Marlboro Township Public Schools

Energy Savings Plan

Project Number: ESG-Project #DPBWI00567

Marlboro Township, New Jersey | Revised August 29th, 2019

energy systems group

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SECTION 1. EXECUTIVE SUMMARY

Various energy conservation measures were evaluated in the development of this Energy Savings Plan (ESP). Energy Systems Group has performed field verifications, collected data and taken field measurements to ensure the development of the most cost-effective solutions as well as accurate savings calculations. Various solutions were reviewed with the school district's administration to develop a set of Energy Conservation Measures (ECMs) that allow the school district to address the facility's priority items while reducing the total annual energy spend for the District. This study expands upon the original energy audit conducted by TRC Energy Services (TRC). The original audit information was used for building descriptions as well as an overall indication of the District needs.

Priority items include:

- Upgrade Interior lighting throughout all 10 buildings with newer LED technology
- Implement addressable fire alarm systems at all 10 buildings
- Replace heating hot water boilers at Asher Holmes, Frank Defino, Marlboro Elementary, Robertsville Elementary, Marlboro Memorial Middle, and Marlboro Middle School
- Replace domestic water heaters at Frank Defino, Marlboro Elementary, Robertsville Elementary, and Marlboro Middle School
- Replace unit ventilators at DAELC and Frank Defino. Refurbish Unit Ventilators at Asher Holmes, Marlboro Elementary, and Robertsville Elementary School
- Upgrade the HVAC controls to open protocol type, web-based Building Energy Management System (BEMS) across all 10 buildings
- Addition of cooling at all elementary schools Gyms and redesign the BoE Administration Building HVAC

Energy Savings

Energy saving calculations performed in the development of this ESP was completed using Microsoft Excel worksheets with Bin weather data to accurately model the building systems. Additional spreadsheets were used for measures that are not affected by the weather, such as lighting savings. Energy savings calculations have been provided electronically for ease of review. All of the energy savings calculations that have been performed are in accordance with the New Jersey Clean Energy Program Protocols to Measure Resource Savings.

Benefits

The measures investigated in this Energy Savings Plan could result in an annual utility savings of 3,055,564 kWh's of electricity and save 174,949 Therms of natural gas. The total utility cost savings is $14,006,671 over the life of the project (20 years). Additionally, these energy savings will result in a net reduction of greenhouse gases and will reduce the school district's carbon footprint by 3,263.9 metric tons of CO_2 annually. All these savings are achieved while improving the classroom environment and renewing many items that have been in service beyond useful life expectancy.

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SECTION 2. PROJECT DESCRIPTION

This Energy Savings Plan (ESP) addresses the following facilities. Any description in this report-stating "district wide" or similar refers only to the buildings listed below:

Marlboro Township Public Schools' Facilities	
David C. Abbott Early Learning Center	171 Tennent Road, Morganville, NJ 07751
BOE Administrative Office	1980 Township Drive, Marlboro, NJ 07746
Asher Holmes Elementary School	48 Menzel Lane, Morganville, NJ 07751
Frank Defino Central School	175 State Highway 79, Marlboro, NJ 07746
Frank J. Dugan Elementary School	48 Topanemus Road, Marlboro, NJ 07746
Marlboro Elementary School	100 School Road, West Marlboro, NJ 07746
Marlboro Memorial Middle School	71 Nolan Rd, Morganville, NJ 07751
Robertsville Elementary School	36 Menzel Lane, Morganville, NJ 07751
Transportation Garage	1 Lotta Burke Way, Marlboro, NJ 07746
Marlboro Middle School	355 County Road 520, Marlboro, NJ 07746

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Facility Descriptions

David C. Abbott Early Learning Center

Background Information

David C. Abbott Early Learning Center is located at 171 Tennent Road, Morganville, New Jersey. This 39,538 ft^2 facility was originally built in 2002 and remains in good condition. The Early Learning Center is one floor consisting of classrooms, office space, a nurse's station, storage, electrical and mechanical space, and other common areas.

Building Occupancy

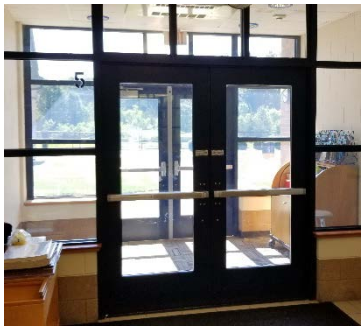
Approximate enrollment is 272 students and 72 staff.

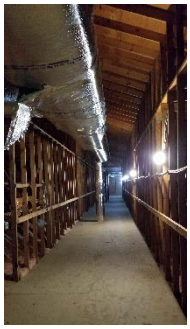
Hours of Operation

- Monday through Friday 8:30 am to 4:00 pm (students/staff)
- Saturday and Sunday 9:00 am to 1:00 pm
- The facility also operates throughout the summer for day camps.

Envelope

The building is constructed of structural steel with a brick façade. The building has a pitched metal roof supported by wood framing that is in good condition. The building has double paned windows which are in good condition and show little sign of excessive infiltration. The exterior doors are constructed of aluminum with metal framed glass, and are in good condition.





Building Envelope

Lighting

Typical Classroom Lights

Lighting is provided mostly by 32-Watt linear fluorescent T8 lamps with electronic ballasts as well as 2-Watt and 13-Watt compact fluorescent lamps (CFL) and a few incandescent lamps. Most of the linear fluorescent fixtures are 4-foot long luminaires. Exit signs are LED fixtures.

The building's exterior lighting consists primarily of high pressure sodium (HPS), metal halide (MH), and fixtures that are controlled by timers.

Lighting Controls: Lighting control in most spaces is provided by wall switches. There are a few locations with occupancy sensors that are either wall or ceiling mounted depending on the space layout. Some of the exterior light fixtures are controlled by timers.

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Motors

Motors

The HVAC systems that serve the building utilize fan and pump motors which are generally in good condition and high efficiency. These systems include hot water pumps, chilled water pumps, exhaust/return fan motors and supply fan motors. All motors in excess of 5 horsepower either currently utilize a variable frequency drive or were analyzed for retrofit.

Mechanical Systems

Boilers

HVAC Systems and Equipment: The hot water system consists of two Aerco Benchmark 2.0 condensing boilers. The boilers have a nominal combustion efficiency of 88%. The boilers operate in a lead/lag configuration, and are rotated during non-peak weather. Both boilers may be required during cold weather. The existing boilers currently do not operate on a hot water reset schedule. The boilers are in good condition and are well maintained. Two constant flow hot water heating pumps provide hot water to the classroom fan units and to the air handling units.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
Boiler	2	Boiler Room	All School	Aerco	Benchmark 2.0	18 yrs	88%	1720 MBH
Chiller	1	Outside	Building Chilled Water	McQuay	ALS171CS 27	18 yrs	-	171 Tons
AHU-1	1	Attic Mech. Rm	Student Commons	McQuay	CAH010FD AC	18 yrs	-	16 Tons
AHU-2	1	Attic Mech. Rm	Guidance Area	McQuay	CAH010FD AC	18 yrs	-	16 Tons
AHU-3	1	Attic Mech. Rm	Administration	McQuay	CAH010FD AC	18 yrs	-	14 Tons
UV	19	Classroom Mech Closets	Classroom	Airedale	UV6CHW4	18 yrs	-	5 Tons
ACH-1	1	Outside	Building Chilled Water	McQuay	ALS171CS 27-ER11	18 yrs	-	171 Tons

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HVAC System

The facility is served by a single chilled water plant. The chiller plant consists of a single 170 ton McQuay air cooled screw chiller with two constant flow chilled water pumps. This chiller provides cooling to the entire building. The chiller system is older, but has been well maintained, and is in fair condition. There are ¾ HP

Airedale fan units serve each classroom providing both cooling and heating to these zones. The Airedale units are located in mechanical closets in each room and are in a vertical configuration. These units are in varying condition, many of which are currently being refurbished with new fans.

Three McQuay air handler units located in the attic provide cooling and heating to common area spaces including the administration area, nurse's office, and the northern corridor. The air handlers are constant volume and have chilled water and hot water coils. It was observed the heating hot water bypass valves were open, resulting in constant water flow through the heating coil when the boiler plant is operating. It was also observed that supply and return fans were operating in hand mode.

Domestic Hot Water System

Domestic Hot Water

The domestic hot water heating system for the facility consists of a single A.O. Smith water heater with an input rating of 199 MBH and a nominal efficiency of 80%. The water heater has a 100 gallon storage tank.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Agee	Efficiency	Capacity
HWH-1	1	Boiler Room	All School	AO Smith	BTR-197 118	1 yr	80%	199 MBH

Building Controls (HVAC Controls)

The buildings HVAC systems are controlled using a Johnson Controls building energy management system (BEMS). Currently there are operating issues with the BEMS and the facility staff are operating much of the equipment in manual operation.

Building Controls

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Kitchen Equipment

The Early Learning Center does not have a full kitchen. Food is prepared at another school facility and delivered to the building. Equipment consists of a warming cart, reach in refrigerator, chest refrigerator, and chest freezer.

Plug Load

There are roughly 28 computer work stations throughout the facility. Roughly 90% of the computers are desktop units with LCD monitors. There is no centralized PC power management software installed. There are roughly 27 projectors and Smartboards in the classrooms, as well as about nine printers throughout the building.

The facility has two vending machines, one of which is a refrigerated beverage vending machine.

ESG observed to following significant plug load technologies:

Device Type:	Quantity:
Computer	26
Laptops	2
Small Printer/ Copier	4
Medium Printer/ Copier	3
Large Printer/ Copier	2
Projector	14
Microwave	5
Medium Refrigerator	3
Large Refrigerator	3
Coffee Machine	2
Toaster	1
Toaster Oven	2
Wall Mount Fan	1
Smart Board	13
Reach in Refrigerated Case	1
Refrigerated Vending	1
Non-Refrigerated Vending	1

Building Plug Loads

Plumbing/Water System

There are single use toilet rooms in each classroom, along with two gang restrooms, and a faculty toilet room. A sampling of restrooms found that the faucets are rated at 2.0 gallons per minute (gpm) or lower, and the toilets and urinals are 1.6 gallons per flush (gpf) or less.

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BOE Administrative Office

Background Information

The Administrative Office is located at 1980 Township Drive, Marlboro, New Jersey. This 7,900 ft^2 facility was originally built in 1980. This single story building is comprised of open offices, private offices, faculty lounge, board room, and conference rooms.

Building Occupancy

The facility is occupied by approximately 25 staff members.

Hours of Operation

- Monday through Friday 8:00 am to 5:00 pm (Administrative Office)
- Saturday and Sunday no use

Envelope

The Administrative Office is constructed of concrete block and structural steel with a concrete facade. The Administrative Office has single pane windows, while the in general, the windows are in good condition and show little sign of excessive infiltration. The exterior doors are constructed of aluminum and appear in good condition.

Building Envelope

Lighting

Typical BOE Office Lighting

Interior lighting at the facilities are provided mostly by linear 32-Watt fluorescent T8 lamps with electronic ballasts as well as some compact fluorescent lamps (CFL) and incandescent lamps. Most of the fixtures in the Administrative Office are 4-lamp, 4-foot long troffers with diffusers.

The exterior lighting is minimal and consists primarily of high pressure sodium (HPS) fixtures.

Lighting Controls: Lighting was observed to be manually controlled with wall switches. Exterior light fixtures are controlled with a timer or manually switched.

Mechanical Systems

Heat Pumps

HVAC Systems and Equipment: There are 17 McQuay packaged terminal air conditioners with electric heat serving the exterior perimeter offices and conference rooms. Each PTAC has on board controls with only “heat” or “cool” options, no temperature settings. The interior of the Administrative Office is conditioned by three 5-ton split-system air-source heat pumps serving three air handling units (AHU) located in the building’s attic. These are controlled with programmable thermostats.

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Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
TWU-1	7	In Room	Perimeter Offices	AAF-McQuay	R14CIA1	9 yrs	-	1 Tons
TWU-2	8	In Room	Perimeter Offices	AAF	Series 16	-	-	1 Tons
TQU-3	8	In Room	Perimeter Offices	McQuay	ENR012B 4032CC	12 yrs	-	1 Tons
AHU-1, 2, 3	3	Attic	Core Area	Coleman	MP20DN4 1A	-	-	5 Tons
CU-1	1	On Grade	AHU	Coleman	THE60B41 SA	-	-	5 Tons
CU-2	1	On Grade	AHU	Coleman	THJD60S4 4S5B	-	-	5 Tons
CU-3	1	On Grade	AHU	Coleman	THJD60S4 4S5B	-	-	5 Tons

Domestic Hot Water Systems

The domestic hot water heating system for the Administrative Office consists of two electric domestic water heaters, a 30-gallon 7 kW water heater and a 50-gallon 8 kW water heater.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
HWH-1	1	Attic	Kitchenette	AO Smith	-	15 yrs	-	30Gal 7kW
-	-	-	-	-	-	-	-	50Gal 8kW

Building Controls (HVAC Controls)

Building Controls

The building does not have a central building energy management system and operates off local control. The PTAC units have individual units controls that accommodate either a hot or cold setting with limited temperature range, or manual fan speed settings.

The split system heat pumps are controlled by standalone programmable thermostats.

Plug Load

The admin building has 35 computer work stations consisting of desktop units with LCD monitors and has no centralized PC power management software installed.

The Administrative Office has a single refrigerated beverage vending machine.

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ESG observed to following significant plug load technologies:

Device Type:	Quantity:
Desktop PC	35
small - Printer/Copier	7
medium - Printer/Copier	12
large - Printer/Copier	2
Projector	4
Microwave	1
small - Refrigerator	1
medium - Refrigerator	1
large - Refrigerator	1
Coffee Machine	2
Toaster Oven	1
42" LCD TV	2
50" LED TV	2
standing fans	2
Refrigerated Vending	1

Building Plug Load

Plumbing/Water System

There are four restrooms in the Administrative Office. A sampling of restrooms and breakroom/kitchenette areas found that the faucets to either be rated for 2.0 gallons per minute (gpm) or 2.2 gpm, the toilets are rated at 1.6 gallons per flush (gpf).

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Asher Holmes Elementary School

Background Information

Asher Holmes Elementary School is located at 48 Menzel Lane, Morganville, New Jersey. This 70,825 ft^2 facility was originally built in 1974 and has had three additions since then. In 1997 the cafeteria was added followed by the addition of four new classrooms in 2008. A new main office and security area was added in 2015. The one story building consists of classrooms but also has a gymnasium, cafeteria, kitchen, and offices.

Building Occupancy

Approximate enrollment is 506 students with a staff of 75 people.

Hours of Operation

- Monday through Friday 8:00 am to 3:30 pm (September-June)
- Occasional gym use Saturdays and during the summer

Envelope

The building is constructed of concrete block, and structural steel with a brick facade. The building has a flat roof covered with light colored membrane. The building's three additions have double pane windows which are in good condition and show little sign of excessive infiltration. The original building still has single pane windows. The exterior doors for the three additions are constructed of aluminum with double pane windows while the exterior doors on the original building are aluminum with single pane fenestration.

Building Envelope

Lighting

Asher Holmes Gymnasium

Lighting at the facility is provided mostly by 32-Watt linear fluorescent T8 lamps with electronic ballasts as well as some compact fluorescent lamps (CFL) and a few linear LED tube lights. The fixtures are a mix of 2-lamp, 3-lamp, or 4-lamp, 4-foot long troffers with diffusers. The majority of the fixtures contain 4-lamps. The cafeteria is lit with a mix of U-bend fluorescent fixtures and CFL lamps that are located in recessed can fixtures. The gymnasium is lit with 8-lamp CFL fixtures. Exit signs contain fluorescent lamps.

The building's exterior lighting consists of a mix of fixtures including CFLs, linear fluorescent T8s, high pressure sodium (HPS), metal halide (MH) and incandescent fixtures.

Lighting Controls: Lighting control in most spaces is provided by manual wall switches. The main office and security area addition's lighting is controlled with occupancy sensors that are either wall or ceiling mounted depending on the space layout. The exterior light fixtures are controlled by either photocells or time clocks.

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Motors

Motors

The HVAC systems that serve the building utilize fan and pump motors which are generally in good condition and standard efficiency. These systems include heating hot water, exhaust fan motors and supply fan motors. All motors in excess of 5 horsepower were analyzed for variable frequency drive retrofit, if one did not already exist.

Mechanical Systems

Boilers

HVAC Systems and Equipment: The hot water system consists of two Superior 3,252 Btu/hr input, forced draft boilers. The boilers have a nominal combustion efficiency of 80%, when new. Each boiler has a 0.5 hp forced draft fan. The boilers are configured in a constant flow primary distribution with two hot water pumps. Each boiler is supplied by a dedicated 2 hp pump. Boilers are shut off when the outside air exceeds 60°F. The boilers provide hot water to the original building's hallway fan coil units, cafeteria packaged AC units, and the in-room packaged AC units serving classrooms 1A & 1B as well as the 45 unit ventilators serving the majority of the remaining classrooms. The buildings occupied heating setpoint is 72°F and is setback to 65°F when unoccupied.

The boilers were retrofit with forced draft burners approximately ten years ago.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
RTU-1	1	Roof	Perimeter Offices	AAF-McQuay	RN-008-8-0-EA09-12A	5 yrs	-	8 Tons
AC-1, 2	2	Roof	Library	York	Series 16	-	-	3 Tons
AC-3	1	Roof	Teacher's Lounge	Goodman	PCK036-1A	15 yrs	-	3 Tons
AC-4	1	Roof	CR Addition	Goodman	PC024-1B	-	-	2 Tons
AC-5	1	Roof	Locker Area	York	DAPM-F030AB	-	-	2.5 Tons
HV-1, 2	2	Gymnasium	Gymnasium	-	-	-	-	315 MBH
UV-1	33	Classroom	Classroom	-	-	20 yrs	-	60 MBH
B-1, 2	2	Boiler Room	All	Superior	N4AA380 G	46 yrs	71.3%	3,252 MBH
CU-1	1	Roof	IT Closet	Mitsubishi	SUZ-KA12NA	3 yrs	-	1 Ton
CU-2	1	Roof	Office Suite	Carrier	24AHA424 A300	2 yrs	-	2 Tons
CU-3	1	Roof	-	Sanyo	C0911	26 yrs	-	0.75 Tons

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Asher Holmes Elementary School is served by a variety of direct-expansion (DX) units including ductless split systems, window AC units, in room packaged AC units, and rooftop packaged units. The majority of the split system AC units and packaged AC units are located on the roof and serve the second addition (four classrooms), faculty lounge, media center, tech closet, and the main office. These units range in size from 0.75 tons to 15 tons. The 8-ton AAON packaged AC unit serving the main office also has 15 kW of electric resistance heating. The two 15-ton Trane packaged AC units serving the cafeteria and the two 3-ton Airedale in-room packaged AC units serving classrooms 1A & 1B are equipped with hot water coils that are served by the boilers. Classrooms 2, 3, & 12 each have two 1-ton window AC units for cooling.

HVAC System

The units are manually controlled by a thermostat located in zone. The units operate on demand to maintain a space temperature setpoint of 72°F when occupied and 81°F when unoccupied.

Domestic Hot Water Systems

The domestic hot water heating system for the facility consists of two Lochinvar gas fired condensing hot water heaters with an input rating of 285 MBH each and a rated thermal efficiency of 91%. Each water heater has a 116 gallon storage tank.

Domestic Hot Water

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
HWH-1, 2	2	Boiler Room	Domestic Hot	AO Smith	SNA286-125	-	91%	285 MBH

Building Controls (HVAC Controls)

The hot water heating system is tied to pneumatic central control system. This system controls the building based on seven control zones. The facility operators do manually adjust settings to maintain control of the system.

The rooftop units and split systems are controlled by programmable thermostats. Per discussions with facility personnel, the cooling setpoint is 69°F during occupied periods of time and set back overnight to 84°F.

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Kitchen Equipment

The school has a kitchen that is used to prepare lunches daily for the students and staff. The kitchen equipment consists of an Ice cream novelty freezer, three single door commercial refrigerators, a double door commercial refrigerator, counter top steamer, convection oven, warmer, warming table, cool table, walk-in freezer, and a dishwasher. The kitchen is in operation Monday through Friday from 7:30 AM to 1:40 PM September through June.

Plug Load

There are roughly 46 desktop computer work stations throughout the facility and 33 laptops. There is no centralized PC power management software installed. There is a single tech closest that has cooling provided a by dedicated split system.

General office equipment and break room amenities contribute to the plug load. Classrooms are outfitted with projectors, smartboards, and other audio visual aids.

The facility has one refrigerated beverage vending machine and one non-refrigerated vending machine.

ESG observed to following significant plug load technologies:

Device Type:	Quantity:
Desktop Computer	46
Laptops	33
Small Printer	3
Medium Printer	5
Large Printer	4
Projectors	34
Microwaves	3
Refrigerators	3
Coffee Machine	3
Toaster Oven	1
Dishwasher	1
Standing Fans	58
Smart Board	1
Refrigerated Vending	1
Non-Refrigerated Vending	1

Building Plug Load

Plumbing/Water System

There are 4 gang restrooms, 2 locker rooms, and 4 faculty restrooms at this facility a faculty lounge with a dishwasher, and the kitchen. A sampling of restrooms found that most of the fixtures were fitted with low flow controls.

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Frank Defino Central School

Background Information

Frank Defino Central School is located at 175 State Highway 79, Marlboro, New Jersey. This 70,047 ft^2 facility was originally built in 1956 and has had four additions since then. The first addition added three classrooms, followed by the addition of the cafeteria and kitchen and then the fourth-grade hall. The last edition was in 2011 and included two more classrooms and a new main office. The one story building consists mainly of classrooms with a gymnasium, cafeteria, kitchen, and offices in a single story building.

Building Occupancy

Approximate enrollment is 522 students with a staff of 84 people.

Hours of Operation

- Monday through Friday 8:30 am to 3:00 pm (students)
- Saturday 12:30 pm to 5:00 pm

Envelope

The building is constructed of concrete block and structural steel with a brick facade. The building has a flat foam roof covered with light colored membrane, except for the 2011 addition, which has an ethylene propylene diene monomer (EPDM) rubber roof. The building's three most recent additions have double pane windows which are in good condition and show little sign of excessive infiltration. The original portion of the building still has single pane windows. The majority of the exterior doors are single pane glass with metal frames. The 2011 addition has aluminum framed doors with double pane windows.

Building Envelope

Lighting

Frank Defino Cafeteria

Lighting is provided mostly by 32-Watt linear fluorescent T8 lamps with electronic ballasts as well as some compact fluorescent lamps (CFL) and a few linear LED strip lights. The fixtures are a mix of 2-lamp, 3-lamp, or 4-lamp, 4-foot long troffers with prismatic lens. The majority of the fixtures contain 2-lamps. The cafeteria is lit with a mix of 4-lamp 4-foot long fluorescent fixtures and CFL lamps that are located in recessed can fixtures. The gymnasium is lit with 9-lamp CFL fixtures. Exit signs contain incandescent lamps.

The building's exterior lighting consists of a mix of fixtures including CFLs, linear fluorescent T8s, and high pressure sodium (HPS) fixtures.

Lighting Controls: Lighting control in most spaces is provided by manual wall switches. The main office and security area lighting is controlled with occupancy sensors that are either wall or ceiling mounted depending on the space layout. Exterior fixtures are controlled by either a photocell and timeclock combination or just a timeclock, with the majority of them controlled by only a timeclock.

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Motors

Motors

The HVAC systems that serve the building utilize fan and pump motors which are generally in good condition and high efficiency. These systems include heating hot water pumps, exhaust fan motors and supply fan motors. All motors in excess of 5 horsepower were analyzed for variable frequency drive retrofit, if one did not already exist.

Mechanical Systems

Boilers

HVAC Systems and Equipment: The hot water heating system consists of two Cleaver Brooks forced draft boilers. Boiler 1 has a rated input of 5,230 MBH and boiler 2 has a rated input of 3,347 MBH, both with a nominal combustion efficiency of 80%. Boiler 1 has a 5 hp forced draft fan and boiler 2 has a 2 hp forced draft fan. The boilers provide hot water to the building's hallway and gym radiators, gym air handling units, in-room units serving classrooms, duct mounted heating coils, and the indirect domestic hot water system. The buildings occupied heating setpoint is 68°F.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
AHU-1, 2	2	Cafeteria Roof	Cafeteria	Trane	-	15 yrs	-	15 Tons
AHU-3	1	Roof Above Guidance	Guidance	Trane	-	15 yrs	-	3.5 Tons
AHU-4	1	Roof Above Nurse	Nurses Office	Trane	-	15 yrs	-	2.5 Tons
RTU-1	1		Work Rooms, Conference	Lennox	LGH092H 4BM1Y	9 yrs	80%	7.5 Tons
RTU-2	1	Roof Above Main Office	Main Office	Lennox	-	9 yrs	80%	5 Tons
RTU	1	Roof Above Teachers' Lounge	Teachers' Lounge	Goodman	PCK048-1	15 yrs	-	4 Tons
RTU	1	Roof Above IT Closet	IT Closet	Goodman	PCK024-1	15 yrs	-	2 Tons
RTU	2	Roof Above Media	Media Center	York	DPAM-F048AD	15 yrs	-	4 Tons
RTU-1, 2	2	Addition Roof	Back Class Addition	Lennox	LGH240H 4BH2G	9 yrs	80%	20 Tons
B-1	1	Boiler Room	Throughout	Cleaver Brooks	CB400-125	23 yrs	80%	5,230 MBH
B-2	1	Boiler Room	Throughout	Cleaver Brooks	CB900-80	29 yrs	80%	3,347 MBH

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HVAC System

This school is served by a variety of direct-expansion (DX) cooling units including ductless split systems, window AC units, in-room packaged AC units, and rooftop packaged units. The majority of the split system AC units and packaged AC units are located on the roof and serve the classrooms, media center, cafeteria, IT room, teacher's lounge, nurses' office, and the main office. These units range in size from 2 tons to 20 tons, and along with the window AC units provide mechanical cooling to approximately 30% of the facility. The two 15-ton Trane packaged AC units serving the cafeteria with no heating in the unit, but have a hot water coil in the supply duct. The 8 and 5-ton units serving the main office area and the two 20-ton units serving classrooms 42 – 47 which are equipped with 80% efficient natural gas furnaces. The two 3-ton Airedale in-room packaged AC units that serve classrooms 13 and 14 are equipped with hot water coils that are served by the boilers. Three of the classrooms have window AC units for cooling. The units operate to maintain a cooling space temperature setpoint of 72°F and a heating setpoint of 68°F.

Domestic Hot Water Systems

There is a small domestic hot water heating system serving the 2011 addition, which consists of a single 19 gallon 2.5 kW A.O. Smith electric water heater. The remainder of the campus receives domestic hot water via an indirect system; heating is provided by the boilers via a heat exchanger. The hot water from the indirect system is stored in a tank.

Domestic Hot Water

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
ST-1	1	Boiler Room	Whole Building	-	-	15 yrs	N/A	670 Gal

Building Controls (HVAC Controls)

Building Controls

The older unit ventilators and air handler systems are controlled through a pneumatic control system. Newer installed systems have digital controlled thermostats and sensors that are configured as standalone and not tied centrally together.

The units controlled by programmable thermostats. Per discussions with facility personnel, the cooling setpoint is 69°F during occupied periods of time and set back overnight to 84°F.

Kitchen Equipment

The school's kitchen is used to prepare lunches daily for the students and staff. The kitchen equipment consists of an ice cream novelty freezer, four solid double door commercial refrigerators, one glass door refrigerator, reach-in milk cooler, four electric convection ovens, warmer, walk-in freezer, and a dishwasher. The kitchen is occupied Monday through Friday from 7:45 AM to 1:45 PM September through June.

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Plug Load

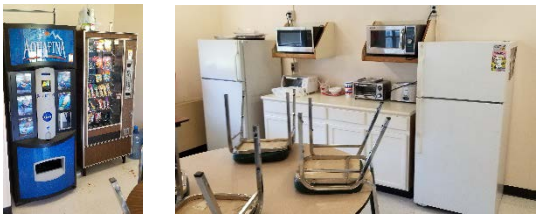
There are roughly 68 desktop computer work stations throughout the facility. There is no centralized PC power management software installed.

General office equipment and break room amenities contribute to the plug load. Classrooms are outfitted with projectors, starboards, and other audio visual aids

The facility has one refrigerated beverage vending machine and one non-refrigerated vending machine.

ESG observed to following significant plug load technologies:

Device Type:	Quantity:
Desktop Computers	68
small - Printer/Copier	17
medium - Printer/Copier	8
large - Printer/Copier	4
Paper Shredder	1
Projector	49
Microwave	3
large - Refrigerator	3
Coffee Machine	3
Toaster	2
Toaster Ovens	3
42" LCD TV	2
Fans	57
Smartboards	47
Refrigerated Vending	1
Non-Refrigerated Vending	1



Building Plug Load

Plumbing/Water System

There are 10 gang restrooms along with several single use restrooms at this facility, a faculty lounge with a sink, and the kitchen. A sampling of restrooms found the faucets rated for 2.0 gallons per minute (gpm).

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Frank J. Dugan Elementary School

Background Information

Frank J. Dugan Elementary School is located at 48 Topanemus Road, Marlboro, New Jersey. This 83,000 ft^2 facility was originally built in 1988. The one story building consists of classrooms, office space, a cafeteria, kitchen, nurse's station, storage, and other common areas.

Building Occupancy

Approximate enrollment is 621 students with a staff of 98 people.

Hours of Operation

- Monday through Friday 8:20 am to 3:00 pm
- Saturdays 8:30 am to 12:30 pm
- Sundays 12:00 am to 9:00 pm (July and August only)

Envelope

The school is constructed of concrete block with a brick facade. The building has areas with a pitched shingled roof and other areas with a flat built-up roof. The roof is in fair condition. The building has double pane windows which are in good condition and show little sign of excessive infiltration. The exterior doors are constructed of aluminum and glass and are in good condition.

Building Envelope

Lighting

Frank J. Dugan Gymnasium

Lighting is provided mostly by linear fluorescent T8 and T12 lamps, U-Bend fluorescent T8 lamps, and CFLs, incandescent, and exterior LED lamps. The linear fluorescent fixtures are primarily 2-, 3-, and 4-foot long luminaires. The cafeteria, kitchen, and some closet spaces are primarily lit with incandescent bulbs rated between 40-Watt and 100-Watt. The gym is lit with large fixtures with 42-Watt pin based CFLs.

The building's exterior lighting is all LED lights.

Lighting Controls: The interior lighting controls are primarily wall switches, but there are occupancy sensors in a few locations as well. The exterior light fixtures are primarily controlled with timers or photocells.

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Motors

Motors

The HVAC systems that serve the building utilize fan and pump motors which are generally in good condition and high efficiency. These systems include heating hot water pumps, exhaust fan motors, and supply fan motors. All motors in excess of 5 horsepower either currently utilize a variable frequency drive or were analyzed for retrofit.

Mechanical Systems

Boilers

HVAC Systems and Equipment: The hot water heating system consists of three P-K Mach C-200 condensing hot water boilers with 1,920 MBH output with ha nominal combustion efficiency of 96%. . The boilers operate in a lead/lag configuration, and both may be required to operate during cold weather. The boilers are configured with two 5 HP pumps that supply the radiators, and two 5 HP pumps that supply the AHU's. Hot water is supplied at 185°F when the outside air temperature is below 38°F and the setpoint is reset to 120°F when the outside air is above 60°F. There are also rooftop units that provide heat, including two 225 MBH McQuay rooftop furnace units that supply the cafeteria, and a single 125 MBH rooftop unit. The two McQuay packaged units have an 81% efficiency, and one other packaged unit has an efficiency of 80%.

The heating system is controlled with the building management system, and operates with a set point of 72°F when occupied. The boilers are in good condition and well maintained. The McQuay roof top units are in good condition, and others in fair condition.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
RTU-1, 2	2	Cafeteria Roof	Cafeteria	McQuay	MPS010B GDM22E	9 yrs	81%	10 Tons
RTU-3	1	Kitchen Roof	Kitchen	York	DW-05N13NW AAA3B	-	80	5 Tons
AHU-1	1	Mech Mezz East	Main Office	McQuay	LSL111CH	20 yrs	-	109 MBH
AHU-2	1	Mechanical Mezz Gym	Library	McQuay	LSL111CH	20 yrs	-	7.5 Tons
HV-1	1	Mechanical Mezz Gym	Gym	McQuay	LSL122DH	20 yrs	-	280 MBH
HV-2	1	Mechanical Mezz Gym	Gym	McQuay	LSL122DH	20 yrs	-	290 MBH
HV-3	1	Mechanical Mezz Gym	CR 21 - 27	McQuay	-	20 yrs	-	233 MBH
HV-5	1	Mech Mezz West	CR 28 - 39	McQuay	-	20 yrs	-	300 MBH
HV-7	1	Mech Mezz East	CR 1, 2, 3 ,4	McQuay	LSL111CH	20 yrs	-	150 MBH

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HV-8	1	Mech Mezz North	CR 5 - 18	McQuay	-	20 yrs	-	370 MBH
B-1, 2, 3	3	Boiler Room	Throughout	Paterson Kelly	C-2000	12 yrs	85.0%	2000 Btu/h
CU	1	Cafeteria Roof	-	UPG	GCGD24S 21S2XB	15 yrs	-	2
CU-1, 2	2	Gym Roof	Rm 40 & 41	Trane	4TTA3036 A4000BA	9 yrs	-	3
CU-3	1	Cafeteria Roof	AHU-2	McQuay	-	20 yrs	-	7.5
CU	1	Cafeteria	-	Trane	TTA09024 AAA00AE	19 yrs	-	7.5

The classrooms are primarily heated only via four hot water heating and ventilating units located mechanical mezzanines above each served wing along with baseboard heat. These H&V units feed shutoff terminal boxes located in each classroom. The cafeteria and kitchen are conditioned by three packaged rooftop units with natural gas heating. The main office, library, and security entry are served by split system air handlers with hot water heat. The gymnasium is heated only by two heating and ventilating units with hot water coils.

HVAC System

The packaged units are controlled with the building management system, and generally operate at 72°F when occupied. The split systems are controlled by programmable thermostats.

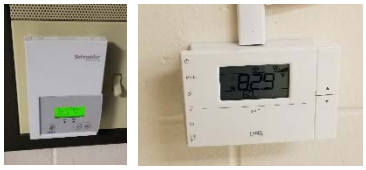
Domestic Hot Water Systems

The domestic water heating system for the facility consists of a single gas fired water heater with an input rating of 399 MBH and a nominal efficiency of 80%. The water heater has a 250-gallon storage tank. A single pump distributes the hot water to the entire site.

Domestic Hot Water

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
HWH-1	1	Boiler Room	Domestic Hot	PVI	500N2 50A-TP	-	80%	399 MBH

Building Controls (HVAC Controls)



Building Controls

The hot water heating system is tied to the Schneider building energy management system (BEMS). The BEMS aggregates the DDC points from throughout the building. Both DDC points and remaining pneumatic control points are tied into the BMS System. Per discussions with facility personnel, the heating setpoint is 71°F during occupied periods of time and is set back overnight to 64°F.

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The RTUs are controlled by programmable thermostats. The cooling setpoint is 69°F during occupied periods of time and set back overnight to 84°F.

Kitchen Equipment

The facility has a full commercial kitchen that is used to prepare breakfast and lunch for the students and employees. The kitchen equipment includes a gas fired oven and kettle, and an electric food warmer. There is a Hobart conveyor dishwasher with a high temp electric heater that provides rinse water.

The kitchen has multiple different refrigeration and freezer equipment. There is a walk-in refrigerator as well as a cooler that are used to store food prepared for school lunches. The refrigerator has a single 2-ton compressor, and the cooler has a 1.5 ton compressor. The kitchen also has a large stand up refrigerator, a standing refrigerator, two freezer chests, and two refrigerated chests.

Plug Load

There are roughly 66 computer work stations and 45 printers throughout the facility. Most classrooms have a projector or Smart Board. There are multiple coffee machines, kettles, microwaves, and refrigerators throughout the classroom and office spaces.

The facility has two vending machines, one of which is a refrigerated beverage machine.

ESG observed to following significant plug load technologies:

Device Type:	Quantity:
Computers	66
Small Printer/ Copier	39
Medium Printer/ Copier	3
Large Printer/ Copier	3
Projector	43
Microwave	4
Large Refrigerator	2
Coffee Machine	2
Wall Fan	43
Kettle	29
Smart Board	45
Refrigerated Vending	1
Non-Refrigerated Vending	1


Building Plug Load

Plumbing/Water System

There are 24 restrooms gang and single use at this facility. A sampling of restrooms found that the faucets are rated for 2 gallons per minute (gpm) or less, and the toilets and urinals are rated at 1.6 gallons per flush (gpf) or less.

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Marlboro Elementary School

Background Information

Marlboro Elementary School is located at 100 School Road, West Marlboro, New Jersey. This 74,219 ft^2 facility was originally built in 1970. The original building had a square footprint with an open courtyard in the center. In 1992, an addition was built in the center for the courtyard, housing what is now the media center. The gym was added as an extension to the rear of the building. The one story building consists of classrooms offices, food preparation, dining areas, offices, maintenance and storage areas and a gymnasium.

Building Occupancy

Approximate enrollment is 498 students with a staff of 72 people.

Hours of Operation

- Monday through Friday 9:00 am to 3:30 pm (students)
- Saturday and Sunday 8:00 am to 2:00 pm

Envelope

The building is constructed of concrete block with a brick veneer, and structural steel roof framing. The building has flat roof sections covered with rubber membrane or foam that is in fair condition. The original building has single pane windows and the media center has double pane windows. All windows have metal frames and are in fair condition.

Building Envelope

Lighting

Marlboro Elementary Cafeteria

Lighting is provided mostly by 32-Watt linear fluorescent T8 lamps with electronic ballasts as well as some compact fluorescent lamps (CFL). Most of the fixtures are 1-, 2-, 3- or 4-lamp, 4-foot long troffers with diffusers.

The building's exterior lighting includes pole fixtures with high pressure sodium luminaires, a compact fluorescent (CFL) wall-pack, and CFL and linear fluorescent fixtures in a covered walkway. The gym has 250-Watt pin-based CFL high-bay fixtures.

Lighting Controls: Lighting control in most spaces is provided by wall switches. The administrative areas of the building have wall mounted occupancy sensors. The covered walkway fixtures are controlled by a timer and the wall-pack and pole fixtures are controlled by photocells.

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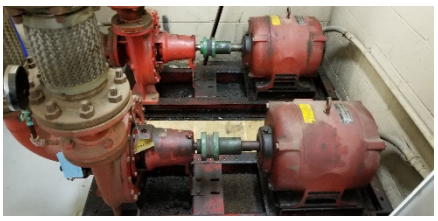
Motors



Motors

The HVAC systems that serve the building utilize fan and pump motors which are generally in good condition and high efficiency. These systems include heating hot water pumps, exhaust fan motors, and supply fan motors. All motors in excess of 5 horsepower either currently utilize a variable frequency drive or were analyzed for retrofit.

Mechanical Systems

Boilers

HVAC Systems and Equipment: The hot water system consists of two Superior Model H 5,120 MBH input scotch marine forced draft. The boilers have a nominal combustion efficiency of 80%. The boilers are configured in a constant flow distribution with two 15 HP hot water pumps supplying the unit heaters and radiators in the original building, and two 3 HP pumps supplying units in the gym. The boilers operate in a lead/lag configuration. Only a single boiler is required to meet the facility heating demand. Boiler operation is rotated weekly.

The boilers are over 40 years old and may be nearing the end of their useful life.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
RTU-1	1	Roof	-	Trane	TCD074C 30CBC	23 yrs	-	6 Tons
RTU-2	1	Roof	-	Goodman	PCK048-1	16 yrs	-	4 Tons
MRTU-1	1	Media Addition Roof	-	Lennox	CHA16-513-3Y	27 yrs	-	5 Tons
MRTU-2	1	Media Addition Roof	-	Lennox	CHA16-513-3Y	27 yrs	-	5 Tons
MRTU-3	1	Media Addition Roof	-	Lennox	CHA16-413-3Y	27 yrs	-	4 Tons
MRTU-4	1	Media Addition Roof	-	Lennox	CHA16-513-3Y	27 yrs	-	5 Tons
MRTU-5	1	Media Addition Roof	-	Lennox	CHA16-513-3Y	27 yrs	-	5 Tons
RTU-3, 4	2	Roof	Cafeteria	Trane	-	23 yrs	-	-
RTU-5	1	Roof	-	Goodman	PCK024-1	20 yrs	-	2 Tons
RTU-6	1	Roof	-	York	DAPM-F036AA	20 yrs	-	3 Tons
HV-1, 2	2	Stage,	Gymnasium	-	-	20	-	363 MBH

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		Mezz				yrs		
UV	5	1992 Classrooms	Classrooms	-	-	20 yrs	-	65 MBH
UV	3	1992 Classrooms	Classrooms	-	-	20 yrs	-	30 MBH
UV	36	Classrooms	Classrooms	-	-	20 yrs	-	30 MBH
B-1, 2	2	Boiler Room	Whole Building	Superior	N4AA5125G	49 yrs	-	5,120 Btu/h
CU-1	1	Roof	IT Closet	Fujitsu	AOU24RLB	-	-	2

There are 11 DX roof top units (RTUs) serving administrative offices, the media center, cafeteria, tech closets and maintenance office. The RTUs are equipped with economizers. The Principal's office has a mini-split system with a wall mounted evaporator and a roof mounted condenser. There are also window AC units and package terminal air conditioners serving other parts of the building.

HVAC System

Domestic Hot Water Systems

The domestic hot water heating system for the facility is an indirect system that uses a pump to circulate heating hot water from the heating system boilers to a heat exchanger in a large domestic hot water tank. One small circulation pump circulates domestic hot water to the rest of the building. The teacher lounge rest room is served by a 4.1 kW tankless water heater for the lavatory.

Domestic Hot Water

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
ST-1	1	Boiler Room	Whole Building	-	-	49 yrs	Storage	864 Gal

Building Controls (HVAC Controls)

Building Controls

The building has a Barber Coleman Network 8000 building energy management system (BEMS) that controls the HVAC systems. Occupied set points are 74°F heating and 68°F cooling. Unoccupied set points are 68°F heating and 74°F cooling.

The RTUs are controlled by programmable thermostats. Per discussions with facility personnel, the cooling setpoint is 69°F during occupied periods of time and set back overnight to 84°F.

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Kitchen Equipment

Most of the cooking is done using the four convection ovens. There is also a large electric food holding cabinet and a single tank conveyer dish washer.

The kitchen has a walk-in refrigerator with a 0.25-ton compressor and a walk-in freezer with a 0.5-ton compressor that are used to store food prepared for school lunches. The kitchen also has a free standing commercial size refrigerator and display cooler.

Plug Load

There are roughly 71 computer work stations and 45 small to medium printers throughout the facility. Most of the computers are desktop units with LCD monitors. There is no centralized PC power management software installed. There are also roughly 73 projectors and 41 smart boards.

Other plug loads include staff refrigerators, coffee machines, toaster ovens, fans, microwaves, a pretzel warmer and a display warmer.

ESG observed to following significant plug load technologies:

Device Type:	Quantity:
Desktop	71
Small Printers	39
Projectors	73
Refrigerators	4
Coffee Machine	3
Toaster oven	3
Television, LED, 50%	1
Fan	72
Smart Board	41
Microwave	3
Printer Med	6
Printer Large	4
Pretzel Warmer	1
Display Warmer	1
Refrigerated Vending	1
Non-Refrigerated Vending	1

Building Plug Load

Plumbing/Water System

There are 9 restrooms in the facility. A sampling of restrooms found that one faucet in the kitchen rest room was rated for 2.5 gallons per minute (gpm).

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Marlboro Memorial Middle School

Background Information

Marlboro Memorial Middle School is located at 71 Nolan Rd, Morganville, New Jersey. This 154,373 ft^2 facility was originally built in 2003, and is in good condition. The one story building consists of classrooms, a gymnasium, cafeteria, kitchen, and offices.

Building Occupancy

Approximate enrollment is 879 students with a staff of 120 people.

Hours of Operation

- Monday through Friday 7:00 am to 5:00 pm (students)
- Saturday and Sunday 9:00 am to 2:00 pm.

Envelope

The MMMS building is constructed of structural steel with a brick façade. The building has a pitched metal roof that is in good condition. The building has operable double paned windows which are in good condition and show little sign of excessive infiltration. The exterior doors are constructed of aluminum with metal framed glass and are in good condition.

Building Envelope

Lighting

Memorial MS Lighting

Lighting is provided mostly by 32-Watt linear fluorescent T8 lamps with electronic ballasts as well as 26-Watt and 13-Watt compact fluorescent lamps (CFL) and a few incandescent lamps. Most of the linear fluorescent fixtures are 4-foot long luminaires. Exit signs are LED fixtures.

The building's exterior lighting consists primarily of metal halide (MH), mercury vapor and CFL fixtures.

Lighting Controls: Lighting control in most spaces is provided by wall switches. There are only a few locations with occupancy sensors. Exterior Lighting is controlled by timers.

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Motors

Motors

The HVAC systems that serve the building utilize fan and pump motors which are generally in good condition and high efficiency. These systems include chilled water pumps, hot water pumps, exhaust fan motors, and supply fan motors. All motors in excess of 5 horsepower either currently utilize a variable frequency drive or were analyzed for retrofit.

Mechanical Systems

Boilers

Hot Water Heating (HHW) System: The hot water system consists of six Thermal Solutions EVH-2000 condensing boilers. Each boiler has an output capacity of 1,760 MBH and nominal combustion efficiency of 88%. The boilers operate when the OAT is lower than 60ºF. The boilers are at least 15 years old, and have recently required significant maintenance to maintain operation. Two constant flow hot water heating pumps operating in lead/lag on a rotating schedule that is controlled by BEMS which provides hot water to the UVs, AHUs, and RTUs. The AHUs mainly serve the common areas and offices while the RTUs serve the gym, cafeteria, kitchen, library and music rooms.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
RTU-1	1	Mech Room Roof	Gymnasium	Trane	TSCA035 GCC0BAA	17 yrs	-	67 Tons
RTU-2	1	Mech Room Roof	Aux Gym, Locker Rooms	Trane	TSCA021 BBB0A	17 yrs	-	34 Tons
RTU-3	1	Low Roof	Cafetorium	Trane	TSCA040 GAC0A	17 yrs	-	66 Tons
RTU-4	1	Low Roof	Library	Trane	TSCA021 GCC0BAA	17 yrs	-	30 Tons
RTU-5	1	Low Roof	Music Room	Trane	TSCA010 U0A	17 yrs	-	12 Tons
RTU-6	1	Low Roof	Kitchen	Trane	TSCA014 U0A	17 yrs	-	513.6 MBH
AHU-1	1	Attic	Toilets / Corridor	Trane	MCCA008	17 yrs	-	8 Tons
AHU-2	1	Attic	Faculty / Corridor	Trane	-	17 yrs	-	5 Tons
AHU-3	1	Attic	Administration	Trane	-	17 yrs	-	6 Tons
AHU-4	1	Attic	Guidance	Trane	-	17 yrs	-	7.5 Tons
AHU-5	1	Attic	Toilets / Corridor	Trane	-	17 yrs	-	7 Tons
AHU-6, 7, 9, 11, 13,	7	Attic	Science Lab	Trane	-	17 yrs	-	8 Tons

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17, 18								
AHU-8	1	Attic	Toilets / Corridor	Trane	-	17 yrs	-	8.5 Tons
AHU-10, 12	2	Attic	Home Economics	Trane	-	17 yrs	-	6 Tons
AHU-14, 15	2	Attic	Tech Lab	Trane	-	17 yrs	-	7.5 Tons
AHU-16	1	Attic	Toilets / Corridor	Trane	-	17 yrs	-	7.5 Tons
AC-1	6	Classrooms	Classrooms	Trane	-	17 yrs	-	2 Tons
AC-2	3	Classrooms	Classrooms	Trane	VUVC10021F	17 yrs	-	3.5 Tons
AC-3	6	Classrooms	Classrooms	Trane	-	17 yrs	-	4 Tons
AC-4	43	Classrooms	Classrooms	Trane	-	17 yrs	-	5 Tons
CPU-1, 2	2	IT Room	IT Room	Fujitsu	ASU36CLX	2 yrs	-	3 Tons
B-1 to 6	6	Main Mechanical Room	Throughout	Thermal Solutions	EVH2000BN1-UEBM	17 yrs	88.0%	2,000,000 Btu/h
CH-1, 2	2	Outside	Building Chilled Water	Carrier	30XAB350FC-0-RH3	17 yrs	-	350 Tons
CU-1, 2	2	Lower Roof	IT Room	Fujitsu	AOU36CLX	2 yrs	-	3 Tons

Chilled Water System: The facility is served by a single chilled water plant. The chiller plant consists of a two 350 ton Carrier air cooled screw chiller with two constant flow chilled water pumps. These chillers provide cooling to the entire building. The chillers stage based on the cooling demand. The chilled water is distributed to 18 air handler units (AHUs), 58 unit ventilators (UV), and six roof-top units (RTUs) on a primary-secondary loop. The primary loop has three 40 hp pumps while the secondary loop has two 100 hp pumps that operate in lead/lag. There is an operation/rotation schedule in the building energy management system (BEMS) that determines which pump operates. The chillers operate when the outside air temperature (OAT) is greater than 60ºF. The chillers are new and well maintained.


Chiller System


Air Handler Unit (AHU)

Chilled Water Air Conditioning System (CHW): The chilled water produced by the chillers described in the chilled water system section above, serve the cooling coils for 18 air handling units (AHUs 1-18), 58 unit ventilators, and six roof-top units (RTUs1-6). The AHUs mainly serve the common areas and offices while the RTUs serve the gym, cafeteria, kitchen, library and music rooms. Unit ventilators typically serve the classrooms. The AHUs and RTUs are all constant air volume units serving single zones and are controlled by the Niagara BEMS system. Control is based on a schedule and the zone temperature set points. The systems have separate heating and cooling set points. Winter (heating) zone set points are globally set to 72-73ºF when occupied and set back to 65ºF

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when unoccupied. Summer (cooling) zone set points are globally set to 73-74ºF when occupied and set back to 80ºF when unoccupied. The AHUs and RTUs have outside air economizer to utilize free cooling when the outside air temperature is lower than the return air temperature. The outside air economizer is an electrical/mechanical system that requires periodic inspection and maintenance. We recommend that the economizers to the units be inspected for functionality as they could be wasting energy, decreasing comfort or impacting the air quality.

Split System AC (IT Room)

Direct Expansion Air Conditioning System (DX): There are two 3-ton split system ACs used in the IT office. The units are manually controlled by a thermostat located in the zone. The unit operate on demand to maintain a space temperature set point (adjustable by staff).

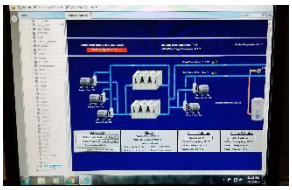
Domestic Hot Water Systems

The domestic hot water heating system for the facility consists of a single PVI-Turbopower water heater with an input rating of 1,600 MBh and a nominal efficiency of 80%. The water heater has a 900 gallon storage tank.

Domestic Hot Water

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
HWH-1	1	Main Mechanical Room	Building Domestic Hot	PVI	2000-P-900A-TP	17 yrs	80%	1,600 MBH

Building Controls (HVAC Controls)



Building Controls

The majority of the facility is controlled with a Tridium Niagara building energy management system (BEMS). The BEMS aggregates the DDC points from throughout the building. The system controls the boiler and chiller plant as well as all the AHUs and RTUs. Operation schedules, set points, setbacks, etc. for the various mechanical equipment can be programmed on the BEMS. A drawback on the existing system is there is currently only a single schedule setup to control all areas of the buildings.

Kitchen Equipment

The school has a kitchen that is used to prepare approximately 1100 lunches per day for the students and staff. Most of the cooking is done using the gas ovens, steamers and a large stove.

The kitchen has several refrigerators and coolers as well as one walk-in freezer and a walk-in cooler. These appliances appear to be new.

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Plug Load

There are roughly 1,200 desktop and laptop computers throughout the facility. Roughly 86% of the computers are laptops while the remaining 14% are desktop units with LCD monitors. There is no centralized PC power management software installed. There are roughly 53 projectors and 49 Smartboards in the classrooms, as well as about 65 printers throughout the building.

The facility has four vending machines, three of which are refrigerated vending machines.

ESG observed to following significant plug load technologies:

Device Type:	Quantity:
Desktop Computer	163
Laptops	1,003
Small Printer	59
Medium Printer	4
Large Printer	2
Projectors	53
Microwaves	13
Sm. Refrigerators	2
Md. Refrigerators	3
Lg. Refrigerators	6
Coffee Machine	10
Toaster Oven	3
Standing Fans	3
Smart Board	49
Cold/Hot Water Dispenser	1
Refrigerated Vending	3
Non-Refrigerated Vending	1

Building Plug Load

Plumbing/Water System

There are 25 restrooms in facility single and multi-user. A sampling of restrooms found that the faucets are rated for 2.2 gallons per minute (gpm) and the urinals are rated at 1.0 gallons per flush (gpf).

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Robertsville Elementary School

Background Information

Robertsville Elementary School is located at 36 Menzel Lane, Morganville, New Jersey. This 70,880 ft^2 facility was originally built in 1968 and has since had three additions. In 1997, new classrooms were added followed by the addition of a faculty lounge, six new classrooms, additional restrooms, and updates to the nurse's office and a cafeteria in 1997. Then most recently in 2015 a new main office and security area were added. The one story building consists of classrooms with a gymnasium, cafeteria, kitchen, and offices

Building Occupancy

Approximate enrollment is 491 students with a staff of 84 people.

Hours of Operation

- Monday through Friday 9:00 am to 3:30 pm (September through June)
- Gym open Saturdays (November through February)
- Some classrooms open Sundays 2:00 pm to 6:00 pm (September through May)

Envelope

The school building is constructed of concrete block, and structural steel with a brick facade. The building's roof was redone approximately four years ago and is a flat foam roof covered with light colored membrane. The building's three additions have double pane windows which are in good condition and show little sign of excessive infiltration. The original building still has single pane windows. The exterior doors are constructed of aluminum and glass.

Building Envelope

Lighting

Robertsville ES Gymnasium

Lighting is provided mostly by 32-Watt linear fluorescent T8 lamps with electronic ballasts as well as some compact fluorescent lamps (CFL). The fixtures are a mix of 2-lamp, 3-lamp, or 4-lamp, 4-foot long troffers with diffusers. The majority of the fixtures are 2-lamp. The gymnasium is lit with 9-lamp CFL fixtures.

The building's exterior lighting is minimal and consists of a mix of CFLs, linear fluorescent T8s, high pressure sodium (HPS), and mercury vapor (MV) fixtures

Lighting Controls: Lighting control in most spaces is provided by manual wall switches. The lighting for the main office, VP office, security area, and two classrooms are controlled with occupancy sensors that are either wall or ceiling mounted depending on the space layout. Exterior fixtures are controlled by a timer.

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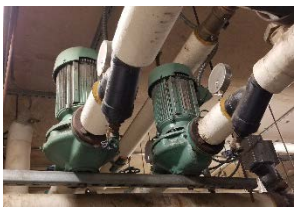
Motors



Motors

The HVAC systems that serve the building utilize fan and pump motors which are generally in good condition and high efficiency. These systems include heating hot water pumps, exhaust fan motors, and supply fan motors. All motors in excess of 5 horsepower either currently utilize a variable frequency drive or were analyzed for retrofit.

Mechanical Systems

Boilers

HVAC Systems and Equipment: The hot water system consists of two Superior 2,678 MBH input, forced draft boilers. The boilers have a nominal combustion efficiency of 80%. Each boiler has a 0.75 hp forced draft fan. The boilers are shut off when the outside air exceeds 65°F. The boilers provide heating hot water to the entire building's HVAC system. The buildings occupied heating setpoint is 72°F and is setback to 65°F when unoccupied. The boilers operate year-round to provide domestic hot water. The boilers, while over 50 years old, appear to be in okay condition and maintained.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
B-1, 2	2	Boiler Room	Throughout	Superior	N4AA580 G	52 yrs	70.2%	2,678 Btu/h
HV-1, 2	2	Mezzanine	Gym	Nesbitt	LPH55HC	-	-	-
UV	3	Library	Library	Trane	-	23 yrs	-	3 Tons
UV-5	1	Classroom 37A	Classroom 37A	Airedale	-	3 yrs	-	2 Tons
UV-6	1	Classroom 37B	Classroom 37B	Airedale	-	3 yrs	-	4 Tons
UV	32	Classroom	Classroom	-	-	20 yrs	-	-
CU-1, 2, 3	3	Roof	-	Sanyo	C0911	10 yrs	-	0.75 Tons
CU-4	1	Roof	Security Vestibule	Carrier	24AHA424 A300	2 yrs	-	3.5 yrs
CU-5, 6, 7	3	On Grade	Library	Trane	TTR036C1 00A2	23 yrs	-	3 Tons
RTU-1	1	Roof	Faculty Room	Goodman	PCK048-C	18 yrs	-	4 Tons
RTU-2	1	Roof	Administrati on	Trane	TCD074C	23 yrs	-	7 Tons
RTU-3,4	2	Roof	Cafeteria	Trane	TCD	23 yrs	-	15 Tons

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HVAC System

Robertsville Elementary School is served by a variety of direct-expansion (DX) units including ductless split systems, window AC units, in-room packaged AC units, and rooftop packaged units. The majority of the split system AC units and packaged AC units are located on the roof and serve the faculty lounge, media center, tech closet, cafeteria, IT room, and the main office. These units range in size from 0.75 tons to 15 tons and provide mechanical cooling to approximately 20% of the facility. The 15-ton Trane packaged AC units serving the cafeteria have duct mounted heating hot water coils. The two 4-ton Airedale in-room packaged AC units serving classrooms 37 & 37B are equipped with hot water coils that are served by the boilers. Twelve of the classrooms have window AC units for cooling.

The units operate to maintain a space temperature setpoint of 72°F when occupied and 81°F when unoccupied.

Domestic Hot Water Systems

This site does not have a dedicated domestic hot water heating system. Domestic hot water is indirectly provided by the heating boilers via a heat exchanger. Domestic hot water is stored in a 400-gallon tank.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
EDWH-1	1	Janitor Closet	Mop Sink	AO Smith	-	-	-	1.2kW
ST-1	1	Boiler Room	Building Service Hot Water	-	-	52 yrs	-	750 Gal

Building Controls (HVAC Controls)


Building Controls

The building has a Barber Coleman Network 8000 building energy management system (BEMS) that controls the HVAC systems, and is tied into the original Barber pneumatic control panel. Occupied set points are 74°F heating and 68°F cooling. Unoccupied set points are 68°F heating and 74°F cooling.

The RTUs are controlled by programmable thermostats. Per discussions with facility personnel, the cooling setpoint is 69°F during occupied periods of time and set back overnight to 84°F.

Kitchen Equipment

The school's kitchen is used to prepare lunches daily for the students and staff. The kitchen equipment consists of an ice cream novelty freezer, three double door commercial refrigerators, reach-in milk cooler, gas convection oven with six electric range top burners, four convection ovens, a warmer, walk-in freezer, walk in cooler, and a dishwasher. The kitchen is occupied Monday through Friday from 8:00 AM to 2:00 PM September through June.

The kitchen also has a walk-in cooler with a walk-in freezer located inside the cooler.

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Plug Load

There are roughly 67 desktop computer work stations throughout the facility and 34 laptops. There is no centralized PC power management software installed. General office equipment and break room amenities contribute to the plug load. Classrooms are outfitted with projectors, starboards, and other audio visual aids. The facility has one refrigerated beverage vending machine and one non-refrigerated vending machine.

ESG observed to following significant plug load technologies:

Device Type:	Quantity:
Desktop computers	67
Laptops	34
Small Printer/Copier	3
Medium Printer/Copier	3
Large Printer/Copier	3
Projectors	43
Microwaves	5
Small Refrigerator	1
Medium Refrigerator	1
Large Refrigerator	4
Coffee Machine	1
Toaster	2
Toaster Oven	1
50" LED TV	3
Standing Fans	66
Smart Boards	44
cash registers	2
Refrigerated Vending	1
Non-Refrigerated Vending	1

Building Plug Load

Plumbing/Water System

There are 20 restrooms at this facility, a faculty lounge, and the kitchen both with sinks. A sampling of restrooms found that most of the fixtures were low flow.

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Transportation Garage

Background Information

The Transportation Garage is located at 1 Lotta Burke Way, Marlboro, New Jersey. This 9,060 ft^2 facility was originally built in 1980. The one story building consists of comprised of office space in the front and a large transportation garage in the back. The office space and the garage are single story, but the garage is an open space with high ceilings. The office area has a break room, kitchen, restrooms, and office space. The garage has storage, a tire room, and restrooms.

Building Occupancy

The facility has approximately 10 full time staff, with multiple drivers cycling in and out of the building.

Hours of Operation

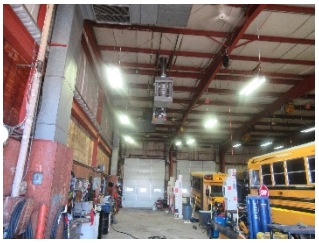
- Monday through Friday 6:00 am to 5:00 pm
- Saturday and Sunday not occupied

Envelope

The transportation garage is constructed of metal stud walls, with a corrugated metal façade on the garage, and vinyl siding on the office space. The buildings have slightly slanted metal roofs that appear to be in good condition. The buildings have single paned windows which are in fair condition. The single paned windows should be considered for replacement to reduce energy use and improve comfort. Replacing windows with high efficiency windows is not typically cost effective based only on energy savings. The exterior doors are constructed of aluminum and in good condition.

Building Envelope

Lighting



Transportation Garage

Lighting is provided predominately by 32-Watt linear fluorescent T8 lamps with electronic ballasts. Most of the building spaces use 2-lamp or 4-lamp, 2-foot wide by 4-foot long fixtures. The maintenance bay lighting fixture were recently replaced with LED Bulbs. The building has minimal exterior lighting, which consists of high pressure sodium fixtures, compact fluorescent, and incandescent fixtures.

Lighting Controls: Lighting control in most interior spaces is provided by wall switches. Exterior lights are controlled by timers

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Mechanical Systems

HVAC Systems and Equipment: The Transportation Garage has a combination heat and air conditioning system serving the office area. The heating portion consists of two 120 MBH Thermo Products Oil-Fired Furnaces, located in the garage. Air conditioning is provided by a direct expansion system that consists of two Johnson Controls split system AC units. The compressors and condensers are located next to each other on the exterior of the garage, and each evaporator is located above the furnaces in the garage. The heating and air conditioning utilize a common distribution system

The garage bays are heated by oil fired unit heaters. There are also ceiling mount electric heaters serving the storage room, and electric baseboard heat in the break room.

The units are manually controlled by a thermostat located in the zone. The unit operates on demand to maintain a space temperature setpoint around 72°F (adjustable by staff).

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
AH-1, 2	2	Closet	Office	Thermo Pride	-	2 yrs	87.0%	3 Tons
UH-1	4	Garage	Garage	-	-	-	80.0%	200 MBH
CU-1	2	On Grade	Office	Coleman	TCJD36S4 1S3EA	2 yrs	-	3 Tons

HVAC System

Domestic Hot Water Systems

The domestic hot water system for the facility consists of one Bradford White electric hot water heater with an input rating of 4.5 kW. The water heater has a 30-gallon storage tank. The system operates on the water supply pressure, so no pumps are required.

Domestic Hot Water

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
HWH-1	1	Garage	Building	Bradford White	RE330S6	2 yrs	100%	4.5 kW

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Building Controls (HVAC Controls)

The building has no central building management system and units are controlled by individual programmable thermostats.

Plug Load

There are roughly seven computer work stations throughout the facility and four printers. There is no centralized PC power management software installed.

The facility has a single refrigerated beverage vending machine.

ESG observed to following significant plug load technologies:

Device Type:	Quantity:
Computers	7
Small Printer/ Copier	1
Medium Printer/ Copier	2
Large Printer/ Copier	1
Paper Shredder	1
Microwaves	3
Large Refrigerators	2
Coffee Machines	3
Toaster	1
Toaster Oven	1
Dishwasher	1
LED 30" TV	1
Hot and Cold Water Dispense	1
Standing Fans	2
Cooking Range	1
Refrigerated Vending	1

Building Plug Load

Plumbing/Water System

There are three restrooms at this facility. A sampling of restrooms found that all of the faucets are rated for around 2 gallons per minute (gpm) and the toilets are rated at 1.6 gallons per flush (gpf).

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Marlboro Middle School

Background Information

Marlboro Middle School is located at 355 County Road 520, Marlboro, New Jersey. This 198,820 ft^2 facility was originally built in 1976 and has since had several additions over the years, with the most recent being the addition of the D Wing in 1997. The three story building consists mainly of classrooms, but also has multiple gymnasiums, cafeterias, kitchens, and offices

Building Occupancy

Approximate enrollment is 1,052 students and 164 faculty.

Hours of Operation

- Monday through Friday 7:30 am to 2:30 pm (September through June)
- Saturday 9:00 am to 4:00 pm
- Sunday 9:00 am to 3:00 pm

Envelope

The building is constructed of concrete block and structural steel with a brick facade. The building has a flat roof covered with a rubber membrane. The membrane on the older section of the building is a lighter color, while the newer wings have a dark colored membrane. The older portion of the building has single pane aluminum framed windows and doors while the newer sections have double pane windows.

Building Envelope

Lighting

Marlboro MS Hallway

Lighting is provided mostly by 32-Watt linear fluorescent T8 lamps with electronic ballasts as well as some compact fluorescent lamps (CFL). Most of the fixtures are 2-lamp, 4-foot long troffers with diffusers or suspended linear fluorescent fixtures.

The building's exterior lighting is minimal and consists of a mix of high pressure sodium (HPS), mercury vapor (MV), CFL, and LED fixtures.

Lighting Controls: Lighting control in most spaces is provided by manually operated wall switches. The nurse's office suite and storage area lighting is controlled with occupancy sensors that are either wall or ceiling mounted depending on the space layout. Exterior fixtures are controlled by photocells

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Motors

Motors

The HVAC systems that serve the building utilize fan and pump motors which are generally in good condition and high efficiency. These systems include heating hot water pumps, chilled water pumps, exhaust fan motors, and supply fan motors. All motors in excess of 5 horsepower either currently utilize a variable frequency drive or were analyzed for retrofit.

Mechanical Systems

Boilers

HVAC Systems and Equipment: The hot water heating system consists of three Cleaver Brooks forced draft boilers. The boilers each have a rated input of 5,230 MBH and a nominal combustion efficiency of 80%. Each boiler has a 5 hp blower motor. The boilers provide hot water to the building's 88 unit ventilators, hallway baseboard radiators, rooftop units, and the indirect domestic hot water system. The hot water is distributed by two 15 HP, four 5 HP, and two 1.5 HP constant volume pumps.

Designation	System Quantity	Location	Floor/ Serves	Manufacturer	Model/ Make	Age	Efficiency	Capacity
RTU-1	1	Roof	MP Room	Trane	PCCC023 XCA	21 yrs	-	-
RTU-2	1	Roof	MP Room	Trane	PCCC014 XCA	21 yrs	-	-
RTU-3	1	Roof	-	Trane	PCCC014 XCA	21 yrs	-	-
RTU-4	1	Roof	D-Wing	Trane	PCCC018 XCA	21 yrs	-	-
RTU-5	1	Roof	Guidance Office	Trane	PCCC007 XCA	21 yrs	-	-
RTU-6	1	Roof	Main Office	Trane	PCCC007 XCA	21 yrs	-	-
RTU-7	1	Roof	B-Wing	Trane	PCCC018 XCA	21 yrs	-	-
RTU-8	1	Roof	A-Wing	Trane	PCCC018 XCA	21 yrs	-	-
RTU-9	1	Roof	B-Wing	Trane	PCCC007 XCA	21 yrs	-	-
RTU-10	1	Roof	A-Wing	Trane	PCCC007 XCA	21 yrs	-	-
ERU	1	Kitchen Roof	Locker Rooms/Restrooms	Semco	FVTS2000 R-6RT2AB	9 yrs	-	-
RTU-1	1	Kitchen Roof	Gymnasium	Trane	WLHE4E044C10C59D200	9 yrs	92.4%	50 Tons
RTU-1	1	Roof	MP Room	Trane	PCCC023 XCA	21 yrs	-	-

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RTU-2	1	Roof	MP Room	Trane	PCCC014 XCA	21 yrs	-	-
RTU-3	1	Roof	-	Trane	PCCC014 XCA	21 yrs	-	-
RTU-4	1	Roof	D-Wing	Trane	PCCC018 XCA	21 yrs	-	-
RTU-5	1	Roof	Guidance Office	Trane	PCCC007 XCA	21 yrs	-	-
RTU-6	1	Roof	Main Office	Trane	PCCC007 XCA	21 yrs	-	-
RTU-7	1	Roof	B-Wing	Trane	PCCC018 XCA	21 yrs	-	-
RTU-8	1	Roof	A-Wing	Trane	PCCC018 XCA	21 yrs	-	-
RTU-9	1	Roof	B-Wing	Trane	PCCC007 XCA	21 yrs	-	-
RTU-10	1	Roof	A-Wing	Trane	PCCC007 XCA	21 yrs	-	-
ERU	1	Kitchen Roof	Locker Rooms/Restrooms	Semco	FVTS2000 R-6RT2AB	9 yrs	-	-
RTU-1	1	Kitchen Roof	Gymnasium	Trane	WLHE4E044C10C59D200	9 yrs	92.4%	50 Tons
RTU-1	1	Roof	Classroom 102	Trane	YHC048E4RHA	9 yrs	81.0%	4 Tons
RTU-2	1	Roof	Classroom 101	Trane	YHC048E4RHA	9 yrs	81.0%	4 Tons
RTU-3	1	Roof	Locker Rooms/Restrooms	Trane	YHC036E4RMA	9 yrs	81.0%	3 Tons
RTU	1	Roof	Mini-Theater	Trane	SACA-1004-8	23 yrs	-	10 Tons
UV	76	Classrooms	Classrooms	Various	-	20 yrs	-	-
B-1	1	Boiler Rm	Throughout	Cleaver Brooks	CB-800-125	58 yrs	82.0%	5,230 MBH
B-2	1	Boiler Rm	Throughout	Cleaver Brooks	CB-800-125	58 yrs	82%	5,230 MBH
B-3	1	Boiler Rm	Throughout	Cleaver Brooks	CB-800-125	58 yrs	82.0%	5,230 MBH
ACCH-1	2	Grade	D-Wing	Trane	RTAF170EUAFHXUA2	1 yr	-	340 Tons
Split AC	68	Roof	Various	Various	Various	-	Various	Various

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The D Wing is served by a single 340-ton Trane air-cooled screw chiller. Chilled water is supplied to the D Wing's two packaged rooftop units and indoor chilled water unit ventilators and air handlers by two 30 HP constant volume pumps. There is also a glycol loop serving the D Wing to keep the CHW and HHW from freezing. The Glycol loop flow is maintained by two 15 HP constant flow pumps.

Chiller

Split-System AC Condenser

Typical classrooms throughout the facility conditioned by either split system unit ventilators with hot water heating and direct expansion cooling, or they are outfitted with chilled water cooling and hot water heating. The split system condensing units are typically located on the roof.

There are several packaged AC units range in size from 3 tons to 50 tons, and along with the air-cooled chiller serving the D wing, provide mechanical cooling to the facility. Other package units are equipped with hot water coils.

Building Controls (HVAC Controls)

Building Controls

The building management system consists of an old pneumatic control system that is tied to a Barber Coleman 8000 Network. Several of the newer rooftop units are equipped with DDC controls that are tied to Building Energy Management System (BEMS) front end located in the main boiler room.

Kitchen Equipment

The school has three kitchens: the main kitchen, the A Wing kitchen, and the B Wing kitchen. The kitchens are used to prepare lunches daily for the students and staff. The A and B Wing kitchens each have a freezer chest, reach-in milk cooler, double door refrigerator, two food warmers, and an electric convection oven. The main kitchen's equipment consists of an electric six plate cooking range, four door freezer/refrigerator, glass door refrigerator, a walk-in cooler, and a walk-in freezer. The kitchen is occupied Monday through Friday from September through June.

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Plug Load

There are approximately 230 desktop computer work stations throughout the facility and roughly 1,050 Chromebooks. There is no centralized PC power management software installed.

General office equipment and break room amenities contribute to the plug load. Classrooms are outfitted with projectors, smartboards, and other audio-visual aids.

The facility has three refrigerated beverage vending machines.

ESG observed to following significant plug load technologies:

Device Type:	Quantity:
Desktop computer	230
laptop	2
Chromebook	1,050
Small printer/copier	56
medium printer/copier	18
large printer/copier	5
projector	77
smart board	77
paper shredder	2
microwave	16
small refrigerator	2
medium refrigerator	7
large refrigerator	8
coffee machine	5
Clothes washer	1
Clothes dryer	1
50" LED TV	1
oven w/Induction cooking range	8
cash registers	4
Refrigerated Vending	3

Building Plug Load

Plumbing/Water System

There are approximately 23 restrooms at this facility three faculty lounges with sinks, the three kitchens, and various locker rooms. A sampling of restrooms found the faucets rated for 1.5 to 2.0 gallons per minute (gpm) and the toilets are rated at 1.6 gallons per flush (gpf).

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Utility Baseline Analysis

Electric

Electrical energy is provided to Marlboro Township Public Schools from Jersey Central Power & Light (JCP&L). JCP&L, which is the electric transport company and Constellation Energy Inc. is the commodity supplier. In the event Constellation Energy Inc. is not the supplier then JCP&L is the default supplier. The electric utility measures consumption in kilowatt-hours (kWh). One kWh usage is equivalent to 1000 watts running for one hour.

The primary electric rate used by the buildings at Marlboro Township Public Schools, is the General Service Secondary (GS).

Natural Gas

Marlboro Township Public Schools has natural gas transported by New Jersey Natural Gas (NJNG) and the supplier is Woodruff Energy. The gas utility measures consumption in cubic feet x 100 (CCF) and converts the quantity into Therms of energy. The district buildings fall under the General Service Large (GSL) Rate structure for natural gas.

Fuel Oil

Transportation Garage utilizes fuel oil for the building heat. J Swanton Fuel Co. provides fuel oil to this building.

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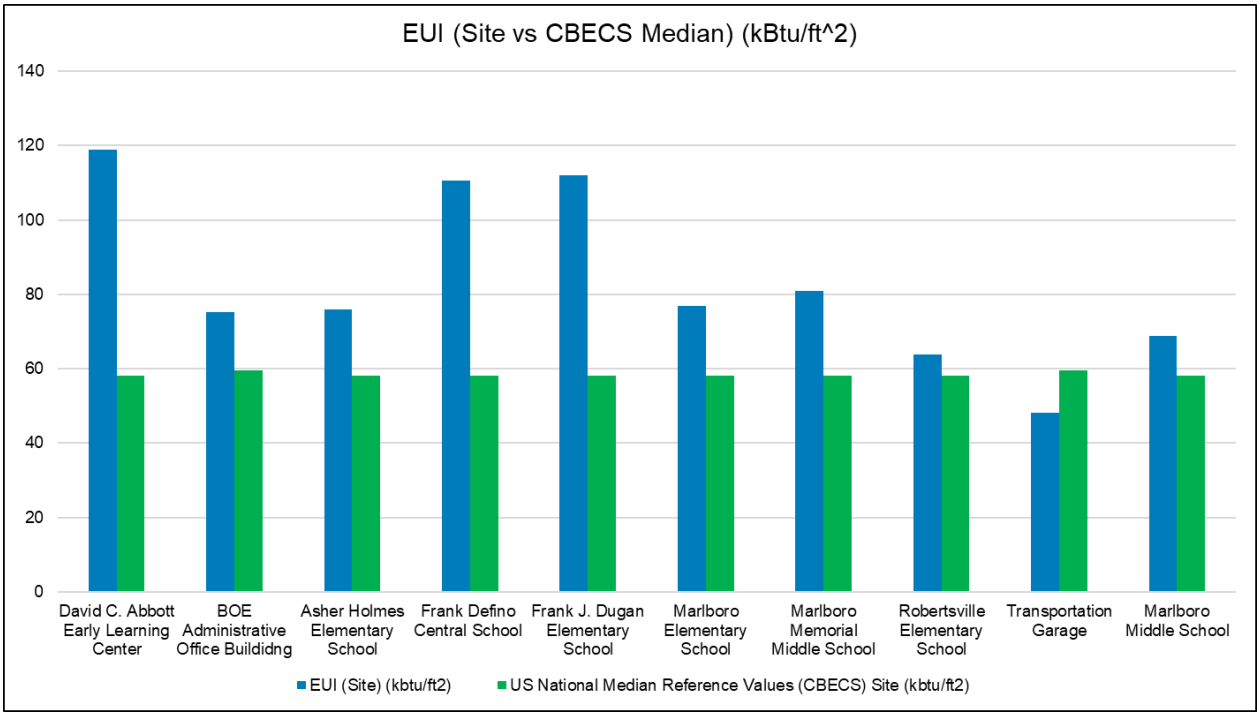
Energy Usage Summary

Marlboro Township Public Schools Energy Summary Analysis Table

Baseline Data	Electric		Natural Gas		Fuel Oil		Water		EUI
Facility Name	Annual kWh	Total $	Therms	Total $	Annual Gallons	Total $	Total Cost	Total Utility Cost	EUI - Pre (Btu/ft²)
David C. Abbott Early Learning Center	527,680	$62,090	23,393	$27,869	-	-	$2,236	$92,194	104,715
BOE Administrative Office Buildidng	174,160	$20,858	-	-	-	-	$657	$21,515	75,242
Asher Holmes Elementary School	441,760	$49,177	38,672	$46,351	-	-	$4,383	$99,911	75,891
Frank Defino Central School	724,400	$78,554	52,967	$57,645	-	-	$4,264	$140,463	110,913
Frank J. Dugan Elementary School	789,120	$81,718	63,779	$69,244	-	-	$5,680	$156,643	109,291
Marlboro Elementary School	536,640	$59,254	39,273	$48,043	-	-	$7,427	$114,725	77,582
Marlboro Memorial Middle School	1,753,200	$195,500	65,105	$80,482	-	-	$6,079	$282,061	80,935
Robertsville Elementary School	381,920	$46,236	32,268	$39,706	-	-	$3,901	$89,843	63,915
Transportation Garage	127,600	$13,415	-	-	4,028	$8,467	$1,327	$23,208	109,865
Marlboro Middle School	1,728,800	$193,057	80,414	$94,361	-	-	$10,169	$297,587	70,123
Totals	**7,185,280**	**$ 799,860**	**395,871**	**$ 463,700**	**4,028**	**$ 8,467**	**$ 46,123**	**$1,318,150**	**31,494**



Marlboro Township Public Schools Energy Use Index (EUI) Analysis

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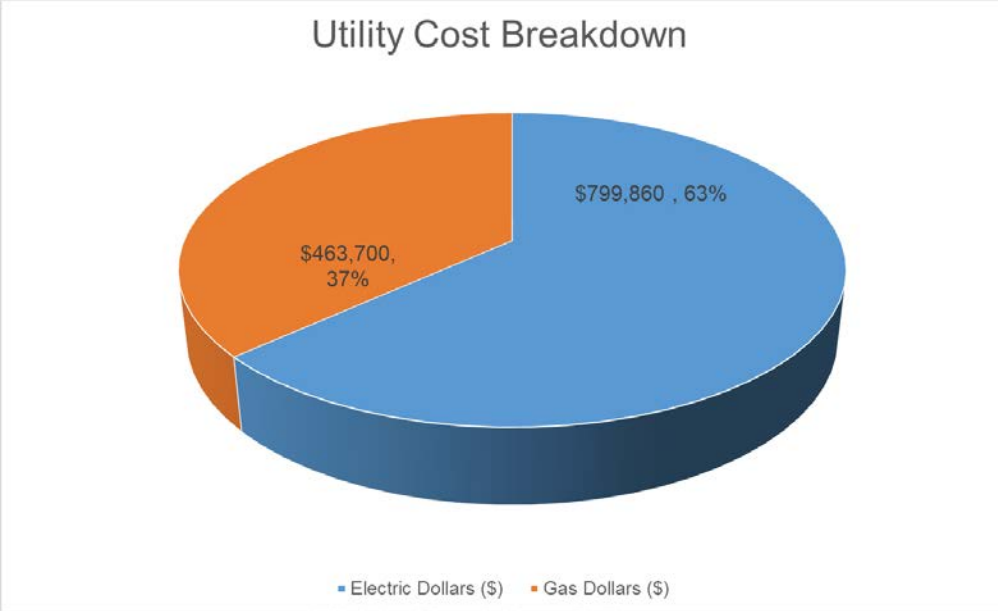
The pie chart below shows the distribtuion of these two energy source costs relative to the entire District energy consumption. At 70% of the total consumption, electricity comprises a larger share of the energy costs.



Marlboro Township Public Schools Utility Cost Breakdown

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Marginal Rates

For the purposes of determining how energy conservation measures will affect the utility bill, it is important to understand what portions of the cost can be saved. In general, there are costs associated with utility bills that are fixed and independent of usage, such as the monthly meter charge. For example, in the case of a monthly meter charge, this charge often exists even if the energy usage were zero. An energy conservation measure often cannot produce a cost savings on this portion of the bill. The utility rate structure has to, therefore, be analyzed to determine what portion of the bill a cost savings can be produced using a specific energy conservation measure. For the purposes of this report, the blended average utility rate is the total cost divided by the total energy units. The effective rate is the portion of the bill effected by energy saving or the applied energy conservation measure.

The utility rates identified below were used for purposes of calculating the dollar effect of the energy savings.

Electric

Electric Rates	$/kWh	$/kW
GS	$0.090	$6.42

The effective suppy rate is based on the most recent available bill for Marlboro Middle School with meter reading of 11/19/2018. The effective transport $/kWh and $/kW demand rates are based on the JCPL tariff rates as of 12/1/18 effective 11/1/2018. The total effective $/kWh rate is the summation of the supply and transport effective rates. A simplified weighted average $/kW demand is used as the effective rate for savings calculations. It was calculated by taking the summation of the annual $/kW demand times 8/12 plus the total summer $/kW demand times 4/12. Summer demand rates are considered June through September.

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Building Name	Rate	Meter #	Electric Transport Account #	Effective Rate (Note 2)		EFFECTIVE RATE (Note 2)		Total Baseline Electric	Peak Demand Billed (Note 4)	TOTAL Electric Cost		Blended Avg Unit Cost ($ / Unit) (Note 5)	Base Year
				Supply	Delivery	TOTAL							
				$/kWh (Note 3)	Effective $/kWh	Effective $/kW	Eff $/kWh	kWh	kW	Cost $			
David C. Abbott Early Learning Center	GS 3	L86352810	100 045 560 537	$0.0739	$0.01642	**$6.42**	**$0.090**	527,680	277.9	$	62,090	$ 0.118	Jan-18 - Dec-18
BOE Administrative Office Building	GS 3	S 313226079	100 011 280 029	$0.0739	$0.01642	**$6.42**	**$0.090**	174,160	106.3	$	20,858	$ 0.120	Jan-18 - Dec-18
Asher Holmes Elementary School	GS 3	G35518235	100 012 105 894	$0.0739	$0.01642	**$6.42**	**$0.090**	441,760	158.4	$	49,177	$ 0.111	Jan-18 - Dec-18
Frank Define Central School	GS 3	G35535416	100 010 894 200	$0.0739	$0.01642	**$6.42**	**$0.090**	724,400	230.2	$	78,554	$ 0.108	Jan-18 - Dec-18
Frank J. Dugan Elementary School	GS 3	G28742976	100 011 596 317	$0.0739	$0.01642	**$6.42**	**$0.090**	789,120	198.6	$	81,718	$ 0.104	Jan-18 - Dec-18
Marlboro Elementary School	GS 3	S 07019146	100 011 233 606	$0.0739	$0.01642	**$6.42**	**$0.090**	536,640	190.1	$	59,254	$ 0.110	Jan-18 - Dec-18
Marlboro Memorial Middle School	GS 3	S 309603485	100 037 289 632	$0.0739	$0.01642	**$6.42**	**$0.090**	1,753,200	705.6	$	195,500	$ 0.112	Jan-18 - Dec-18
Robertsville Elementary School	GS 3	S 322263415	100 012 105 969	$0.0739	$0.01642	**$6.42**	**$0.090**	381,920	189.4	$	46,236	$ 0.121	Jan-18 - Dec-18
Transportation Garage	GS 3	S 316386080	100 011 239 967	$0.0739	$0.01642	**$6.42**	**$0.090**	127,600	39.2	$	13,415	$ 0.105	Jan-18 - Dec-18
Marlboro Middle School	GS 3	G28742929	100 011 239 058	$0.0739	$0.01642	**$6.42**	**$0.090**	1,728,800	716.4	$	193,057	$ 0.112	Jan-18 - Dec-18

Note 1: The electric commodity suppler of electricity for the baseline period is Constellation Energy Inc. and the transport company is Jersey Central Power & Lighting (JCP&L).
Note 2: The effective rate does not include fixed charges and is the portion of energy costs that can be affected by a change in energy or demand. The effective transport $/kWh and $/kW demand rates are based on the JCPL tariff rates as of 12/1/18 effective 11/1/2018. The total effective $/kWh rate is the summation of the supply and transport effective rates. Summer rate is considered months June through September. A simplified weighed average delivery/transport $/kW demand rate is used in determining the Total Effective rate for savings calculations. The $/kW demand rate was calculated by taking the summation of the non-summer $/kW rate times 8/12 plus the Summer $/kW rate times 4/12.
Note 3: Effective Supply rate for Constellation Energy includes JCP&L transmission charge. For simplicity the effective supply rate is the Constellation and JCP&L transmission cost divided by the billed kWh total and is based on the most recent available bill for Marlboro Middle School with meter reading of 11/19/2018.
Note 4: Peak Demand Billed is the highest billed demand that occurred during the baseline period.
Note 5: The average blended unit cost is the total 12 month utility costs divided by the total 12 month billed kWhs.

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Natural Gas

Due to the complex nature and variablity of the gas rates which includes demand and balancing charges in the tarriff rates the blened average unit cost minus fixed charges is consided the effective rate for savings calculations. In cases where more than one account/meter serves a school the total average of all combined accouts is used unless the accout is not significant, for instance where the accout exists but delivers no natual gas on a regual basis or uses a very small ammout relative to the other accouts.

Building	$/Therm
David C. Abbott Early Learning Center	$1.16
Asher Holmes Elementary School	$1.18
Frank Defino Central School	$1.08
Frank J. Dugan Elementary School	$1.08
Marlboro Elementary School	$1.21
Marlboro Memorial Middle School	$1.23
Robertsville Elementary School	$1.21
Marlboro Middle School	$1.17

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Building Name	Rate	Account #	Total Effective Rate (Note 2)	Baseline Consumption	TOTAL COST	Blended Avg Unit Cost ($ / Unit)	Base Year
			$/therm	therms	$		
David C. Abbott Early Learning Ctr	GSL	22-0007-4918-34	**$1.16**	23,393	$ 27,869	$ 1.19	Jan-18 - Dec-18
Asher Holmes Elementary School	GSL	22-0011-8867-67	**$1.18**	38,672	$ 46,351	$ 1.20	Jan-18 - Dec-18
Frank Defino Central School	GSL	12-2368-3995-14	**$1.08**	52,967	$ 57,645	$ 1.09	Jan-18 - Dec-18
Frank J. Dugan Elementary School	GSL	20-3487-0700-20	**$1.08**	63,779	$ 69,244	$ 1.09	Jan-18 - Dec-18
Marlboro Elementary School	GSL	22-0011-8488-75	**$1.21**	39,273	$ 48,043	$ 1.22	Jan-18 - Dec-18
Marlboro Memorial Middle School	GSL	22-0007-9340-92	**$1.23**	65,105	$ 80,482	$ 1.24	Jan-18 - Dec-18
Robertsville Elementary School	GSL	22-0011-8870-06	**$1.21**	32,268	$ 39,706	$ 1.23	Jan-18 - Dec-18
Marlboro Middle School	GSL	22-0005-2472-64	**$1.17**	80,414	$ 94,361	$ 1.17	Jan-18 - Dec-18

Note 1: Natural gas commodity supplier for the baseline period is Woodruff Energy. The transport company is New Jersery Natural Gas.
Note 2: For simplification of the rates, the effective rate is the total cost minus $624.21 or the fixed service charge for the GSL rates during the baseline period. This is considered the overall effective rate for savings calculations which integrates the demand and balancing charge into a single blended rate while subtracting out the fixed service charges.
Note 3: The Blended Average Unit Cost is the total costs divided by the total usage.

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Fuel Oil

Building	$/gallon
Transportation Garage	$2.10

The effectiuve fue oil rate is the most current available and is based on March 8th, 2019 fuel costs.

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Building Name	Effective Rate	Baseline Usage	Baseline Cost	Adjusted Baseline Cost	Base Year
	$/gallon	gallons	$	$	
Transportation Garage	**$2.10**	4,028	$ 8,466.56	$ 8,458.65	Oct-17 - Sep-18

Note 5: The effective rate is the most current available and is based on March 8th, 2019 fuel costs.

Note 6: Adjusted baseline total costs is what the baseline costs would be for the baseline usage using the effective rates and is the baseline usage multiplied by the effective rate.

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Water

The following table summarizes the effective water rates used in calculation of water cost savings.

Building	$/kgal
David C. Abbott Early Learning Center	$6.44
BOE Administrative Office Building	$5.70
Asher Holmes Elementary School	$8.48
Frank Define Central School	$8.48
Frank J. Dugan Elementary School	$5.70
Marlboro Elementary School	$5.70
Marlboro Memorial Middle School	$8.48
Robertsville Elementary School	$8.48
Transportation Garage	$5.70
Marlboro Middle School	$8.48

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Building Name	Water Supplier	Effective Water Rate ($/kgal)	Total Combined Effective Rate ($/kgal)	Total Consumption kgal	Total Cost $	Base Year		
David C. Abbott Early Learning Center	MT	$ 6.44	**$ 6.44**	255	$ 2,236	Jan-18	-	Dec-18
BOE Administrative Office Building	G	$ 5.70	**$ 5.70**	72	$ 657	Jan-18	-	Dec-18
Asher Holmes Elementary School	MT	$ 8.48	**$ 8.48**	652	$ 4,383	Jan-18	-	Dec-18
Frank Define Central School	MT	$ 8.48	**$ 8.48**	546	$ 4,264	Jan-18	-	Dec-18
Frank J. Dugan Elementary School	G	$ 5.70	**$ 5.70**	792	$ 5,680	Jan-18	-	Dec-18
Marlboro Elementary School	G	$ 5.70	**$ 5.70**	555	$ 7,427	Jan-18	-	Dec-18
Marlboro Memorial Middle School	MT	$ 8.48	**$ 8.48**	724	$ 6,079	Jan-18	-	Dec-18
Robertsville Elementary School	MT	$ 8.48	**$ 8.48**	503	$ 3,901	Jan-18	-	Dec-18
Transportation Garage	G	$ 5.70	**$ 5.70**	165	$ 1,327	Jan-18	-	Dec-18
Marlboro Middle School	MT	$ 8.48	**$ 8.48**	1,517	$ 10,169	Jan-18	-	Dec-18

Note 1: Gordons (G) Water Rate $5.7/kgal as of Aug 29, 2018.
Note 2: Marlboro Township (MT) Water Rates are tiered (0-30,000gal $3.7/kgal, 30,001-50,000gal $6.44/kgal, and 50,001gal $8.44/kgal)
Note 3: Sewer is provided by Western Monmouth Utilities Authority and the rate is a fixed charge regardless of usage so the effective rate is zero.

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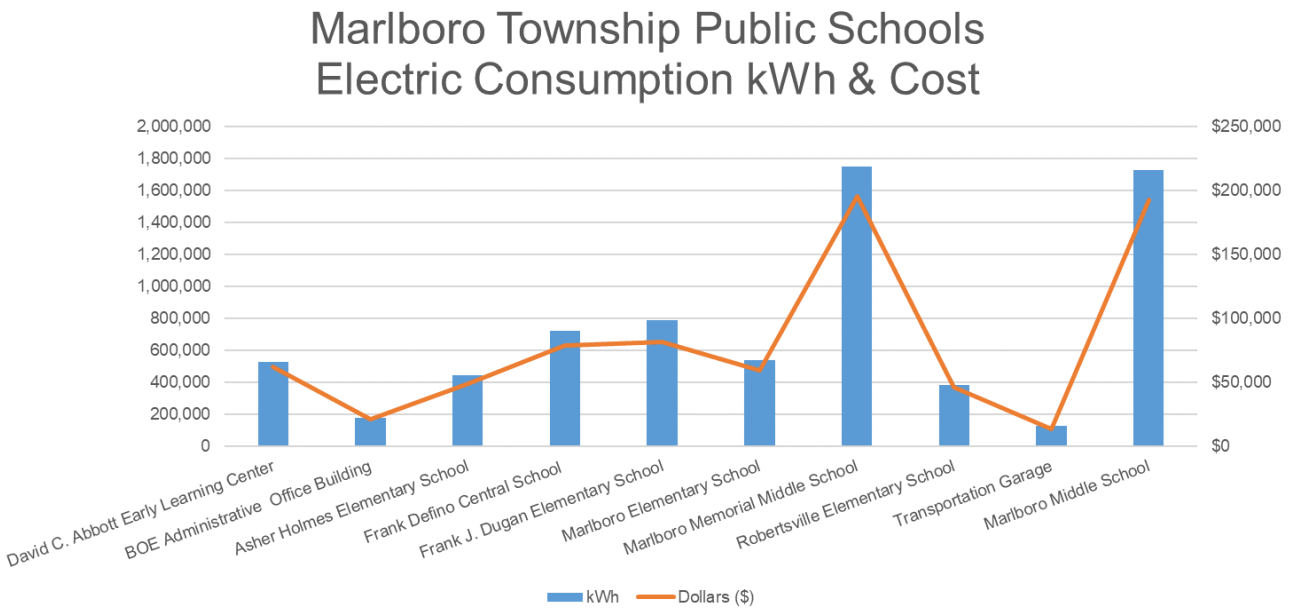
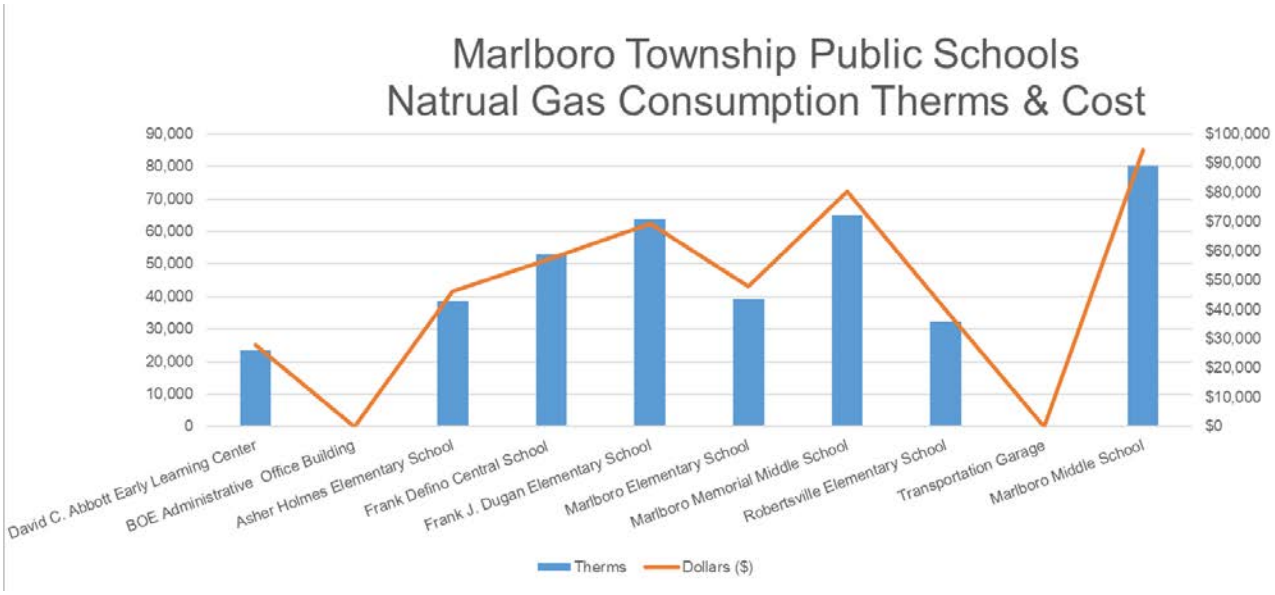
Utility Breakdown by Building





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Utility Escalation Rates

For purposes of calculating the extended value of the energy savings of this project, the following utility escalation rates have been used.

Name of School	Energy					
	Electric Consumption		Annual Electric Demand		Natural Gas	
	Escalation Rate	Start Year of Escalation	Escalation Rate	Start Year of Escalation	Escalation Rate	Start Year of Escalation
David C. Abbott Early Learning Center	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
BOE Administrative Office	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Asher Holmes Elementary School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Frank Defino Central School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Frank J. Dugan Elementary School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Marlboro Elementary School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Marlboro Memorial Middle School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Robertsville Elementary School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Transportation Garage	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1
Marlboro Middle School	2.2%	Year 1	2.2%	Year 1	2.4%	Year 1

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SECTION 3. FINANCIAL IMPACT

Energy Savings and Cost Summary

The table below provides a summary of the costs and savings associated with the measures recommended in the Energy Savings Plan. The savings have been calculated based on the savings methodology detailed throughout this report and included in the appendix of this report. Costs for each measure have been estimated based on project implementation experience and industry standards.

ECM ID	Energy Conservation Measure	ECM Sell Price	Total Savings, $/yr	Simple Payback	Installation Plan	Recommend for Installation
Asher Holmes Elementary School						
1	Asher Holmes Elementary School - Addressable Fire Alarms	$201,757	$4,947	40.8	Public Bidding	Yes
2	Asher Holmes Elementary School - Boiler Replacement	$631,035	$8,551	30.7	Public Bidding	Yes
3	Asher Holmes Elementary School - Direct Install	$20,497	$6,086	2.9	Public Bidding	Yes
4	Asher Holmes Elementary School - Unit Ventilator Refurbishment	$303,043	$5,413	56.0	Public Bidding	Yes
5	Asher Holmes Elementary School - Plug Load Controls	$7,729	$831	9.3	Public Bidding	Yes
6	Asher Holmes Elementary School - Repair HVAC Insulation	$10,110	$638	15.9	Public Bidding	Yes
7	Asher Holmes Elementary School - Variable Speed Kitchen Hood Controls	$20,785	$311	66.9	Public Bidding	Yes
8	Asher Holmes Elementary School - Water Conservation	$29,886	$2,732	10.1	Public Bidding	Yes
9	Asher Holmes Elementary School - Refrigeration Controls	$3,699	$467	4.0	Public Bidding	Yes
10	Asher Holmes Elementary School - Building Envelope Weatherization	$18,902	$1,374	13.8	Public Bidding	Yes
11	Asher Holmes Elementary School - Retro Cx	$16,847	$1,712	9.8	Public Bidding	Yes
12	Asher Holmes Elementary School - Dishwasher Replacement	$0	$2,469	0.0	Public Bidding	Yes
13	Asher Holmes Elementary School - BMS - Central Plant	$71,345	$1,578	45.2	Public Bidding	Yes
14	Asher Holmes Elementary School - BMS - Terminal Units	$220,039	$0	N/A	Public Bidding	Yes
15	Asher Holmes Elementary School - BMS - Common Areas (AHUs, RTUs)	$82,588	$755	109.3	Public Bidding	Yes
16	Asher Holmes Elementary School - Destratification Fans	$24,216	$2,320	10.4	Public Bidding	Yes
17	Asher Holmes Elementary School - Add Cooling - Gym	$277,322	$548	505.7	Public Bidding	Yes

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BOE Administrative Office & Building						
18	BOE Administrative Office & Building - Addressable Fire Alarms	$22,504	$4,947	4.5	Public Bidding	Yes
19	BOE Administrative Office & Building - Direct Install	$7,311	$2,977	2.2	Public Bidding	Yes
20	BOE Administrative Office & Building - Plug Load Controls	$2,727	$148	18.4	Public Bidding	Yes
21	BOE Administrative Office & Building - Water Conservation	$1,666	$185	8.5	Public Bidding	Yes
22	BOE Administrative Office & Building - Building Envelope Weatherization	$3,507	$271	13.0	Public Bidding	Yes
23	BOE Administrative Office & Building - BMS - Central Plant	$18,653	$0	N/A	Public Bidding	Yes
24	BOE Administrative Office & Building - BMS - Terminal Units	$8,418	$0	N/A	Public Bidding	Yes
25	BOE Administrative Office & Building - BMS - Common Areas (AHUs, RTUs)	$12,460	$0	N/A	Public Bidding	Yes
26	BOE Administrative Office & Building - Redesign HVAC (VRF)	$349,516	$2,151	162.5	Public Bidding	Yes
David C. Abbott Early Learning Center						
27	David C. Abbott Early Learning Center - Addressable Fire Alarms	$112,630	$4,947	22.8	Public Bidding	Yes
28	David C. Abbott Early Learning Center - Direct Install	$220,888	$23,364	8.6	Public Bidding	Yes
29	David C. Abbott Early Learning Center - Unit Ventilator Replacement	$613,628	$4,996	122.8	Public Bidding	Yes
30	David C. Abbott Early Learning Center - Plug Load Controls	$2,577	$171	15.1	Public Bidding	Yes
31	David C. Abbott Early Learning Center - Repair HVAC Insulation	$10,294	$737	14.0	Public Bidding	Yes
32	David C. Abbott Early Learning Center - VFDs on HVAC Motors	$116,915	$3,681	31.8	Public Bidding	Yes
33	David C. Abbott Early Learning Center - Water Conservation	$9,381	$894	9.5	Public Bidding	Yes
34	David C. Abbott Early Learning Center - Refrigeration Controls	$1,233	$156	4.0	Public Bidding	Yes
35	David C. Abbott Early Learning Center - Building Envelope Weatherization	$11,279	$865	13.0	Public Bidding	Yes
36	David C. Abbott Early Learning Center - Retro Cx	$15,674	$1,873	8.4	Public Bidding	Yes
37	David C. Abbott Early Learning Center - BMS - Central Plant	$51,946	$0	N/A	Public Bidding	Yes
38	David C. Abbott Early Learning Center - BMS - Terminal Units	$86,741	$0	N/A	Public Bidding	Yes
39	David C. Abbott Early Learning Center - BMS - Common Areas (AHUs, RTUs)	$35,267	$0	N/A	Public Bidding	Yes

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40	David C. Abbott Early Learning Center - Chiller Replacement	$332,387	$2,196	130.9	Public Bidding	Yes
41	David C. Abbott Early Learning Center - Window Film	$13,875	$685	20.2	Public Bidding	Yes
Frank Defino Central School						
42	Frank Defino Central School - Lighting Upgrades - LED	$237,238	$14,404	4.4	Public Bidding	Yes
43	Frank Defino Central School - Addressable Fire Alarms	$199,540	$4,947	40.3	Public Bidding	Yes
44	Frank Defino Central School - Boiler Replacement	$646,127	$7,493	20.5	Public Bidding	Yes
45	Frank Defino Central School - Water Heater Replacement	$180,408	$318	137.0	Public Bidding	Yes
46	Frank Defino Central School - Unit Ventilator Replacement	$443,657	$5,560	79.8	Public Bidding	Yes
47	Frank Defino Central School - Plug Load Controls	$7,577	$700	10.8	Public Bidding	Yes
48	Frank Defino Central School - Repair HVAC Insulation	$7,917	$501	15.8	Public Bidding	Yes
49	Frank Defino Central School - Variable Speed Kitchen Hood Controls	$21,139	$971	18.1	Public Bidding	Yes
50	Frank Defino Central School - Water Conservation	$29,917	$2,151	12.5	Public Bidding	Yes
51	Frank Defino Central School - Refrigeration Controls	$6,165	$1,579	2.4	Public Bidding	Yes
52	Frank Defino Central School - Building Envelope Weatherization	$73,144	$4,549	16.1	Public Bidding	Yes
53	Frank Defino Central School - Retro Cx	$16,661	$2,434	6.8	Public Bidding	Yes
54	Frank Defino Central School - Dishwasher Replacement	$0	$2,390	0.0	Public Bidding	Yes
55	Frank Defino Central School - BMS - Central Plant	$92,028	$1,437	64.0	Public Bidding	Yes
56	Frank Defino Central School - BMS - Terminal Units	$246,042	$0	N/A	Public Bidding	Yes
57	Frank Defino Central School - BMS - Common Areas (AHUs, RTUs)	$104,147	$940	110.8	Public Bidding	Yes
58	Frank Defino Central School - Destratification Fans	$9,977	$868	11.5	Public Bidding	Yes
59	Frank Defino Central School - Add Cooling - Gym	$230,699	$293	788.2	Public Bidding	Yes
Frank J. Dugan Elementary School						
60	Frank J. Dugan Elementary School - Addressable Fire Alarms	$236,439	$4,947	47.8	Public Bidding	Yes
61	Frank J. Dugan Elementary School - Direct Install	$49,697	$16,782	2.5	Public Bidding	Yes
62	Frank J. Dugan Elementary School - Plug Load Controls	$9,093	$608	15.0	Public Bidding	Yes

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63	Frank J. Dugan Elementary School - Repair HVAC Insulation	$14,059	$931	15.1	Public Bidding	Yes
64	Frank J. Dugan Elementary School - Variable Speed Kitchen Hood Controls	$21,427	$1,209	7.1	Public Bidding	Yes
65	Frank J. Dugan Elementary School - Water Conservation	$27,119	$1,671	14.5	Public Bidding	Yes
66	Frank J. Dugan Elementary School - Refrigeration Controls	$3,699	$1,163	2.0	Public Bidding	Yes
67	Frank J. Dugan Elementary School - Building Envelope Weatherization	$31,688	$2,301	13.8	Public Bidding	Yes
68	Frank J. Dugan Elementary School - Retro Cx	$19,742	$2,845	6.9	Public Bidding	Yes
69	Frank J. Dugan Elementary School - Dishwasher Replacement	$0	$1,206	0.0	Public Bidding	Yes
70	Frank J. Dugan Elementary School - HVAC Armor/Refurb.	$2,709	$285	8.1	Public Bidding	Yes
71	Frank J. Dugan Elementary School - Premium Efficiency Motors	$8,012	$35	226.9	Public Bidding	Yes
72	Frank J. Dugan Elementary School - BMS - Central Plant	$65,186	$0	N/A	Public Bidding	Yes
73	Frank J. Dugan Elementary School - BMS - Terminal Units	$233,836	$0	N/A	Public Bidding	Yes
74	Frank J. Dugan Elementary School - BMS - Common Areas (AHUs, RTUs)	$118,200	$536	220.6	Public Bidding	Yes
75	Frank J. Dugan Elementary School - Destratification Fans	$33,796	$2,854	11.8	Public Bidding	Yes
76	Frank J. Dugan Elementary School - Add Cooling - Gym	$271,020	$355	764.3	Public Bidding	Yes
Marlboro Elementary School						
77	Marlboro Elementary School - Addressable Fire Alarms	$211,425	$4,947	42.7	Public Bidding	Yes
78	Marlboro Elementary School - Boiler Replacement	$639,197	$9,688	19.0	Public Bidding	Yes
79	Marlboro Elementary School - Water Heater Replacement	$180,408	$682	67.4	Public Bidding	Yes
80	Marlboro Elementary School - Direct Install	$55,770	$19,788	2.5	Public Bidding	Yes
81	Marlboro Elementary School - Unit Ventilator Refurbishment	$284,905	$5,153	55.3	Public Bidding	Yes
82	Marlboro Elementary School - Plug Load Controls	$7,729	$606	12.7	Public Bidding	Yes
83	Marlboro Elementary School - Repair HVAC Insulation	$14,528	$1,213	12.0	Public Bidding	Yes
84	Marlboro Elementary School - Variable Speed Kitchen Hood Controls	$25,038	$1,669	15.0	Public Bidding	Yes
85	Marlboro Elementary School - Water Conservation	$20,621	$1,490	12.7	Public Bidding	Yes

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86	Marlboro Elementary School - Refrigeration Controls	$3,699	$1,163	2.0	Public Bidding	Yes
87	Marlboro Elementary School - Building Envelope Weatherization	$71,738	$5,628	12.7	Public Bidding	Yes
88	Marlboro Elementary School - Retro Cx	$17,654	$1,905	9.3	Public Bidding	Yes
89	Marlboro Elementary School - Dishwasher Replacement	$0	$2,235	0.0	Public Bidding	Yes
90	Marlboro Elementary School - BMS - Central Plant	$71,336	$0	N/A	Public Bidding	Yes
91	Marlboro Elementary School - BMS - Terminal Units	$189,766	$0	N/A	Public Bidding	Yes
92	Marlboro Elementary School - BMS - Common Areas (AHUs, RTUs)	$90,785	$0	N/A	Public Bidding	Yes
93	Marlboro Elementary School - Destratification Fans	$10,010	$998	10.0	Public Bidding	Yes
94	Marlboro Elementary School - Add Cooling - Gym	$289,551	$548	528.0	Public Bidding	Yes
Marlboro Memorial Middle School						
95	Marlboro Memorial Middle School - Lighting Upgrades - LED	$571,374	$42,786	3.8	Public Bidding	Yes
96	Marlboro Memorial Middle School - Addressable Fire Alarms	$439,757	$4,947	88.9	Public Bidding	Yes
97	Marlboro Memorial Middle School - Boiler Replacement	$743,372	$2,418	19.3	Public Bidding	Yes
98	Marlboro Memorial Middle School - Cogeneration	$317,148	$6,379	49.7	Public Bidding	Yes
99	Marlboro Memorial Middle School - Plug Load Controls	$12,275	$1,522	8.1	Public Bidding	Yes
100	Marlboro Memorial Middle School - Repair HVAC Insulation	$17,496	$99	176.3	Public Bidding	Yes
101	Marlboro Memorial Middle School - Variable Speed Kitchen Hood Controls	$22,206	$2,059	5.8	Public Bidding	Yes
102	Marlboro Memorial Middle School - VFDs on HVAC Motors	$51,021	$4,690	10.9	Public Bidding	Yes
103	Marlboro Memorial Middle School - VFDs on HVAC Motors	$75,994	$20,908	1.8	Public Bidding	Yes
104	Marlboro Memorial Middle School - Water Conservation	$42,734	$5,008	8.0	Public Bidding	Yes
105	Marlboro Memorial Middle School - Refrigeration Controls	$6,165	$1,579	2.4	Public Bidding	Yes
106	Marlboro Memorial Middle School - Building Envelope Weatherization	$39,441	$3,035	13.0	Public Bidding	Yes
107	Marlboro Memorial Middle School - Retro Cx	$40,799	$5,956	6.9	Public Bidding	Yes
108	Marlboro Memorial Middle School - Dishwasher Replacement	$0	$4,375	0.0	Public Bidding	Yes
109	Marlboro Memorial Middle School - BMS - Central Plant	$43,038	$0	N/A	Public Bidding	Yes

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110	Marlboro Memorial Middle School - BMS - Terminal Units	$33,408	$0	N/A	Public Bidding	Yes
111	Marlboro Memorial Middle School - BMS - Common Areas (AHUs, RTUs)	$46,288	$0	N/A	Public Bidding	Yes
112	Marlboro Memorial Middle School - Destratification Fans	$64,322	$8,014	8.0	Public Bidding	Yes
113	Marlboro Memorial Middle School - Window Film	$4,295	$393	10.9	Public Bidding	Yes
Marlboro Middle School						
114	Marlboro Middle School - Lighting Upgrades - LED	$671,853	$36,687	5.4	Public Bidding	Yes
115	Marlboro Middle School - MMS Auditorium Lighting	$86,240	$4,779	16.2	Public Bidding	Yes
116	Marlboro Middle School - Addressable Fire Alarms	$566,371	$4,947	114.5	Public Bidding	Yes
117	Marlboro Middle School - Boiler Replacement	$944,773	$16,336	14.7	Public Bidding	Yes
118	Marlboro Middle School - Water Heater Replacement	$199,889	$1,208	42.5	Public Bidding	Yes
119	Marlboro Middle School - Unit Ventilator Refurbishment	$642,427	$17,198	37.4	Public Bidding	Yes
120	Marlboro Middle School - Plug Load Controls	$11,518	$1,147	10.0	Public Bidding	Yes
121	Marlboro Middle School - Repair HVAC Insulation	$29,314	$2,038	14.4	Public Bidding	Yes
122	Marlboro Middle School - Variable Speed Kitchen Hood Controls	$18,771	$2,009	4.9	Public Bidding	Yes
123	Marlboro Middle School - VFDs on HVAC Motors	$49,341	$3,144	4.9	Public Bidding	Yes
124	Marlboro Middle School - Water Conservation	$55,244	$8,205	6.4	Public Bidding	Yes
125	Marlboro Middle School - Refrigeration Controls	$6,165	$1,423	2.6	Public Bidding	Yes
126	Marlboro Middle School - Building Envelope Weatherization	$29,244	$2,494	11.7	Public Bidding	Yes
127	Marlboro Middle School - Retro Cx	$55,173	$6,169	8.9	Public Bidding	Yes
128	Marlboro Middle School - Dishwasher Replacement	$0	$8,178	0.0	Public Bidding	Yes
129	Marlboro Middle School - BMS - Central Plant	$87,146	$4,043	21.6	Public Bidding	Yes
130	Marlboro Middle School - BMS - Terminal Units	$384,037	$0	N/A	Public Bidding	Yes
131	Marlboro Middle School - BMS - Common Areas (AHUs, RTUs)	$163,109	$2,989	54.6	Public Bidding	Yes
132	Marlboro Middle School - Chiller Replacement	$0	$2,800	0.0	Public Bidding	Yes
133	Marlboro Middle School - Destratification Fans	$26,594	$2,596	10.2	Public Bidding	Yes

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134	Marlboro Middle School - Construction Contingency	$432,250	$0	N/A	Public Bidding	Yes
135	Marlboro Middle School - Energy Star Refrigerator Replacement	$11,100	$757	14.7	Public Bidding	Yes
Robertsville Elementary School						
136	Robertsville Elementary School - Addressable Fire Alarms	$201,913	$4,947	40.8	Public Bidding	Yes
137	Robertsville Elementary School - Boiler Replacement	$667,795	$8,821	20.3	Public Bidding	Yes
138	Robertsville Elementary School - Water Heater Replacement	$180,408	$491	72.6	Public Bidding	Yes
139	Robertsville Elementary School - Direct Install	$25,943	$16,393	1.3	Public Bidding	Yes
140	Robertsville Elementary School - Unit Ventilator Refurbishment	$331,529	$6,030	55.0	Public Bidding	Yes
141	Robertsville Elementary School - Plug Load Controls	$8,790	$868	10.1	Public Bidding	Yes
142	Robertsville Elementary School - Repair HVAC Insulation	$17,951	$969	18.5	Public Bidding	Yes
143	Robertsville Elementary School - Variable Speed Kitchen Hood Controls	$27,822	$1,482	8.5	Public Bidding	Yes
144	Robertsville Elementary School - Water Conservation	$27,943	$2,841	9.2	Public Bidding	Yes
145	Robertsville Elementary School - Refrigeration Controls	$4,932	$1,267	2.4	Public Bidding	Yes
146	Robertsville Elementary School - Building Envelope Weatherization	$109,927	$6,957	15.8	Public Bidding	Yes
147	Robertsville Elementary School - Retro Cx	$16,860	$1,471	11.5	Public Bidding	Yes
148	Robertsville Elementary School - Dishwasher Replacement	$0	$2,490	0.0	Public Bidding	Yes
149	Robertsville Elementary School - BMS - Central Plant	$85,438	$1,651	51.7	Public Bidding	Yes
150	Robertsville Elementary School - BMS - Terminal Units	$261,918	$0	N/A	Public Bidding	Yes
151	Robertsville Elementary School - BMS - Common Areas (AHUs, RTUs)	$49,319	$1,011	48.8	Public Bidding	Yes
152	Robertsville Elementary School - Destratification Fans	$10,241	$1,135	9.0	Public Bidding	Yes
153	Robertsville Elementary School - Add Cooling - Gym	$289,551	$604	479.2	Public Bidding	Yes
Transportation Garage						
154	Transportation Garage - Addressable Fire Alarms	$25,809	$4,947	5.2	Public Bidding	Yes
155	Transportation Garage - Direct Install	$6,665	$2,799	2.1	Public Bidding	Yes
156	Transportation Garage - Water Conservation	$1,436	$37	31.0	Public Bidding	Yes

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157	Transportation Garage - Building Envelope Weatherization	$10,687	$1,203	8.9	Public Bidding	Yes
158	Transportation Garage - BMS - Central Plant	$7,779	$0	N/A	Public Bidding	Yes
159	Transportation Garage - BMS - Terminal Units	$1,791	$0	N/A	Public Bidding	Yes
160	Transportation Garage - BMS - Common Areas (AHUs, RTUs)	$12,785	$0	N/A	Public Bidding	Yes
161	Transportation Garage - Bus Advertising	$0	$3,000	0.0	Public Bidding	Yes
All Facilities						
162	All Facilities - Computer Power Management	$34,580	$17,789	1.9	Public Bidding	Yes
	Totals	**$19,345,045**	**$575,474**	**33.62**		

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Operational Savings Estimates

The lighting retrofits recommended for this project will reduce the amount of lamps that need to be replaced each year due to the longer lasting lamps and new technology fixtures. The LED lighting recommended for the exterior fixtures will last much longer than the current high intensity discharge (HID) lighting and will generate material cost savings.

A brief description of the operational savings estimated for this project is included below. Energy Systems Group has worked with the District to quantify the exact sources of savings by going through past invoices and expenses. The operational savings will not be escalated.

Operational Savings for Financial Model	
ECM Description	Annual Savings
LED Lighting Upgrades & Occupancy Sensors – District Wide (10 Buildings)	$69,053
HVAC, Refrigeration Upgrades / Equipment Replacement	$206,729
Totals	**$275,782**

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Potential Revenue Generation Estimates

As part of the Energy Savings Plan for the Marlboro Township Public Schools, several avenues for obtaining rebates and incentives have been investigated which include:

- NJ Smart Start Equipment Incentives
- Pay for Performance
- Combined Heat and Power Incentive
- Demand Response Energy Efficiency Credit

The estimated incentive amount for each program is listed below. Upon final selection of project scope and award of subcontractor bids, the incentive applications will be filed.

NJ Smart Start Equipment Incentives

The NJ Smart Start Equipment Incentives provide prescriptive rebates for defined retrofits. Incentives are applied on a unit-by-unit basis for making energy efficiency upgrades. The table below summarizes the equipment incentives, which will be applied for at Marlboro Township Public Schools:

Building	ECM Type	Energy Rebate/ Incentives
Frank Defino Central School	Lighting Upgrades - LED	**$29,922**
Marlboro Memorial Middle School	Lighting Upgrades - LED	**$84,000**
Marlboro Middle School	Lighting Upgrades - LED	**$66,000**
Asher Holmes Elementary School	Boiler Replacement	**$12,000**
Frank Defino Central School	Boiler Replacement	**$24,000**
Marlboro Elementary School	Boiler Replacement	**$24,000**
Marlboro Memorial Middle School	Boiler Replacement	**$36,000**
Robertsville Elementary School	Boiler Replacement	**$24,000**
Marlboro Middle School	Boiler Replacement	**$48,000**
Frank Defino Central School	Water Heater Replacement	**$998**
Marlboro Elementary School	Water Heater Replacement	**$1,995**
Robertsville Elementary School	Water Heater Replacement	**$1,995**
Marlboro Middle School	Water Heater Replacement	**$3,500**
Frank Defino Central School	Variable Speed Kitchen Hood Controls	**$200**
Frank J. Dugan Elementary School	Variable Speed Kitchen Hood Controls	**$1,800**
Marlboro Memorial Middle School	Variable Speed Kitchen Hood Controls	**$1,800**
Robertsville Elementary School	Variable Speed Kitchen Hood Controls	**$1,800**
Marlboro Middle School	Variable Speed Kitchen Hood Controls	**$1,800**
Marlboro Middle School	VFDs on HVAC Motors	**$7,000**
Marlboro Memorial Middle School	VFDs on HVAC Motors	**$20,200**
David C. Abbott Early Learning Center	Chiller Replacement	**$44,880**
		$435,890

Pay for Performance Incentives

This project will not utilize P4P because minimum savings criteria will not be met with current scope of work.

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Cogeneration Incentives

This project will not utilize Cogeneration incentives because the minimum effective full load run hours requirement will not be met.

Demand Response Energy Efficiency Credit

The LED Lighting Upgrades recommended for the District will be eligible for the Energy Efficiency Credit available through PJM. The Energy Efficiency Credit pays consumers based on the permanent load reduction through the installation of energy efficiency measures. The following table summarizes the available Demand Response Incentives available due to the lighting upgrades to be performed in the District.

Demand Response Energy – Emergency Capacity Credit	
PJM Payment Year	Annual Customer Capacity Benefit
2021/2022	$9,000
2022/2023	$7,500
2023/2024	$7,500
2024/2025	$7,500
Totals	$31,500

Incentive Breakout for Recommended Project

Year	DR EE Credit	NJ Clean Energy Rebates	Pay for Performance	CHP	Total
1	$9,000	$435,890	$0	$0	$444,890
2	$7,500	$0	$0	$0	$7,500
3	$7,500	$0	$0	$0	$7,500
4	$7,500	$0	$0	$0	$7,500
TOTAL	**$31,500**	**$435,890**	**$0**	**$0**	**$467,390**

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Business Case for Recommended Project

FORM VI - ENERGY SAVINGS PLAN

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM
Marlboro Township Public Schools ESIP
ENERGY SAVINGS IMPROVEMENT PROGRAM

ESCO Name: ENERGY SYSTEMS GROUP **Project Scenario 3**

Note: Respondents must use the following assumptions in all financial calculations:

(a) The cost of all types of energy should be assumed to inflate at 2.4% gas, 2.2% electric per year; and

1. Term of Agreement: 20 years
2. Construction period[2] (months): 12 Capital Cont. $4,100,000 ✔ Project (Pass/Fail)
3. Cash Flow Analysis Format: Food Service Capital $192,942

Total Financed Amount[4] $ 15,082,103
Total ESG Project Cost [1] $ 19,345,045 Interest Rate to be used for Proposal Purposes: 2.60%

	Annual Energy Savings	Annual Operational Savings	Energy Rebates/ Incentives	Solar PPA	Total Annual Savings	Annual Project Costs	Board Costs	Annual Service Costs	Net Cash-Flow to client	Cumulative Cash Flow
Installation[3]	$ 117,479	$ -	$ -	$ 186,013	$ 303,493	$ -	$ -	$ -	$ 303,493	$ 303,493
1	$ 711,090	$ 275,782	$ 444,890	$ 376,119	$ 1,807,882	$ 1,711,498	$ 1,805,482	$ 93,984	$ 2,400	$ 305,893
2	$ 606,997	$ 275,782	$ 7,500	$ 198,380	$ 1,088,659	$ 1,086,259	$ 1,086,259	$ -	$ 2,400	$ 308,293
3	$ 620,685	$ 76,522	$ 7,500	$ 202,745	$ 907,452	$ 905,052	$ 905,052	$ -	$ 2,400	$ 310,693
4	$ 634,682	$ 76,522	$ 7,500	$ 207,205	$ 925,910	$ 923,510	$ 923,510	$ -	$ 2,400	$ 313,093
5	$ 648,996	$ 76,522	$ -	$ 211,764	$ 937,282	$ 934,882	$ 934,882	$ -	$ 2,400	$ 315,493
6	$ 663,634	$ -	$ -	$ 216,422	$ 880,056	$ 877,656	$ 877,656	$ -	$ 2,400	$ 317,893
7	$ 678,602	$ -	$ -	$ 221,184	$ 899,786	$ 897,386	$ 897,386	$ -	$ 2,400	$ 320,293
8	$ 693,909	$ -	$ -	$ 226,050	$ 919,959	$ 917,559	$ 917,559	$ -	$ 2,400	$ 322,693
9	$ 709,562	$ -	$ -	$ 231,023	$ 940,585	$ 938,185	$ 938,185	$ -	$ 2,400	$ 325,093
10	$ 725,569	$ -	$ -	$ 236,105	$ 961,674	$ 959,274	$ 959,274	$ -	$ 2,400	$ 327,493
11	$ 741,938	$ -	$ -	$ 241,300	$ 983,237	$ 980,837	$ 980,837	$ -	$ 2,400	$ 329,893
12	$ 758,677	$ -	$ -	$ 246,608	$ 1,005,285	$ 1,002,885	$ 1,002,885	$ -	$ 2,400	$ 332,293
13	$ 775,794	$ -	$ -	$ 252,034	$ 1,027,828	$ 1,025,428	$ 1,025,428	$ -	$ 2,400	$ 334,693
14	$ 793,299	$ -	$ -	$ 257,578	$ 1,050,877	$ 1,048,477	$ 1,048,477	$ -	$ 2,400	$ 337,093
15	$ 811,199	$ -	$ -	$ 263,245	$ 1,074,444	$ 1,072,044	$ 1,072,044	$ -	$ 2,400	$ 339,493
16	$ 829,504	$ -	$ -	$ -	$ 829,504	$ 827,104	$ 827,104	$ -	$ 2,400	$ 341,893
17	$ 848,224	$ -	$ -	$ -	$ 848,224	$ 845,824	$ 845,824	$ -	$ 2,400	$ 344,293
18	$ 867,367	$ -	$ -	$ -	$ 867,367	$ 864,967	$ 864,967	$ -	$ 2,400	$ 346,693
19	$ 886,942	$ -	$ -	$ -	$ 886,942	$ 880,167	$ 880,167	$ -	$ 6,776	$ 353,469
20	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 353,469
Totals	**$ 14,006,671**	**$ 781,131**	**$ 467,390**	**$ 3,587,763**	**$ 18,842,954**	**$ 18,698,995**	**$ 18,792,979**	**$ 93,984**	**$ 353,469**	**$ 353,469**

NOTES:

1 **Includes: Hard costs and project service fees defined in ESCO's PROPOSED 'FORM V"**
2 **No payments are made by the Board during the construction period.**
3 **Installation period savings for Energy Savings and Operational Savings are guaranteed. These savings will be used in addition to the first loan payment.**
4 **Total Financed Cost includes all Fees and project costs.**
5 Interest rate is indicative rate only. Final rate will vary with market conditions at time of closing.
6 ESG is an energy services and engineering company, not a financial advisor.
7 ESG is not a financial advisor and the presented cash flow proforma is for information only
8 The cash flow shown is for illustration purposes, and is not intended as financial advice.
9 Loan repayment includes interest accumulation in the construction period
10 Loan repayment assumes that the 1st repayment starts immediately after constructior
11 The annual energy 2.25% and labor .% escalation are in accordance with the RFP
12 The utility incentive amount shown is typical expected and is not indicative of the actual amount as project timing, changes to utility program and availability of funds affect the outcome

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Greenhouse Gas Reductions

The project's reduced emissions would be equivalent to:

CO_2 sequestered by	83,690	tree seedlings grown for 10 years in an urban scenario	
CO_2 sequestered by	696	acres of pine or fir forests	
CO_2 emissions from	624	passenger vehicles	
CO_2 emissions from	7,590	barrels of oil consumed	
CO_2 emissions from the *energy* use of	278	homes for one year	
CO_2 emissions from burning	17	coal railcars	

Source:
All carbon equivalencies extracted directly from the EPA website.
"Greenhouse Gas Equivalencies Calculator." Clean Energy. U.S. Environmental Protection Agency. <www.epa.gov/cleanenergy/energy-resources/refs.html> (Jan. 24,2011).

AVOIDED EMISSIONS	Total Electric Savings	Total Natural Gas Savings	Total Annual Avoided Emissions
Annual Unit Savings	3,055,564 kWh	174,949 Therms	
NO_X	3,392 lbs.	1,610 lbs.	5,001 lbs.
SO_2	2,994 lbs.	0 lbs.	2,994 lbs.
CO_2	4,198,345 lbs.	2,046,903 lbs.	6,245,248 lbs.

Factors Used in Calculations:

CO_2 Electric Emissions:	1,374 lbs. per MWh saved
CO_2 Gas Emissions:	11.7 lbs. per therm saved
NO_X Electric Emissions:	1.11 lbs. per MWh saved
NO_X Gas Emissions:	0.0092 lbs. per therm saved
SO_2 Electric Emissions:	0.98 lbs. per MWh saved

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SECTION 4. ENERGY CONSERVATION MEASURES

Comprehensive LED Lighting Upgrades

ECM Summary

Memorial Middle School Light Fixtures

Lighting Retrofit and Replacement: Most of the lighting fixtures throughout the Marlboro School District, utilize older technologies that can be upgraded. Improvements to lighting will reduce electrical consumption and improve lighting levels. The costs of material to maintain the current systems will also be reduced since these renovations replace items (i.e., lamps and ballasts) that are near the end of their life cycle and/or considered environmentally hazardous.

Where appropriate, lighting levels will be adjusted to meet Illumination Engineering Society (IES) standards.

Lighting Levels: Our proposed lighting system improvements will maximize savings while maintaining or improving existing light levels in each area. All installations will comply with IES standards. Post-retrofit light levels are typically increased because of the improved design and installation of newer equipment, but areas that are currently over lit will be adjusted to maintain IES recommended light level. Before and after sample light level reading will be performed to confirm expected results.

Exterior Lighting: In an effort to reduce electricity consumption and provide better security for the Marlboro School District buildings, ESG is proposing to retrofit the existing outside lighting on the buildings with newer, LED technology with photo cells for automatic control. In addition, every effort will be made to standardize the installed components for equipment uniformity and maintenance simplicity. Typical LED lighting system exhibit the following characteristics:

- Extremely Long Life – up to 50,000+ hours
- Highly efficient with very low wattage consumption
- Solid state lighting technology ensures that the fixtures are highly durable

Lighting Controls: Lighting controls are effective in areas where lighting is left on unnecessarily, mainly because it is a common area or due to the inconvenience to manually switch lights off when a room is left or on when a room is first occupied. This is common in rooms that are occupied for only short periods and only a few times per day. 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 of a current wall switch, or on the ceiling to cover large areas. Lighting controls will be installed in various offices, break rooms, restrooms, and other locations where appropriate. In the next phase, ESG will perform detailed sample measurements to determine coincident

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lighting room occupancy and overall lighting level information to accurately determine and identify spaces suitable for lighting controls throughout each facility.

Facilities Recommended for this Measure

- David C. Abbott Learning Center (via Direct Install)
- BOE Administrative Offices (via Direct Install)
- Asher Holmes Elementary School (via Direct Install)
- Frank Defino Central School
- Frank J. Dugan Elementary School (via Direct Install)
- Marlboro Elementary School (via Direct Install)
- Marlboro Memorial Middle School
- Robertsville Elementary School (via Direct Install)
- Transportation Garage (via Direct Install)
- Marlboro Middle School

Scope of Work

- Safely disconnect the existing lighting fixture from live circuit
- Remove existing Fluorescent Lamps
- Where necessary remove existing receptacles in the fixtures
- Install the retrofit kit and install 10.5-watt LED line voltage tubes
- Reconnect all the wiring
- Test for operation
- Clean-up work area
- Properly dispose of removed material
- Provide training to staff on operation of new lighting system
- Refer to Line by Line inventory included in Appendix.

Savings Methodology

In general, savings calculations for lighting retrofits are calculated using the following methodology:

Savings Calculation Method		
Baseline Energy Usage (kWh / yr)	=	Existing Fixture Watts x Operating Hours / yr x 1 kW / 1000 Watts
Estimated Energy Usage (kWh / yr)	=	Proposed Fixture Watts x Op. Hours/yr x 1 kW / 1000 Watts
Energy Savings (kWh / yr)	=	Baseline Energy Usage – Estimated Energy Usage
Baseline Demand (kW)	=	Existing Fixture Watts / 1000 Watts
Retrofit Demand (kW)	=	Proposed Fixture Watts / 1000 Watts
Energy Savings (kW)	=	(Existing Fixture Watts – Proposed Fixture Watts) x 1 kW / 1000 Watts

Maintenance

Lighting will need to be routine maintenance to ensure that devices/fixtures a clean and in working condition.

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Benefits

- Electrical energy savings
- Improved exterior light quality
- Reduction in maintenance of exterior lighting system
- Improved safety around school perimeter
- Reduced lamp replacement for 5 to 10 years for LEDs

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Direct Install Program (Lighting, Controls, HVAC)

ECM Summary

Existing small to mid-sized commercial and industrial facilities with an average 12 preceding month electric demand that did not exceed 200 kW are eligible to participate in Direct Install. Applicants will submit the last 12 months of electric utility bills indicating that they are below the demand threshold and have occupied the building during that time. Buildings must be located in New Jersey and served by one of the State's public, regulated electric or natural gas utility companies. Created specifically for existing small to medium-sized facilities, Direct Install is a turnkey solution that makes it easy and affordable to upgrade to high efficiency equipment. The program pays up to 80% of retrofit costs, dramatically improving your payback on the project.

Facilities Available for Direct Install

- Asher Holmes Elementary
- BOE Administration Building
- David C. Abbott Learning Center
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Robertsville Elementary School
- Transportation Garage

Scope of Work

- ESG will work closely with one of the program partners to evaluate the Direct Install Program
- The systems and equipment addressed by the program are
    - Lighting at all eligible buildings
    - Three (3) Rooftop Units at Asher Holmes Elementary
    - Two (2) Rooftop Units at Frank J. Dugan Elementary
    - Four (4) Rooftop Units at Marlboro Elementary
    - Fuel Use Economizers for Three (3) Rooftop Units at Frank J Dugan Elementary
    - Low flow aerators for sinks at all eligible buildings

Savings Methodology

See savings calculations provided in Appendix.

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Reduced installation cost utilizing Direct Install Incentive Program.
- Electrical and Natural Gas energy savings

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Addressable Fire Alarms

ECM Summary

The existing fire alarm systems at the schools are outdated and the district desires a new addressable fire alarm system to be installed in its place. This measure intends to upgrade the existing fire system as part of the overall Building Management System Upgrades.

Facilities Recommended for this Measure

- David C. Abbott Learning Center
- BOE Administrative Offices
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Transportation Garage
- Marlboro Middle School

Scope of Work

This measure is intended to provide a complete solution for the replacement of the existing fire alarm system with the new 4100ES and 4010ES fire alarm platform. As part of the replacement a complete upgrade of all field devices is also proposed.

The proposed install includes a state of the art Simplex 4100ES or 4010ES system that is focused on meeting the needs of the Marlboro School District on a per building basis. These are summarized as follows:

- Provide a side by side install including all new wire to the existing system and then demo the existing system upon acceptance of new system.
- Provide a solution that will allow for ease of operation and troubleshooting
- Provide a system with room for expansion (10%) as the facility changes and grows
- Provide the school with the ability to give voice commands for student evacuation
- Provide a system with the capability for specified staff the opportunity to override the traditional fire alarm notification with real time voice commands through the remote microphone
- Provide a system that meets the latest New Jersey Carbon Monoxide Detection code/laws

Our field device design will be based on National Fire Alarm Code NFPA 72, Life Safety Code 101, and the American's with Disabilities Act. Compliance with these governing codes will allow for a design that will be approved by the local authority prior to the start of the installation.

Includes the following:

- Shop drawings, submittals, as built AutoCAD drawings.
- Installation of new FACP, Nodes, transponders, wiring and devices. • Free- run cable (color red) to be installed above drop ceilings areas.

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- Programming, system start up, checkout, test and inspection. One inspection per phase and one total system inspection.
- Eight hours of end user training.
- Demo of all existing fire alarm devices, control panels, wiring and abandoned conduit
- Locations where existing wall-mounted devices are removed, the back boxes will be blanked

Savings Methodology

Account savings from not having to pay the monthly phone bills. These savings are reduced by an amount that will be paid for Fire Alarm cellular communication service for all 10 buildings receiving new Fire Alarm systems.

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Improved Life Safety Systems.

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Boiler Replacement

ECM Summary

Typical Existing Boiler Systems

The heating boiler systems located in each of the schools recommended for replacement is typically a natural gas fuel, fire-tube boiler manufactured by Superior or Cleaver Brooks that generates hot water. Hot water from the boilers is delivered to radiant fin-tube, hot water coils of the unit ventilators, and air-handling units in various locations throughout the buildings.

Existing Boilers:

Location	No.	Manufacturer	Model	Capacity MBH	Utility
Asher	2	Superior	N4AA	3,252	Nat-Gas
Defino	2	Cleaver Brooks	CB400-125 CB900-80	5,230 3,347	Nat-Gas
Marlboro ES	2	Superior	N4AA	5,120	Nat-Gas
Memorial MS	6	Thermal Solutions	EVH2000	2,000	Nat-Gas
Robertsville	2	Superior	N4AA	3,500	Nat-Gas
Marlboro MS	3	Cleaver Brooks	CB-800-125	5,230	Nat-Gas

Proposed Boilers:

Location	No.	Manufacturer	Model	Capacity MBH	Utility
Asher	2	AERCO	BMK	3,000	Nat-Gas
Defino	2	AERCO	BMK	3,000	Nat-Gas
Marlboro ES	2	AERCO	BMK	3,000	Nat-Gas
Memorial MS	3	AERCO	BMK	3,000	Nat-Gas
Robertsville	2	AERCO	BMK	3,000	Nat-Gas
Marlboro MS	4	AERCO	BMK	3,000	Nat-Gas

Note: Final Sizing and manufacturer to be performed during design.

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Facilities Recommended for this Measure

- Asher Holmes Elementary School
- Frank Defino Central School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

Demolition and Removal Work

- Demolish and Remove existing boiler(s). Cut and cap existing piping for future connection during proposed work.
- Disconnect, remove and properly dispose of hot water supply and return piping for boilers to nearest isolation valves or as required for new installation.
- Disconnect, remove and properly dispose of gas flue for boilers as required.
- Disconnect all electric, controls, gas piping, water lines, pressure reliefs and drains.

New Installation Work

Typical Details of installation to include the following:

- Furnish and Install (F&I) new high-efficiency condensing gas boiler with integral burner set on concrete pad.
- F&I new hot water supply and return piping from new boilers to existing piping capped during proposed work.
- F&I new boiler drains, pressure reliefs piped to floor drains, water supply, blow down drains piped over to existing floor drains.
- F&I new 2" fiberglass insulation on all new and existing hot water piping 'that has no insulation', drain lines, piping in boiler room.
- F&I new gas line piping from existing gas line to new burners with new shut off valves.
- F&I AL29-4C single wall stainless steel flue pipe to connect from each new boiler to existing main flue in boiler room or new flue up through roof.
- F&I proper pipe suspensions for all piping.
- F&I pipe identification and tags for all pipe, valves, etc.
- Reconnect existing line voltage electrical circuits to new boilers.
- Provide factory startup; assist during start up and testing of new boilers.
- Final Boiler sizing will be based on an updated heat loss and gain calculation.

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Savings Methodology

Savings Calculation Methodology		
Existing Boiler Efficiency	=	Existing Heat Production/ Existing Fuel Input
Proposed Boiler Efficiency	=	Proposed Heat Production/ Proposed Fuel Input
Energy Savings	=	Heating Production (Proposed Efficiency – Existing Efficiency)

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Improved heating system efficiency.
- Lower water supply temperature during shoulder seasons.

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Water Heater Replacement

ECM Summary

The existing domestic water heaters at some Marlboro Township Schools facilities are nearing or are at the end of their useful life. As existing DHW boiler(s) age, they typically experience a loss in efficiency due to fouling and scaling on the internal heat exchange components, as well as an increase in maintenance costs. This measure will include replacing these units with new high-efficiency domestic water heating systems.

Typical Domestic Water Heater

The existing domestic hot water heaters are typically storage tanks tied to the existing heating hot water boilers. This measure will include the installation of new hot water heaters to replace these aging, lower efficiency ones. New condensing water heaters are available that operate at efficiencies up to 97%.

Facilities Recommended for this Measure

- Frank Defino Central School
- Marlboro Elementary School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

Demolition and Removal Work

- Drain, disconnect hot water piping, gas piping, electrical and metal flue venting for removing and properly disposing of existing gas fired domestic hot water heater.

New Installation Work

Typical work scope per facility:

- Furnish and Install (F&I) Lochinvar Shield Model SNA gas fired domestic hot water heater of the following sizes.

Location	No.	Manufacturer	Model	Capacity MBH	Utility
Defino	2	Lochinvar	SNA286-125	285	Nat-Gas
Marlboro ES	2	Lochinvar	SNA286-125	285	Nat-Gas
Robertsville	2	Lochinvar	SNA286-125	285	Nat-Gas
Marlboro MS	2	Lochinvar	SNA501-125	500	Nat-Gas

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- Set new heater on existing concrete housekeeping pad.
- F&I new mixing valve.
- F&I new copper pipe, fittings, valves and insulation to reconnect existing hot water piping to new water heater.
- F&I new combustion air intake and flue exhaust piping.
- Reconnect existing gas piping to new water heater.
- Reconnect existing electric to new water heater.
- Provide factory-authorized start-up with written combustion report.
- All existing piping, supply pumps and check valve to remain.

Savings Methodology

Savings Calculation Methodology		
Existing DHWH Efficiency	=	Existing Heat Production/ Existing Fuel Input
Proposed DHWH Efficiency	=	Proposed Heat Production/ Proposed Fuel Input
Energy Savings	=	Heating Production (Proposed Efficiency – Existing Efficiency)

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Natural gas savings
- System is now separate from heating boiler loop.

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Solar Power Purchase Agreement (PPA)

ECM Summary

The entire district was evaluated for the potential to install rooftop photovoltaic (PV) solar panels for power generation. The locations of solar panel installation were agreed upon with the district. Present technology incorporates the use of solar cell arrays that produce direct current (DC) electricity. The DC current is converted to alternating current (AC) with the use of an electrical device known as an inverter. The amount of available roof area and ground space determines how large of a solar array can be installed on any given location.

The proposed system layouts can be found on the next pages.

Facilities Recommended for this Measure

- David C. Abbott Early Learning Center
- BOE Administrative Office & Building
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Transportation Garage
- Marlboro Middle School

Scope of Work

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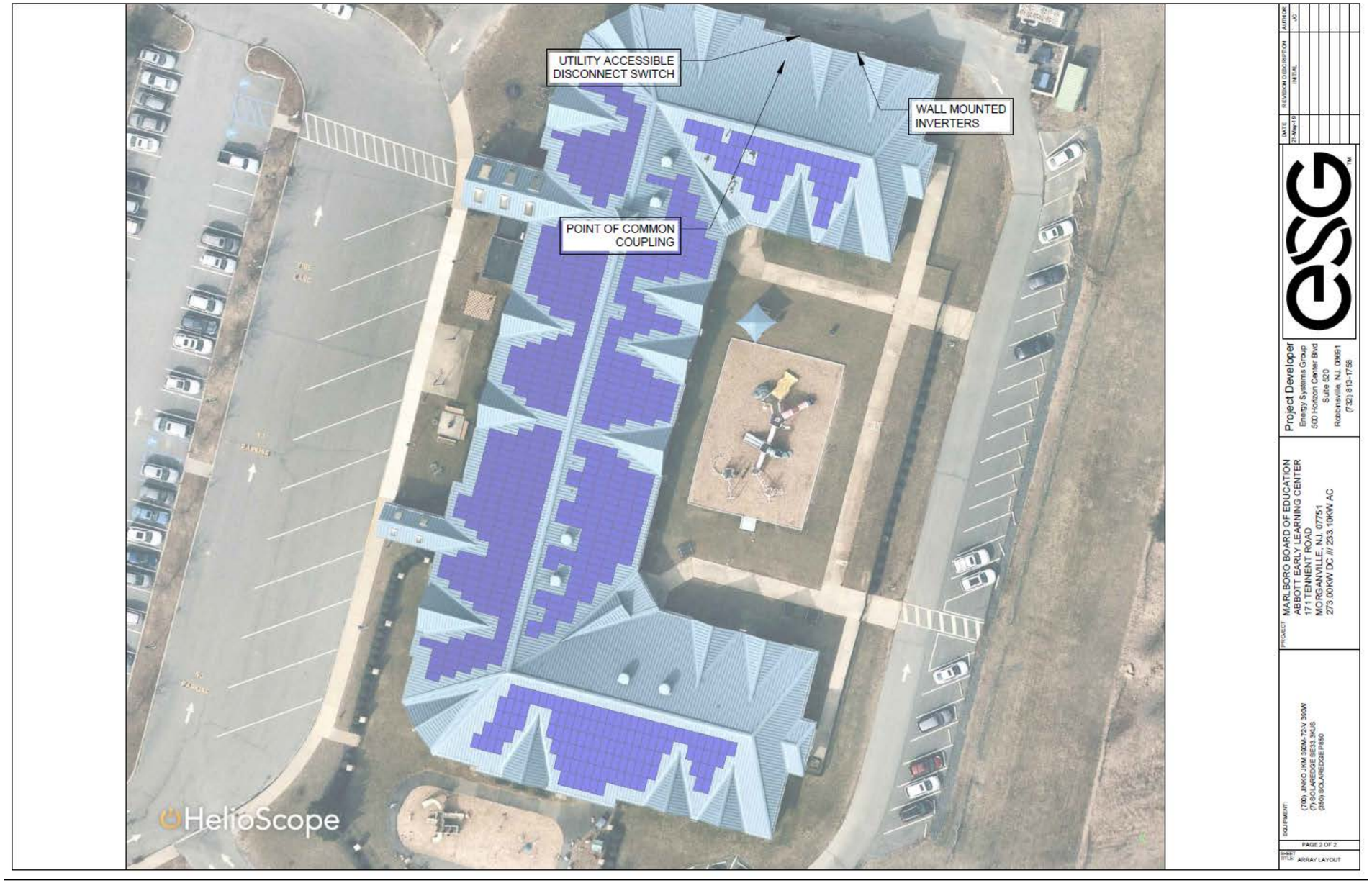
David C. Abbott – 242.58 kW-DC



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Energy Systems Group
500 Horizon Center Blvd
Suite 520
Robbinsville, NJ 08691
(732) 813-1758

esg

DATE 21-May-19
REVISION DISCRIPTION INITIAL
AUTHOR JD

PROJECT
MARLBORO BOARD OF EDUCATION
ABBOTT EARLY LEARNING CENTER
171 TENNENT ROAD
MORGANVILLE, NJ. 07751
273.001KW DC /// 233.10KW AC

EQUIPMENT
(700) JINKO JKM 390M-72-V 390W
(7) SOLAREDGE SE33.3KUS
(350) SOLAREDGE P650

PAGE 2 OF 2

SHEET TITLE ARRAY LAYOUT

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BOE Administrative Office & Building – 53.04 kW-DC

DATE | REVISION DESCRIPTION | AUTHOR
21-May-19 | INITIAL | JC

Project Developer
Energy Systems Group
500 Horizon Center Blvd
Suite 520
Robbinsville, NJ. 08691
(732) 813-1758

PROJECT:
MARLBORO BOARD OF EDUCATION
BOE ADMINISTRATIVE OFFICE
1980 TOWNSHIP DRIVE
MARLBORO, NJ. 07746
52.65KW DC // 40.10KW AC

EQUIPMENT:
(135) JINKO JAM 390M-72-V 390W
(2) SOLAREDGE SE3000-US
(66) SOLAREDGE P650

PAGE 2 OF 2

SHEET TITLE: ARRAY LAYOUT

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Asher Holmes Elementary School – 259.748 kW-DC

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500 Horizon Center Blvd
Suite 920
Robbinsville, NJ. 08691
(732) 813-1758

esg™

DATE: 21-May-19 | REVISION DESCRIPTION: INITIAL | AUTHOR: JC

PROJECT:
MARLBORO BOARD OF EDUCATION
ASHER HOLMES ELEMENTARY
48 MENZEL LANE
MORGANVILLE, NJ. 07751
248.04KW DC /// 216.00KW AC

EQUIPMENT:
(656) JINKO JKM 380M-72V 380W
(1) SOLAREDGE SE43.2US
(316) SOLAREDGE P650

PAGE 2 OF 2

SHEET TITLE: ARRAY LAYOUT

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Frank Defino Central School – 336.96 kW-DC

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Energy Systems Group
500 Horizon Center Blvd
Suite 920
Robbinsville, NJ 08691
(732) 813-1758

PROJECT:
MARLBORO BOARD OF EDUCATION
FRANK DEFINO CENTRAL
175 STATE HIGHWAY 79
MARLBORO, NJ 07746
358.02KW DC / 300.00KW AC

EQUIPMENT:
(918) JINKO JKM 390M-72V 390W
(6) SMA TRIPOWER CORE1 50KW

PAGE 2 OF 2

SHEET TITLE: ARRAY LAYOUT

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Frank J. Dugan Elementary School – 400.14 kW-DC

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Energy Systems Group
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Suite 520
Robbinsville, NJ. 08691
(732) 813-1758

esg™

DATE 23-May-19 | REVISION DESCRIPTION: INITIAL | AUTHOR: JC

PROJECT:
MARLBORO BOARD OF EDUCATION
FRANK DUGAN ELEMENTARY
48 TOPANEMUS ROAD
MARLBORO, NJ. 07746
496.08KW DC /// 400.00KW AC

EQUIPMENT:
(1272) JINKO JKM 395M-72V 395W
(9) SMA TRIPOWER CORE1 55KW

PAGE 2 OF 2

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Marlboro Elementary School – 308.88 kW-DC

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Marlboro Memorial Middle School – 844.74 kW-DC

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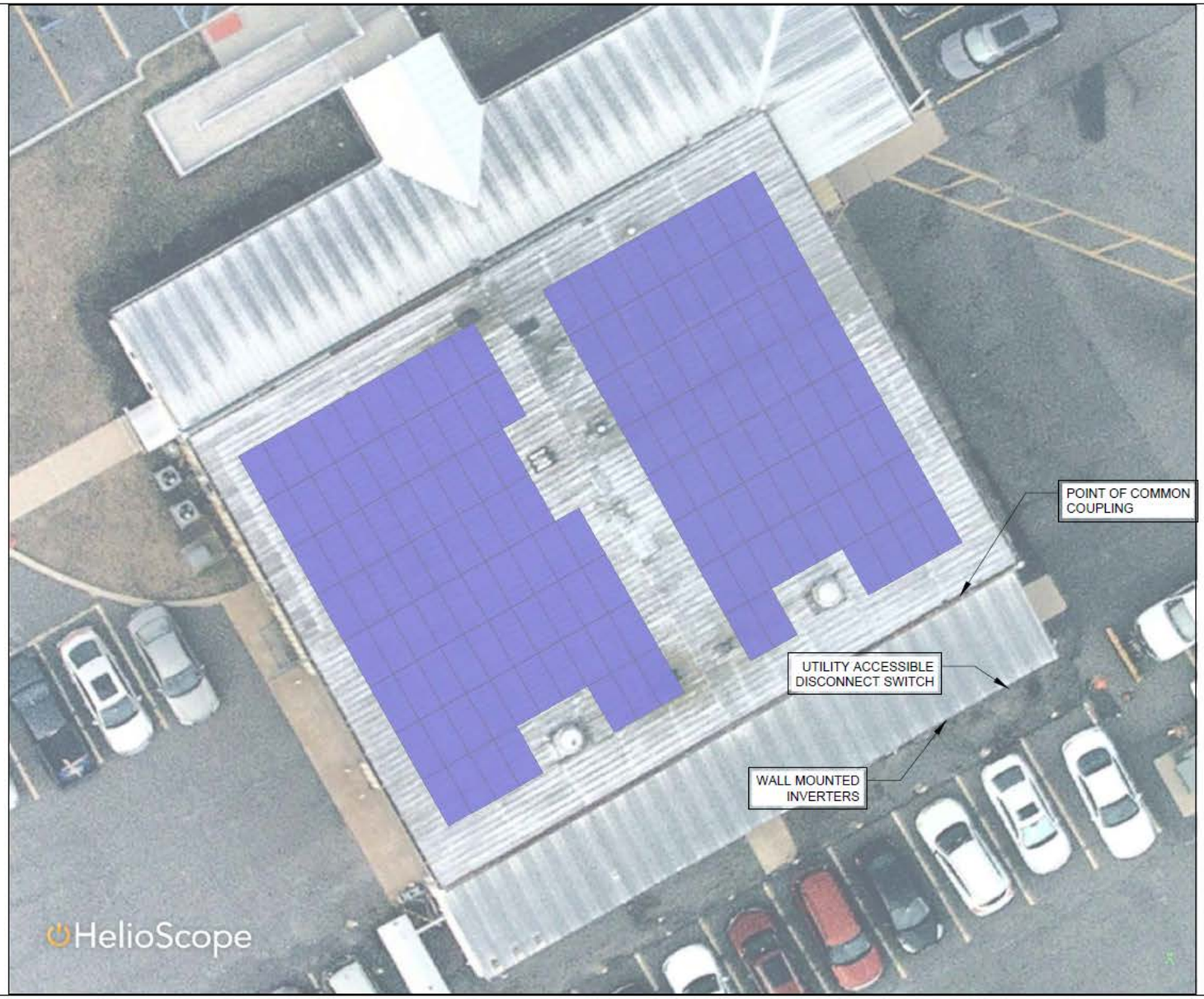
Transportation Garage – 56.16 kW-DC



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(732) 813-1758

DATE 21-May-19 | REVISION DESCRIPTION INITIAL | AUTHOR JC

PROJECT
MARLBORO BOARD OF EDUCATION
TRANSPORTATION GARAGE
1 LOTTA BURKE WAY
MARLBORO, NJ 07746
56.16KW DC // 40.1KW AC

EQUIPMENT
(144) JINKO JKM 390M-72V 390W
(2) SOLAREDGE SE20K-US
(72) SOLAREDGE P650

PAGE 2 OF 2

SHEET TITLE: ARRAY LAYOUT

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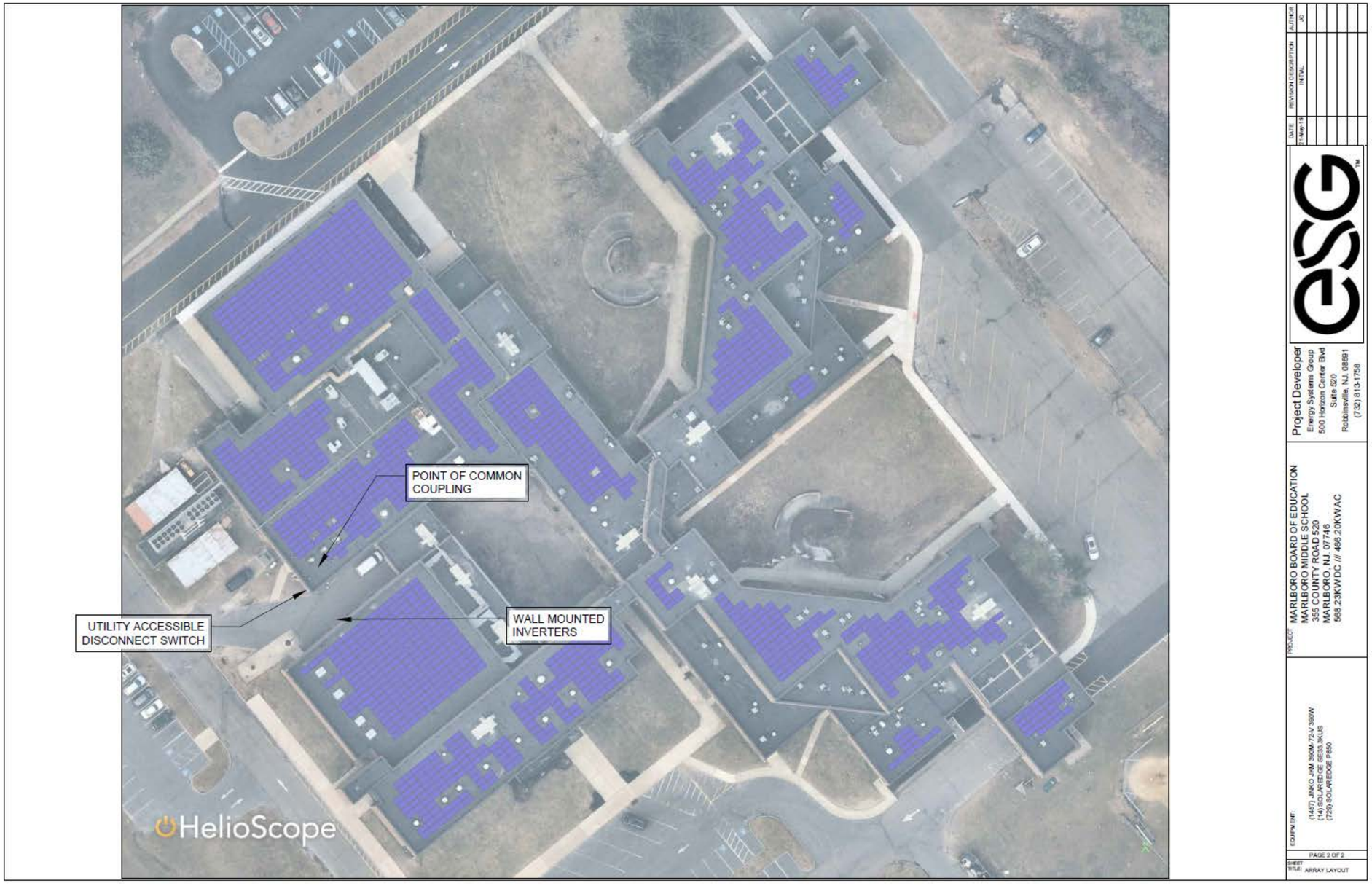
Marlboro Middle School – 528.45 kW-DC



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esg™

DATE: 31-May-19
REVISION DESCRIPTION: INITIAL
AUTHOR: JC

PROJECT:
MARLBORO BOARD OF EDUCATION
MARLBORO MIDDLE SCHOOL
355 COUNTY ROAD 520
MARLBORO, NJ. 07746
568.23KWDC /// 466.20KWAC

EQUIPMENT:
(1457) JINKO JKM 390M-72-V 390W
(14) SOLAREDGE SE33.3KUS
(729) SOLAREDGE P850

PAGE 2 OF 2

SHEET TITLE: ARRAY LAYOUT

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Unit Ventilator Replacement

ECM Summary

We recommend replacing the existing unit ventilators with new unit ventilators equipped with high efficiency EC motors. The advantages of replacing existing permanent split capacity (PSC) motors with electronically commutated motors (ECM) is the increase in control ability of the motor. EC Motors may be programmed to vary speed and can reach efficiencies up to 80% above standard PSC motors.

Based on discussions with facility personnel and the inspection of existing unit ventilators throughout the building, there are several units in poor condition and in need of replacement.

Facilities Recommended for this Measure

- David C. Abbott Learning Center
- Asher Holmes Elementary School (Investigated but not recommended at this time)
- Frank Defino Central School
- Marlboro Elementary School (Investigated but not recommended at this time)
- Robertsville Elementary School (Investigated but not recommended at this time)

Scope of Work

- Demolition, removal and disposal of existing unit ventilators
- Furnish and install the following:
    - High-efficiency Unit Ventilators with EC motors
    - Extend and reconnect piping to/from the existing distribution systems
    - Electrical power and control wiring to new unit(s)
    - Coordinate with new DDC controls
- Provide new unit start-up and commissioning

Savings Methodology

Savings Calculation Method		
Electric Usage Savings (kWh)	=	(# of Unit Ventilators) x (Unit Ventilator Motor HP) x (Run Hours) x (0.746) x (Existing Motor Load Factor – New Motor Load Factor) / (Old Motor Efficiency – New Motor Efficiency)
Electric Demand Savings (kWh)	=	(# of Unit Ventilators) x (Unit Ventilator Motor HP) x (Peak Load Months) x (Demand Load Factor) x (0.746) x (Existing Motor Load Factor – New Motor Load Factor) / (Old Motor Efficiency – New Motor Efficiency)
Cooling Consumption (kWh)	=	(# of Unit Ventilators) x ((4.5 x OA CFM x (h ent - h lvg) x Clg Hrs x % Time at Full Load Summer)/ Conversion) / COP
Heating Consumption (Therm)	=	(# of Unit Ventilators) x ((1.08 x OA CFM x (T lvg - T ent) x Htg Hrs x % Time at Full Load Winter) / Conversion) / Htg EFF
Ventilation Energy Savings (DCV)	=	(# of Unit Ventilators) x ((Original Ventilation Energy) - (Proposed Ventilation Energy))

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Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric savings
- Natural Gas Savings
- Improved Heating Performance
- Improved airflow.

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Unit Ventilator Refurbishment

ECM Summary

We investigated refurbishing the existing standard efficiency motors with high efficiency EC motors in the unit ventilators throughout the District. The advantages of replacing existing permanent split capacity (PSC) motors with electronically commutated motors (ECM) is the increase in control ability of the motor. EC Motors may be programmed to vary speed and can reach efficiencies up to 80% above standard PSC motors.

Based on discussions with facility personnel and the inspection of existing unit ventilators throughout the building, they are several units in poor condition and in need of substantial refurbishment or replacement.

Facilities Considered for this Measure

- Asher Holmes Elementary School
- Frank Defino Central School (Investigated but not recommended at this time)
- Marlboro Elementary School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

- Replace each existing Unit Vent systems with (1) each high-efficiency EC motor-based Unit Vent systems on each of the Unit Vent systems.
    - The metal cabinet (shroud) of the existing Unit Vents will remain in place. Replacement components should fit within the allowed space of the existing metal cabinet
    - All internal components to be replaced to provide optimal efficiency.
- Furnish & install (F&I) (1) each high-efficiency EC motor-based Unit Vent system on each of the Unit Vent systems.
- In installations currently equipped for outdoor air, replacement Unit Vents to include economizer with single enthalpy control.
- Clean existing hot water coil, flush out any debris in coil piping and place back in service.
- F & I new fan assembly, motor, 2 -way control valve, dampers, OA actuator with linkage, drain pan, filter and controls. Remove damaged internal lining within each Unit Vent and replaced with adhesive applied duct liner with anti-microbial coating.
- F&I new DDC controller to manage Unit Vent system and integrate with building DDC Controls Upgrade project. DDC controller shall be capable of executing demand control ventilation sequences.
- F&I new room thermostat controller and CO2 sensor.

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Savings Methodology

Savings Calculation Method		
Electric Usage Savings (kWh)	=	(# of Unit Ventilators) x (Unit Ventilator Motor HP) x (Run Hours) x (0.746) x (Existing Motor Load Factor – New Motor Load Factor) / (Old Motor Efficiency – New Motor Efficiency)
Electric Demand Savings (kWh)	=	(# of Unit Ventilators) x (Unit Ventilator Motor HP) x (Peak Load Months) x (Demand Load Factor) x (0.746) x (Existing Motor Load Factor – New Motor Load Factor) / (Old Motor Efficiency – New Motor Efficiency)
Cooling Consumption (kWh)	=	(# of Unit Ventilators) x ((4.5 x OA CFM x (h ent - h lvg) x Clg Hrs x % Time at Full Load Summer)/ Conversion) / COP
Heating Consumption (Therm)	=	(# of Unit Ventilators) x ((1.08 x OA CFM x (T lvg - T ent) x Htg Hrs x % Time at Full Load Winter) / Conversion) / Htg EFF
Ventilation Energy Savings (DCV)	=	(# of Unit Ventilators) x ((Original Ventilation Energy) - (Proposed Ventilation Energy))

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric savings
- Natural Gas savings
- Improved Controllability

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Plug Load Controls

ECM Summary

Office equipment is regularly left in the 'on' state at all times allowing the individual machine to revert to the 'Sleep' mode based on an internal timer. This measure will plug the office equipment into a networkable device that will allow for scheduling of the plugged-in equipment.

Facilities Recommended for this Measure

- David C. Abbott Learning Center
- BOE Administrative Offices
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

Energy Systems Group recommends utilizing specialty wall sockets from BERT that have software to track real-time electrical usage of your appliances. The software also allows you to use your web browser to view this usage and automatically turn on/off any and all appliances plugged into these outlets.

David C. Abbott Learning Center

Device Type:	Baseline Hours ON:	# of Berts
Projector	8760	7
Projector/Smartboard Combo	8760	3
Charging Cart	8760	4
Printer	8760	2
Large Printer/Copier	8760	1
TOTAL		**17**

BOE Administrative Offices

Device Type:	Baseline Hours ON:	# of Berts
Projector	8760	4
Printer	8760	13
Large Printer/Copier	8760	1
TOTAL		**18**

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Asher Holmes Elementary School

Device Type:	Baseline Hours ON:	# of Berts
Projector	8760	13
Smartboard TV	8760	2
Projector/Smartboard Combo	8760	1
Charging Cart	8760	25
Printer	8760	2
Large Printer/Copier	8760	1
Soda Vending	8760	1
AC - 110 (15A)	8760	6
TOTAL		**51**

Frank Defino Central School

Device Type:	Baseline Hours ON:	# of Berts
Projector	8760	27
Charging Cart	8760	18
Printer	8760	2
Soda Vending	8760	1
AC - 110 (15A)	8760	2
TOTAL		**50**

Frank J. Dugan Elementary School

Device Type:	Baseline Hours ON:	# of Berts
Projector	8760	31
Charging Cart	8760	19
Printer	8760	4
Large Printer/Copier	8760	1
TV/LCD/Smart TV	8760	3
AC - 110 (15A)	8760	2
TOTAL		**60**

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Marlboro Elementary School

Device Type:	Baseline Hours ON:	# of Berts
Projector	8760	21
Charging Cart	8760	23
Printer	8760	3
AC - 110 (15A)	8760	4
TOTAL		**51**

Marlboro Memorial Middle School

Device Type:	Baseline Hours ON:	# of Berts
Projector	8760	29
Charging Cart	8760	41
Printer	8760	4
TV/LCD/Smart TV	8760	1
Soda Vending	8760	1
TOTAL		**76**

Robertsville Elementary School

Device Type:	Baseline Hours ON:	# of Berts
Projector	8760	17
Smartboard TV	8760	3
Projector/Smartboard Combo	8760	2
Charging Cart	8760	25
Printer	8760	3
Large Printer/Copier	8760	1
Soda Vending	8760	1
AC - 110 (15A)	8760	6
TOTAL		**58**

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Marlboro Middle School

Device Type:	Baseline Hours ON:	# of Berts
Projector	8760	29
Charging Cart	8760	41
Printer	8760	4
TV/LCD/Smart TV	8760	1
Soda Vending	8760	1
TOTAL		**76**

Savings Methodology

Savings are calculated using the following methodology for all devices plugged in:

Savings Calculation Methodology		
Baseline Energy Usage (kWh / yr)	=	Average kW x Baseline Weekly Hours x 4.348 wks/mo. x Months/yr
Proposed Energy Usage (kWh/ yr)	=	Average kW x Proposed Weekly Hours x 4.348 wks/mo. x Months/yr
Electrical Savings (kWh/ yr)	=	Baseline Energy Usage – Proposed Energy Usage

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical energy savings

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Repair Missing Piping Insulation

ECM Summary

The un-insulated pipes (Memorial Middle)

Non-insulated pipelines and associated valves and fittings carrying thermal fluids because heat loss where not intended and result in excess fuel consumption, as well as discomfort in occupied areas. Valves and fittings without insulation were observed throughout the buildings and installation of new insulation is recommended. Installation of the proper amount of insulation will not only conserve energy but will also improve safety by reducing the chance for burns on hot piping or slipping due to condensate on a pipe.

Facilities Recommended for this Measure

- David C. Abbott Learning Center
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

Findings

- Pipe Insulation – un-insulated pipes in the heating hot water, chilled water, and domestic hot water systems are leading to unnecessary distribution losses and wasted energy. All buildings in the Marlboro Township Public School District that have recommended mechanical insulation improvements have un-insulated straight pipes. Most of the un-insulated straight pipes are located in a close vicinity to the centrifugal pumps.
- Valve & Fitting Insulation – valves and fittings are difficult components of a mechanical system to insulate and as a result are frequently left un-insulated. The following components were found to be un-insulated in Marlboro, NJ: Bonnets, Butterfly valves, Check valves, Control valves, Flex Fittings, Flo-Check valves, Gate valves, Strainers, and Suction Diffusors. These un-insulated or poorly insulated components have the same temperature fluids passing through them as the pipes that are more likely to be insulated and lead to unnecessary distribution losses and wasted energy.
- Tank Insulation – tanks are difficult components of a mechanical system to insulate and as a result are frequently left un-insulated. There are un-insulated tanks at the David C. Abbott Early Learning Center, Marlboro Memorial Middle School, and Frank J. Dugan Elementary School. Un-insulated Air Separator tanks have the same temperature fluids passing through them as the

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surrounding pipes that are more likely to be insulated; un-insulated components of the distribution system lead to unnecessary distribution losses and wasted energy.

Recommendations

- Pipe Insulation
- Valve, Fitting & Tank Insulation
    - Auburn Manufacturing Ever Green Cut 'n Wrap is recommended at Valves and Fittings for the project.
- Refer to calculations for a detailed inventory of insulation scope of work.

***Note**: All insulation thickness shall be confirmed to be in accordance with the New Jersey Energy Conservation Code, ASHRAE 90.1-2013. Contract shall be responsible for verification of these thicknesses.*

Savings Methodology

Mechanical Insulation Savings Calculations

This section describes our methodology for calculating energy savings. We use standard heat transfer methods to compute heat loss from bare and insulated mechanical systems (piping, valves, fittings, tanks and ductwork). The difference in heat loss is the energy savings, as follows:

Energy Savings = [Existing Heat Loss] – [Insulated Heat Loss]

Methodology

We use standard heat transfer methods to compute radiation, convection, and conduction heat loss from (Alternatively, gain to, for cold systems) bare and insulated systems. Key parameters that affect the heat transfer rate include: temperature of fluid (e.g. steam, hot water, chilled water, etc.); surface temperature of the component (e.g. pipe, fitting, tank, ductwork); temperature of environment; emissivity of surface; average wind speed where applicable; percentage of existing component covered with insulation; and condition of existing insulation, where applicable.

Energy Use

Existing and proposed energy use are computed as follows:

Pipes & Fittings

Heat Loss (Btu/h) = (Heat Loss / lin.ft. bare pipe) * (lin.ft. of pipe) * [1 – (%insulated)] +
(Heat Loss / lin.ft. insulated pipe) * (lin.ft. of pipe) * (%insulated)
Fuel Loss (MMBTU/yr) = (Heat Loss Btu/h) * (heating hrs/year) ÷ (efficiency)
Electric Loss (kWh/yr) = (Heat Loss Btu/h) * (cooling hrs/year) ÷ (12,000 Btu/ton-hr) x (cooling kW/ton)

Tanks, Plates, & Ductwork

Existing and proposed heat loss for tanks, plates, and ductwork are calculated as follows:

Heat Loss (Btu/h) = (Heat Loss / sq.ft.) * (sq.ft. of component) * (qty) * [1 – (%insulated)] +
(Heat Loss / sq.ft. insulated) * (qty) * (sq.ft. of component) * (%insulated)

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Fuel Loss (MMBTU/yr) = (Heat Loss Btu/h) * (heating hrs/year) ÷ (efficiency)
Electric Loss (kWh/yr) = (Heat Loss Btu/h) * (cooling hrs/year) ÷ (12,000 Btu/ton-hr) x (cooling kW/ton)

Energy Savings

Energy savings are the difference between existing and proposed heat loss:

Fuel Savings (MMBTU/yr) = (Existing Fuel Loss) – (Proposed Fuel Loss)
Electric Savings (MMBTU/yr) = (Existing Electric Loss) – (Proposed Electric Loss)
Cost Savings ($/yr) = (Fuel Savings MMBTU/yr) * (Fuel Rate $/MMBTU) + (Electric Savings kWh/yr) * (Electric Rate $/kWh)

Heat Transfer: Bare Systems

Bare systems are subject to convection and radiation heat transfer. We ignore conductive heat transfer through the pipe/fitting material (e.g. steel, copper, PVC etc.) as this is negligible as compared to heat transfer through insulation and air convection.

Pipes & Fittings

This section describes the heat transfer calculations for pipes and fittings for indoor systems subject to natural convection (no wind). The calculations for outdoor systems subject to forced convection (wind) are similar except that the formulas are more complicated. These methods are presented following this section.

For fittings (valves, elbows, strainers, etc.), we estimate heat loss based on equivalent length of straight pipe, which is the ratio of the area of the fitting to the area of 1 linear foot of pipe of the same size (fitting equivalent length = Area of fitting, ft^2 / Area of pipe of equivalent diameter, ft^2).

$$q_{pipe} = \frac{2 * \pi * \Delta T}{\frac{1}{h * \left(D_{outer}/_2\right)}}$$

Where:
q_{pipe} = *heat loss per linear foot = Btu/h/lin.ft.*

h = *total convective heat transfer factor* $= h_{convection} + h_{radiation}$

$$h_{convection} = 0.213 * \left(\frac{\Delta T}{D}\right)^{\left(\frac{1}{4}\right)}$$ [ASHRAE 2005, Ch. 3, Eq. T10.16]

$T = T_{surface} - T_{air}$
$\Delta T = T_{surface} - T_{air}$
D = Outer diameter

$$h_{radiation} = \varepsilon * \sigma * \left(T_{surface}^4 - T_{air}^4\right) / \left(T_{surface} - T_{air}\right)$$

e = emissivity of surface
s = Stefan-Boltzmann constant = 0.1714 x 10-8 Btu / (hr-ft^2-°R^4)
$T_{surface}$ = *Temperature of surface*
T_{air} = *Average ambient air temperature*

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Heat Transfer: Insulated Systems

Insulated systems are subject to convection, radiation, and conductive heat transfer. We ignore conductive heat transfer through the pipe/fitting material (e.g. steel, copper, PVC etc.) as this is negligible when compared to heat transfer through insulation and air convection.

$$q_{pipe} = \frac{2 * \pi * \Delta T}{\frac{ln\left(D_{outer}/D_{inner}\right)}{k} + \frac{1}{h * \left(D_{outer}/2\right)}}$$

Where:
q_{pipe} = *heat loss per linear foot = Btu/h/lin.ft.*

$$h_{convection} = 0.213 * \left(\frac{\Delta T}{D}\right)^{\left(\frac{1}{4}\right)}$$ [ASHRAE 2005, Ch. 3, Eq. T10.16]

$T = T_{surface} - T_{air}$
$\Delta T = T_{surface} - T_{air}$
D = Outer diameter

$$h_{radiation} = \varepsilon * \sigma * \left(T_{surface}^4 - T_{air}^4\right) / \left(T_{surface} - T_{air}\right)$$

e = emissivity of surface
s = Stefan-Boltzmann constant = 0.1714 x 10-8 Btu / (hr-ft^2-°R^4)
$T_{surface}$ = *Temperature of surface*
T_{air} = *Average ambient air temperature*
L = Pipe length or fitting equivalent length

Heat Transfer for Outdoor Systems

The methods for computing heat loss for outdoor systems subject to forced convection (wind) are identical to the methods for indoors systems described above except that the formulas to compute the convective heat transfer coefficient h is more complicated. These methods are described below:

Pipes & Fittings: Outdoor Systems

The convection heat transfer coefficient is:

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$$h_{convection} = Nu * k / D_{outer}$$

$$Nu = Nussault\ number = 0.3 + \frac{0.62 * Re^{\left(\frac{1}{2}\right)} * Pr^{\left(\frac{1}{3}\right)}}{\left[1 + \left(\frac{0.4}{Pr}\right)^{\left(\frac{2}{3}\right)}\right]^{\left(\frac{1}{4}\right)}} * \left[1 + \left(\frac{Re}{282{,}000}\right)^{\left(\frac{5}{8}\right)}\right]^{\left(\frac{4}{5}\right)}$$

$$Re = Reynolds\ number = \frac{V * D_{outer}}{v}$$

$\Pr = Prandtl\ number = 0.7\ (for\ air)$
$v = kinematic\ viscosity\ of\ air$
$V = wind\ speed$
$D_{outer} = outer\ pipe\ diameter$

Plates, Tanks, Ductwork: Outdoor Systems

The convection heat transfer coefficient for flat surfaces is estimated as follows

$$h_{convection} = Nu * k / D_{outer}$$

$$Nu = Nussault\ number = 0.415 * Re^{\left(\frac{1}{2}\right)} * Pr^{\left(\frac{1}{3}\right)}$$

$$Re = Reynolds\ number = \frac{V * L}{v}$$

$\Pr = Prandtl\ number = 0.7\ (for\ air)$
$v = kinematic\ viscosity\ of\ air$
$V = wind\ speed$
$L = width\ or\ diameter\ of\ component$

Maintenance

The maintenance staff should maintain the newly installed equipment per manufacturers' recommendations. The manufacturer specification sheets will be provided for exact maintenance requirements.

Benefits

- Fuel energy savings

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Install Kitchen Hood Controls

ECM Summary

In this measure we examined optimizing kitchen hood operation through Melink's Intelli-Hood® (or equal) control system. The proposed system is designed for commercial kitchen ventilation systems and can save fan energy by improving the efficiency of the hoods.

With the Melink system installed, when the hood is started, the fans go to a preset minimum speed of 10-50% (typical). The speed control is achieved using a variable frequency drive. When the cooking appliances are turned on, the fan speed increases upon detecting an increase in the exhaust air temperature (detected by a temperature sensor). During the actual cooking the fan reaches 100% of the speed until smoke/vapor, detected by an optical sensor is removed. Each Optic Sensor enclosure has a purge fan that keeps the environment inside the enclosure under a positive air pressure. This prevents contaminated air from entering the sensor unit. If applicable, the makeup-air unit associated with the hood exhaust fan, simply follows the speed (airflow) of the exhaust fan, so proper pressurization is maintained during the entire operation.

Facilities Considered for this Measure

- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Marlboro Middle School

Savings Methodology

Savings Calculation Methodology		
Exhaust Fan Energy Usage (kWh)	=	(EF HP x Load Factor x (% Airflow) x 0.746 / Motor Efficiency) x Hours at % Airflow
Supply Fan Energy Usage (kWh)	=	(SF HP x Load Factor x (% Airflow) x 0.746 / Motor Efficiency) x Hours at % Airflow
Heating Energy Usage (MMBtu)	=	(1.08 x (EF CFM - SF CFM) x (Tin - Tout max) x Op Hrs x (Htg Hrs / Tot Hrs per Yr) x %Full Load Winter / 1,000,000
Energy Savings (Units/ yr)	=	Baseline Energy Usage – Proposed Energy Usage

Maintenance

Periodically the equipment should be checked to ensure proper operation and sensors should be cleaned.

Benefits

- Electric and Natural Gas savings.

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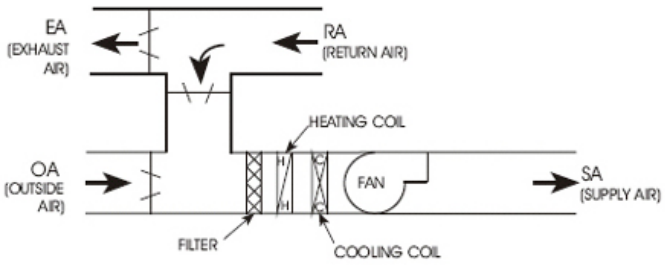
Install HVAC Related Variable Frequency Drives (VFDs)

ECM Summary



Air Handling Unit Schematic

Typical Cooling Tower Application

We recommend installing VFDs to control fans and pumps on all motors in excess of 5HP. A control signal, integrated with the building management system, will cause the VFD to modulate fan speed to maintain the appropriate design parameters. Energy savings results from reducing fan/pump speed (and power) when there is a reduced load required for the zone. The magnitude of energy savings is based on the estimated amount of time that fan motors operate at partial load.

The VFDs will include a bypass to allow the motor to operate at full speed in HAND in the event of VFD failure. The VFD will be supplied complete with an open protocol communications card for integration with existing Building Management System (BMS) or newly installed BMS. The VFD will be controlled by the BMS to maintain the condenser water temperature setpoint.

Additional Option: Pump Consolidation

In addition to adding VFDs to the heating water pumps at serval of the schools the heating loop pumps will also be consolidated as part of the boiler upgrade project. Currently several of the buildings have multiple pumps to feed the original building and subsequent additions. Consolidating to a single set of primary pumps will reduce the overall pumping power.

Facilities Recommended for this Measure

- David C. Abbott Learning Center
- Marlboro Memorial Middle School
- Marlboro Middle School

Scope of Work

- Remove existing fan/pump motor starter, and safely disconnect electrical supply
- Where applicable, replace existing motors with new, inverter duty motors
- Properly dispose of all removed equipment and waste materials
- Furnish and install new VFDs. Each VFD to have the following features
    - Open protocol EMS interface card to connect to existing control system
    - Three Contactor Bypass
    - Fusible or Circuit Breaker Disconnect
- Furnish and install new pumps, where applicable.
- Provide electrical power wiring from the main electrical panel to each new VFD.

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- Reuse existing electrical wiring where possible
- Modify electrical power wiring distribution panel as needed
- Extend communication bus to/from each VFD to/from existing Building Management System
- Perform any required programming and graphics modifications
- Start-up and commissioning of VFDs

Savings Methodology

Savings Calculation Method		
Energy Savings (kWh)	=	0.746 * HP * HRS * (ESF/η motor)
Demand Savings (kW)	=	0.746 * HP * (DSF/η motor)

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric and Natural Gas savings

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Water Conservation

ECM Summary

We recommend eliminating unnecessary water consumption by tuning each domestic water fixture to the right amount of water, thereby creating cost savings. The following proposed strategies will improve the efficiency and performance of toilets and sink faucets:

- Flushometers (Toilets and Urinals):
    - Increased Performance and Flush-to-Flush Consistency. The first objective is to ensure each and very fixture operates properly. Our calibration and tuning via Variable Flow Technology will ensure each fixture is using the right amount of water.
    - Flushometer Scope:
    - Valve Recommissioning: Replace diaphragm kit and inner cap. Re- engineering of the new kit will provide the proper flush curve for each fixture.
    - Valve Rebuilding: Remove and replace diaphragm kit and inner cap. Re- engineering of the new kit will provide the proper flush curve for each fixture. Replace vacuum breaker, handle assembly and O-Rings.
    - Spud and/or Flushtube Replacement: remove and replace the fixture spuds and flushtubes (optional or as needed).
- Tank Toilet Retrofit Upgrade:
    - Tank Toilet Retrofit Upgrade: remove and replace the flapper, flow diverter ballcock assembly, and refill tube. As necessary, to ensure proper operation during the warranty period, remove and replace the trip lever and supply line.
- Sinks:
    - Pressure Independent Performance. End-users will enjoy the same level of performance regardless of incoming pressure (flow rate is constant at pressures between 20 and 80 psi). Pressure variations within the facility would be transparent to the end-users.
    - Invisible to End-Users. Because we carefully apply the appropriate flow rate and pattern to each sink (based upon sink application), end-users will not realize a decline in performance.

Facilities Recommended for this Measure

- David C. Abbott Early Learning Center
- BOE Administrative Office & Building
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Transportation Garage
- Marlboro Middle School

Scope of Work

The following table indicates combined scope of work for all buildings by fixture type:

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Site Information			"Scope of Work"																		
			Flushometer Fixtures						Tank Toilets			Sinks			Showers		New Fixtures				
Building or Meter	Recommended Scope of Work Option #	In Scope of Work	Valve Recommissioning	Valve Rebuilding	Valve Replacement	Spud & Flushtube Replacement	Control Stop Modify/Replace	Handle-Mount Hands-Free	System Tuning	Retrofit Upgrade	Convert & Retrofit Upgrade	Vandal Resistant Flow Control	Manual Faucet	Hands-Free Faucet	Wall Showerhead	Handheld Showerhead	Flushometer Toilet	Tank Toilet	Urinal	Kitchen Sprayers
David C. Abbott Early Learning Center	2	x	-	28	-	7	-	-	-	-	-	-	-	-	-	-	-	-	-	-
BOE Administrative Office & Building	3	x	-	-	1	1	-	-	-	5	-	-	-	-	-	-	-	-	-	-
Asher Holmes Elementary School	3	x	1	-	62	35	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Frank Defino Central School	3	x	-	-	58	31	-	-	-	2	-	53	-	-	-	-	-	-	-	-
Frank J. Dugan Elementary School	3	x	-	-	57	30	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marlboro Elementary School	3	x	-	-	38	38	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Marlboro Memorial Middle School	3	x	-	-	83	45	-	-	-	-	-	91	-	-	-	-	-	-	-	-
Robertsville Elementary School	3	x	-	-	55	41	-	-	-	3	-	-	-	-	-	-	-	-	-	-
Transportation Garage	3	x	-	-	1	1	-	-	-	4	-	-	-	-	-	-	-	-	-	-
Marlboro Middle School	3	x	-	-	109	61	-	-	-	-	-	89	-	-	-	-	-	-	-	-
Total		x	**1**	**28**	**464**	**290**	**0**	**0**	**0**	**18**	**0**	**233**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Savings Methodology

Frequency of Use	=	Number of users x % year-round occupancy x fixture uses/day/person
Water Savings (kgal/yr)	=	Frequency of Use x (Baseline – Post-Retrofit Flow Rate) (gpm or gpf per fixture) x days/year x % high-flow fixtures
Energy Savings (MMBtu/yr)	=	Sink/Shower Water Savings (gal/yr) x (T_{mixed} -T_{cold}) (°F) x (1 Btu/lb °F X 8.34 (lb/gal) x 1 MMBtu/1,000,000 Btu
Energy Savings (kWh/yr)	=	Energy Savings (MMBtu/yr) x 293.1 kWh/1 MMBtu
Cost Savings ($/yr)	=	[(Energy Savings (MMbtu/yr)] x 1/boiler efficiency (%) x Thermal Rate ($/MMbtu)] + [(Energy Savings (kWh/yr)] x 1/boiler efficiency (%) x Electric Rate ($/kWh)]

Maintenance

The maintenance staff should maintain the newly installed equipment per manufacturers' recommendations. The manufacturer specification sheets will be provided for exact maintenance requirements.

Benefits

Water use reduction

Fuel use reduction

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Walk-In Cooler Controls

ECM Summary

The kitchens at the Marlboro School District contain walk-in freezers, walk-in coolers, reach-in freezers and reach-in coolers. These units are controlled by a dry bulb temperature and as a result run continuously throughout the year. Installing an **eTemp** control retrofit was assessed. The refrigeration systems usually monitor circulating air temperature in order to decide when to switch on and off. The circulating air temperature tends to rise far more quickly than the food temperature, and as result, the refrigeration unit works harder than necessary to maintain stored products at the right temperature. This, in turn, leads to excessive electricity consumption and undue wear and tear on the equipment. With **eTemp**, the thermostat regulates the refrigeration temperature based upon product temperature rather than air temperature, thereby maintaining product at the proper temperature. Savings is a result of reduced frequency of the compressor cycles, which are now based on food temperature rather than volatile air temperature. The equipment present in the middle school are shown in the table below.

Facilities Recommended for this Measure

- Abbott Early Learning Center
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

- Furnish and install one (1) eTemp on the following locations.
- Fit eTemp to the thermostat sensor that controls the compressor.

Building	Type	Quantity
All Schools	Walk-In Freezer	6
	Walk-In Cooler	6
	Reach-in Cooler	8
	Reach-in Freezer	8

- Provide start up and warranty.
- Provide training for maintenance personnel.

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Savings Methodology

Savings are calculated using the following methodology:

Energy savings will result from reducing the compressor cycling. In general, ESG uses the following approach to determine savings for this specific measure:

Savings Calculation Method		
Pre - kW	=	Compressor (HP) x 0.746 x Pre Cycles/hr
Post - kW	=	Compressor (HP) x 0.746 x Post Cycles/hr
Summer Season Hrs (Hs)	=	Total Hrs/yr x 55%
Winter Season Hrs (Hw)	=	Total Hrs/yr x 45%
Compressor Summer Cycling (% On) (Cs)	=	55%
Compressor Winter Cycling (% On) (Cw)	=	35%
Compressor Summer Operating (Hrs)	=	Hs x Cs
Compressor Winter Operating (Hrs)	=	Hw x Cw
Savings (kW)	=	Pre – Post (KW)
Savings (kWh)	=	(Compressor Summer Operating (Hrs)+ Compressor Winter Operating (Hrs)) x (Pre – Post (KW))

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical energy savings

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Building Envelope Weatherization

ECM Summary

Infiltration drives energy costs higher by allowing unconditioned outside air to enter the building, thus adding to the building load and causing additional unnecessary heating and cooling loads. All Marlboro School buildings were surveyed in order to identify potential improvements for outside air infiltration reduction. The main observations are listed below:

- Most entrance doors need weather stripping, sweeps or the closure or strike plate adjusted;
- Sealant is recommended around the perimeter of several windows;
- Numerous penetrations were observed that need to be sealed.

These deficiencies mostly reflect the skin of the buildings, which either have existed since original construction of the building, were added during some retrofit periods, or were caused by deterioration.

Facilities Recommended for this Measure

- David C. Abbott Learning Center
- BOE Administration Building
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Transportation Building
- Marlboro Middle School

Scope of Work

A building envelope audit was performed for the entire district. The results of the audit were the identification of several areas of envelope deficiency. The deficient areas were tabulated and their savings potential calculated. Building Envelope Scope drawings are listed in the Appendix.

<u>Findings</u>

- Door Weather Stripping – deteriorated weather-stripping materials, ineffective weather stripping installation and daylight showing at the perimeter of door systems create direct pathways for unwanted infiltration/ exfiltration.
- Hopper Window Weatherization - there is no existing seal present on the windows at Frank Defino Elementary School and Robertsville Elementary School. As a result, the single pane, hopper style windows are subsequently acting as an air filter rather than an air barrier. Without a tight a compression seal between the sash and the frame, the windows are allowing air leaks even when the windows are shut. These windows are in the direct vicinity of classrooms, often times close to where students and teachers sit; as a result, the air leakage coming through these windows is also a contributing factor to reduced occupancy comfort. While these windows are overall aged, proper weather stripping will seal the gaps that are allowing the unwanted air leakage. This will help prolong the life of the windows prior to replacement.

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- Overhang Air Sealing – overhangs are roofs, floor systems or areas above entryways that extend beyond the plane of the exterior wall system. These areas of construction are often misunderstood by builders and the cavity that extends beyond the plane of the exterior wall system is often incorrectly "connected" to the interior heated spaces of the building. Overhangs that are not properly sealed at the plane of the surface that should separate the conditioned space from the outdoors lead to excessive air leakage and heat loss at these vulnerable areas in the building envelope. There are unsealed overhangs, which pose a significant building envelope weakness, at Frank Defino Elementary School, Frank J Dugan Elementary School, Marlboro Elementary School, and Robertsville Elementary School.
- Overhead Door/Roll-Up Door Weather Stripping - remove existing weather stripping and replace with new commercial grade weather stripping to create a full air seal around the door. With low grade, none, or deteriorating materials in place overhead and roll-up doors are a major air leakage source in any building with one these systems.
- Penetration Air Sealing – penetrations in the Marlboro Township Public School District exist in the form of exposed air handling ducts in the respective gyms of Asher Holmes Elementary School and Marlboro Middle School. The oversized gaps around the perimeter of these large ducts are a direct pathway for unwanted air to enter the conditioned gym. Each one of these penetrations is contributing to unwanted energy loss as unconditioned air enters through these gaps and conditioned air escapes to the exterior.
- Roof Insulation – the mechanics bay at the Transportation Garage has an improper thermal barrier that is leading to wasted energy in this building and is also contributing to a reduced occupancy comfort for the workers, especially in the winter. The existing insulation that is attached to the underside of the metal roof deck is damaged throughout the bay, and the fiberglass material is not thick enough to properly insulate the space based on the recommended R-value for the New Jersey climate.
- Roof-Wall Intersection Air Sealing – the roof-wall intersection is regularly an area that allows unwanted air leakage through the building shell. This area, as well as un-sealed overhangs, makes up the most significant building envelope weaknesses in the assessed buildings of the Marlboro Township Public Schools. Exterior flashing and finish details at this area are not constructed to stop air leakage (exterior flashings are for water control, not air control); unsealed exterior flashing details combine with interior gaps in the framing between the roof and wall assembly to allow infiltration/ exfiltration.

<u>Recommendations</u>

- Door Weather Stripping
- Hopper Window Weatherization
- Overhang Air Sealing
- Overhead Door/Roll-Up Door Weather Stripping
    - Weather Strip – install heavy-duty aluminum carrier with oversized vinyl insert gasket at the sides: install heavy-duty aluminum carrier with an oversized bottom U-style gasket at bottom.
- Penetration Air Sealing
    - Air Handling Duct Air Sealing (Asher Holmes Elementary School & Marlboro Middle School) - use polyurethane spray foam to create an air barrier seal around the air handling duct penetrations in the respective gyms where they intersect the wall.
- Roof Insulation

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  - Garage Bay Insulation (Transportation Garage) - Install white-faced insulation between the grooves at the underside of the metal deck. Prep time required to apply support wires to hold insulation in place.
- Roof-Wall Intersection Air Sealing

Savings Methodology

The energy savings derived from this measure are a result of the heating and cooling systems (DX cooling and boilers) not having to work as hard to achieve the desired environmental conditions. The amount of savings is dependent on the existing building conditions and the amount of air leakage under the current operating conditions.

Energy savings are based on the ASHRAE crack method calculations. If the process reveals any variation in the as-built conditions, then savings will be adjusted accordingly. Determination of air current air leakage rates is based on many factors, including:

- Linear feet of cracks
- Square feet of openings
- Stack coefficient
- Shield class
- Average wind speed
- Heating or cooling set point
- Average seasonal ambient temperatures

Savings due to infiltration reduction:

The following equation is based on the ASHRAE crack method:

Heat loss per hour: $\dot{q}$ = 1.08 x Q x ΔT

Where Q represents the airflow in cubic feet per minute (CFM) and is calculated in the following manner:

$$Q = A_{crack} \times \sqrt{(C_s \Delta T + C_w V^2}$$

In this equation, A_{crack} represents the crack area in square inches to be reduced. The other values in the equation are standard for these buildings and are based on shelter class, height, and local wind speed.

Cw = wind coefficient = 0.0104 average

V = wind speed = 8.8 average mph

Cs = stack coefficient = 0.0299 (two-story typical)

ΔT = temperature difference = Tout – Tin

ΔT is calculated by subtracting the average outdoor air temperature per hour from the indoor temperature, using 24 data points per month to accurately account for weather variances, and subsequently calculating airflow and heat loss for each set of data. Therefore, 288 data points are used, and Δt is the number of hours each data point represents. The total heat loss is calculated as follows:

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$$q = \sum_{x=1}^{288} 1.08 \times A_{crack} \times \sqrt{C_s \left(T_{out} - T_{in}\right) + C_w V^2} \times \left(T_{out} - T_{in}\right) \times \Delta t$$

Maintenance

After the building envelopes have been improved, operations and maintenance should be reduced, due to improved space conditions and lower humidity during the cooling season. The maintenance staff should maintain the newly installed equipment per manufacturers' recommendations. The manufacturer specification sheets will be provided for exact maintenance requirements.

Benefits

- Electrical energy savings
- Fuel energy savings
- Increased thermal comfort

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Retro-commissioning Study & HVAC Improvements

ECM Summary

Due to the complexity of today's HVAC systems and controls, it is likely for systems to be operating incorrectly or not as efficiently as they could be. Retro-commissioning studies reveal hidden deficiencies and highlights operational & maintenance (O&M) issues that could have been avoided as well as exposes hidden control system problems. There are valuable benefits to retro-commissioning in existing buildings. It is a detailed and specialized process that reviews how an HVAC system is controlled and designed to operate. Applying retro-commissioning to existing facilities includes planning, discovering root causes of inefficiencies, development of a cost-effective project delivery and a focus on optimizing value to the building owner. The study includes functional system testing under various modes, such as heating or cooling loads, occupied and unoccupied modes, varying outside air temperature and space temperatures.

This is a systematic process to ensure that the building energy systems perform interactively according to the original design intent and the current operational needs of the facility. Retro-commissioning is a common practice recommended by the American Society of Heating Refrigeration and Energy (ASHRAE) to be revisited every couple of years. We recommend that an engineering firm who specializes in energy control systems and retro-commissioning be contacted for a detailed evaluation and implementation costs. Facility operations personnel would work with the engineers to develop goals and objectives. During on-site testing, the qualified personnel conducting the study would immediately make any no/low cost improvements as identified. Furthermore, any suggested corrective actions which require the purchase of material, a contractor who specializes in that scope of work would be contacted to implement the remaining improvements.

Facilities Recommended for this Measure

- David C. Abbott Learning Center
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

The Commissioning Agent (CA) plans to deploy a phased approach to this project;

Documentation Review

To kick off the project, the CA will coordinate a meeting with the necessary parties to understand the concerns present of the current system, coordinate onsite activities and to gather the necessary documentation so a Retro-Commissioning Plan can be developed.

CA will review all available documentation that should include a current set of mechanical and electrical drawings, building equipment list, TAB report, control drawings, points list, maintenance records, and list of recent repairs. These documents will be used to develop the site assessment forms as well as the diagnostic and functional test plans that will be required to verify the equipment performance.

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Onsite Investigation Phase

- After gaining a clear understanding of the project goals, the District's operating requirements, and current operating conditions at the facilities, CA will develop a detailed retro-commissioning project plan.
- The RCx Plan shall define (at a minimum) the Commissioning Schedule for the Planning and Investigation Phase, and define the approach moving forward.
- CA shall have an initial walk-through of the facility. The School's operating requirements and building operations plan will be reviewed. CA will walk through the building to gain an understanding of the types of spaces and equipment that will be retro-commissioned.
- CA will interview key maintenance and operations personnel and other relevant parties as needed to define the current needs and issues related to the systems and sub-systems. A list of all parties proposed to be interviewed, including key maintenance and operations personnel will be compiled for review and approval by the District. The interview process is required to understand and define potential issues and problems, uncover potential improvement opportunities, confirm the current facility requirements and to develop consensus on the commissioning process goals to be reviewed and approved by the School. Upon completion of the above, prepare a draft RCx Plan, draft CFR report, completed interview forms/sheets, and a periodic issues database report. After review is completed, CA shall incorporate comments prior to the issuance of final documents.
- CA will perform functional testing of the HVAC System components in efforts to develop a deficiency log so identified repairs can be made by facility staff or outside contractors. In addition to functional issues, CA will document all issues pertaining to maintenance, serviceability and installation deficiencies.
- In addition to the Building Automation System, CA will deploy data loggers within the space in pre-determined locations to validate sensor calibration, trend temperatures and identify inconsistent patterns in the space. The data loggers will be deployed for a period of two weeks at a time which will require data trending on the BAS with the same programmed time intervals. CA will coordinate with Maintenance personnel to setup and document.

Implementation Plan Development and Final Report Phase

- Upon completion of the retro-commissioning efforts, CA will develop a final report documenting all findings and a plan of remediation to be considered for implementation.
- The final report for the project should include the following at a minimum;
    - Executive Summary
    - Data Logger Data and Analysis
    - BAS Review and Analysis
    - Inspection of All Equipment and Analysis
    - Implementation Plan

Savings Methodology

Savings Calculation Method		
Cooling Savings (kWh)	=	Stipulated Savings % * Total Annual Electrical Usage
Heating Savings (Therm)	=	Stipulated Savings % * Total Annual Natural Gas Usage

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Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric and Natural Gas savings

Retro-Commissioning	Non-Measured: Savings are retro-commissioning the HVAC equipment to ensure they are working as expected.	Pre M&V: Accepted engineering practices / building simulations will be used to calculate energy consumption baselines. Operating parameters of the system will be verified through BAS system. Post M&V: Various control points within the building management system will be trended and/or totalized. This data will be used to verify that all control strategies are in place and functioning as intended. Energy Savings: Savings are retro-commissioning the HVAC equipment to ensure they are working as expected.

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Demand Response Programs

ECM Summary

This measure is a contract that facilitates customer participation in the PJM Energy Efficiency Demand Response Program. PJM Energy Efficiency is defined as a permanent reduction in electric energy consumption in return for payments from the electric power markets. A customer that has recently installed more efficient devices/equipment or implemented more efficient processes or systems, that exceed industry standards at the time of the implementations can participate in the PJM Energy Efficiency program.

PJM Energy Efficient Program payments are independent of the local utilities payments. A customer that implemented energy efficiency retrofits receives benefits from lower demand charges (by lowering their electricity consumption), rebates from local utilities and/or the PJM Energy Efficiency program. Energy Efficiency retrofits that would qualify for the PJM Energy Efficiency Program include implementation of lighting retrofits, appliances, air conditioning installations, building insulation or process improvements, and permanent load shifts that will not be dispatched on the price or other factors.

A customer with a permanent reduction qualifies for up to four consecutive years of revenue for the same energy efficiency measures. The four-year mark starts from the completion year of the project.

Facilities Considered for this Measure

- David C. Abbott Learning Center
- BOE Administration Building
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Transportation Building
- Marlboro Middle School

Demand Response - Energy Efficiency Credit	Non-Measured: Savings are from participating in the Energy Efficiency program of PJM with a permanent reduction in electric energy consumption.	Pre M&V: ESG will determine the energy efficiency value based on the FIM strategies proposed. kW measurement may be taken on a sample of equipment that will be replaced. Post M&V: ESG will verify the equipment are installed and operating properly. kW measurement may be taken on a sample of equipment that are installed. Loggers will be installed to verify the coincident factor Energy Savings: Savings are from participating in the Energy Efficiency program of PJM with a permanent reduction in electric energy consumption.

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Demand Response Energy Efficiency Credit

The LED Lighting Upgrades recommended for the District will be eligible for the Energy Efficiency Credit available through PJM. The Energy Efficiency Credit pays consumers based on the permanent load reduction through the installation of energy efficiency measures. The following table summarizes the available Demand Response Incentives available due to the lighting upgrades to be performed in the District.

Demand Response Energy – Emergency Capacity Credit	
PJM Payment Year	Annual Customer Capacity Benefit
2021/2022	$9,000
2022/2023	$7,500
2023/2024	$7,500
2024/2025	$7,500
Totals	$31,500

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Premium Efficiency Motors

ECM Summary

Energy-efficient motors owe their higher performance to key design improvements and more accurate manufacturing tolerances. Lengthening the core and using lower electrical loss steel, thinner stator laminations and more copper in the windings reduce electrical losses. Improved bearings and a smaller, aerodynamic cooling fan further increase efficiency.

Facilities Recommended for this Measure

- David C. Abbott Learning Center
- Frank J. Dugan Elementary School
- Marlboro Memorial Middle School

Scope of Work

- Shut off the main electric power to the unit to be replaced;
- Disconnect and remove the existing motor. Inspect the mounting area and install replacement unit. Replacement unit shall be premium efficiency. Motors shall also be inverter-duty ready when coupled with VFDs;
- Reuse existing concrete pad, electrical and other infrastructure;
- Turn power back on, inspect unit operation, proper rotation and perform necessary electrical tests;
- Dispose old motors properly.

Savings Methodology

Savings Calculation Method		
Energy Savings (kWh)	=	0.746 x HP x HRS x Load Factor x (1/η exist – 1/η prop)
Demand Savings (kW)	=	0.746 x HP x Demand Factor x (1/η exist – 1/η prop))

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Add Cooling - Gymnasiums

ECM Summary

The gymnasiums/multipurpose rooms in several of the elementary schools are currently heated only and do not have air conditioning. As part of this measure cooling will be added to these systems through either entire replacement of the existing air handling unit or by the addition of a direct expansion cooling coil in the supply ductwork downstream of the air handler.

Facilities Recommended for this Measure

- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Robertsville Elementary School

Scope of Work

The scope of work is as follows:

- Demo and dispose of existing heating and ventilating unit (where applicable)
- Furnish and install the following:
    - New split hot water / DX air handling unit, where applicable.
    - New Direct Expansion Cooling coil mounted in supply duct, where applicable.
    - New high efficiency condensing unit.
    - Reconnect existing hot water heating supply & return lines to new air handling units.
    - New Space Thermostat, with DDC connectivity.
    - Electric power and control wiring to new units.
- Provide new unit start-up and commissioning

Savings Methodology

In general, savings calculations for addition of cooling are calculated using the following methodology that compares a baseline code equivalent efficient system to the proposed equipment efficiency.

Savings Calculation Method		
Cooling Savings (kWh)	=	Capacity (Tons) x Scheduled Usage (%) x (Baseline Efficiency – Proposed Efficiency) x Operating Hours per Year
Demand Savings (kW)	=	Peak Capacity (Tons) x (Baseline Efficiency – Proposed Efficiency)

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric Savings
- Improved gymnasium indoor environment.

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Cogeneration (CHP)

ECM Summary

Energy Systems Group proposes to install one (1) 35 kW cogeneration machine at Marlboro Memorial Middle School to supply electricity and heat to the building, which will offset a portion of the boiler load. The recovered heat will be rejected into the boiler hot water heating system and domestic hot water system.

Location: There is ample space on the exterior of the boiler room where the unit will be installed. The radiator, which will reject the excess heat, will be installed on roof or next to the unit outside. The radiator location must be verified and agreed upon with School District.

Facilities Recommended for this Measure

- Marlboro Memorial Middle School

Scope of Work

New YANMAR 35 kW system will be located next to existing boilers on concrete pad with module, etc.

New Installation Work:

Furnish & Install (1) Yanmar Model CP35D1 (35kW) using natural gas or propane, the high-efficiency generator provides 10kW of electrical power. The engine heat is captured and heats water at a rated temperature of 158°F for immediate use or storage in your facility. Excess electricity production may be sold back onto the grid in certain states, creating a credit on your electric bill.

- Natural gas fired CHP unit with heat rejection system located on outside wall of boiler room mounted in existing combustion air louver converted for radiator and fan. New CHP location will be in basement and set on new concrete housekeeping pad.
- F&I new gas piping to CHP unit from main gas meter bank.
- F&I new insulated hot water piping overhead from Yanmar CHP pump module to heating hot water system piping and heat rejection system.
- F&I new electrical power from Yanmar CHP unit to building electrical main switchgear.
- New exhaust vent piping to go through exterior wall and onto the roof

Savings Methodology

In general, savings calculations are performed using the following methodology:

Savings Calculation Method	
Energy:	35 kW/module x 1 module(s) x 1 net after "parasitic losses"
	= 35 net kW output x $/kWh avg. displaced energy x run hours
Demand :	35kW/module x 1 module(s) available x 1 net after "parasitic losses"
When Heat Used to Displace Boiler Gas Use:	$\frac{\left(\frac{Th}{hr\ module}\right)\ x}{boiler\ efficiency}\ x\ 1\ modules\ x\ \$/\text{Th boiler gas rate}$

Maintenance

Follow manufacturers' recommendations for preventative maintenance. In order to be eligible for New Jersey Clean Energy incentives, Marlboro School District must demonstrate that they have contracted for an extended maintenance agreement to service the cogeneration units. This maintenance agreement will be conducted outside of the Energy Savings Improvement Program, as required by law.

Benefits

- The installation of a cogeneration unit will result in significant economic benefits to the overall ESIP program. These benefits include:
    - Up to 20-year financing term.
    - Potential demand response revenue generation.

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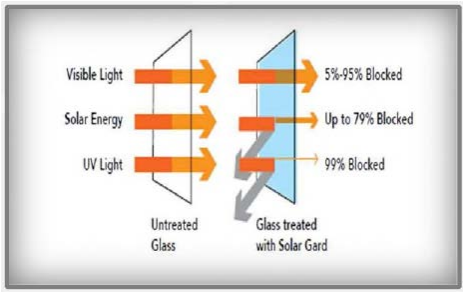
Window Film – Solar/Security Film

ECM Summary

Window films offer the following benefits:

1. By rejecting the heat of the sun, you use less energy
2. By keeping the window treatments open, you use less lighting energy and save on energy costs

Window films help create a more efficient building envelope and help improve HVAC systems' performance.



Facilities Considered for this Measure

- David C. Abbott Early Learning Center
- Marlboro Memorial Middle School

Scope of Work

Building	Qty. of Windows
David. C. Abbott	23
Marlboro Memorial Middle School	4

Savings Methodology

Detailed spreadsheet calculations are provided in the electronic appendix.

Maintenance

Minimal maintenance is required.

Benefits

- Reduced HVAC energy consumption.

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Bus Advertising

ECM Summary

School Bus advertising service makes it easy for advertisers and school districts to use school buses as a means to generate revenue. Is the school district looking for ways to increase funding? With SchoolBusAds.org, your school district can quickly and easily increase revenue.

Savings Methodology

MTPS generates a revenue of $3,000/year from bus advertising. This revenue is accounted for in the project cashflow.

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Demand Control Ventilation

ECM Summary

Air Handling Units that serve common areas are subject to occupancies that vary widely throughout the day/week. In conjunction with any efforts to schedule the unit conditioning these spaces to operate for the minimal time required, additional energy savings can be realized through the installation of carbon-dioxide (CO2) sensors and programming a 'Demand Controlled Ventilation' sequence. This enhancement will estimate real-time room occupancy through a correlation to the measured level of carbon-dioxide and adjust the air handling units outside air damper accordingly to only admit the limited level required for proper ventilation. Savings will take the form of a reduced amount of electricity and natural gas required to condition the reduced amount of ventilation air.

Facilities Considered for this Measure

- David C. Abbott Learning Center
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

- On affected air handlers that are currently 100% outside air, the following scope of work will be completed
  - Provide new return air damper and return air actuator
  - Provide new sheet metal duct opening within space
- The following scope of work is applicable to all affected air handlers
  - Furnish and install CO2 sensor(s) located in the return air stream for the AHU(s)
  - Revise existing control sequence
- Provide start-up and commissioning for the sensors.
- Provide all control programming to implement demand control ventilation on the applicable AHUs.
- • Provide training for maintenance personnel.

Savings Methodology

Savings Calculation Method		
Cooling Consumption (kWh)	=	(# of Units) x ((4.5 x OA CFM x (h ent - h lvg) x Clg Hrs x % Time at Full Load Summer)/ Conversion) / COP
Heating Consumption (Therm)	=	(# of Units) x ((1.08 x OA CFM x (T lvg - T ent) x Htg Hrs x % Time at Full Load Winter) / Conversion) / Htg EFF
Ventilation Energy Savings (DCV)	=	(# of Units) x ((Original Ventilation Energy) - (Proposed Ventilation Energy))

Maintenance

Perform general maintenance on actuators and dampers.

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Benefits

- Improved indoor air quality.
- Electric and Natural Gas Savings.

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Redesign BOE HVAC

ECM Summary

The Board of Education Building uses Packaged Terminal Air Conditioning units to serve the perimeter offices. In lieu of replacing these units in kind for new more efficient PTAC's this measure would install a new variable refrigerant flow heat pump system to condition the perimeter offices.

Facilities Recommended for this Measure

- BOE Administration Building

Scope of Work

Demolition and Removal Work:

- Demolish in place existing PTACs and seal outdoor air intakes.
- Disconnect electrical, controls and condensate piping.
- Reclaim refrigerant.

New Installation Work:

Proposed are the following;

- F&I Qty. 23 ceiling cassette VRF, 1 Ton units and accessories.
- Install 1 new 20 Ton outdoor heat pump unit for the VRF system
- Install new electrical to indoor and outdoor VRF units.
- Install required refrigerant piping and devices for the VRF units.
- Install new low voltage wall mounted thermostat to control unit.
- F&I new PVC condensate trap at unit.
- Provide startup of new units.

Savings Methodology

Savings Calculation Method		
Cooling Savings (kWh)	=	Size (Tons) x Cooling gradient (%) x (Existing kW/Ton – New kW/Ton) x Bin Hours
Heating Savings (Therm)	=	(Size (Btu/h)/Existing Eff.) – (Size (Btu/h)/ New Eff.)) x Heating gradient (%) x Bin Hours/100000

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric and Natural Gas savings
- Improved cooling and heating performance.

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Install High Efficiency Air-Cooled Chiller

ECM Summary

The replacement of an older chiller with a new chiller will significantly increase the efficiency of the chilled water plant during all load hours through the use of newer Variable Frequency Drive (VFD) technology and advanced control capabilities of the new chiller system. The VFD's allow for improved performance at part load conditions, in the case of most buildings, this would be the majority of operating hours. The newer chiller will also utilize new, environmentally friendly refrigerant which will help to decrease the carbon footprint of the School as well as minimize the risk exposed by having the discontinued refrigerant on site.

Facilities Recommended for this Measure

- Abbot Early Learning Center
- Marlboro Middle School (savings only. This chiller was replaced in fall of 2018 by the Marlboro Township Public Schools)

Scope of Work

- Remove and dispose of existing air-cooled chiller
- Install new, Daikin, or approved equal, air-cooled scroll chiller with integrated VFD
- Provide necessary power and controls wiring to new chiller
- Provide piping modifications and connections for chiller connection to existing chilled water system
- Provide coordination with building automation system including system start-up and commissioning
- Provide customer training on maintenance procedures
- Provide operations and maintenance handbooks and assist in developing scope of work for preventative maintenance activities on new chiller

Savings Methodology

Energy savings will result from reducing the amount of energy the compressor will consume. In general, ESG uses the following approach to determine savings for this specific measure:

Savings Calculation Method		
Energy Savings (kWh)	=	Tons * Equivalent Full Load Hours * (IPLV Baseline – IPLV New Equipment)
Demand Savings (kW)	=	Tons * (Peak Duty Cycle = 67%) * (IPLV Baseline – IPLV New Equipment)

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

Electrical energy savings.

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Destratification Fans

ECM Summary

In rooms with high ceilings typically stratification of heated air occurs, resulting in air at ceiling level being warmer than the floor level. Since temperature at the floor level dictates the comfort of occupants and is typically the location of the thermostat controlling the system, this results in additional operating hours to satisfy space conditions. A de-stratification fan continuously mixes the air, balancing temperatures from ceiling to floor and wall to wall which helps the HVAC system maintain the desired temperature.

Facilities Considered for this Measure

- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

- Furnish and install Airius Model 25 de-stratification fans.
- Furnish and install the required new power wiring to connect the fans
- Furnish the required new circuit breaker, electrical metallic tubing (EMT) conduit and miscellaneous wiring devices to complete the installation
- Start and test the new fan
- Clean up area
- Provide required warranty
- Provide training required for operating personnel

Savings Methodology

Savings Calculation Method		
Fan Energy Usage (kWh)	=	Fan Power (W) x Operating Hours x Conversion
Heating Savings (Therm)	=	Oversize Factor x Space Heating Capacity x HDD x Degree Adjustment Factor x 24 Hours / Day x (1/Design Temp Different) x (1/Eff) x Savings Percentage

Maintenance

Routine maintenance including lubrication and cleaning.

Benefits

Improved indoor environment.

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Upgrade Building Management System (BMS)

ECM Summary

This ECM includes modernization of the District's DDC control system for the HVAC equipment. With the communication between the control devices and the new updated digital interface/software, the facility manager will be able to take advantage of scheduling for occupied and unoccupied periods based on the actual occupancy of each space in the facility. The DDC system will also aid in the response time to service / maintenance issues when the facility is not under normal maintenance supervision, i.e. after-hours.

Facilities Recommended for this Measure

- David C. Abbott Learning Center
- BOE Administrative Offices
- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Transportation Garage
- Marlboro Middle School

Scope of Work (General)

District BMS Infrastructure

A. BMS Archival Data Server
    1. Centralized Alarming
    2. Open Protocol Control System (BACnet)
    3. Open Source Control System
    4. Energy Usage Collection and archiving from the district's schools,

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5. Provide one Niagara Supervisor for coordinating the MTPS's site Building Management Systems.
6. Provide two portable web graphical user interface devices for use by the Buildings and Grounds field technicians.
7. Provide for each site and the MTPS a customized district, site, and equipment 3-dimensional web-based graphic interface
8. Web-based accessibility

B. Common Items for each school, unless otherwise noted.
1. Performance functionality and sequencing testing of devices which are to remain, including enclosures, control valves, transformers, relays, sensors wiring, etc
2. Provide Report of any non-operable device to District for remediation consideration.
3. Web-Based Open Source/Open System Building Network Communication bus (BACnet) to each DDC controller, plenum rated.
4. The District to provide TCP/IP drop at each Network Controller to their WAN.
5. (1) Operator Workstation with Web-based Graphics
6. Utility meters provided by others, or existing.
7. Institute Energy Reduction Strategies, including but not limited to:
   a) Demand Control Ventilation
   b) Centralized Synchronized Scheduling
8. Equipment not within DDC control:
   a) Cabinet Unit Heaters (Local control)
   b) Kitchen Makeup Air Units (Local Control)
   c) Domestic Hot Water (Local Control)
   d) Emergency Generators, including fuel oil systems (Local Control)
   e) Building Sumps (Local Control)
   f) Lighting Controls (furnished by others)
   g) Window AC Unit Controls (Local Control)
   h) Wall mounted mini-split unit controls (Local Control)

Scope of Work (David C. Abbott Early Learning Center)

A. Provide a Honeywell (WEBs) Niagara Network Controller for the District BMS.
1. New Honeywell (WEBs) 8000 Supervisory Network Controller.
2. New enclosure (NEMA 1) and control power transformer.
3. New network communications wiring between the new BMS DDC controllers.
4. Integration of the Fire Alarm System to the Building Management System.

B. Provide control of the (1) Central Hot Water System:
1. New Honeywell (WEBs) Building Level DDC controller
2. New enclosure (NEMA 1) and control power transformer.
3. New enable and status relays for the hot water boiler control panel.
4. New temperature sensors for the hot water system supply and return.
5. New control relays and status current sensors for all hot water pumps.
6. New temperature sensor for outside air control.
7. New Hot Water VFD speed signal for hot water system pressure control.

C. Provide control of the (1) Central Chilled Water System:
1. New Honeywell (WEBs) Building Level DDC controller
2. New enclosure (NEMA 1) and control power transformer.
3. New enable and status relays for the new chiller control.

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4. New supply and return temperature sensors for the chilled water system control.
5. New enable and status relays for the all chilled water pump control.
6. New communications integration for the new chiller.
7. New Chilled Water VFD speed signal for hot water system pressure control.

D. Provide control of the (3) existing Air Handling Unit (HW/CHW)(Single Zone):
1. New Honeywell (WEBs) Building Level DDC controller
2. New enclosure (NEMA 1) and control power transformer.
3. New temperature sensors for space, discharge, mixed, and return air control.
4. New temperature low-limit switch for fan safety shutdown.
5. New carbon-dioxide sensor for return air (Demand Control Ventilation)
6. New actuators for the outside and return dampers
7. New control relays and status current sensors for fan control.
8. Existing control valves shall be incorporated for temperature control.
9. VFD Signals for Supply and Return Fans.

E. Provide control of the (19) new Unit Ventilators (HW/CHW):
1. New Unit Ventilators
   - New Honeywell (WEBs) Application Level DDC controller
   - New temperature sensors for space and discharge air control.
   - New control valves and actuators.
   - New control relays and status current sensors for fan control.
   - Units to be provided by others as DDC ready:
     - New temperature low-limit switch for fan safety shutdown (UM)
     - New actuators for the outside and return dampers (UM)
   - New carbon-dioxide sensor (Demand Control Ventilation)

F. Provide control of the (28) existing Fintube Radiation coils (HW):
1. Existing control valves shall be incorporated for temperature control to the associated DDC controller. . Existing control power and wiring to be reutilized.
2. New temperature sensors for space air control, where existing.

G. Provide monitoring of (1) Mini-Split AC with a BMS DDC Space Temperature sensors.

Scope of Work (Administration Building)

A. Provide a Honeywell (WEBs) Niagara Network Controller for the District BMS.
1. New Honeywell (WEBs) 8000 Supervisory Network Controller.
2. New enclosure (NEMA 1) and control power transformer.
3. New network communications wiring between the new BMS DDC controllers.
4. Integration of the Fire Alarm System to the Building Management System.

B. Provide control of the (3) existing Air Handling Unit (Electric/DX)(Single Zone):
1. New Honeywell (WEBs) Building Level DDC controller
2. New enclosure (NEMA 1) and control power transformer.
3. New temperature sensors for space, discharge, mixed, and return air control.
4. New temperature low-limit switch for fan safety shutdown.
5. New carbon-dioxide sensor for return air (Demand Control Ventilation)

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6. New actuators for the outside and return damper control.
7. New control relays and status current sensors for fan control.
8. New control relays for heating staging control.
9. New control relays for DX cooling staging control.

C. Provide a BMS interface to the (23) new wall mounted Heat Pump Units.
   1. The equipment shall be provided with unit manufacturer own unit mounted self-contained controls.
   2. AME shall provide interlock wiring based on a VRF configuration.

Scope of Work (Asher-Holmes Elementary School)

A. Provide a Honeywell (WEBs) Niagara Network Controller for the District BMS.
   1. New Honeywell (WEBs) 8000 Supervisory Network Controller.
   2. New enclosure (NEMA 1) and control power transformer.
   3. New network communications wiring between the new BMS DDC controllers.
   4. Integration of the Fire Alarm System to the Building Management System.

B. Provide control of the (1) Central Hot Water System:
   1. New Honeywell (WEBs) Building Level DDC controller
   2. New NEMA 1 enclosure and control transformer.
   3. New enable and status relays for the hot water boiler control panel.
   4. New temperature sensors for the hot water system supply and return.
   5. New control relays and status current sensors for all hot water pumps.
   6. New temperature sensor for outside air control.
   7. New differential pressure sensor for hot water system pressure control.
   8. New Hot Water VFD speed signal for hot water system pressure control.

C. Provide control of the (3) existing Roof Top Unit (NG/DX):
   1. New Honeywell (WEBs) Building Level DDC controller
   2. New control power transformer.
   3. New temperature sensors for space, discharge, mixed, and return air control.
   4. New carbon-dioxide sensor for return air (Demand Control Ventilation)
   5. New actuators for the outside and return dampers
   6. New control relays and status current sensors for fan control.
   7. New control relays for NG heating control.
   8. New control relays for DX cooling control.

D. Provide control of the (6) existing Variable Air Volume boxes w/ Hot Water Reheat:
   1. New Honeywell (WEBs) Application Level DDC controller
   2. New temperature sensors for space and discharge air control.
   3. Existing control valves shall be incorporated for temperature control.

E. Provide control of the (2) existing Heating & Ventilating Units (HW)(Gym):
   1. New Honeywell (WEBs) Building Level DDC controller
   2. New enclosure (NEMA 1) and control power transformer.
   3. New temperature sensors for space, discharge, mixed, and return air control.
   4. New temperature low-limit switch for fan safety shutdown.

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5. New carbon-dioxide sensor for return air (Demand Control Ventilation)
6. New actuators for the outside and return dampers
7. New control relays and status current sensors for fan control.
8. Existing control valves shall be incorporated for temperature control.
9. Space Cooling (Alt): New control relays for DX staging cooling control (duct coil)

F. Provide monitoring of (4) Mini-Split AC with BMS DDC Space Temperature sensors.

G. Provide control of the (4) existing AC-Split Systems (DX):
1. New Honeywell (WEBs) Smart Thermostat Application Level DDC controller
2. New control power transformer.
3. New temperature sensors for discharge air control.
4. New control relays and status current sensors for fan control.
5. New control relays for DX cooling staging control.

H. Provide control of the (47) existing Unit Ventilators (HW):
1. Existing Unit Ventilators:
   - New Honeywell (WEBs) Application Level DDC controller
   - New control power transformer.
   - New control relays and status current sensors for fan control.
   - New temperature sensors for space and discharge air control.
   - New temperature low-limit switch for fan safety shutdown.
   - New actuators for the outside and return dampers.
   - Existing control valves shall be incorporated for temperature control.
   - New carbon-dioxide sensor (Demand Control Ventilation)

I. Provide control of the (47) existing Fintube Radiation coils (HW):
1. Existing control valves shall be incorporated for temperature control to the associated DDC controller. . Existing control power and wiring to be reutilized.
2. New temperature sensors for space air control, where existing are present

Scope of Work (Frank Defino Central Elementary School)

A. Provide a Honeywell (WEBs) Niagara Network Controller for the District BMS.
1. New Honeywell (WEBs) 8000 Supervisory Network Controller.
2. New enclosure (NEMA 1) and control power transformer.
3. New network communications wiring between the new BMS DDC controllers.
4. Integration of the Fire Alarm System to the Building Management System.

B. Provide control of the (1) Central Hot Water System:
1. New Honeywell (WEBs) Building Level DDC controller
2. New enclosure (NEMA 1) and control power transformer.
3. New enable and status relays for the hot water boiler control panel.
4. New temperature sensors for the hot water system supply and return.
5. New control relays and status current sensors for all hot water pumps.
6. New temperature sensor for outside air control.
7. New differential pressure sensor for hot water system pressure control.
8. New Hot Water VFD speed signal for hot water system pressure control.

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C. Provide control of the (2) existing Roof Top Unit (NG/DX)(Cafeteria):
1. New Honeywell (WEBs) Building Level DDC controller and control transformer.
2. New temperature sensors for space, discharge, mixed, and return air control.
3. New carbon-dioxide sensor for return air (Demand Control Ventilation)
4. New actuators for the outside and return damper control.
5. New control relays and status current sensors for fan control.
6. New control relays for NG heating staging control.
7. New control relays for DX cooling staging control.
8. New Duct Hot Water Reheat Coil control.

D. Provide control of the (2) existing Roof Top Unit (NG/DX)(Classrooms):
1. New Honeywell (WEBs) Building Level DDC controller and control transformer.
2. New temperature sensors for space, discharge, mixed, and return air control.
3. New carbon-dioxide sensor for return air (Demand Control Ventilation)
4. New actuators for the outside and return damper control.
5. New control relays and status current sensors for fan control.
6. New control relays for NG heating staging control.
7. New control relays for DX cooling staging control.

E. Provide control of the (2) existing Roof Top Unit (NG/DX)(Offices):
1. New Honeywell (WEBs) Building Level DDC controller and control transformer.
2. New temperature sensors for space, discharge, mixed, and return air control.
3. New carbon-dioxide sensor for return air (Demand Control Ventilation)
4. New actuators for the outside and return damper control.
5. New control relays and status current sensors for fan control.
6. New control relays for NG heating staging control.
7. New control relays for DX cooling staging control.

F. Provide control of the (2) existing Heating & Ventilating Units (HW):
1. New Honeywell (WEBs) Building Level DDC controller
2. New enclosure (NEMA 1) and control power transformer.
3. New temperature sensors for space, discharge, mixed, and return air control.
4. New temperature low-limit switch for fan safety shutdown.
5. New carbon-dioxide sensors for return air (Demand Control Ventilation)
6. New actuators for the outside and return dampers
7. New control relays and status current sensors for fan control.
8. New DDC control valves for 2-way Hot Water coil temperature control.
9. Space Cooling (Alt): New control relays for DX staging cooling control (duct coil)

G. Provide control of the (47) new Unit Ventilators (HW):
1. New Unit Ventilators (Option B):
   - New Honeywell (WEBs) Application Level DDC controller
   - New temperature sensors for space and discharge air control.
   - New control valves and actuators.
   - New control relays and status current sensors for fan control.
   - Units to be provided by others as DDC ready:
     - New temperature low-limit switch for fan safety shutdown (UM)
     - New actuators for the outside and return dampers (UM)

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- New carbon-dioxide sensor (Demand Control Ventilation)

H. Provide control of the (47) existing Fintube Radiation coils (HW):
   1. New control valves for 2-way Hot Water coil temperature control shall be incorporated to the associated DDC controller, including new control power and wiring, where required.

I. Provide control of the (2) existing Airedale Unit Ventilators (DX/HW):
   1. New Honeywell (WEBs) Application Level DDC controller
   2. New control power transformer.
   3. New temperature sensors for space and discharge air control.
   4. New temperature low-limit switch for fan safety shutdown.
   5. New actuators for the outside and return dampers
   6. New control relays and status current sensors for fan control.
   7. Existing DDC control valves shall be incorporated for temperature control.
   8. New carbon-dioxide sensor (Demand Control Ventilation)

J. Provide monitoring of temperatures in (3) VRF Classrooms

Scope of Work (Frank Dugan Elementary School)

A. Provide a Honeywell (WEBs) Niagara Network Controller for the District BMS.
   1. New Honeywell (WEBs) 8000 Supervisory Network Controller.
   2. New enclosure (NEMA 1) and control power transformer.
   3. New network communications wiring between the new BMS DDC controllers.
   4. Integration of the Fire Alarm System to the Building Management System.

B. Provide control of the (1) Central Hot Water System:
   1. New Honeywell (WEBs) Building Level DDC controller
   2. New NEMA 1 enclosure and control transformer.
   3. New enable and status relays for the hot water boiler control panel.
   4. New temperature sensors for the hot water system supply and return.
   5. New control relays and status current sensors for all hot water pumps.
   6. New temperature sensor for outside air control.
   7. New differential pressure sensor for hot water system pressure control.
   8. New Hot Water VFD speed signal for hot water system pressure control.

C. Provide control of the (3) existing Roof Top Unit (NG/DX):
   1. New Honeywell (WEBs) Building Level DDC controller and control transformer.
   2. New temperature sensors for space, discharge, mixed, and return air control.
   3. New carbon-dioxide sensor for return air (Demand Control Ventilation)
   4. New actuators for the outside and return damper control.
   5. New control relays and status current sensors for fan control.
   6. New control relays for NG heating staging control.
   7. New control relays for DX cooling staging control.

D. Provide control of the (8) existing Air Handling/Heating & Ventilating Units (HW):
   1. New Honeywell (WEBs) Building Level DDC controller
   2. New enclosure (NEMA 1) and control power transformer.

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3. New temperature sensors for space, discharge, mixed, and return air control.
4. New temperature low-limit switch for fan safety shutdown.
5. New carbon-dioxide sensor for return air (Demand Control Ventilation)
6. New actuators for the outside and return dampers
7. New control relays and status current sensors for fan control.
8. Existing control valves shall be incorporated for temperature control.
9. Space Cooling (Alt): New control relays for DX staging cooling control (duct coil)

E. Provide control of the (56) existing zones (Classrooms)(HW):
1. Existing control valves shall be incorporated for temperature control to the associated DDC controller. . Existing control power and wiring to be reutilized.
2. New temperature sensors for space air control, where existing.

F. Provide control of the (6) existing Booster Heater Coils (HW):
1. New Honeywell (WEBs) Smart thermostat DDC controller
2. New control power transformer.
3. New temperature sensors for space and discharge air control.
4. Existing control valves shall be incorporated for temperature control.

G. Provide control of the (6) existing AC-Split Systems (DX):
1. New Honeywell (WEBs) Smart Thermostat Application Level DDC controller
2. New control power transformer.
3. New temperature sensors for discharge air control.
4. New control relays and status current sensors for fan control.
5. New control relays for DX cooling control.

H. Provide control of the (3) existing Cabinet Unit Heaters (HW):
1. New Honeywell (WEBs) Smart Thermostat Application Level DDC controller
2. Non-DDC units to remain under local control.
3. Existing control valves shall be incorporated for temperature control.

I. Existing Variable Air Volume boxes are non-functional, not included within this Scope at this time.

Scope of Work (Marlboro Elementary School)

A. Provide a Honeywell (WEBs) Niagara Network Controller for the District BMS.
1. New Honeywell (WEBs) 8000 Supervisory Network Controller.
2. New enclosure (NEMA 1) and control power transformer.
3. New network communications wiring between the new BMS DDC controllers.
4. Integration of the Fire Alarm System to the Building Management System.

B. Provide control of the (1) Central Hot Water System:
1. New Honeywell (WEBs) Building Level DDC controller
2. New NEMA 1 enclosure and control transformer.
3. New enable and status relays for the hot water boiler control panel.
4. New temperature sensors for the hot water system supply and return.
5. New control relays and status current sensors for all hot water pumps.

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6. New temperature sensor for outside air control.
7. New differential pressure sensor for hot water system pressure control.
8. New Hot Water VFD speed signal for hot water system pressure control.

C. Provide control of the (2) existing Roof Top Unit (NG/DX)(Café/Kitchen)
1. New Honeywell (WEBs) Building Level DDC controller and control transformer.
2. New temperature sensors for space, discharge, mixed, and return air control.
3. New carbon-dioxide sensor for return air (Demand Control Ventilation)
4. New actuators for the outside and return damper control.
5. New control relays and status current sensors for fan control.
6. New control relays for NG heating staging control.
7. New control relays for DX cooling staging control.

D. Provide control of the (2) existing Heating & Ventilating Units (HW)(Gym):
1. New Honeywell (WEBs) Building Level DDC controller
2. New enclosure (NEMA 1) and control power transformer.
3. New temperature sensors for space, discharge, mixed, and return air control.
4. New temperature low-limit switch for fan safety shutdown.
5. New carbon-dioxide sensor for return air (Demand Control Ventilation)
6. New actuators for the outside and return dampers
7. New control relays and status current sensors for fan control.
8. Existing control valves shall be incorporated for temperature control.
9. Space Cooling (Alt): New control relays for DX staging cooling control (duct coil)

E. Provide control of the (5) existing Roof Top Units (DX)(Media Center)
1. New Honeywell (WEBs) Smart Thermostat Application Level DDC controller
2. New control power transformer.
3. New temperature sensors for discharge air control.
4. New control relays and status current sensors for fan control.
5. New control relays for DX cooling staging control.

F. Provide control of the (42) existing Unit Ventilators (HW):
1. Existing Unit Ventilators:
   - New Honeywell (WEBs) Application Level DDC controller
   - New control power transformer.
   - New control relays and status current sensors for fan control.
   - New temperature sensors for space and discharge air control.
   - New temperature low-limit switch for fan safety shutdown.
   - New actuators for the outside and return dampers.
   - Existing control valves shall be incorporated for temperature control.
   - New carbon-dioxide sensor (Demand Control Ventilation)

G. Provide control of the (3) existing Cabinet Unit Heaters:
1. New Honeywell (WEBs) Smart Thermostat Application Level DDC controller
2. Non-DDC units to remain under local control.
3. Existing control valves shall be incorporated for temperature control.

Scope of Work (Marlboro Memorial Middle School)

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A. Integrate the existing (2) Niagara N4 Network Controllers for the District BMS.
   1. Integration of the Fire Alarm System to the Building Management System.
   2. Integration of (1) existing Central Chilled Water System control points:
   3. Integration of (1) existing Central Hot Water System control points:
   4. Integration of (6) existing Roof Top Unit (NG/DX)(Lib/Music/Kitch):
   5. Integration of (97) existing Room and Unitary controls (HW/CHW) control points:
   6. Integration of (14) existing Air Handling Unit (HW/CHW) control points:

B. Provide control of the (4) existing Air Handling Unit (HW/CHW):
   1. New Honeywell (WEBs) Building Level DDC controller
   2. New enclosure (NEMA 1) and control power transformer.
   3. New temperature sensors for space, discharge, mixed, and return air control.
   4. New temperature low-limit switch for fan safety shutdown.
   5. New carbon-dioxide sensor for return air (Demand Control Ventilation)
   6. New actuators for the outside and return dampers
   7. New control relays and status current sensors for fan control.
   8. Existing control valves shall be incorporated for temperature control.

C. Provide control of the (1) Combined Heat and Power System:
   1. New Honeywell (WEBs) Building Level DDC controller
   2. New enclosure (NEMA 1) and control power transformer.
   3. New commercial grade CHP BTU power meter.
   4. New commercial grade CHP Gas meter.
   5. New BACNet communications integration.

D. Other than the BACnet integration, the CHP system shall come as a complete package and shall require no other devices or wiring by the BMS

Scope of Work (Robertsville Elementary School)

A. Provide a Honeywell (WEBs) Niagara Network Controller for the District BMS.
   1. New Honeywell (WEBs) 8000 Supervisory Network Controller.
   2. New enclosure (NEMA 1) and control power transformer.
   3. New network communications wiring between the new BMS DDC controllers.
   4. Integration of the Fire Alarm System to the Building Management System.

B. Provide control of the (1) Central Hot Water System:
   1. New Honeywell (WEBs) Building Level DDC controller
   2. New enclosure (NEMA 1) and control power transformer.
   3. New enable and status relays for the hot water boiler control panel.
   4. New temperature sensors for the hot water system supply and return.
   5. New temperature low-limit switch for fan safety shutdown.
   6. New control relays and status current sensors for all hot water pumps.
   7. New temperature sensor for outside air control.
   8. New differential pressure sensor for hot water system pressure control.
   9. New Hot Water VFD speed signal for hot water system pressure control.

C. Provide control of the (51) existing Unit Ventilators (HW):

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1. Existing Unit Ventilators:
    - New Honeywell (WEBs) Application DDC controller & control power transformer.
    - New control relays and status current sensors for fan control.
    - New temperature sensors for space and discharge air control.
    - New temperature low-limit switch for fan safety shutdown.
    - New actuators for the outside and return dampers.
    - Existing control valves shall be incorporated for temperature control.
    - New carbon-dioxide sensor (Demand Control Ventilation).

D. Provide control of the (51) existing Fintube Radiation coils (HW):
1. Existing control valves shall be incorporated for temperature control to the associated DDC controller. . Existing control power and wiring to be reutilized.

E. Provide control of the (6) existing AC-Split Systems (DX):
1. New Honeywell (WEBs) Smart Thermostat DDC controller & control power transformer.
2. New temperature sensors for discharge air control.
3. New control relays and status current sensors for fan control.
4. New control relays for DX cooling staging control.

F. Provide control of the (2) existing Roof Top Units (DX)
1. New Honeywell (WEBs) Smart Thermostat Application Level DDC controller
2. New control power transformer.
3. New temperature sensors for discharge air control.
4. New control relays and status current sensors for fan control.
5. New control relays for DX cooling staging control.

G. Provide monitoring of (1) Mini-Split AC with a BMS DDC Space Temperature sensors

Scope of Work (Transportation Garage)

A. Provide a Honeywell (WEBs) Niagara Network Controller for the District BMS.
1. New Honeywell (WEBs) 8000 Supervisory Network Controller.
2. New enclosure (NEMA 1) and control power transformer.
3. New network communications wiring between the new BMS DDC controllers.
4. Integration of the Fire Alarm System to the Building Management System.

B. Provide control of the (2) existing HVAC-Split Systems (Oil/DX):
1. New Honeywell (WEBs) Smart Thermostat Application Level DDC controller
2. New actuators for the outside and return damper control.
3. New control relays and status current sensors for fan control.
4. New control relays for NG heating staging control.
5. New control relays for DX cooling staging control.

C. Provide new control relays and status current sensors for the building's (2) exhaust fans.

D. Provide monitoring of the Garage space by a BMS DDC Space Temperature sensors.

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Scope of Work (Marlboro Middle School)

A. Provide a Honeywell (WEBs) Niagara Network Controller for the District BMS.
   1. New Honeywell (WEBs) 8000 Supervisory Network Controller.
   2. New enclosure (NEMA 1) and control power transformer.
   3. New network communications wiring between the new BMS DDC controllers.
   4. Integration of the Fire Alarm System to the Building Management System.

B. Provide control of the (1) Central Hot Water System:
   1. New Honeywell (WEBs) Building Level DDC controller
   2. New enclosure (NEMA 1) and control power transformer.
   3. New enable and status relays for the hot water boiler control panel.
   4. New temperature sensors for the hot water system supply and return.
   5. New control relays and status current sensors for all hot water pumps.
   6. New temperature sensor for outside air control.
   7. New Hot Water VFD speed signal for hot water system pressure control.
   8. New differential pressure sensor for hot water system pressure control.

C. Integration of the existing (1) Central Chilled Water System control points:

D. Provide control of the (6) existing Air Handling Units (CHW/HW):
   1. New Honeywell (WEBs) Building Level DDC controller
   2. New enclosure (NEMA 1) and control power transformer.
   3. New temperature sensors for space, discharge, mixed, and return air control.
   4. New temperature low-limit switch for fan safety shutdown.
   5. New carbon-dioxide sensor for return air (Demand Control Ventilation)
   6. New actuators for the outside and return dampers
   7. New control relays and status current sensors for fan control.
   8. Existing control valves shall be incorporated for temperature control.

E. Provide control of the (10) existing Roof Top Unit (NG/DX):
   1. New Honeywell (WEBs) Building Level DDC controller and control power transformer.
   2. New temperature sensors for space, discharge, mixed, and return air control.
   3. New carbon-dioxide sensor for return air (Demand Control Ventilation)
   4. New actuators for the outside and return dampers
   5. New control relays and status current sensors for fan control.
   6. New control relays for NG heating control.
   7. New control relays for DX cooling control.

F. Provide control of the (81) existing Unit Ventilators (CHW/HW):
   1. Existing Unit Ventilators (Option A):
      - New Honeywell (WEBs) Application Level DDC controller
      - New control power transformer.
      - New control relays and status current sensors for fan control.
      - New temperature sensors for space and discharge air control.
      - New temperature low-limit switch for fan safety shutdown.
      - New actuators for the outside and return dampers.
      - Existing control valves shall be incorporated for temperature control.
      - New carbon-dioxide sensor (Demand Control Ventilation).

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2. New Unit Ventilators (Option B):
   - New Honeywell (WEBs) Application Level DDC controller
   - New temperature sensors for space and discharge air control.
   - New control valves and actuators.
   - New control relays and status current sensors for fan control.
   - Units to be provided by others as DDC ready:
     - New temperature low-limit switch for fan safety shutdown (UM)
     - New actuators for the outside and return dampers (UM)
   - New carbon-dioxide sensor (Demand Control Ventilation).

G. Provide control of the (81) existing Fintube Radiation coils (HW):
1. Existing control valves shall be incorporated for temperature control to the associated DDC controller. . Existing control power and wiring to be reutilized.

H. Provide control of the (5) existing Fan Coil Units (CHW/HW):
1. New Honeywell (WEBs) Application DDC controller & control power transformer.
2. New temperature sensors for space and discharge air control.
3. New temperature low-limit switch for fan safety shutdown.
4. New actuators for the outside dampers
5. New control relays and status current sensors for fan control.

I. Existing control valves shall be incorporated for temperature control

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Computer (PC) Power Management System

ECM Summary

Marlboro Middle School Computer Carts

Energy Systems Group will furnish and install a software utility that measures, manages, and minimizes the energy consumed by the network's PC clients through one centralized interface. It provides IT departments with a powerful approach to automate energy-efficient "best practices" throughout their networks, while it adds new control and flexibility to traditional PC power management.

With the help and cooperation of the District, ESG will install and rapidly deploy PC Power Management software on the District's PC network. A one-day deployment plan will address server and client installation, basic administrative configurations, logical power management profile groupings, and energy consumption reporting. Ongoing technical support and product revisions, with an annual energy audit to ensure maximized energy savings are also included for a period of three years.

Facilities Recommended for this Measure

- All Facilities

Scope of Work

Deploy PC Power Management software

PC Power Management software such as PWRSmart is an easy-to-deploy software utility that addresses network energy waste and reduces operating costs without impacting PC users. The software measures, manages, and minimizes the energy consumed by the network's PC clients through one centralized interface. The program will be installed on PC Desktop computers to maximize energy savings.

Savings calculation details can be found in the accompanying electronic appendix.

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Energy Star Refrigerator Replacement

ECM Summary

Energy Star labeled refrigerators are energy efficient refrigerators and should replace existing refrigerators. The replacement of older refrigerators will reduce the energy consumption of the equipment located throughout staff lounges. The refrigerators are a very visible item used by most of the staff throughout the day and will make a positive impact on the teachers by being replaced.

Facilities and Scope of Work

Marlboro Middle School – 14 Qty. Refrigerators

- Remove and properly dispose of existing refrigerator
- Furnish and install new energy star refrigerator
- It is the responsibility of MTPS' staff to remove items in the refrigerator prior to replacement.

Savings Methodology

Energy savings will result from reduced compressor energy. In general, ESG uses the following approach to determine savings for this specific measure:

Savings Calculation Method		
Stipulated Energy Savings	=	8,386 kWh

Benefits

- Electrical energy savings
- Upgrade of equipment in teacher and staff lounges
- Recognition of energy savings efforts

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Dishwasher Replacement

ECM Summary

Energy Star labeled dishwashers are energy efficient and use less water. The MTPS is currently under process of replacing older dishwashers throughout all schools.

Facilities Recommended for this Measure

- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Marlboro Middle School (two (2) dishwashers)

Scope of Work

MTPS has engaged a contractor outside of ESG's scope of work for this scope of work.

Savings Methodology

Detailed savings calculations are provided within the electronic appendix.

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electrical energy savings
- Fuel use reduction and cost savings
- Water use reduction and cost savings

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Refurbish Condensing Units and Install HVAC Armor

ECM Summary

Condensing unit coils and their performance are key to the efficiency of a unit's energy performance. Coils that have deterioration, scaling, decomposition, or damage due to fin collapse consume more energy than original design.

HVAC Armor is a product and a service. The product is a restorative coating that is impregnated with 65% aluminum in a base of industrial grade polyurethane. This combination provides an impenetrable layer of protection that provides a heat transfer medium thus the energy savings. The service is our stringent application requirements that clean and strip the coil of dirt, scale, and debris prior to our application.

Facilities Recommended for this Measure

- Asher Holmes Elementary School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Marlboro Memorial Middle School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

- General cleanup of overall unit and wash-down of coils. Deep clean condenser coils to remove final materials in coils, and corrosion.
- Disassemble equipment to perform deep clean of condenser coils, removing final materials in coils and corrosion.
- Straighten aluminum fins.
- Spray each condenser coil with HVAC Armor from both outside-in and inside-out, applying even coverage.
- Assemble and ensure equipment is operating.
- Anticipated installation time can range from 3 hrs. to 2 days per unit depending on size. Machines will need to be powered down and locked out for the duration of the installation.

Savings Methodology

Refer to Appendix for savings calculations and methodology.

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Improvement in efficiency, and saving energy consumption at the unit.
- Physical protection of coil.
- Extends life of HVAC equipment

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SECTION 5. MEASUREMENT AND VERIFICATION

Measurement & Verification (M&V) Methodologies

This section contains a description of the types of Measurement and Verification (M&V) methodologies that Energy Systems Group will use to guarantee the performance of this project.

They have been developed and defined by two independent authorities:

- International Performance Measurement and Verification Protocol (IPMVP)
- Federal Energy Management Program (FEMP)

There are four guarantee options that may be used to measure and verify the performance of a particular energy conservation measure. Each one is described below.

Option A – Retrofit Isolation: Key Parameter Measurement

Energy savings is determined by field measurement of the key parameters affecting the energy use of the system(s) to which an improvement measure was applied separate from the energy use of the rest of the facility. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the measured parameter, and the length of the reporting period.

Measurement of key parameters means that those parameters not selected for field measurement will be estimated. Estimates can be based on historical data, manufacturer's specifications, or engineering judgment. Documentation of the source or justification of the estimated parameter will be described in the M&V plan in the contract. Energy savings is determined through engineering calculations of the baseline and post-retrofit energy used based on the combination of measured and estimated parameters, along with any routine adjustments.

Option B – Retrofit Isolation: All Parameter Measurement

Like Option A, energy savings is determined by field measurement of the energy use of the systems to which an improvement measure was applied separate from the energy use of the rest of the facility. However, all of the key parameters affecting energy use are measured; there are no estimated parameters used for Option B. Measurement frequency ranges from short-term to continuous, depending on the expected variations in the savings and the length of the reporting period. Energy savings is determined through engineering calculations of the baseline and post-retrofit energy used based on the measured parameters, along with any routine adjustments.

Option C – Whole Building Metering/Utility Bill Comparisons

Option C involves the use of utility meters or whole building sub-meters to assess the energy performance of a total building. Option C assesses the impact of any type of improvement measure, but not individually if more than one is applied to an energy meter. This option determines the collective savings of all improvement measures applied to the part of the facility monitored by the energy meter. In addition, since whole building meters are used, savings reported under Option C include the impact of any other change made in facility energy use (positive or negative).

Option C may be used in cases where there is a high degree of interaction between installed improvement measures or between improvement measures and the rest of the building or the isolation and measurement of individual improvement measures is difficult or too costly.

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This Option is intended for projects where savings are expected to be large enough to be discernable from the random or unexplained energy variations that are normally found at the level of the whole facility meter. The larger the savings, or the smaller the unexplained variations in the baseline, the easier it will be to identify savings. In addition, the longer the period of savings analysis after installing the improvement measure, the less significant is the impact of short-term unexplained variations. Typically, savings should be more than 20% of the baseline energy use if they are to be separated from the noise in the baseline data.

Periodic inspections should be made of all equipment and operations in the facility after the improvement measure installation. These inspections will identify changes from baseline conditions or intended operations. Accounting for changes (other than those caused by the improvement measures) is the major challenge associated with Option C-particularly when savings are to be monitored for long periods.

Savings are calculated through analysis of whole facility utility meter or sub-meter data using techniques from simple comparison to regression analysis.

Option D – Calibrated Simulation

Option D involves the use of computer simulation software to predict energy use, most often in cases where baseline data does not exist. Such simulation models must be calibrated so that it predicts an energy use and demand pattern that reasonably matches actual utility consumption and demand data from either the base-year or a post-retrofit year.

Option D may be used to assess the performance of all improvement measures in a facility, akin to Option C. However, different from Option C, multiple runs of the simulation in Option D allow estimates of the savings attributable to each improvement measure within a multiple improvement measure project.

Option D may also be used to assess just the performance of individual systems within a facility, akin to Option A and B. In this case, the system's energy use must be isolated from that of the rest of the facility by appropriate meters.

Savings are calculated using energy use simulation models, calibrated with hourly or monthly utility billing data and/or end-use metering.

Selecting M&V Options for a Specific Project

The tailoring of your specific M&V option is based on the level of M&V precision required to obtain the desired accuracy level in the savings determination and is dependent on:

- The complexity of the Energy Conservation Measure
- The potential for changes in performance
- The measured savings value.

The challenge of the M&V plan is to balance three related elements:

- The cost of the M&V Plan
- Savings certainty
- The benefit of the particular conservation measure.

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Savings can also be non-measured. If savings are non-measured, these savings are mutually agreed upon as achieved at substantial completion of the respective facility improvement measure and shall not be measured or monitored during the term of the performance contract.

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Recommended Performance Verification Methods

Energy Systems Group's performance verification methods are designed to provide the facility's administration with the level of M&V necessary to protect them from an under-performing ECM, yet have a minimal impact on the project's financial success.

The selection of the M&V methods to be used is based on the criteria as detailed by IPMVP and Energy Systems Group's experience with hundreds of successful performance contracts in the K-12, state, and local government sectors. Following is a table illustrating how the savings of the major energy conservation measures proposed for this project will be verified.

ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
Comprehensive LED Lighting Upgrades (Includes NJDI)	Option A: One-time pre and post-retrofit kW measurement. Burn hours agreed upon with school district.	Pre M&V: Lighting power readings will be taken on a sample of lighting fixtures. Lighting burn hours were measured through the use of light loggers. Post M&V: Lighting power readings will be taken on a sample of lighting fixtures. Measurements will occur once at the outset of the agreement. "Occupied" hours logged during the baseline data collection will be used as the post-installation burn hours. Energy Savings: Energy savings will be calculated using the actual measured wattage reduction and measured burn-hours.
Building Envelope & Weatherization	Non-Measured: Existing envelope deficiencies will be documented based on collected field data to provide a baseline for evaluating the effectiveness of the air barrier system. Post-retrofit verifications of improvements will be documented.	Pre M&V: The magnitude of the air infiltration caused by cracks and joint deficiencies was determined by field surveys. Post M&V: The areas identified for weatherization improvements will be verified to be complete through visual inspections and as-built documentation. A one-time infrared survey of the buildings, when seasonally appropriate, will be conducted for the M&V agreement. Energy Savings: Energy savings will be based on the ASHRAE crack method calculations. If the commissioning process reveals any variation in the as-built conditions, then savings will be adjusted accordingly.
Pipe Insulation/Blankets	Non-Measured: Existing insulation deficiencies will be documented based on collected field data to provide a baseline for evaluating the heat loss. Post-retrofit verifications of improvements will be documented.	Pre M&V: The deficiencies and the amount of pipe insulation missing or deficient were measured during the field audit. Post M&V: Following installation, new insulation installation will be verified to be complete through visual inspections and as-built documentation. . Energy Savings: Savings are from a reduction in heat loss through uninsulated pipes and valves.
HVAC Related VFD Upgrades	Option A: Savings are from the reduced full load operating	Pre M&V: Quantity of motors and horsepower were determined in the field survey. Nameplate data was used

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ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
	hours of the plugged in equipment.	to determine the total kW of related equipment. Post M&V: Once the installation is complete, the VFD's will be inspected to ensure proper operation. During the guarantee term, actual operating conditions will be downloaded from the BMS to verify motors (and associated fans/pumps are being operated at part load. Energy Savings: Savings are from the reduced kW load of the equipment at reduced speed.
Boiler Replacement	Option A: Baseline energy consumption based on collected field data for existing boilers. Post installation energy consumption based on published combustion efficiency of new boilers.	Pre M&V: Manufacturer's data and operating parameters will be collected on the existing boilers. The efficiency of the existing boilers will be determined by manufacturer documentation and by application of acceptable engineering standards. Post M&V: Once the installation is completed, the new boilers will be inspected to verify if they are working properly. The efficiency of the new boilers will be determined from manufacturer provided written data sheets. Energy Savings: Savings are from reduced losses from installing high efficiency boilers.
Refrigeration Controls (Walk-In Cooler/Freezer Controls)	Non-Measured: Savings are from the reduced electric consumption of freezer and refrigerator.	Pre M&V: Manufacturer's data and operating parameters will be collected on the freezer and refrigerator. Post M&V: Once the installation is completed, the walk-in box control system will be inspected to ensure proper operation. Energy Savings: Savings are from the reduced electric consumption of freezer and refrigerator.
Combined Heat and Power	Option B: Savings are from the electric and heat provided by the cogeneration system.	Pre M&V: The baseline utility bills were analyzed to determine baseline heating and electric loads and the time that the cogeneration system is able to operate per year and the capacity of the cogeneration system. Post M&V: The electric generation output from the cogeneration system will be measured with an electric meter. The heat output from the cogeneration system will be determined by measuring the water inlet/outlet temperature and flow rate. The gas input to the cogeneration system will be measured with a gas meter. Combined, these data points will be used to verify the conversion efficiency of the cogeneration system. Energy Savings: Savings are from the electric and heat provided by the cogeneration system.
Building Automation Controls Upgrades - Central Plant	Option A: Savings are from implementing control strategies.	Pre M&V: Accepted engineering practices / building simulations will be used to calculate energy consumption baselines. Operating parameters of the system will be verified through BAS system. The temperature loggers and

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ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
		motor loggers will be installed to determine the space temperature and motor operation schedule where applicable. The power readings will be taken on a sample of RTUs. Post M&V: Various control points within the building management system will be trended and/or totalized. This data will be used to verify that all control strategies are in place and functioning as intended. Energy Savings: Savings are from implementing control strategies.
Building Automation Controls Upgrades - Primary AHUs	Option A: Savings are from implementing control strategies.	Pre M&V: Accepted engineering practices / building simulations will be used to calculate energy consumption baselines. Operating parameters of the system will be verified through BAS system. The temperature loggers and motor loggers will be installed to determine the space temperature and motor operation schedule where applicable. The power readings will be taken on a sample of RTUs. Post M&V: Various control points within the building management system will be trended and/or totalized. This data will be used to verify that all control strategies are in place and functioning as intended. Energy Savings: Savings are from implementing control strategies.
Building Automation Controls Upgrades - Terminal Units	Option A: Savings are from implementing control strategies.	Pre M&V: Accepted engineering practices / building simulations will be used to calculate energy consumption baselines. Operating parameters of the system will be verified through BAS system. The temperature loggers and motor loggers will be installed to determine the space temperature and motor operation schedule where applicable. The power readings will be taken on a sample of RTUs. Post M&V: Various control points within the building management system will be trended and/or totalized. This data will be used to verify that all control strategies are in place and functioning as intended. Energy Savings: Savings are from implementing control strategies.
Chiller Replacement	Option A: Savings are from utilizing more efficient chiller equipment.	Pre M&V: The baseline chilled water load was analyzed to determine total cooling ton-hours and system efficiency (kW/ton). Post M&V: The new chiller efficiency will be verified from chiller manufacturer's written specifications to ensure compliance with calculations.

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ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
		Energy Savings: Savings are from reduced electrical consumption and peak demand.
Transformer Replacement	Option A: Savings are from installing high efficiency transformers.	Pre M&V: Manufacturer's data and operating parameters will be collected on the existing transformers. The efficiency of the existing transformers will be determined through the test. Post M&V: Once the installation is completed, the new transformers will be inspected to verify if they are working properly. The efficiency of the new transformers will be determined through the test. Energy Savings: Savings are from reduced losses from installing high efficiency transformers.
Domestic Water Heater Replacement	Option A: Savings are from installing high efficiency domestic water heater(s).	Pre M&V: Manufacturer's data and operating parameters will be collected on the existing domestic water heaters (DWH's). The efficiency of the existing DWH's will be determined by manufacturer documentation and by application of acceptable engineering standards. Post M&V: Once the installation is completed, the new DWH will be inspected to verify if they are working properly. The efficiency of the new DWH's will be determined from manufacturer provided written data sheets. Energy Savings: Savings are from reduced losses from installing high efficiency DWH's.
Unit Ventilator Replacement/Refurbishment	Non-Measured: Savings are from replacing the existing unit ventilators with new unit ventilators.	Pre M&V: Manufacturer's data and operating parameters will be collected on the unit ventilators requiring replacement. Post M&V: The new unit ventilators will be inspected following installation to verify proper operation. Energy Savings: Savings are from replacing the existing unit ventilators with new unit ventilators.
Retro-Commissioning	Non-Measured: Savings are retro-commissioning the HVAC equipment to ensure they are working as expected.	Pre M&V: Accepted engineering practices / building simulations will be used to calculate energy consumption baselines. Operating parameters of the system will be verified through BAS system. Post M&V: Various control points within the building management system will be trended and/or totalized. This data will be used to verify that all control strategies are in place and functioning as intended. Energy Savings: Savings are retro-commissioning the HVAC equipment to ensure they are working as expected.
Plug Load Management	Non-Measured: Savings are from reduced electric consumption by controlling	Pre M&V: Manufacturer's data of the plug load and the occupancy mode of the affected spaces will be collected during the field audit. Typical plug load is assumed to run

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ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
	plugged equipment.	24 hours per day. Post M&V: The occupancy mode is assumed to be same pre and post, so the post retrofit operating hours are determined as the "occupied" hours from the pre-installation. Following the installation, a sample of sensors and correspondent equipment associated with them will be inspected to ensure the sensors are in place and operating. Energy Savings: Savings are from reduced electric consumption by controlling plugged equipment.
Demand Response - Energy Efficiency Credit	Non-Measured: Savings are from participating in the Energy Efficiency program of PJM with a permanent reduction in electric energy consumption.	Pre M&V: ESG will determine the energy efficiency value based on the FIM strategies proposed. kW measurement may be taken on a sample of equipment that will be replaced. Post M&V: ESG will verify the equipment are installed and operating properly. kW measurement may be taken on a sample of equipment that are installed. Loggers will be installed to verify the coincident factor Energy Savings: Savings are from participating in the Energy Efficiency program of PJM with a permanent reduction in electric energy consumption.
Addition of Cooling	Non-Measured: Savings are from adding additional cooling to the space, using an assumption of standard efficiency cooling equipment as the baseline.	Pre M&V: Under existing conditions, some of the spaces are not cooled. The manufacturer rated efficiency of standard equipment (with appropriate de-rate for age of equipment) will be used in the simulation model to determine energy consumption. Post M&V: Savings will be calculated based on manufacturer specifications for the more efficient equipment and the agreed upon schedule for the spaces. Energy Savings: Savings are from an improvement in efficiency between standard equipment and more energy efficient equipment.
Computer Power Management	Non-Measured: Baseline and post-retrofit computer operating hours are tracked through the computer power management software. This data along with typical wattages in different modes will be used to calculate the savings.	Pre M&V: The pre-retrofit computer energy consumption in different modes (stand by, sleep, etc.) was determined by installing the software and testing a sample of computers. Post M&V: The post retrofit computer energy consumption in different mode will be tracked through the software. Energy Savings: Based on the difference in actual computer operating hours, rated power draw and operational profile, energy savings will be calculated.
Water Conservation	Non-Measured: Savings are from a reduction in domestic water usage through the use of low-flow water fixtures.	Pre M&V: Where appropriate, flow rates will be taken on a sample of the existing sinks and toilets. Typical usage of those fixtures will be estimated using data from the AWWA.

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ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
		Post M&V: Where appropriate, flow rates will be taken on a sample of the new sinks and toilets. Measurements will occur once at the outset of the agreement. The typical fixture usage outlined in the baseline case will be used for the post retrofit case. Water Savings: Water savings will be calculated using the pre and post flow rates and agreed-upon usage characteristics.
Solar PV System	Non-Measured: Savings are from the reduction of purchased electricity from the utility company through the use of a solar PV system.	Pre M&V: A solar simulation program and local sunlight data was used to determine the expected kWh generation of PV system. Post M&V: Once the installation is complete, the PV system will be checked to ensure it works properly. Solar PV PPA provider's bills will be recorded to log the electricity generated by the Solar PV system. Energy Savings: Electricity generated by the solar PV system will equate to the energy savings.
Kitchen Hood Controls	Option A: Savings are from the reduced full load operating hours of the plugged in equipment.	Pre M&V: Quantity of motors and horsepower were determined in the field survey. Nameplate data was used to determine the total kW of related equipment. Post M&V: Once the installation is complete, the VFD's will be inspected to ensure proper operation. During the guarantee term, actual operating conditions will be downloaded from the BMS to verify motors (and associated fans/pumps are being operated at part load. Energy Savings: Savings are from the reduced kW load of the equipment at reduced speed.
Premium Efficiency Motors	Option A: Savings are from the installation of high efficiency motors.	Pre M&V: Manufacturer's data and operation parameters of existing motors were collected during the audit. Post M&V: Once the installation is completed, the new motors will be inspected to ensure proper operation. Efficiency data will be obtained for manufacturer's written documentation to ensure compliance with energy savings calculations. Energy Savings: Savings are from the installation of high efficiency motors.
Addressable Fire Alarms	Non-Measured: Savings are from the removal of existing phone lines.	Pre M&V: Existing phone bills were analyzed to determine savings. Post M&V: Once the installation is completed, no phone lines will be required. Savings: Savings are from no longer having to pay phone bills.
HVAC Armor/Refurb.	Non-Measured: Savings are	Pre M&V: The surface temperature and the size of the

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ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
	from installing HVAC Armor.	space requiring HVAC Armor were measured during the field audit. Post M&V: Following installation, the size and the surface temperature of the space where the Armor is installed will be verified. Energy Savings: Savings are from a reduction in heat loss.
Window Film	Non-Measured: Savings are from installing new window film.	Pre M&V: The size and property of the existing window will be determined from the field audit. Post M&V: Once the installation is completed, the size and property of the new window film will be verified via as-built and manufacturer cut sheet. Energy Savings: Savings are from installing new window film.
Redesign HVAC (VRF)	Option A: Savings are from high efficiency condensing units.	Pre M&V: Manufacturer's data and operating parameters will be collected on the existing condensing units (CU). The efficiency of the existing CU's will be determined from manufacturer's documentation. Post M&V: Once the installation is completed, the new CU's will be inspected to verify if they are working properly. The efficiency of the new CU's will be determined from manufacturer's written documentation. Energy Savings: Savings are from increased condensing unit operational efficiency.
Destratification Fans	Non-Measured: Savings are from the inside temperature reduction due to ceiling fans being installed.	Pre M&V: Assumptions were determined for roof "U" value and square footage from audit. Post M&V: New equipment will be inspected following installation to ensure proper operation. Energy Savings: Savings are from the reduced heating costs required.
Energy Start Refrigerator Replacement	Non-Measured: Savings are from the reduced electric consumption by replacing equipment with Energy Star equipment.	Pre M&V: Manufacturer's data and operating parameters of the equipment where replacement is required will be collected during the field audit. Loggers will be installed if applicable. Post M&V: New equipment will be inspected following installation to ensure proper operation. Energy Savings: Savings are from the reduced electric consumption by replacing the kitchen equipment.
Dishwasher Replacement	Non-Measured: Savings are generated from an efficiency increase by using less water which reduces domestic hot water usage which is heated by	Pre M&V: Client is self-installing the new dishwashers. Post M&V: No post measurement will be performed and the client has agreed to install the new dishwasher as described.

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ECM Description	Measurement and Verification Method – Summary	Detail of M&V Methodology
	natural gas and electric hot water heater boosters therefore reducing natural gas and electric usage. This also provides a water utility savings	

Measurement and Verification Services

Measurement and Verification Services will be provided in association with the guarantee provided by Energy Systems Group. The guarantee will be in effect for each year that the District elects to participate in the Measurement and Verification Services. The cost of the measurement and verification services is included in the business case in the "Annual Services" column as outlined in the table below:

Year	Annual Amount ($/Yr)
1	$93,984
Total	$93,984

ESG will provide the M&V Services set forth below in connection with the Assured Performance Guarantee.

- During the Installation Period, an ESG Performance Engineer will track Measured Project Benefits. ESG will report the Measured Project Benefits achieved during the Installation Period, as well as any Non-Measured Project Benefits applicable to the Installation Period, to Customer within 60 days of the commencement of the Guarantee Term.
- Within 60 days of each anniversary of the commencement of the Guarantee Term, ESG will provide Customer with an annual report containing:
    - An executive overview of the project's performance and Project Benefits achieved to date;
    - A summary analysis of the Measured Project Benefits accounting; and
    - Depending on the M&V Option, a detailed analysis of the Measured Project Benefits calculations.
- During the Guarantee Term, an ESG Performance Engineer will monitor the on-going performance of the Improvement Measures, as specified in this Agreement, to determine whether anticipated Measured Project Benefits are being achieved. The Performance Engineer will visit Customer regularly and assist Customer on-site or remotely, with respect to the following activities:
    - Review of information furnished by Customer from the facility management system to confirm that control strategies are in place and functioning;
    - Advise Customer's designated personnel of any performance deficiencies based on such information;
    - Coordinate with Customer's designated personnel to address any performance deficiencies that affect the realization of Measured Project Benefits; and
    - Inform Customer of opportunities to further enhance project performance and of opportunities for the implementation of additional Improvement Measures.

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- Track utility bills on a monthly basis to determine current utility rate costs and to identify any billing anomalies.

- For specified Improvement Measures, ESG will:
  - Conduct pre and post installation measurements required under this Agreement;
  - Confirm the building management system employs the control strategies and set points specified in this Agreement; and
  - Analyze actual as-built information and adjust the Baseline and/or Measured Project Benefits to conform to actual installation conditions (e.g., final lighting benefits calculations will be determined from the as-built information to reflect the actual mix of retrofits encountered during installation).
  - Confirm that the appropriate metering and data points required to track the variables associated with the applicable Improvement Measures' benefits calculation formulas are established; and
  - Set up appropriate data capture systems (e.g., trend and totalization data on the facility management system) necessary to track and report Measured Project Benefits for the applicable Improvement Measure.

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SECTION 6. CUSTOMER SUPPORT

Maintenance Impacts/ On-Going Service

New pieces of equipment that are installed as part of the ESIP project will be provided with the standard manufacturer warranty. Once installation of the equipment is complete, the remaining warranty period will be transferred to Marlboro Township Board of Education; any warranty issues will be handled directly with the equipment manufacturer rather than with Energy Systems Group.

a) ESG subcontractors will warranty the installation for a period of 12 months, beginning at substantial completion.

b) In addition, ESG will facilitate warranty related issues for a period of 12 months, beginning at substantial completion. Extended manufacture warranties beyond the 12 month installation warranty period will be facilitated by the District.

The installation of the recommended measures will reduce the amount of emergency maintenance required by the district through the installation of new equipment; however, preventative maintenance is still required in order to ensure the correct operation of the equipment for the expected lifetime. A service agreement cannot be included as part of this project per the New Jersey Local Finance Notice 2009-11. Once the scope is finalized and bids are received, Energy Systems Group will assist the District in preparing bids for any preventative service agreement that is felt necessary for the new equipment. The service agreement will cover recommended maintenance per each equipment manufacturer. Training on the proper maintenance and operation of each piece of equipment has also been included as part of the ESIP project which will allow the District to complete the majority of maintenance and repair in-house in order to utilize District resources.

In order to ensure the District is fully capable of achieving the energy savings and fully utilizing the new HVAC and Building Automation Systems, Energy Systems Group has included training for district employees.

Energy Systems Group recommends the District go out to bid for the following 3rd party service contracts in order to achieve the continuous savings throughout the term of the Energy Savings Improvement Program:

- Cogeneration Service Agreement to allow for emergency service and preventative maintenance on the new cogeneration systems. In order to receive the incentives for the cogeneration system, a 10-year maintenance contract must be in place.

Services for Lighting, Boiler Replacements, Combined Heat and Power, Plug Load Management, and walk-in freezer controller upgrades, such as filter changes and on-going maintenance can be completed by District staff.

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Design and Compliance Issues

The Marlboro School District will work closely with Energy Systems Group and the project engineer of record to oversee and complete all design engineering for the purposes of public bidding of the work as well as completing construction drawings.

The following items will be verified during the design engineering process to ensure a code compliant design.

- Conformance of design with current NJ Building and Rehabilitation Codes.
- Outdoor Air requirements in spaces through mechanical or natural ventilation.
- Assessment of space constraints and clearance for replaced equipment.
- Building Main Electric Service changes for added loads.
- Modifications to existing electric panels for added loads.
- Emergency Power Systems.
- Fire Alarm System Upgrades
- Structural Loads for new and/or replaced rooftop equipment.

Adherence of upgraded lighting systems to current IES and NJ Education Code Guidelines for light levels.

Customer Risks

Asbestos reports were obtained and reviewed for all schools as part of Energy Systems Group's safety policy. Based on the reports, asbestos materials will have to be abated prior to any work being performed. If any additional asbestos is found during the installation of the measures, Energy Systems Group will stop work and notify the School District. Any work associated with testing or remediation of asbestos containing material will be the responsibility of Marlboro Township Board of Education. Based on the asbestos reports provided, we feel this is a low risk item.

The NJ SmartStart, Demand Response Energy Efficiency Credit, and Combined Heat and Power Incentives outline the anticipated incentive amounts to Marlboro Township Board of Education. Energy Systems Group does not guarantee the rebate or state incentive structure. If the programs change or the incentive amounts differ, Marlboro Township Board of Education will be responsible to make up the difference in received incentives for the financing. The difference could result from over performance of energy conservation measures, other rebates/ incentives that may be available, restructuring the loan payment for years 1 and 2, or capital contributions by the District.

Public Engagement and Community Outreach

Student Engagement in ESIP Development: ESG has involved students at all levels in the energy related fields. At Marlboro Township, we plan to expand on interests related to energy conservation throughout the district and would welcome and actively encourage student involvement in various phases of the proposed project. Furthermore, in line with our commitment, and with Marlboro Township's concurrence, we propose to offer presentations to Energy Clubs, including them in the process.

STEM EXPO Sponsorship: ESG has a history of sponsoring STEM programs for many school districts and Universities across the country. If selected, ESG would like to sponsor the Marlboro Township's Annual STEM EXPO and further complement your Engineering/Technology Science curriculum.

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Community Outreach Program: ESG is focused on creating a partnership with Marlboro Township Public Schools that will extend beyond the scope of this project. Keeping the community informed and involved in the process is key to success. One way this can be achieved is through a ***Community Scholarship Program.*** At Northern Illinois University (NIU), ESG established The **Energy Systems Group Scholarship Award in Engineering** to underscore our commitment. Established in 2001, ESG and NIU jointly select students for award of this scholarship. To date, we have awarded **$35,000** to NIU engineering students with superior academic excellence. ESG would like to establish a similar program for Marlboro Township Public Schools.

ESG will seek to develop and build partnerships between The National Education Foundation (NEF) and the Marlboro Township Public Schools. These partnerships were developed by ESG and the NEF, to bring engineering and engineering technology career opportunities to students through the educational programs offered by the University of Salt Lake City Utah. These programs help students who might not otherwise consider careers in these sciences or further expand the knowledge of the children who are participating in such class. In addition, this affords local colleges and Universities the opportunity to recruit future applicants from the local school boards. Some of these programs are listed below:

Student Engagement in ESIP Development: ESG has involved students at all levels in the energy related fields. At EBPS, we plan to expand on interests related to energy conservation throughout the EBPS campus and would welcome and actively encourage student involvement in various phases of the proposed project. Furthermore, in line with our commitment, and with EBPS's concurrence, we propose to offer presentations to Energy Clubs, including them in the process.

Solar Photovoltaic Systems at Work Grades 9-12: This program includes learning activities for the secondary levels and a supply kit to investigate solar energy and its uses. Additional instructional materials include the Renewable Energy Sources poster, Energist, the Electrical Generation poster and Energist, the Energy Basics CD, and the Eye Chart poster. The program can stand alone or complement Energy Fun, Energy Fundamentals, Energy Action Technology, or Energy Action Patrol.

Career Exploration, grades 11-12: Provides students with career related work experience while obtaining up to 40 hours of academic credit. The program allows students a superb opportunity to integrate classroom theory into the world of work, as well as providing career option exploration, skill development, work environment exposure, and professional contacts.

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SECTION 7: IMPLEMENTATION SCHEDULE

A preliminary installation schedule for the measures implemented as part of the ESP is included below to provide a reasonable expectation for the timeline of construction. Once final bids are received and financing of the project is complete, the installation will be finalized in much greater detail and reviewed with the team from the Marlboro Township Board of Education to ensure agreement. A high-level review of the next steps in the process is shown below as well as the estimated time frame to complete each step:

- Accept Energy Savings Plan Pending Necessary Reviews – August 20, 2019
- Complete Third Party Engineering Review of Energy Savings Plan – 2 weeks (Aug 26 – Sep 13)
- Complete Board of Public Utilities Review of Energy Savings Plan – 14 days (Sep 16 – Sep 30)
- Approval resolution to contract with Energy Systems Group: October 20, 2019
- Financing of project: November 2019 – December 2019
- Complete 100% design drawings and bid specifications – December 30, 2019
- Public bidding for Sub-Contractors – January 2 – February 4, 2020
- Installation – March 2020 - December 2020
- Maintenance: On-going

The project plan on the following page details the Installation Phase schedule.

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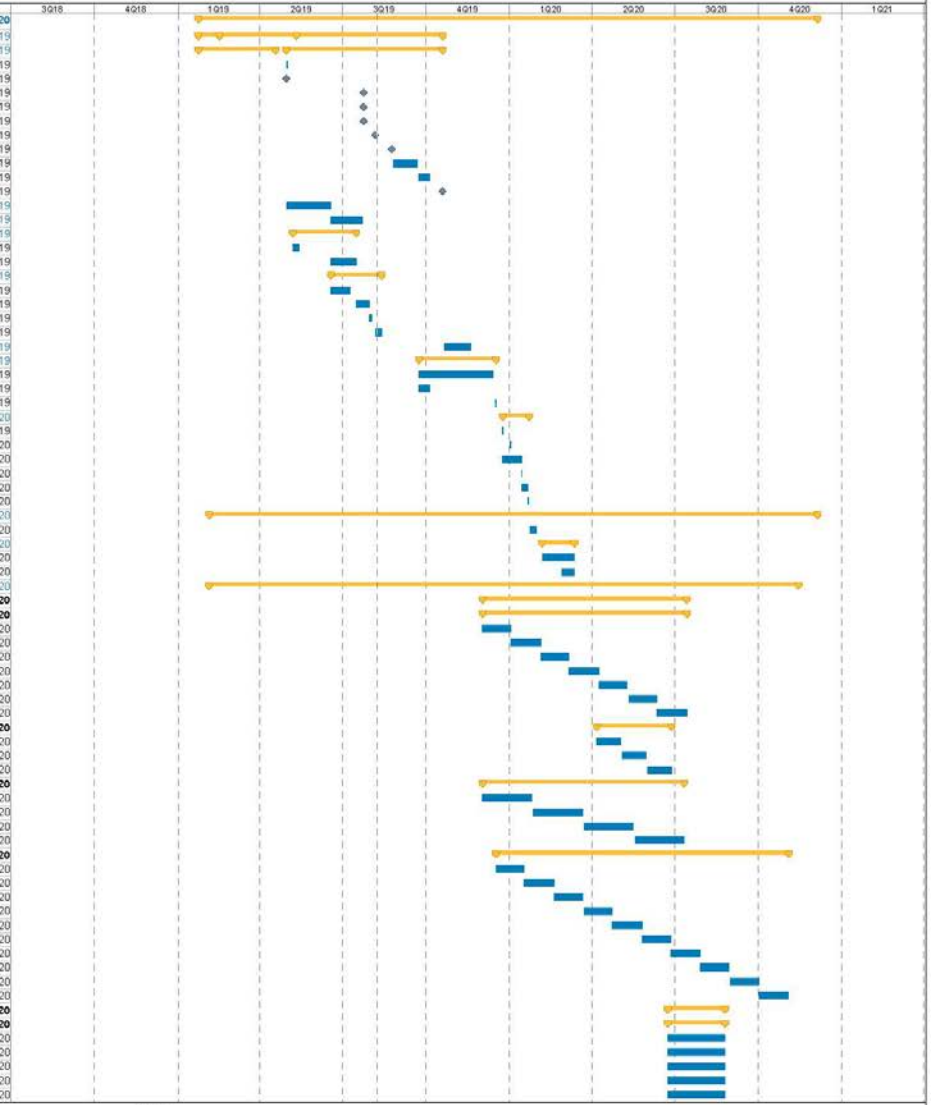
Marlboro Township Public Schools
ESP Development & Installation Schedule

ID	Task Name	Duration	Start	Finish
1	**Marlboro Township Board of Education (MTBoE)**	**488 days**	**Wed 1/23/19**	**Fri 12/4/20**
2	Phase 1 Investment Grade Audit/ Energy Savings Plan	61 days	Fri 3/15/19	Fri 5/10/19
3	Major Milestones	61 days	Wed 1/23/19	Wed 4/17/19
4	Signed Investment Grade Audit Agreement	1 day	Tue 4/30/19	Tue 4/30/19
5	Customer Kick-off Workshop	0 days	Tue 4/30/19	Tue 4/30/19
6	ECM Verification Workshop	0 days	Wed 7/24/19	Wed 7/24/19
7	Baseline Utility Workshop	0 days	Wed 7/24/19	Wed 7/24/19
8	Measurement & Verification Workshop	0 days	Wed 7/24/19	Wed 7/24/19
9	Business Case Workshop	0 days	Tue 8/6/19	Tue 8/6/19
10	IGEA Results Presented to MTBoE	0 days	Fri 8/23/19	Fri 8/23/19
11	3rd Party Engineering Review Complete and Comments Addressed	4 wks	Mon 8/26/19	Fri 9/20/19
12	Submit Energy Savings Plan to BPU for Review	2 wks	Mon 9/23/19	Fri 10/4/19
13	MTBoE Approval & Acceptance of ESP & ESG Contract	0 days	Fri 10/18/19	Fri 10/18/19
14	Detailed Site Visits	7 wks	Tue 4/30/19	Mon 6/17/19
15	Scope Design & Construction Cost Estimating	5 wks	Tue 6/18/19	Mon 7/22/19
16	Detailed Energy Analysis	50 days	Tue 5/7/19	Mon 7/15/19
17	Update Utility Bills	1 wk	Tue 5/7/19	Mon 5/13/19
18	Energy Saving Calculations	4 wks	Tue 6/18/19	Mon 7/15/19
19	ESP Report Development	40 days	Tue 6/18/19	Mon 8/12/19
20	Detailed Scope Write-up	15 days	Tue 6/18/19	Mon 7/8/19
21	Detailed Energy Savings Analysis	2 wks	Tue 7/16/19	Mon 7/29/19
22	Develop Business Case	3 days	Tue 7/30/19	Thu 8/1/19
23	Energy Savings Plan Appendix	1 wk	Tue 8/6/19	Mon 8/12/19
24	Project Financing	21 days	Mon 10/21/19	Mon 11/18/19
25	Phase 2 Design	61 days	Mon 9/23/19	Mon 12/16/19
26	Final Design Engineering	12 wks	Mon 9/23/19	Fri 12/13/19
27	Bid Specification Development	2 wks	Mon 9/23/19	Fri 10/4/19
28	Final Design Review Workshop	1 day	Mon 12/16/19	Mon 12/16/19
29	Phase 3 Procurement	21 days	Tue 12/24/19	Tue 1/21/20
30	Advertise Bids	1 day	Tue 12/24/19	Tue 12/24/19
31	Pre-Proposal Conference & Site Visits	1 day	Wed 1/1/20	Wed 1/1/20
32	Bid Duration for Subcontractors	3 wks	Tue 12/24/19	Mon 1/13/20
33	Opening of Bids	1 hr	Mon 1/13/20	Mon 1/13/20
34	Evaluation of Bids and Confer on Selection of Sub-Contractors	1 wk	Tue 1/14/20	Mon 1/20/20
35	Subcontractor Selection	1 day	Tue 1/21/20	Tue 1/21/20
36	Phase 4 Construction	480 days	Mon 2/4/19	Fri 12/4/20
37	Issue Subcontracts	1 wk	Thu 1/23/20	Wed 1/29/20
38	Pre- Construction Activities	25 days	Thu 2/6/20	Wed 3/11/20
39	Planning / Engineering	25 days	Thu 2/6/20	Wed 3/11/20
40	Shop Drawing Approval	10 days	Thu 2/27/20	Wed 3/11/20
41	Installation of Recommended ECMs	465 days	Mon 2/4/19	Fri 11/13/20
42	**Direct Install**	**161 days**	**Mon 12/2/19**	**Mon 7/13/20**
43	**Lighting - DI**	**161 days**	**Mon 12/2/19**	**Mon 7/13/20**
44	David C. Abbott Early Learning Center	23 days	Mon 12/2/19	Wed 1/1/20
45	BOE Administrative Office & Building	23 days	Thu 1/2/20	Mon 2/3/20
46	Asher Holmes Elementary School	23 days	Tue 2/4/20	Thu 3/5/20
47	Frank J. Dugan Elementary School	23 days	Fri 3/6/20	Tue 4/7/20
48	Marlboro Elementary School	23 days	Wed 4/8/20	Fri 5/8/20
49	Robertsville Elementary School	23 days	Mon 5/11/20	Wed 6/10/20
50	Transportation Garage	23 days	Thu 6/11/20	Mon 7/13/20
51	**RTU Replacements**	**60 days**	**Mon 4/6/20**	**Fri 6/26/20**
52	Asher Holmes Elementary School	20 days	Mon 4/6/20	Fri 5/1/20
53	Frank J. Dugan Elementary School	20 days	Mon 5/4/20	Fri 5/29/20
54	Marlboro Elementary School	20 days	Mon 6/1/20	Fri 6/26/20
55	**Lighting - Non-DI**	**160 days**	**Mon 12/2/19**	**Fri 7/10/20**
56	Frank Defino Central School	40 days	Mon 12/2/19	Fri 1/24/20
57	Marlboro Memorial Middle School	40 days	Mon 1/27/20	Fri 3/20/20
58	Marlboro Middle School	40 days	Mon 3/23/20	Fri 5/15/20
59	MMS Auditorium Lighting	40 days	Mon 5/18/20	Fri 7/10/20
60	**Addressable FA System**	**230 days**	**Tue 12/17/19**	**Mon 11/2/20**
61	David C. Abbott Early Learning Center	23 days	Tue 12/17/19	Thu 1/16/20
62	BOE Administrative Office & Building	23 days	Fri 1/17/20	Tue 2/18/20
63	Asher Holmes Elementary School	23 days	Wed 2/19/20	Fri 3/20/20
64	Frank Defino Central School	23 days	Mon 3/23/20	Wed 4/22/20
65	Frank J. Dugan Elementary School	23 days	Thu 4/23/20	Mon 5/25/20
66	Marlboro Elementary School	23 days	Tue 5/26/20	Thu 6/25/20
67	Marlboro Middle School	23 days	Fri 6/26/20	Tue 7/28/20
68	Robertsville Elementary School	23 days	Wed 7/29/20	Fri 8/28/20
69	Transportation Garage	23 days	Mon 8/31/20	Wed 9/30/20
70	Marlboro Middle School	23 days	Thu 10/1/20	Mon 11/2/20
71	**Heating System Upgrades**	**45 days**	**Tue 6/23/20**	**Mon 8/24/20**
72	**Boiler Replacements**	**45 days**	**Tue 6/23/20**	**Mon 8/24/20**
73	Asher Holmes Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
74	Frank Defino Central School	45 days	Tue 6/23/20	Mon 8/24/20
75	Marlboro Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
76	Marlboro Memorial Middle School	45 days	Tue 6/23/20	Mon 8/24/20
77	Robertsville Elementary School	45 days	Tue 6/23/20	Mon 8/24/20



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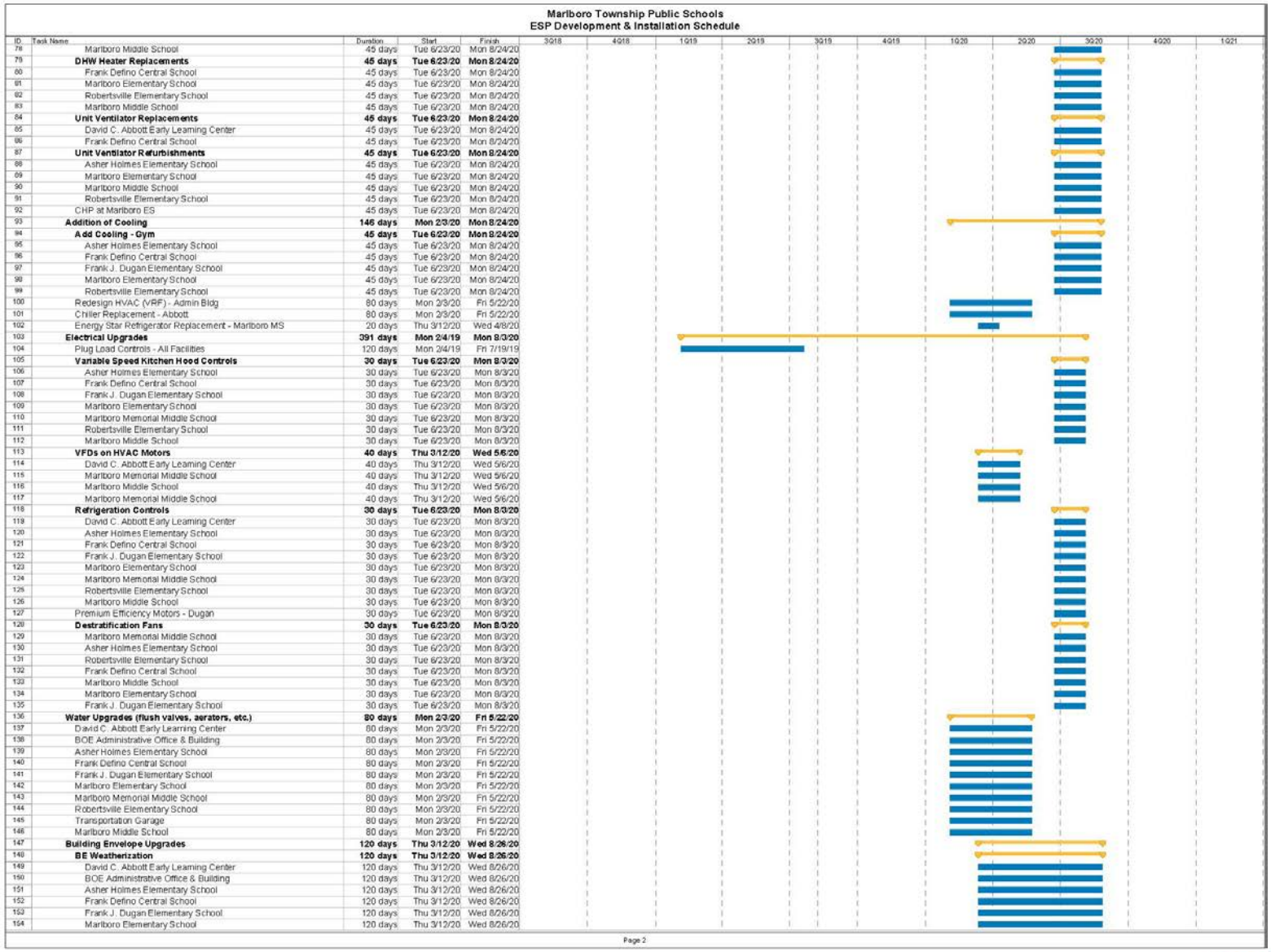

Marlboro Township Public Schools
ESP Development & Installation Schedule

ID	Task Name	Duration	Start	Finish
78	Marlboro Middle School	45 days	Tue 6/23/20	Mon 8/24/20
79	**DHW Heater Replacements**	**45 days**	**Tue 6/23/20**	**Mon 8/24/20**
80	Frank Defino Central School	45 days	Tue 6/23/20	Mon 8/24/20
81	Marlboro Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
82	Robertsville Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
83	Marlboro Middle School	45 days	Tue 6/23/20	Mon 8/24/20
84	**Unit Ventilator Replacements**	**45 days**	**Tue 6/23/20**	**Mon 8/24/20**
85	David C. Abbott Early Learning Center	45 days	Tue 6/23/20	Mon 8/24/20
86	Frank Defino Central School	45 days	Tue 6/23/20	Mon 8/24/20
87	**Unit Ventilator Refurbishments**	**45 days**	**Tue 6/23/20**	**Mon 8/24/20**
88	Asher Holmes Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
89	Marlboro Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
90	Marlboro Middle School	45 days	Tue 6/23/20	Mon 8/24/20
91	Robertsville Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
92	CHP at Marlboro ES	45 days	Tue 6/23/20	Mon 8/24/20
93	**Addition of Cooling**	**146 days**	**Mon 2/3/20**	**Mon 8/24/20**
94	**Add Cooling - Gym**	**45 days**	**Tue 6/23/20**	**Mon 8/24/20**
95	Asher Holmes Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
96	Frank Defino Central School	45 days	Tue 6/23/20	Mon 8/24/20
97	Frank J. Dugan Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
98	Marlboro Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
99	Robertsville Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
100	Redesign HVAC (VRF) - Admin Bldg	80 days	Mon 2/3/20	Fri 5/22/20
101	Chiller Replacement - Abbott	80 days	Mon 2/3/20	Fri 5/22/20
102	Energy Star Refrigerator Replacement - Marlboro MS	20 days	Thu 3/12/20	Wed 4/8/20
103	**Electrical Upgrades**	**391 days**	**Mon 2/4/19**	**Mon 8/3/20**
104	Plug Load Controls - All Facilities	120 days	Mon 2/4/19	Fri 7/19/19
105	**Variable Speed Kitchen Hood Controls**	**30 days**	**Tue 6/23/20**	**Mon 8/3/20**
106	Asher Holmes Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
107	Frank Defino Central School	30 days	Tue 6/23/20	Mon 8/3/20
108	Frank J. Dugan Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
109	Marlboro Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
110	Marlboro Memorial Middle School	30 days	Tue 6/23/20	Mon 8/3/20
111	Robertsville Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
112	Marlboro Middle School	30 days	Tue 6/23/20	Mon 8/3/20
113	**VFDs on HVAC Motors**	**40 days**	**Thu 3/12/20**	**Wed 5/6/20**
114	David C. Abbott Early Learning Center	40 days	Thu 3/12/20	Wed 5/6/20
115	Marlboro Memorial Middle School	40 days	Thu 3/12/20	Wed 5/6/20
116	Marlboro Middle School	40 days	Thu 3/12/20	Wed 5/6/20
117	Marlboro Memorial Middle School	40 days	Thu 3/12/20	Wed 5/6/20
118	**Refrigeration Controls**	**30 days**	**Tue 6/23/20**	**Mon 8/3/20**
119	David C. Abbott Early Learning Center	30 days	Tue 6/23/20	Mon 8/3/20
120	Asher Holmes Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
121	Frank Defino Central School	30 days	Tue 6/23/20	Mon 8/3/20
122	Frank J. Dugan Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
123	Marlboro Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
124	Marlboro Memorial Middle School	30 days	Tue 6/23/20	Mon 8/3/20
125	Robertsville Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
126	Marlboro Middle School	30 days	Tue 6/23/20	Mon 8/3/20
127	Premium Efficiency Motors - Dugan	30 days	Tue 6/23/20	Mon 8/3/20
128	**Destratification Fans**	**30 days**	**Tue 6/23/20**	**Mon 8/3/20**
129	Marlboro Memorial Middle School	30 days	Tue 6/23/20	Mon 8/3/20
130	Asher Holmes Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
131	Robertsville Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
132	Frank Defino Central School	30 days	Tue 6/23/20	Mon 8/3/20
133	Marlboro Middle School	30 days	Tue 6/23/20	Mon 8/3/20
134	Marlboro Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
135	Frank J. Dugan Elementary School	30 days	Tue 6/23/20	Mon 8/3/20
136	**Water Upgrades (flush valves, aerators, etc.)**	**80 days**	**Mon 2/3/20**	**Fri 5/22/20**
137	David C. Abbott Early Learning Center	80 days	Mon 2/3/20	Fri 5/22/20
138	BOE Administrative Office & Building	80 days	Mon 2/3/20	Fri 5/22/20
139	Asher Holmes Elementary School	80 days	Mon 2/3/20	Fri 5/22/20
140	Frank Defino Central School	80 days	Mon 2/3/20	Fri 5/22/20
141	Frank J. Dugan Elementary School	80 days	Mon 2/3/20	Fri 5/22/20
142	Marlboro Elementary School	80 days	Mon 2/3/20	Fri 5/22/20
143	Marlboro Memorial Middle School	80 days	Mon 2/3/20	Fri 5/22/20
144	Robertsville Elementary School	80 days	Mon 2/3/20	Fri 5/22/20
145	Transportation Garage	80 days	Mon 2/3/20	Fri 5/22/20
146	Marlboro Middle School	80 days	Mon 2/3/20	Fri 5/22/20
147	**Building Envelope Upgrades**	**120 days**	**Thu 3/12/20**	**Wed 8/26/20**
148	**BE Weatherization**	**120 days**	**Thu 3/12/20**	**Wed 8/26/20**
149	David C. Abbott Early Learning Center	120 days	Thu 3/12/20	Wed 8/26/20
150	BOE Administrative Office & Building	120 days	Thu 3/12/20	Wed 8/26/20
151	Asher Holmes Elementary School	120 days	Thu 3/12/20	Wed 8/26/20
152	Frank Defino Central School	120 days	Thu 3/12/20	Wed 8/26/20
153	Frank J. Dugan Elementary School	120 days	Thu 3/12/20	Wed 8/26/20
154	Marlboro Elementary School	120 days	Thu 3/12/20	Wed 8/26/20

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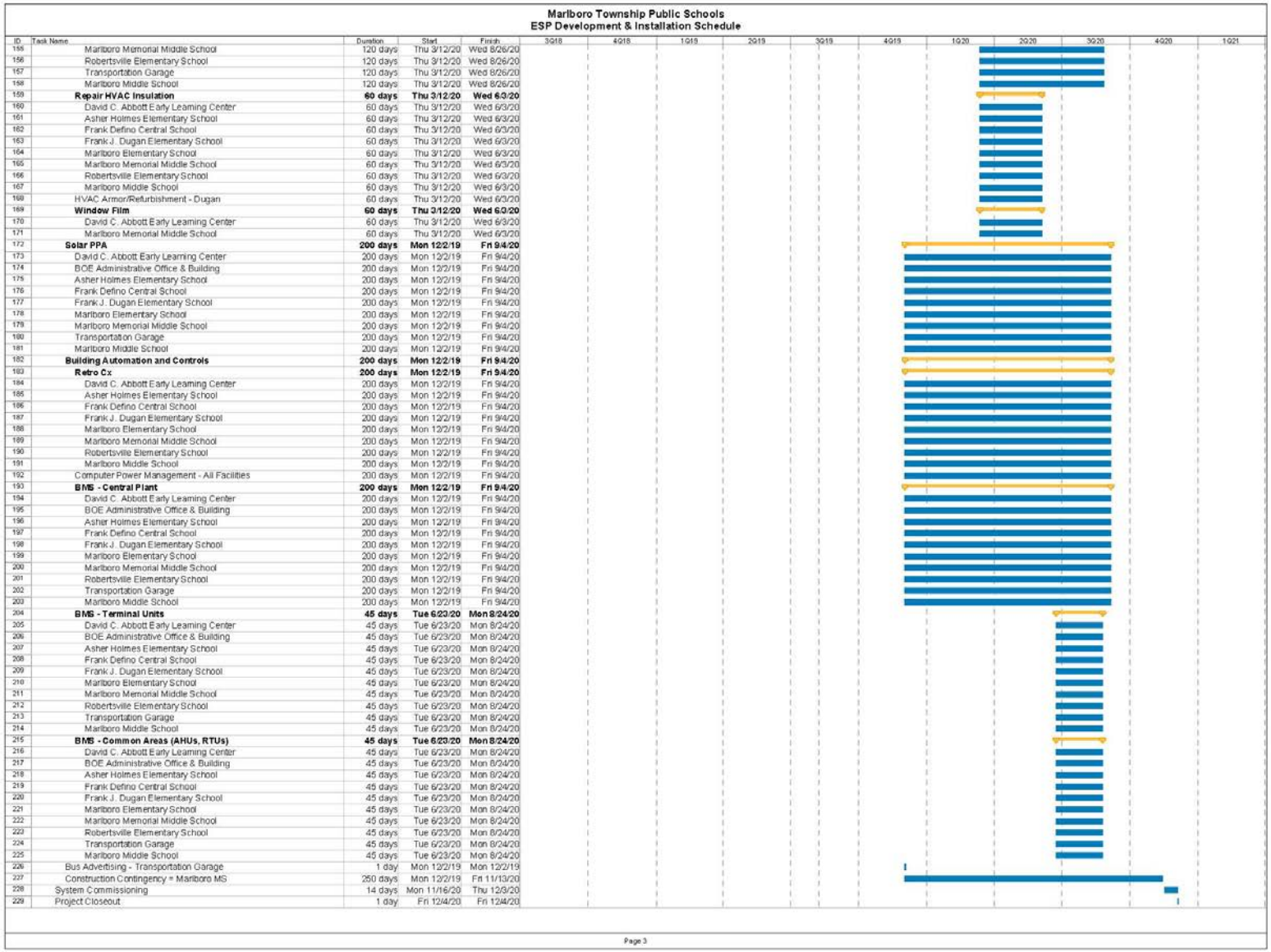

ID	Task Name	Duration	Start	Finish
155	Marlboro Memorial Middle School	120 days	Thu 3/12/20	Wed 8/26/20
156	Robertsville Elementary School	120 days	Thu 3/12/20	Wed 8/26/20
157	Transportation Garage	120 days	Thu 3/12/20	Wed 8/26/20
158	Marlboro Middle School	120 days	Thu 3/12/20	Wed 8/26/20
159	**Repair HVAC Insulation**	**60 days**	**Thu 3/12/20**	**Wed 6/3/20**
160	David C. Abbott Early Learning Center	60 days	Thu 3/12/20	Wed 6/3/20
161	Asher Holmes Elementary School	60 days	Thu 3/12/20	Wed 6/3/20
162	Frank Defino Central School	60 days	Thu 3/12/20	Wed 6/3/20
163	Frank J. Dugan Elementary School	60 days	Thu 3/12/20	Wed 6/3/20
164	Marlboro Elementary School	60 days	Thu 3/12/20	Wed 6/3/20
165	Marlboro Memorial Middle School	60 days	Thu 3/12/20	Wed 6/3/20
166	Robertsville Elementary School	60 days	Thu 3/12/20	Wed 6/3/20
167	Marlboro Middle School	60 days	Thu 3/12/20	Wed 6/3/20
168	HVAC Armor/Refurbishment - Dugan	60 days	Thu 3/12/20	Wed 6/3/20
169	**Window Film**	**60 days**	**Thu 3/12/20**	**Wed 6/3/20**
170	David C. Abbott Early Learning Center	60 days	Thu 3/12/20	Wed 6/3/20
171	Marlboro Memorial Middle School	60 days	Thu 3/12/20	Wed 6/3/20
172	**Solar PPA**	**200 days**	**Mon 12/2/19**	**Fri 9/4/20**
173	David C. Abbott Early Learning Center	200 days	Mon 12/2/19	Fri 9/4/20
174	BOE Administrative Office & Building	200 days	Mon 12/2/19	Fri 9/4/20
175	Asher Holmes Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
176	Frank Defino Central School	200 days	Mon 12/2/19	Fri 9/4/20
177	Frank J. Dugan Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
178	Marlboro Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
179	Marlboro Memorial Middle School	200 days	Mon 12/2/19	Fri 9/4/20
180	Transportation Garage	200 days	Mon 12/2/19	Fri 9/4/20
181	Marlboro Middle School	200 days	Mon 12/2/19	Fri 9/4/20
182	**Building Automation and Controls**	**200 days**	**Mon 12/2/19**	**Fri 9/4/20**
183	**Retro Cx**	**200 days**	**Mon 12/2/19**	**Fri 9/4/20**
184	David C. Abbott Early Learning Center	200 days	Mon 12/2/19	Fri 9/4/20
185	Asher Holmes Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
186	Frank Defino Central School	200 days	Mon 12/2/19	Fri 9/4/20
187	Frank J. Dugan Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
188	Marlboro Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
189	Marlboro Memorial Middle School	200 days	Mon 12/2/19	Fri 9/4/20
190	Robertsville Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
191	Marlboro Middle School	200 days	Mon 12/2/19	Fri 9/4/20
192	Computer Power Management - All Facilities	200 days	Mon 12/2/19	Fri 9/4/20
193	**BMS - Central Plant**	**200 days**	**Mon 12/2/19**	**Fri 9/4/20**
194	David C. Abbott Early Learning Center	200 days	Mon 12/2/19	Fri 9/4/20
195	BOE Administrative Office & Building	200 days	Mon 12/2/19	Fri 9/4/20
196	Asher Holmes Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
197	Frank Defino Central School	200 days	Mon 12/2/19	Fri 9/4/20
198	Frank J. Dugan Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
199	Marlboro Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
200	Marlboro Memorial Middle School	200 days	Mon 12/2/19	Fri 9/4/20
201	Robertsville Elementary School	200 days	Mon 12/2/19	Fri 9/4/20
202	Transportation Garage	200 days	Mon 12/2/19	Fri 9/4/20
203	Marlboro Middle School	200 days	Mon 12/2/19	Fri 9/4/20
204	**BMS - Terminal Units**	**45 days**	**Tue 6/23/20**	**Mon 8/24/20**
205	David C. Abbott Early Learning Center	45 days	Tue 6/23/20	Mon 8/24/20
206	BOE Administrative Office & Building	45 days	Tue 6/23/20	Mon 8/24/20
207	Asher Holmes Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
208	Frank Defino Central School	45 days	Tue 6/23/20	Mon 8/24/20
209	Frank J. Dugan Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
210	Marlboro Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
211	Marlboro Memorial Middle School	45 days	Tue 6/23/20	Mon 8/24/20
212	Robertsville Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
213	Transportation Garage	45 days	Tue 6/23/20	Mon 8/24/20
214	Marlboro Middle School	45 days	Tue 6/23/20	Mon 8/24/20
215	**BMS - Common Areas (AHUs, RTUs)**	**45 days**	**Tue 6/23/20**	**Mon 8/24/20**
216	David C. Abbott Early Learning Center	45 days	Tue 6/23/20	Mon 8/24/20
217	BOE Administrative Office & Building	45 days	Tue 6/23/20	Mon 8/24/20
218	Asher Holmes Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
219	Frank Defino Central School	45 days	Tue 6/23/20	Mon 8/24/20
220	Frank J. Dugan Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
221	Marlboro Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
222	Marlboro Memorial Middle School	45 days	Tue 6/23/20	Mon 8/24/20
223	Robertsville Elementary School	45 days	Tue 6/23/20	Mon 8/24/20
224	Transportation Garage	45 days	Tue 6/23/20	Mon 8/24/20
225	Marlboro Middle School	45 days	Tue 6/23/20	Mon 8/24/20
226	Bus Advertising - Transportation Garage	1 day	Mon 12/2/19	Mon 12/2/19
227	Construction Contingency = Marlboro MS	250 days	Mon 12/2/19	Fri 11/13/20
228	System Commissioning	14 days	Mon 11/16/20	Thu 12/3/20
229	Project Closeout	1 day	Fri 12/4/20	Fri 12/4/20

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SECTION 8. SAMPLE ENERGY PERFORMANCE CONTRACT

A sample Energy Performance Contract has been provided electronically to the District for review.

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APPENDIX 1. ENERGY CONSERVATION MEASURES INVESTIGATED BUT NOT RECOMMENDED AT THIS TIME

Rooftop Unit Replacement

ECM Summary

Rooftop units in the Marlboro schools vary based on age and condition. Replacing aged rooftop HVAC units will reduce the operating and maintenance costs of these systems. Both heating and cooling efficiencies of packaged rooftop equipment have significantly increased in the past 10 years. ESG has identified a number of older units that still utilize R22 refrigerant as the prime candidates for replacement. The following is a list of units proposed for replacement:

Defino Central:

Quantity	Tag	Location	Cooling Capacity (Tons)	Heating Capacity (MBH)	Heating Type
2	AHU-1, 2	Cafeteria Roof	15	N/A	N/A
1	AHU-3	Roof Above Guidance	3.5	N/A	N/A
1	AHU-4	Roof Above Nurse	2.5	N/A	N/A
1	RTU	Roof Above Teacher's lounge	4	N/A	N/A
1	RTU	Roof Above IT Closet	2	N/A	N/A
2	RTU	Roof Above Media	4	N/A	N/A

Marlboro Elementary:

Quantity	Tag	Location	Cooling Capacity (Tons)	Heating Capacity (MBH)	Heating Type
1	RTU	Roof (TCD074C3DCBC)	7.5	N/A	N/A
1	RTU	Roof (PCK048-1)	4	N/A	N/A
1	RTU	Library Roof (CHA16-413-3Y)	4	N/A	N/A
1	RTU	Roof (PCK024-1)	2	N/A	N/A
2	RTU	Cafeteria (Trane)	15	N/A	N/A

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Robertsville Elementary:

Quantity	Tag	Location	Cooling Capacity (Tons)	Heating Capacity (MBH)	Heating Type
2	RTU-3, 4	Cafeteria Roof	15	N/A	N/A
1	RTU-1	Faculty Room	4	125	Gas
1	RTU-2	Administration	7	N/A	N/A
1	RTU-6	Roof	2	N/A	N/A

Marlboro Middle:

Quantity	Tag	Location	Cooling Capacity (Tons)	Heating Capacity (MBH)	Heating Type
1	RTU	Roof Above Mini Theater	10	N/A	N/A

Facilities Recommended for this Measure

- Frank Defino Central School
- Marlboro Elementary School
- Robertsville Elementary School
- Marlboro Middle School

Scope of Work

Demolition and Removal Work:

- Disconnect electrical, controls and gas piping.
- Reclaim refrigerant.
- Crane existing rooftop units off of the roof onto flatbed trailer for disposal.

New Installation Work:

Proposed are the following;

- F&I Qty. new packaged gas heating (where applicable) and electric cooling rooftop units of equivalent size with efficiencies that meet or exceed ASHRAE90.1-2013 energy efficiency requirements.
- Units to include economizer with single enthalpy control and smoke detector.
- Units to include demand control ventilation, where applicable.
- Units to include single zone variable air volume, where applicable.
- Reconnect line voltage power to new unit disconnects.
- F&I new return air smoke detector.
- F&I new room thermostat controller. (BMS integration by controls contractor)
- Provide crane for the removal of RTU's and setting of new units.
- F&I new PVC condensate trap at unit.
- Provide air test and balance of new RTU's only.

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Savings Methodology

Savings Calculation Method		
Cooling Savings (kWh)	=	RTU-Size (Tons) x Cooling gradient (%) x (Existing RTU kW/Ton – New RTU kW/Ton) x Bin Hours
Heating Savings (Therm)	=	((RTU-Size (Btu/h)/Existing RTU Eff.) – (RTU-Size (Btu/h)/ New RTU Eff.)) x Heating gradient (%) x Bin Hours/100000

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric and Natural Gas savings
- Improved cooling and heating performance.
- Improved reliability.

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Generator Replacement

ECM Summary

This ECM includes installation of new standby generator's that will replace the existing units at each facility. The generator will be used to power critical loads and life safety components. The system will be equipped with an automatic transfer switch that will provide a seamless transition from utility power to the generator in the event of a power loss at the site.

Facilities Considered for this Measure

- Abbott Early Learning Center
- Marlboro Memorial Middle School
- Marlboro Middle School

Scope of Work

Typical scope of work:

- Demolition, removal and disposal of existing emergency generator
- Furnish and install the following:
  - New Natural Gas Fired Generator of equal or increased sized based on loads to be added.
  - New Automatic Transfer Switch and Emergency Panels.
  - Wiring for additional emergency load circuits.
  - Electrical power and control wiring to new unit(s)
  - Fuel Gas Supply.
- Provide new unit start-up and commissioning.
- Provide training for staff on operation and maintenance procedures.

Savings Methodology

No Energy Savings associated with this measure.

Maintenance

Periodically the equipment should be checked to ensure proper operation, monthly generator testing.

Benefits

- Increased reliability.
- Additional emergency power circuits.

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Add Cooling - Classrooms

ECM Summary

Typical classrooms throughout the district's elementary schools are heated only and not provided with air conditioning. Classroom that do have air conditioning, is performed by several individual system types including, self-contained unit ventilators, window air conditioners, mini-split systems, variable refrigerant flow systems, and rooftop units. This measure intends to add cooling by means of two options to each classroom currently not equipped with cooling.

Option 1: Unit Ventilator

Dependent on the selection of unit ventilator refurbishment or replacement, this option would install a direct expansion cooling coil with the new unit ventilators. The split outdoor unit would be located directly outside the classroom on grade or on the roof.

Option 2: Variable Refrigerant Flow

This option would install new cooling only variable refrigerant flow ceiling cassettes / wall mount units in each classroom. Typically each classroom would be supplied with a 3-ton indoor unit attached to a central outdoor unit that will serve several classrooms in a wing.

Facilities Recommended for this Measure

- Asher Holmes Elementary School
- Frank Defino Central School
- Frank J. Dugan Elementary School
- Marlboro Elementary School
- Robertsville Elementary School

Scope of Work

The scope of work is as follows:

Option 1:

- Furnish and install the following:
  - New Direct Expansion Cooling coil for replacement unit ventilator.
  - New 19 SEER 2-stage condensing unit.
  - Electric power and control wiring to new units.
- Provide new unit start-up and commissioning

Option 2:

- Furnish and install the following:
  - Samsung or equivalent high-efficiency VRF units
  - Electrical power and control wiring to new unit(s)
  - Coordinate with new DDC controls
- Provide new unit start-up and commissioning
  - Existing UV's will be left in place for heating and ventilation
    - New VRF Units will be used for cooling only

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- Control strategies will be put in place to utilize the exiting unit ventilators for ventilation during summer operation

Option 3:

- Furnish and install the following:
  - York or equal high efficiency mini-split unit
  - Electrical power and control wiring between indoor and outdoor condensing units
  - Refrigerant piping and insulation
  - Condensate piping
  - Perform startup and test of new systems

Savings Methodology

In general, savings calculations for addition of cooling are calculated using the following methodology that compares a baseline code equivalent efficient system to the proposed equipment efficiency.

Savings Calculation Method		
Cooling Savings (kWh)	=	Capacity (Tons) x Scheduled Usage (%) x (Baseline Efficiency – Proposed Efficiency) x Operating Hours per Year
Demand Savings (kW)	=	Peak Capacity (Tons) x (Baseline Efficiency – Proposed Efficiency)

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric Savings
- Improved classroom indoor environment.

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Replace BOE PTACs

ECM Summary

The Board of Education Building uses Packaged Terminal Air Conditioning units to serve the perimeter offices. The existing units vary in age and condition, most of which are past their useful life expectancy. New more efficient units would provide both energy efficiency and comfort benefits.

Facilities Recommended for this Measure

- BOE Administration Building

Scope of Work

Demolition and Removal Work:

- Demo and dispose of existing unit ventilator. Reuse existing wall sleeve.
- Disconnect electrical, controls and condensate piping.
- Reclaim refrigerant.

New Installation Work:

Proposed are the following;

- F&I Qty. new PTAC unit in place of the existing unit.
- Reuse existing electrical connections.
- Seal any air infiltration leaks around unit.
- Install new low voltage wall mounted thermostat to control unit.
- F&I new PVC condensate trap at unit.
- Provide startup of new units.

Savings Methodology

Savings Calculation Method		
Cooling Savings (kWh)	=	Size (Tons) x Cooling gradient (%) x (Existing kW/Ton – New kW/Ton) x Bin Hours
Heating Savings (Therm)	=	(Size (Btu/h)/Existing Eff.) – (Size (Btu/h)/ New Eff.)) x Heating gradient (%) x Bin Hours/100000

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

- Electric and Natural Gas savings
- Improved cooling and heating performance.

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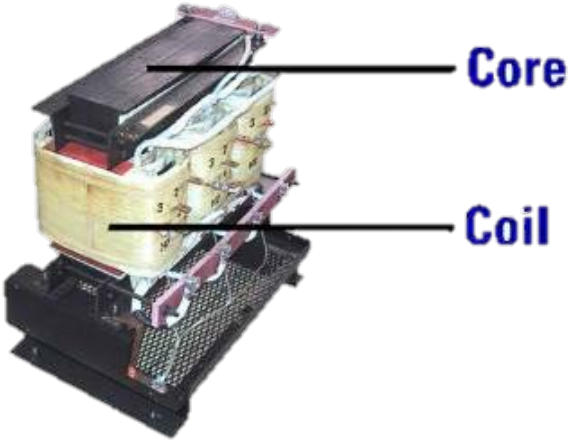
High Efficiency Transformers

ECM Summary

The primary goal of this ECM is increased energy savings through replacement of old, inefficient transformers with new, ultra-high efficient transformers. While facilities can be unique, electrical infrastructure is almost always based on U.S. industry standard transformers. Transformers are typically purchased as part of a total electrical distribution package, installed, and forgotten for 40-50 years. The majority of these transformers are operating at a small fraction of their nameplate capacity, resulting in very low efficiency, and are producing large amounts of excess heat, resulting in energy losses and higher utility costs. In addition, half of all existing transformers, according to the Dept. of Energy, are approaching a mean time to failure of 32 years. Replacing these units prior to a sudden end of life, results in lower risk of facility down time.

For a transformer retrofit to deliver real energy savings, the losses of the new transformer must be measurably lower than those of the existing transformer. This may sound obvious, but losses of existing transformers are not widely understood in relation to actual load conditions and load profiles. Given a real world setting, estimating or “stipulating” savings using factory or industry test data/standards for either the existing or typical replacement unit would be significantly flawed.

Transformers are comprised of two major components: a steel core, and windings made of aluminum or copper.



Because transformers are in operation 24-hours/day, 365-days/year, they produce energy losses around the clock. Core losses, also known as no-load-losses, are constant. The core remains energized at all times, regardless of the % load (so losses are always the same). Coil losses, also known as load losses, vary with the load placed upon them, i.e. as load increases, as do the losses.

Code and all published data are based on performance at a 35% linear load. Therefore, almost all transformers are designed for highest efficiency under that load profile. However, this profile does not typically exist in the real world. Linear loads essentially ceased to exist with the advent of computers and VFD’s, and the average load on a transformer in 2016, across almost all verticals, is only about 13%. To

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reach this extreme percentile, the vast majority must be loaded at lower than 10%! Under this lower load profile, virtually all the losses are found in the core. Through the use of design and manufacturing advances, but more importantly, better materials (i.e. higher-grade insulation, copper, aluminum and, most critically, steal in the core), energy efficient transformers lower resistance, producing extremely low no-load-losses and minimized load-losses.

Facilities Considered for this Measure

- David C. Abbott Learning Center
- BOE Administrative Offices
- Marlboro Memorial Middle School
- Marlboro Middle School

Scope of Work

The old, inefficient transformers will be removed and replaced with new high-efficient transformers. To the maximum extent practicable, the existing conductors and conduit will be reused. Below is the list of schools and transformer sizes, which are in the scope.

Abbott Early Learning		
Size kVA	Total Quantity	Replacement Quantity
45	1	1
75	2	2

BOE Administration		
Size kVA	Total Quantity	Replacement Quantity
75	1	1

Memorial Middle School		
Size kVA	Total Quantity	Replacement Quantity
75	7	7
112.5	1	1
300	1	1

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Marlboro Middle School		
Size kVA	Total Quantity	Replacement Quantity
30	1	1
75	4	4
150	2	2

Savings Methodology

Savings are calculated using the following methodology for all the transformers:

Savings Calculation Methodology		
Baseline Annual losses from Transformers (kWh/yr)	=	(Baseline Transformer kW Losses (Normal Operation) x Equipment Operating hrs/ day x Equipment Operating days/yr) + Baseline Transformer kW Losses (Outside Op. hrs) x (24 x 365 - Equipment Operating hrs/ day x Equipment Operating days/yr)
Powersmith Annual losses from Transformers (kWh/yr)	=	(Powersmiths Transformer kW Losses (Normal Operation) x Equipment Operating hrs/ day x Equipment Operating days/yr) + Powersmiths Transformer kW Losses (Outside Op. hrs) x (24 x 365 - Equipment Operating hrs/ day x Equipment Operating days/yr)
Electrical Savings (kWh/yr)	=	Baseline Annual losses from Transformers – Powersmith Annual losses from Transformers

Maintenance

Periodically the equipment should be checked to ensure proper operation.

Benefits

Electrical energy savings

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APPENDIX 2. ENERGY SAVINGS CALCULATIONS

Energy Savings

Energy savings were calculated using an Excel based bin calculation workbook developed by Energy Systems Group; all savings calculations and field measurements will be provided electronically.

Operational Savings

New LED Fixtures

Annual operational savings are calculated based on the reduced amount of material needed for replacement of the lighting system. This is calculated by comparing the existing lifetime of the T8, HID and halogen lamps to the new lifetime of LED lighting. The calculations are based on replacements of T8 fixtures every three years, T8 ballasts every 5 years, HID lamps every 5 years and halogen lamps being replaced every 2 years. The table below highlights the various lamp types and associated replacement timing as well as total cost with replacement. These savings do not include any costs for labor to replace the bulbs or additional material needed for replacement such as lifts, replacement fixtures, new sockets, etc.

Material Type	Lifetime	Cost/ Unit
Linear fluorescent (T8)	3 years	$5
Electronic Ballast	5 years	$25
HID Lamp	5 years	$25
HID Ballast	5 years	$75
Halogen, PARs, BRs	2 years	$10
Incandescent, CFLs, MRs	2 years	$2

This methodology is used to determine the annual savings through the replacement of all lamp types with new LED lamps and fixtures. The fixture warranty associated with each of these replacements is 10 years. Operational savings have been claimed for a total of 5 years per the BPU regulations.

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Mechanical Upgrades (Boiler Replacement & Controls Upgrades)

The annual operating expenses for Marlboro Township BOE was provided to Energy Systems Group in order to determine the amount of emergency repair maintenance conducted annually at the District. The installation of new equipment along with manufacturers' warranties will effectively eliminate the need for these emergency repair costs. The operational savings for these measures have been claimed for 2 years per the BPU regulations and in agreement with MTPS.

Operational Savings Summary

Energy Systems Group has worked with the District to quantify the exact sources of savings by going through past invoices and expenses. The table below summarizes the cost savings estimated from invoices provided by the District; these invoices are summarized only by the applicable ECMs and any non-recurring charge. Any preventative maintenance or service contracts that will remain were not factored into this analysis. The complete list of invoices is provided electronically. The operational savings will not be escalated.

Operational Savings for Financial Model	
ECM Description	Annual Savings
LED Lighting Upgrades & Occupancy Sensors – District Wide (10 Buildings)	$69,053
HVAC, Refrigeration Upgrades / Equipment Replacement	$206,729
Totals	**$275,782**

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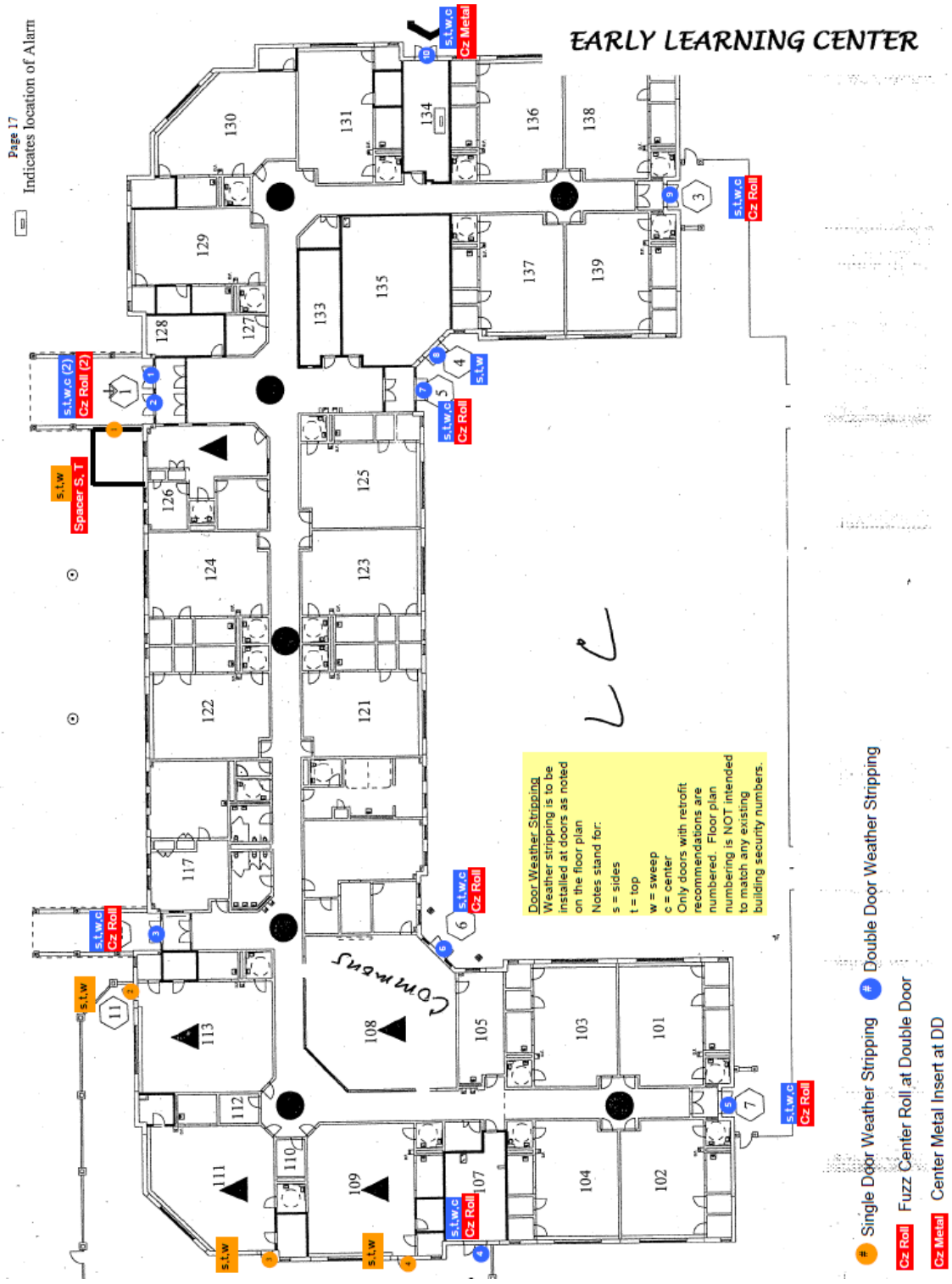
APPENDIX 3. BUILDING ENVELOPE SCOPE DRAWINGS

David C. Abbott Early Learning Center



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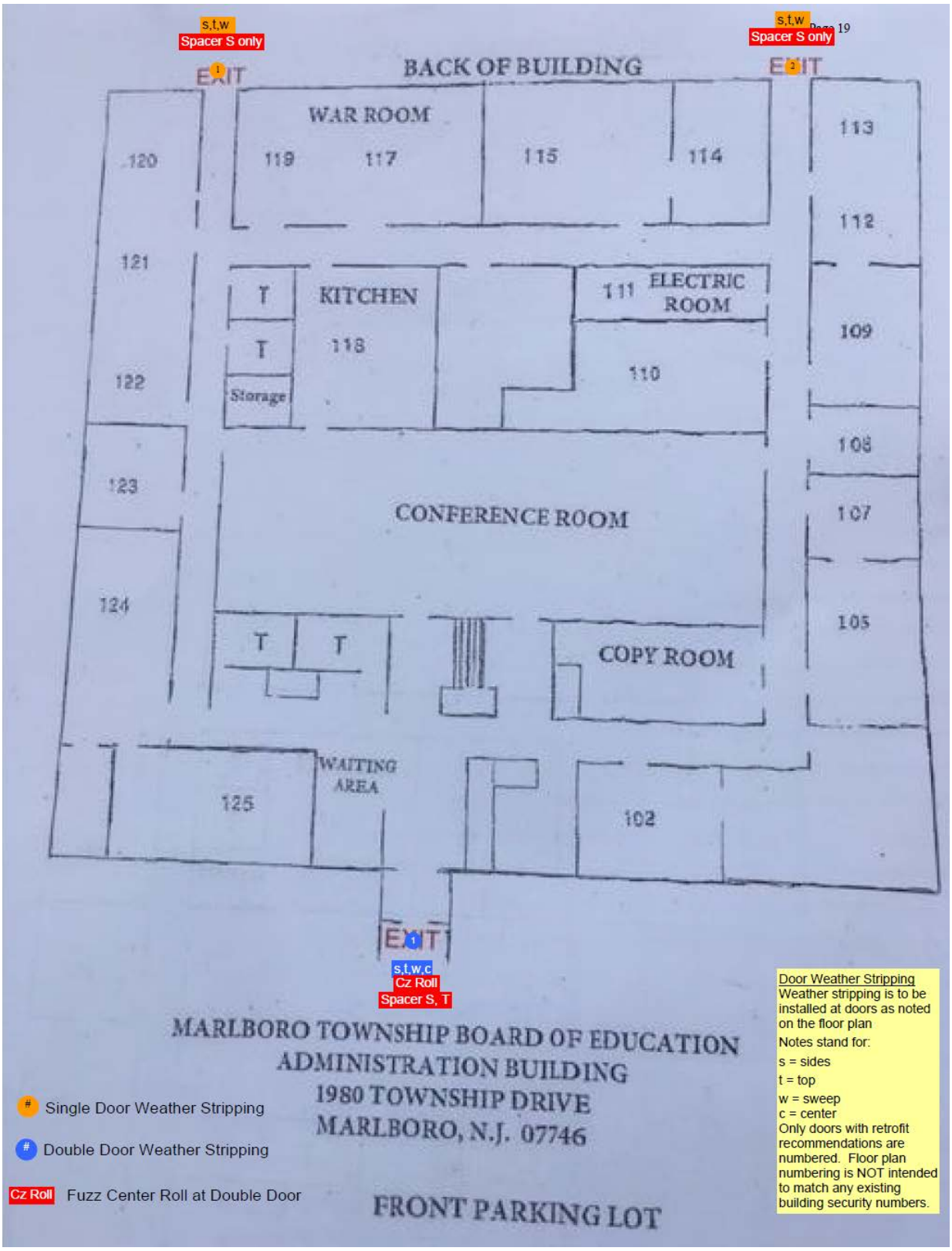
BOE Administrative Office



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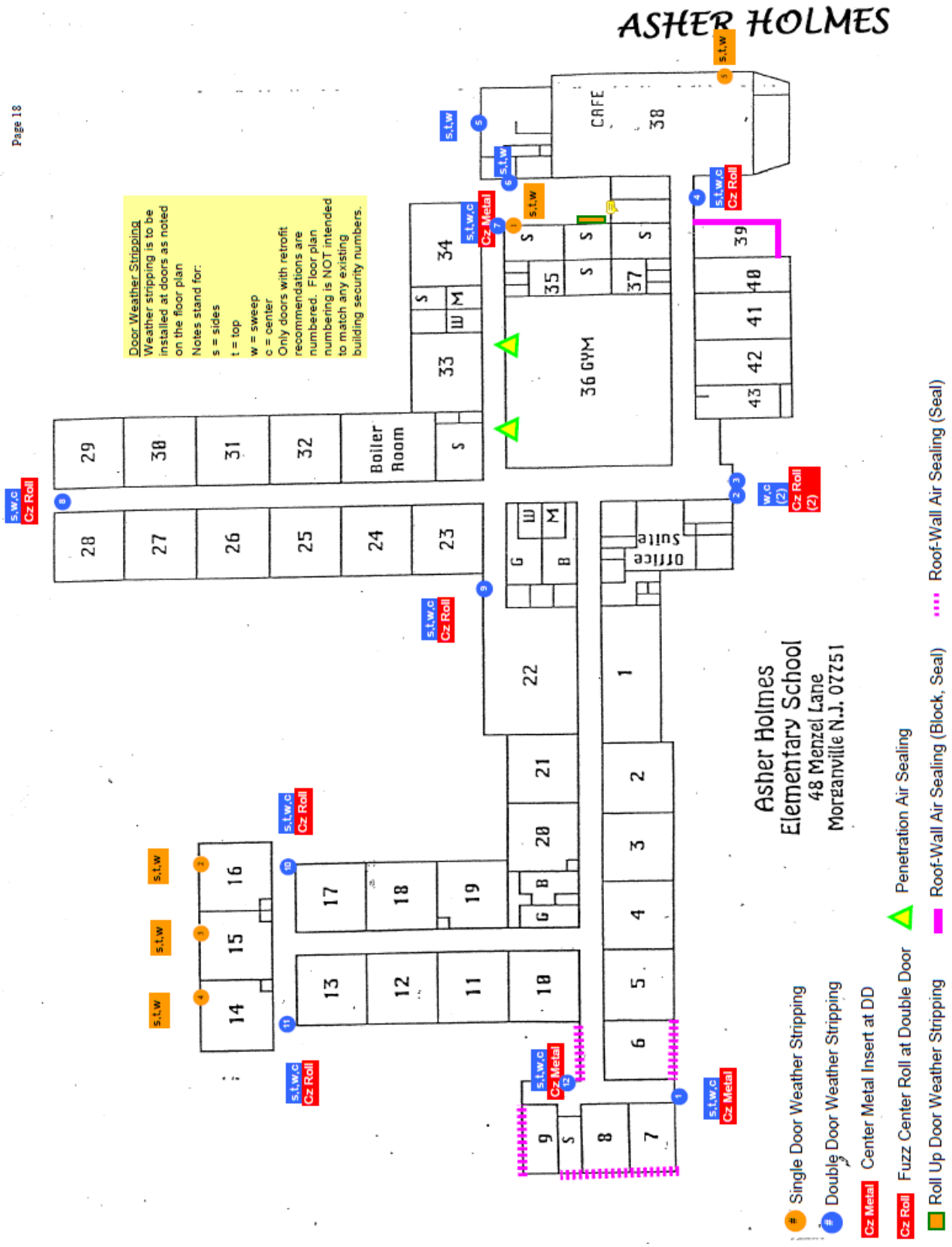
Asher Holmes Elementary School



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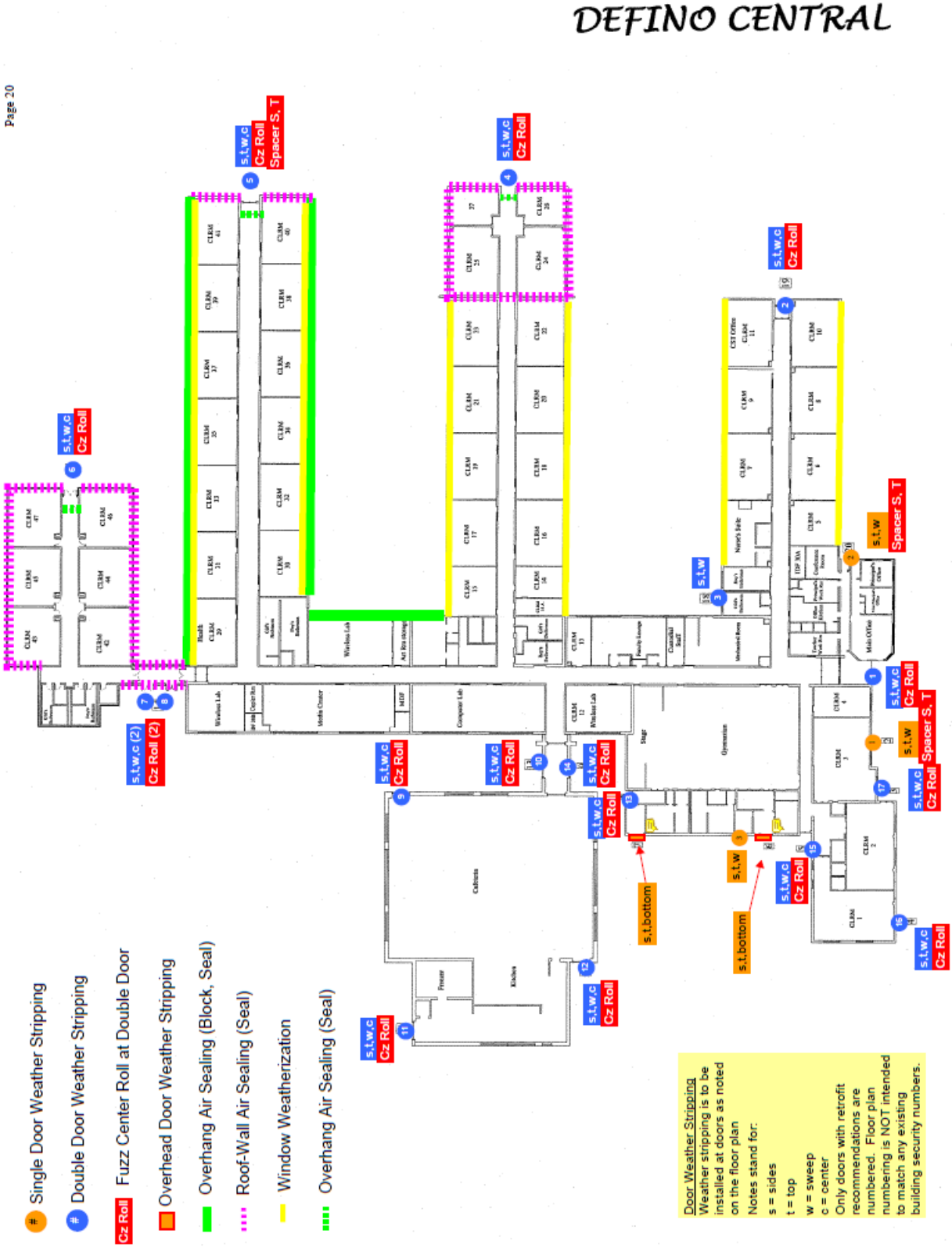
Frank Defino Central School



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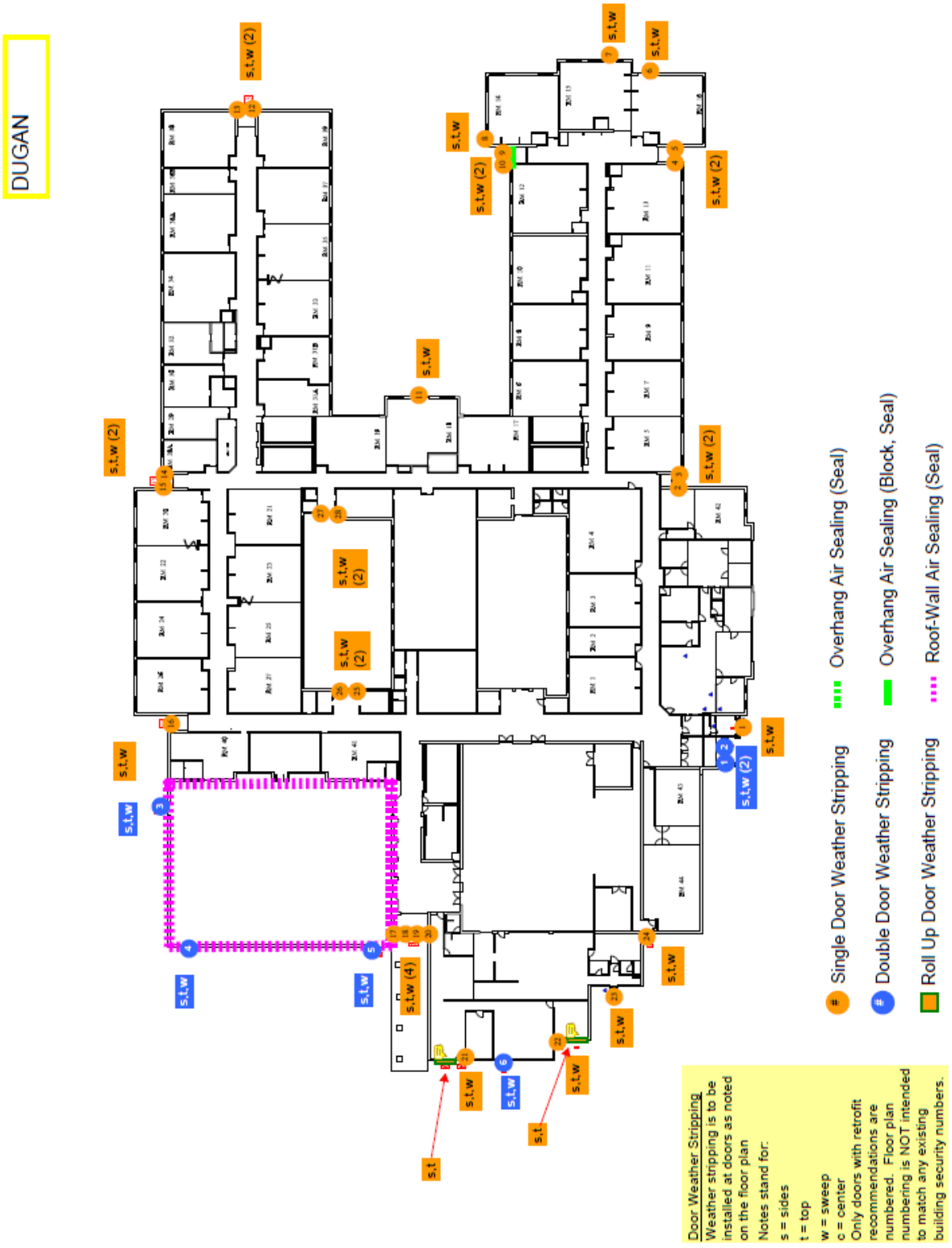
Frank J. Dugan Elementary School



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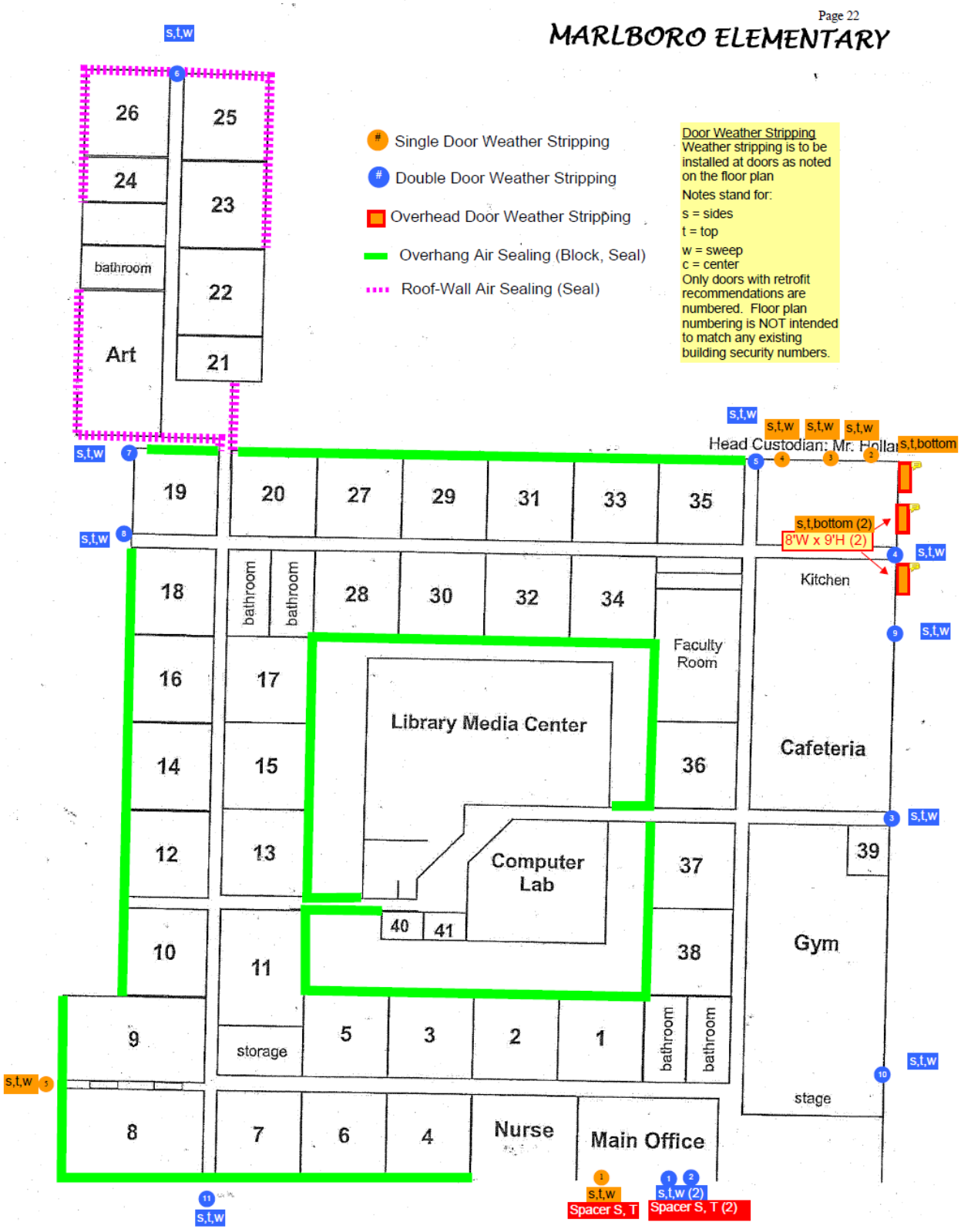
Marlboro Elementary School



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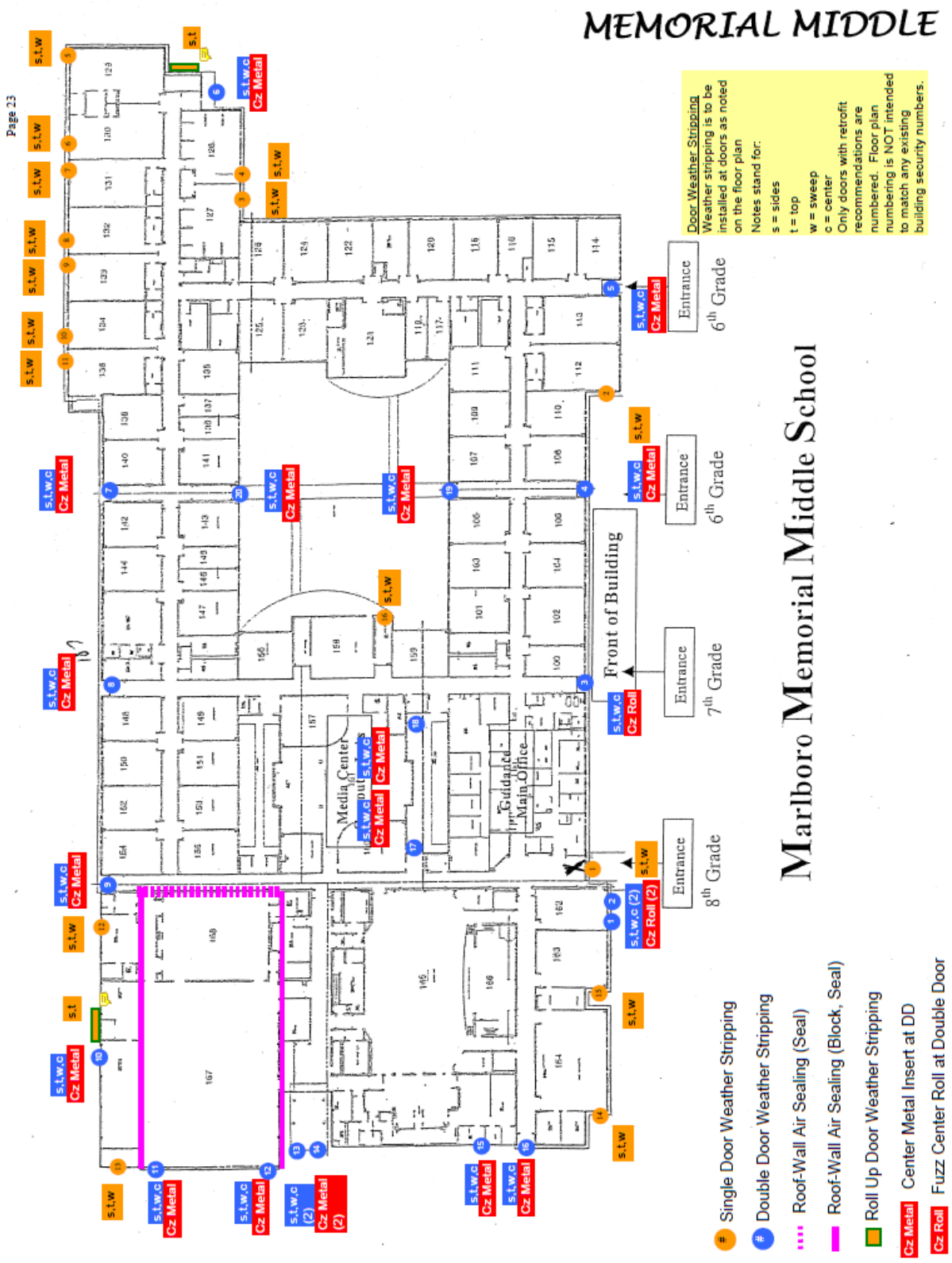
Marlboro Memorial Middle School



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Robertsville Elementary School

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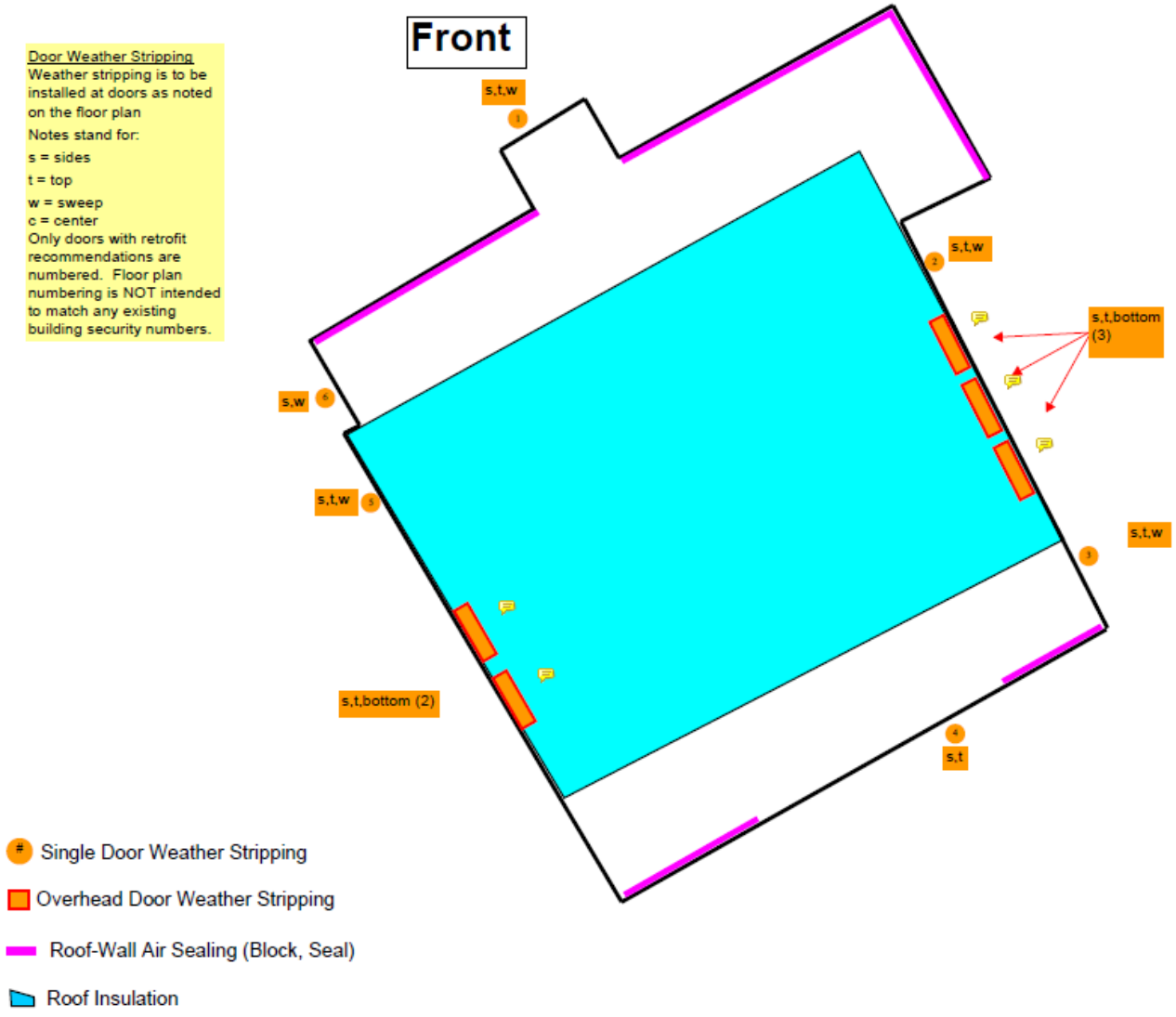
Transportation Garage

Transportation Garage - Marlboro, NJ



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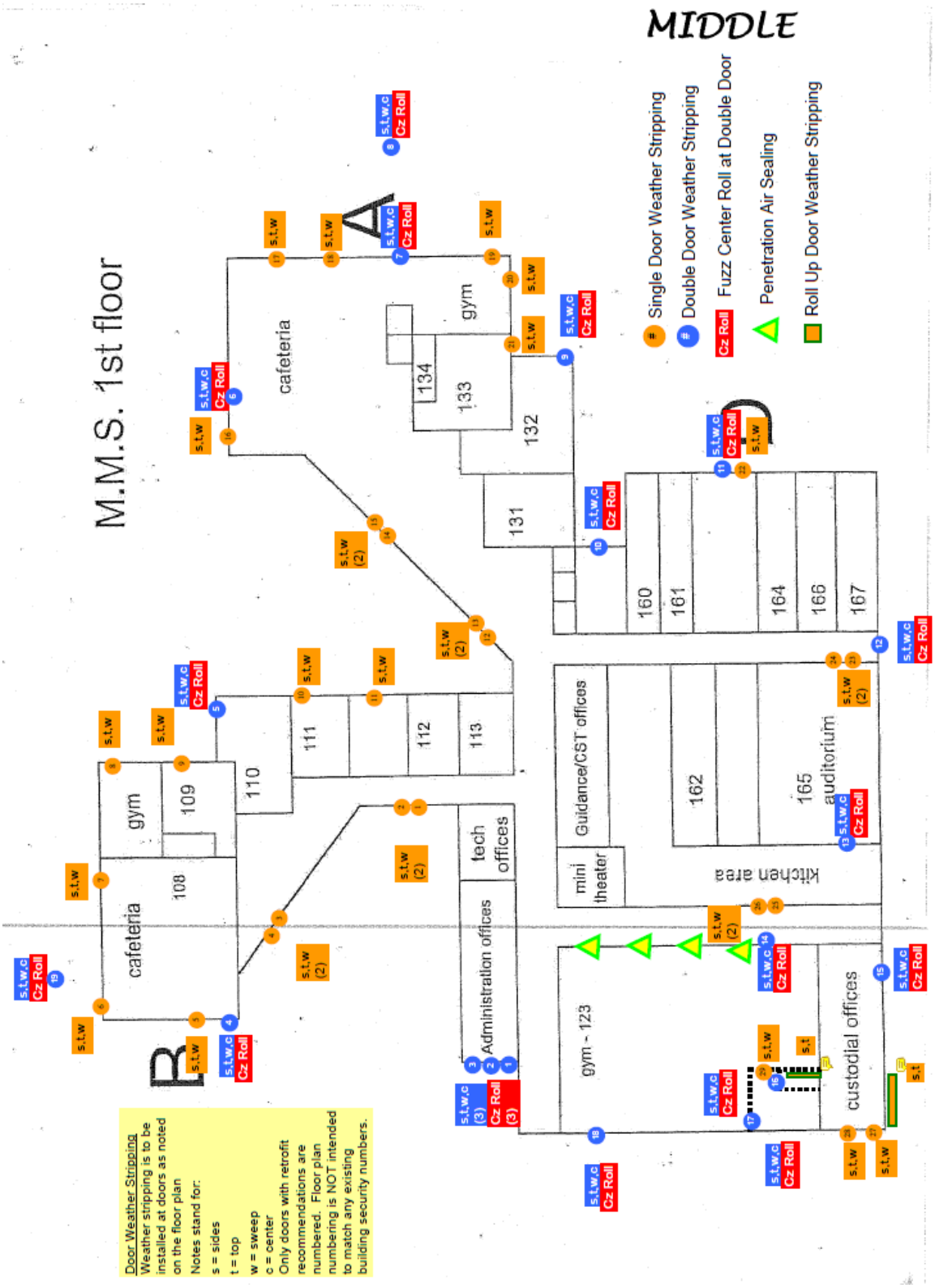
Marlboro Middle School



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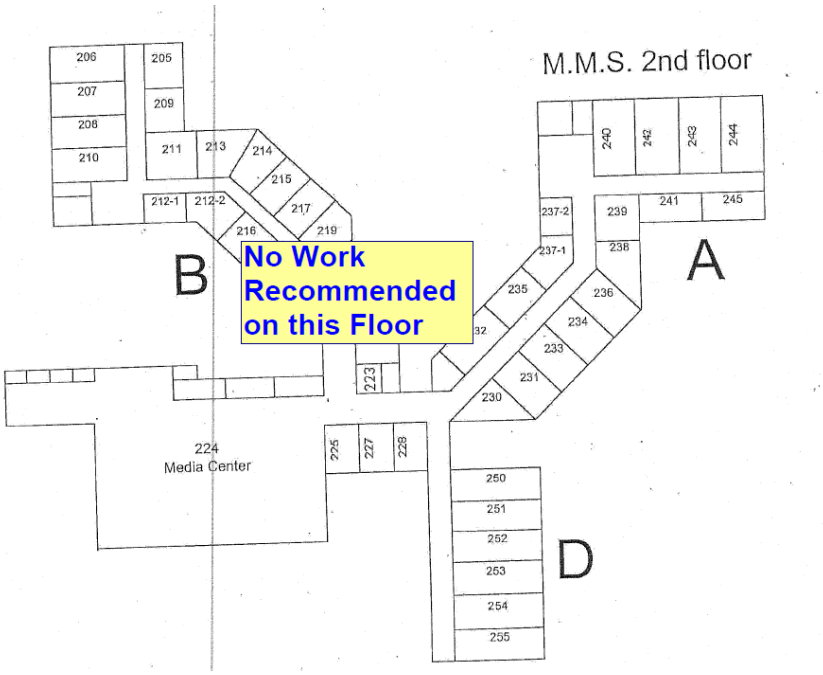
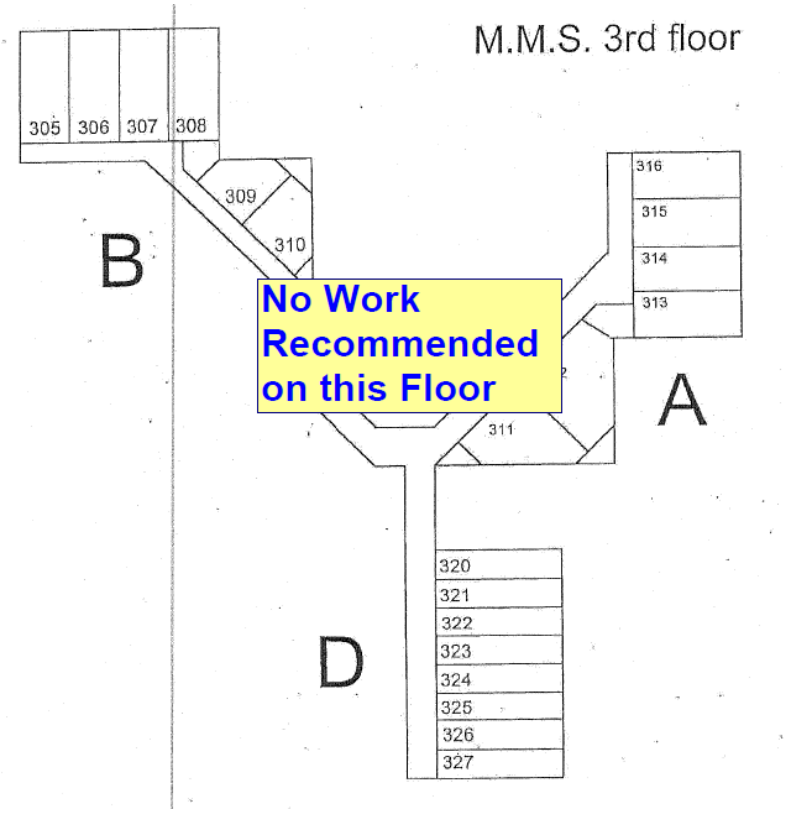
Marlboro Middle School (cont.)





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APPENDIX 4. DETAILED SCOPE DESCRIPTIONS

Design Drawings will be available electronically.

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APPENDIX 5. RECOMMENDED PROJECT – ESP

ECM ID	Energy Conservation Measure	ECM Sell Price	Total Savings, $/yr	Simple Payback	Installation Plan	Recommend for Installation
Asher Holmes Elementary School						
1	Asher Holmes Elementary School - Addressable Fire Alarms	$201,757	$4,947	40.8	Public Bidding	Yes
2	Asher Holmes Elementary School - Boiler Replacement	$631,035	$8,551	30.7	Public Bidding	Yes
3	Asher Holmes Elementary School - Direct Install	$20,497	$6,086	2.9	Public Bidding	Yes
4	Asher Holmes Elementary School - Unit Ventilator Refurbishment	$303,043	$5,413	56.0	Public Bidding	Yes
5	Asher Holmes Elementary School - Plug Load Controls	$7,729	$831	9.3	Public Bidding	Yes
6	Asher Holmes Elementary School - Repair HVAC Insulation	$10,110	$638	15.9	Public Bidding	Yes
7	Asher Holmes Elementary School - Variable Speed Kitchen Hood Controls	$20,785	$311	66.9	Public Bidding	Yes
8	Asher Holmes Elementary School - Water Conservation	$29,886	$2,732	10.1	Public Bidding	Yes
9	Asher Holmes Elementary School - Refrigeration Controls	$3,699	$467	4.0	Public Bidding	Yes
10	Asher Holmes Elementary School - Building Envelope Weatherization	$18,902	$1,374	13.8	Public Bidding	Yes
11	Asher Holmes Elementary School - Retro Cx	$16,847	$1,712	9.8	Public Bidding	Yes
12	Asher Holmes Elementary School - Dishwasher Replacement	$0	$2,469	0.0	Public Bidding	Yes
13	Asher Holmes Elementary School - BMS - Central Plant	$71,345	$1,578	45.2	Public Bidding	Yes
14	Asher Holmes Elementary School - BMS - Terminal Units	$220,039	$0	N/A	Public Bidding	Yes
15	Asher Holmes Elementary School - BMS - Common Areas (AHUs, RTUs)	$82,588	$755	109.3	Public Bidding	Yes
16	Asher Holmes Elementary School - Destratification Fans	$24,216	$2,320	10.4	Public Bidding	Yes
17	Asher Holmes Elementary School - Add Cooling - Gym	$277,322	$548	505.7	Public Bidding	Yes
BOE Administrative Office & Building						
18	BOE Administrative Office & Building - Addressable Fire Alarms	$22,504	$4,947	4.5	Public Bidding	Yes
19	BOE Administrative Office & Building - Direct Install	$7,311	$2,977	2.2	Public Bidding	Yes
20	BOE Administrative Office & Building - Plug Load Controls	$2,727	$148	18.4	Public Bidding	Yes

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21	BOE Administrative Office & Building - Water Conservation	$1,666	$185	8.5	Public Bidding	Yes
22	BOE Administrative Office & Building - Building Envelope Weatherization	$3,507	$271	13.0	Public Bidding	Yes
23	BOE Administrative Office & Building - BMS - Central Plant	$18,653	$0	N/A	Public Bidding	Yes
24	BOE Administrative Office & Building - BMS - Terminal Units	$8,418	$0	N/A	Public Bidding	Yes
25	BOE Administrative Office & Building - BMS - Common Areas (AHUs, RTUs)	$12,460	$0	N/A	Public Bidding	Yes
26	BOE Administrative Office & Building - Redesign HVAC (VRF)	$349,516	$2,151	162.5	Public Bidding	Yes
David C. Abbott Early Learning Center						
27	David C. Abbott Early Learning Center - Addressable Fire Alarms	$112,630	$4,947	22.8	Public Bidding	Yes
28	David C. Abbott Early Learning Center - Direct Install	$220,888	$23,364	8.6	Public Bidding	Yes
29	David C. Abbott Early Learning Center - Unit Ventilator Replacement	$613,628	$4,996	122.8	Public Bidding	Yes
30	David C. Abbott Early Learning Center - Plug Load Controls	$2,577	$171	15.1	Public Bidding	Yes
31	David C. Abbott Early Learning Center - Repair HVAC Insulation	$10,294	$737	14.0	Public Bidding	Yes
32	David C. Abbott Early Learning Center - VFDs on HVAC Motors	$116,915	$3,681	31.8	Public Bidding	Yes
33	David C. Abbott Early Learning Center - Water Conservation	$9,381	$894	9.5	Public Bidding	Yes
34	David C. Abbott Early Learning Center - Refrigeration Controls	$1,233	$156	4.0	Public Bidding	Yes
35	David C. Abbott Early Learning Center - Building Envelope Weatherization	$11,279	$865	13.0	Public Bidding	Yes
36	David C. Abbott Early Learning Center - Retro Cx	$15,674	$1,873	8.4	Public Bidding	Yes
37	David C. Abbott Early Learning Center - BMS - Central Plant	$51,946	$0	N/A	Public Bidding	Yes
38	David C. Abbott Early Learning Center - BMS - Terminal Units	$86,741	$0	N/A	Public Bidding	Yes
39	David C. Abbott Early Learning Center - BMS - Common Areas (AHUs, RTUs)	$35,267	$0	N/A	Public Bidding	Yes
40	David C. Abbott Early Learning Center - Chiller Replacement	$332,387	$2,196	130.9	Public Bidding	Yes
41	David C. Abbott Early Learning Center - Window Film	$13,875	$685	20.2	Public Bidding	Yes
Frank Defino Central School						
42	Frank Defino Central School - Lighting Upgrades - LED	$237,238	$14,404	4.4	Public Bidding	Yes

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43	Frank Defino Central School - Addressable Fire Alarms	$199,540	$4,947	40.3	Public Bidding	Yes
44	Frank Defino Central School - Boiler Replacement	$646,127	$7,493	20.5	Public Bidding	Yes
45	Frank Defino Central School - Water Heater Replacement	$180,408	$318	137.0	Public Bidding	Yes
46	Frank Defino Central School - Unit Ventilator Replacement	$443,657	$5,560	79.8	Public Bidding	Yes
47	Frank Defino Central School - Plug Load Controls	$7,577	$700	10.8	Public Bidding	Yes
48	Frank Defino Central School - Repair HVAC Insulation	$7,917	$501	15.8	Public Bidding	Yes
49	Frank Defino Central School - Variable Speed Kitchen Hood Controls	$21,139	$971	18.1	Public Bidding	Yes
50	Frank Defino Central School - Water Conservation	$29,917	$2,151	12.5	Public Bidding	Yes
51	Frank Defino Central School - Refrigeration Controls	$6,165	$1,579	2.4	Public Bidding	Yes
52	Frank Defino Central School - Building Envelope Weatherization	$73,144	$4,549	16.1	Public Bidding	Yes
53	Frank Defino Central School - Retro Cx	$16,661	$2,434	6.8	Public Bidding	Yes
54	Frank Defino Central School - Dishwasher Replacement	$0	$2,390	0.0	Public Bidding	Yes
55	Frank Defino Central School - BMS - Central Plant	$92,028	$1,437	64.0	Public Bidding	Yes
56	Frank Defino Central School - BMS - Terminal Units	$246,042	$0	N/A	Public Bidding	Yes
57	Frank Defino Central School - BMS - Common Areas (AHUs, RTUs)	$104,147	$940	110.8	Public Bidding	Yes
58	Frank Defino Central School - Destratification Fans	$9,977	$868	11.5	Public Bidding	Yes
59	Frank Defino Central School - Add Cooling - Gym	$230,699	$293	788.2	Public Bidding	Yes
Frank J. Dugan Elementary School						
60	Frank J. Dugan Elementary School - Addressable Fire Alarms	$236,439	$4,947	47.8	Public Bidding	Yes
61	Frank J. Dugan Elementary School - Direct Install	$49,697	$16,782	2.5	Public Bidding	Yes
62	Frank J. Dugan Elementary School - Plug Load Controls	$9,093	$608	15.0	Public Bidding	Yes
63	Frank J. Dugan Elementary School - Repair HVAC Insulation	$14,059	$931	15.1	Public Bidding	Yes
64	Frank J. Dugan Elementary School - Variable Speed Kitchen Hood Controls	$21,427	$1,209	7.1	Public Bidding	Yes
65	Frank J. Dugan Elementary School - Water Conservation	$27,119	$1,671	14.5	Public Bidding	Yes
66	Frank J. Dugan Elementary School - Refrigeration Controls	$3,699	$1,163	2.0	Public Bidding	Yes

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67	Frank J. Dugan Elementary School - Building Envelope Weatherization	$31,688	$2,301	13.8	Public Bidding	Yes
68	Frank J. Dugan Elementary School - Retro Cx	$19,742	$2,845	6.9	Public Bidding	Yes
69	Frank J. Dugan Elementary School - Dishwasher Replacement	$0	$1,206	0.0	Public Bidding	Yes
70	Frank J. Dugan Elementary School - HVAC Armor/Refurb.	$2,709	$285	8.1	Public Bidding	Yes
71	Frank J. Dugan Elementary School - Premium Efficiency Motors	$8,012	$35	226.9	Public Bidding	Yes
72	Frank J. Dugan Elementary School - BMS - Central Plant	$65,186	$0	N/A	Public Bidding	Yes
73	Frank J. Dugan Elementary School - BMS - Terminal Units	$233,836	$0	N/A	Public Bidding	Yes
74	Frank J. Dugan Elementary School - BMS - Common Areas (AHUs, RTUs)	$118,200	$536	220.6	Public Bidding	Yes
75	Frank J. Dugan Elementary School - Destratification Fans	$33,796	$2,854	11.8	Public Bidding	Yes
76	Frank J. Dugan Elementary School - Add Cooling - Gym	$271,020	$355	764.3	Public Bidding	Yes
Marlboro Elementary School						
77	Marlboro Elementary School - Addressable Fire Alarms	$211,425	$4,947	42.7	Public Bidding	Yes
78	Marlboro Elementary School - Boiler Replacement	$639,197	$9,688	19.0	Public Bidding	Yes
79	Marlboro Elementary School - Water Heater Replacement	$180,408	$682	67.4	Public Bidding	Yes
80	Marlboro Elementary School - Direct Install	$55,770	$19,788	2.5	Public Bidding	Yes
81	Marlboro Elementary School - Unit Ventilator Refurbishment	$284,905	$5,153	55.3	Public Bidding	Yes
82	Marlboro Elementary School - Plug Load Controls	$7,729	$606	12.7	Public Bidding	Yes
83	Marlboro Elementary School - Repair HVAC Insulation	$14,528	$1,213	12.0	Public Bidding	Yes
84	Marlboro Elementary School - Variable Speed Kitchen Hood Controls	$25,038	$1,669	15.0	Public Bidding	Yes
85	Marlboro Elementary School - Water Conservation	$20,621	$1,490	12.7	Public Bidding	Yes
86	Marlboro Elementary School - Refrigeration Controls	$3,699	$1,163	2.0	Public Bidding	Yes
87	Marlboro Elementary School - Building Envelope Weatherization	$71,738	$5,628	12.7	Public Bidding	Yes
88	Marlboro Elementary School - Retro Cx	$17,654	$1,905	9.3	Public Bidding	Yes
89	Marlboro Elementary School - Dishwasher Replacement	$0	$2,235	0.0	Public Bidding	Yes
90	Marlboro Elementary School - BMS - Central Plant	$71,336	$0	N/A	Public Bidding	Yes

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91	Marlboro Elementary School - BMS - Terminal Units	$189,766	$0	N/A	Public Bidding	Yes
92	Marlboro Elementary School - BMS - Common Areas (AHUs, RTUs)	$90,785	$0	N/A	Public Bidding	Yes
93	Marlboro Elementary School - Destratification Fans	$10,010	$998	10.0	Public Bidding	Yes
94	Marlboro Elementary School - Add Cooling - Gym	$289,551	$548	528.0	Public Bidding	Yes
Marlboro Memorial Middle School						
95	Marlboro Memorial Middle School - Lighting Upgrades - LED	$571,374	$42,786	3.8	Public Bidding	Yes
96	Marlboro Memorial Middle School - Addressable Fire Alarms	$439,757	$4,947	88.9	Public Bidding	Yes
97	Marlboro Memorial Middle School - Boiler Replacement	$743,372	$2,418	19.3	Public Bidding	Yes
98	Marlboro Memorial Middle School - Cogeneration	$317,148	$6,379	49.7	Public Bidding	Yes
99	Marlboro Memorial Middle School - Plug Load Controls	$12,275	$1,522	8.1	Public Bidding	Yes
100	Marlboro Memorial Middle School - Repair HVAC Insulation	$17,496	$99	176.3	Public Bidding	Yes
101	Marlboro Memorial Middle School - Variable Speed Kitchen Hood Controls	$22,206	$2,059	5.8	Public Bidding	Yes
102	Marlboro Memorial Middle School - VFDs on HVAC Motors	$51,021	$4,690	10.9	Public Bidding	Yes
103	Marlboro Memorial Middle School - VFDs on HVAC Motors	$75,994	$20,908	1.8	Public Bidding	Yes
104	Marlboro Memorial Middle School - Water Conservation	$42,734	$5,008	8.0	Public Bidding	Yes
105	Marlboro Memorial Middle School - Refrigeration Controls	$6,165	$1,579	2.4	Public Bidding	Yes
106	Marlboro Memorial Middle School - Building Envelope Weatherization	$39,441	$3,035	13.0	Public Bidding	Yes
107	Marlboro Memorial Middle School - Retro Cx	$40,799	$5,956	6.9	Public Bidding	Yes
108	Marlboro Memorial Middle School - Dishwasher Replacement	$0	$4,375	0.0	Public Bidding	Yes
109	Marlboro Memorial Middle School - BMS - Central Plant	$43,038	$0	N/A	Public Bidding	Yes
110	Marlboro Memorial Middle School - BMS - Terminal Units	$33,408	$0	N/A	Public Bidding	Yes
111	Marlboro Memorial Middle School - BMS - Common Areas (AHUs, RTUs)	$46,288	$0	N/A	Public Bidding	Yes
112	Marlboro Memorial Middle School - Destratification Fans	$64,322	$8,014	8.0	Public Bidding	Yes
113	Marlboro Memorial Middle School - Window Film	$4,295	$393	10.9	Public Bidding	Yes
Marlboro Middle School						

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114	Marlboro Middle School - Lighting Upgrades - LED	$671,853	$36,687	5.4	Public Bidding	Yes
115	Marlboro Middle School - MMS Auditorium Lighting	$86,240	$4,779	16.2	Public Bidding	Yes
116	Marlboro Middle School - Addressable Fire Alarms	$566,371	$4,947	114.5	Public Bidding	Yes
117	Marlboro Middle School - Boiler Replacement	$944,773	$16,336	14.7	Public Bidding	Yes
118	Marlboro Middle School - Water Heater Replacement	$199,889	$1,208	42.5	Public Bidding	Yes
119	Marlboro Middle School - Unit Ventilator Refurbishment	$642,427	$17,198	37.4	Public Bidding	Yes
120	Marlboro Middle School - Plug Load Controls	$11,518	$1,147	10.0	Public Bidding	Yes
121	Marlboro Middle School - Repair HVAC Insulation	$29,314	$2,038	14.4	Public Bidding	Yes
122	Marlboro Middle School - Variable Speed Kitchen Hood Controls	$18,771	$2,009	4.9	Public Bidding	Yes
123	Marlboro Middle School - VFDs on HVAC Motors	$49,341	$3,144	4.9	Public Bidding	Yes
124	Marlboro Middle School - Water Conservation	$55,244	$8,205	6.4	Public Bidding	Yes
125	Marlboro Middle School - Refrigeration Controls	$6,165	$1,423	2.6	Public Bidding	Yes
126	Marlboro Middle School - Building Envelope Weatherization	$29,244	$2,494	11.7	Public Bidding	Yes
127	Marlboro Middle School - Retro Cx	$55,173	$6,169	8.9	Public Bidding	Yes
128	Marlboro Middle School - Dishwasher Replacement	$0	$8,178	0.0	Public Bidding	Yes
129	Marlboro Middle School - BMS - Central Plant	$87,146	$4,043	21.6	Public Bidding	Yes
130	Marlboro Middle School - BMS - Terminal Units	$384,037	$0	N/A	Public Bidding	Yes
131	Marlboro Middle School - BMS - Common Areas (AHUs, RTUs)	$163,109	$2,989	54.6	Public Bidding	Yes
132	Marlboro Middle School - Chiller Replacement	$0	$2,800	0.0	Public Bidding	Yes
133	Marlboro Middle School - Destratification Fans	$26,594	$2,596	10.2	Public Bidding	Yes
134	Marlboro Middle School - Construction Contingency	$432,250	$0	N/A	Public Bidding	Yes
135	Marlboro Middle School - Energy Star Refrigerator Replacement	$11,100	$757	14.7	Public Bidding	Yes
Robertsville Elementary School						
136	Robertsville Elementary School - Addressable Fire Alarms	$201,913	$4,947	40.8	Public Bidding	Yes
137	Robertsville Elementary School - Boiler Replacement	$667,795	$8,821	20.3	Public Bidding	Yes
138	Robertsville Elementary School - Water Heater Replacement	$180,408	$491	72.6	Public Bidding	Yes

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139	Robertsville Elementary School - Direct Install	$25,943	$16,393	1.3	Public Bidding	Yes
140	Robertsville Elementary School - Unit Ventilator Refurbishment	$331,529	$6,030	55.0	Public Bidding	Yes
141	Robertsville Elementary School - Plug Load Controls	$8,790	$868	10.1	Public Bidding	Yes
142	Robertsville Elementary School - Repair HVAC Insulation	$17,951	$969	18.5	Public Bidding	Yes
143	Robertsville Elementary School - Variable Speed Kitchen Hood Controls	$27,822	$1,482	8.5	Public Bidding	Yes
144	Robertsville Elementary School - Water Conservation	$27,943	$2,841	9.2	Public Bidding	Yes
145	Robertsville Elementary School - Refrigeration Controls	$4,932	$1,267	2.4	Public Bidding	Yes
146	Robertsville Elementary School - Building Envelope Weatherization	$109,927	$6,957	15.8	Public Bidding	Yes
147	Robertsville Elementary School - Retro Cx	$16,860	$1,471	11.5	Public Bidding	Yes
148	Robertsville Elementary School - Dishwasher Replacement	$0	$2,490	0.0	Public Bidding	Yes
149	Robertsville Elementary School - BMS - Central Plant	$85,438	$1,651	51.7	Public Bidding	Yes
150	Robertsville Elementary School - BMS - Terminal Units	$261,918	$0	N/A	Public Bidding	Yes
151	Robertsville Elementary School - BMS - Common Areas (AHUs, RTUs)	$49,319	$1,011	48.8	Public Bidding	Yes
152	Robertsville Elementary School - Destratification Fans	$10,241	$1,135	9.0	Public Bidding	Yes
153	Robertsville Elementary School - Add Cooling - Gym	$289,551	$604	479.2	Public Bidding	Yes
Transportation Garage						
154	Transportation Garage - Addressable Fire Alarms	$25,809	$4,947	5.2	Public Bidding	Yes
155	Transportation Garage - Direct Install	$6,665	$2,799	2.1	Public Bidding	Yes
156	Transportation Garage - Water Conservation	$1,436	$37	31.0	Public Bidding	Yes
157	Transportation Garage - Building Envelope Weatherization	$10,687	$1,203	8.9	Public Bidding	Yes
158	Transportation Garage - BMS - Central Plant	$7,779	$0	N/A	Public Bidding	Yes
159	Transportation Garage - BMS - Terminal Units	$1,791	$0	N/A	Public Bidding	Yes
160	Transportation Garage - BMS - Common Areas (AHUs, RTUs)	$12,785	$0	N/A	Public Bidding	Yes
161	Transportation Garage - Bus Advertising	$0	$3,000	0.0	Public Bidding	Yes
All Facilities						

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162	All Facilities - Computer Power Management	$34,580	$17,789	1.9	Public Bidding	Yes
	Totals	**$19,345,045**	**$575,474**	**33.62**		

Operational Savings for Financial Model	
ECM Description	Annual Savings
LED Lighting Upgrades & Occupancy Sensors – District Wide (10 Schools)	$76,522
HVAC Upgrades / Equipment Replacement	$199,260
Totals	**$275,782**

Building	ECM Type	Energy Rebate/ Incentives
Frank Defino Central School	Lighting Upgrades - LED	**$29,922**
Marlboro Memorial Middle School	Lighting Upgrades - LED	**$84,000**
Marlboro Middle School	Lighting Upgrades - LED	**$66,000**
Asher Holmes Elementary School	Boiler Replacement	**$12,000**
Frank Defino Central School	Boiler Replacement	**$24,000**
Marlboro Elementary School	Boiler Replacement	**$24,000**
Marlboro Memorial Middle School	Boiler Replacement	**$36,000**
Robertsville Elementary School	Boiler Replacement	**$24,000**
Marlboro Middle School	Boiler Replacement	**$48,000**
Frank Defino Central School	Water Heater Replacement	**$998**
Marlboro Elementary School	Water Heater Replacement	**$1,995**
Robertsville Elementary School	Water Heater Replacement	**$1,995**
Marlboro Middle School	Water Heater Replacement	**$3,500**
Frank Defino Central School	Variable Speed Kitchen Hood Controls	**$200**
Frank J. Dugan Elementary School	Variable Speed Kitchen Hood Controls	**$1,800**
Marlboro Memorial Middle School	Variable Speed Kitchen Hood Controls	**$1,800**
Robertsville Elementary School	Variable Speed Kitchen Hood Controls	**$1,800**
Marlboro Middle School	Variable Speed Kitchen Hood Controls	**$1,800**
Marlboro Middle School	VFDs on HVAC Motors	**$7,000**
Marlboro Memorial Middle School	VFDs on HVAC Motors	**$20,200**
David C. Abbott Early Learning Center	Chiller Replacement	**$44,880**
		$435,890

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Demand Response Energy – Emergency Capacity Credit	
PJM Payment Year	Annual Customer Capacity Benefit
2021/2022	$9,000
2022/2023	$7,500
2023/2024	$7,500
2024/2025	$7,500
Totals	$31,500

Incentive Breakout for Recommended Project

Year	DR EE Credit	NJ Clean Energy Rebates	Pay for Performance	CHP	Total
1	$9,000	$435,890	$0	$0	$444,890
2	$7,500	$0	$0	$0	$7,500
3	$7,500	$0	$0	$0	$7,500
4	$7,500	$0	$0	$0	$7,500
TOTAL	**$31,500**	**$435,890**	**$0**	**$0**	**$467,390**

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Energy Conservation Measure	Electric				Natural Gas		Fuel Oil		Phone Lines	Water		Total Savings
	Average Monthly kW Saved	Electrical Annual - kw	Annual kWh Saved	Electrical Annual - kwh	Natural Gas Annual	Annual therms saved	Fuel Oil Annual	Fuel Oil Annual Gallons saved	Phone Lines	Water Annual	Water Annual Kgallons Saved	Total Annual
David C. Abbott Early Learning Center - 01 - Lighting Upgrades - LED		$0		$0	$0		$0		$0	$0		$0
BOE Administrative Office & Building - 01 - Lighting Upgrades - LED		$0		$0	$0		$0		$0	$0		$0
Asher Holmes Elementary School - 01 - Lighting Upgrades - LED		$0		$0	$0		$0		$0	$0		$0
Frank Defino Central School - 01 - Lighting Upgrades - LED	47.3	$3,643	131,150	$11,845	$0		$0		$0	$0		$15,488
Frank J. Dugan Elementary School - 01 - Lighting Upgrades - LED		$0		$0	$0		$0		$0	$0		$0
Marlboro Elementary School - 01 - Lighting Upgrades - LED		$0		$0	$0		$0		$0	$0		$0
Marlboro Memorial Middle School - 01 - Lighting Upgrades - LED	143	$11,019	387,371	$34,987	$0		$0		$0	$0		$46,007
Robertsville Elementary School - 01 - Lighting Upgrades - LED		$0		$0	$0		$0		$0	$0		$0
Transportation Garage - 01 - Lighting Upgrades - LED		$0		$0	$0		$0		$0	$0		$0
Marlboro Middle School - 01 - Lighting Upgrades - LED	121	$9,343	333,323	$30,106	$0		$0		$0	$0		$39,449
Marlboro Middle School - 49 - MMS Auditorium Lighting	11	$851	47,472	$4,288	$0		$0		$0	$0		$5,139
David C. Abbott Early Learning Center - 02 - Addressable Fire Alarms		$0		$0	$0		$0		$4,947	$0		$4,947
BOE Administrative Office & Building - 02 - Addressable Fire Alarms		$0		$0	$0		$0		$4,947	$0		$4,947
Asher Holmes Elementary School - 02 - Addressable Fire Alarms		$0		$0	$0		$0		$4,947	$0		$4,947
Frank Defino Central School - 02 - Addressable Fire Alarms		$0		$0	$0		$0		$4,947	$0		$4,947
Frank J. Dugan Elementary School - 02 - Addressable Fire Alarms		$0		$0	$0		$0		$4,947	$0		$4,947
Marlboro Elementary School - 02 - Addressable Fire Alarms		$0		$0	$0		$0		$4,947	$0		$4,947
Marlboro Memorial Middle School - 02 - Addressable Fire Alarms		$0		$0	$0		$0		$4,947	$0		$4,947
Robertsville Elementary School - 02 - Addressable Fire Alarms		$0		$0	$0		$0		$4,947	$0		$4,947
Transportation Garage - 02 - Addressable Fire Alarms		$0		$0	$0		$0		$4,947	$0		$4,947
Marlboro Middle School - 02 - Addressable Fire Alarms		$0		$0	$0		$0		$4,947	$0		$4,947
Asher Holmes Elementary School - 03 - Boiler Replacement	1	$68	9,425	$851	$8,276	6,999	$0		$0	$0		$9,195
Frank Defino Central School - 03 - Boiler Replacement	0.3	$21	2,877	$260	$7,777	7,224	$0		$0	$0		$8,057
Marlboro Elementary School - 03 - Boiler Replacement	2	$142	19,627	$1,773	$8,503	7,042	$0		$0	$0		$10,417
Marlboro Memorial Middle School - 03 - Boiler Replacement		$0		$0	$2,600	2,120	$0		$0	$0		$2,600
Robertsville Elementary School - 03 - Boiler Replacement	2	$152	20,975	$1,894	$7,438	6,141	$0		$0	$0		$9,485
Marlboro Middle School - 03 - Boiler Replacement	2	$116	15,680	$1,416	$16,034	13,755	$0		$0	$0		$17,566
Frank Defino Central School - 04 - Water Heater Replacement		$0		$0	$342	318	$0		$0	$0		$342
Marlboro Elementary School - 04 - Water Heater Replacement		$0		$0	$733	607	$0		$0	$0		$733
Robertsville Elementary School - 04 - Water Heater Replacement		$0		$0	$528	436	$0		$0	$0		$528
Marlboro Middle School - 04 - Water Heater Replacement		$0		$0	$1,299	1,114	$0		$0	$0		$1,299
David C. Abbott Early Learning Center - 05 - Direct Install	46	$3,538	135,315	$12,222	$9,363	8,039	$0		$0	$0		$25,122
BOE Administrative Office & Building - 05 - Direct Install	7	$570	29,139	$2,632	$0		$0		$0	$0		$3,202
Asher Holmes Elementary School - 05 - Direct Install	11	$815	39,134	$3,535	$2,194	1,856	$0		$0	$0		$6,544
Frank J. Dugan Elementary School - 05 - Direct Install	48	$3,707	145,524	$13,144	$1,194	1,110	$0		$0	$0		$18,045
Marlboro Elementary School - 05 - Direct Install	55	$4,267	173,236	$15,647	$1,364	1,129	$0		$0	$0		$21,278
Robertsville Elementary School - 05 - Direct Install	50.6	$3,899	151,002	$13,639	$89	73	$0		$0	$0		$17,627
Transportation Garage - 05 - Direct Install	7	$546	26,130	$2,360	$0		$103	49	$0	$0		$3,009
David C. Abbott Early Learning Center - 06 - Solar PV		$0		$0	$0		$0		$0	$0		$0
BOE Administrative Office & Building - 06 - Solar PV		$0		$0	$0		$0		$0	$0		$0
Asher Holmes Elementary School - 06 - Solar PV		$0		$0	$0		$0		$0	$0		$0
Frank Defino Central School - 06 - Solar PV		$0		$0	$0		$0		$0	$0		$0

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Frank J. Dugan Elementary School - 06 - Solar PV		$0		$0	$0		$0		$0	$0		$0
Marlboro Elementary School - 06 - Solar PV		$0		$0	$0		$0		$0	$0		$0
Marlboro Memorial Middle School - 06 - Solar PV		$0		$0	$0		$0		$0	$0		$0
Transportation Garage - 06 - Solar PV		$0		$0	$0		$0		$0	$0		$0
Marlboro Middle School - 06 - Solar PV		$0		$0	$0		$0		$0	$0		$0
David C. Abbott Early Learning Center - 07 - Unit Ventilator Replacement	2	$174	26,843	$2,424	$2,773	2,381	$0		$0	$0		$5,372
Frank Defino Central School - 07 - Unit Ventilator Replacement	1.0	$79	5,262	$475	$5,425	5,039	$0		$0	$0		$5,979
Asher Holmes Elementary School - 08 - Unit Ventilator Refurbishment	1	$77	5,220	$471	$5,272	4,459	$0		$0	$0		$5,821
Marlboro Elementary School - 08 - Unit Ventilator Refurbishment	1	$77	4,872	$440	$5,024	4,161	$0		$0	$0		$5,541
Robertsville Elementary School - 08 - Unit Ventilator Refurbishment	1.2	$90	5,684	$513	$5,880	4,855	$0		$0	$0		$6,484
Marlboro Middle School - 08 - Unit Ventilator Refurbishment	2	$139	56,869	$5,136	$13,216	11,338	$0		$0	$0		$18,492
Marlboro Memorial Middle School - 26 - Cogeneration	29	$2,235	149,360	$13,490	($8,638)	(7,042)	$0		$0	$0		$7,088
David C. Abbott Early Learning Center - 11 - Plug Load Controls		$0	1,893	$171	$0		$0		$0	$0		$171
BOE Administrative Office & Building - 11 - Plug Load Controls		$0	1,642	$148	$0		$0		$0	$0		$148
Asher Holmes Elementary School - 11 - Plug Load Controls		$0	9,202	$831	$0		$0		$0	$0		$831
Frank Defino Central School - 11 - Plug Load Controls		$0	7,751	$700	$0		$0		$0	$0		$700
Frank J. Dugan Elementary School - 11 - Plug Load Controls		$0	6,734	$608	$0		$0		$0	$0		$608
Marlboro Elementary School - 11 - Plug Load Controls		$0	6,715	$606	$0		$0		$0	$0		$606
Marlboro Memorial Middle School - 11 - Plug Load Controls		$0	16,853	$1,522	$0		$0		$0	$0		$1,522
Robertsville Elementary School - 11 - Plug Load Controls		$0	9,605	$868	$0		$0		$0	$0		$868
Marlboro Middle School - 11 - Plug Load Controls		$0	12,700	$1,147	$0		$0		$0	$0		$1,147
David C. Abbott Early Learning Center - 12 - Repair HVAC Insulation		$0		$0	$792	680	$0		$0	$0		$792
Asher Holmes Elementary School - 12 - Repair HVAC Insulation		$0		$0	$686	580	$0		$0	$0		$686
Frank Defino Central School - 12 - Repair HVAC Insulation		$0		$0	$538	500	$0		$0	$0		$538
Frank J. Dugan Elementary School - 12 - Repair HVAC Insulation		$0		$0	$1,001	930	$0		$0	$0		$1,001
Marlboro Elementary School - 12 - Repair HVAC Insulation		$0		$0	$1,304	1,080	$0		$0	$0		$1,304
Marlboro Memorial Middle School - 12 - Repair HVAC Insulation		$0		$0	$107	87	$0		$0	$0		$107
Robertsville Elementary School - 12 - Repair HVAC Insulation		$0		$0	$1,042	860	$0		$0	$0		$1,042
Marlboro Middle School - 12 - Repair HVAC Insulation		$0		$0	$2,191	1,880	$0		$0	$0		$2,191
Asher Holmes Elementary School - 13 - Variable Speed Kitchen Hood Controls		$0	1,366	$123	$211	178	$0		$0	$0		$334
Frank Defino Central School - 13 - Variable Speed Kitchen Hood Controls		$0	3,593	$325	$719	668	$0		$0	$0		$1,044
Frank J. Dugan Elementary School - 13 - Variable Speed Kitchen Hood Controls		$0	4,835	$437	$863	802	$0		$0	$0		$1,300
Marlboro Elementary School - 13 - Variable Speed Kitchen Hood Controls		$0	5,574	$503	$1,291	1,069	$0		$0	$0		$1,795
Marlboro Memorial Middle School - 13 - Variable Speed Kitchen Hood Controls		$0	9,584	$866	$1,348	1,099	$0		$0	$0		$2,214
Robertsville Elementary School - 13 - Variable Speed Kitchen Hood Controls		$0	8,081	$730	$863	713	$0		$0	$0		$1,593
Marlboro Middle School - 13 - Variable Speed Kitchen Hood Controls		$0	7,813	$706	$1,454	1,248	$0		$0	$0		$2,160
David C. Abbott Early Learning Center - 14 - VFDs on HVAC Motors	8	$621	36,942	$3,337	$0		$0		$0	$0		$3,958
Marlboro Memorial Middle School - 14 - VFDs on HVAC Motors	5	$385	51,570	$4,658	$0		$0		$0	$0		$5,043
Marlboro Middle School - 14 - VFDs on HVAC Motors	8	$598	27,250	$2,461	$322	276	$0		$0	$0		$3,381
Marlboro Memorial Middle School - 14 - VFDs on HVAC Motors	23	$1,800	183,217	$16,548	$4,134	3,370	$0		$0	$0		$22,481
David C. Abbott Early Learning Center - 15 - Water Conservation		$0		$0	$249	214	$0		$0	$712	111	$961
BOE Administrative Office & Building - 15 - Water Conservation		$0	850	$77	$0		$0		$0	$123	22	$199
Asher Holmes Elementary School - 15 - Water Conservation		$0		$0	$434	367	$0		$0	$2,504	295	$2,938
Frank Defino Central School - 15 - Water Conservation		$0		$0	$276	256	$0		$0	$2,038	240	$2,313
Frank J. Dugan Elementary School - 15 - Water Conservation		$0		$0	$385	358	$0		$0	$1,412	248	$1,797
Marlboro Elementary School - 15 - Water Conservation		$0		$0	$360	298	$0		$0	$1,243	218	$1,603
Marlboro Memorial Middle School - 15 - Water Conservation		$0		$0	$1,002	817	$0		$0	$4,383	517	$5,385
Robertsville Elementary School - 15 - Water Conservation		$0		$0	$413	341	$0		$0	$2,641	311	$3,054
Transportation Garage - 15 - Water Conservation		$0		$0	$0		$20	9	$0	$20	3	$40
Marlboro Middle School - 15 - Water Conservation		$0		$0	$970	832	$0		$0	$7,853	926	$8,823

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David C. Abbott Early Learning Center - 16 - Refrigeration Controls		$0	1,725	$156	$0		$0		$0	$0		$156
Asher Holmes Elementary School - 16 - Refrigeration Controls		$0	5,175	$467	$0		$0		$0	$0		$467
Frank Defino Central School - 16 - Refrigeration Controls		$0	17,480	$1,579	$0		$0		$0	$0		$1,579
Frank J. Dugan Elementary School - 16 - Refrigeration Controls		$0	12,880	$1,163	$0		$0		$0	$0		$1,163
Marlboro Elementary School - 16 - Refrigeration Controls		$0	12,880	$1,163	$0		$0		$0	$0		$1,163
Marlboro Memorial Middle School - 16 - Refrigeration Controls		$0	17,480	$1,579	$0		$0		$0	$0		$1,579
Robertsville Elementary School - 16 - Refrigeration Controls		$0	14,030	$1,267	$0		$0		$0	$0		$1,267
Marlboro Middle School - 16 - Refrigeration Controls		$0	15,755	$1,423	$0		$0		$0	$0		$1,423
David C. Abbott Early Learning Center - 17 - Building Envelope Weatherization		$0	1,772	$160	$770	661	$0		$0	$0		$930
BOE Administrative Office & Building - 17 - Building Envelope Weatherization		$0	3,223	$291	$0		$0		$0	$0		$291
Asher Holmes Elementary School - 17 - Building Envelope Weatherization		$0	2,781	$251	$1,226	1,037	$0		$0	$0		$1,477
Frank Defino Central School - 17 - Building Envelope Weatherization		$0	9,950	$899	$3,993	3,709	$0		$0	$0		$4,892
Frank J. Dugan Elementary School - 17 - Building Envelope Weatherization		$0	5,035	$455	$2,019	1,877	$0		$0	$0		$2,474
Marlboro Elementary School - 17 - Building Envelope Weatherization		$0	11,199	$1,011	$5,040	4,174	$0		$0	$0		$6,051
Marlboro Memorial Middle School - 17 - Building Envelope Weatherization		$0	5,962	$538	$2,725	2,222	$0		$0	$0		$3,264
Robertsville Elementary School - 17 - Building Envelope Weatherization		$0	13,809	$1,247	$6,234	5,147	$0		$0	$0		$7,481
Transportation Garage - 17 - Building Envelope Weatherization		$0		$0	$0	4,441	$1,293	615	$0	$0		$1,293
Marlboro Middle School - 17 - Building Envelope Weatherization		$0	5,110	$462	$2,221	1,905	$0		$0	$0		$2,682
David C. Abbott Early Learning Center - 19 - Retro Cx	0	$0	13,192	$1,192	$681	585	$0		$0	$0		$1,873
Asher Holmes Elementary School - 19 - Retro Cx		$0	8,835	$798	$914	773	$0		$0	$0		$1,712
Frank Defino Central School - 19 - Retro Cx	0.0	$0	14,488	$1,309	$1,125	1,045	$0		$0	$0		$2,434
Frank J. Dugan Elementary School - 19 - Retro Cx	0	$0	15,782	$1,425	$1,419	1,319	$0		$0	$0		$2,845
Marlboro Elementary School - 19 - Retro Cx	0	$0	10,733	$969	$936	775	$0		$0	$0		$1,905
Marlboro Memorial Middle School - 19 - Retro Cx	0	$0	43,830	$3,959	$1,997	1,628	$0		$0	$0		$5,956
Robertsville Elementary School - 19 - Retro Cx	0.0	$0	7,638	$690	$781	645	$0		$0	$0		$1,471
Marlboro Middle School - 19 - Retro Cx	0	$0	43,220	$3,904	$2,265	1,943	$0		$0	$0		$6,169
Asher Holmes Elementary School - 48 - Dishwasher Replacement		$0	9,025	$815	$882	746	$0		$0	$772	91	$2,469
Frank Defino Central School - 48 - Dishwasher Replacement		$0	9,025	$815	$803	746	$0		$0	$772	91	$2,390
Frank J. Dugan Elementary School - 48 - Dishwasher Replacement		$0	4,841	$437	$490	455	$0		$0	$279	49	$1,206
Marlboro Elementary School - 48 - Dishwasher Replacement		$0	9,025	$815	$901	746	$0		$0	$519	91	$2,235
Marlboro Memorial Middle School - 48 - Dishwasher Replacement		$0	15,042	$1,359	$1,736	1,415	$0		$0	$1,280	151	$4,375
Robertsville Elementary School - 48 - Dishwasher Replacement		$0	9,025	$815	$904	746	$0		$0	$772	91	$2,490
Marlboro Middle School - 48 - Dishwasher Replacement		$0	30,085	$2,717	$2,900	2,488	$0		$0	$2,561	302	$8,178
Frank J. Dugan Elementary School - 20 - HVAC Armor/Refurb.		$0	3,393	$306	$0		$0		$0	$0		$306
Frank J. Dugan Elementary School - 21 - Premium Efficiency Motors	0	$7	340	$31	$0		$0		$0	$0		$38
David C. Abbott Early Learning Center - 38 - BMS - Central Plant		$0		$0	$0		$0		$0	$0		$0
BOE Administrative Office & Building - 38 - BMS - Central Plant		$0		$0	$0		$0		$0	$0		$0
Asher Holmes Elementary School - 38 - BMS - Central Plant		$0		$0	$1,754	1,483	$0		$0	$0		$1,754
Frank Defino Central School - 38 - BMS - Central Plant		$0		$0	$1,596	1,483	$0		$0	$0		$1,596
Frank J. Dugan Elementary School - 38 - BMS - Central Plant		$0		$0	$0		$0		$0	$0		$0
Marlboro Elementary School - 38 - BMS - Central Plant		$0		$0	$0		$0		$0	$0		$0
Marlboro Memorial Middle School - 38 - BMS - Central Plant		$0		$0	$0		$0		$0	$0		$0
Robertsville Elementary School - 38 - BMS - Central Plant		$0		$0	$1,835	1,515	$0		$0	$0		$1,835
Transportation Garage - 38 - BMS - Central Plant		$0		$0	$0		$0		$0	$0		$0
Marlboro Middle School - 38 - BMS - Central Plant		$0		$0	$4,493	3,854	$0		$0	$0		$4,493
David C. Abbott Early Learning Center - 39 - BMS - Terminal Units		$0		$0	$0		$0		$0	$0		$0
BOE Administrative Office & Building - 39 - BMS - Terminal Units		$0		$0	$0		$0		$0	$0		$0
Asher Holmes Elementary School - 39 - BMS - Terminal Units		$0		$0	$0		$0		$0	$0		$0
Frank Defino Central School - 39 - BMS - Terminal Units		$0		$0	$0		$0		$0	$0		$0
Frank J. Dugan Elementary School - 39 - BMS - Terminal Units		$0		$0	$0		$0		$0	$0		$0

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Marlboro Elementary School - 39 - BMS - Terminal Units		$0		$0	$0		$0		$0	$0		$0
Marlboro Memorial Middle School - 39 - BMS - Terminal Units		$0		$0	$0		$0		$0	$0		$0
Robertsville Elementary School - 39 - BMS - Terminal Units		$0		$0	$0		$0		$0	$0		$0
Transportation Garage - 39 - BMS - Terminal Units		$0		$0	$0		$0		$0	$0		$0
Marlboro Middle School - 39 - BMS - Terminal Units		$0		$0	$0		$0		$0	$0		$0
All Facilities - 22 - Computer Power Management	0	$0	196,950	$17,789	$0	0	$0		$0	$0		$17,789
David C. Abbott Early Learning Center - 40 - BMS - Common Areas (AHUs, RTUs)		$0		$0	$0		$0		$0	$0		$0
BOE Administrative Office & Building - 40 - BMS - Common Areas (AHUs, RTUs)		$0		$0	$0		$0		$0	$0		$0
Asher Holmes Elementary School - 40 - BMS - Common Areas (AHUs, RTUs)	0	$0	1,578	$143	$697	589	$0		$0	$0		$839
Frank Defino Central School - 40 - BMS - Common Areas (AHUs, RTUs)		$0	1,868	$169	$876	813	$0		$0	$0		$1,044
Frank J. Dugan Elementary School - 40 - BMS - Common Areas (AHUs, RTUs)	0	$0	1,306	$118	$477	444	$0		$0	$0		$595
Marlboro Elementary School - 40 - BMS - Common Areas (AHUs, RTUs)		$0		$0	$0		$0		$0	$0		$0
Marlboro Memorial Middle School - 40 - BMS - Common Areas (AHUs, RTUs)		$0		$0	$0		$0		$0	$0		$0
Robertsville Elementary School - 40 - BMS - Common Areas (AHUs, RTUs)	0.0	$0	2,070	$187	$936	773	$0		$0	$0		$1,123
Transportation Garage - 40 - BMS - Common Areas (AHUs, RTUs)		$0		$0	$0		$0		$0	$0		$0
Marlboro Middle School - 40 - BMS - Common Areas (AHUs, RTUs)	0	$0	9,361	$845	$2,476	2,124	$0		$0	$0		$3,321
David C. Abbott Early Learning Center - 33 - Chiller Replacement	7.21	$556	19,989	$1,805	$0		$0		$0	$0		$2,361

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Business Case for Recommended Project

FORM VI - ENERGY SAVINGS PLAN

ESCO's PRELIMINARY ENERGY SAVINGS PLAN (ESP):
ESCO's PRELIMINARY ANNUAL CASH FLOW ANALYSIS FORM
Marlboro Township Public Schools ESIP
ENERGY SAVINGS IMPROVEMENT PROGRAM

ESCO Name: ENERGY SYSTEMS GROUP **Project Scenario 3**

Note: Respondents must use the following assumptions in all financial calculations:

(a) The cost of all types of energy should be assumed to inflate at 2.4% gas, 2.2% electric per year; and

1. Term of Agreement: 20 years
2. Construction period[2] (months): 12 — Capital Cont. $4,100,000
3. Cash Flow Analysis Format: — Food Service Capital $192,942

✓ Project (Pass/Fail)

Total Financed Amount[4] $ 15,082,103
Total ESG Project Cost [1] $ 19,345,045

Interest Rate to be used for Proposal Purposes: 2.60%

	Annual Energy Savings	Annual Operational Savings	Energy Rebates/ Incentives	Solar PPA	Total Annual Savings	Annual Project Costs	Board Costs	Annual Service Costs	Net Cash-Flow to client	Cumulative Cash Flow
Installation[3]	$ 117,479	$ -	$ -	$ 186,013	$ 303,493	$ -	$ -	$ -	$ 303,493	$ 303,493
1	$ 711,090	$ 275,782	$ 444,890	$ 376,119	$ 1,807,882	$ 1,711,498	$ 1,805,482	$ 93,984	$ 2,400	$ 305,893
2	$ 606,997	$ 275,782	$ 7,500	$ 198,380	$ 1,088,659	$ 1,086,259	$ 1,086,259	$ -	$ 2,400	$ 308,293
3	$ 620,685	$ 76,522	$ 7,500	$ 202,745	$ 907,452	$ 905,052	$ 905,052	$ -	$ 2,400	$ 310,693
4	$ 634,682	$ 76,522	$ 7,500	$ 207,205	$ 925,910	$ 923,510	$ 923,510	$ -	$ 2,400	$ 313,093
5	$ 648,996	$ 76,522	$ -	$ 211,764	$ 937,282	$ 934,882	$ 934,882	$ -	$ 2,400	$ 315,493
6	$ 663,634	$ -	$ -	$ 216,422	$ 880,056	$ 877,656	$ 877,656	$ -	$ 2,400	$ 317,893
7	$ 678,602	$ -	$ -	$ 221,184	$ 899,786	$ 897,386	$ 897,386	$ -	$ 2,400	$ 320,293
8	$ 693,909	$ -	$ -	$ 226,050	$ 919,959	$ 917,559	$ 917,559	$ -	$ 2,400	$ 322,693
9	$ 709,562	$ -	$ -	$ 231,023	$ 940,585	$ 938,185	$ 938,185	$ -	$ 2,400	$ 325,093
10	$ 725,569	$ -	$ -	$ 236,105	$ 961,674	$ 959,274	$ 959,274	$ -	$ 2,400	$ 327,493
11	$ 741,938	$ -	$ -	$ 241,300	$ 983,237	$ 980,837	$ 980,837	$ -	$ 2,400	$ 329,893
12	$ 758,677	$ -	$ -	$ 246,608	$ 1,005,285	$ 1,002,885	$ 1,002,885	$ -	$ 2,400	$ 332,293
13	$ 775,794	$ -	$ -	$ 252,034	$ 1,027,828	$ 1,025,428	$ 1,025,428	$ -	$ 2,400	$ 334,693
14	$ 793,299	$ -	$ -	$ 257,578	$ 1,050,877	$ 1,048,477	$ 1,048,477	$ -	$ 2,400	$ 337,093
15	$ 811,199	$ -	$ -	$ 263,245	$ 1,074,444	$ 1,072,044	$ 1,072,044	$ -	$ 2,400	$ 339,493
16	$ 829,504	$ -	$ -	$ -	$ 829,504	$ 827,104	$ 827,104	$ -	$ 2,400	$ 341,893
17	$ 848,224	$ -	$ -	$ -	$ 848,224	$ 845,824	$ 845,824	$ -	$ 2,400	$ 344,293
18	$ 867,367	$ -	$ -	$ -	$ 867,367	$ 864,967	$ 864,967	$ -	$ 2,400	$ 346,693
19	$ 886,942	$ -	$ -	$ -	$ 886,942	$ 880,167	$ 880,167	$ -	$ 6,776	$ 353,469
20	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 353,469
Totals	**$ 14,006,671**	**$ 781,131**	**$ 467,390**	**$ 3,587,763**	**$ 18,842,954**	**$ 18,698,995**	**$ 18,792,979**	**$ 93,984**	**$ 353,469**	**$ 353,469**

NOTES:

1 Includes: Hard costs and project service fees defined in ESCO's PROPOSED 'FORM V"
2 No payments are made by the Board during the construction period.
3 Installation period savings for Energy Savings and Operational Savings are guarenteed. These savings will be used in addition to the first loan payment.
4 Total Financed Cost includes all Fees and project costs.
5 Interest rate is indicative rate only. Final rate will vary with market conditions at time of closing.
6 ESG is an energy services and engineering company, not a financial advisor.
7 ESG is not a financial advisor and the presented cash flow proforma is for information only
8 The cash flow shown is for illustration purposes, and is not intended as financial advice.
9 Loan repayment includes interest accumulation in the construction period
10 Loan repayment assumes that the 1st repayment starts immediately after construction
11 The annual energy 2.25% and labor .% escalation are in accordance with the RFP
12 The utility incentive amount shown is typical expected and is not indicative of the actual amount as project timing, changes to utility program and availability of funds affect the outcome

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APPENDIX 6. LIGHTING UPGRADES

Frank Defino Central School

Ex Fixt Qty	Existing Fixture or Lamp Description	New Fixture or Lamp Qty	Replacement Fixture or Lamp Description
1	*2' FIXTURE, 1-F17/T8/STD LAMPS, (.88) ELECTRONIC BALLAST	1	G4 SP 2 Foot 8W 4000K 140LPW Nano Lens SEP LED Tube - DLC Listed
18	*2' FIXTURE, 2-F17/T8/STD LAMPS, (.88) ELECTRONIC BALLAST	36	G4 SP 2 Foot 8W 4000K 140LPW Nano Lens SEP LED Tube - DLC Listed
6	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	18	G4 SP 2 Foot 8W 4000K 140LPW Nano Lens SEP LED Tube - DLC Listed
38	*4' FIXTURE, 1-F32/T8 LAMP, (.88) ELECTRONIC BALLAST	38	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
315	*4' FIXTURE, 2-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	630	G4 SP 4 Foot 15W 4000K 140LPW Nano Lens SEP LED Tube - DLC Listed
458	*4' FIXTURE, 2-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	916	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
127	*4' FIXTURE, 3-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	381	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
28	*4' FIXTURE, 4-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	28	INTERIOR LUMINAIRES, G2 THIN PANEL, 2X4, 36W, 4000K, 120-277VAC, DIMMABLE - DLC LISTED
58	*4' FIXTURE, 4-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	232	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
0	0 - N/A	0	*---- Placeholder ----*
0	0 - N/A	5	**** ALREADY LED ****
0	0 - N/A	127	1 Lamp Universal Tombstone Kit with Ballast Disconnect T8
0	0 - N/A	4	16 INCH- 2 LAMP HARNESS
0	0 - N/A	909	2 Lamp Universal Tombstone Kit with Ballast Disconnect T8
0	0 - N/A	67	3 Lamp Universal Tombstone Kit with Ballast Disconnect T8
0	0 - N/A	12	ACCESSORY, HIGH BAY, G2 ECO LINEAR, WIRE GUARD KIT, COMPATIBLE WITH 128XX3-3XX (141W), 128XX5-3XX (161W), AND 128XX6-3XX (201W 2FT)
0	0 - N/A	1	BRISK SM 17L 14W 70CRI 4000K NEUTRAL LED 120-277V PCU BRONZE - DLC LISTED
0	0 - N/A	2	ENERGI TRI-PACK WIRELESS CEILING/SWITCH PACKAGE
0	0 - N/A	16	Fulham HotSpot Linear kit: battery/driver/linear array
0	0 - N/A	1	Lutron Maestro Multi-Location Companion Switch, White
0	0 - N/A	54	MAESTRO DUAL TECH OCCUPANCY SENSING SWITCH
0	0 - N/A	6	Retrofit Kit for 2' U-Tube (Includes (3) Sockets)
0	0 - N/A	2230	T8 non shunted socket - common
0	0 - N/A	40	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
1	1 - 13W CFL	1	MAXLITE-ENCLOSED RATED 9W DIMMABLE LED OMNI A19 4000K GEN 6
3	1-70 Watt MH	3	FUTURE FLOOD 39W NEUTRAL LED 120V TO 277V BRONZE - DLC Listed
8	1-70 Watt MH	8	BRISK SM 17L 14W 70CRI 4000K NEUTRAL LED 120-277V PCU BRONZE - DLC LISTED
1	1L - A LAMP 60 WATT INCANDESCENT	1	BRISK SM 17L 14W 70CRI 4000K NEUTRAL LED 120-277V BRONZE - DLC LISTED
21	1L - A LAMP 60 WATT INCANDESCENT	21	MAXLITE-ENCLOSED RATED 9W DIMMABLE LED OMNI A19 4000K GEN 6
23	2 - 26 WATT CFL Fixture	23	Economy 18W LED 8" Round 4100K White 110° 1260lm Type IC Damp ES CRI 80 - Energy Star
8	2 - 26 WATT CFL QUAD - PIN FIXTURE	12	PL Stab-In Ballast Bypass, Horizontal, G24q/G24d 10.5W, 3000K, 120-277v
12	8-42 Watt CFL Highbay	12	HIGH BAY, G2 ECO LINEAR, 2x2, 161W, 4000K, 120-277VAC, DIMMABLE, GENERAL FROSTED OPTIC
4	BR 30 75 WATT INCANDESCENT	4	BR40, E26 Base, 14 Watt, 120V, 3000K, Dimmable - Energy Star
20	BR 30 75 WATT INCANDESCENT	20	LED BR30 8 WATT CLOUD DESIGN, E26 BASE, 120V, 4000K, DIMMABLE (ENERGY STAR)
1	BR 40 65 WATT INCANDESCENT	1	BR40, E26 Base, 14 Watt, 120V, 3000K, Dimmable - Energy Star
2	Fluorescent, Circline, (1) 32W lamp, preheat ballast	2	Metalux AP Series-Round Flush Mount-15"-21.3W 4000K 1700 LUMEN
2	HIGH PRESSURE SODIUM, 1-70 WATT LAMP	2	BRISK SM 17L 14W 70CRI 4000K NEUTRAL LED 120-277V PCU BRONZE - DLC LISTED
1	METAL HALIDE, 1-100 WATT LAMP	1	WALLPACK 30W 4000K NEUTRAL LED 120-277V W/ POLYCARB LENS BZ - DLC Listed
5	METAL HALIDE, 1-175 WATT LAMP	5	LPACK WALLPACK 26W NEUTRAL LED W/BACKPLATE & JUNC BOX BRONZE - DLC Listed
2	METAL HALIDE, 1-250 WATT LAMP	2	FLEXFLOOD 78W NEUTRAL LED SLIPFITTER BRONZE - DLC Listed
1	METAL HALIDE, 1-50 WATT LAMP	1	FUTURE FLOOD 18W COOL LED 120V TO 277V BRONZE - DLC Listed
1	METAL HALIDE, 2-250 WATT LAMP	2	FLEXFLOOD 78W NEUTRAL LED SLIPFITTER BRONZE - DLC Listed
1165		5875	

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Marlboro Memorial Middle School

Ex Fixt Qty	Existing Fixture or Lamp Description	New Fixture or Lamp Qty	Replacement Fixture or Lamp Description
99	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	239	G4 SP 2 Foot 8W 4000K 140LPW Nano Lens SEP LED Tube - DLC Listed
3	*3' FIXTURE, 1-F25/T8/ LAMPS, ELECTRONIC BALLAST	3	G4 SP 3 Foot 12W 4000K 120LPW Nano Lens SEP LED Tube
7	*4' FIXTURE, 1-F32/T8 LAMP, (.88) ELECTRONIC BALLAST	7	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
792	*4' FIXTURE, 2-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	1584	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
244	*4' FIXTURE, 3-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	732	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
915	*4' FIXTURE, 4-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	3312	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
7	*4' FIXTURE, 6-F32/T8 LAMPS, ELECTRONIC BALLAST	42	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
0	0 - N/A	7	WIRE GUARD WP3 AND WP4 WALLPACKS
0	0 - N/A	0	*---- Placeholder ----*
0	0 - N/A	10	1 Lamp Universal Tombstone Kit with Ballast Disconnect T8
0	0 - N/A	6	16 INCH- 2 LAMP HARNESS
0	0 - N/A	800	2 Lamp Universal Tombstone Kit with Ballast Disconnect T8
0	0 - N/A	245	3 Lamp Universal Tombstone Kit with Ballast Disconnect T8
0	0 - N/A	915	4 Lamp Universal Tombstone Kit with Ballast Disconnect T8
0	0 - N/A	7	6 Lamp Universal Tombstone Kit with Ballast Disconnect T8
0	0 - N/A	33	MAESTRO DUAL TECH OCCUPANCY SENSING SWITCH
0	0 - N/A	70	Retrofit Kit for 2' U-Tube (Includes (3) Sockets)
0	0 - N/A	5770	T8 non shunted socket - common
0	0 - N/A	170	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
1	1 - 13 WATT - 4 PIN BIAX	1	BRISK SM 17L 14W 70CRI 4000K NEUTRAL LED 120-277V BRONZE - DLC LISTED
42	150 Watt MH wall pack	42	MAXLITE-WALLMAX OPEN FACE WALL PACK - 28W, 120-277V, 4000K, BRONZE
8	1L - A LAMP 60 WATT INCANDESCENT	8	MAXLITE-ENCLOSED RATED 9W DIMMABLE LED OMNI A19 4000K GEN 6
28	2 - 13 WATT CFL DUAL - PIN FIXTURE	28	BRISK SM 17L 14W 70CRI 4000K NEUTRAL LED 120-277V BRONZE - DLC LISTED
4	2 - 13 WATT CFL DUAL - PIN FIXTURE	4	Economy 18W LED 8" Round 4100K White 110° 1260lm Type IC Damp ES CRI 80 - Energy Star
31	2 - 13 WATT CFL DUAL - PIN FIXTURE	62	PL H G24q 4.5W PL EDGE Series DIRect Ballast Compatible, 4000K
7	2 - 13 WATT CFL DUAL - PIN FIXTURE	14	PL H G24q/G24d 9.5W PL EDGE Series ByPass 120-277V Horizontal
5	2 - 13 WATT CFL DUAL - PIN FIXTURE	5	Super Thin 12W LED 6" Round 4100K White 110° 800lm Type IC Damp ES CRI 80 - Energy Star
6	2 - 13 WATT CFL DUAL - PIN FIXTURE	6	VANDALPROOF CANOPY 10W NEUTRAL LED 120-277 WITH DROP LENS
5	2 - 26 WATT CFL Fixture	10	PL H G24q/G24d 9.5W PL EDGE Series ByPass 120-277V Horizontal
6	2-9W CFL Bi-Pin Fixture	6	BRISK SM 17L 14W 70CRI 4000K NEUTRAL LED 120-277V BRONZE - DLC LISTED
4	4-36 WATT BIAX	16	Green Creative PLL PL EDGE Series, 13 Watt, Glass Lens, Plug and Play, DIRect Ballast, 2G11 Base, 4000K, Dimmable (98479)
31	4-36 WATT BIAX	124	PL Stab-In 4 Pin, 2G11, Ballast Compatible, 14.5W, 3500K
4	6-36 WATT 4 PIN CFL	24	Green Creative PLL PL EDGE Series, 13 Watt, Glass Lens, Plug and Play, DIRect Ballast, 2G11 Base, 4000K, Dimmable (98479)
4	8-32 Watt CFL quad-pin	32	Green Creative PLL PL EDGE Series, 13 Watt, Glass Lens, Plug and Play, DIRect Ballast, 2G11 Base, 4000K, Dimmable (98479)
57	CFL High Bay, 8-42Watt Stab-In	57	KBL Highbay, 27,500 Lumens, Universal Mount, 80+ CRI, 4000K, 120-277V, 0-10V Dim - DLC Listed
14	METAL HALIDE, 1-100 WATT LAMP	14	Super Thin 12W LED 6" Round 4100K White 110° 800lm Type IC Damp ES CRI 80 - Energy Star
29	METAL HALIDE, 1-120 WATT LAMP	38	ALED50 TYPE IV WITH 8 POLE MOUNTING ARM NEUTRAL LED BZ - DLC Listed
16	METAL HALIDE, 1-120 WATT LAMP	16	LED AREA LIGHT 26W NEUTRAL LED W/SQUARE POLE MOUNT ADAPTOR BZ - DLC Listed
13	METAL HALIDE, 1-50 WATT LAMP	13	PIP FLOODLIGHT 15W NEUTRAL LED 120-277V DIM W/ ARM BZ
16	METAL HALIDE, 1-70 WATT LAMP	16	LED A21 18.5 Watt, High Output, E26 Base, 120-277V, 4000K, Non-Dimmable Direct L
2398		**14488**	

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Marlboro Middle School

Ex Fixt Qty	Existing Fixture or Lamp Description	New Fixture or Lamp Qty	Replacement Fixture or Lamp Description
15	*2' FIXTURE, 1-F17/T8/STD LAMPS, (.88) ELECTRONIC BALLAST	15	G4 SP 2 Foot 8W 4000K 140LPW Nano Lens SEP LED Tube - DLC Listed
4	*2' FIXTURE, 2-F17/T8/STD LAMPS, (.88) ELECTRONIC BALLAST	8	G4 SP 2 Foot 8W 4000K 140LPW Nano Lens SEP LED Tube - DLC Listed
71	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	211	G4 SP 2 Foot 8W 4000K 140LPW Nano Lens SEP LED Tube - DLC Listed
24	*2' FIXTURE, 2-F32/T8/U6 LAMPS, ELECTRONIC BALLAST	24	INTERIOR LUMINAIRES, G2 THIN PANEL, 2X2, 20W, 4000K, 120-277VAC, DIMMABLE - DLC LISTED
2	*2' FIXTURE, 3-F17/T8/STD LAMPS, (.88) ELECTRONIC BALLAST	2	INTERIOR LUMINAIRES, G2 THIN PANEL, 2X2, 20W, 4000K, 120-277VAC, DIMMABLE - DLC LISTED
24	*3' FIXTURE, 2-F25/T8/LAMPS, ELECTRONIC BALLAST	48	G4 SP 3 Foot 12W 4000K 120LPW Nano Lens SEP LED Tube
110	*4' FIXTURE, 1-F32/T8 LAMP, (.88) ELECTRONIC BALLAST	110	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
18	*4' FIXTURE, 2-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	18	INTERIOR LUMINAIRES, G2 THIN PANEL, 2X4, 36W, 4000K, 120-277VAC, DIMMABLE - DLC LISTED
1571	*4' FIXTURE, 2-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	3182	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
287	*4' FIXTURE, 3-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	861	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
22	*4' FIXTURE, 4-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	22	INTERIOR LUMINAIRES, G2 THIN PANEL, 2X4, 36W, 4000K, 120-277VAC, DIMMABLE - DLC LISTED
147	*4' FIXTURE, 4-F32/T8 LAMPS, (.88) ELECTRONIC BALLAST	588	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
0	0 - N/A	2	**** ALREADY LED ****
0	0 - N/A	24	16" Clear Polycarbonate Reflector Single Pack
0	0 - N/A	800	4FT WALLFIXTURE W LENS 2 LIGHT
0	0 - N/A	24	Cree 16" Clear Prismatic Conical Lens for Prismatic & Acrylic Reflectors
0	0 - N/A	97	Fulham HotSpot Linear kit: battery/driver/linear array
0	0 - N/A	8	Lotus LED Lights Adder for 277-347V driver for Model LB8R
0	0 - N/A	75	MAESTRO DUAL TECH OCCUPANCY SENSING SWITCH
0	0 - N/A	75	Retrofit Kit for 2' U-Tube (Includes (3) Sockets)
0	0 - N/A	720	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
3	1 - 42 Watt Stab-In	3	LBACKUP WPLED 26W COOL LED EMERGY BATT 120V - 277V BRONZE - DLC Listed
3	1 - 42 Watt Stab-In	3	SLIM 26W COOL LED 120V TO 277V WALLMOUNT BRONZE - DLC Listed
7	1 - 42 Watt Stab-In	7	Economy 18W LED 8" Round 4100K White 110° 1260lm Type IC Damp ES CRI 80 - Energy Star
1	175 Watt MH Flood Light	1	FUTURE FLOOD 39W COOL LED TRUNNION BRONZE - DLC Listed
1	175 Watt MH wall pack	1	WALLPACK 37W COOL LED 277V PC W/ GLASS LENS BZ - DLC Listed
42	1L - A LAMP 60 WATT INCANDESCENT	42	MAXLITE-ENCLOSED RATED 9W DIMMABLE LED OMNI A19 4000K GEN 6
6	2 - 26 WATT CFL QUAD - PIN FIXTURE	6	EATON-TERRAPIN ROUND WALLPACK-20 WATTS, LED-EYELID TYPE, 4000K, OPAL LENS, BRONZE, UL LISTED
11	2 - 26 WATT CFL QUAD - PIN FIXTURE	11	Economy 18W LED 8" Round 4100K White 110° 1260lm Type IC Damp ES CRI 80 - Energy Star
15	2 - 26 WATT CFL QUAD - PIN FIXTURE	26	PL H G24q/G24d 9.5W PL EDGE Series ByPass 120-277V Horizontal
11	2 - 26 WATT CFL QUAD - PIN FIXTURE	11	Super Thin 12W LED 6" Round 4100K White 110° 800lm Type IC Damp ES CRI 80 - Energy Star
6	2 - 42 WATT CFL PIN Fixture	6	Commercial Downlight Retrofit 8", 32W, 120/277V, 40K, Dim - Energy Star
21	2' Fixture, 3-F31/T8/ 31 Watt Lamps, Electronic Ballast	35	G4 SP 2 Foot 8W 4000K 140LPW Nano Lens SEP LED Tube - DLC Listed
3	4' FIXTURE, 1-F34/T12 LAMP, STANDARD MAGNETIC BALLAST	3	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
6	4' FIXTURE, 2-F34/T12 LAMPS, ELECTRONIC BALLAST	12	Tube Light, T8, G4, 10.5W, 4Ft, SEP, Nano, 4000K, High Efficacy - DLC Listed
27	8-32 Watt CFL quad-pin	27	HIGHBAY 78W COOL LED 3X26W WITH HOOK AND CORD WHITE - DLC Listed
6	8-32 Watt CFL quad-pin	6	INTERIOR LUMINAIRES, G2 THIN PANEL, 2X4, 50W, 4000K, 120-277VAC, DIMMABLE - DLC LISTED
24	8-42 Watt CFL Highbay	24	KBL Highbay, 27,500 Lumens, Universal Mount, 80+ CRI, 4000K, 120-277V, 0-10V Dim - DLC Listed
3	BR 30 65 WATT INCANDESCENT	3	MAXLITE-8W DIMMABLE BR30 4000K G3
15	BR 30 75 WATT DIMMABLE INCANDESCENT	15	MAXLITE-11W PAR30 WET RATED LONG NECK DIM 4000K FLOOD
10	BR 40 75 WATT INCANDESCENT	10	BR40, E26 Base, 14 Watt, 120V, 3000K, Dimmable - Energy Star
8	METAL HALIDE, 1-100 WATT LAMP	2	AREA LIGHT POST TOP 78W COOL LED TYPE V CLEAR LENS BZ - DLC Listed
3	METAL HALIDE, 1-100 WATT LAMP	1	WALLPACK 24W COOL LED BRONZE - DLC Listed
1	METAL HALIDE, 1-150 WATT LAMP	1	Economy 18W LED 8" Round 4100K White 110° 1260lm Type IC Damp ES CRI 80 - Energy Star
7	METAL HALIDE, 1-150 WATT LAMP	7	PAR38, E26 Base, 17 Watt, 120-277V 40°, 4000K, High CRI, Non-Dimmable
8	METAL HALIDE, 1-150 WATT LAMP	8	VANDALPROOF CANOPY 20W COOL LED 120-277V W/ DROP LENS BZ
36	METAL HALIDE, 1-250 WATT LAMP	42	ALED78 TYPE IV WITH 8 POLE MOUNTING ARM COOL LED BRONZE - DLC Listed

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Marlboro Middle School (cont.)

Ex Fixt Qty	Existing Fixture or Lamp Description	New Fixture or Lamp Qty	Replacement Fixture or Lamp Description
2	METAL HALIDE, 1-250 WATT LAMP	2	FLEXFLOOD 78W COOL LED SLIPFITTER BRONZE - DLC Listed
1	METAL HALIDE, 1-250 WATT LAMP	1	FUTURE FLOOD 39W COOL LED TRUNNION BRONZE - DLC Listed
2	METAL HALIDE, 1-250 WATT LAMP	2	EX39 100 Watt, 120-277V, Cool White 4000K, 14,000lm - DLC LISTED
1	METAL HALIDE, 1-50 WATT LAMP	1	SLIM 26W COOL LED 120V TO 277V WALLMOUNT BRONZE - DLC Listed
6	PAR 30 FLOOD 65 WATT	6	PAR30, E26 Base, 11 Watt, 120V 40°, 3000K, High CRI, Dimmable - Energy Star
18	PAR 38 FLOOD 75 WATT	18	PAR38, E26 Base, 17 Watt, 120-277V 40°, 4000K, High CRI, Non-Dimmable
Sum : 2609		Sum : 7257	

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APPENDIX 7. DIRECT INSTALL SCOPE OF WORK

David C. Abbott Early Learning Center

Room Info		*Existing Fixture Info*		*Lighting Fixture Upgrades*	*Occupancy Sensor Upgrades*		
Floor	**Location**	**No. of Fix.**	**Fixture Type**	**Upgrade Description**	**Sens Qty**	**Sensor(s)**	**ECM Description**
Exterior	Parking Lot	12	Pole Top-MH175	(1) 36w Medium E26 LED HID		No Sensor Control	Retrofit 1-Lamp HID Fixture with (1) 36 Watt Medium E26 LED HID Lamp. Existing ballast will be disconnected.
Exterior	Building Perimeter	38	Sconce-(2)PL26	(2) 10.5w Horizontal LED 4-Pin PL B		No Sensor Control	Retrofit 2-Lamp Plug-In Compact Fluorescent Fixture with (2) 10.5 Watt Line Voltage Horizontal LED 4-Pin PL B Lamps.
Exterior		6	Wallpack-LED30	No Upgrade			No Lighting Upgrade Specified
Exterior		2	Pole-Shoe-MH250	New 96w LED Shoebox			Replace Existing Fixture with New 96 Watt LED Shoebox Fixture with 100,000 Hour L80 Rating.
Exterior		7	Bollard-MH50	(1) 15w Medium E26 LED HID			Retrofit 1-Lamp HID Fixture with (1) 15 Watt Medium E26 LED HID Lamp. Existing ballast will be disconnected.
Ground Floor	Vestibule	4	1x8-2FO32-Tube	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Lobby	8	1x8-2FO32-Tube	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		2	4x4-6FO32-L	(6) 10.5w 4' T8 LED B			Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		2	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B			Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Main Office	8	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Vestibule	2	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Vestibule	2	Sconce-(2)PL26	(2) 10.5w Horizontal LED 4-Pin PL B		Under Sensor Control	Retrofit 2-Lamp Plug-In Compact Fluorescent Fixture with (2) 10.5 Watt Line Voltage Horizontal LED 4-Pin PL B Lamps.
Ground Floor	Office	4	2x2-2FO17-Vol	New 18w 2x2 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 18 Watt 2x2 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Restroom	1	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer		No Sensor Control	Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Office	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	7	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x2-2FO17-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x2-2FO17-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	7	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x2-2FO17-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x2-2FO17-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Custodian	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Men's Restroom	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Women's Restroom	2	2x4-3FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	2	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		6	HH8-2PL26	(2) 10.5w Horizontal LED 4-Pin PL B			Retrofit 2-Lamp Plug-In Compact Fluorescent Fixture with (2) 10.5 Watt Line Voltage Horizontal LED 4-Pin PL B Lamps.
Ground Floor		15	2x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	4x4-6FO32-L	(6) 10.5w 4' T8 LED B			Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Vestibule	4	HH8-2PL26	(2) 10.5w Horizontal LED 4-Pin PL B		No Sensor Control	Retrofit 2-Lamp Plug-In Compact Fluorescent Fixture with (2) 10.5 Watt Line Voltage Horizontal LED 4-Pin PL B Lamps.
Ground Floor	Lounge	5	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	Snack Machine	Snack Miser			Install Snack Miser.
Ground Floor		1	Soda Machine	Vending Miser			Install Vending Miser.
Ground Floor	Lounge	6	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	13	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.

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Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	**Location**	**No. of Fix.**	**Fixture Type**	**Upgrade Description**	**Sens Qty**	**Sensor(s)**	**ECM Description**
Ground Floor		6	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x2-2FO17-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	2	2x4-4FO32-P32	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		6	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	2	2x4-4FO32-P32	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	13	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		6	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Computer Room	4	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Electrical	7	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	4	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	10	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		5	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		34	HH8-2PL26	(2) 10.5w Horizontal LED 4-Pin PL B			Retrofit 2-Lamp Plug-In Compact Fluorescent Fixture with (2) 10.5 Watt Line Voltage Horizontal LED 4-Pin PL B Lamps.
Ground Floor	Corridor	4	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.

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Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	**Location**	**No. of Fix.**	**Fixture Type**	**Upgrade Description**	**Sens Qty**	**Sensor(s)**	**ECM Description**
Ground Floor		1	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		8	2x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Vestibule	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	CST	14	2x4-4FO32-P32	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Nurse (Locked)	8	2x4-4FO32-P32	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Vestibule	4	HH8-2PL26	(2) 10.5w Horizontal LED 4-Pin PL B		No Sensor Control	Retrofit 2-Lamp Plug-In Compact Fluorescent Fixture with (2) 10.5 Watt Line Voltage Horizontal LED 4-Pin PL B Lamps.
Ground Floor	Mechanical	12	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	4	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	2	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		2	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		12	2x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Computer Room	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	1x8-6FO32-Dir/Ind	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Electrical	4	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	13	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.

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Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	Location	No. of Fix.	Fixture Type	Upgrade Description	Sens Qty	Sensor(s)	ECM Description
Ground Floor		4	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	10	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	10	1x8-6FO32-Dir/Ind	(6) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 6-Lamp 4' Fixtures with (6) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-3FO32-Dir/Ind	(3) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	2	2x4-4FO32-P32	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage (Locked)	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
	Total	**651**			**0**		

Hot Water Demand Control Measures

	Measure Description	Measure Location	# of Units Installed	Days per Year Facility Operates	Hot Water Fuel Source	Current Flow Rate (gpm)	Anticipated Incentive	Total Cost	Annual kWh Savings	Natural Gas Savings (therms /yr)	Annual Energy Savings @ (.75/Therm)	Simple Payback (Yrs)
1	Low-Flow Aerators (Lavatory)	Bathrooms	7	300	Gas	2.2	$31.43	$83.30	0	196.8	$147.60	0.35
2	Low-Flow Aerators (Kitchen)	Kitchens	1	300	Gas	3.5	$4.68	$12.40	0	30.5	$22.84	0.34
David C Abbott Learning Center							**$36.11**	**$95.70**	**0**	**227.3**	**$170.44**	**0.35**

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BOE Administrative Office

Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	Location	No. of Fix.	Fixture Type	Upgrade Description	Sens Qty	Sensor(s)	ECM Description
Ground Floor	Vestibule	2	2x2-2FO17-L	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Reception	1	2x2-2FO32U-L	(3) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (3) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Superintendent	2	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	HR Office 1	3	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	HR Office 2	2	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Personnel	2	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Business Office Se	3	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Business Office	4	2x2-2FO32U-L	(3) 8w 2' T8 LED B-Ref	1	IWSZP3Px	Retrofit U-Lamp 2' Fixtures with (3) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Corridor	5	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Benefits Office 1	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Benefits Office 2	2	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Conference Room C	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	2	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref	1	IWSZP3Px	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor		1	2x4-4FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Math Office	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Curriculm Office 1	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Curriculm Office 2	2	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Curriculm Corridor	2	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor		2	2x4-4FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Curriculm Office 3	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Curriculm Office 4	3	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Women's Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Men's Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Janitor's Closet (Lo	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Conference Room	14	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	3	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Janitor's Closet	1	1x4-1FO32-W	(1) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 1-Lamp 4' Fixtures with (1) 10.5 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Copy Room	3	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Business Office	2	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Server	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Electrical	1	1x8-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	3	2x4-4FO32-L	(4) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Kitchenette	4	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x4-2FO32-Van	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x4-2FO32-Van	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Janitor's Closet (Lo	1	1x4-1FO32-S	(1) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 1-Lamp 4' Fixtures with (1) 10.5 Watt Line Voltage Type B LED T8 Tube.
Exterior	Building Perimeter	1	Wallpack-HPS70	New 28w LED Cutoff Wallpack		Under Sensor Control	Replace Existing Fixture with New 28 Watt LED Cutoff Wallpack Fixture with 50,000 Hour L97 Rating.
Exterior	Parking Lot	6	Pole-Shoe-MH250	New 96w LED Shoebox		No Sensor Control	Replace Existing Fixture with New 96 Watt LED Shoebox Fixture with 100,000 Hour L80 Rating.
	Total	105			13		

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Hot Water Demand Control Measures

	Measure Description	Measure Location	# of Units Installed	Days per Year Facility Operates	Hot Water Fuel Source	Current Flow Rate (gpm)	Anticipated Incentive	Total Cost	Annual kWh Savings	Natural Gas Savings (therms /yr)	Annual Energy Savings @ (.1211/kWh)	Simple Payback (Yrs)
1	Low-Flow Aerators (Lavatory)	Bathrooms	4	320	Electric	2.2	$38.08	$47.60	2,899	0.0	$351.02	0.03
2	Low-Flow Aerators (Kitchen)	Kitchens	1	320	Electric	3.5	$9.92	$12.40	785	0.0	$95.07	0.03
BOE Admin Office Bldg							**$48.00**	**$60.00**	**3,684**	**0.0**	**$446.09**	**0.03**

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Asher Holmes Elementary School

Room Info		*Existing Fixture Info*		*Lighting Fixture Upgrades*	*Occupancy Sensor Upgrades*		
Floor	**Location**	**No. of Fix.**	**Fixture Type**	**Upgrade Description**	**Sens Qty**	**Sensor(s)**	**ECM Description**
Ground Floor	Open Office	3	HH6-PL32	New 13.5w 6-Inch LED Downlight		No Sensor Control	Replace Existing Fixture with New 13.5 Watt 6-Inch LED Downlight Fixture with 40,000 Hour L70 Rating.
Ground Floor	Restroom	1	Drum-60A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Nurse Restroom	1	Drum-60A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Classroom 14 Rest	1	Drum-60A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Classroom 15 Rest	1	Drum-60A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Classroom 16 Rest	1	Drum-60A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Classroom 19 Rest	2	Drum-60A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Women's Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Janitor's Closet	2	Drum-60A	(1) 10w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 10 Watt Dimmable LED A Lamp.
Ground Floor	Men's Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Classroom 20 Rest	2	Drum-60A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Server Room	8	2x2-2LED9-L	No Upgrade		No Sensor Control	No Lighting Upgrade Specified
Ground Floor	Men's Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Women's Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Shop Restroom	2	Drum-60A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Gym Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Gym	20	Sportlite-(8)PL42	New 160w LED High Bay		No Sensor Control	Install New 160 Watt LED High Bay Fixture with 100,000 Hour L76 Rating. Includes Acrylic Reflector and Dimmable Driver.
Ground Floor	Music Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Women's Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Men's Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Auditorium	40	2x2-2FO32U-L	(3) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (3) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor		35	HH8-2PL26	New 19w 8-Inch LED Downlight			Replace Existing Fixture with New 19 Watt 8-Inch LED Downlight Fixture with 40,000 Hour L70 Rating.
Ground Floor	Kitchen	4	Bare-75A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor		1	Jelly-60A	(1) 11w Dimmable LED A			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Exterior	Building Perimeter	4	Canopy-(2)PL32	(2) 10.5w Horizontal LED 4-Pin PL B		No Sensor Control	Retrofit 2-Lamp Plug-In Compact Fluorescent Fixture with (2) 10.5 Watt Line Voltage Horizontal LED 4-Pin PL B Lamps.
Exterior		2	Sconce-(2)PL32	(2) 10.5w Horizontal LED 4-Pin PL B			Retrofit 2-Lamp Plug-In Compact Fluorescent Fixture with (2) 10.5 Watt Line Voltage Horizontal LED 4-Pin PL B Lamps.
Exterior		4	1x3-1FP39HO-Up	(1) 16w 3' T5HO LED B			Retrofit 1-Lamp 3' Fixtures with (1) 16 Watt Line Voltage Type B LED T5HO Tube.
Exterior		9	Wallpack-HPS70	New 28w LED Cutoff Wallpack			Replace Existing Fixture with New 28 Watt LED Cutoff Wallpack Fixture with 50,000 Hour L97 Rating.
Exterior		8	Wallpack-HPS150	New 42.7w LED Cutoff Wallpack			Replace Existing Fixture with New 42.7 Watt LED Cutoff Wallpack Fixture with 50,000 Hour L97 Rating.
Exterior		3	Square-100A	(1) 11w Dimmable LED A			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
	Total	**164**			**0**		

Electric HVAC

	Default Annual Cooling EFLH	HVAC Location	Measure Description	# of Units	Age of Existing Equipment (Yrs)	Baseline EER/SEER	Min. EER/ SEER	Anticipated Incentive	Total Cost	kW Saved	Demand Savings (kW)	Annual kWh Savings	Annual Energy Savings @ (.1116/kWh)	Simple Payback (Yrs)
1	394	AC-3	Packaged RTU (Single-Phase, Electric Only): 3-Tons	1	15	13.0	15.0	$6,210.40	$7,763.00	0.4	0.2	145	$16.24	95.63
2	394	AC-4	Packaged RTU (Single-Phase, Electric Only): 2-Tons	1	15	13.0	15.0	$6,137.60	$7,672.00	0.2	0.1	97	$10.82	141.77
3	394	AC-5	Packaged RTU (Single-Phase, Electric Only): 2.5-Tons	1	15	13.0	15.0	$6,183.20	$7,729.00	0.3	0.2	121	$13.53	114.26
Asher Holmes Elementary								**$18,531.20**	**$23,164.00**	**0.92**	**0.46**	**364**	**$40.59**	**114.14**

Hot Water Demand Control Measures

	Measure Description	Measure Location	# of Units Installed	Days per Year Facility Operates	Hot Water Fuel Source	Current Flow Rate (gpm)	Anticipated Incentive	Total Cost	Annual kWh Savings	Natural Gas Savings (therms /yr)	Annual Energy Savings @ (.75/Therm)	Simple Payback (Yrs)
1	Low-Flow Aerators (Lavatory)	Bathrooms	27	300	Gas	2.2	$257.04	$321.30	0	759.1	$569.30	0.11
2	Low-Flow Aerators (Kitchen)	Kitchens	36	300	Gas	3.5	$357.12	$446.40	0	1,096.4	$822.33	0.11
Asher Holmes Elementary							**$614.16**	**$767.70**	**0**	**1,855.5**	**$1,391.63**	**0.11**

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Frank J. Dugan Elementary School

Room Info		*Existing Fixture Info*		*Lighting Fixture Upgrades*	*Occupancy Sensor Upgrades*		
Floor	**Location**	**No. of Fix.**	**Fixture Type**	**Upgrade Description**	**Sens Qty**	**Sensor(s)**	**ECM Description**
Ground Floor	Vestibule	2	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Gym	24	Low Bay-MH250	New 160w LED High Bay		No Sensor Control	Install New 160 Watt LED High Bay Fixture with 100,000 Hour L76 Rating. Includes Acrylic Reflector and Dimmable Driver.
Ground Floor	Office (Locked)	2	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage (Locked)	2	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Lobby	18	2x4-3FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Women's Restroom	10	1x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Men's Restroom	9	1x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	5	1x4-2FO32-IH	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Cafeteria	48	2x4-3FO32-L	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Stage	8	1x4-2F40-IH	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Receiving	14	1x4-2FO32-IH	New 23w 1x4 LED Low Bay		No Sensor Control	Replace Existing Fixture with New 23 Watt 1x4 LED Low Bay Fixture with 100,000 Hour L70 Rating.
Ground Floor	Office	1	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-2F20-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	7	1x4-2FO32-IH	New 23w 1x4 LED Low Bay		No Sensor Control	Replace Existing Fixture with New 23 Watt 1x4 LED Low Bay Fixture with 100,000 Hour L70 Rating.
Ground Floor	Electrical	2	1x4-2FO32-IH	New 23w 1x4 LED Low Bay		No Sensor Control	Replace Existing Fixture with New 23 Watt 1x4 LED Low Bay Fixture with 100,000 Hour L70 Rating.
Ground Floor	Storage	1	1x8-2F96SS-IH	New 41w 1x8 LED Low Bay		No Sensor Control	Replace Existing Fixture with New 41 Watt 1x8 LED Low Bay Fixture with 100,000 Hour L70 Rating.
Ground Floor	Kitchen	14	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		6	Jelly-100A	(1) 11w Dimmable LED A			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Storage (Locked)	2	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	1x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	8	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-1F20-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Storage (Locked)	1	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	1	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Electrical	1	1x8-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	8	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Vestibule	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Mechanical	1	Bare-60A	(1) 10w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 10 Watt Dimmable LED A Lamp.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Restroom	1	1x2-2F20-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage (Locked)	1	1x8-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Electrical (Locked)	1	1x8-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-2F20-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Custodian	1	1x4-1FO32-S	(1) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 1-Lamp 4' Fixtures with (1) 10.5 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Electrical (Locked)	1	1x8-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-3FO32-L	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.

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Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	Location	No. of Fix.	Fixture Type	Upgrade Description	Sens Qty	Sensor(s)	ECM Description
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Corridor	8	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Vestibule	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Classroom	6	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Corridor	16	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Classroom	2	1x8-4FO32-IH	New 41w 1x8 LED Low Bay		No Sensor Control	Replace Existing Fixture with New 41 Watt 1x8 LED Low Bay Fixture with 100,000 Hour L70 Rating.
Ground Floor	Classroom	6	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	4	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	4	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Electrical	1	1x8-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Custodian	1	1x8-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	11	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Restroom	1	1x2-1F20-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Classroom	9	2x4-2FP54HO-Vol	New 36w 2x4 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 36 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Classroom	3	2x4-2FP54HO-Vol	New 36w 2x4 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 36 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Vestibule	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-2FP54HO-Vol	New 36w 2x4 Volumetric LED Troffer		No Sensor Control	Replace Existing Fixture with New 36 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Classroom	3	2x4-2FP54HO-Vol	New 36w 2x4 Volumetric LED Troffer		No Sensor Control	Replace Existing Fixture with New 36 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Women's Restroom	5	1x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Men's Restroom	5	1x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	11	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Closet	1	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Women's Restroom	5	1x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Men's Restroom	5	1x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Corridor	11	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Electrical (Locked)	1	1x8-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	10	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Restroom	1	1x2-1F20-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Vestibule	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Corridor	5	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor		1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Vestibule	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Restroom	1	1x2-1F20-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Restroom	1	1x2-1F20-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Classroom	11	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.

Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	Location	No. of Fix.	Fixture Type	Upgrade Description	Sens Qty	Sensor(s)	ECM Description
Ground Floor	Restroom	1	1x2-1F20-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Corridor	14	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Corridor	12	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Vestibule	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Vestibule	1	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	6	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Nurse	6	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		2	1x4-2FO32-WW	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-1F20-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Main Office	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref			Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Storage	2	1x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Workroom	2	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office (Locked)	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Conference Room	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office (Locked)	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-2F20-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Vestibule	2	2x2-2FO17-Vol	New 18w 2x2 Volumetric LED Troffer		No Sensor Control	Replace Existing Fixture with New 18 Watt 2x2 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Vestibule	2	2x2-2FO17-Vol	New 18w 2x2 Volumetric LED Troffer		No Sensor Control	Replace Existing Fixture with New 18 Watt 2x2 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Corridor	19	2x4-3FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Vestibule	6	2x2-2FO17-Vol	New 18w 2x2 Volumetric LED Troffer		No Sensor Control	Replace Existing Fixture with New 18 Watt 2x2 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Music Room	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	2	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	3	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Music Room	14	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Vestibule	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Storage	1	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Computer Room	1	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	2	2x2-2LED9-L	No Upgrade		No Sensor Control	No Lighting Upgrade Specified
Ground Floor	Lounge	8	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	Soda Machine	Vending Miser			Install Vending Miser.
Ground Floor		1	Snack Machine	Snack Miser			Install Snack Miser.
Ground Floor	Restroom	1	1x2-2F20-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-2F20-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-2F20-WW	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Kitchenette	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Library	30	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		31	1x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Workroom	4	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Restroom	1	1x2-1F20-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	2	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
Ground Floor	Classroom	9	2x4-3FO32-L (2 Bal)	40w 2x4 LED Troffer Retro Kit		No Sensor Control	Retrofit Existing Fixture with 40 Watt 2x4 LED Troffer Retrofit Kit with 50,000 Hour L70 Rating.
	Total	**877**			**0**		

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Electric HVAC

	Default Annual Cooling EFLH	HVAC Location	Measure Description	# of Units	Age of Existing Equipment (Yrs)	Baseline EER/SEER	Min. EER/SEER	Anticipated Incentive	Total Cost	kW Saved	Demand Savings (kW)	Annual kWh Savings	Annual Energy Savings @ (.14/kWh)	Simple Payback (Yrs)
1	394	RTU-1	Packaged RTU (Gas Heating): 10-Tons	1	9	11.0	12.0	$10,491.70	$17,689.00	0.9	0.5	358	$50.15	143.53
2	394	RTU-2	Packaged RTU (Gas Heating): 10-Tons	1	9	11.0	12.0	$10,491.70	$17,689.00	0.9	0.5	358	$50.15	143.53
Frank J Dugan Elementary								**$20,983.39**	**$35,378.00**	**1.82**	**0.91**	**716**	**$100.29**	**143.53**

HVAC Controls

	Measure Description	Measure Location	# of Units Installed	HVAC Unit Capacity (MBH)	HVAC Fuel Source	Annual Fuel Usage	Anticipated Incentive	Total Cost	Annual kWh Savings	Natural Gas Savings (therms /yr)	Annual Energy Savings @ (.75/Therm)	Simple Payback (Yrs)
1	Electronic Fuel-Use Economizers (for Forced Air Heat)	RTU -1	1	225	Gas	2,363	$320.88	$541.00	0	307.2	$230.39	0.96
2		RTU -2	1	225	Gas	2,363	$320.88	$541.00	0	307.2	$230.39	0.96
3		RTU -3	1	125	Gas	1,313	$320.88	$541.00	0	170.7	$128.02	1.72
Frank J Dugan Elementary							**$962.63**	**$1,623.00**		**785.1**	**$588.80**	**1.12**

Hot Water Demand Control Measures

	Measure Description	Measure Location	# of Units Installed	Days per Year Facility Operates	Hot Water Fuel Source	Current Flow Rate (gpm)	Anticipated Incentive	Total Cost	Annual kWh Savings	Natural Gas Savings (therms /yr)	Annual Energy Savings @ (.75/Therm)	Simple Payback (Yrs)
4	Low-Flow Aerators (Lavatory)	Restrooms	4	300	Gas	2.2	$28.23	$47.60	0	112.5	$84.34	0.23
5	Low-Flow Aerators (Kitchen)	Kitchens	5	300	Gas	3.5	$36.77	$62.00	0	152.3	$114.21	0.22
Frank J Dugan Elementary							**$65.01**	**$109.60**	**0**	**264.7**	**$198.55**	**0.22**

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Marlboro Elementary School

Room Info		*Existing Fixture Info*		*Lighting Fixture Upgrades*	*Occupancy Sensor Upgrades*		
Floor	**Location**	**No. of Fix.**	**Fixture Type**	**Upgrade Description**	**Sens Qty**	**Sensor(s)**	**ECM Description**
Exterior	Building Perimeter	6	Drum-LED15	No Upgrade		No Sensor Control	No Lighting Upgrade Specified
Exterior		36	1x3-1FP39HO-Up	(1) 16w 3' T5HO LED B			Retrofit 1-Lamp 3' Fixtures with (1) 16 Watt Line Voltage Type B LED T5HO Tube.
Exterior		1	Wallpack-PL42	(1) 10.5w Horizontal LED 4-Pin PL B			Retrofit 1-Lamp Plug-In Compact Fluorescent Fixture with (1) 10.5 Watt Line Voltage Horizontal LED 4-Pin PL B Lamp.
Exterior		11	Wallpack-MH250	New 60w LED Wallpack			Replace Existing Fixture with New 60 Watt LED Wallpack Fixture with 50,000 Hour L70 Rating.
Exterior		4	Square-MH50	(1) 16.5w LED HID			Retrofit 1-Lamp HID Fixture with (1) 16.5 Watt LED HID Lamp. Existing ballast will be disconnected.
Exterior		4	Square-LED20	No Upgrade			No Lighting Upgrade Specified
Exterior	Driveway	5	Pole Top-MH175	(1) 36w Medium E26 LED HID		No Sensor Control	Retrofit 1-Lamp HID Fixture with (1) 36 Watt Medium E26 LED HID Lamp. Existing ballast will be disconnected.
Exterior	Parking Lot	4	Pole-Flood-HPS400	New 111w LED Flood		No Sensor Control	Replace Existing Fixture with New 111 Watt LED Flood Fixture with 60,000 Hour L70 Rating.
Ground Floor	Stage	2	Jelly-LED12A	No Upgrade		No Sensor Control	No Lighting Upgrade Specified
Ground Floor		1	Jelly-CF23	(1) 11w Dimmable LED A			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor		1	2x4-4FO32-W	(4) 10.5w 4' T8 LED B			Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Gym	15	Low Bay-MH250	New 160w LED High Bay		No Sensor Control	Install New 160 Watt LED High Bay Fixture with 100,000 Hour L76 Rating. Includes Acrylic Reflector and Dimmable Driver.
Ground Floor	Women's Locker Room	2	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Vestibule	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Men's Locker Room	4	2x4-4FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	2	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	18	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	15	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Cafeteria	24	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Kitchen	11	1x8-4FO32-VAP	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		5	1x4-2FO32-VAP	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		6	Jelly-100A	(1) 11w Dimmable LED A			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Locker Room	1	1x8-4FO32-VAP	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-1FO17-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Office	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Pantry	4	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Cooler	2	Jelly-100A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Vestibule	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	10	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	4	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	7	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-1F20-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Storage (Locked)	1	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Receiving	4	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Shop	8	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Electrical	1	1x4-2F40-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage (Locked)	1	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.

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Room Info			*Existing Fixture Info*	*Lighting Fixture Upgrades*	*Occupancy Sensor Upgrades*		
Floor	**Location**	**No. of Fix.**	**Fixture Type**	**Upgrade Description**	**Sens Qty**	**Sensor(s)**	**ECM Description**
Ground Floor	Custodian	1	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Boiler Room	9	1x4-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Custodian	3	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	1x4-1F40-S	(1) 10.5w 4' T8 LED B			Retrofit 1-Lamp 4' Fixtures with (1) 10.5 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	4	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	12	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	15	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Laundry	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	2x4-4FO32-L (2 Bal)	(4) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	2x4-4FO32-L (2 Bal)	(4) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mechanical	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	2	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-1FO17-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Restroom	1	1x2-1FO17-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Coats	3	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	13	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	3	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Nurse	7	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		2	2x2-2FO32U-L	(3) 8w 2' T8 LED B-Ref			Retrofit U-Lamp 2' Fixtures with (3) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Exam Room	3	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Conference Room	3	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer		No Sensor Control	Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Main Office	13	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Restroom	1	1x2-1FO17-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Computer Room	1	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Break Room	1	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Mail Room	3	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Office	6	2x2-2FO17-Vol	New 18w 2x2 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 18 Watt 2x2 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.

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Floor	**Location**	**No. of Fix.**	**Fixture Type**	**Upgrade Description**	**Sens Qty**	**Sensor(s)**	**ECM Description**
Ground Floor	Office	4	2x2-2FO17-Vol	New 18w 2x2 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 18 Watt 2x2 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Office	4	2x2-2FO17-Vol	New 18w 2x2 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 18 Watt 2x2 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Security	4	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Lobby	2	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Storage	1	1x8-4F40-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	7	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		10	2x4-3FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Library	38	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	4	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Workroom	2	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Electrical	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Classroom	4	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	4	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	15	2x4-3FO32-P18	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Lounge	12	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref			Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor		1	Snack Machine	Snack Miser			Install Snack Miser.
Ground Floor		1	Soda Machine	Vending Miser			Install Vending Miser.
Ground Floor	Restroom	1	1x2-1FO17-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Restroom	1	1x2-1FO17-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Computer Room	5	2x2-2FO17-L	(2) 8w 2' T8 LED B		No Sensor Control	Retrofit 2-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Copy Room	2	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Women's Restroom	4	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref			Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Custodian	1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Men's Restroom	4	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref			Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Corridor	17	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	20	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Coats	1	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-1FO17-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Storage	4	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	9	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Custodian	1	1x2-1FO17-WW	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Men's Restroom	4	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref			Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.

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Room Info			*Existing Fixture Info*	*Lighting Fixture Upgrades*	*Occupancy Sensor Upgrades*		
Floor	**Location**	**No. of Fix.**	**Fixture Type**	**Upgrade Description**	**Sens Qty**	**Sensor(s)**	**ECM Description**
Ground Floor Ground Floor	Women's Restroom	4 1	2x4-2FO32-L 2x2-2FO32U-L	(2) 10.5w 4' T8 LED B (2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes. Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
	Total	**892**			**0**		

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Electric HVAC

	Default Annual Cooling EFLH	HVAC Location	Measure Description	# of Units	Age of Existing Equipment (Yrs)	Baseline EER/SEER	Min. EER/ SEER	Anticipated Incentive	Total Cost	kW Saved	Demand Savings (kW)	Annual kWh Savings	Annual Energy Savings @ (.14/kWh)	Simple Payback (Yrs)
3	394	MRTU-1	Packaged RTU (Three-Phase, Electric Only): 5-Tons	1	27	13.0	14.0	$7,786.46	$10,817.50	0.3	0.2	130	$18.18	166.68
4	394	MRTU-2	Packaged RTU (Three-Phase, Electric Only): 5-Tons	1	27	13.0	14.0	$7,786.46	$10,817.50	0.3	0.2	130	$18.18	166.68
6	394	MRTU-4	Packaged RTU (Three-Phase, Electric Only): 5-Tons	1	27	13.0	14.0	$7,786.46	$10,817.50	0.3	0.2	130	$18.18	166.68
7	394	MRTU-5	Packaged RTU (Three-Phase, Electric Only): 5-Tons	1	27	13.0	14.0	$7,786.46	$10,817.50	0.3	0.2	130	$18.18	166.68
Marlboro Elementary								**$31,145.84**	**$43,270.00**	**1.32**	**0.66**	**520**	**$72.74**	**166.68**

Hot Water Demand Control Measures

	Measure Description	Measure Location	# of Units Installed	Days per Year Facility Operates	Hot Water Fuel Source	Current Flow Rate (gpm)	Anticipated Incentive	Total Cost	Annual kWh Savings	Natural Gas Savings (therms /yr)	Annual Energy Savings @ (.75/Therm)	Simple Payback (Yrs)
1	Low-Flow Aerators (Lavatory)	Restrooms	26	325	Gas	2.2	$222.71	$309.40	0	791.9	$593.90	0.15
2	Low-Flow Aerators (Kitchen)	Kitchens	4	325	Gas	3.5	$35.70	$49.60	0	132.0	$98.98	0.14

	Measure Description	Measure Location	Pipe Diameter (inches)	Pipe Length (feet)	Hot Water Fuel Source	Low or High Temp Piping?	Anticipated Incentive	Total Cost	Annual kWh Savings	Natural Gas Savings (therms /yr)	Annual Energy Savings @ (.75/Therm)	Simple Payback (Yrs)
3	Pipe Wrap Insulation	Domestic HW	0.75	60.00	Gas	High	$302.32	$420.00	0	205.5	$154.13	0.76
Marlboro Elementary							**$560.73**	**$779.00**	**0**	**1,129.3**	**$847.01**	**0.26**

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Robertsville Elementary School

Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	Location	No. of Fix.	Fixture Type	Upgrade Description	Sens Qty	Sensor(s)	ECM Description
Ground Floor	Open Office	2	HH6-PL32	New 13.5w 6-Inch LED Downlight		Under Sensor Control	Replace Existing Fixture with New 13.5 Watt 6-Inch LED Downlight Fixture with 40,000 Hour L70 Rating.
Ground Floor		7	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer			Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Corridor	2	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Vestibule	4	2x4-2FO32-Vol	New 28w 2x4 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 28 Watt 2x4 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Kitchenette	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Copy Room	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	8	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	4	2x2-2FO17-Vol	New 18w 2x2 Volumetric LED Troffer		Under Sensor Control	Replace Existing Fixture with New 18 Watt 2x2 Volumetric LED Troffer Fixture with 60,000 Hour L80 Rating.
Ground Floor	Nurse	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		8	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi			Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Exam Room	1	2x4-4FO32-L (2 Bal)	(4) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L (E)	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	15	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	1	1x8-4FO32-S	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-1FO17-Van	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Cubbies	8	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	15	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-1FO17-Van	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	18	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L (E)	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Library	48	1x4-2FO32-Up/Down	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		9	2x4-4FO32-L (2 Bal)	(4) 10.5w 4' T8 LED B-Bi			Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		2	2x4-4FO32-L (2 Bal)	(4) 10.5w 4' T8 LED B-Bi			Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		8	HH8-2PL26	New 19w 8-Inch LED Downlight			Replace Existing Fixture with New 19 Watt 8-Inch LED Downlight Fixture with 40,000 Hour L70 Rating.
Ground Floor		6	Chandelier-(2)PL32	(2) 10.5w Horizontal LED 4-Pin PL B			Retrofit 2-Lamp Plug-In Compact Fluorescent Fixture with (2) 10.5 Watt Line Voltage Horizontal LED 4-Pin PL B Lamps.
Ground Floor	Office	3	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Computer Room	2	2x4-4FO32-L (2 Bal)	(4) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Electrical/Copy	3	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	16	2x4-4FO32-L (2 Bal)	(4) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	16	2x4-4FO32-L (2 Bal)	(4) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	8	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	16	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.

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Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	Location	No. of Fix.	Fixture Type	Upgrade Description	Sens Qty	Sensor(s)	ECM Description
Ground Floor	Classroom	18	2x4-2FO32-P1.5	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	18	2x4-2FO32-P1.5	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		6	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-1FO17-Van	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Classroom	3	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	4	1x8-4FO32-S	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-S	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Receiving	2	1x8-4FO32-S	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	5	1x4-2FO32-W	(2) 10.5w 4' T8 LED B	1	LHMTS1Gx	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x2-1F20-W	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Electrical	1	1x8-4FO32-S	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Receiving	1	1x4-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Boiler Room	3	1x8-4FO32-S	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		5	1x4-2FO32-S	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet (Locked)	1	1x8-4FO32-S	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Music Room	1	HH-75R40	(1) 11.5w Dimmable LED R40		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11.5 Watt Dimmable LED R40 Lamp.
Ground Floor		2	2x4-4FO32-L	(4) 10.5w 4' T8 LED B			Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		4	2x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x4-2FO32-Surf	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet	2	HH-75A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Guidance	1	HH-75R40	(1) 11.5w Dimmable LED R40		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11.5 Watt Dimmable LED R40 Lamp.
Ground Floor		5	2x4-4FO32-L	(4) 10.5w 4' T8 LED B			Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x4-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet (Locked)	2	HH-75A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	Corridor	1	1x4-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Gym	16	Sportlite-(6)PL42	New 160w LED High Bay		No Sensor Control	Install New 160 Watt LED High Bay Fixture with 100,000 Hour L76 Rating. Includes Acrylic Reflector and Dimmable Driver.
Ground Floor	Stage	1	Bare-100A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor		1	Flood-200Q	New 20w LED Flood			Replace Existing Fixture with New 20 Watt LED Flood Fixture with 60,000 Hour L70 Rating.
Ground Floor		4	Drum-150A	(1) 17w Dimmable LED A			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 17 Watt Dimmable LED A Lamp.
Ground Floor	Corridor	2	1x4-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Gym Closet	1	1x8-4FO32-S	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	1x4-2FO32-S	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	2	2x4-4FO32-L (2 Bal)	(4) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 4-Lamp 4' Bi-Level Switched Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	1	Jelly-100A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor		5	Bare-100A	(1) 11w Dimmable LED A			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor	File Cabs	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	1x4-2FO32-S	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.

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Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	Location	No. of Fix.	Fixture Type	Upgrade Description	Sens Qty	Sensor(s)	ECM Description
Ground Floor	Classroom (Locked)	3	2x4-3FO32-L	(3) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 3-Lamp 4' Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Cafeteria	45	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		5	2x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		6	2x4-3FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 3-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Kitchen	5	Bare-75A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Ground Floor		15	2x4-4FO32-L	(4) 10.5w 4' T8 LED B			Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		4	2x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		7	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref			Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor		2	1x4-2F40-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Cooler	2	Jelly-60A	(1) 10w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 10 Watt Dimmable LED A Lamp.
Ground Floor	Restroom	1	2x4-2FO32-L (E)	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Pantry (Locked)	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Women's Restroom	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Men's Restroom	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Janitor's Closet	1	1x2-1FO17-W	(1) 8w 2' T8 LED B		No Sensor Control	Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	4	2x4-4FO32-P32	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	4	2x4-4FO32-P32	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	4	2x4-4FO32-P32	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	12	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	8	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Women's Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor		3	2x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Storage	1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Men's Restroom	1	2x2-2FO32U-L	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor		3	2x4-2FO32-L	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	18	2x4-2FO32-P1.5	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	18	2x4-2FO32-P1.5	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	18	2x4-2FO32-P1.5	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Server Room	3	2x4-2LED15-L	No Upgrade		No Sensor Control	No Lighting Upgrade Specified
Ground Floor	Classroom	6	2x4-2LED15-L	No Upgrade		No Sensor Control	No Lighting Upgrade Specified
Ground Floor	Classroom	9	2x4-2LED15-L	No Upgrade		No Sensor Control	No Lighting Upgrade Specified

Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	Location	No. of Fix.	Fixture Type	Upgrade Description	Sens Qty	Sensor(s)	ECM Description
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet (Locked)	1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Women's Restroom	3	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Janitor's Closet	1	1x2-1LED9-S	No Upgrade		No Sensor Control	No Lighting Upgrade Specified
Ground Floor	Men's Restroom	3	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	16	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Open Office	8	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Break Room	12	2x4-3FO32-L (2 Bal)	(3) 10.5w 4' T8 LED B-Bi		No Sensor Control	Retrofit 3-Lamp 4' Bi-Level Switched Fixtures with (3) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	2x2-2FO32U-L	(3) 8w 2' T8 LED B-Ref			Retrofit U-Lamp 2' Fixtures with (3) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Restroom	1	2x4-2FO32-L (E)	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Restroom	1	2x2-2FO32U-L (E)	(2) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (2) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor		1	1x2-1FO17-W	(1) 8w 2' T8 LED B			Retrofit 1-Lamp 2' Fixtures with (1) 8 Watt Line Voltage Type B LED T8 Tube.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Classroom	6	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		3	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Server Room	2	2x2-2FO32U-L	(3) 8w 2' T8 LED B-Ref		No Sensor Control	Retrofit U-Lamp 2' Fixtures with (3) 8 Watt Line Voltage Type B LED T8 Tubes, New Socket Bar Kit and White Reflector.
Ground Floor	Vestibule	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	85	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		2	2x2-2LED9-L	No Upgrade			No Lighting Upgrade Specified
Ground Floor		4	1x4-1FO32-Up	(1) 10.5w 4' T8 LED B			Retrofit 1-Lamp 4' Fixtures with (1) 10.5 Watt Line Voltage Type B LED T8 Tube.
Exterior	Building Perimeter	2	Canopy-LED15	No Upgrade		No Sensor Control	No Lighting Upgrade Specified
Exterior		16	1x3-1FP39HO-Up	(1) 16w 3' T5HO LED B			Retrofit 1-Lamp 3' Fixtures with (1) 16 Watt Line Voltage Type B LED T5HO Tube.
Exterior		1	Flood-HPS400	New 111w LED Flood			Replace Existing Fixture with New 111 Watt LED Flood Fixture with 60,000 Hour L70 Rating.
Exterior		1	Wallpack-LED15	No Upgrade			No Lighting Upgrade Specified
Exterior		7	Wallpack-MH175	New 42.7w LED Cutoff Wallpack			Replace Existing Fixture with New 42.7 Watt LED Cutoff Wallpack Fixture with 50,000 Hour L97 Rating.
Exterior		1	Jelly-100A	(1) 11w Dimmable LED A			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Exterior		3	Wallpack-HPS70	New 28w LED Cutoff Wallpack			Replace Existing Fixture with New 28 Watt LED Cutoff Wallpack Fixture with 50,000 Hour L97 Rating.
Exterior		1	Square-100A	(1) 11w Dimmable LED A			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Exterior		1	Jelly-100A	(1) 11w Dimmable LED A			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
Exterior		1	Flood-MH400	New 111w LED Flood			Replace Existing Fixture with New 111 Watt LED Flood Fixture with 60,000 Hour L70 Rating.
Exterior		2	Pole-Flood-HPS400	New 111w LED Flood			Replace Existing Fixture with New 111 Watt LED Flood Fixture with 60,000 Hour L70 Rating.
Exterior	Roof Mechanical	1	Jelly-100A	(1) 11w Dimmable LED A		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 11 Watt Dimmable LED A Lamp.
	Total	**979**			**1**		

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Hot Water Demand Control Measures

	Measure Description	Measure Location	# of Units Installed	Days per Year Facility Operates	Hot Water Fuel Source	Current Flow Rate (gpm)	Anticipated Incentive	Total Cost	Annual kWh Savings	Natural Gas Savings (therms /yr)	Annual Energy Savings @ (.75/Therm)	Simple Payback (Yrs)
1	Low-Flow Aerators (Lavatory)	Restrooms	32	320	Gas	2.2	$304.64	$380.80	0	959.6	$719.71	0.11
2	Low-Flow Aerators (Kitchen)	Kitchens	1	320	Gas	3.5	$9.92	$12.40	0	32.5	$24.37	0.10
Robertsville Elementary							**$314.56**	**$393.20**	**0**	**992.1**	**$744.08**	**0.11**

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Transportation Garage

Room Info		Existing Fixture Info		Lighting Fixture Upgrades	Occupancy Sensor Upgrades		
Floor	Location	No. of Fix.	Fixture Type	Upgrade Description	Sens Qty	Sensor(s)	ECM Description
Ground Floor	Vestibule	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Reception	4	2x4-4FO32-L	(4) 10.5w 4' T8 LED B		Under Sensor Control	Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Break Room	14	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		Under Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	3	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Men's Restroom	1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Women's Restroom	1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Electrical (Locked)	1	1x8-2FO32-IH	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 8' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Corridor	2	2x4-4FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	2	2x4-2FO32-L	(2) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Office	6	2x4-2FO32-L	(2) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Garage	18	High Bay-LED150	No Upgrade		No Sensor Control	No Lighting Upgrade Specified
Ground Floor	Shop	1	1x8-4FO32-W	(4) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	1x4-2FO32-W	(2) 10.5w 4' T8 LED B			Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Break Room	3	2x4-2FO32-L	(2) 10.5w 4' T8 LED B	1	IWSZP3Px	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Tire Storage	1	2x4-2FO32-L	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		1	2x4-4FO32-L	(4) 10.5w 4' T8 LED B			Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Exterior	Building Perimeter	8	Flood-HPS400	New 111w LED Flood		No Sensor Control	Replace Existing Fixture with New 111 Watt LED Flood Fixture with 60,000 Hour L70 Rating.
Exterior		3	Wallpack-HPS70	New 28w LED Cutoff Wallpack			Replace Existing Fixture with New 28 Watt LED Cutoff Wallpack Fixture with 50,000 Hour L97 Rating.
Exterior		1	Flood-90PAR38	(1) 15w Dimmable LED Par38			Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 15 Watt Dimmable LED Par38 Lamp.
Ground Floor	Maintenance Garag	5	1x4-2FO32-W	(2) 10.5w 4' T8 LED B		No Sensor Control	Retrofit 2-Lamp 4' Fixtures with (2) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor		2	1x8-2F96SS-IH	New 41w 1x8 LED Low Bay			Replace Existing Fixture with New 41 Watt 1x8 LED Low Bay Fixture with 100,000 Hour L70 Rating.
Ground Floor		1	1x8-4FO32-W	(4) 10.5w 4' T8 LED B			Retrofit 4-Lamp 8' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Exterior	Building Perimeter	10	Flood-90PAR38	(1) 15w Dimmable LED Par38		No Sensor Control	Re-Lamp 1-Lamp Incandescent or Compact Fluorescent Fixture with (1) 15 Watt Dimmable LED Par38 Lamp.
Ground Floor	Small Garage	7	1x8-2F96SS-IH	New 41w 1x8 LED Low Bay		No Sensor Control	Replace Existing Fixture with New 41 Watt 1x8 LED Low Bay Fixture with 100,000 Hour L70 Rating.
Ground Floor		1	1x4-4FO32-W	(4) 10.5w 4' T8 LED B			Retrofit 4-Lamp 4' Fixtures with (4) 10.5 Watt Line Voltage Type B LED T8 Tubes.
Ground Floor	Closet (Locked)	2	1x8-2F96SS-IH	New 41w 1x8 LED Low Bay		No Sensor Control	Replace Existing Fixture with New 41 Watt 1x8 LED Low Bay Fixture with 100,000 Hour L70 Rating.
Exterior	Building Perimeter	1	Wallpack-HPS70	New 28w LED Cutoff Wallpack		No Sensor Control	Replace Existing Fixture with New 28 Watt LED Cutoff Wallpack Fixture with 50,000 Hour L97 Rating.
	Total	**103**			**4**		

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Hot Water Demand Control Measures

	Measure Description	Measure Location	# of Units Installed	Days per Year Facility Operates	Hot Water Fuel Source	Current Flow Rate (gpm)	Anticipated Incentive	Total Cost	Annual kWh Savings	Natural Gas Savings (therms /yr)	Annual Energy Savings @ (.75/Therm)	Simple Payback (Yrs)
1	Low-Flow Aerators (Lavatory)	Bathrooms	2	254	Gas	2.2	$19.04	$23.80	0	47.6	$35.70	0.13
2	Low-Flow Aerators (Kitchen)	Kitchens	1	254	Gas	3.5	$9.92	$12.40	0	25.8	$19.34	0.13
Transportation Garage							**$28.96**	**$36.20**	**0**	**73.4**	**$55.04**	**0.13**

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APPENDIX 8. 3RD PARTY REVIEW CORRESPONDANCE (DLB ASSOCIATES)

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