Master Plan a goal of 30% renewable energy by 2020. To help reach this goal New Jersey created the Office of Clean Energy under the direction of the Board of Public Utilities and instituted a Renewable Energy Incentive Program to provide additional funding to private and public entities for installing qualified renewable energy technologies. A renewable energy source can greatly reduce a building's operation expenses while producing clean environmentally friendly energy. CEG has assessed the feasibility of installing renewable energy measures (REM) for the municipality utilizing renewable technologies and concluded that there is potential for solar energy generation. The solar photovoltaic system calculation summary will be concluded as **ECM#4** within this report.

Solar energy produces clean energy and reduces a building's carbon footprint. This is accomplished via photovoltaic panels which will be mounted on all south and southwestern facades of the building. Flat roof, as well as sloped areas can be utilized; flat areas will have the panels turned to an optimum solar absorbing angle. (A structural survey of the roof would be necessary before the installation of PV panes is considered). The state of NJ has instituted a program in which one Solar Renewable Energy Certificate (SREC) is given to the Owner for every 1000 kWh of generation. SREC's can be sold anytime on the market at their current market value. The value of the credit varies upon the current need of the power companies. The average value per credit is around \$350, this value was used in our financial calculations. This equates to \$0.35 per kWh generated.

CEG has reviewed the existing roof area of the building being audited for the purposes of determining a potential for a roof mounted photovoltaic system. It was determined that due to lack of roof area, a carport type and ground mount system would be recommended. The available area for a carport system is approximately 3,600 S.F. directly in front of the Vehicle Storage/Garage building. A ground mount system of 675 S.F. can be utilized behind the Block House building for a PV system. A depiction of the area utilized is shown in **Renewable / Distributed Energy Measures Calculation Appendix**. Using this square footage it was determined that a system size of 61.4 kilowatts could be installed. A system of this size has an estimated kilowatt hour production of 70,951 kWh annually, reducing the overall utility bill by approximately 12% percent. A detailed financial analysis can be found in the **Renewable / Distributed Energy Measures Calculation Appendix**. This analysis illustrates the payback of the system over a 25 year period. The eventual degradation of the solar panes and the price of accumulated SREC's are factored into the payback.

The proposed photovoltaic array layout is designed based on the specifications of the Sun Power SPR-230 panel. This panel has a "DC" rated full load output of 230 watts, and has a total panel conversion efficiency of 18%. Although panels rated at higher wattages are available through Sun Power and other various manufacturers, in general most manufacturers who produce commercially available solar panels produce a similar panel in the 200 to 250 watt range. This provides more manufacturer options to the public entity if they wish to pursue the proposed solar recommendation without losing significant system capacity.

The array system capacity was sized on available ground space at the Sunnymeade Pump Station. Our auditors noted that there was an opportunity for a covered carport area in front of the Vehicle Storage/Garage and also, an area behind the Block House that could be utilized for a ground mount system. Estimated solar array generation was then calculated based on the National Renewable Energy Laboratory PV Watts Version 1.0 Calculator. In order to calculate the array generation an appropriate location with solar data on file must be selected. In addition the system DC rated kilowatt (kW) capacity must be inputted, a DC to AC de-rate factor, panel tilt angle, and array azimuth angle. The DC to AC de-rate factor is based on the panel nameplate DC rating, inverter and transformer efficiencies (95%), mismatch factor (98%), diodes and connections (100%), dc and ac wiring (98%, 99%), soiling (95%), system availability (95%), shading (if applicable) and age (new 100%). The overall DC to AC de-rate factor has been calculated at an overall rating of 81%. The PV Watts Calculator program then calculates estimated system generation based on average monthly solar irradiance and user provided inputs. The monthly energy generation and offset electric costs from the PV Watts calculator is shown in the **Renewable/Distributed Energy Measures Calculation Appendix**.

The proposed solar array is qualified by the New Jersey Board of Public Utilities Net Metering Guidelines as a Class I Renewable Energy Source. These guidelines allow onsite customer generation using renewable energy sources such as solar and wind with a capacity of 2 megawatts (MW) or less. This limits a customer system design capacity to being a net user and not a net generator of electricity on an annual basis. Although these guidelines state that if a customer does not generate (produce more electricity than they use), the customer will be credited those kilowatt-hours generated to be carried over for future usage on a month to month basis. Then, on an annual basis if the customer is a net generator the customer will then be compensated by the utility the average annual PJM Grid LMP price per kilowatt-hour for the over generation. Due to the aforementioned legislation, the customer is at limited risk if they generate more than they use at times throughout the year. With the inefficiency of today's energy storage systems, such as batteries, the added cost of storage systems is not warranted and was not considered in the proposed design.

Direct purchase involves the MUA paying for 100% of the total project cost upfront via one of the methods noted in the Installation Funding Options section below. Calculations include a utility inflation rate as well as the degradation of the solar panels over time. Based on our calculations the following is the payback period:

**Table 6**  
**Financial Summary – Photovoltaic System**

<b>FINANCIAL SUMMARY – PHOTOVOLTAIC SYSTEM</b>				
<b>PAYMENT TYPE</b>	<b>SIMPLE PAYBACK</b>	<b>SIMPLE ROI</b>	<b>NET PRESENT VALUE</b>	<b>INTERNAL RATE OF RETURN</b>
Direct Purchase	15.5 Years	6.5%	\$416,801	4.7%

\*The solar energy measure is shown for reference in the executive summary ECM table

Given the large amount of capital required by the MUA to invest in a solar system through a Direct Purchase, CEG does not recommend the MUA pursue this route. It would be more advantageous for the MUA to solicit Power Purchase Agreement (PPA) Providers who will own, operate, and maintain the system for a period of 15 years. During this time the PPA Provider would sell all of the electric generated by Solar Arrays to the MUA at a reduced rate compared to their existing electric rate.

In addition to the Solar Analysis, CEG also conducted a review of the applicability of wind energy for the facility. Wind energy production is another option available through the Renewable Energy Incentive Program. Wind turbines of various types can be utilized to produce clean energy on a per building basis. Cash incentives are available per kWh of electric usage. Based on CEG's review of the applicability of wind energy for the facility, it was determined that the average wind speed (approximately 2 mph) is not adequate for purchase of a commercial wind turbine. Therefore, wind energy is not a viable option to implement at the Sunnymeade Pump Station.

## **XI. ENERGY PURCHASING AND PROCUREMENT STRATEGY**

### **Load Profile:**

Load Profile analysis was performed to determine the seasonal energy usage of the facility. Irregularities in the load profile will indicate potential problems within the facility. Consequently based on the profile a recommendation will be made to remedy the irregularity in energy usage. For this report, the facility's energy consumption data was gathered in table format and plotted in graph form to create the load profile, refer to The Electric Usage Profiles included within this report to reference the respective electricity usage load profiles.

### Electricity

The Electric Usage Profile demonstrates a fairly typical seasonal load profile for a pumping station that may be experiencing extraneous flow issues. There is a slightly erratic yearlong electric load indicating the pump electric motors are the dominant electricity consumers at the pumping station. Peak month electric consumption is 35% above average and minimum month consumption is 34% below average. The high and low consumptions are suggestive of a system with extraneous flows that may be excessive. A flat load profile will allow for more competitive energy prices when shopping for alternative suppliers. Extraneous flows are increasing electric costs. It is estimated that annual electricity charges could be reduced between \$10,000 and \$25,000 at the Sunnymeade Pump Station alone if the HTMUA were to implement an aggressive infiltration and inflow reduction program. Additional savings at outlying pumping stations would undoubtedly occur as well. The cost savings for these stations is beyond the scope of this report.

### Natural Gas

Not Applicable.

### **Tariff Analysis:**

#### Electricity:

This facility receives electrical service through Public Service Electric and Gas (PSE&G) on a commercial and industrial account rate schedule. This facility's rate is based in part on a three phase service at secondary voltages. For electric supply (generation), the customer will use the utilities Basic Generation Service (BGS) or a Third Party Supplier (TPS). This facility uses Basic Generation service from the utility. Therefore, they will pay according to the BGS default service for BGS generator capacity, BGS transmission capacity, BGS energy on-peak and BGS energy off-peak. The PSE&G delivery service includes the following charges: service charge, annual demand, summer demand, kWh off-peak, societal benefits, and securitization transition.

**Recommendations:**

CEG recommends a global approach that will be consistent with all facilities within the HTMUA service area. The primary area for potential improvement is seen in the electric costs. The average price per kWh (kilowatt hour) for all buildings based on 1-year historical average price is \$0.151/kWh (this is the average “price to compare” if the client intends to shop for energy). Energy commodities are among the most volatile of all commodities, however at this point and time, energy is extremely competitive. The HTMUA could see improvement in its energy costs if it were to take advantage of these current market prices quickly, before they increase. Based on annual historical consumption (July 2008 through June 2009) and current electric rates, the HTMUA could see an improvement in its electric costs of up to 20% annually. (Note: Savings were calculated using Average Annual Consumption and a variance to a Fixed Average One-Year commodity contract). CEG recommends aggregating the entire HTMUA electric load to gain the most optimal energy costs. CEG recommends advisement for alternative sourcing and supply of energy on a “managed approach”.

CEG also recommends that the municipality schedule a meeting with the current utility providers to review their utility charges and current tariff structures for electricity. This meeting would provide insight regarding alternative procurement options that are currently available. Through its meeting with the Local distribution Company (LDC), the HTMUA can learn more about the competitive supply process. HTMUA can acquire a list of approved Third Party Suppliers from the New Jersey Board of Public Utilities website at [www.nj.gov/pbu](http://www.nj.gov/pbu). HTMUA should consider using a billing-auditing service to further analyze the utility invoices, manage the data and use the information for ongoing demand-side management projects. Furthermore, special attention should be given to credit mechanisms, imbalances, balancing charges and commodity charges when meeting with the utility representative. The Township should ask the utility representative about alternative billing options, such as consolidated billing when utilizing the service of a Third Party Supplier.

## X. INSTALLATION FUNDING OPTIONS

CEG has reviewed various funding options for the facility owner to utilize in subsidizing the costs for installing the energy conservation measures noted within this report. Below are a few alternative funding methods:

- i. *Energy Savings Improvement Program (ESIP)* – Public Law 2009, Chapter 4 authorizes government entities to make energy related improvements to their facilities and pay for the costs using the value of energy savings that result from the improvements. The “Energy Savings Improvement Program (ESIP)” law provides a flexible approach that can allow all government agencies in New Jersey to improve and reduce energy usage with minimal expenditure of new financial resources.
- ii. *Municipal Bonds* – Municipal bonds are a bond issued by a city or other local government, or their agencies. Potential issuers of municipal bonds include cities, counties, redevelopment agencies, school districts, publicly owned airports and seaports, and any other governmental entity (or group of governments) below the state level. Municipal bonds may be general obligations of the issuer or secured by specified revenues. Interest income received by holders of municipal bonds is often exempt from the federal income tax and from the income tax of the state in which they are issued, although municipal bonds issued for certain purposes may not be tax exempt.
- iii. *Power Purchase Agreement* – Public Law 2008, Chapter 3 authorizes contractor up to fifteen (15) years for contracts commonly known as “power purchase agreements.” These are programs where the contracting unit (Owner) procures a contract for, in most cases, a third party to install, maintain, and own a renewable energy system. These renewable energy systems are typically solar panels, windmills or other systems that create renewable energy. In exchange for the third party’s work of installing, maintaining and owning the renewable energy system, the contracting unit (Owner) agrees to purchase the power generated by the renewable energy system from the third party at agreed upon energy rates.
- iv. *New Jersey Environmental Infrastructure Trust* – The New Jersey Environmental Infrastructure Trust (NJEIT) works in conjunction with the New Jersey Department of Environmental Protection (NJDEP) to identify “clean water” projects and to establish an annual “priority list” for the disbursement of low interest and no interest 20 year loans. The NJEIT also administers the American Recovery and Reinvestment Act of 2009 (ARRA or “Stimulus Program”). Project funded in FY 2009 are eligible for a 25% market rate loan (currently 4.0-4.5%) and a 75% 0% interest rate loan. Project receiving a high priority are also eligible for a 50% loan forgiveness up to \$5 million. Competition for the 50% forgiveness is severe; however, a 75/25 loan is a very attractive means for financing a project with an effective interest rate of only

slightly more than 1%. Also renewable energy projects are given favorable consideration and often receive funding set asides.

CEG recommends the Owner review the use of the above-listed funding options in addition to utilizing their standard method of financing for facilities upgrades in order to fund the proposed energy conservation measures.

## **XI. ADDITIONAL RECOMMENDATIONS**

The following recommendations include no cost/low cost measures, Operation & Maintenance (O&M) items, and water conservation measures with attractive paybacks. These measures are not eligible for the Smart Start Buildings incentives from the office of Clean Energy but save energy none the less.

- A. The new dry pit submersible pumps, VFDs and communicator should become a part of a larger pump station upgrade. The additional items are considered moderately extensive since the structures, generator and chemical feed equipment appear serviceable for many years to come. We recommend HVAC systems be upgraded, the lighting be improved, the instrumentation and communications be improved, emergency lighting be improved, refinish the building exterior and replace the roofing system.
- B. Maintain all weather stripping on windows and doors.
- C. Clean all light fixtures to maximize light output.
- D. Provide more frequent air filter changes to decrease overall system power usage and maintain better IAQ.

In addition to the recommendations above, implementing Retro-Commissioning would be beneficial for this facility. Retro-Commissioning is a means to verify your current equipment is operating in its designed mechanical efficiency range, hydraulic flow capacity, designed motor efficiency and overall performance. Retro-Commissioning provides valuable insight into systems or components not performing correctly or efficiently. The commissioning process defines the original system design parameters and recommends revisions to the current system operating characteristics.

**ECM COST & SAVINGS BREAKDOWN**  
CONCORD ENGINEERING GROUP

Hillsborough MUA - Sunnyside Pump Station

**ECM ENERGY AND FINANCIAL COSTS AND SAVINGS SUMMARY**

ECM NO.	DESCRIPTION	INSTALLATION COST			YEARLY SAVINGS			ECM LIFETIME (Yr)	LIFETIME ENERGY SAVINGS (Yearly Saving * ECM Lifetime) (\$)	LIFETIME MAINTENANCE SAVINGS (Yearly Maint Saving * ECM Lifetime) (\$)	LIFETIME ROI (Lifetime Savings - Net Cost) / (Net Cost) (%)	SIMPLE PAYBACK (Net cost / Yearly Savings) (Yr)	INTERNAL RATE OF RETURN $\sum_{t=0}^N \frac{C_t}{(1+r)^t}$ (%)	NET PRESENT VALUE (NPV) (\$)
		MATERIAL (\$)	LABOR (\$)	REBATES INCENTIVES (\$)	NET INSTALLATION COST (\$)	ENERGY (\$/Yr)	MAINT. / SECC (\$/Yr)							
ECM #1	Lighting Upgrade - General	\$768	\$500	\$100	\$1,168	\$59	\$7	\$66	\$997	\$105	-14.6%	17.6	-1.92%	(\$74,60)
ECM #2	Lighting Controls	\$269	\$409	\$105	\$573	\$16	\$0	\$16	\$240	\$0	-58.1%	35.8	-9.32%	(\$81,19)
ECM #3	Pump and Motor System Upgrade	\$106,700	\$71,170	\$20,482	\$157,388	\$17,890	\$12,726	\$30,576	\$611,520	\$244,520	286.5%	5.1	18.81%	\$297,505.67
ECM #4	Solar PV Direct Purchase	\$552,690	\$0	\$0	\$552,690	\$10,939	\$24,833	\$35,772	\$894,300	\$620,825	61.8%	15.5	4.10%	\$70,213.12

**Notes:** 1) The variable C<sub>n</sub> in the formulas for Internal Rate of Return and Net Present Value stands for the cash flow during each period.  
 2) The variable DR in the NPV equation stands for Discount Rate  
 3) For NPV and IRR calculations: From n=0 to N periods where N is the lifetime of ECM and C<sub>n</sub> is the cash flow during each period.

## INSTALLATION COST AND REBATES

### CONCORD ENGINEERING GROUP

#### Sunnymead Mill Pumping Station

#### ECM 1: LIGHTING UPGRADE

	Qty	Unit Cost \$	Material \$	Labor \$	Total \$
Lighting Fixture Replacement	LS	\$21,979			\$1,268
Utility Incentive – NJ Smart Start					(\$100)
Total Cost Less Incentive					\$1,168

#### ECM 2: LIGHTING CONTROLS

	Qty	Unit Cost \$	Material \$	Labor \$	Total \$
Dual – Technology Sensor	4	\$110	\$150	\$290	\$440
Daylight Sensor	1	\$238	\$119	\$119	\$238
Utility Incentive – NJ SmartStart					(\$105)
Total Cost Less Incentive					\$573

#### ECM 3: PUMP AND MOTOR SYSTEM UPGRADE

	Qty	Unit Cost \$	Material \$	Labor \$	Total \$
3 Pumps, 3 VFDs, Comminutor, 1 Flow Meter, Misc.	1	\$177,870	\$106,700	\$71,170	\$177,870
Utility Incentive – NJ Smart Start		\$128,011	\$0.16		(\$20,482)
Total Cost Less Incentive					\$157,388

#### ECM 4: SOLAR PV SYSTEM

	Qty	Unit Cost \$	Material \$	Labor \$	Total \$
Solar PV System	1	L.S.			\$552,690
Utility Incentive – N/A					
Total Cost Less Incentive					\$552,690



# Concord Engineering Group, Inc.

520 BURNT MILL ROAD  
VOORHEES, NEW JERSEY 08043  
PHONE: (856) 427-0200  
FAX: (856) 427-6508

## SmartStart Building Incentives

The NJ SmartStart Buildings Program offers financial incentives on a wide variety of building system equipment. The incentives were developed to help offset the initial cost of energy-efficient equipment. The following tables show the current available incentives as of January, 2009:

### **Electric Chillers**

Water-Cooled Chillers	\$12 - \$170 per ton
Air-Cooled Chillers	\$8 - \$52 per ton

### **Gas Cooling**

Gas Absorption Chillers	\$185 - \$400 per ton
Gas Engine-Driven Chillers	Calculated through custom measure path)

### **Desiccant Systems**

\$1.00 per cfm – gas or electric	
----------------------------------	--

### **Electric Unitary HVAC**

Unitary AC and Split Systems	\$73 - \$93 per ton
Air-to-Air Heat Pumps	\$73 - \$92 per ton
Water-Source Heat Pumps	\$81 per ton
Packaged Terminal AC & HP	\$65 per ton
Central DX AC Systems	\$40- \$72 per ton
Dual Enthalpy Economizer Controls	\$250

### **Ground Source Heat Pumps**

Closed Loop & Open Loop	\$370 per ton
-------------------------	---------------

### **Gas Heating**

Gas Fired Boilers < 300 MBH	\$300 per unit
Gas Fired Boilers ≥ 300 - 1500 MBH	\$1.75 per MBH
Gas Fired Boilers ≥1500 - ≤ 4000 MBH	\$1.00 per MBH
Gas Fired Boilers > 4000 MBH	(Calculated through Custom Measure Path)
Gas Furnaces	\$300 - \$400 per unit

### Variable Frequency Drives

Variable Air Volume	\$65 - \$155 per hp
Chilled-Water Pumps	\$60 per hp
Compressors	\$5,250 to \$12,500 per drive

### Natural Gas Water Heating

Gas Water Heaters ≤ 50 gallons	\$50 per unit
Gas-Fired Water Heaters >50 gallons	\$1.00 - \$2.00 per MBH
Gas-Fired Booster Water Heaters	\$17 - \$35 per MBH

### Premium Motors

Three-Phase Motors	\$45 - \$700 per motor
--------------------	------------------------

### Prescriptive Lighting

T-5 and T-8 Lamps w/Electronic Ballast in Existing Facilities	\$10 - \$30 per fixture, (depending on quantity)
Hard-Wired Compact Fluorescent	\$25 - \$30 per fixture
Metal Halide w/Pulse Start	\$25 per fixture
LED Exit Signs	\$10 - \$20 per fixture
T-5 and T-8 High Bay Fixtures	\$16 - \$284 per fixture

### Lighting Controls – Occupancy Sensors

Wall Mounted	\$20 per control
Remote Mounted	\$35 per control
Daylight Dimmers	\$25 per fixture
Occupancy Controlled hi-low Fluorescent Controls	\$25 per fixture controlled

### Lighting Controls – HID or Fluorescent Hi-Bay Controls

Occupancy hi-low	\$75 per fixture controlled
Daylight Dimming	\$75 per fixture controlled

### Other Equipment Incentives

Performance Lighting	\$1.00 per watt per SF below program incentive threshold, currently 5% more energy efficient than ASHRAE 90.1-2004 for New Construction and Complete Renovation
Custom Electric and Gas Equipment Incentives	not prescriptive

**Portfolio Manager “Statement of Energy Performance”**

Not applicable at this time. A Portfolio Manager for wastewater pumping stations has not been developed at the time of this audit’s preparation.



**INVESTMENT GRADE LIGHTING AUDIT**

**CONCORD ENERGY SERVICES**  
"Sunnymead Pump Station"

CEG Job #: PHB00500.01  
Project: Hillsborough Energy Audit  
Address: Sunnymead P.S.  
City: Hillsborough Twp.  
Building SF: 790

DATE: 1/4/2010  
KWH COST: \$0.151

**ECM # 1: Lighting Upgrade**

EXISTING LIGHTING										PROPOSED LIGHTING										SAVINGS				
Line No.	Fixture Location	No. Fixts	No. Lamps	Fixture Type	Yearly Usage	Watts Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	No. Fixts	Retro-Unit Description	Watts Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly \$ Savings	Yearly Payback			
1	Exterior of Building Superstructure	9	1	1- Lamp Incandescent Recessed Par Fixture	100	150	1.35	135	\$20.39	9	1-Lamp 23 W CFL Recessed PAR 38 MaxLite M/NSKR3823FL	26	0.23	23.4	3.5334	\$11.67	\$105.03	1.12	111.6	16.8516	6.23			
2	Motor Room	6	2	1'x4' 2-Lamp T-12 Industrial Strip Magnetic Ballast	300	80	0.48	144	\$21.74	6	1'x4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N CC	55	0.33	99	\$14.95	\$100.00	\$600.00	0.15	45	6.795	88.30			
3	Wet well and Generator building	4	2	1'x4' 2-Lamp T-12 Industrial Strip Magnetic Ballast	300	80	0.32	96	\$14.50	4	1'x4' 2-Lamp 32W T-8 Prism Lens/Elect Ballast; Metalux M/N CC	55	0.22	66	\$9.97	\$100.00	\$400.00	0.10	30	4.53	88.30			
4	Dry Well - Pump Room	7	1	1-Lamp EV type Incandescent enclosed fixture	200	100	0.70	140	\$21.14	7	1-Lamp 23 W CFL Recessed PAR 38 MaxLite M/NSKR3823FL	26	0.18	36.4	\$5.50	\$11.67	\$81.69	0.52	103.6	15.6436	5.22			
5	Wet Well	7	1	1-Lamp EV type Incandescent enclosed fixture	200	100	0.70	140	\$21.14	7	1-Lamp 23 W CFL Recessed PAR 38 MaxLite M/NSKR3823FL	26	0.18	36.4	\$5.50	\$11.67	\$81.69	0.52	103.6	15.6436	5.22			
<b>Totals</b>		33			2000	330	3.55	655	\$98.91	33		115	1.15	261.2	\$39.44		\$1,268.41	2.40	393.8	\$59.46	21.33			

**INVESTMENT GRADE LIGHTING AUDIT**

**CONCORD ENERGY SERVICES**

"Sunnymead Pump Station"

DATE: 1/4/2010  
KWH COST: **\$0.151**

CEG Job #: PHB0050001  
Project: Hillsborough Energy Audit  
Address: Sunnymead P.S.  
City: Hillsborough Twp.  
Building SF: 1,000

**ECM # 2: Lighting Controls**

EXISTING LIGHTING										PROPOSED LIGHTING										SAVINGS			
Line No.	Fixture Location	No. Fixts	No. Lamps	Fixture Type	Yearly Usage	Watts Used	Total kW	kWh/Yr Fixtures	Yearly \$ Cost	No. Fixts	No. Lamps	Lighting Control Description	Watts Used	Total kW	Reduction %	kWh/Yr Fixtures	Yearly \$ Cost	Unit Cost (INSTALLED)	Total Cost	kW Savings	kWh/Yr Savings	Yearly \$ Savings	Yearly Payback
1	Exterior of Building Superstructure	9	1	1- Lamp Incandescent Recessed Par Fixture	100	150	1.35	135	\$20.39	9	1	Dual technology occupancy sensor plus timer	120	1.08	20%	108	\$16.31	\$238.00	\$238.00	0.27	27	\$4.08	58.38
2	Motor Room	6	2	1x4' 2-Lamp T-12 Industrial Strip Magnetic Ballast	300	80	0.48	144	\$21.74	6	2	Dual technology on/off switch plus timer	68	0.41	15%	122.4	\$18.48	\$110.00	\$110.00	0.07	21.6	\$3.26	33.73
3	Wet well and Generator building	4	2	1x4' 2-Lamp T-12 Industrial Strip Magnetic Ballast	300	80	0.32	96	\$14.50	4	2	Dual technology on/off switch plus timer	68	0.27	15%	81.6	\$12.32	\$110.00	\$110.00	0.05	14.4	\$2.17	50.59
4	Dry Well - Pump Room	7	1	1-Lamp EV type Incandescent enclosed fixture	200	100	0.70	140	\$21.14	7	1	Dual technology on/off switch plus timer	85	0.60	15%	119	\$17.97	\$110.00	\$110.00	0.11	21	\$3.17	34.69
5	Wet Well	7	1	1-Lamp EV type Incandescent enclosed fixture	200	100	0.70	140	\$21.14	7	1	Dual technology on/off switch plus timer	85	0.60	15%	119	\$17.97	\$110.00	\$110.00	0.11	21	\$3.17	34.69
<b>Totals</b>		<b>33</b>					<b>3.55</b>	<b>655</b>	<b>\$98.91</b>	<b>33</b>				<b>2.95</b>		<b>550</b>	<b>\$83.05</b>		<b>\$678.00</b>	<b>0.60</b>	<b>105</b>	<b>\$15.86</b>	<b>42.76</b>