Town of Westerly

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Executive Summary

Overview

The Town of Westerly, RI and Johnson Controls, Inc. have entered into an agreement to decrease Westerly building energy costs by implementing an energy performance contract. The project consists of eight Energy Conservation Measures (ECMs) performed at thirteen town buildings. The length of the agreement is a twenty year term which runs through August 2034. Project utility cost avoidance will be measured regularly throughout the term with formal reports delivered annually. The goals of the project are to cut energy costs, provide capital upgrades, increase the energy efficiency and the reliability of the town mechanical and electrical systems, and to maintain or improve occupant comfort and well-being. All while providing guaranteed cost avoidance to Westerly in order to fund the cost of the project. The first year annual guaranteed utility cost avoidance is $54,458 with a $1,210 operations and maintenance (O&M) cost avoidance; totaling a first year guarantee of $55,668. Beginning in the second year, the guaranteed utility cost avoidance escalates by 3.5% annually and the O&M cost avoidance escalates by 3.25% each year to compensate for inflation.

Table 1: Project Summary

Total Project Benefits			
Year	**Annual Guaranteed Project Benefits**	**Verified Project Benefits**	**Surplus / Shortfall**
Installation	$0	$35,891	N/A
1	$55,668	$57,186	$1,518
2	$57,613	-	-
3	$59,626	-	-
4	$61,710	-	-
5	$63,866	-	-
6	$66,098	-	-
7	$68,408	-	-
8	$70,799	-	-
9	$73,273	-	-
10	$75,834	-	-
11	$78,484	-	-
12	$81,227	-	-
13	$84,065	-	-
14	$87,003	-	-
15	$90,044	-	-
16	$93,190	-	-
17	$96,447	-	-
18	$99,818	-	-
19	$103,306	-	-
20	$106,917	-	-
Total	**$1,573,396**	**$93,077**	**$1,518**

This report provides the results of the work performed by JCI over the Year 1 performance period ranging from September 2014 – August 2015 and delivers the calculated cost avoidance of the project over that period. JCI is pleased to announce a utility cost avoidance of $57,186 for the duration of the period.

The scope of the project consisted of improvements to lighting, weatherization, temperature controls, boilers, pipe insulation, space heat movement, water fixtures, and ventilation systems. Additional information on each measure can be found in the 'Energy Conservation Measure Analysis' section of the report.

The following buildings were included in the scope of work of the project:

Table 2: Project Scope Summary

Building	Address	Energy Conservation Measure							
		ECM 1	ECM 3	ECM 5	ECM 6	ECM 8	ECM 11A	ECM 12	ECM 13
		Lighting	Weatherization	Temperature Setback	Boiler Replacement	Pipe & Valve Insulation	DPW Destratification	Water Conservation	Condition A-Rooftop AHU
Landfill Building #2	37 Larry Hirsch Way, Westerly, RI	x	x	x		x			
Animal Control	33 Larry Hirsch Way, Westerly, RI		x			x			
Armory	8 Dixon St, Westerly, RI		x						
WWTP	87 Margin St, Westerly, RI	x	x	x		x		x	
Town Hall	45 Broad St, Westerly, RI	x	x	x	x	x		x	x
Beach Building #2	365 Atlantic Ave, Westerly, RI	x							
Adult Day Center	5 Union St, Westerly, RI	x	x						
Water Dept. Building #1	68 White Rock Rd, Westerly, RI	x	x						
Water Dept. Building #2	20 White Rock Rd, Westerly, RI	x	x	x					
Water Dept. Building #3	38 White Rock Rd, Westerly, RI	x	x						
DPW Highway	35 Larry Hirsch Way, Westerly, RI		x	x		x	x		
Senior Center	39 State St, Westerly, RI	x	x	x		x		x	
Bus Garage	6 Springbrook Rd, Westerly, RI		x	x					

Year 1 Period Utility Cost Avoidance

Utility Rates were obtained from the contract. The gas rate at the Town Hall was obtained from utility usage and cost over the past year. Rates are as follows:

Table 3: Year 1 Period Rate Summary

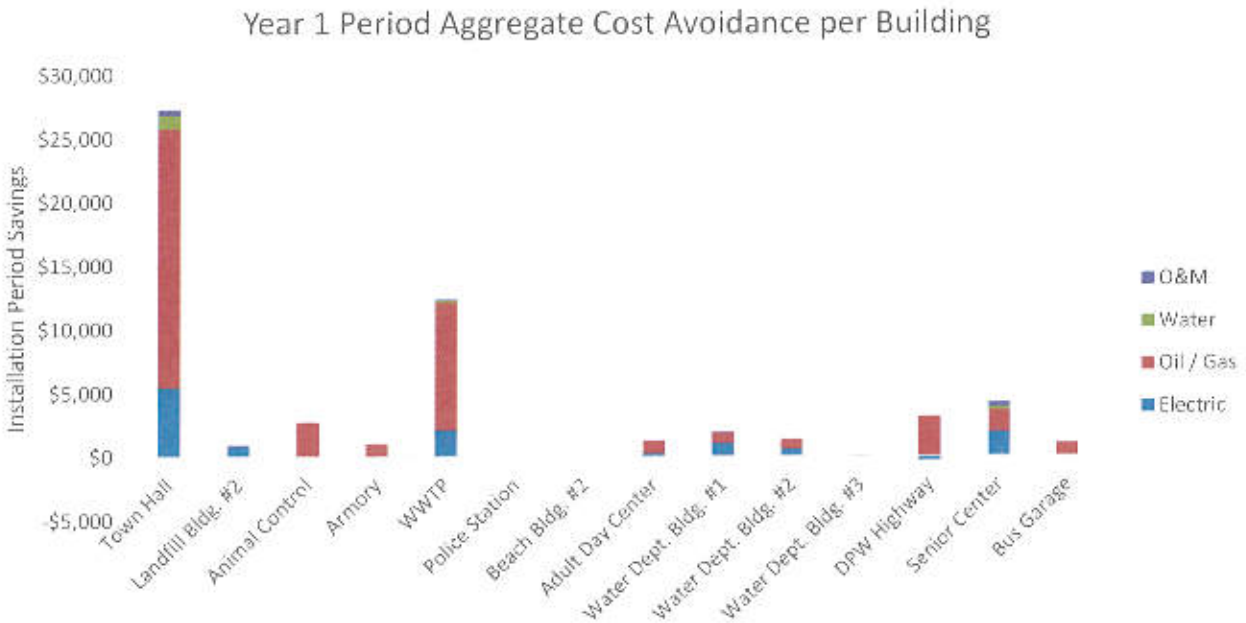
Year 1 Period Rate Summary				
Building	$/kWh	$/Gal Oil	$/Therm Gas	$/kGal
Town Hall	$0.11	$3.33	$1.19	$13.76
Landfill Building #2	$0.15	N/A	N/A	-
Animal Control	$0.12	N/A	$1.65	-
WWTP	$0.15	$3.33	N/A	$10.46
Police Station	$0.14	N/A	$1.58	-
Beach Building #2	$0.23	N/A	N/A	-
Water Dept. Building #1	$0.13	$3.33	$2.23	-
Water Dept. Building #2	$0.13	N/A	$1.48	-
Water Dept. Building #3	$0.17	N/A	$3.97	-
DPW Highway	$0.13	$3.33	$1.62	-
Bus Garage	-	$3.33	N/A	-
Senior Center	$0.12	N/A	$1.53	$10.41
Adult Day Center	$0.23	N/A	$1.51	-
Armory	$0.18	$3.33	$1.59	-

These rates serve as the rates used for the Year 1 period savings calculations.

The following savings have been calculated for the following buildings based off the data provided in the report.

Table 4: Year 1 Period Cost Avoidance Summary

Year 1 Period Cost Avoidance Summary									
Building	Electric Savings		Thermal Savings			Water / Sewer Savings		O & M	Total $ Saving
	kWh	Cost $	Oil Gals	Gas Therms	Cost $	kGal	Cost $	Savings	by Buildin
Town Hall	49,033	$5,419	8,900	(7,892)	$20,367	76	$1,050	$459	$27,29
Landfill Bldg. #2	5,192	$802	-	-	$0	0	$0	$127	$92
Animal Control	265	$32	-	1,649	$2,716	0	$0	$0	$2,74
Armory	0	$0	246	149	$1,052	0	$0	$0	$1,05
WWTP	13,931	$2,090	3,019	-	$10,017	15	$152	$116	$12,37
Police Station	0	$0	-	0	$0	0	$0	$0	$
Beach Bldg. #2	254	$59	-	-	$0	0	$0	$10	$6
Adult Day Center	1,202	$273	-	635	$959	0	$0	$30	$1,26
Water Dept. Bldg. #1	8,073	$1,030	264	-	$871	0	$0	$66	$1,96
Water Dept. Bldg. #2	4,625	$586	-	509	$753	0	$0	$21	$1,36
Water Dept. Bldg. #3	89	$15	-	15	$59	0	$0	$1	$7
DPW Highway	(2,517)	($315)	558	778	$3,113	0	$0	$0	$2,79
Senior Center	16,133	$1,915	-	1,108	$1,694	24	$246	$381	$4,23
Bus Garage	0	$0	308	-	$1,021	0	$0	$0	$1,02
TOTAL	**96,281**	**$11,905**	**13,294**	**(3,048)**	**$42,623**	**114**	**$1,448**	**$1,210**	**$57,18**


Year 1 Period Aggregate Cost Avoidance per Building
Installation Period Savings
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$0
-$5,000
Town Hall
Landfill Bldg. #2
Animal Control
Armory
WWTP
Police Station
Beach Bldg. #2
Adult Day Center
Water Dept. Bldg. #1
Water Dept. Bldg. #2
Water Dept. Bldg. #3
DPW Highway
Senior Center
Bus Garage
O&M
Water
Oil / Gas
Electric

Energy Conservation Measure Analysis

ECM 1: Lighting – Fixture Retrofit

ECM Overview

This measure consisted of lighting savings by replacing a combination of lamps, lamps & ballasts, or entire fixtures in areas throughout the following buildings and exterior spaces:

- **Westerly Town Hall**: Total of 358 Lighting Fixtures replaced / re-lamped
- **Landfill Building #2**: Total of 23 Lighting Fixtures replaced / re-lamped
- **Waste Water Treatment Plant**: Total of 212 Lighting Fixtures replaced / re-lamped
- **Beach Building #2**: Total of 7 Lighting Fixtures replaced / re-lamped
- **Adult Day Center**: Total of 31 Lighting Fixtures replaced / re-lamped
- **Water Department Building #1**: Total of 106 Lighting Fixtures replaced / re-lamped
- **Water Department Building #2**: Total of 24 Lighting Fixtures replaced / re-lamped
- **Water Department Building #3**: Total of 6 Lighting Fixtures replaced / re-lamped
- **Senior Center**: Total of 128 Lighting Fixtures replaced / re-lamped

M&V Activities

Pre- Installation:

- Baseline fixture inventory was established and recorded.
- Fixture power was determined by a combination of standard lighting and measurements taken.

Post- Installation:

- Visual inspection for completeness of installation.
- Fixture & Lamp / Ballast power was determined by measurement of sample of 38.5% of lighting power in conjunction with manufactures data and burn hours to calculate savings for ECM 1.

Savings & Calculations

The following two tables show the calculated Year 1 period savings along with the annual guaranteed savings for the lighting fixture retrofit for the Year 1 period.

Table 5: ECM 1 Lighting Savings Summary

ECM 1- Lighting – Fixture Retrofit								
Building	Annually Guaranteed Savings				Year 1 Period Savings			
	kW	kWh	MMBtu	Cost $	kW	kWh	MMBtu	Savings $
Town Hall	14.3	29,051	(54)	$1,906	22.8	43,523	(81)	$2,855
Landfill Building #2	1.6	2,794	-	$432	1.7	2,462		$380
WWTF	4.5	12,283	(21)	$1,350	5.7	13,931	(28)	$1,419
Beach Building #2	0.3	313	-	$72	0.3	254		$59
Adult Day Center	1.8	4,457	(7)	$909	0.4	916	(2)	$182
Water Dept. Building #1	3.0	8,073	(14)	$707	2.3	8,073	(16)	$642
Water Dept. Building #2	1.5	2,774	(5)	$280	1.5	4,625	(9)	$449
Water Dept. Building #3	0.4	98	(0)	$10	0.4	89	(0)	$8
Senior Center	7.2	27,046	(42)	$2,569	3.4	14,726	(27)	$1,329
TOTAL	**34.6**	**86,889**	**(142)**	**$8,234**	**38.3**	**88,599**	**(164)**	**$7,323**

Table 6: ECM 1 Lighting Savings Breakdown

ECM 1- Lighting – Fixture Retrofit Year 1 Period Savings									
Building	Lighting Savings		Cooling Credit	Heating Penalty		Total Savings			
	kW	kWh	kWh	kWh	MMBtu	kW	kWh	MMBtu	Savings $
Town Hall	22.8	40,293	3,230	-	(81)	22.8	43,523	(81)	$2,855
Landfill Building #2	1.7	5,990		(3,527)		1.7	2,462		$380
WWTF	5.7	13,931		-	(28)	5.7	13,931	(28)	$1,419
Beach Building #2	0.3	254		-		0.3	254		$59
Adult Day Center	0.4	848	68	-	(2)	0.4	916	(2)	$182
Water Dept. Building #1	2.3	8,073		-	(16)	2.3	8,073	(16)	$642
Water Dept. Building #2	1.5	4,625		-	(9)	1.5	4,625	(9)	$449
Water Dept. Building #3	0.4	89		-	(0)	0.4	89	(0)	$8
Senior Center	3.4	13,633	1,093	-	(27)	3.4	14,726	(27)	$1,329
TOTAL	**38.3**	87,736	4,391	**(3,527)**	**(164)**	**38.3**	**88,599**	**(164)**	**$7,323**

The following is a summary of the power measurements taken for the Lighting Retrofit to verify savings as per the contractual scope of work to verify the savings realized by the Town.
Post- Installation lighting power measurements were performed on 3/12/2014.

Table 7: ECM 1 Lighting Measurement Summary

Town of Westerly RI			Pre-Retrofit			Post-Retrofit		
Building Name	**Room Name**	**New Fixture Description**	**Fix Count**	**Total Wattage**	**Watts / Fixture**	**Fix Count**	**Measured Wattage**	**Watts / Fixture**
Town Hall	Court Room	12W LED SI	6	3510	585	6	607	101
Town Hall	Court Room	50W PAR56 LED	24	7200	300	24	646	27
Town Hall	Board Of Canvassors	2X4 2L 4' 25W T8 WR HEL	20	1760	88	20	909	45
Town Hall	Town Clerk	2X4 2L 4' 25W T8 WR HEL	20	1760	88	20	973	49
Landfill Building #2	Storage	NF 8' 4L 25WT8 WR HEL	3	369	123	3	121	40
Landfill Building #2	Storage	8' 4L 25WT8 WR HEL	4	492	123	4	240	60
Landfill Building #2	Storage	2X4 2L 4' 25W T8 WR HEL	2	288	144	2	60	30
WWTP	Elec. Room	4' 2L 4'25W T8 HEL	25	1125	45	25	1080	43
WWTP	Pump Room	4' VP 3L 25W T8 HEL	8	672	84	8	432	54
WWTP	Pump Room	4' VP 3L 25W T8 HEL	15	1260	84	15	810	54
WWTP	Pump Room	4' VP 3L 25W T8 HEL	20	1680	84	20	1080	54
Beach Building #2	Kitchen	4' 2L 25W T8 HEL	4	240	60	4	150	38
Adult Day Center	Serendipity	2 17W T8s, WR HEN	4	176	44	4	126	32
Adult Day Center	Hallways	2 17W T8s, WR HEN	3	132	44	3	102	34
Water Dept. Bldg. #1	Lobby	2X2 2L 17W T8 WR HEN	9	540	60	9	312	35
Water Dept. Bldg. #1	Toms Office	2X2 2L 17W T8 WR HEN	6	432	72	6	208	35
Water Dept. Bldg. #1	3 Bay Garage	4' 2L 25W T8 HEL	14	840	60	14	399	29
Water Dept. Bldg. #2	Main Garage Area	NF 8' 4L 25WT8 R Wrap	6	738	123	6	648	108
Water Dept. Bldg. #2	Storage	New 17W LED SI	3	300	100	3	84	28
Water Dept. Bldg. #2	Storage	New 17W LED SI	6	600	100	6	132	22
Water Dept. Bldg. #3	Pump Room 2	4' 4L 4'25W T8 HEL	3	432	144	3	228	76
Senior Center	Craft Room	4L 4'-25W T8 HEL	8	936	117	8	614	77
Senior Center	Woodshop	3L 4' 25W T8 HEL	9	792	88	9	419	47
Senior Center	Multipurpose Room	3L 4' 25W T8 HEL	18	1584	88	18	1176	65
Senior Center	Cafeteria	3L 4' 25W T8 HEL	23	2024	88	23	1503	65
Senior Center	Cafeteria	4L 4'-25W T8 HEL	15	1755	117	15	1152	77

The below formulas were used to calculate the electric savings:

$$EFW_i = \frac{EMCW_i}{EF_i}$$

$$NFW_i = \frac{NMCW_i}{NF_i}$$

EFW_i:	Existing Fixture Kilo-Wattage for Each Type (i) (Kilo-Watts per fixture type)
$EMCW_i$:	Existing Measured Circuit Kilo-Wattage for Each Type (i) (Kilo-Watts)
EF_i:	Number of Existing Fixtures on Circuit for Each Type (i).
NFW_i:	New Fixture Kilo-Wattage for Each Type (i) (Kilo-Watts per fixture type)
$NMCW_i$:	New Measured Circuit Kilo-Wattage for Each Type (i) (Kilo-Watts)
NF_i:	Number of Fixtures on Circuit for Each Type (i).

$$LTG = \sum (NFW_i - EFW_i)\ x\ HRS_i$$

LTG:	Lighting kWh Reduction
$\sum (NFW_i - EFW_i)$:	Sum of Fixture kilo-wattage savings from Lighting Retrofit
HRS_i:	Annual Burn Hours per Fixture (as defined by loggers)

Since more efficient lighting is being introduced, cooling equipment does not have to cool as much heat coming from the lighting. However, more heating is required. This is taken into account with the following formulas:

$$CLR = LTG\ x\ \frac{12{,}000}{3.5}\ x\ \frac{4.5}{12}\ x\ \frac{0.65}{12{,}000}$$

$$HEAT = LTG\ x\ \frac{12{,}000}{3.5}\ x\ \frac{7.5}{12}\ x\ \frac{1}{1{,}00{,}000}$$

CLR:	Cooling Load Reduction (kWh)
$HEAT$:	Heating Load Increase (MMBtu)
$\frac{12{,}000}{3.5}$:	3.5 kWh of Lighting generates 12,000 BTU's of Heating Load
$\frac{4.5}{12}$ / $\frac{7.5}{12}$:	Percentage of cooling / heating per year
$\frac{0.65}{12{,}000}$:	0.65 kWh of electrical power is needed for the HVAC system to remove 12,000 BTU's of Heat
$\frac{1}{1{,}000{,}000}$:	Conversion factor from BTU's to MMBTU's

ECM 3: Weatherization

ECM Overview

This measure consisted of savings by reducing infiltration / exfiltration through the installation of a combination of door sweeps, frame weatherization, and astragals (center partition between double doors) in the following buildings:

- **Westerly Town Hall**
- **Landfill Building #2**
- **Animal Control**
- **Armory**
- **WWTP**
- **Adult Day Center**
- **Water Department Building #1**
- **Water Department Building #2**
- **DPW Highway**
- **Water Department Building #3**
- **Senior Center**
- **School Bus Garage**

M&V Activities

Pre- Installation:

- Record and measure weatherization areas to be included in scope of work.
- Identify weatherization portion of whole facility thermal savings.

Post- Installation:

- Visual inspection for completeness of installation and scope completion.

Savings & Calculations

The following calculated Year 1 period savings & annual guaranteed savings for the weatherization scope are performed via spreadsheet analysis using industry standard ASHRAE methodology.

Table 8: ECM 3 Weatherization Savings Summary

ECM 3- Weatherization						
Building	Annually Guaranteed			Year 1 Period		
	kWh	MMBtu	$ Savings	kWh	MMBtu	$ Savings
Town Hall	189	56	$1,383	189	56	$1,383
Landfill Building #2	1,610	0	$249	1,610	0	$249
Animal Control	265	60	$1,028	265	60	$1,028
Armory	0	49	$1,052	0	49	$1,052
WWTP	0	128	$3,062	0	128	$3,062
Adult Day Center	286	65	$1,050	286	65	$1,050
Water Dept. Bldg. #1	0	53	$1,259	0	53	$1,259
Water Dept. Bldg. #2	0	46	$686	0	46	$686
DPW Highway	0	51	$1,016	0	51	$1,016
Water Dept. Bldg. #3	0	2	$66	0	2	$66
Senior Center	229	52	$827	229	52	$827
Bus Garage	0	23	$546	0	23	$546
TOTAL	**2,580**	**585**	**$12,223**	**2,580**	**585**	**$12,223**

ECM 5: Temperature Setback

ECM Overview

Temperature Setback will occur in spaces during unoccupied periods (nights, weekends, holidays) using the capabilities from the Energy Management Systems (EMS) in the following buildings:

- **Westerly Town Hall**
- **Senior Center**

Temperature Setback will occur in spaces during unoccupied periods (nights, weekends) using the capabilities from new programmable thermostats in the following buildings:

- **Landfill Building #2**
- **WWTP**
- **Water Department Building #2**
- **DPW Highway**
- **School Bus Garage**

M&V Activities

Pre- Installation:

- Record existing control strategies, capabilities, and specifications of the equipment and controls.
- Perform short-term trending of temperatures, loads, etc.

Post- Installation:

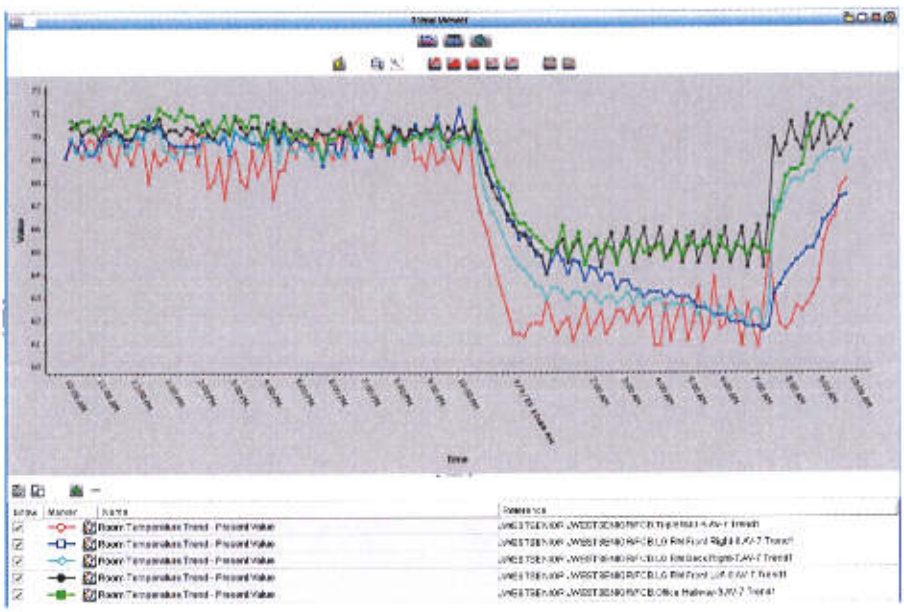
- Verify scope of work has been properly implemented.
- Continuous trending of parameters affecting performance (setpoints, temperatures, motor run hours, schedules, etc.) for calculation of electric savings.

Senior Center

Senior Center setback savings modelled on 730 AM to 530PM usage Monday through Friday

Building	Existing HVAC Hours	Proposed HVAC Hours
Senior Center	7:30 AM – 5:30 PM (M-F)	7:30 AM – 5:30 PM (M-F)

Building EMS occupied scheduled for 7AM to 10PM- 7 days a week for all spaces
Office area schedule reduced to 7AM to 6PM on 3/2/15 to provide additional setback savings



According to the trend study, all five zones are setting back in the Senior Center during unoccupied periods. At the time of this trend capture (3/2/15), the Large Room front left unoccupied temperature (black) setpoint was changed from 65F to 61F (based on ability to rise quickly to occupied temp). Also, the office hallway (green) unoccupied setpoint was modified from 63F to 61F (also due to response rate). This placed the unoccupied temperature for all spaces at a global 61F for the building.

Town Hall

Town Hall setback savings modelled on 7 AM to 5PM usage Monday through Friday

Building	Existing HVAC Hours	Proposed HVAC Hours
Town Hall	7:00 AM – 5:00 PM (M-F)	7:00 AM – 5:00 PM (M-F)

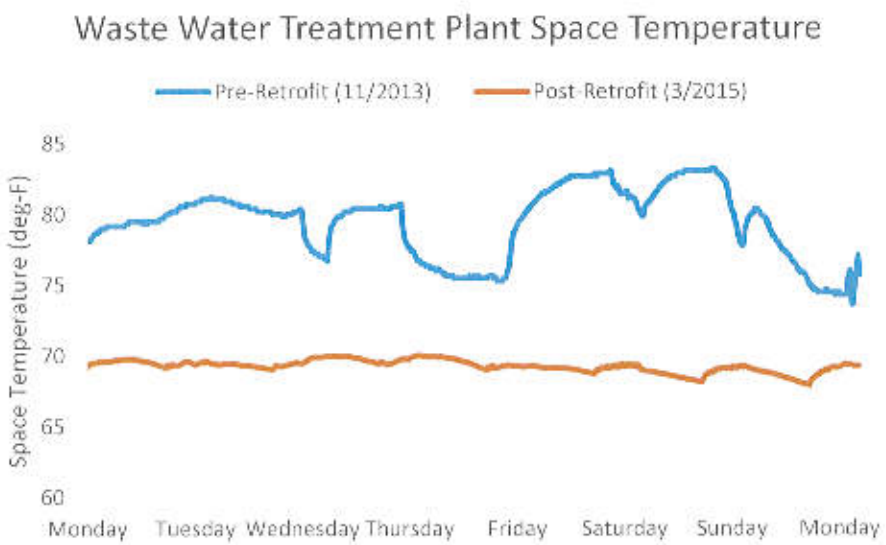
Building occupied EMS schedule has been modified several times over the course of the Year 1 period. The first notable change was in the middle of January when the schedule for AHU-1 & AHU-2 was changed to 24-7 occupied period. This was discovered at the end of February by JCI due to high gas bill and reverted to 5 day scheduled operation. This impact can be seen in the building usage in February 2015 (also happened to be the coldest February on record).

Another notable change was made in the middle of August 2015 when the units were once again scheduled for 7 day operation. (See 'Additional Recommendations / Notes' of the following page). The current schedule has the units turn on between 5:25AM and 6AM and run all day until Midnight.

Also, due to reversed polarity of valves in the town hall fan coil units, there was a period during the middle of summer in which 17 of the 60 units were overridden to have fans run continuously with a wide open valve. This item is still being addressed by JCI- with Westerly personnel.

WWTP

Water treatment plant space temperatures are much more desirable during winter-time conditions with the work performed on site as part of this project. Temperatures are no longer in the high 70's to 80's with poor control of the steam heat. Savings are realized from reducing heat to necessary levels. Data obtained pre-project from November 11 – 18 in 2013 and post project March 9 – 16 in 2015.



Savings & Calculations

The electric savings from installation of temperature setback are provided below and were performed via spreadsheet analysis using industry standard ASHRAE methodology.

Table 9: ECM 5 Temperature Setback Savings Summary

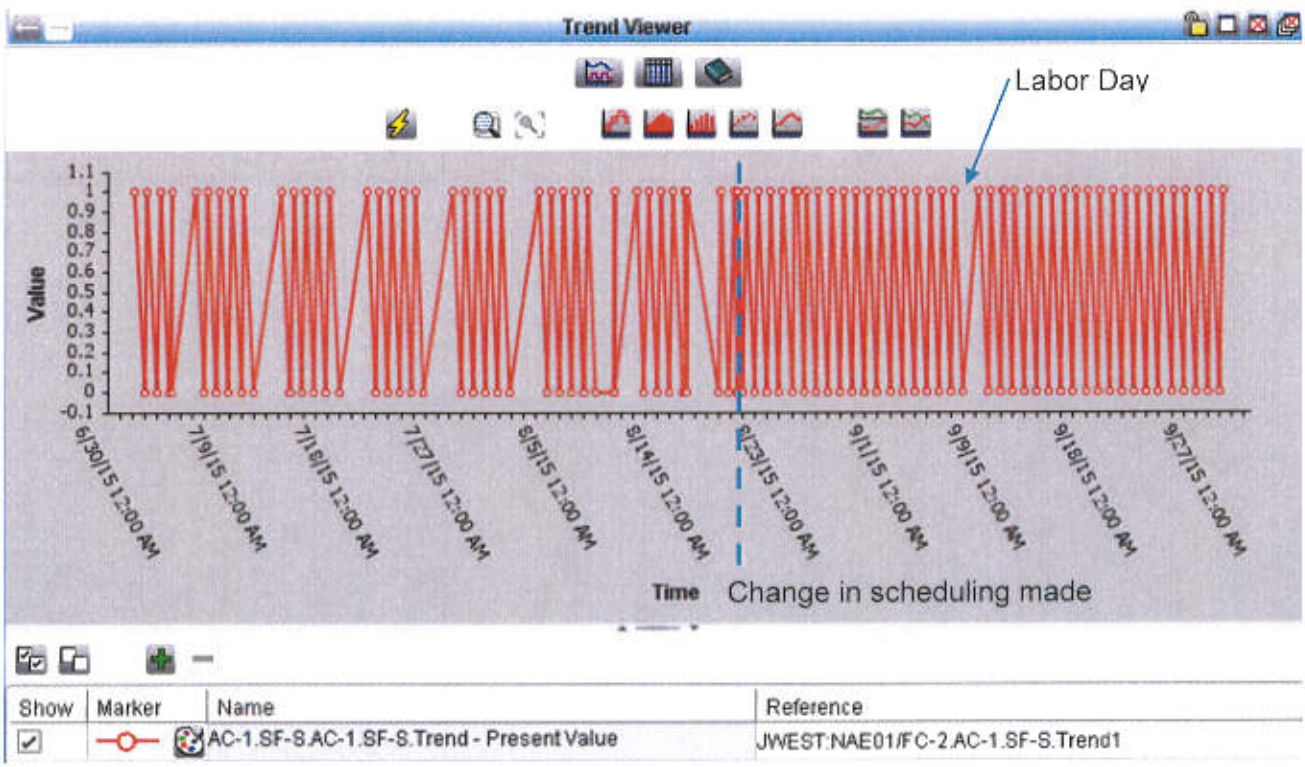
ECM 5- Temperature Setback						
Building	Annually Guaranteed			Year 1 Period		
	kWh	MMBtu	$ Savings	kWh	MMBtu	$ Savings
Town Hall	3,503	231	$5,966	5,321	132	$3,776
Senior Center	2,062	113	$1,979	1,034	0	$160
Landfill Building #2	1,034	-	$160	0	105	$2,521
WWTP	-	100	$2,400	0	14	$205
Water Dept. Bldg. #2	-	14	$205	0	35	$696
DPW Highway	-	28	$557	1,178	56	$997
Bus Garage	-	20	$475	0	20	$475
TOTAL	**6,599**	**506**	**$11,742**	**7,533**	**362**	**$8,830**

Additional Recommendations / Notes

Examination of occupied schedules for optimal energy savings at Town Hall

Project savings modelled on 7AM to 5PM usage Monday through Friday

Currently 7 days a week 5AM through Midnight- changed in end of August



*** Proof of Impact- Utility Billing shows that 1 month electric utility usage after change has used an estimated 5,000 kWh above expected usage from change

ECM 6: Heating System- Boiler Replacement

ECM Overview

Replacement of existing boilers will create savings through combustion efficiency increases and through the conversion in fuel from oil to natural gas in the following buildings:

- **Westerly Town Hall**

M&V Activities

Pre- Installation:

- Record existing control strategies during varying outdoor air conditions
- Use BIN data (outdoor air temperature) to determine boilers energy usage consumption baseline
- Perform boiler combustion efficiency testing

Post- Installation:

- Verify scope of work has been properly implemented.
- Trending of parameters affecting performance (through EMS system)
- Tracking of natural gas usage via utility bills
- Boiler combustion efficiency testing

Old Oil fired boilers which were removed

1 of 2 Natural Gas fired Boilers Installed

Savings & Calculations

The savings from installation of new boilers are provided below and were performed via spreadsheet analysis using industry standard ASHRAE methodology and verified using utility history from the building over the past year.

Table 10: ECM 6 Boiler Replacement Savings Summary

ECM 6- Heating System – Boiler Replacement				
Building	Annually Guaranteed		Year 1 Period	
	MMBtu Savings	Cost $ Savings	MMBtu Savings	Cost $ Savings
Town Hall	183	$8,902	203	$14,569

Equations used within the calculation include:

$$Boiler\ Efficiency_i = \frac{Heat\ Production_i}{Fuel\ Input_i}$$

$$Energy\ Savings = Fuel\ Input_{Pre}\ x\ (1 - \frac{Boiler\ Efficiency_{Pre}}{Boiler\ Efficiency_{Post}})$$

$$Cost\ Savings = (Fuel\ Input_{\ Pre} x\ \frac{\$}{Gallon_{Oil}}) - (Fuel\ Input_{Post}\ x\ \frac{\$}{Therm_{Gas}})$$

where $Fuel\ Input_i$ reflects the building usage less savings from other measures

ECM 8: Pipe & Valve Insulation

ECM Overview

Through the installation of new piping insulation on piping with damaged or non-existent insulation, thermal savings will be realized by providing better temperature control and fewer losses in the following buildings:

- **Westerly Town Hall**
- **Landfill Building #2**
- **Animal Control**
- **WWTP**
- **DPW Highway**
- **Senior Center**

M&V Activities

Pre- Installation:

- Record and measure pipe and valve insulation areas to be included in scope of work.
- Identify pipe and ambient temperatures of insulation areas

Post- Installation:

- Verify scope of work has been properly implemented.
- Review of savings using ASHRAE formulas and as-built scope

Savings & Calculations

Below are the calculated Year 1 period savings along with the annual guaranteed savings for the pipe and valve insulation.

Table 11: ECM 8 Pipe & Valve Insulation Savings Summary

ECM 8- Pipe & Valve Insulation						
Building	Annually Guaranteed Savings			Year 1 Period Savings		
	kWh	MMBTU	$ Savings	kWh	MMBTU	$ Savings
Town Hall	-	133	$3,202	-	133	$3,202
Landfill Bldg. #2	86	-	$13	86	-	$13
Animal Control	-	104	$1,721	-	104	$1,721
WWTP	-	206	$4,928	-	206	$4,928
DPW Highway	-	39	$784	-	39	$784
Senior Center	-	27	$407	-	27	$407
TOTAL	**86**	**509**	**$11,055**	**86**	**509**	**$11,055**

Using the following formulas, the insulation savings for the Year 1 period are calculated:

Q = K (Delta T) / L+(K/Ht)
Q = Heatloss (BTU/Hr. / Sq. Ft.)
K = Thermal Conductivity (25) (BTU/Ft.Hr.deg F)
L = Insultion Thickness (in.)
Delta T = Surface Temp - Ambient Temp.
Ht = Combined Coefficients (3.2) - (Radiation, Convection and Conduction)

~~ECM 11: Computer Management System~~
ECM 11A: Fan Circulation System

ECM Overview

Ceiling mounted fans have been installed in order to de-stratify air in areas where roof height in areas is higher than the conventional standard one story height. These fans will push warmer air downward during heating months, there-by satisfying the thermostat longer and requiring less heat. They have been installed in the following buildings:

- **DPW Highway**

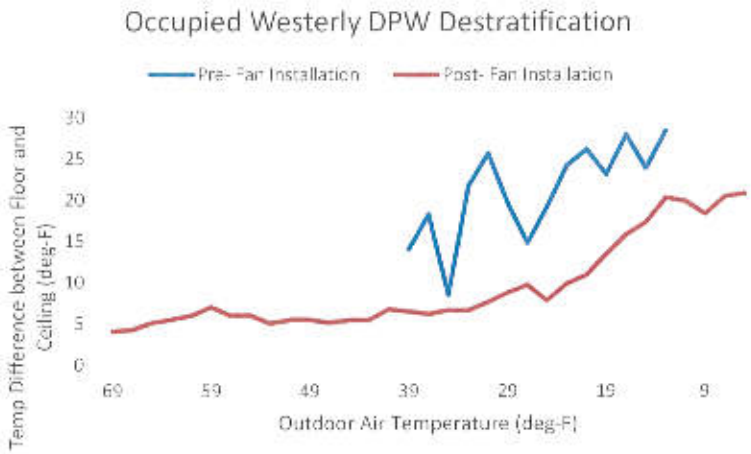
M&V Activities

Pre- Installation:

- Measurement of distances of roof and wall heights
- Data logging in various areas to obtain thermal layering in building

Post- Installation:

- Use of data loggers to confirm thermal layering in building has been decreased



Savings & Calculations

The savings from fans in the space provided below and were performed via the provided calculations.

Table 12: ECM 11A Fan Circulation System Savings Summary

ECM 11A- Fan Circulation System						
Building	Annually Guaranteed Savings*			Year 1 Period Savings		
	kWh	MMBtu	Cost $ Savings	kWh	MMBtu	Cost $ Savings
DPW Highway	2,806	0	$365	(2,517)	31	$301

*Annually Guaranteed Savings is from ECM 11- Computer Power Management

Savings are comprised of thermal heating savings with a small deduct for added electrical usage.

ECM 12: Water Conservation

ECM Overview

Savings are obtained in this measure through the reduction in water usage at end fixtures such as sinks, showers, toilets, and urinals at the following locations:

- **Westerly Town Hall**
- **WWTP**
- **Senior Center**

M&V Activities

Pre- Installation:

- Perform sampling on existing fixtures to verify manufacturer specifications.
- Identify domestic water heating portion of whole facility thermal usage.

Post- Installation:

- Sampling of new fixtures to confirm manufacturer specifications to calculate water savings.

Savings & Calculations

There are no electric savings as part of this measure.
The gas / oil savings from water conservation is analyzed as part of the line by line workbook calculation which uses the formula included below.
Below are the calculated Year 1 period water savings along with the annual guaranteed savings.

Table 13: ECM 12 Water Savings Calculation

ECM 12- Water Conservation (Water / Sewer)						
Building	Annually Guaranteed Savings			Year 1 Period Savings		
	kGal	MMBtu	Cost $ Savings	kGal	MMBtu	Cost $ Savings
Town Hall	97	0	$1,344	76	0	$1,050
WWTP	16	7	$273	15	7	$329
Senior Center	26	3	$320	24	3	$295
TOTAL	**138**	**11**	**$1,937**	**114**	**11**	**$1,674**

Using the following formula, the water savings for the Year 1 period is calculated:

$$WATER = \sum USE_i \; x \; [GAL_{Pre_i} - GAL_{Post_i}] \; x \; \frac{1\,kGal}{1{,}000\,Gal}$$

$WATER$:	Water Fixture Replacement Savings (kGal)
USE_i:	Average users / use per fixture (i)
GAL_{Pre_i}:	Gallons per minute / gallons per flush before replacement
GAL_{Post_i}:	Gallons per minute / gallons per flush after replacement

ECM 13: Condition "A" – Rooftop AHU

ECM Overview

JCI has identified and repaired existing AHUs which were not operating correctly. The issues with AHUs were non -functioning controls and defunct valve actuators and linkages. These lead to lack of control and inability of the systems to meet ventilation requirements and has been eliminated in the following locations:

- **Westerly Town Hall**

Scope

- Remove and replace frozen dampers in AHUs
- Remove and replace 6 actuators in AHUs

M&V Activities

Pre- Installation:

- Identify scope of work

Post- Installation:

- Verify scope of work has been completed

Savings & Calculations

There are no savings as part of this measure.

Environmental Impact

The included tables provide a summary of the environmental impact of the Year 1 period and the reduction in greenhouse gas (Carbon Dioxide) emissions as a result of reduced electric, oil, and natural gas usage for Westerly buildings.

Table 14: Greenhouse Gas Calculator Summary

Energy Project GHG Calculator *for the US*

Please provide data on expected energy consumption savings based on the project's characteristics for each different source.		Total Reduced GHGs	151.7	metric tons CO_2-e
Electricity				
		eGRID Subregion	NEWE	NPCC New England
Enter location's Zip Code:	02891	Emission Factor	0.00033465	metric tons CO_2-e/kWh
kWh	96,281	Reduced GHGs	32.2	metric tons CO_2-e
Natural Gas				
		Emission Factor	0.0053	metric tons CO_2-e/therms
Therms	-3,048	Reduced GHGs	-16.2	metric tons CO_2-e
Propane/LPG				
		Emission Factor	0.0058	metric tons CO_2-e/gal
Gallons		Reduced GHGs	0.0	metric tons CO_2-e
Distillate Fuel Oil (#1,2 & 4)				
		Emission Factor	0.0102	metric tons CO_2-e/gal
Gallons	13,294	Reduced GHGs	135.6	metric tons CO_2-e
Residual Fuel Oil (#5 & 6)				
		Emission Factor	0.0119	metric tons CO_2-e/gal
Gallons		Reduced GHGs	0.0	metric tons CO_2-e

* All fossil fuel emission factors consider stationary combustion only.

Sources:

Electricity: Non-baseload output emissions rates* eGRID 2012 Version 1.0 files from EPA website: <http://www.epa.gov/cleanenergy/energy-resources/egrid/index

Other emission factors: EPA Climate Leaders Guidance Documents, Direct Emissions from Stationary Combustion Sources, November 2009.

Energy Project GHG Calculator, USA Version 5.1

Table 15: Greenhouse Gas Equivalency Summary

The project's reduced emissions would be equivalent to:

CO_2 sequestered by	**3,889**	**tree seedlings grown for 10 years in an urban scenario**	
CO_2 sequestered by	**32**	**acres of pine or fir forests**	
CO_2 emissions from	**29**	**passenger vehicles**	
CO_2 emissions from	**353**	**barrels of oil consumed**	
CO_2 emissions from the *energy* use of	**13**	**homes for one year**	
CO_2 emissions from burning	**1**	**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>

Appendix A:
Report Acceptance

Year 1 Period Report
September 2014 – August 2015
Total Cost Avoidance: $57,186

This report was presented and accepted in accordance with the guarantee documents that are part of the performance contract agreement between Westerly RI and Johnson Controls, Inc.

Authorized Signature
Westerly, RI

Date

Authorized Signature
Johnson Controls, Inc.

Date

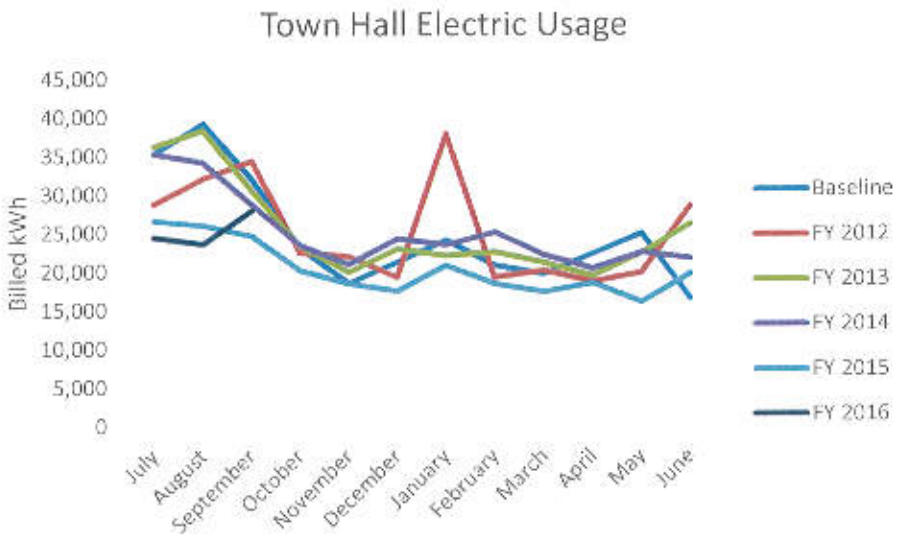
Appendix B:
Large Building -Utility Use Analysis

Westerly Town Hall

Electricity:

Table 16: Town Hall Electric Utility Usage

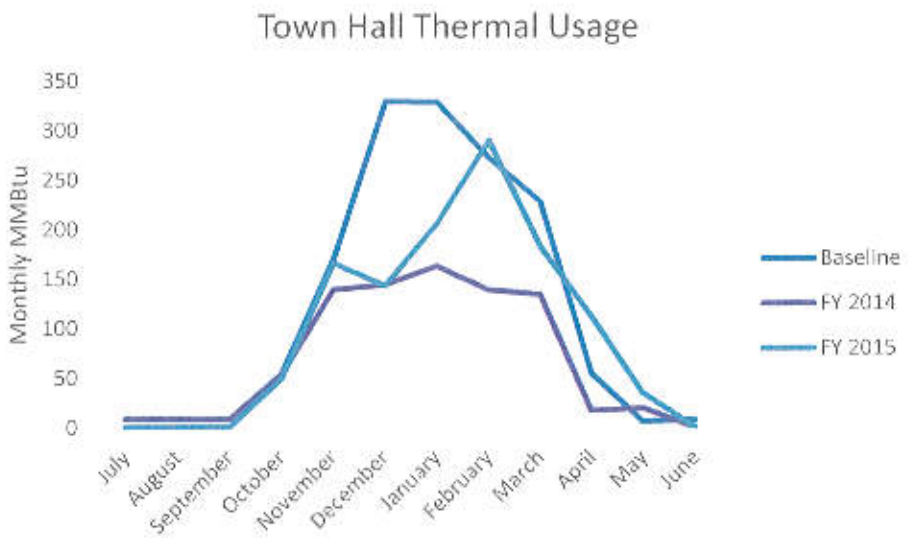
Westerly Town Hall kWh Usage									
Month	**Year**								
	FY 2009	*FY 2010*	*Baseline*	... ...	*FY 2012*	*FY 2013*	*FY 2014*	*FY 2015*	*FY 2016*
July	37,520	33,200	35,360	... ...	28,800	36,320	35,280	26,560	24,400
August	34,640	43,840	39,240	... ...	32,080	38,320	34,160	26,000	23,600
September	33,680	30,320	32,000	... ...	34,400	30,560	28,720	24,640	27,920
October	24,720	21,280	23,000	... ...	22,480	23,360	23,440	20,160	
November	18,080	18,880	18,480	... ...	22,000	20,000	20,960	18,400	
December	22,240	20,240	21,240	... ...	19,320	22,960	24,240	17,520	
January	23,760	24,400	24,080	... ...	37,920	22,080	23,520	20,800	
February	22,320	19,280	20,800	... ...	19,280	22,560	25,120	18,400	
March	20,240	19,120	19,680	... ...	20,160	21,200	22,160	17,360	
April	18,240	26,360	22,300	... ...	18,720	19,440	20,400	18,480	
May	16,240	33,600	24,920	... ...	19,840	22,400	22,480	16,000	
June	30,880	2,160	16,520	... ...	28,480	26,160	21,680	19,680	
Total	**302,560**	**292,680**	**297,620**	... ...	**303,480**	**305,360**	**302,160**	**244,000**	-



Natural Gas / Oil (Thermal):

Table 17: Town Hall Thermal Utility Usage

Westerly Town Hall MMBtu Usage							
Month	**Year**						
	FY 2009	*FY 2010*	*Baseline*	*... ...*	*FY 2014*	*FY 2015*	*FY 2016*
July	5	12	9	... ...	9	0	0
August	5	12	9	... ...	9	0	0
September	5	12	8	... ...	8	0	
October	45	62	54	... ...	53	49	
November	195	145	170	... ...	139	166	
December	345	313	329	... ...	144	143	
January	307	351	329	... ...	163	206	
February	274	271	272	... ...	139	290	
March	300	155	228	... ...	134	183	
April	105	3	54	... ...	17	112	
May	8	4	6	... ...	20	34	
June	12	3	7	... ...	0	0	
Total	**1,607**	**1,342**	**1,474**	**... ...**	**835**	**1,183**	

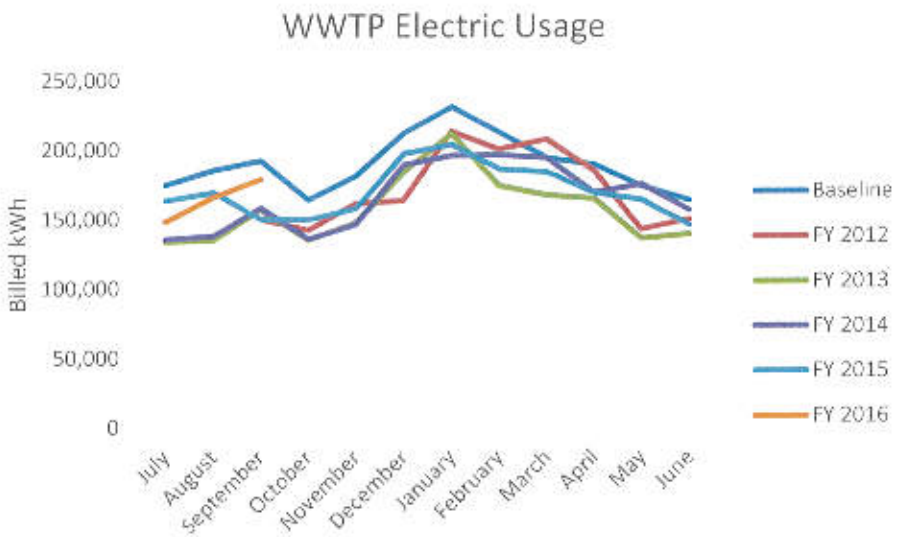


Westerly WWTP

Electricity:

Table 18: WWTP Electric Utility Usage

Westerly WWTP kWh Usage									
Month	**Year**								
	FY 2009	*FY 2010*	*Baseline*	... ...	*FY 2012*	*FY 2013*	*FY 2014*	*FY 2015*	*FY 2016*
July	191,969	157,838	174,904	... ...		133,984	135,482	163,550	148,356
August	208,738	162,132	185,435	... ...		134,954	137,964	169,593	166,197
September	198,758	185,709	192,234	... ...	150,279	157,051	158,289	149,914	178,914
October	153,578	174,955	164,267	... ...	142,500	135,458	135,947	149,873	
November	186,777	175,721	181,249	... ...	161,541	147,482	146,271	157,891	
December	223,854	201,032	212,443	... ...	163,729	183,995	189,297	197,291	
January	224,038	238,421	231,230	... ...	213,762	211,794	196,101	204,110	
February	221,356	204,211	212,784	... ...	200,617	174,468	196,386	186,201	
March	194,120	194,025	194,073	... ...	207,657	167,581	194,091	184,089	
April	189,891	188,742	189,317	... ...	185,249	164,936	169,248	169,102	
May	186,112	161,921	174,017	... ...	142,963	136,055	175,287	163,909	
June	162,407	164,744	163,576	... ...	149,976	139,246	156,592	145,803	
Total	**2,341,598**	**2,209,451**	**2,275,525**	**... ...**	**-**	**1,887,004**	**1,990,955**	**2,041,326**	**-**



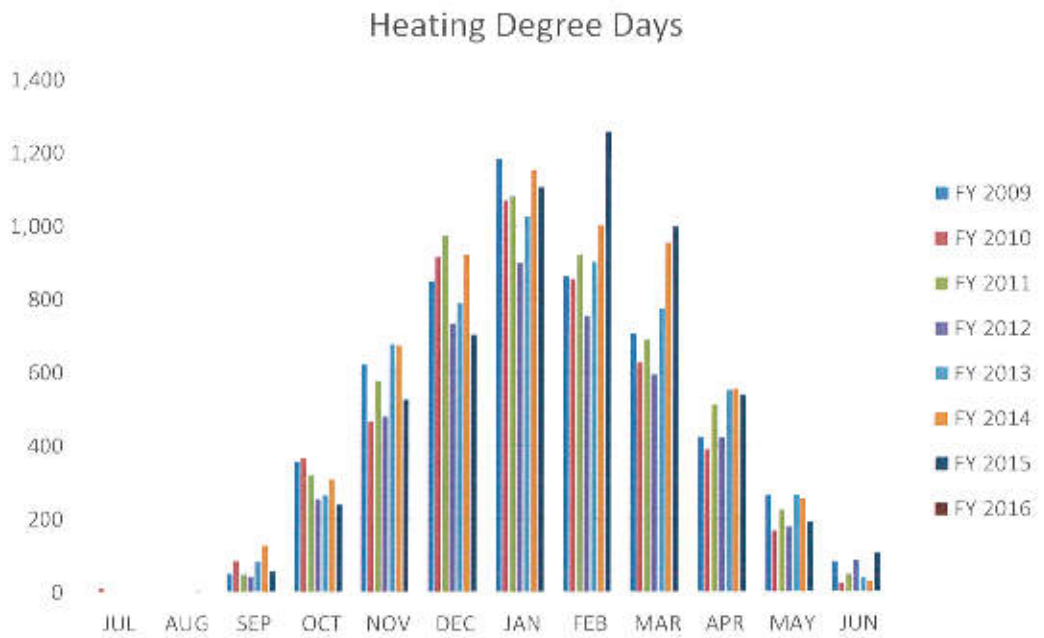
Appendix C: Weather Data

Heating Degree Days

Table 19: Heating Degree Day History

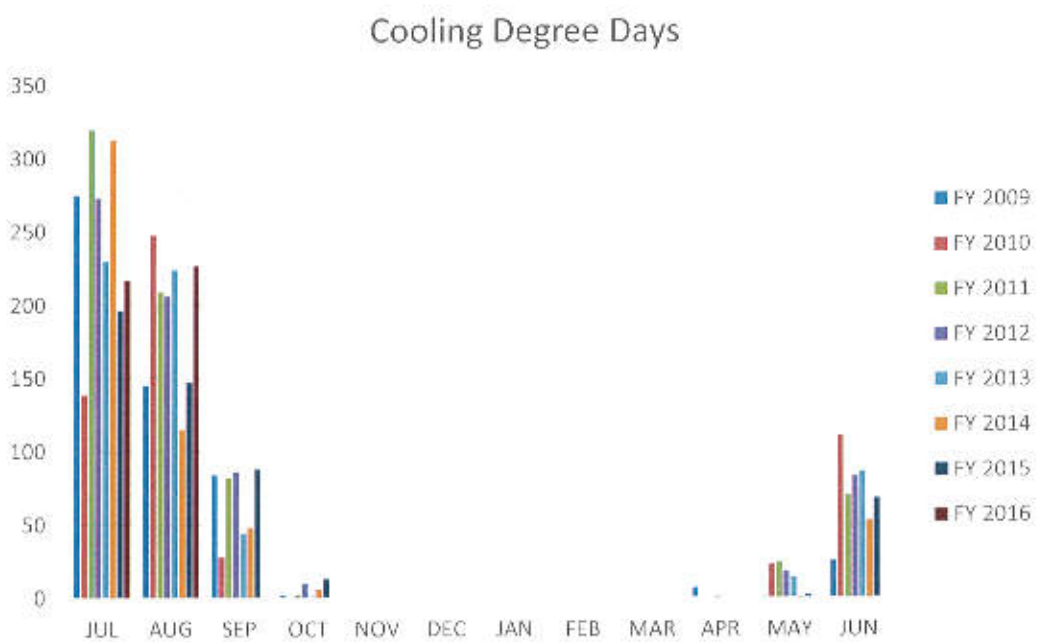
Heating Degree Days								
Newport, RI (Base 65F)								
MONTH	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
JUL	0	11	0	0	1	0	0	0
AUG	1	1	2	0	0	4	1	0
SEP	51	87	50	43	85	129	58	
OCT	356	366	320	254	265	308	240	
NOV	622	467	578	480	678	674	526	
DEC	850	916	974	734	789	923	703	
JAN	1,184	1,071	1,082	900	1,026	1,154	1,107	
FEB	863	856	922	754	903	1,003	1,257	
MAR	706	628	689	595	775	955	999	
APR	424	390	512	422	552	555	539	
MAY	265	168	225	179	265	257	192	
JUN	83	25	48	86	40	31	106	
TOTAL	**5,405**	**4,986**	**5,402**	**4,447**	**5,379**	**5,993**	**5,728**	-

Source: National Oceanic and Atmospheric Administration
http://www.erh.noaa.gov/box/dailystns.shtml



Cooling Degree Days

Table 20: Cooling Degree Day History

Cooling Degree Days								
Newport, RI (Base 65F)								
MONTH	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016
JUL	275	139	320	273	230	313	196	217
AUG	145	248	209	206	224	115	147	227
SEP	84	28	82	86	44	48	88	
OCT	2	0	2	10	1	6	13	
NOV	0	0	0	0	0	0	0	
DEC	0	0	0	0	0	0	0	
JAN	0	0	0	0	0	0	0	
FEB	0	0	0	0	0	0	0	
MAR	0	0	0	0	0	0	0	
APR	7	0	0	1	0	0	0	
MAY	1	23	24	18	14	1	2	
JUN	25	111	70	83	86	53	68	
TOTAL	**539**	**549**	**707**	**677**	**599**	**536**	**514**	-

Source: National Oceanic and Atmospheric Administration
http://www.erh.noaa.gov/box/dailystns.shtml