Onondaga County Energy Performance Project

ONONDAGA COUNTY WASTEWATER TREATMENT PLANTS-
Baldwinsville-Seneca, Brewerton, Meadow Brook-Limestone, and Oak Orchard

Prepared for

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SECTION 1 – EXECUTIVE SUMMARY

1.1 – Purpose

Baldwinsville-Seneca, Brewerton, Meadow Brook-Limestone, and Oak Orchard Waste Water Treatment Plants are part of a comprehensive countywide energy initiative. Onondaga County has contracted with Carrier Corporation, in the form of a performance contract, to survey the 25 largest energy-using sites in an effort to identify and develop energy conservation measures, "ECMs." These energy conservation measures will be analyzed and collectively evaluated for potential implementation by Carrier Corporation in conjunction with/or independent of any "Capital Plan" being developed for the Onondaga County Justice Center.

The objectives of Carrier's partnership with Onondaga County in the performance of the energy project are:

- **Reduce energy consumption**
- **Reduce operating costs**
- **Positively affect the facilities personnel, internees, and visitor's comfort**
- **Upgrade antiquated infrastructure to today's standards**
- **Heating and Cooling System reliability**
- **Provide facility operational guidelines**
- **Service and maintenance of equipment and control systems for optimal energy efficiency and long-term reliability.**

1.2 – Site Overviews

Baldwinsville-Seneca Waste Water Treatment Plant

The Baldwinsville-Seneca Waste Water Treatment Plant includes three buildings; a control building, a pump building and a treatment building. The office building is staffed 24 hours a day / 365 days a year. The combined size of the buildings is approximately 70,500 Sq./ft. and is approximately 20 years old.

The square footage breakdown of the facility is as given in Table ***1.1***. A picture of the facility is given in Figure1.1.

Area	Square Footage
Process Area	*39,308*
Office Area	*31,216*
Heated Area	*70,524*
Cooled Area	*31,216*
Heated & Cooled	*31,216*

Table 1.1, Baldwinsville square footage breakdown

Figure1.1, Baldwinsville waste water treatment plant

Brewerton Waste Water Treatment Plant

The Brewerton Waste Water Treatment Plant includes three buildings; a control building, pump building and treatment building. The office building is staffed 24 hours a day / 365 days a year. The combined size of the buildings is approximately 16,4700 Sq./ft. and is 30 years old.

The square footage breakdown of the facility is as given in Table ***1.2***. A picture of the facility is given in Figure ***1.2***.

Area	Square Footage
Process Area	*11,333*
Office Area	*5,064*
Heating Area	*16,397*
Cooling Area	*3,584*
Heated & Cooled	*3,584*

Table 1.2, Brewerton square footage breakdown

Figure 1.2, Brewerton waste water treatment plant

Meadow Brook-Limestone Waste Water Treatment Plant

The Meadowbrook-Limestone Waste Water Treatment Plant consists of five buildings. The office building is staffed 24 hours a day / 365 days a year. The combined size of the buildings is approximately 19,000 Sq./ft. The facility was built approximately 27 years ago.

The square footage breakdown of the facility is as given in Table ***1.32***. A picture of the facility is given in Figure 1.3 .

Area	Square Footage
Process Area	*12,024*
Office Area	*6,960*
Heating Area	*18,984*
Cooling Area	*3,016*
Heated & Cooled	*3,016*

Table 1.32, Meadowbrook square footage breakdown

Figure 1.3, Meadowbrook-Limestone waste water treatment plant

Oak Orchard Waste Water Treatment Plant

The Oak Orchard Waste Water Treatment Plant consists of four buildings; a control building, compressor building, pump building, and treatment building. The office building is staffed 24 hours a day / 365 days a year

The building was constructed in or around 1976 and has a total floor area of approximately 83,000 square feet. The square footage breakdown of the facility is as given in
Table ***1.4***. A picture of the facility is given in
Figure ***1.4***.

Area	Square Footage
Process Area	*56,984*
Office Area	*25,984*
Heating Area	*82,968*
Cooling Area	*16,800*
Heated & Cooled	*16,800*

Table 1.4, Oak Orchard square footage breakdown

Figure 1.4, Oak Orchard waste water treatment plant

1.3 – Project Summary

The total electrical and gas energy costs at the Waste Water Treatment Plants for the base year (2002) are shown in table 1.5 below:

Facility	Electric Cost	Natural Gas Cost	Total Energy Cost
Baldwinsville-Seneca	$536,373	$0	$536,373
Brewerton	$237,298	$0	$237,298
Meadow Brook-Limestone	$366,810	$0	$366,810
Oak Orchard	$372,543	$71,391	$443,934
			Total = $1,584,414

Table 1.5

The ECMs listed in the Summary Tables, tables 1.6 and 1.7, in this section represent an estimated annual savings of $97,101 (exclusively electric savings). The ECM projected savings are based on current energy costs budgeted for 2006.

The Waste Water Treatment Facility's listed in this report had their facility lighting, electric motors, heating, cooling and process systems evaluated for energy savings. As of this printing, the county has elected to implement the lighting retrofit ECM at Oak Orchard and has incorporated this ECM into the 13 site lighting project (authorized by the Onondaga County Legislature in August 2004). Additionally, high efficiency motors and variable speed drives are being installed on applications which were evaluated during the County wide motor project for the quickest payback, at Baldwinsville-Seneca, Brewerton and Oak Orchard. The motor project was authorized by the Onondaga County Legislature in August 2005.

New York State Energy Research and Development Authority (NYSERDA) incentives are available to reduce the total implementation costs of all proposed electrical ECMs. Based on the NYSERDA Programs (PONs) in effect as of this publication, an estimated amount of $106,793 is available towards electric based ECM implementation ($0.10 per kWh for motors & process improvements and $0.05 per kWh for lighting based measures,).

Project Summary Tables

ECM's Approved for Implementation (Implemented or Implementation In Progress)

Energy Conservation Measure Description	Fuel Type Saved	Total Annual Energy Saved (kWh or Therms)	Annual Dollars Saved [7]	Estimated ECM Costs	NYSERDA Incentive Rebates	Simple Payback Period *(Years)
Oak Orchard Lighting Control & Lamp/Ballast Upgrades	Elec.	612,090 kWh 96.29 kW	$66,213	$193,137	$18,418	2.9 **2.6
Baldwinsville High Efficiency Motors	Elec.	56,270 kWh 6.4 kW	$4,783	$35,845	$5,627	6.3
Brewerton High Efficiency Motors	Elec.	44,420 kWh 10 kW	$3,776	$33,063	$4,443	7.6
Oak Orchard High Efficiency Motors& VFDs	Elec.	87,250 kWh 10.6 kW	$10,257	$105,114	$8,725	9.4
TOTAL	Elec.	800,030 kWh 123.29 kW	$85,029	$367,159	$37,213	26.2

Table 1.6

Proposed ECM's For Approval

Energy Conservation Measure Description	Fuel Type Saved	Total Annual Energy Saved (kWh or Therms)	Annual Dollars Saved	Estimated ECM Costs	NYSERDA Incentive Rebates	Simple Payback Period *(Years)
Baldwinsville High Efficiency Lighting & Controls Measures	Elec.	53,435 kWh 16 kW	$7,635	$90,475	$2,672	11.8 **11.5
Brewerton High Efficiency Lighting & Controls Measures	Elec.	10,511 kWh 4 kW	$1,762	$26,897	$526	15.3
Meadowbrook High Efficiency Lighting & Controls Measures	Elec.	1957 kWh 1 kW	$271	$9,951	$98	37
Oak Orchard High Efficiency Surface Aerators	Elec.	522,096 kWh 60 kW	$60,040	$364,328	$52,209	6.0 **5.2
Baldwinsville High Efficiency Surface Aerators	Elec.	194,378 kWh 15 kW	$21,000	$276,545	$19,400	13.2 **12.2
Brewerton Variable Speed Drives on Aeration Blowers	Elec.	282,000 kWh	$27,000	$145,600	$28,200	5.4 **4.3
All Sites Programmable Thermostats for Electric Unit Heaters 97 Total	Elec.	88,000 kWh	$7900	$54,800	$3688	6.9 **6.5
Total Cost & Savings	Elec.	1,152,377 kWh 96 kW	$133,768	$968,596	$106,793	7.2 **6.4

Table 1.7

Measurement and Verification for Proposed ECM's

NYSERDA (2 Year Period) + Carrier Guarantee (Duration of Guarantee)	$15,718

Table 1.8

Project Summary Tables 1.6 and 1.7 Notes:

1. Fuel Type Saved: Elec – Electricity, NGas – Natural Gas
2. 1 Therm = 100,000 BTU's, kWh = 1,000 Watts/hour
3. Annual Dollars Saved based on 2006 Budgeted Energy Costs:

   Oak Orchard & Baldwinsville ($0.097/kWh, $12.69/kW)
   Meadowbrook ($0.097/kWh, $8.62/kW)
   Brewerton ($0.095/kW, $15.15/kW)

4. Estimated Cost for Implementation does not include financing costs. They do not include costs for Measurement & Verification necessary to secure NYSERDA incentive rebates.
5. * Simple payback calculations do not include avoided costs for equipment replacement or for reduced operation and/or maintenance costs.
   **Simple payback that includes Carrier reserved NYSERDA incentive monies.

Proposed Related Work

Description	Benefits	Estimated Costs
BaldwinsVille Variable Speed Drive Air Compressors and High Efficiency Oxygen Generators RetroFit	Assure equipment and controls are operating in accordance with current best practices for energy efficiency and reliability, while replacing 35 year old equipment critical to the operation of the plants. Estimated Electric Savings are $ 53,200 annually. Estimated Maintenance Savings are $10,000 annually.	$1,583,900
Oak Orchard Variable Speed Drive Air Compressors and High Efficiency Oxygen Generators RetroFit	Assure equipment and controls are operating in accordance with current best practices for energy efficiency and reliability, while replacing 35 year old equipment critical to the operation of the plants. Estimated Electric & Maintenance Savings are $27,400 annually. Estimated Maintenance Savings are $10,000 annually.	$1,675,700

Table 1.9

SECTION 2 – SITE, BUILDING, & SYSTEMS DESCRIPTIONS

2.1 Building Descriptions - Baldwinsville-Seneca WWTP

The Baldwinsville-Seneca Waste Water Treatment Plant includes three buildings; a control building, a pump building and a treatment building. The office building is staffed 24 hours a day / 365 days a year. The combined size of the buildings is approximately 70,500 Sq./ft. and is approximately 20 years old.

The square footage breakdown of the facility is as given in Table 2.1. A picture of the facility is given in Figure 2.1.

Area	Square Footage
Process Area	*39,308*
Office Area	*31,216*
Heated Area	*70,524*
Cooled Area	*31,216*
Heated & Cooled	*31,216*

Table 2.1, Baldwinsville square footage breakdown

Figure 2.1, Baldwinsville waste water treatment plant

2.2 Building Systems - Baldwinsville-Seneca

The facilities HVAC equipment is listed as follows.

Office Area
These areas are served with electric baseboard heat. A thermostat is located in each office.

Office Area Air Handler (ACS-1)
This unit mixes return & outside air and then supplies air to individual offices, the kitchen, the hallway and a conference room located in the basement. This unit provides cooling only via direct expansion. It does not have a heating coil. The unit set point is 70° F when in use. There is setback for the nights and weekends.

Laboratory Air Handler (ACSI-2)
This 100% outdoor air unit serves the laboratory on the second floor. This unit provides direct expansion cooling to the space. The unit also contains two electrical duct heaters to provide heat.

HVU-1
This 100% outside air unit, which appears in Figure 2.2, supplies air to the pump room, sludge loading area, dry chemical storage, parts and equipment storage area, and the grit screening room. The unit has electric heating coils as well as a heat recovery wheel which recovers heat from several areas. Most of the time, the electric heat is not used as the heat recovered is sufficient to warm the air to 55° F, which is the set point for the areas. This unit runs continuously.

Figure 2.2, HVU-1

HVU-2
This unit serves the stairway adjacent to the mechanical room, the pre-thickener area of gallery 2, the compressor room, and the tunnel between the control building and the process structure. This unit also serves all the galleries indirectly. The unit has an electric heating coil and a heat recovery coil. The heat recovery coil uses heat from the compressor coolant as its source. The electrical heating coils are rarely used as the heat recovery coil provides sufficient heat. This unit runs continuously.

HVU-3
This unit, which is pictured in Figure 2.3, mixes air outside air and return air from the plenum. Air is returned to the plenum through the light fixtures. The unit has an electric coil, although this coil operates only when HVU-2 is not operating or the space temperature in gallery 2 is below 40° F.

Figure 2.3, HVU-3

2.3 Building Description - Brewerton

The Brewerton Waste Water Treatment Plant includes three buildings; a control building, pump building and treatment building. The office building is staffed 24 hours a day / 365 days a year. The combined size of the buildings is approximately 16,4700 Sq./ft. and is 30 years old.

The square footage breakdown of the facility is as given in Table 2.2. A picture of the facility is given in Figure 2..

Area	Square Footage
Process Area	*11,333*
Office Area	*5,064*
Heating Area	*16,397*
Cooling Area	*3,584*
Heated & Cooled	*3,584*

Table 2.2, Brewerton square footage breakdown

Figure 2.4, Brewerton waste water treatment plant

2.4 Building Systems- Brewerton

The facilities HVAC equipment is listed as follows.

Control Building

RTU
A roof top unit with a DX coil provides cooling to the control room.

Unit Heaters
The control room, storage room, locker room, generator room and blower room are heated by unit heaters. A typical unit heater is shown in Figure 2.5. There are a total of ten unit heaters serving these rooms. The unit heaters in the blower room are rarely on as the heat produced by the blowers is sufficient to heat the room.

Figure 2.5, Typical unit heater

Baseboard Heating
Heating in the lunch room is provided by baseboard heating.

Window Unit
Cooling in the lunch room is provided by a window unit.

Process Area

A total of 26 unit heaters provide heat to the process areas including the east and west galleries, the chemical storage building, the sludge thickening room, thickening drum room, raw sewage building, screen room, composite room and chlorine room.

2.5 Building Description - Meadow Brook-Limestone

The Meadowbrook-Limestone Waste Water Treatment Plant consists of five buildings. The office building is staffed 24 hours a day / 365 days a year. The combined size of the buildings is approximately 19,000 Sq./ft. The facility was built approximately 27 years ago.

The square footage breakdown of the facility is as given in Table 2.3. A picture of the facility is given in Figure 2.6 .

Area	Square Footage
Process Area	*12,024*
Office Area	*6,960*
Heating Area	*18,984*
Cooling Area	*3,016*
Heated & Cooled	*3,016*

Table 2.3, Meadowbrook square footage breakdown

Figure 2.6, Meadowbrook-Limestone waste water treatment plant

The wastewater treatment plant is heated with electric heat. See Section 5 for ECM details.

2.6 Building Systems - Meadow Brook-Limestone

The facilities HVAC equipment is listed as follows.

Control/ Office Building

Split System
A split system (both condenser and unit are outside) with electric heat is the main source of heating and cooling for the office space. This unit is pictured in Figure 2.7.

Meadow Brook-Limestone

Figure 2.7, Split system serving the office

Perimeter Baseboard Heating
Heat in the office space is supplemented by electric baseboard heating.

Unit Heater
A 5 KW unit heater serves the generator room.

Make-Up Air Unit
A 15,000 cfm make-up air unit with electric heating serves the effluent room. This unit is pictured in Figure 2.8.

Figure 2.8, Make-Up air unit serving the effluent room

Meadow Brook-Limestone

Garage/Office Building

Packaged AC Unit
One packaged electric/DX unit serves the office and lunch room. This unit is pictured in Figure 2..

Figure 2.9, Packaged Unit

Unit Heaters
Six, 5 KW unit heaters serve the garage area.

Process Area

A total of eleven 5 KW and one 7.5 KW unit heaters serve the process areas including the chemical room, re-circulating pump room, digester room, rotary drum thickening room and aeration blower room.

2.7 Building Description - Oak Orchard Waste Water Treatment Plant

The Oak Orchard Waste Water Treatment Plant consists of four buildings; a control building, compressor building, pump building, and treatment building. The office building is staffed 24 hours a day / 365 days a year

The building was constructed in or around 1976 and has a total floor area of approximately 83,000 square feet. The square footage breakdown of the facility is as given in Table 2.4. A picture of the facility is given in Figure 2.10.

Area	Square Footage
Process Area	*56,984*
Office Area	*25,984*
Heating Area	*82,968*
Cooling Area	*16,800*
Heated & Cooled	*16,800*

Table 2.4, Oak Orchard square footage breakdown

Figure 2.10, Oak Orchard waste water treatment plant

2.8 Building Systems - Oak Orchard Waste Water Treatment Plant

The wastewater treatment facility has two natural gas boilers as the primary heating system. These boilers produce low pressure steam, and produce hot water for space heating using a shell and tube heat exchanger. The heating system also consists of some electric heat. Only office area's, Lab's and the Control Room are air-conditioned with package units. See Section 5 for ECM details.

A more detailed description of the facilities HVAC equipment is listed as follows.

Oak Orchard Waste Water Treatment Plant

Office Building (Building A):

Multi-Zone Unit
The office building (except for the lab) is served by multi-zone air handling unit which is pictured in Figure 2.11. This unit has a steam coil for heating and direct expansion cooling system. The unit returns air from the zones and mixes it with outdoor air. The unit has automatic air dampers for each zone of the nine zones it serves. These zone dampers are located on the unit. A Johnson Controls Metasys system controls the unit. This unit runs continually. The unit is depicted in Figure 2.11and the unit also has a rooftop condenser that is not pictured.

Hot water baseboard heating is used in some of the office areas as shown in Figure 2.12. Three ductless AC split systems have also been added in specific locations in the space.

Figure 2.11, Multi-Zone unit

Figure 2.12, Perimeter radiant heat

Oak Orchard Waste Water Treatment Plant

Four Seasons Units
Portions of the office are heated and cooled by a "4 Seasons" unit which has an electric heating coil and a direct expansion cooling coil. This unit is pictured in Figure 2.13. These units are very new and run continuously. Another "4 Seasons" unit serves the cooling and heating needs of the laboratory.

Figure 2.13, Typical "4-Seasons" Unit

Liebert Unit
A Liebert unit provides cooling in the control room.

Unit Heaters
The maintenance shop and storage area are heated by unit heaters with steam coils.

Boilers
There are two low pressure steam boilers that were installed in the facility in 1980. Both appear to be in good condition. A typical boiler is shown in Figure 2.14. The staff believes that the burners on these units are oversized due to frequent cycling.

Oak Orchard Waste Water Treatment Plant

Figure 2.14, Typical boiler

Building B:

Make Up Air Units
This area has four make-up air units. These units contain steam coils that provide heat to the building. One of these units' mixes outdoor air and return air, the other three use 100% return air. There is also an additional four units that reticulate air for de-stratification. All of these units run continuously.

Building C:

Make Up Air Unit
There is one make-up air unit in this area with a steam coil. This unit is a new Trane unit.

Chlorine Storage Building:
This building is located about ¼ mile away from the main facility.

Make Up Air Unit

This building contains a make-up air unit with an electric heating coil. This unit was originally installed because of the spaces former explosion proof requirement.

Unit Heaters

The building is heated with an electric 5 kW unit heater.

SECTION 3 – ENERGY USAGE HISTORY & ANALYSIS

Baldwinsville-Seneca Waste Water Treatment Plant

3.1 Electric Usage History & Analysis - Baldwinsville-Seneca

Thirty six months of utility billing data were used to characterize the historic electricity use of the Baldwinsville- Seneca Waste Water Treatment Plant. The utility data spanned the period from January 2001 through December 2003. Electricity is the only commodity used in this plant.

3.2 Electric Energy Billing Summary - Baldwinsville-Seneca

The data is summarized in Table 3.1. Additionally, the data is analyzed in Figure 3.1 through Figure 3.3. Please note that Table 3.1 also contains water flow rates for this period. The average electrical unit cost (EUC) for this data is given below.

$$EUC = 0.096 \, {}^{\$}/_{kWh}$$

The water flow rates are compared to the electrical usage in Figure 3.4. Also the flow is compared to electrical demand in Figure 3.5. No clear relationship was found in order to normalize the electrical consumption against flow.

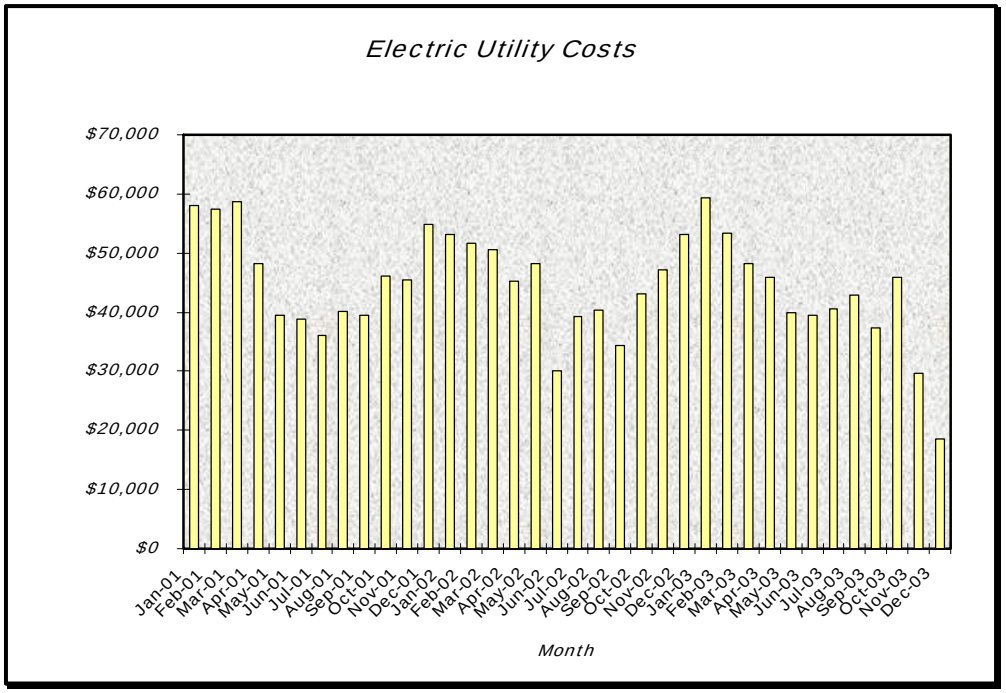
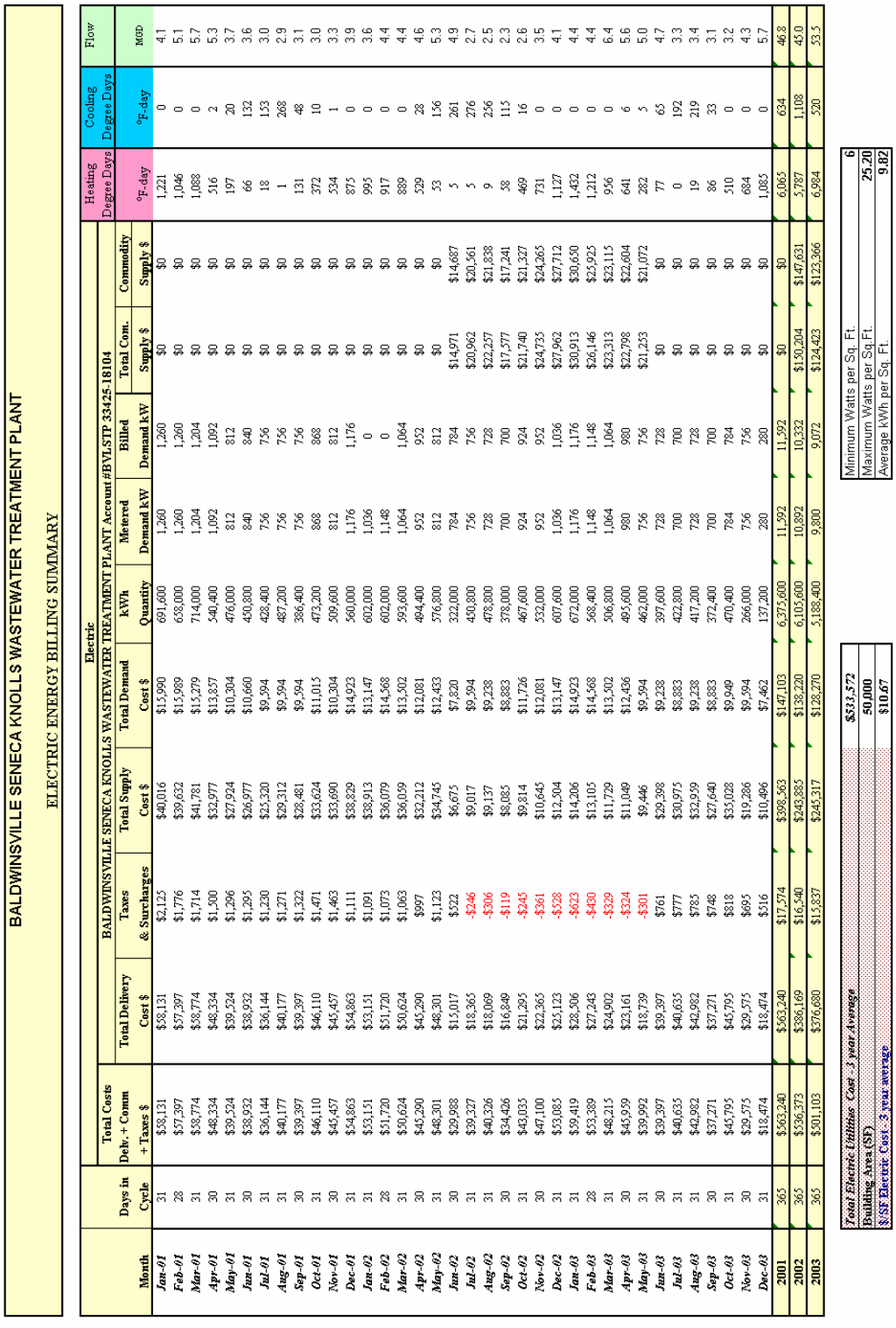


Figure 3.1, Baldwinsville Utility Costs



BALDWINSVILLE SENECA KNOLLS WASTEWATER TREATMENT PLANT

ELECTRIC ENERGY BILLING SUMMARY

		Electric										Heating Degree Days	Cooling Degree Days	Flow
		Total Costs	BALDWINSVILLE SENECA KNOLLS WASTEWATER TREATMENT PLANT Account #BYLSTP 33425-18104											
Month	Days in Cycle	Del. + Comm + Taxes $	Total Delivery Cost $	Taxes & Surcharges	Total Supply Cost $	Total Demand Cost $	kWh Quantity	Metered Demand kW	Billed Demand kW	Total Com. Supply $	Commodity Supply $	°F-day	°F-day	MGD
Jan-01	31	$58,131	$58,131	$2,125	$40,016	$15,990	691,600	1,260	1,260	$0	$0	1,221	0	4.1
Feb-01	28	$57,397	$57,397	$1,776	$39,632	$15,989	658,000	1,260	1,260	$0	$0	1,046	0	5.1
Mar-01	31	$58,774	$58,774	$1,714	$41,781	$15,279	714,000	1,204	1,204	$0	$0	1,088	0	5.7
Apr-01	30	$48,334	$48,334	$1,500	$32,977	$13,857	540,400	1,092	1,092	$0	$0	516	2	5.3
May-01	31	$39,524	$39,524	$1,296	$27,924	$10,304	476,000	812	812	$0	$0	197	20	3.7
Jun-01	30	$38,932	$38,932	$1,295	$26,977	$10,660	450,800	840	840	$0	$0	66	132	3.6
Jul-01	31	$36,144	$36,144	$1,230	$25,320	$9,594	428,400	756	756	$0	$0	18	153	3.0
Aug-01	31	$40,177	$40,177	$1,271	$29,312	$9,594	487,200	756	756	$0	$0	1	268	2.9
Sep-01	30	$39,397	$39,397	$1,322	$28,481	$9,594	386,400	756	756	$0	$0	131	48	3.1
Oct-01	31	$46,110	$46,110	$1,471	$33,624	$11,015	473,200	868	868	$0	$0	372	10	3.0
Nov-01	30	$45,457	$45,457	$1,463	$33,690	$10,304	509,600	812	812	$0	$0	534	1	3.3
Dec-01	31	$54,863	$54,863	$1,111	$38,829	$14,923	560,000	1,176	1,176	$0	$0	875	0	3.9
Jan-02	31	$53,151	$53,151	$1,091	$38,913	$13,147	602,000	1,036	0	$0	$0	995	0	3.6
Feb-02	28	$51,720	$51,720	$1,073	$36,079	$14,568	602,000	1,148	0	$0	$0	917	0	4.4
Mar-02	31	$50,624	$50,624	$1,063	$36,039	$13,502	593,600	1,064	1,064	$0	$0	889	0	4.4
Apr-02	30	$45,290	$45,290	$997	$32,212	$12,081	494,400	952	952	$0	$0	529	28	4.6
May-02	31	$48,301	$48,301	$1,123	$34,745	$12,433	576,800	812	812	$0	$0	53	156	5.3
Jun-02	30	$29,988	$15,017	$522	$6,675	$7,820	322,000	784	784	$14,971	$14,687	5	261	4.9
Jul-02	31	$39,327	$18,365	-$246	$9,017	$9,594	450,800	756	756	$20,962	$20,561	5	276	2.7
Aug-02	31	$40,326	$18,069	-$306	$9,137	$9,238	478,800	728	728	$22,257	$21,838	9	256	2.5
Sep-02	30	$34,426	$16,849	-$119	$8,085	$8,883	378,000	700	700	$17,577	$17,241	58	115	2.3
Oct-02	31	$43,035	$21,295	-$245	$9,814	$11,726	467,600	924	924	$21,740	$21,327	469	16	2.6
Nov-02	30	$47,100	$22,365	-$361	$10,645	$12,081	532,000	952	952	$24,735	$24,265	731	0	3.5
Dec-02	31	$53,085	$25,123	-$528	$12,504	$13,147	607,600	1,036	1,036	$27,962	$27,712	1,127	0	4.1
Jan-03	31	$59,419	$28,506	-$623	$14,206	$14,923	672,000	1,176	1,176	$30,913	$30,650	1,432	0	4.4
Feb-03	28	$53,389	$27,243	-$430	$13,105	$14,568	568,400	1,148	1,148	$26,146	$25,925	1,212	0	4.4
Mar-03	31	$48,215	$24,902	-$329	$11,729	$13,502	506,800	1,064	1,064	$23,313	$23,115	956	0	6.4
Apr-03	30	$45,959	$23,161	-$324	$11,049	$12,436	495,600	980	980	$22,798	$22,604	641	6	5.6
May-03	31	$39,992	$18,739	-$301	$9,446	$9,594	462,000	756	756	$21,253	$21,072	282	5	5.0
Jun-03	30	$39,397	$39,397	$761	$29,398	$9,238	397,600	728	728	$0	$0	77	65	4.7
Jul-03	31	$40,635	$40,635	$777	$30,975	$8,883	422,800	700	700	$0	$0	0	192	3.3
Aug-03	31	$42,982	$42,982	$785	$32,959	$9,238	417,200	728	728	$0	$0	19	219	3.4
Sep-03	30	$37,271	$37,271	$748	$27,640	$8,883	372,400	700	700	$0	$0	86	33	3.1
Oct-03	31	$45,795	$45,795	$818	$35,028	$9,949	470,400	784	784	$0	$0	510	0	3.2
Nov-03	30	$29,575	$29,575	$695	$19,286	$9,594	266,000	756	756	$0	$0	684	0	4.3
Dec-03	31	$18,474	$18,474	$516	$10,496	$7,462	137,200	280	280	$0	$0	1,085	0	5.7
2001	365	$563,240	$563,240	$17,574	$398,563	$147,103	6,375,600	11,592	11,592	$0	$0	6,065	634	46.8
2002	365	$536,373	$386,169	$16,540	$243,885	$138,220	6,105,600	10,892	10,332	$130,204	$147,631	5,787	1,108	45.0
2003	365	$501,103	$376,680	$15,837	$245,317	$128,270	5,188,400	9,800	9,072	$124,423	$123,366	6,984	520	53.5

Total Electric Utilities Cost - 3 year Average	*$533,572*
Building Area (SF)	50,000
$/SF Electric Cost - 3 year average	$10.67

Minimum Watts per Sq. Ft.	6
Maximum Watts per Sq. Ft.	25.20
Average kWh per Sq. Ft.	9.82

kWh Cost $0.09

Table 3.1, Baldwinsville Electric Usage and Costs

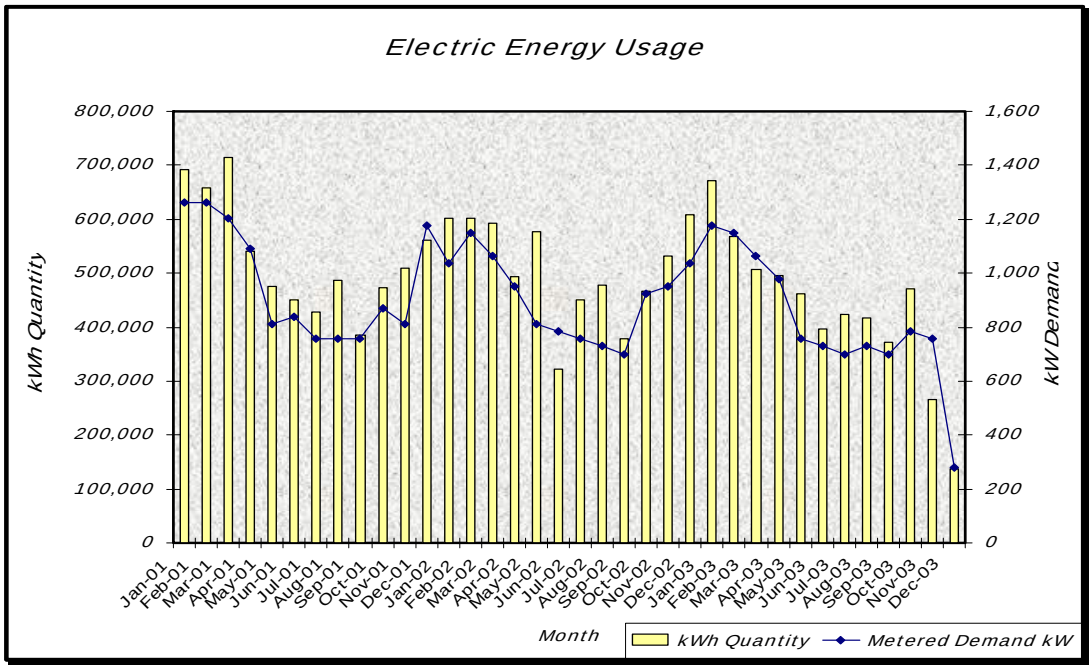


Figure 3.2, Baldwinsville Electrical usage

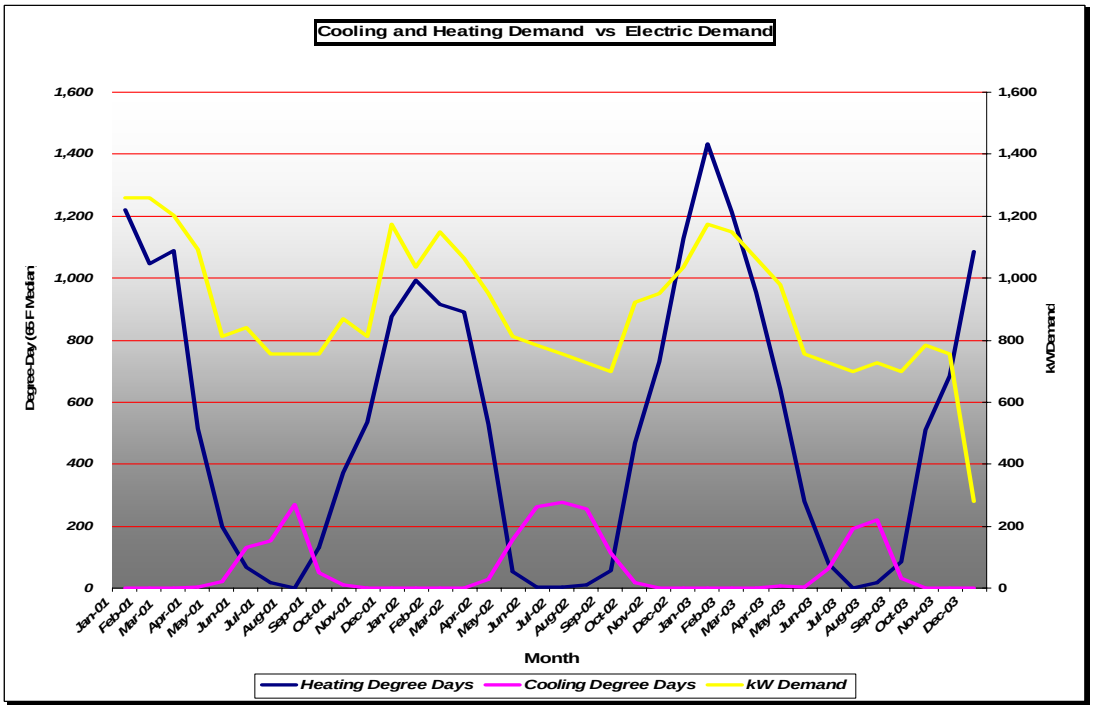


Figure 3.3, Baldwinsville demand usage

Baldwinsville-Seneca

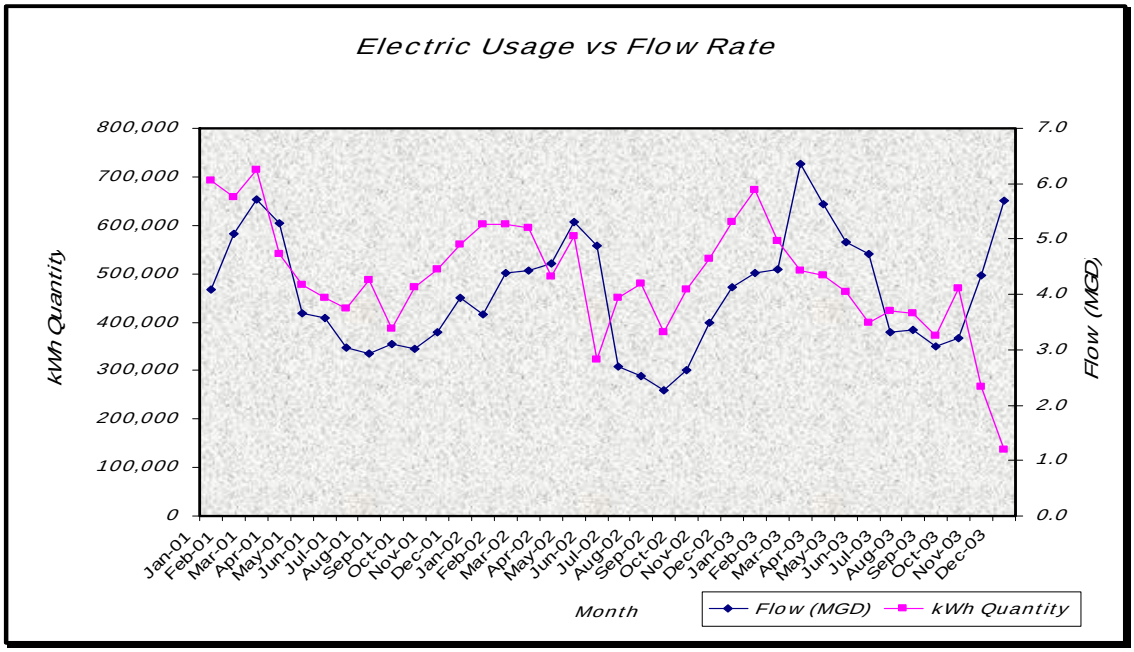


Figure 3.4, Electric usage vs flow

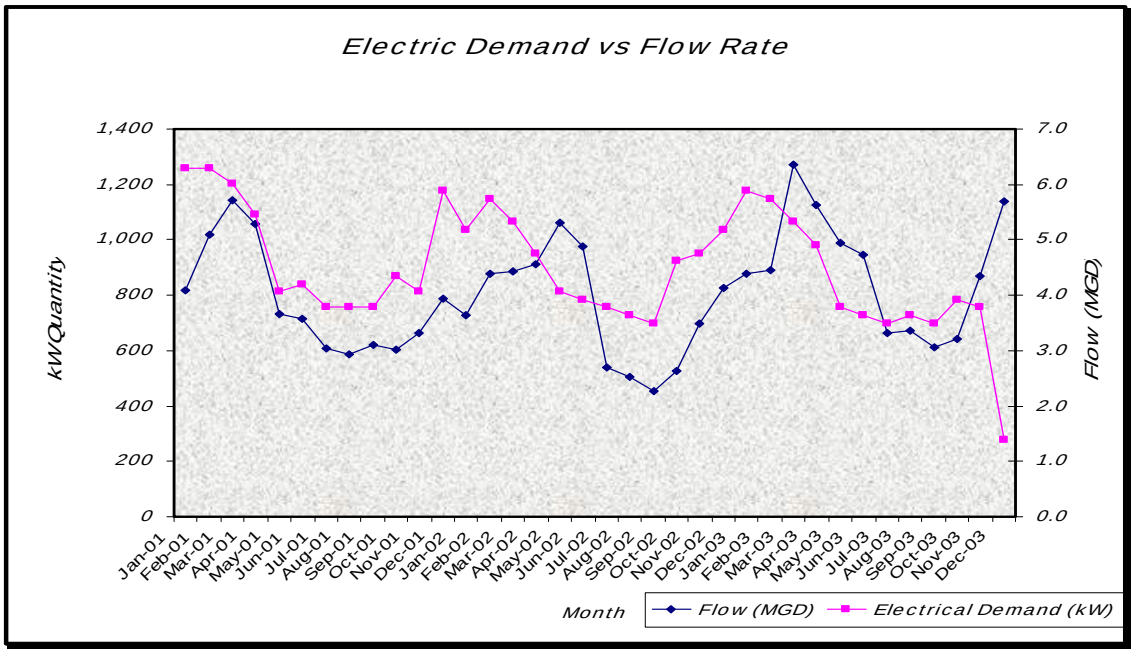


Figure 3.5, Electric Demand vs Flow

Brewerton Waste Water Treatment Plant

3.3 Electric Usage History & Analysis - Brewerton

Thirty six months of utility billing data were used to characterize the historic electricity use of the Brewerton Waste Water Treatment Plant. The utility data spanned the period from January 2001 through December 2003. Electricity is the only commodity used in this plant.

3.4 Electric Energy Billing Summary - Brewerton

The data is summarized in Table 3.2. Additionally, the data is analyzed in Figure 3.6 through Figure 3.8. Please note that Table 3.2 also contains water flow rates for this period. The average electrical unit cost (EUC) for this data is given below.

$$EUC = 0.096 \, {}^{\$}/_{kWh}$$

The water flow rates are compared to the electrical usage in Figure 3.9. Also the flow is compared to electrical demand in Figure 3.10. No clear relationship was found in order to normalize the electrical consumption against flow.

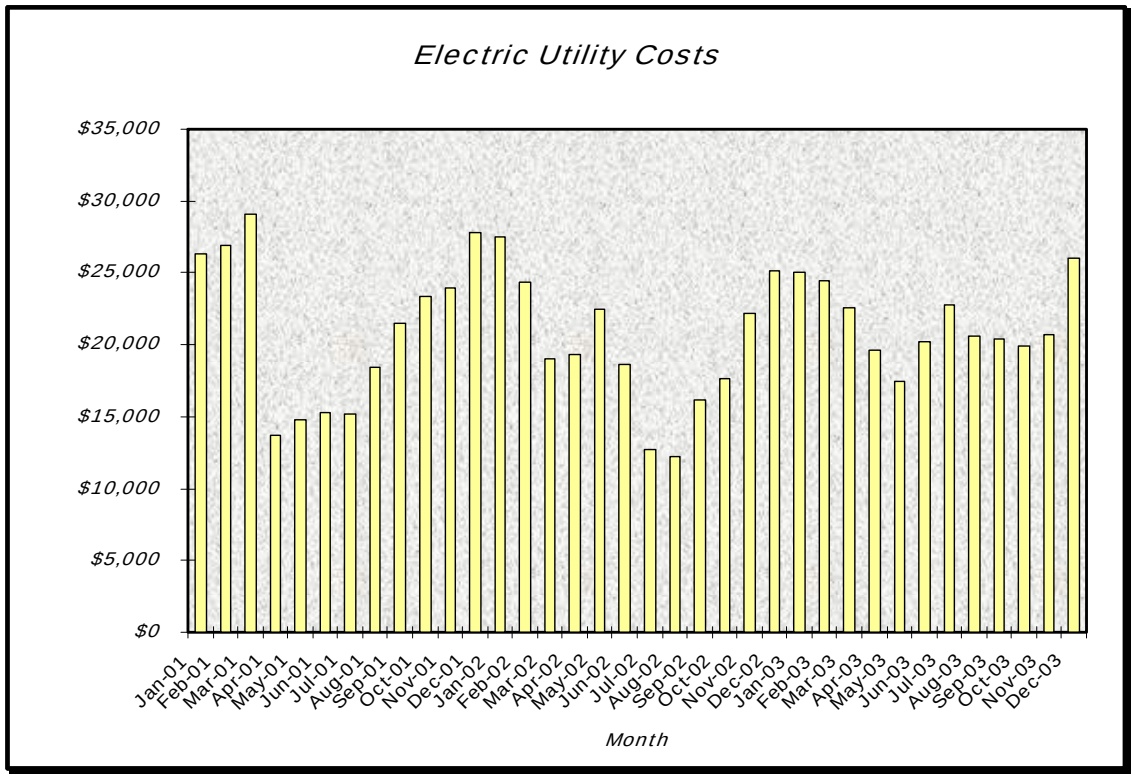


Figure 3.6, Brewerton Utility Costs

BREWERTON WASTE WATER TREATMENT PLANT

ELECTRIC ENERGY BILLING SUMMARY

Month	Days in Cycle	Total Costs Delv. + Comm + Taxes $	Total Delivery Cost $	Taxes & Surcharges	Total Supply Cost $	Total Demand Cost $	kWh Quantity	Metered Demand kW	Billed Demand kW	Total Com. Supply $	Commodity Supply $	Heating Degree Days °F-day	Cooling Degree Days °F-day	Flow MGD
			Electric: BREWERTON WASTE WATER TREATMENT PLANT Account #BRWTN 42376-06105							Electric Commodity				
Jan-01	31	$26,295	$26,295	$829	$17,861	$7,605	305,600	508	508	$0	$0	1,221	0	1.9
Feb-01	28	$26,930	$26,930	$883	$18,023	$8,024	298,800	536	536	$0	$0	1,046	0	2.3
Mar-01	31	$29,037	$29,037	$956	$19,937	$8,144	337,200	544	544	$0	$0	1,088	0	2.7
Apr-01	30	$13,673	$13,673	$614	$5,215	$7,844	81,600	524	524	$0	$0	516	2	2.4
May-01	31	$14,808	$14,808	$647	$9,371	$4,790	147,600	320	320	$0	$0	197	20	1.5
Jun-01	30	$15,302	$15,302	$683	$10,308	$4,311	173,200	288	288	$0	$0	66	132	1.6
Jul-01	31	$15,201	$15,201	$669	$10,400	$4,132	177,200	276	276	$0	$0	18	153	1.4
Aug-01	31	$18,460	$18,460	$723	$12,587	$5,150	212,800	344	344	$0	$0	1	268	1.3
Sep-01	30	$21,516	$21,516	$843	$15,044	$5,629	207,200	376	376	$0	$0	131	48	1.4
Oct-01	31	$23,329	$23,329	$853	$16,248	$6,228	214,000	416	416	$0	$0	372	10	1.5
Nov-01	30	$23,969	$23,969	$840	$16,422	$6,707	228,800	448	448	$0	$0	534	1	1.7
Dec-01	31	$27,813	$27,813	$919	$19,888	$7,006	293,200	468	468	$0	$0	875	0	2.1
Jan-02	31	$27,516	$27,516	$617	$19,414	$7,485	290,800	500	500	$0	$0	995	0	1.8
Feb-02	28	$24,399	$24,399	$604	$16,609	$7,186	272,400	480	480	$0	$0	917	0	2.4
Mar-02	31	$19,067	$19,067	$541	$12,538	$5,988	206,400	400	400	$0	$0	889	0	2.6
Apr-02	30	$19,320	$19,320	$569	$12,763	$5,988	201,600	216	216	$0	$0	529	28	2.0
May-02	31	$22,449	$22,449	$630	$15,651	$6,168	252,000	412	412	$0	$0	53	156	1.3
Jun-02	30	$18,622	$13,192	$244	$6,900	$6,048	203,200	404	404	$5,430	$5,327	5	261	1.3
Jul-02	31	$12,705	$7,942	$247	$2,246	$5,449	102,400	364	364	$4,763	$4,670	5	276	1.3
Aug-02	31	$12,186	$7,423	$227	$2,106	$5,090	102,400	340	340	$4,763	$4,670	9	256	1.5
Sep-02	30	$16,190	$8,383	$116	$3,237	$5,030	168,000	336	336	$7,807	$7,662	58	115	1.9
Oct-02	31	$17,607	$9,763	$113	$3,542	$6,108	168,800	408	408	$7,844	$7,698	469	16	2.2
Nov-02	30	$22,144	$11,135	-$27	$4,336	$6,826	236,800	456	456	$11,009	$10,800	731	0	1.8
Dec-02	31	$25,093	$11,703	-$177	$4,874	$7,006	288,000	468	468	$13,390	$13,136	1,127	0	2.3
Jan-03	31	$25,030	$12,649	-$110	$5,154	$7,605	269,200	508	508	$12,381	$12,276	1,432	0	2.8
Feb-03	28	$24,431	$12,912	-$102	$5,170	$7,844	250,400	524	524	$11,519	$11,421	1,212	0	2.5
Mar-03	31	$22,615	$12,403	-$52	$4,850	$7,605	222,000	508	508	$10,212	$10,125	956	0	2.0
Apr-03	30	$19,613	$10,689	$1	$4,161	$6,527	194,000	436	436	$8,924	$8,848	641	6	2.0
May-03	31	$17,453	$9,210	$46	$3,655	$5,509	179,200	368	368	$8,243	$8,173	282	5	1.4
Jun-03	30	$20,223	$20,223	$491	$14,882	$4,850	208,000	324	324	$0	$0	77	65	1.5
Jul-03	31	$22,768	$22,768	$506	$17,052	$5,210	237,600	348	348	$0	$0	0	192	1.2
Aug-03	31	$20,635	$20,635	$491	$14,875	$5,269	192,800	352	352	$0	$0	19	219	1.6
Sep-03	30	$20,400	$20,400	$489	$15,001	$4,910	208,000	328	328	$0	$0	86	33	2.1
Oct-03	31	$19,907	$19,907	$477	$13,921	$5,509	185,600	368	368	$0	$0	510	0	2.6
Nov-03	30	$20,700	$20,700	$469	$14,183	$6,048	192,400	404	404	$0	$0	684	0	1.9
Dec-03	31	$25,979	$25,979	$503	$18,710	$6,766	250,800	452	452	$0	$0	1,085	0	1.9
2001	365	$256,333	$256,333	$9,459	$171,304	$75,570	2,677,200	5,048	5,048	$0	$0	6,065	634	21.9
2002	365	$237,298	$182,292	$9,247	$104,216	$74,372	2,492,800	4,784	5,040	$55,006	$53,963	5,787	1,108	22.3
2003	365	$259,754	$208,475	$8,968	$131,614	$73,652	2,590,000	4,920	4,984	$51,279	$50,843	6,984	520	23.4

Total Electric Utilities Cost - 3 year Average	$251,128
Building Area (SF)	49,036
$/SF Electric Cost - 3 year average	$5.12

Minimum Watts per Sq. Ft.	4
Maximum Watts per Sq.Ft.	11.09
Average kWh per Sq. Ft.	4.40

kWh Cost	$0.10

Table 3.2, Brewerton Electric Usage and Costs

Brewerton

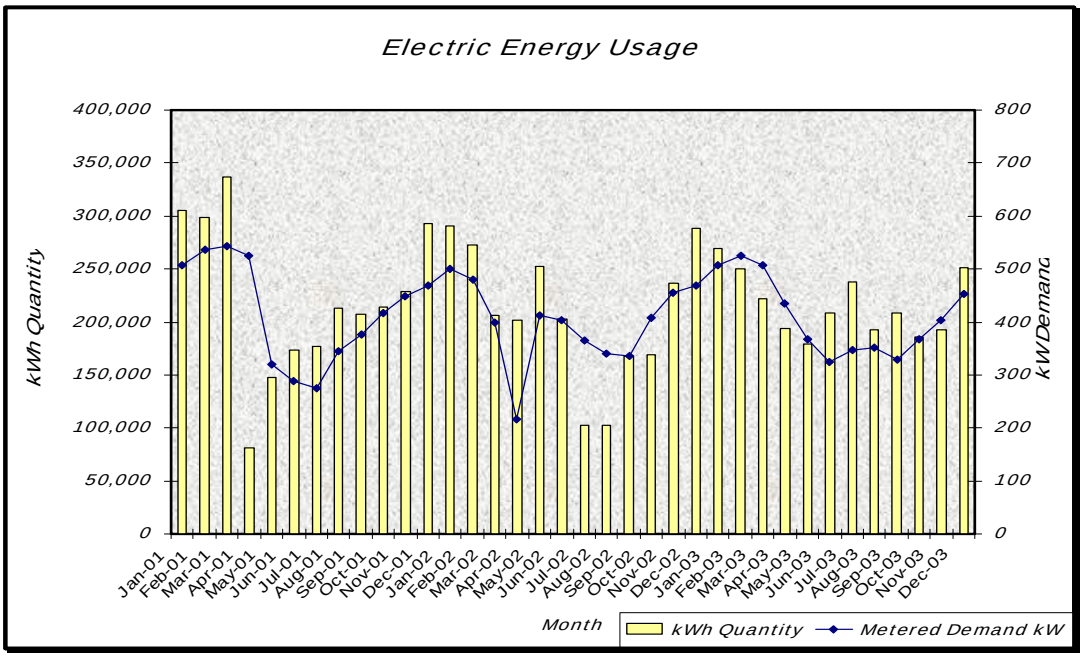


Figure 3.7, Brewerton Electrical Usage

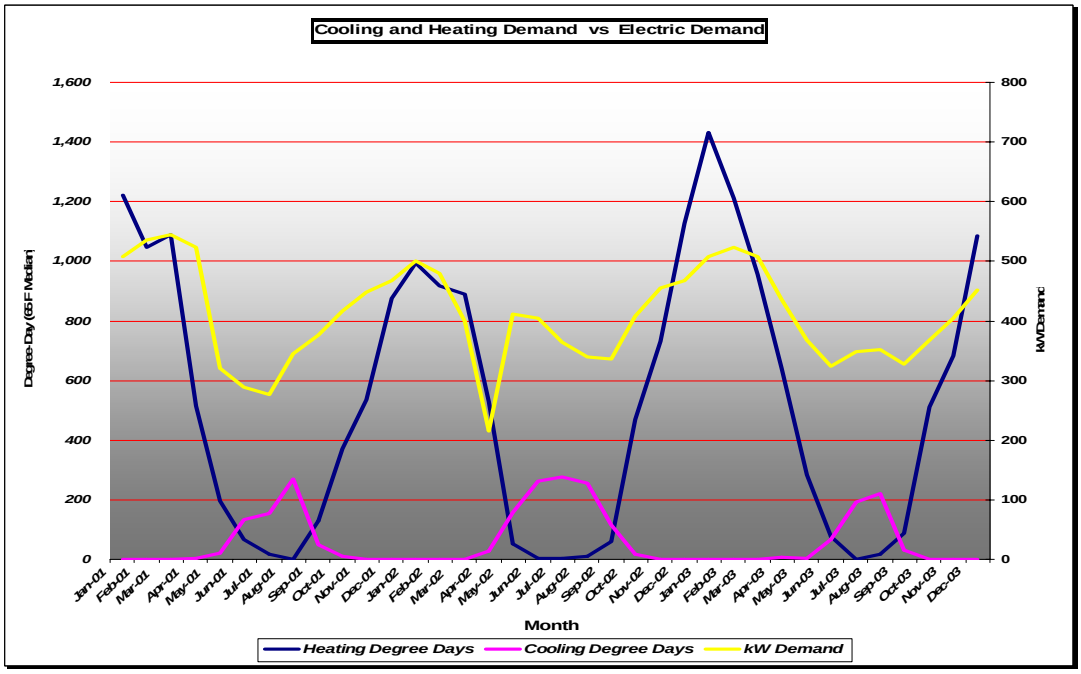


Figure 3.8, Brewerton Demand Usage

Brewerton

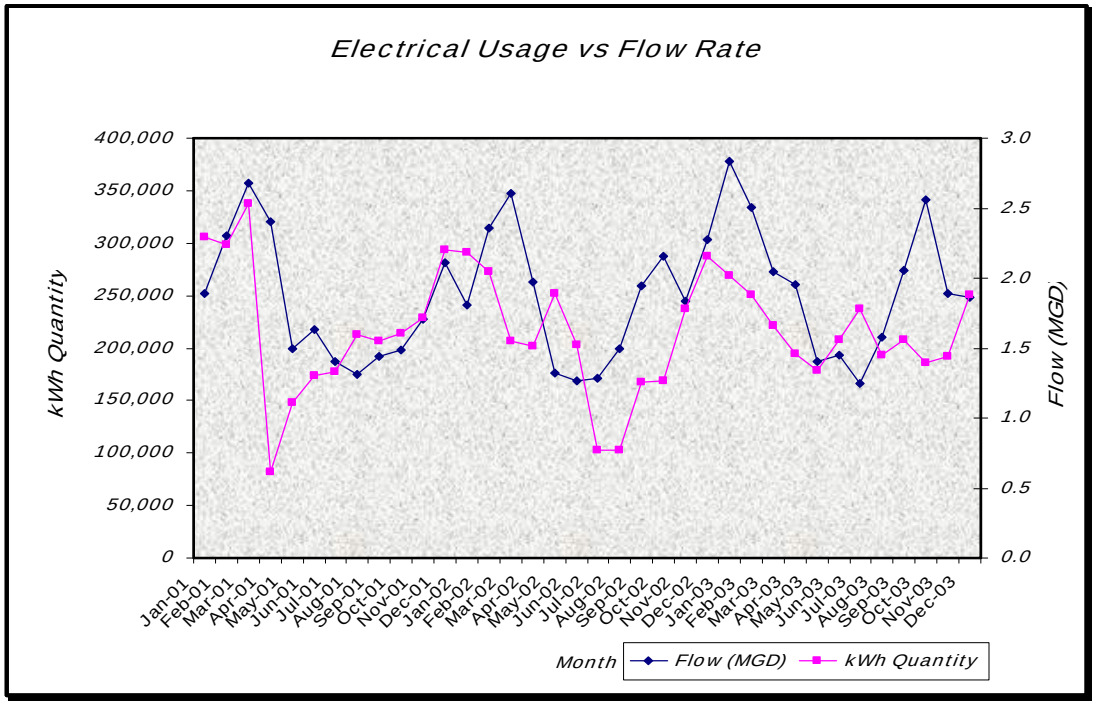


Figure 3.9, Electric usage vs flow

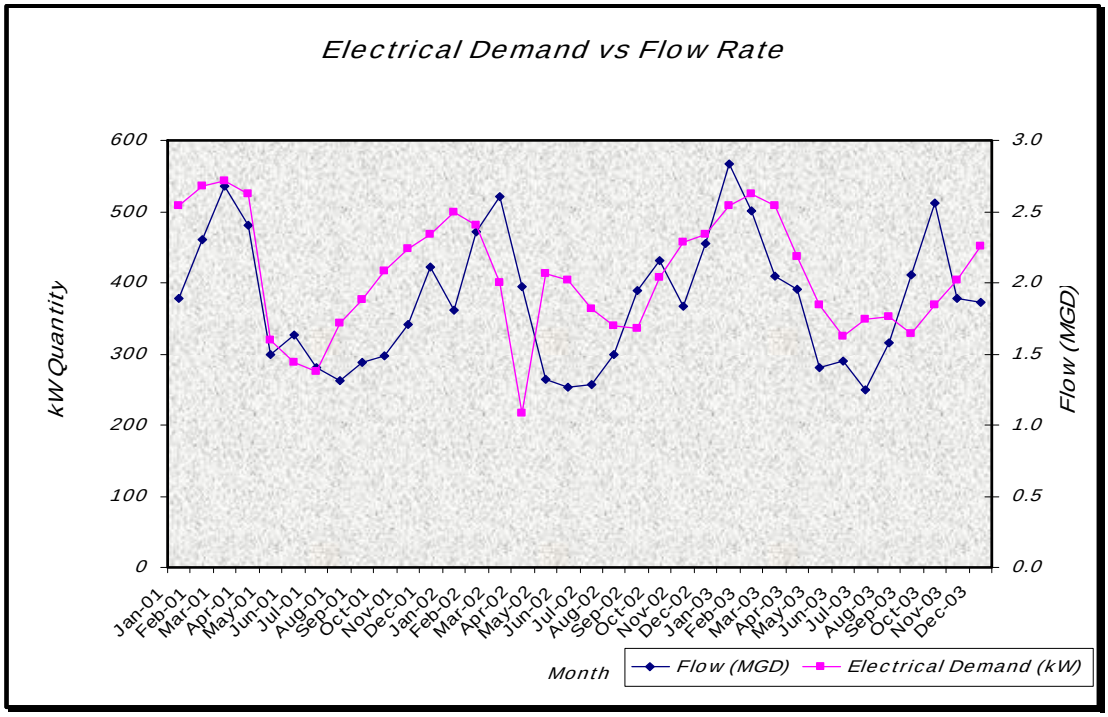


Figure 3.10, Electric demand vs flow

Meadow Brook-Limestone Waste Water Treatment Plant

3.5 Electric Usage History & Analysis - Meadow Brook

Thirty six months of utility billing data were used to characterize the historic electricity use of the Meadowbrook-Limestone Waste Water Treatment Plant. The utility data spanned the period from January 2001 through December 2003. Electricity is the only commodity used in this plant.

3.6 Electric Energy Billing Summary - Meadow Brook

The data is summarized in Table 3.3. Additionally, the data is analyzed in Figure 3.11 through Figure 3.133. Please note that Table 3.3 also contains water flow rates for this period. The average electrical unit cost (EUC) for this data is given below.

$$EUC = 0.096 \, {}^{\$}/_{kWh}$$

The water flow rates are compared to the electrical usage in Figure 3.14. Also the flow is compared to electrical demand in Figure 3.. No clear relationship was found in order to normalize the electrical consumption against flow.

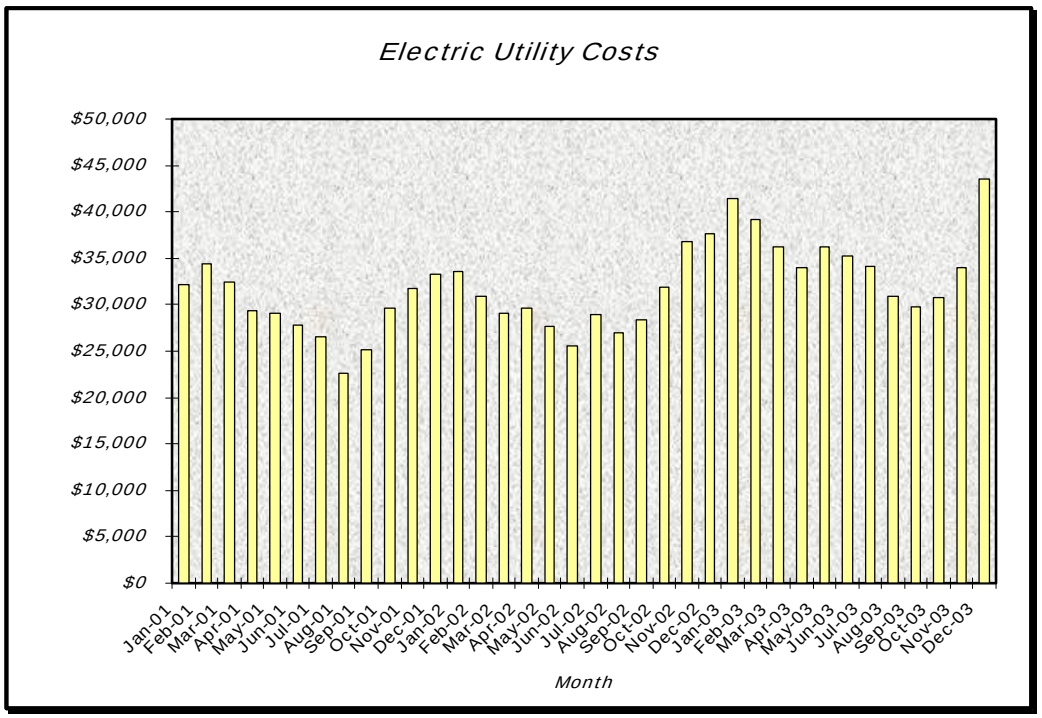


Figure 3.11, Meadowbrooke Utility Costs

MEADOWBROOK-LIMESTONE WASTE WATER TREATMENT PLANT

ELECTRIC ENERGY BILLING SUMMARY

		Electric												Heating Degree Days	Cooling Degree Days	Flow
		MEADOWBROOK-LIMESTONE WASTEWATER TREATMENT PLANT Account #MBROOK 66588-42101														
Month	Days in Cycle	Total Costs Delv. + Comm + Taxes $	Total Delivery Cost $	Taxes & Surcharges	Total Supply Cost $	Total Demand Cost $	kWh Quantity	Metered Demand kW	Billed Demand kW	Total Com. Supply $	Commodity Supply $			°F-day	°F-day	MGD
Jan-01	31	$32,165	$32,165	$1,202	$23,907	$7,056	416,454	812	812	$0	$0			1,221	0	4.2
Feb-01	28	$34,446	$34,446	$1,286	$26,104	$7,056	445,162	844	844	$0	$0			1,046	0	5.5
Mar-01	31	$32,497	$32,497	$1,275	$24,140	$7,082	412,728	808	808	$0	$0			1,088	0	7.2
Apr-01	30	$29,336	$29,336	$1,292	$21,742	$6,302	374,267	718	718	$0	$0			516	2	7.1
May-01	31	$29,086	$29,086	$1,298	$21,519	$6,269	369,881	716	716	$0	$0			197	20	4.2
Jun-01	30	$27,800	$27,800	$1,302	$20,563	$5,935	354,559	676	676	$0	$0			66	132	4.3
Jul-01	31	$26,535	$26,535	$1,281	$19,605	$5,649	338,387	644	644	$0	$0			18	153	3.8
Aug-01	31	$22,623	$22,623	$1,246	$16,842	$4,535	298,382	516	516	$0	$0			1	268	3.3
Sep-01	30	$25,095	$25,095	$1,319	$18,795	$4,981	266,933	568	568	$0	$0			131	48	3.8
Oct-01	31	$29,644	$29,644	$1,277	$22,401	$5,966	304,340	680	680	$0	$0			372	10	3.4
Nov-01	30	$31,761	$31,761	$1,248	$24,118	$6,395	360,439	730	730	$0	$0			534	1	3.6
Dec-01	31	$33,295	$33,295	$1,266	$25,222	$6,807	373,427	776	776	$0	$0			875	0	4.6
Jan-02	31	$33,586	$33,586	$1,030	$25,841	$6,715	403,639	768	768	$0	$0			995	0	4.0
Feb-02	28	$30,926	$30,926	$1,004	$22,661	$7,261	374,077	828	828	$0	$0			917	0	5.8
Mar-02	31	$29,022	$29,022	$1,044	$21,045	$6,933	390,205	792	792	$0	$0			889	0	6.1
Apr-02	30	$29,594	$29,594	$1,015	$22,002	$6,577	356,226	763	763	$0	$0			529	28	5.9
May-02	31	$27,625	$27,625	$1,015	$20,476	$6,134	327,506	706	706	$0	$0			53	156	4.1
Jun-02	30	$25,525	$12,311	$286	$6,366	$5,659	284,210	656	656	$13,214	$12,963			5	261	3.3
Jul-02	31	$28,943	$12,602	$167	$7,310	$5,125	351,700	589	589	$16,341	$16,041			5	276	3.3
Aug-02	31	$26,900	$12,163	$223	$6,648	$5,292	316,747	609	609	$14,737	$14,447			9	256	3.7
Sep-02	30	$28,370	$13,228	$209	$7,076	$5,943	326,520	683	683	$15,142	$14,892			58	115	4.5
Oct-02	31	$31,889	$15,137	$130	$8,188	$6,819	361,804	784	784	$16,752	$16,502			469	16	5.6
Nov-02	30	$36,832	$16,486	$19	$8,963	$7,504	438,036	863	863	$20,366	$19,979			731	0	5.4
Dec-02	31	$37,578	$16,339	-$66	$9,110	$7,295	462,016	839	839	$21,239	$21,073			1,127	0	5.5
Jan-03	31	$41,405	$17,885	-$205	$10,239	$7,851	512,011	896	896	$23,520	$23,353			1,432	0	7.2
Feb-03	28	$39,172	$18,117	-$29	$9,993	$8,153	457,972	930	930	$21,055	$20,888			1,212	0	7.5
Mar-03	31	$36,223	$17,927	$52	$9,644	$8,231	397,853	960	960	$18,296	$18,142			956	0	5.1
Apr-03	30	$34,056	$16,826	$94	$9,479	$7,253	374,558	834	834	$17,230	$17,084			641	6	5.1
May-03	31	$36,236	$16,911	$15	$10,014	$6,882	420,228	786	786	$19,325	$19,162			282	5	4.1
Jun-03	30	$35,318	$33,318	$1,000	$27,982	$6,336	359,537	723	723	$0	$0			77	65	4.1
Jul-03	31	$34,097	$34,097	$979	$27,234	$5,884	377,823	677	677	$0	$0			0	192	3.7
Aug-03	31	$30,929	$30,929	$951	$24,223	$5,755	314,793	657	657	$0	$0			19	219	4.0
Sep-03	30	$29,743	$29,743	$950	$23,005	$5,788	314,322	660	660	$0	$0			86	33	4.9
Oct-03	31	$30,798	$30,798	$901	$23,948	$5,949	325,187	679	679	$0	$0			510	0	7.1
Nov-03	30	$33,969	$33,969	$912	$25,870	$7,187	359,990	826	826	$0	$0			684	0	5.4
Dec-03	31	$43,556	$43,556	$1,031	$35,414	$7,111	489,792	818	818	$0	$0			1,085	0	4.6
2001	365	$354,283	$354,283	$15,292	$264,958	$74,033	4,315,159	8,488	8,488	$0	$0			6,065	634	5.8
2002	365	$366,810	$249,019	$15,120	$165,686	$77,257	4,352,686	8,880	8,444	$117,791	$115,897			5,787	1,108	5.2
2003	365	$422,502	$326,076	$14,838	$237,045	$82,380	4,703,866	9,446	8,428	$99,426	$98,629			6,984	520	6.8

Total Electric Utilities Cost - 3 year Average	$382,198
Building Area (SF)	50,000
$/SF Electric Cost - 3 year average	$7.64

Minimum Watts per Sq. Ft.	10
Maximum Watts per Sq. Ft.	19.20
Average kWh per Sq. Ft.	7.43

kWh Cost $0.09

Table 3.3, Meadowbrooke Electric Usage & Costs

Meadow Brook

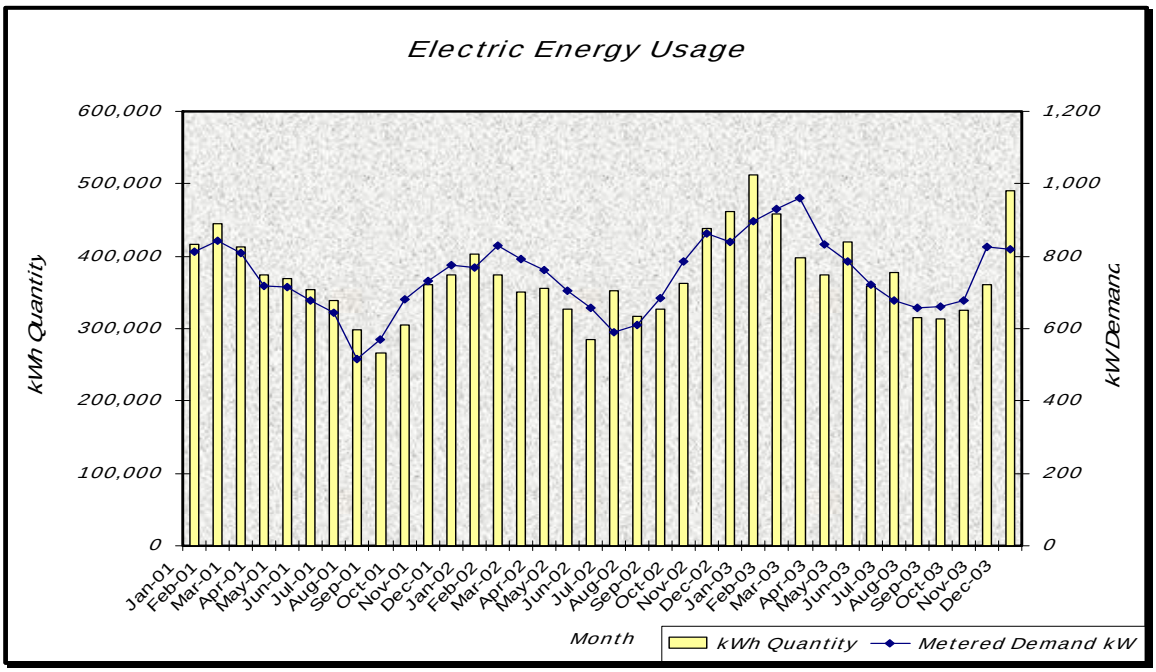


Figure 3.12, Meadowbrooke Electrical Usage

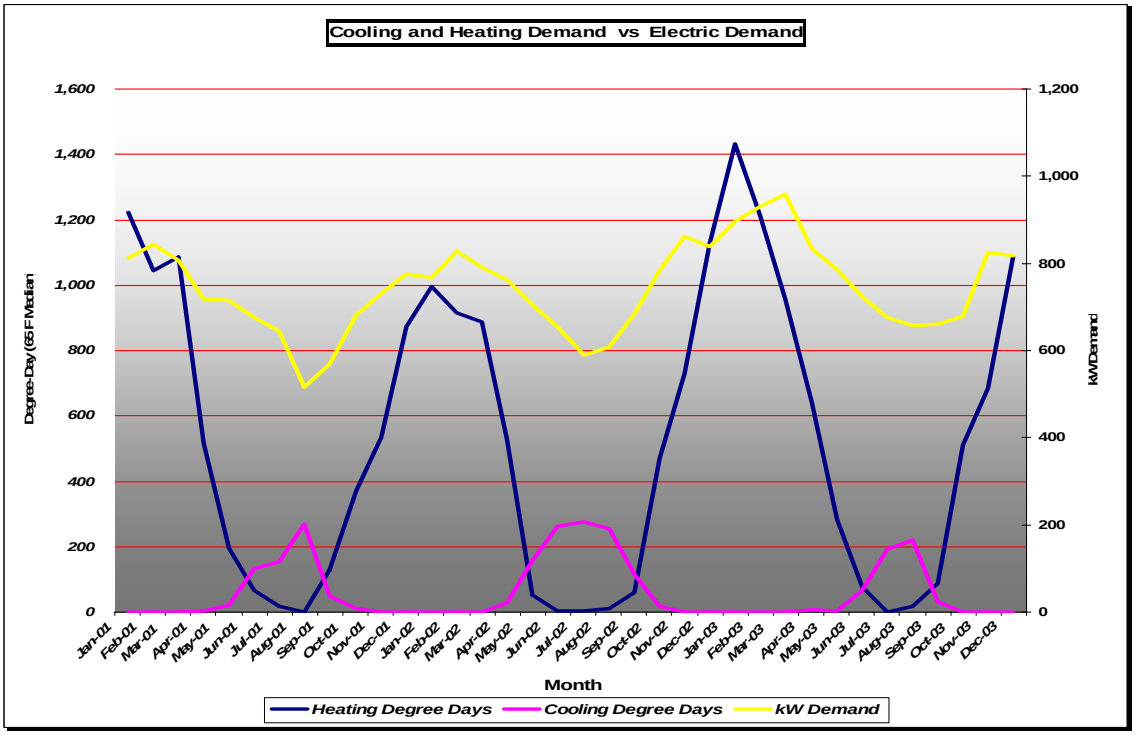


Figure 3.13, Meadowbrook Demand Usage

Meadow Brook

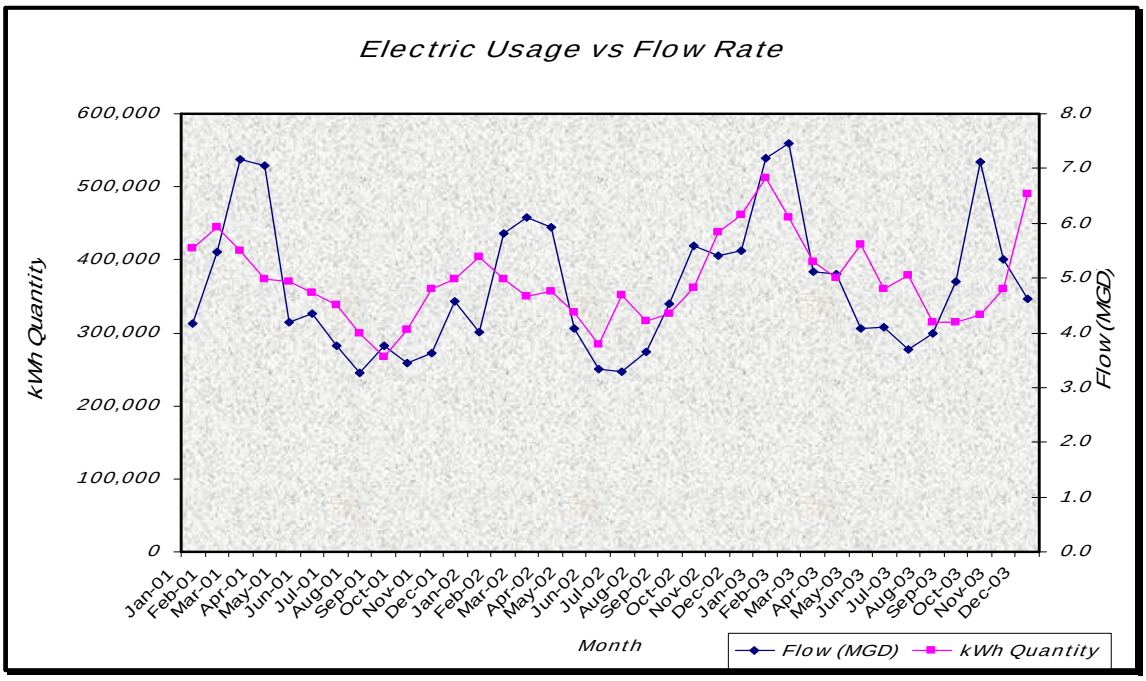


Figure 3.14, Electric Usage vs Flow

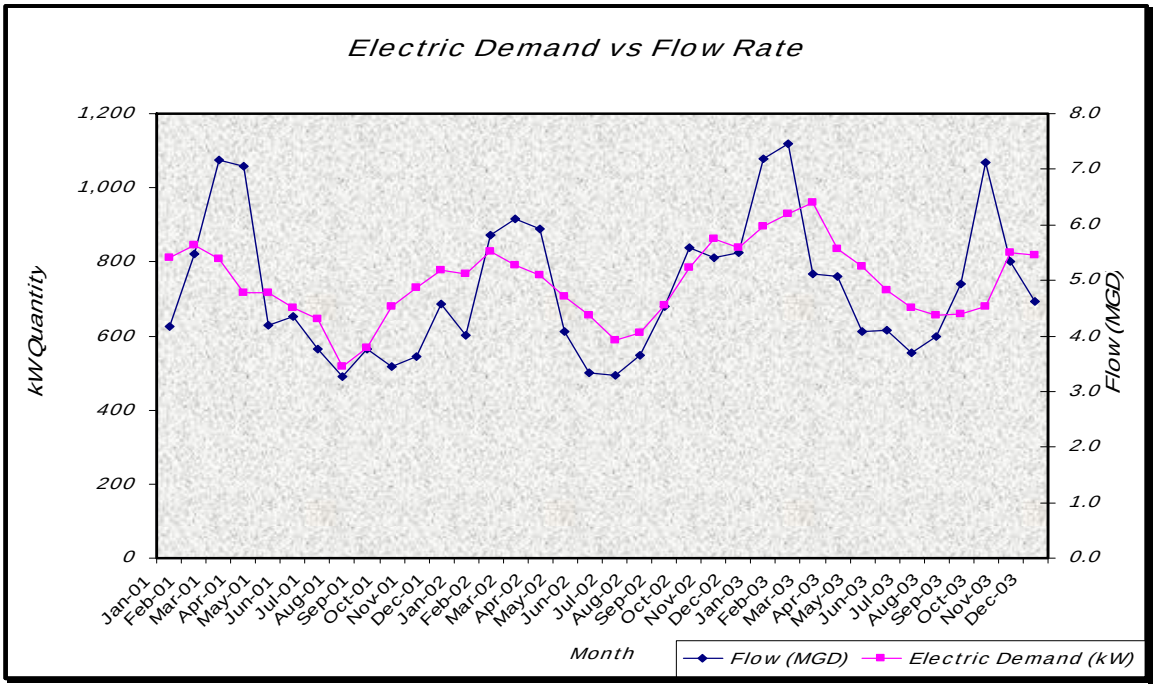


Figure 3.15, Electric Demand vs Flow

Oak Orchard Waste Water Treatment Plant

3.7 Electric Usage History & Analysis - Oak Orchard

Thirty six months of utility billing data were used to characterize the historic electricity use of the Oak Orchard Waste Water Treatment Plant. The utility data spanned the period from January 2001 through December 2003. The facility uses both electricity and natural gas.

3.8 Electric Energy Billing Summary - Oak Orchard

The data is summarized in Table 3.4. Additionally, the data is analyzed in Figure 3.16 through Figure 18. Please note that Table 3.4 also contains water flow rates for this period. The average electrical unit cost (EUC) for this data is given below.

$$EUC = 0.096 \, {}^{\$}/_{kWh}$$

The water flow rates are compared to the electrical usage in Figure 3.19. Also the flow is compared to electrical demand in Figure 3.20. No clear relationship was found in order to normalize the electrical consumption against flow, though demand and usage is relatively constant even when flows reduce significantly, indicating the potential for demand based control savings.

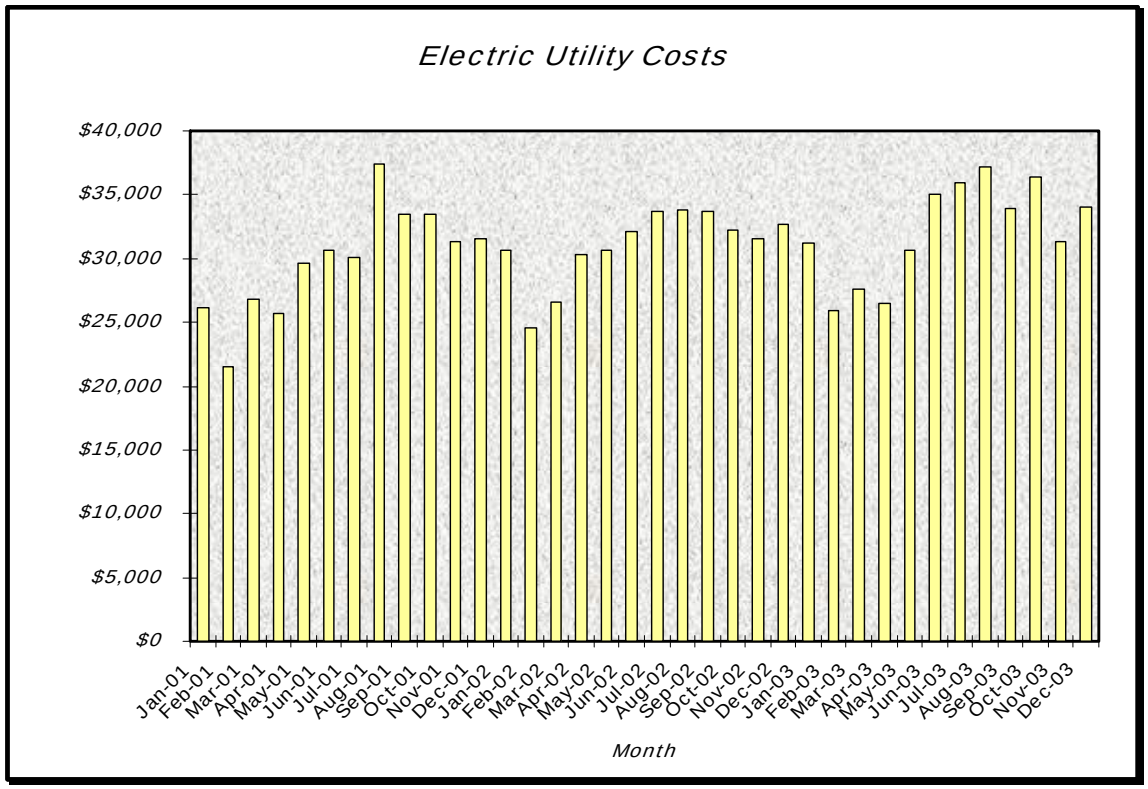


Figure 3.16, Oak Orchard Electric Costs

OAK ORCHARD WASTE WATER TREATMENT PLANT

ELECTRIC ENERGY BILLING SUMMARY

		Electric											Heating Degree Days	Cooling Degree Days	Flow
		Total Costs	OAK ORCHARD WASTE WATER TREATMENT PLANT Account #OAKOCHD 93625-15105							Electric Commodity					
Month	Days in Cycle	Delv. + Comm + Taxes $	Total Delivery Cost $	Taxes & Surcharges	Total Supply Cost $	Total Demand Cost $	kWh Quantity	Metered Demand kW	Billed Demand kW	Total Com. Supply $	Commodity Supply $	°F-day	°F-day	MGD
Jan-01	31	$26,156	$26,156	$1,662	$17,032	$7,462	285,600	588	588	$0	$0	1,221	0	5.7
Feb-01	28	$21,472	$21,472	$1,854	$14,288	$5,330	252,000	420	420	$0	$0	1,046	0	6.6
Mar-01	31	$26,787	$26,787	$1,922	$17,403	$7,462	294,000	588	588	$0	$0	1,088	0	7.7
Apr-01	30	$25,682	$25,682	$1,931	$16,289	$7,462	268,800	588	588	$0	$0	516	2	6.8
May-01	31	$29,612	$29,612	$2,147	$20,003	$7,462	352,800	588	588	$0	$0	197	20	5.1
Jun-01	30	$30,618	$30,618	$2,200	$19,890	$8,528	336,000	672	672	$0	$0	66	132	5.1
Jul-01	31	$30,083	$30,083	$2,247	$20,374	$7,462	361,200	588	588	$0	$0	18	153	4.6
Aug-01	31	$37,368	$37,368	$1,722	$26,052	$9,594	420,000	756	756	$0	$0	1	268	4.5
Sep-01	30	$33,442	$33,442	$1,734	$24,246	$7,462	336,000	588	588	$0	$0	131	48	4.9
Oct-01	31	$33,492	$33,492	$1,522	$24,615	$7,355	353,400	580	580	$0	$0	372	10	4.9
Nov-01	30	$31,287	$31,287	$1,457	$22,795	$7,035	343,035	554	554	$0	$0	534	1	5.2
Dec-01	31	$31,559	$31,559	$1,143	$23,487	$6,929	361,589	546	546	$0	$0	875	0	5.8
Jan-02	31	$30,617	$30,617	$1,126	$22,669	$6,822	358,601	538	538	$0	$0	995	0	5.3
Feb-02	28	$24,532	$24,532	$1,060	$16,756	$6,716	280,019	529	529	$0	$0	917	0	6.1
Mar-02	31	$26,583	$26,583	$1,073	$19,114	$6,396	322,006	504	504	$0	$0	889	0	6.2
Apr-02	30	$30,264	$30,264	$1,165	$21,891	$7,208	346,853	568	568	$0	$0	529	28	6.4
May-02	31	$30,652	$30,652	$1,166	$22,278	$7,208	376,598	568	568	$0	$0	53	156	7.1
Jun-02	30	$32,164	$15,296	$256	$7,629	$7,411	362,803	584	584	$16,868	$16,547	5	261	6.8
Jul-02	31	$33,693	$15,358	$196	$7,548	$7,614	394,421	600	600	$18,335	$17,990	5	276	4.9
Aug-02	31	$33,833	$15,369	$199	$7,556	$7,614	397,140	600	600	$18,464	$18,113	9	256	4.8
Sep-02	30	$33,729	$15,435	$193	$7,679	$7,563	393,682	596	596	$18,294	$17,952	58	115	4.7
Oct-02	31	$32,272	$14,509	$174	$7,026	$7,309	382,292	576	576	$17,763	$17,433	469	16	5.1
Nov-02	30	$31,577	$14,343	$176	$6,908	$7,259	370,676	572	572	$17,234	$16,907	731	0	6.0
Dec-02	31	$32,627	$14,878	$158	$7,411	$7,309	381,756	576	576	$17,749	$17,419	1,127	0	6.6
Jan-03	31	$31,217	$14,521	$160	$7,255	$7,106	362,930	560	560	$16,696	$16,553	1,432	0	5.9
Feb-03	28	$25,945	$12,594	-$23	$6,424	$6,193	290,223	488	488	$13,351	$13,236	1,212	0	6.3
Mar-03	31	$27,573	$13,113	$237	$6,429	$6,447	314,337	508	508	$14,460	$14,337	956	0	8.1
Apr-03	30	$26,433	$13,249	$302	$6,196	$6,751	286,602	532	532	$13,184	$13,072	641	6	7.3
May-03	31	$30,615	$14,424	$211	$7,107	$7,106	351,964	560	560	$16,191	$16,053	282	5	6.2
Jun-03	30	$35,073	$35,073	$1,073	$26,589	$7,411	367,970	584	584	$0	$0	77	65	5.9
Jul-03	31	$35,920	$35,920	$1,073	$27,538	$7,309	379,314	576	576	$0	$0	0	192	4.9
Aug-03	31	$37,160	$37,160	$1,077	$28,824	$7,259	382,583	572	572	$0	$0	19	219	4.8
Sep-03	30	$33,896	$33,896	$1,053	$25,787	$7,056	357,053	556	556	$0	$0	86	33	4.7
Oct-03	31	$36,360	$36,360	$1,074	$27,926	$7,360	377,820	580	580	$0	$0	510	0	5.3
Nov-03	30	$31,300	$31,300	$1,008	$23,135	$7,157	335,061	564	564	$0	$0	684	0	6.3
Dec-03	31	$34,066	$34,066	$882	$26,179	$7,005	352,948	552	552	$0	$0	1,085	0	7.2
2001	365	$357,558	$357,558	$21,541	$246,474	$89,543	3,964,424	7,056	7,056	$0	$0	6,065	634	66.9
2002	365	$372,543	$247,836	$21,005	$154,465	$86,429	4,366,847	6,811	7,006	$124,707	$122,361	5,787	1,108	70.0
2003	365	$385,558	$311,676	$20,211	$219,389	$84,160	4,158,805	6,632	7,115	$73,882	$73,251	6,984	520	72.8

Total Electric Utilities Cost - 3 year Average	$371,886
Building Area (SF)	50,000
$/SF Electric Cost - 3 year average	$7.44

Minimum Watts per Sq. Ft.	8
Maximum Watts per Sq.Ft.	15.12
Average kWh per Sq. Ft.	6.94

kWh Cost	$0.09

Table 3.4, Oak Orchard Electrical Usage & Costs

Oak Orchard

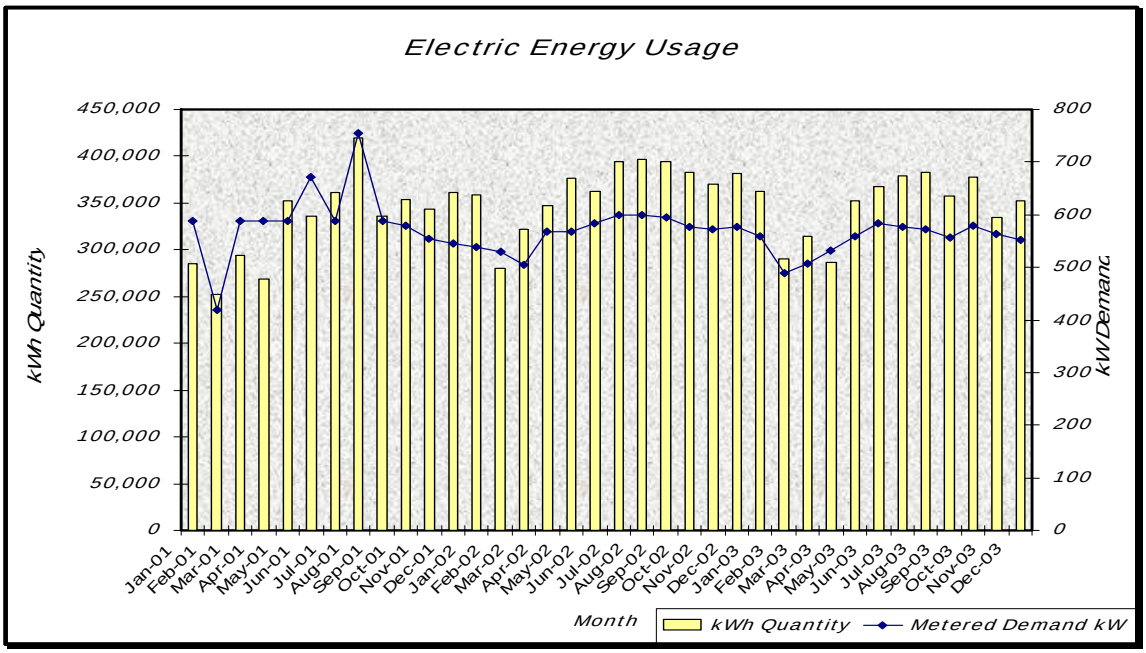


Figure 3.17, Oak Orchard Electrical Usage

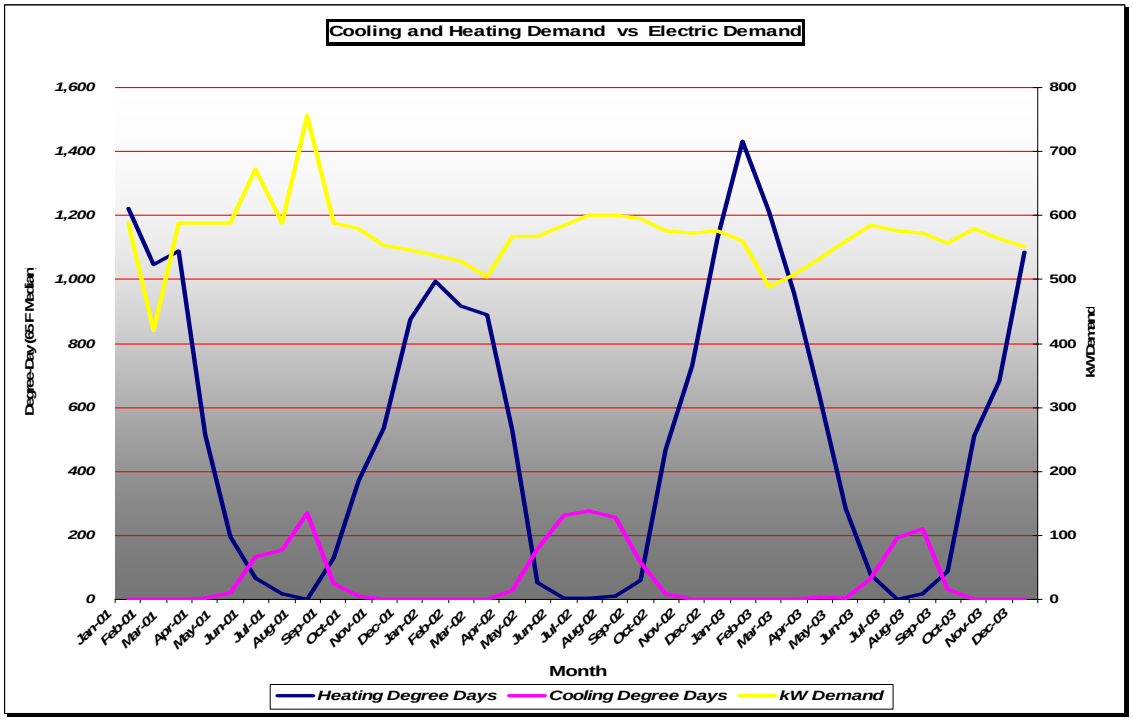


Figure 3.18, Oak Orchard demand usage

Oak Orchard

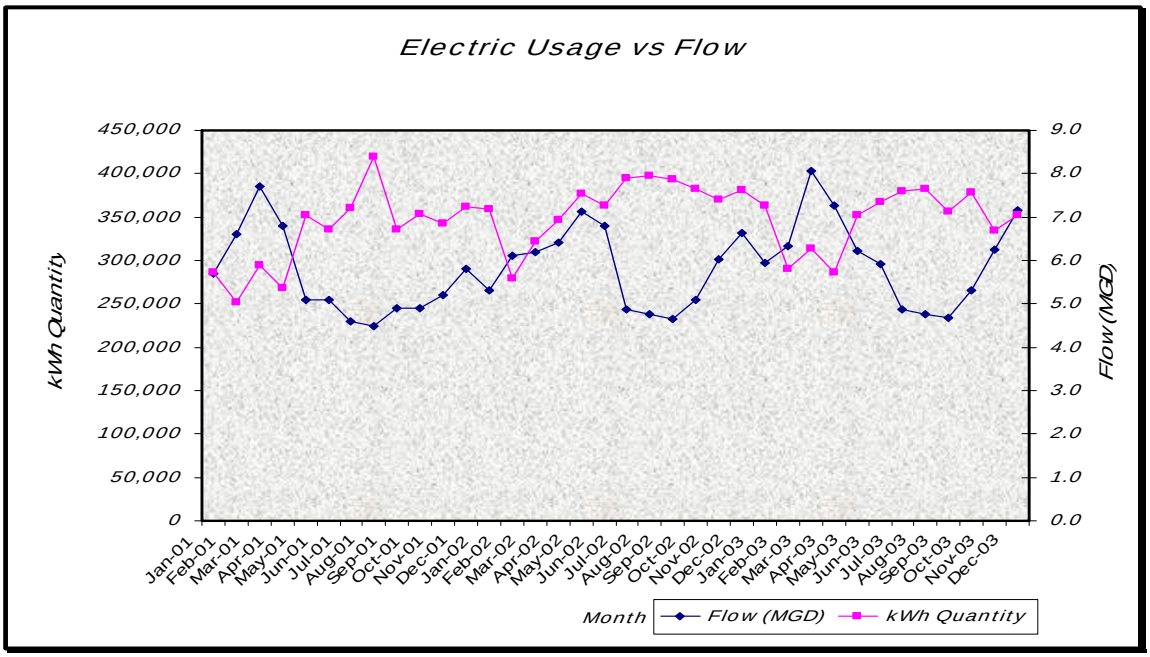


Figure 3.19, Electrical usage vs flow

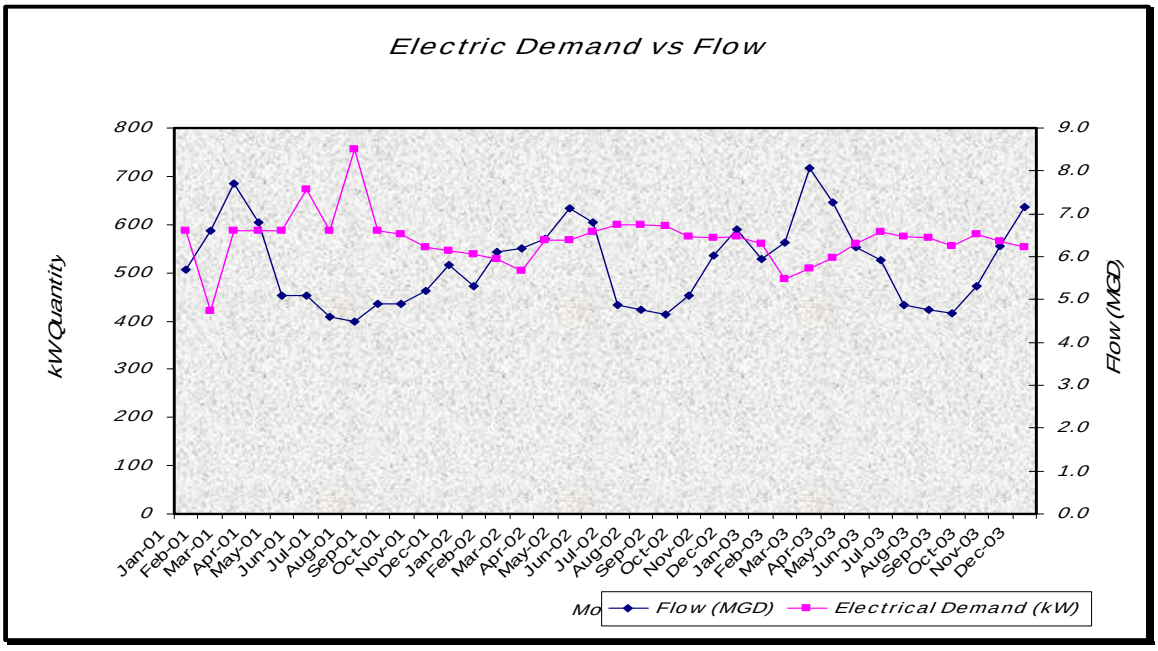


Figure 3.20, Electrical demand vs flow

Oak Orchard

3.9 Natural Gas Billing Summary

The data is summarized in Table 3.5, Additionally, the data is analyzed in Figure 3.1 through Figure 3.22. The average gas unit cost (GUC) for this data is given below.

$$GUC = 7.07\,{}^{\$}/_{MMBTU}$$

Gas consumption fairly closely tracks the heating season as seen in Figures 3.21 and Figure 3.22.

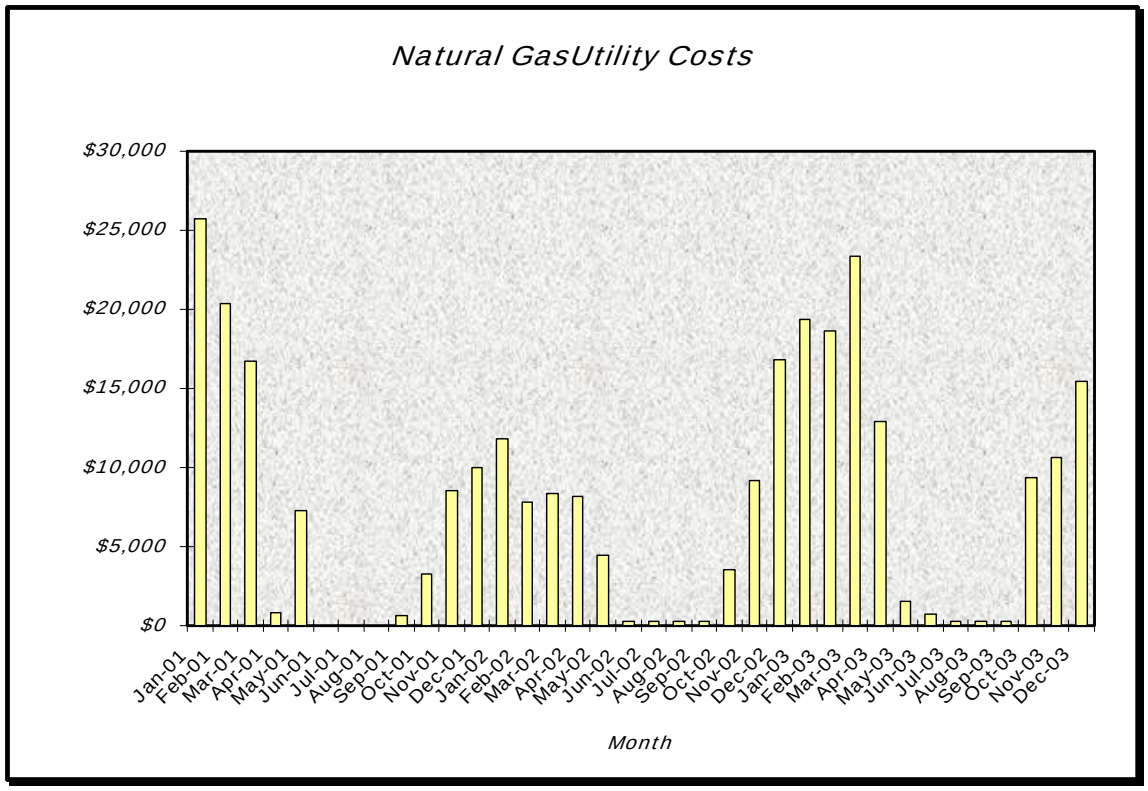


Figure 3.21, Oak Orchard natural Gas Costs

Oak Orchard

OAK ORCHARD WASTEWATER TREATMENT PLANT

NATURAL GAS BILLING SUMMARY

		Natural Gas							Heating	Cooling
		Total Gas	OAK ORCHARD WASTEWATER TREATMENT PLANT Account #OAK O 80463-83106 G						Degree Days	Degree Days
	Days in	Delv. + Comm	Total Delivery	Total Delivery	Total Supply	Therms	Total Com.	Commodity		
Month	Cycle	Cost $	Cost $	Taxes $	Cost $	Quantity	Supply Therms	Supply $	°F-day	°F-day
Jan-01	31	$25,748	$1,083	$133	$950	22,130	24,665	$24,665	1,221	0
Feb-01	28	$20,345	$1,102	$0	$964	23,331	19,243	$19,243	1,046	0
Mar-01	31	$16,693	$1,204	$0	$1,059	24,335	15,489	$15,489	1,088	0
Apr-01	30	$855	$855	$0	$796	4,859	0	$0	516	2
May-01	31	$7,271	$888	$0	$826	5,344	6,383	$6,383	197	20
Jun-01	30	$20	$20	$0	$0	0	0	$0	66	132
Jul-01	31	$20	$20	$0	$0	0	0	$0	18	153
Aug-01	31	$20	$20	$0	$0	0	0	$0	1	268
Sep-01	30	$654	$232	$0	$210	1,157	422	$422	131	48
Oct-01	31	$3,256	$937	$0	$562	7,576	2,319	$2,319	372	10
Nov-01	30	$8,575	$1,770	$0	$1,427	15,999	6,805	$6,805	534	1
Dec-01	31	$9,961	$2,250	$0	$1,910	20,710	7,711	$7,711	875	0
Jan-02	31	$11,862	$2,537	$0	$2,191	23,454	9,325	$9,325	995	0
Feb-02	28	$7,862	$2,019	$0	$1,683	18,497	5,843	$5,843	917	0
Mar-02	31	$8,374	$1,966	$0	$1,631	17,986	6,408	$6,408	889	0
Apr-02	30	$8,153	$1,575	$0	$1,247	14,243	6,705	$6,578	529	28
May-02	31	$4,424	$898	$0	$582	7,762	3,594	$3,526	53	156
Jun-02	30	$305	$305	$0	$0	0	0	$0	5	261
Jul-02	31	$306	$306	$0	$0	0	0	$0	5	276
Aug-02	31	$305	$305	$0	$0	0	0	$0	9	256
Sep-02	30	$306	$306	$0	$0	0	0	$0	58	115
Oct-02	31	$3,536	$699	$313	$386	5,856	2,892	$2,837	469	16
Nov-02	30	$9,137	$1,572	$328	$1,244	14,216	7,712	$7,565	731	0
Dec-02	31	$16,821	$2,769	$0	$2,429	25,859	14,172	$14,052	1,127	0
Jan-03	31	$19,403	$2,835	$0	$2,503	26,465	16,710	$16,568	1,432	0
Feb-03	28	$18,663	$2,563	$0	$2,238	23,843	16,237	$16,100	1,212	0
Mar-03	31	$23,372	$2,167	$0	$1,843	20,033	21,387	$21,205	956	0
Apr-03	30	$12,923	$1,841	$0	$1,520	16,891	11,082	$11,082	641	6
May-03	31	$1,585	$304	$0	$1	1,960	1,281	$1,281	282	5
Jun-03	30	$699	$304	$0	$1	533	395	$395	77	65
Jul-03	31	$303	$303	$0	$0	0	0	$0	0	192
Aug-03	31	$304	$304	$0	$1	0	0	$0	19	219
Sep-03	30	$307	$307	$0	$0	0	0	$0	86	33
Oct-03	31	$9,320	$1,475	$0	$1,155	13,218	7,845	$7,845	510	0
Nov-03	30	$10,655	$1,690	$0	$1,367	15,262	8,965	$8,965	684	0
Dec-03	31	$15,470	$2,322	$0	$2,005	21,414	13,148	$13,148	1,085	0
2001	365	$93,418	$10,381	$133	$8,704	125,441	83,037	$83,037	6,065	634
2002	365	$71,391	$11,835	$641	$11,393	127,873	56,651	$56,134	5,787	1,108
2003	365	$113,004	$12,752	$0	$12,634	139,619	97,050	$96,589	6,984	520

Cost per Therm	**$0.71**
Cost per MMBTU	**$7.07**

Total Gas Utilities Cost - 3 year Average	***$92,604***
Total Gas Therms - 3 year Average	***130,978***
Building Area (SF)	**34,398**
Therms/SF Nat. Gas - 3 year average	**3.81**
$/SF Nat. Gas - 3 year average	**$2.69**

Table 3.5, Natural Gas Usage and Costs

Oak Orchard

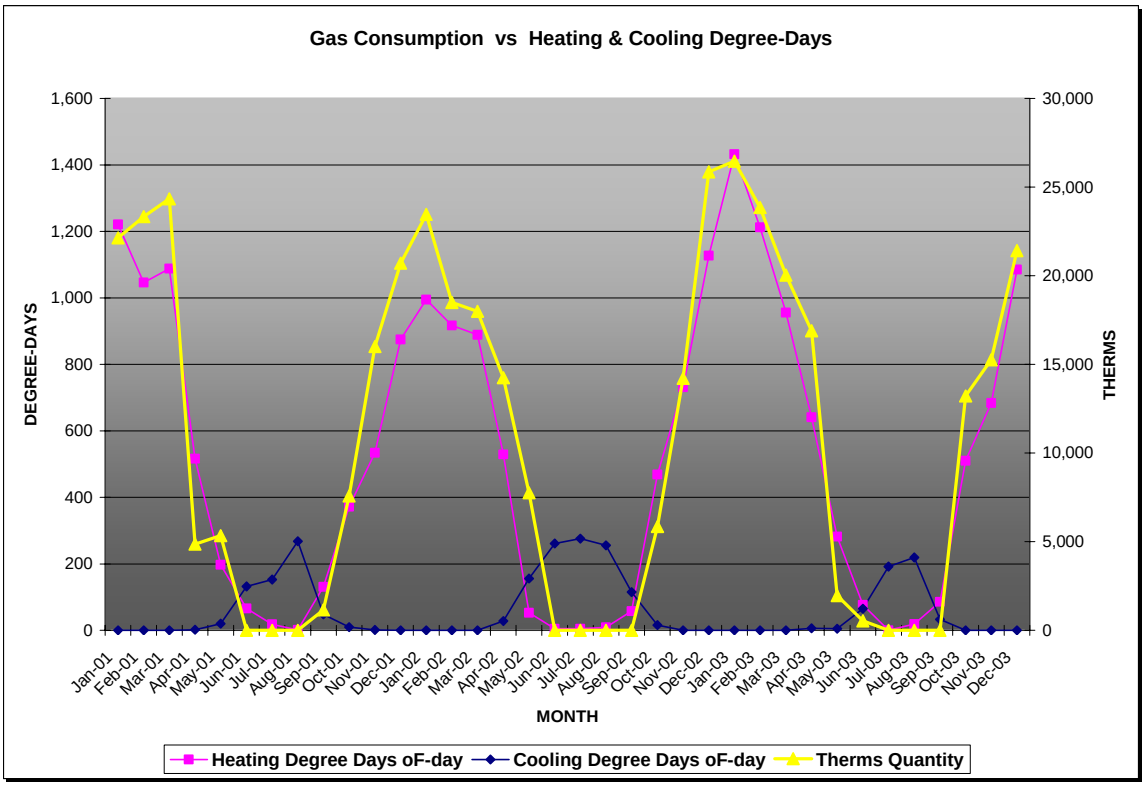


Figure 3.22, Oak Orchard natural Gas Costs

SECTION 4 – ENERGY CONSERVATION MEASURES

Baldwinsville-Seneca Waste Water Treatment Plant

4.1 – Energy Conservation Measure Descriptions - Baldwinsville-Seneca

HEATING /COOLING SYSTEM TEMPERATURE AND VENTILATION CONTROL

BALD ECM #1	**ELIMINATE ELECTRIC HEAT**

PROCESS MEASURES

BALD ECM #2	**INSTALL HIGH EFFICIENCY SURFACE AERATORS**

LIGHTING MEASURES

BALD ECM #3	**LIGHTING CONTROL AND UPGRADES-STANDARD**

The following measures additional energy saving measures (AESM). These measures were identified in this evaluation as potential energy saving measures. However, a full analysis was not performed on these measures due to one or more of the following reasons: estimated savings are too difficult to quantify without further long term study, the measure is impractical, and/or the estimated simple payback is excessive.

BALD AESM #1	**RUN COMPRESSORS IN A LOAD/UNLOAD FASHION**
BALD AESM #2	**INSTALL MORE EFFICIENT COMPRESSORS**
BALD AESM #3	**VARIABLE SPEED DRIVES ON AERATION PUMPS**
BALD AESM #4	**LED EXIT SIGNS**
BALD AESM #5	**VENDING MACHINE OCCUPANCY CONTROLS**

Baldwinsville-Seneca

HEATING /COOLING SYSTEM TEMPERATURE AND VENTILATION CONTROL

BALD-ECM #1 **ELIMINATE ELECTRIC HEAT**

Currently, the facility uses all electric heat. Some of the buildings heating load is offset by a heat recovery coil in the air duct; however, the utility graph shown in Figure 4.1 shows a distinct rise in electrical usage during winter months.

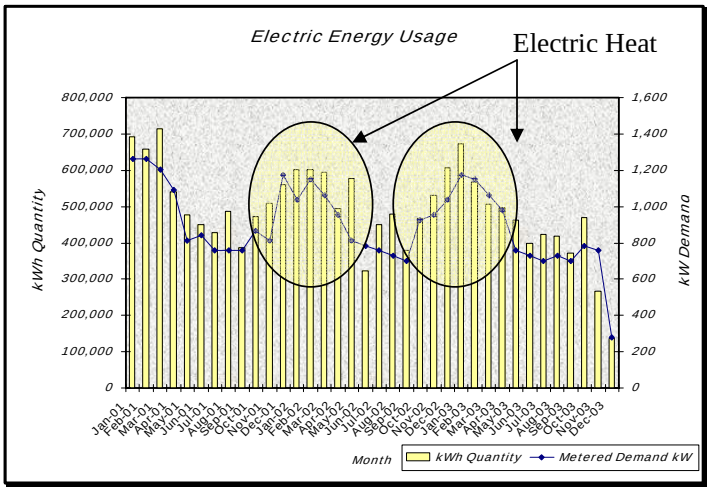


Figure 4.1, Baldwinsville electrical data

Electric heat is much more expensive to operate than other sources of heat. For example, compared to natural gas, electric heat can cost up to four times as much. Thus cost savings can be realized by replacing the current heating system with a natural gas fired system.

Baldwinsville-Seneca

PROCESS MEASURES

BALD ECM #2 **INSTALL HIGH EFFICIENCY SURFACE AERATORS**

Currently, the Baldwinsville-Seneca Waste Water Treatment Plant uses a number of surface aeration mixers in their process. The impellers used in conjunction with these mixers are outdated. Energy savings of 20% to 40% would be achieved if newer, more efficient impellers were installed.

LIGHTING MEASURES

BALD ECM #3 **LIGHTING CONTROL AND UPGRADES-STANDARD**

Currently, the facility utilizes a mix of T-12 and T-8 lamped fluorescent light fixtures, with both magnetic and electronic ballasts, Metal Halide, Low Pressure Sodium and standard incandescent lamp fixtures. Some of the fixtures are vapor tight or recessed fixtures fitting their use in a water treatment plant. Many interior spaces are not lit when un-occupied resulting in low hours of operation on many fixtures.

We will relamp the interior of the facility with new 15, 25, 32 and 108 (96") -watt T-8 lamps where T-12 lamps are currently utilized in high use areas. The new lamps will have an 85CRI and a 20,000 to 25,000 hour bulb life. All existing T-12 light fixtures will be converted to high efficiency, high lumen T-8 lamps, ballasts, and reflectors will be provided as specified.. See schedule for details.
All of the incandescent lamp fixtures which exceed 750 hours of operation per year will be converted to compact fluorescent except for task lighting, which will remain incandescent for best color rendering. Compact Fluorescent lamps provide a minimum of 8000 hours lamp life which significantly reduces maintenance life cycle costs, especially in difficult to access vapor-tite, explosion proof and/or recessed lighting applications.

Install occupancy sensors in rooms as shown on the schedules to turn lights off in rooms that are unoccupied, but entered on a frequent basis. Occupancy sensors shall utilize a combination of passive infrared, ultra-Sonics and/or passive acoustic sensing.

Total projected energy usage savings is 53,435 kWh and 16 kW in demand savings.

BALD AESM #1	**RUN COMPRESSORS IN A LOAD/UNLOAD FASHION**

Currently the Load/Unload feature of the compressors used in the oxygen process at Baldwinsville is bypassed. Monitoring was done to show the effects of turning this feature on. The results of this monitoring, shown in Figure 4.2, clearly indicate an energy savings by switching the Load/Unload feature on.

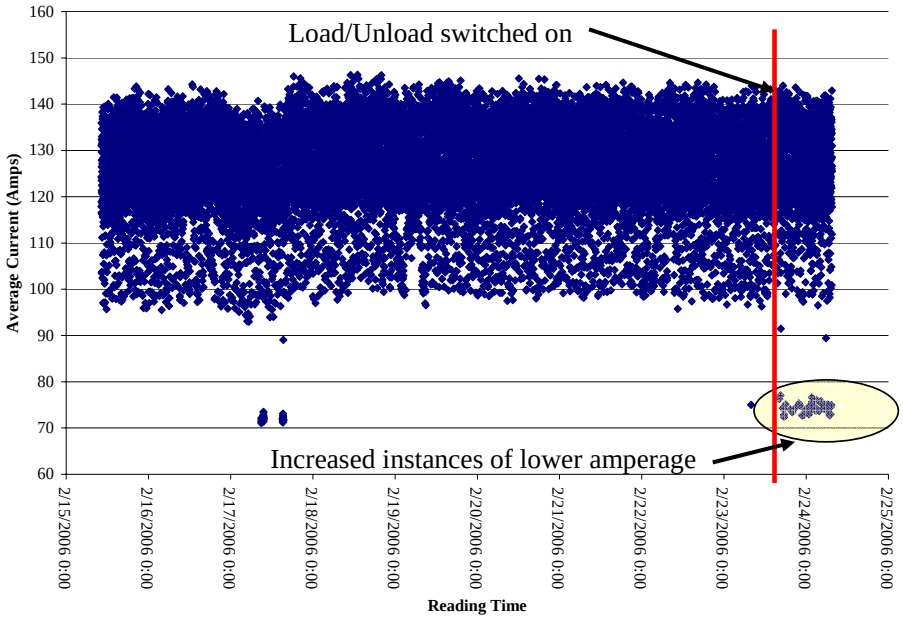


Figure 4. 2, Baldwinsville Compressor #2 amperages under Load/Unload

Baldwinsville-Seneca

BALD AESM #2 **INSTALL MORE EFFICIENT COMPRESSORS**

Currently, the compressors used for making oxygen at the Baldwinsville-Seneca are all reciprocating compressors. These compressors were installed in the late 1970s. Due to the age of these compressors, and the means by which they are controlled, it is believed that more efficient compressors and sequencing controls may be commercially available. Installing more efficient compressors, with variable speed capability to best match demand load conditions could result in significant energy and maintenance savings. The 1970's vintage oxygen generators which these compressors feed would need to be replaced to take full advantage of the variable speed capability of new compressors. To evaluate the full extent of the savings, long term monitoring of effluent oxygen demand vs supply & associated power monitoring would need to be monitored over the period of a year. Short term monitoring performed to date shows promise of substantial energy savings with new equipment selection and installation.

BALD AESM #3 **VARIABLE SPEED DRIVES ON AERATION PUMPS**

Currently, the aeration blowers (Grit Blowers) have Variable Frequency Drives installed.

BALD AESM #4 **LED EXIT SIGNS**

Generally, many facilities contain exit signs with incandescent or fluorescent lights. Energy savings can be achieved by replacing these signs with light emitting diode (LED) exit signs. Generally this measure can have a simple payback between one and three years. LED exit signs are included in the lighting measures proposed for this facility.

BALD AESM #5 **VENDING MACHINE OCCUPANCY CONTROLS**

Generally, many facilities contain soda and snack vending machines. Occupancy controls can be added to existing machines to achieve energy savings. Generally this measure can have a simple payback between one and three years.

Brewerton Waste Water Treatment Plant

4.2 – Energy Conservation Measure Descriptions - Brewerton

HEATING /COOLING SYSTEM TEMPERATURE AND VENTILATION CONTROL

BREW ECM#1	**ELIMINATE ELECTRIC HEAT**

PROCESS SYSTEMS & CONTROLS

BREW ECM #2	**INSTALL VARIABLE SPEED DRIVES WITH DEMAND CONTROL ON AERATION BLOWERS**

LIGHTING MEASURES

BREW ECM #3	**LIGHTING CONTROL AND UPGRADES-STANDARD**

The following measures additional energy saving measures (AESM). These measures were identified in this evaluation as potential energy saving measures. However, a full analysis was not performed on these measures due to one or more of the following reasons: estimated savings are too difficult to quantify without further long term study, the measure is impractical, and/or the estimated simple payback is excessive.

BREW AESM #1	**LED EXIT SIGNS**
BREW AESM #2	**VENDING MACHINE OCCUPANCY CONTROLS**
BREW AESM #3	**IMPLIMENT A COMPRESSED AIR LEAK PROGRAM**
BREW AESM #4	**INSTALL A SMALLER CONTROLS COMPRESSOR**

Brewerton

HEATING /COOLING SYSTEM TEMPERATURE AND VENTILATION CONTROL

BREW ECM #1 **ELIMINATE ELECTRIC HEAT**

Currently, the facility uses all electric heat. Some of the buildings heating load is offset by a heat recovery coil in the air duct; however, the utility graph shown in Figure 4.1 shows a distinct rise in electrical usage during winter months.

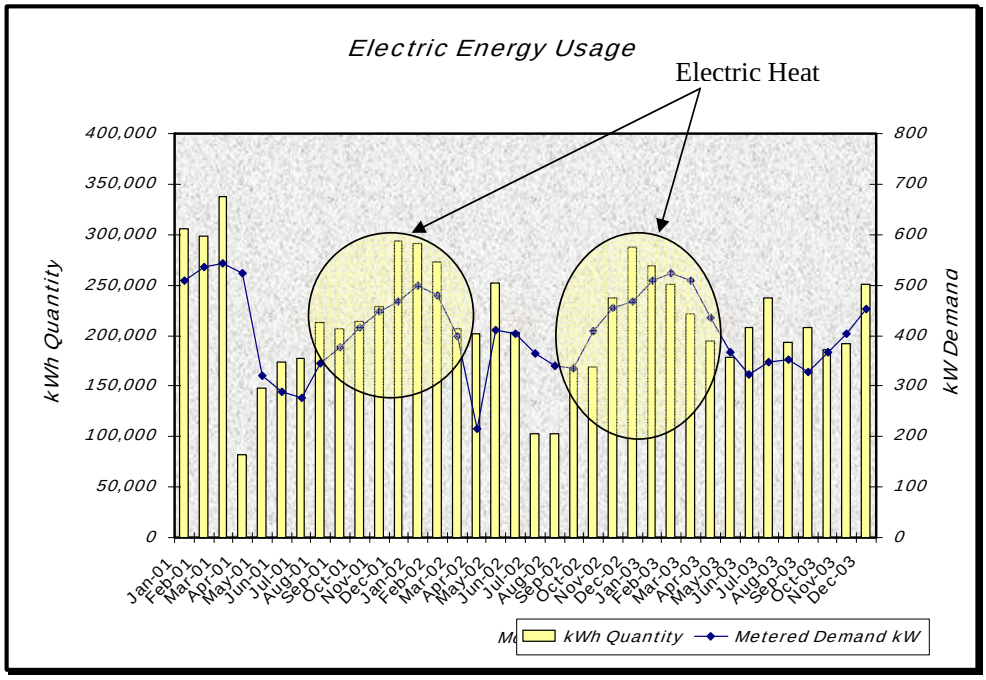


Figure 4.3, Baldwinsville electrical data

Electric heat is much more expensive to operate than other sources of heat. For example, compared to natural gas, electric heat can cost up to four times as much. Thus cost savings can be realized by replacing the current heating system with a natural gas fired system.

Brewerton

PROCESS SYSTEMS & CONTROLS

BREW ECM #2	**INSTALL VARIABLE SPEED DRIVES WITH DEMAND CONTROL ON AERATION BLOWERS**

The Brewerton WWTP aeration blowers are controlled as per Figure 4.4.

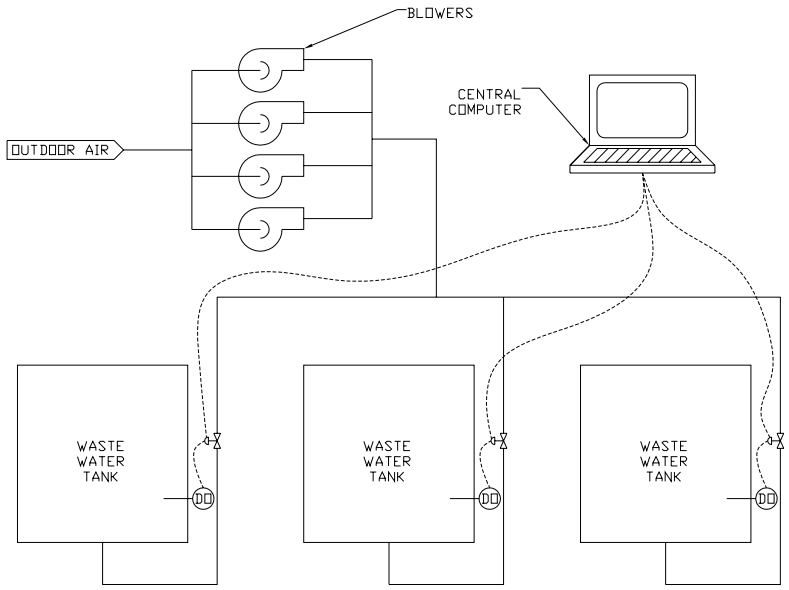


Figure 4.3, current Brewerton blower control

Blower speeds, and air output, are constant for each blower. The air supply to the waste water tanks is controlled using dissolved oxygen sensors which are used to control actuated control valves in the air supply line to the tanks. As the tank requires more aeration, the control valve is opened. The 125 hp blowers are staged on or off to meet the air demands of the process.

Carrier believes that energy savings may be available by controlling the individual blower speeds, and thus output, based on the supply header pressure as shown in Figure 4.4. This proposed ECM would most likely improve the control of air to each of the tanks as control valves are most effective when modulating against a constant pressure. Air flow to the individual tanks would not be affected by this ECM.

Brewerton

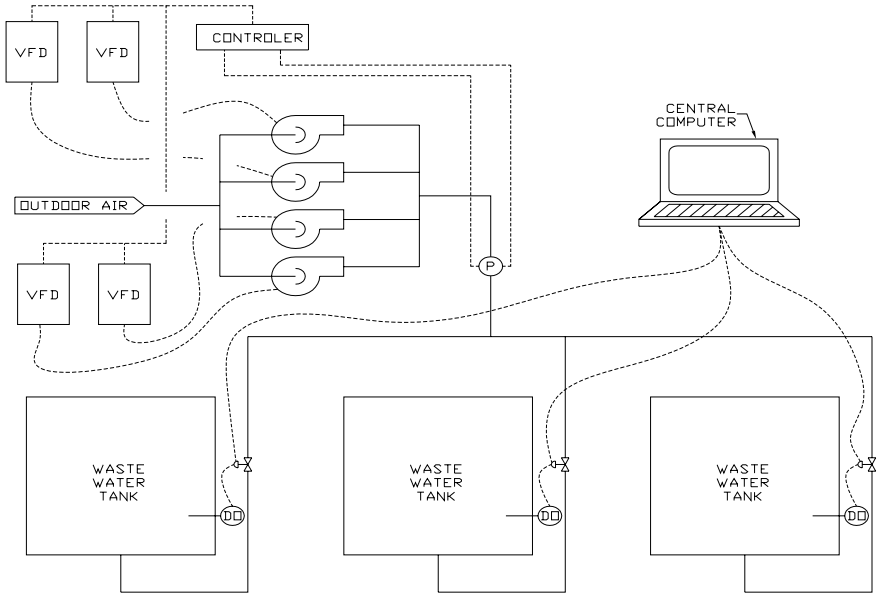


Figure 4.4, Proposed Brewerton blower control

Brewerton

LIGHTING MEASURES

BREW ECM #3 **LIGHTING CONTROL AND UPGRADES-STANDARD**

Currently, the facility utilizes a mix of T-12 and T-8 lamped fluorescent light fixtures, with both magnetic and electronic ballasts, Metal Halide, Low Pressure Sodium and standard incandescent lamp fixtures. Some of the fixtures are vapor tight or recessed fixtures fitting their use in a water treatment plant. Many interior spaces are not lit when un-occupied resulting in low hours of operation on many fixtures.

We will relamp the interior of the facility with new 15, 25, 32 and 108 (96") -watt T-8 lamps where T-12 lamps are currently utilized in high use areas. The new lamps will have an 85CRI and a 20,000 to 25,000 hour bulb life. All existing T-12 light fixtures will be converted to high efficiency, high lumen T-8 lamps, ballasts, and reflectors will be provided as specified.. See schedule for details.
All of the incandescent lamp fixtures which exceed 750 hours of operation per year will be converted to compact fluorescent except for task lighting, which will remain incandescent for best color rendering. Compact Fluorescent lamps provide a minimum of 8000 hours lamp life which significantly reduces maintenance life cycle costs, especially in difficult to access vapor-tite, explosion proof and/or recessed lighting applications.

Install occupancy sensors in rooms as shown on the schedules to turn lights off in rooms that are unoccupied, but entered on a frequent basis. Occupancy sensors shall utilize a combination of passive infrared, ultra-Sonics and/or passive acoustic sensing.

Total projected energy usage savings is 10,511 kWh and 4 kW in demand savings.

BREW AESM #1 **LED EXIT SIGNS**

Generally, many facilities contain exit signs with incandescent or fluorescent lights. Energy savings can be achieved by replacing these signs with light emitting diode (LED) exit signs. Generally this measure can have a simple payback between one and three years. This measure is incorporated in the proposed lighting measures.

BREW AESM #2 **VENDING MACHINE OCCUPANCY CONTROLS**

Generally, many facilities contain soda and snack vending machines. Occupancy controls can be added to existing machines to achieve energy savings. Generally this measure can have a simple payback between one and three years depending on the personnel traffic in the areas the vending machines are located. Less frequently used machines in areas of low traffic have the highest payback in savings.

BREW AESM #3 **IMPLIMENT A COMPRESSED AIR LEAK PROGRAM**

During interviews with plant personnel it was not clear that the plant had an effective compressed air leak monitoring program. Compressed air leaks can be very expensive. A rule of thumb for leak costs is given in Figure 4.5. Although a hole in the line or vessel is implied by this table, leaking valves, valve stem seals, cylinder seals and pipe connection threads are the most common source of leaks. They rob the system of energy and capacity.

	Size	Cost Per Year
	1/16”	$1046
	1/8”	$4,200
	1/4”	$8,800
Costs calculated using an electricity rate of $0.10 per kWh, assuming constant operation and an efficient compressor		

Figure 4.5, Estimated compressed air leak costs[1]

Brewerton

BREW **INSTALL A SMALLER COMPRESSOR**

[1] Taken from “improving Compressed Air System Performance- A Sourcebook for Industry, US Department of Energy, November 2003, page 27

AESM #4

This facility contains a small reciprocating compressor that is used for control equipment. It is suspected that this compressor may be oversized. Energy savings may be achieved if this suspicion is correct by reducing quick cycling times which can cause unnecessary electrical demand.

BREW AESM #5 **INSTALL MORE EFFICIENCT BLOWERS**

A representative from the original equipment manufacture of the aeration blowers was contacted to evaluate this ECM. Based on the nameplate data from a representative blower at this facility, the manufacturer's engineer did not believe that a more efficient blower was available.

Comment [AFK1]:
AFK called on 2/6/2006

Jason @ 8800-543-7736

Said that the blower was probably built in 1991 based on the serial number and he did not think the efficiency could be improved

Meadow Brook-Limestone Waste Water Treatment Plant

4.3 – Energy Conservation Measure Descriptions

HEATING /COOLING SYSTEM TEMPERATURE AND VENTILATION CONTROL

MBL ECM #1	**ELIMINATE ELECTRIC HEAT**

LIGHTING MEASURES

MBL ECM #2	**LIGHTING CONTROL AND UPGRADES-STANDARD**

The following measures additional energy saving measures (AESM). These measures were identified in this evaluation as potential energy saving measures. However, a full analysis was not performed on these measures due to one or more of the following reasons: estimated savings are too difficult to quantify without further long term study, the measure is impractical, and/or the estimated simple payback is excessive.

MBL AESM #1	**VARIABLE SPEED DRIVES ON AERATION PUMPS**
MBL AESM #2	**LED EXIT SIGNS**
MBL AESM #3	**VENDING MACHINE OCCUPANCY CONTROLS**

Meadowbrook Limestone

HEATING /COOLING SYSTEM TEMPERATURE AND VENTILATION CONTROL

MBL ELIMINATE ELECTRIC HEAT
ECM #1

Currently, the facility uses all electric heat. Some of the buildings heating load is offset by a heat recovery coil in the air duct; however, the utility graph shown in Figure 4.1 shows a distinct rise in electrical usage during winter months. This rise in electrical usage does not correlate to a rise in flow through the plant as can be seen in Section 4 of this report.

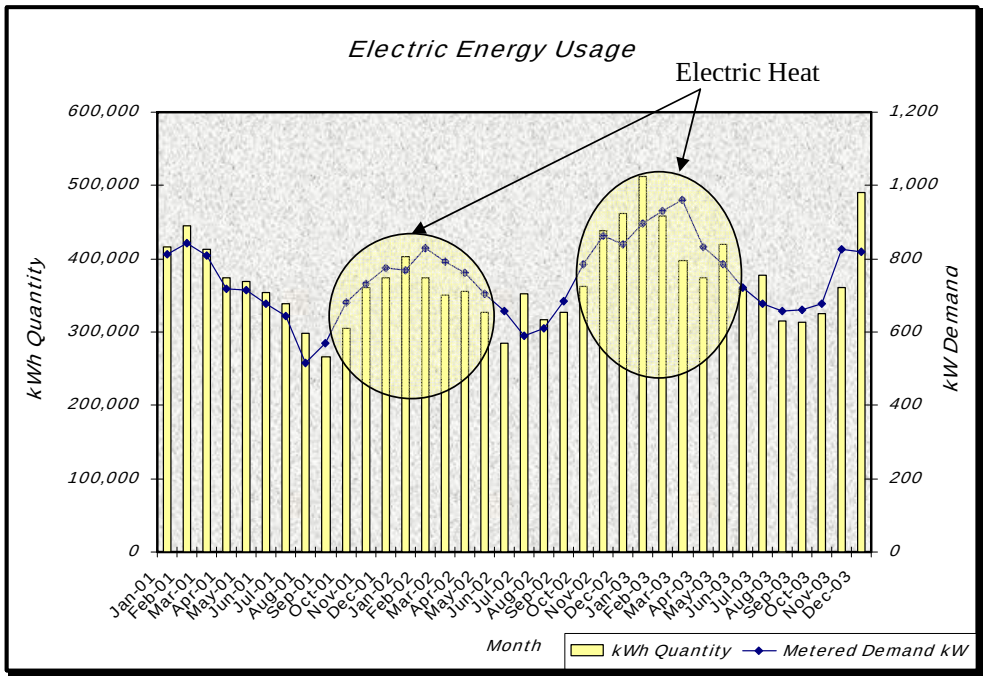


Figure 4.6, Meadowbrook electrical data

Electric heat is much more expensive to operate than other sources of heat. For example, compared to natural gas, electric heat can cost up to four times as much. Thus cost savings can be realized by replacing the current heating system with a natural gas fired system.

Meadowbrook Limestone

LIGHTING MEASURES

MBL ECM #2 **LIGHTING CONTROL AND UPGRADES-STANDARD**

Currently, the facility utilizes a mix of T-12 and T-8 lamped fluorescent light fixtures with electronic ballasts, and incandescent lamp fixtures.
Many of the fixtures are vapor tight or recessed fixtures fitting their use in a waste water treatment plant.
Most interior spaces are not lit when un-occupied resulting in low hours of operation on many fixtures.

We will relamp the interior of the facility with new 15, 25, 32 and 108 (96") -watt T-8 lamps where T-12 lamps are currently utilized in high use areas. The new lamps will have an 85CRI and a 20,000 to 20,000 hour bulb life. All existing T-12 light fixtures will be converted to high efficiency, high lumen T-8 lamps, ballasts, and reflectors will be provided as specified.. See schedule for details.
All of the incandescent lamp fixtures which exceed 750 hours of operation per year will be converted to compact fluorescent except for task lighting, which will remain incandescent for best color rendering. Compact Fluorescent lamps provide a minimum of 8000 hours lamp life which significantly reduces maintenance life cycle costs, especially in difficult to access vapor-tite, explosion proof and/or recessed lighting applications.
Install occupancy sensors in rooms as shown on the schedules to turn lights off in rooms that are unoccupied, but utilized on a frequent basis. Occupancy sensors shall utilize a combination of passive infrared, ultra-Sonics and/or passive acoustic sensing.

Total projected energy usage savings is 1,957 kWh and 1 kW in demand savings.

MBL AESM #1 **VARIABLE SPEED DRIVES ON AERATION PUMPS**

Currently, the aeration pumps for blowers at this facility have variable speed drives on the motors. The drive speed is controlled via an oxygen sensor in the aeration tank.

MBL AESM #2 **LED EXIT SIGNS**

Generally, many facilities contain exit signs with incandescent or fluorescent lights. Energy savings can be achieved by replacing these signs with light emitting diode (LED) exit signs. Generally this measure can have a simple payback between one and three years. LED exit sign replacement is included in the Lighting measures proposed for this facility.

MBL AESM #3	VENDING MACHINE OCCUPANCY CONTROLS

Generally, many facilities contain soda and snack vending machines. Occupancy controls can be added to existing machines to achieve energy savings. Generally this measure can have a simple payback between one and three years depending on the personnel traffic in the areas the vending machines are located. Less frequently used machines in areas of low traffic have the highest payback in savings.

Oak Orchard Waste Water Treatment Plant

4.4 – Energy Conservation Measure Descriptions

PROCESS MEASURES

OAK ECM #1	**INSTALL HIGH EFFICIENCY SURFACE AERATORS**

The following measures additional energy saving measures (AESM). These measures were identified in this evaluation as potential energy saving measures. However, a full analysis was not performed on these measures due to one or more of the following reasons: estimated savings are too difficult to quantify without further long term study, the measure is impractical, and/or the estimated simple payback is excessive.

OAK AESM #1	**INSTALL MORE EFFICIENT COMPRESSORS**
OAK AESM #2	**SURVEY STEAM TRAPS**
OAK AESM #3	**LIGHTING CONTROL FOR SKY LIGHTS**
OAK AESM #4	**REPLACE MULTI-ZONE AIR HANDLER**
OAK AESM #5	**VARIABLE SPEED DRIVES ON AERATION BLOWERS**
OAK AESM #6	**LED EXIT SIGNS**
OAK AESM #7	**RECOVER COMPRESSOR WASTE HEAT**
OAK AESM #8	**VENDING MACHINE OCCUPANCY CONTROLS**

ECM #2 RECOVER COMPRESSOR WASTE HEAT

Currently, the facility is using compressors in the production of pure oxygen. These compressors are cooled via a water loop and a cooling tower. Energy savings would be realized if the heat from the compressors was recovered for space heating during winter months.

PROCESS MEASURES

ECM #3 INSTALL HIGH EFFICIENCY SURFACE AERATORS

Currently, the plant uses a number of surface aeration motors in their process. The impellers used in conjunction with these motors are outdated. Energy savings would be achieved if newer, more efficient impellers were installed.

AESM #1 INSTALL MORE EFFICIENT COMPRESSORS

Currently, the compressors used for making oxygen at Oak Orchard plants are all reciprocating compressors. These compressors were installed in the late 1970s. Due to the age of these compressors it is believed that more efficient compressors may be commercially available. Installing more efficient compressors could result in significant energy and maintenance savings.

AESM #2 SURVEY STEAM TRAPS

Plant personnel indicated that this facility did not have a steam trap maintenance program. Instituting such a program will result in energy savings. Currently, the facility flashes steam from their condensate return system in three different areas. A typical flash steam vent is pictured in Figure 4.7. Steam flashing is observed in the condensate receivers when steam traps have failed and are stuck open, letting steam leak into the condensate system. Significant Energy savings would result if the steam trap(s) which have failed are identified and replaced. The average reliable life of a steam trap is between 7 and 10 years, at which time a trap should be rebuilt or replaced.

Figure 4.7, Condensate flash steam

A rule of thumb for costs associated with malfunction steam traps is given in Table 4.1[2].

Trap Orifice Diameter (inches)	Steam Loss (lb/hr) Steam Pressure (psig)			
	15	100	150	300
1/32	0.85	3.3	4.8	-
1/16	3.4	13.2	18.9	36.2
1/8	13.7	52.8	74.8	145
3/16	30.7	119	170	326
1/4	54.7	211	303	579
3/8	123	475	682	1,303

[2]From the Boiler Efficiency Institute, Steam is discharged to atmospheric pressure

Table 4.1, Steam trap inefficiency costs

LIGHTING CONTROL FOR SKY LIGHTS

Oak orchard has a number of existing skylights. In many places electric lights operate in the same area. Many of these lights can be dimmed or shut off in order to achieve energy savings.

AESM #4 REPLACE MULTI-ZONE AIR HANDLER

The Oak Orchard offices are served by a central multi-zone air handling unit. Plant personnel believe that this unit is not distributing air properly throughout the building. As a result it is believed that this unit is causing discomfort as well as wasting energy. It is difficult to verify or quantify any energy savings wasted by this unit.

AESM #5 VARIABLE SPEED DRIVES ON AERATION PUMPS

Currently, the aeration pumps for all of the waste water treatment plants run at constant speed. The required oxygen content of the aeration tanks varies based on water temperature and volumetric flow. Energy savings may be achievable by installing variable speed drives on the pumps. The drive speed would then be controlled via an oxygen sensor in the aeration tank.

AESM #6 LED EXIT SIGNS

Generally, many facilities contain exit signs with incandescent or fluorescent lights. Energy savings can be achieved by replacing these signs with light emitting diode (LED) exit signs. Generally this measure can have a simple payback between one and three years.

AESM #7 VENDING MACHINE OCCUPANCY CONTROLS

Generally, many facilities contain soda and snack vending machines. Occupancy controls can be added to existing machines to achieve energy savings. Generally this measure can have a simple payback between one and three years.

All Sites-Baldwinsville-Seneca, Brewerton, Meadow Brook-Limestone, and Oak Orchard Waste Water Treatment Plants

4.5– Energy Conservation Measure Descriptions

HEATING /COOLING SYSTEM TEMPERATURE CONTROL

ALL SITES ECM #1	PROGRAMMABLE THERMOSTATS FOR ELECTRIC UNIT HEATERS

Programmable Line Voltage Thermostat Retrofit for Electric Unit Heaters

Baldwinsville-Seneca

The Baldwinsville WWTP utilizes thirty four (34) electric unit heaters located throughout the facility. These units are presently controlled by simple electric line voltage thermostats that enable/disable the unit when setpoint is not met.

This facility does not operate 24 hours a day, 7 days a week. It was apparent that the setpoint for these units varied. During a site visit, it was noted that the electric thermostats were set at 60-80 F. The units should have been set at 55 F, and temporarily set higher to meet the needs of personnel. No personnel were to be observed in the immediate areas. Most units are heating 24/7.

It is our recommendation to provide programmable line voltage thermostats. A customized time schedule will be easily implemented to provide for an operation schedule. These units will be programmed with a typical setpoint temperature and setback during unoccupied times. If personnel require the space to be heated above the pre-programmed temperature, a pushbutton interface will allow the user to increase/decrease setpoint temporarily.

Brewerton

The Brewerton WWTP utilizes forty (40) electric unit heaters located throughout the facility. These units are presently controlled by simple electric line voltage thermostats that enable/disable the unit when setpoint is not met.

This facility does not operate 24 hours a day, 7 days a week. It was apparent that the setpoint for these units varied. During a site visit, it was noted that the electric thermostats were set at 60-80 F. The units should have been set at 55 F, and temporarily set higher to meet the needs of personnel. No personnel were to be observed in the immediate areas. Most units are heating 24/7.

It is our recommendation to provide programmable line voltage thermostats. A customized time schedule will be easily implemented to provide for an operation schedule. These units will be programmed with a typical setpoint temperature and setback during unoccupied times. If personnel require the space to be heated above the pre-programmed temperature, a pushbutton interface will allow the user to increase/decrease setpoint temporarily.

Meadow Brook-Limestone

The Meadowbrook - Limestone WWTP utilizes twenty (20) electric unit heaters located throughout the facility. These units are presently controlled by simple electric line voltage thermostats that enable/disable the unit when setpoint is not met.

This facility does not operate 24 hours a day, 7 days a week. It was apparent that the setpoint for these units varied. During a site visit, it was noted that the electric thermostats were set at 60-80 F. The units should have been set at 55 F, and temporarily set higher to meet the needs of personnel. No personnel were to be observed in the immediate areas. Most units are heating 24/7.

It is our recommendation to provide programmable line voltage thermostats. A customized time schedule will be easily implemented to provide for an operation schedule. These units will be programmed with a typical setpoint temperature and setback during unoccupied times. If personnel require the space to be heated above the pre-programmed temperature, a pushbutton interface will allow the user to increase/decrease setpoint temporarily.

Oak Orchard

The Oak Orchard WWTP utilizes two electric unit heaters and one electric heating coil located in a Make Up Air unit. This equipment resides in the outbuilding, located at the roadway entrance of the facility. These units are presently controlled by simple electric line voltage thermostats that enable/disable the unit when setpoint is not met.

This outbuilding does not operate 24 hours a day, 7 days a week, and very rarely houses personnel for long periods of time. It was also apparent that the setpoint for these units varied. During a site visit, it was noted that the electric thermostats were set at 65-70 F. The units should have been set at 55 F when unoccupied. No personnel were to be observed in the immediate area. The units were heating 24/7.

It is our recommendation to provide programmable line voltage thermostats. A customized time schedule will be easily implemented to provide for an operation schedule. These units will be programmed with a typical setpoint temperature and setback during unoccupied times. If personnel require the space to be heated above the pre-programmed temperature, a pushbutton interface will allow the user to increase/decrease setpoint temporarily.

SECTION 5 – SAVINGS CALCULATIONS & COSTS

Baldwinsville-Seneca Waste Water Treatment Plant

5.1 ECM Savings Calculations & Cost Spread Sheets - Baldwinsville

HEATING /COOLING SYSTEM TEMPERATURE AND VENTILATION CONTROL

BALD ECM #1 **ELIMINATE ELECTRIC HEAT**

Analysis

In order to determine the savings from this measure the base load was estimated for electrical usage. The base load was calculated as the average monthly usage from May to October in 2001, 2002, and 2003. This yielded the following.

kWh Base Load = 439,911 kWh

Next, the deviation from the base loads during the heating months was determined from the provided bills. These deviations are shown in Table 5.1.

Usage Period	kWh Usage	Deviation from Base Load (kWh)
January 2001	691,600	*251,689*
February 2001	658,000	*218,089*
March 2001	714,000	*274,089*
April 2001	540,400	*100,489*
November 2001	509,600	*69,689*
December 2001	560,000	*120,089*
January 2002	602,000	*162,089*
February 2002	602,000	*162,089*
March 2002	593,600	*153,689*
April 2002	494,400	*54,489*
November 2002	532,000	*92,089*
December 2002	607,600	*167,689*
January 2003	672,000	*232,089*
February 2003	568,400	*128,489*
March 2003	506,800	*66,889*
April 2003	495,600	*55,689*
November 2003	266,000	*-173,911*
December 2003	137,200	*-302,711*
	Total	1,832,802
	Annual Average	610,934

Table 5.1, Electrical savings for switching to natural gas

Baldwinsville-Seneca

The estimated total annual energy savings (AES) is given in Table 5.1. However it stands to reason that a portion of the winter energy increase may be due to process loads. Thus the estimated savings have been reduced by 25% in order to remain conservative. Thus the estimated AES are as follows.

$$AES = 458{,}200\ kWh$$

Assuming an 80% combustion efficiency the corresponding natural gas usage (NGU) is as follows.

$$NGU = 1{,}955\ MMBTU$$

Given an electrical usage cost of $0.096 per kWh and an assumed natural gas cost of $10 per MMBTU the estimated annual cost savings (ACS) is as follows.

$$ACS = \$21{,}688$$

Economics

An opinion of the probable construction costs required to complete this project is given in Table 5.2. The data in this table was taken from the 2006 RS Means Cost Data Handbook or the 2006 RS Means Site Work & Landscape Cost Data Handbook unless otherwise noted.

Description	Line #/Source	Unit Price	Quantity	Total
Natural Gas Service				
Gas service piping	*02550-464-110*	*$4.64*	*3,000*	*$13,920*
Excavation & Fill	*G1030-805-1320*	*$3.75*	*3,000*	*$11,250*
HVU-1, 2, 3, & Lab Unit				
Demolition	*15055-300-0410*	*$1,175*	*4*	*$4,700*
New Unit	*D3040-114-1030*	*$27,475*	*4*	*$109,900*
Electrical	*Estimate*	*$3,000*	*4*	*$12,000*
NG Service	*Estimate*	*$3,000*	*4*	*$12,000*
Controls	*Estimate*	*$3,000*	*4*	*$12,000*
Office Baseboard				
Demolition	*15055-300-2740*	*$50*	*50*	*$2,500*
New System	*D301-510-1880*[1]	*$5.03*	*25,984*	*$130,700*
NG Service	*Estimate*	*$3,000*	*4*	*$12,000*
Controls	*Estimate*	*$6,000*	*4*	*$24,000*
			Subtotal	*$344,970*
		25%	*Contingency*	*$86,243*
			Materials Total	*$431,213*
		11%	*Engineering*	*$47,433*
			Grand Total	$478,646

Table 5.2, Opinion of probable construction costs

[1] Unit cost is per square foot

Baldwinsville-Seneca

The simple payback (SP) associate with this measure is as follows. Note that the simple payback should decrease if NYSERDA funding is obtained.

SP = 22 years

PROCESS MEASURES

BALD ECM #2 **INSTALL HIGH EFFICIENCY SURFACE AERATORS**

Analysis

The motors used at the facilities in question are shown in Table 5.3.

Facility	Motor	Motor HP	Measured kW
Baldwinsville	Aerator First Stage 1-1	25	15.80
	Aerator First Stage 1-2	15	9.24
	Aerator First Stage 1-3	15	8.77
	Aerator First Stage 2-1	25	14.88
	Aerator First Stage 2-2	15	8.47
	Aerator First Stage 2-3	15	8.88
	Aerator Second Stage 1-1	25	15.34
	Aerator Second Stage 1-2	15	8.84
	Aerator Second Stage 1-3	15	8.84
	Digester Pump 2	75	33.9
		240	133

Table 5.3, Waste water treatment plant motors

Comment [AFK1]: The HP values for the second stage aerators are taken from the first stage aerators. The measured kW are taken as the average of the first stage measured kW. All this is based on a conversation with Rick Davis on 3/14/06 with Adam Knapp

Thus the current motors are using a total of approximately 133 kW. Manufacturer's literature states that new impellers can reduce energy consumption by 20% to 40%. A portion of the aerators (First stage aerators and the digester pump) operate continually. The second stage aerators operate approximately one thirds of the year. Thus the estimated annual energy savings (AES) is as follows.

Comment [AFK2]: M2T technologies letter dated 3/1/06

Comment [AFK3]: Based on a conversation with Tim Cass of Baldwinsville

$$AES = \left(0.20 \times 99.94\ kW \times 8{,}760\ \tfrac{hrs}{yr}\right) + \left(0.20 \times 33.02\ kW \times \frac{8{,}760}{3}\ \tfrac{hrs}{yr}\right)$$

$$AES = 194{,}378\ kWh$$

Baldwinsville-Seneca

Demand Savings = (0.20 x 99.94 kW) x 75% Diversity = 15 kW

Given an electrical usage cost of $0.097 per kWh, and a Monthly Demand Charge of $12.69 per kW applied over 12 months, the estimated annual cost savings (ACS) is as follows.

$ACS = \$21{,}000$

Economics

Vendor and Installation quotes provide a budgetary cost of $276,545. Based on these figures the estimated simple payback (SP) is as follows.

$SP = 13.2$ *years*

Note that the simple payback should decrease if NYSERDA funding is obtained.

LIGHTING MEASURES

BALD ECM #3	**INSTALL HIGH EFFICIENCY LIGHTING & CONTROLS**

Lighting measures proposed with associated energy savings, in watts, are describe on an area by area, room by room basis in the NYSERDA EF.L spreadsheet shown in Appendix A of this report.

The estimated annual energy savings (AES) is as follows.

AES = 53,435 kWh

With an associated Demand Savings

Demand Savings = 16 kW

Given an electrical usage cost of $0.097 per kWh, and a Monthly Demand Charge of $12.69 per kW applied over 12 months, the estimated annual cost savings (ACS) is as follows.

$ACS = \$7{,}635$

Economics

Vendor and Installation quotes provide a budgetary cost of $90,475. Based on these figures the estimated simple payback (SP) is as follows.

$$SP = 11.8 \; years$$

Note that the simple payback should decrease if NYSERDA funding is obtained.

Brewerton Waste Water Treatment Plant

5.2 ECM Savings Calculations & Cost Spread Sheets - Brewerton

HEATING /COOLING SYSTEM TEMPERATURE AND VENTILATION CONTROL

BREW ECM #1 — **ELIMINATE ELECTRIC HEAT**

Analysis

In order to determine the savings from this measure the base load was estimated for electrical usage. The base load was calculated as the average monthly usage from May to October in 2001, 2002, and 2003. This yielded the following.

kWh Base Load = 185,556 kWh

Next, the deviation from the base loads during the heating months was determined from the provided bills. These deviations are shown in Table 5.1.

Usage Period	kWh Usage	Deviation from Base Load (kWh)
January 2001	305,600	*120,044*
February 2001	298,800	*113,244*
March 2001	337,200	*151,644*
April 2001	81,600	*-103,956*
November 2001	228,800	*43,244*
December 2001	293,200	*107,644*
January 2002	290,800	*105,244*
February 2002	272,400	*86,844*

March 2002	206,400	*20,844*
April 2002	201,600	*16,044*
November 2002	236,800	*51,244*
December 2002	288,000	*102,444*
January 2003	269,200	*83,644*
February 2003	250,400	*64,844*
March 2003	222,000	*36,444*
April 2003	236,800	*51,244*
November 2003	192,400	*6,844*
December 2003	250,800	*65,244*
	Total	1,122,792
	Annual Average	374,264

Table 5.4, Electrical savings for switching to natural gas

Brewerton Waste Water Treatment Plant

The estimated total annual energy savings (AES) is given in Table 5.1. However it stands to reason that a portion of the winter energy increase may be due to process loads. Thus the estimated savings have been reduced by 25% in order to remain conservative. Thus the estimated AES are as follows.

$$AES = 280{,}698\ kWh$$

Assuming an 80% combustion efficiency the corresponding natural gas usage (NGU) is as follows.

$$NGU = 1{,}197\ MMBTU$$

Given an electrical usage cost of $0.10 per kWh and an assumed natural gas cost of $10 per MMBTU the estimated annual cost savings (ACS) is as follows.

$$ACS = \$16{,}099$$

Economics

An opinion of the probable construction costs required to complete this project is given in Table 5.5
The data in this table was taken from the 2006 RS Means Cost Data Handbook or the 2006 RS Means Site Work & Landscape Cost Data Handbook unless otherwise noted

Brewerton

Table ***5.2***

Table 5.5, Opinion of probable construction costs

The simple payback (SP) associate with this measure is as follows. Note that the simple payback should decrease if NYSERDA funding is obtained.

SP = 15.5 years

PROCESS MEASURES

BREW ECM #2 **INSTALL VARIABLE SPEED DRIVES ON AERATION BLOWERS**

Analysis

The blower motors used at the Brewerton Facilities are shown in Table 5.3.

Facility	Motor	Motor HP	Measured kW
Brewerton	Blower 1	125	*
	Blower 2	125	*
	Blower 3	125	65
	Blower 4	125	71
		500	136

Table 5.6, Waste water treatment plant motors
*Not running at time of measurement

The current motors are using a total of approximately 136 kW. Conservatively assuming one motor is base loaded; installation of a VFD on the second motor can reduce energy consumption by 30% to 60% by trimming the second motor in operation to match actual demand based on maintaining a steady state pressure in the aeration supply regardless of actual flow required. Thus the estimated annual energy savings (AES) is as follows.

Comment [AFK4]: M2T technologies letter dated 3/1/06

High Efficiency Motors + Variable Frequency Drives Energy Conservation Measures
Facility:
30-Mar-06

Variable Speed Drives for Compressor Sets

Current Plant Operation

Motor HP	125
Number of Motors	1
Motor Efficiency	93.00%
kW (Est.)	70.18817
Cost/KWH	$0.097
KWH Cost =	$59,640
Full Load Power (KW)	70.18817
Total Annual Hours	8760
Runtime Percentage	100%
Total Calculated Run Hours in Bypass	8,760

% Speed	% of FL Power	Power Draw	% of Time	KWH
0%	100%	70.18817204	0%	0
10%	100%	70.18817204	0%	0
20%	100%	70.18817204	0%	0
30%	100%	70.18817204	0%	0
40%	100%	70.18817204	0%	0
50%	100%	70.18817204	0%	0
60%	100%	70.18817204	0%	0
70%	100%	70.18817204	0%	0
80%	100%	70.18817204	0%	0
90%	100%	70.18817204	0%	0
100%	100%	70.18817204	100%	614,848
			100%	614,848

Variable Speed Drive Operation

Motor HP	125
Number of Motors	1
Motor Efficiency	93.0%
kW	70.188
Cost/KWH	$0.097
KWH Cost =	$32,035
Full Load Power (KW)	70.19
Total Calculated Run Hours in Bypass	8760
	100%
	8,760

% Speed	% of FL Power	Power Draw	% of Time	KWH
0%	0%	0	0%	0
0%	0%	0.00	0%	0
10%	1%	0.75	0%	0
20%	4%	3.00	0%	0
30%	9%	6.76	0%	0
40%	16%	12.02	10%	10,526
50%	25%	18.78	10%	16,447
60%	36%	27.04	20%	47,368
70%	49%	36.80	20%	64,473
80%	64%	48.06	25%	105,262
90%	81%	60.83	10%	53,289
100%	100%	75.10	5%	32,894
			100%	330,260

	KWH	$
Savings		
Current	614,848	$59,640
Proposed	330,260	$32,035
Totals	**284,589**	**$27,605**

$0.095

Table 5.7, Brewerton WWTP Blower Motor VFD Calculation

Brewerton

Thus the estimated annual energy savings (AES) is as follows.

$$AES = 284{,}000\ kWh$$

Given an electrical usage cost of $0.095 per kWh, the estimated annual cost savings (ACS) is as follows.

$$ACS = \$27{,}000$$

Economics

Vendor and Installation quotes provide a budgetary cost of $145,600 to put VFDs on three operational blowers. Based on these figures the estimated simple payback (SP) is as follows.

$$SP = 5.4 \ years$$

Note that the simple payback should decrease if NYSERDA funding is obtained.

LIGHTING MEASURES

BREW ECM #3	**INSTALL HIGH EFFICIENCY LIGHTING & CONTROLS**

Lighting measures proposed with associated energy savings, in watts, are describe on an area by area, room by room basis in the NYSERDA EF.L spreadsheet shown in Appendix A of this report.

The estimated annual energy savings (AES) is as follows.

$$AES = 10{,}511 \ kWh$$

Brewerton

With an associated Demand Savings

$$Demand \ Savings = 4 \ kW$$

Given an electrical usage cost of $0.096 per kWh, and a Monthly Demand Charge of $15.15 per kW applied over 12 months, the estimated annual cost savings (ACS) is as follows.

$$ACS = \$1{,}762$$

Economics

Vendor and Installation quotes provide a budgetary cost of $26,897. Based on these figures the estimated simple payback (SP) is as follows.

$$SP = 15.3 \ years$$

Note that the simple payback should decrease if NYSERDA funding is obtained.

Meadowbrook-Limestone Waste Water Treatment Plant

5.3 ECM Savings Calculations & Cost Spread Sheets - Meadowbrook

HEATING /COOLING SYSTEM TEMPERATURE AND VENTILATION CONTROL

MBL	ELIMINATE ELECTRIC HEAT
ECM #1	

Analysis

In order to determine the savings from this measure the base load was estimated for electrical usage. The base load was calculated as the average monthly usage from May to October in 2001, 2002, and 2003. This yielded the following.

kWh Base Load = 334,048 kWh

Meadowbrook-Limestone

Next, the deviation from the base loads during the heating months was determined from the provided bills. These deviations are shown in Table 5.1.

Usage Period	kWh Usage	Deviation from Base Load (kWh)
January 2001	416,454	*82,406*
February 2001	445,162	*111,114*
March 2001	412,728	*78,680*
April 2001	374,267	*40,219*
November 2001	360,439	*26,391*

December 2001	373,427	*39,379*
January 2002	403,639	*69,591*
February 2002	374,077	*40,029*
March 2002	350,205	*16,157*
April 2002	356,226	*22,178*
November 2002	438,036	*103,988*
December 2002	462,016	*127,968*
January 2003	512,011	*177,963*
February 2003	457,972	*123,924*
March 2003	397,853	*63,805*
April 2003	374,558	*40,510*
November 2003	359,990	*25,942*
December 2003	489,792	*155,744*
	Total	1,345,988
	Annual Average	448,663

Table 5.8, Electrical savings for switching to natural gas

The estimated total annual energy savings (AES) is given in Table 5.1. However it stands to reason that a portion of the winter energy increase may be due to process loads. Thus the estimated savings have been reduced by 25% in order to remain conservative. Thus the estimated AES are as follows.

$$AES = 336{,}497\ kWh$$

Assuming an 80% combustion efficiency the corresponding natural gas usage (NGU) is as follows.

$$NGU = 1{,}435\ MMBTU$$

Given an electrical usage cost of $0.096 per kWh and an assumed natural gas cost of $10 per MMBTU the estimated annual cost savings (ACS) is as follows.

$$ACS = \$15{,}934$$

Meadowbrook-Limestone

Economics

An opinion of the probable construction costs required to complete this project is given in Table 5.9.

Description	Line #/Source	Unit Price	Quantity	Total
Natural Gas Service				
Gas service piping	*02550-464-110*	*$4.64*	*3,000*	*$13,920*
Excavation & Fill	*G1030-805-1320*	*$3.75*	*3,000*	*$11,250*
Heating System				
Demolition	*15055-300-2750*	*$62.50*	*64*	*$4,000*

New Units	*D3020-108-1400*	*$5.82*	*18,984*	*$129,471*
Electrical	*Estimate*	*$3,000*	*4*	*$12,000*
NG Service	*Estimate*	*$1,500*	*4*	*$6,000*
Controls	*Estimate*	*$3,000*	*4*	*$12,000*
			Subtotal	*$188,641*
		25%	*Contingency*	*$47,160*
			Materials Total	*$235,801*
		13%	*Engineering*	*$30,654*
			Grand Total	$266,455

Table 5.9, Meadowbrook- Opinion of probable construction costs

The simple payback (SP) associate with this measure is as follows. Note that the simple payback should decrease if NYSERDA funding is obtained.

SP = 15.7 years

LIGHTING MEASURES

MLB ECM #2 **INSTALL HIGH EFFICIENCY LIGHTING & CONTROLS**

Lighting measures proposed with associated energy savings, in watts, are describe on an area by area, room by room basis in the NYSERDA EF.L spreadsheet shown in Appendix A of this report.

The estimated annual energy savings (AES) is as follows.

AES = 1957 kWh

Meadowbrook-Limestone

With an associated Demand Savings

Demand Savings = 1kW

Given an electrical usage cost of $0.096 per kWh, and a Monthly Demand Charge of $8.62 per kW applied over 12 months, the estimated annual cost savings (ACS) is as follows.

ACS = $271

Economics

Vendor and Installation quotes provide a budgetary cost of $9,951. Based on these figures the estimated simple payback (SP) is as follows.

$$SP = 37 \ years$$

Note that the simple payback should decrease if NYSERDA funding is obtained.

Oak Orchard Waste Water Treatment Plant

5.4 ECM Savings Calculations & Cost Spread Sheets – Oak Orchard

PROCESS MEASURES

OAK ECM #3	**INSTALL HIGH EFFICIENCY SURFACE AERATORS**

Analysis

The motors used at the facilities in question are shown in Table 5.3.

Facility	Motor	Motor HP	Measured kW
Oak Orchard	Mixer 1	30	11.08
	Mixer 2	30	22.27
	Mixer 3	30	20.96
	Mixer 4	30	20.41
	Mixer 5	30	19.00
	Mixer 6	30	22.41
	Mixer 7	30	21.14
	Mixer 8	30	18.25
	Mixer 9	30	19.91
	Mixer 10	30	19.24
	Mixer 11	30	19.66
	Mixer 12	30	17.91
		470	298

Table 5.10, Waste water treatment plant motors

Thus the current motors are using a total of approximately 298 kW. Manufacturer's literature states that new impellers can reduce energy consumption by 20% to 40%. Thus the estimated annual energy savings (AES) is as follows.

Comment [AFK5]: M2T technologies letter dated 3/1/06

$$AES = 0.20 \times 298\ kW \times 8{,}760\ \tfrac{hrs}{yr}$$

$$AES = 522{,}096\ kWh$$

Demand Savings = (0.20 x 298 kW)

Demand Savings =60 kW

Given an electrical usage cost of $0.0975 per kWh, and a Monthly Demand Charge of $12.69 per kW applied over 12 months, the estimated annual cost savings (ACS) is as follows.

$$ACS = \$60{,}040$$

Economics

Vendor and Installation quotes provide a budgetary cost of $364,328. Based on these figures the estimated simple payback (SP) is as follows.

$$SP = 6.0\ years$$

Note that the simple payback should decrease if NYSERDA funding is obtained.

ALL SITES - Waste Water Treatment Plants

5.5 ECM Savings Calculations & Cost Spread Sheets – ALL SITES

PROCESS MEASURES

All-Sites ECM #1	**INSTALL UNIT HEATER PROGRAMABLE THERMOSTATS**

Analysis

There are 97 electric unit heaters located in non-hazardous locations which currently have simple line voltage thermostats. A notable number of thermostats were set at higher than desired temperature setting for essentially un-occupied areas. These electric unit heaters range in size from 3 kW to 15 kW, with an average of 4.5 kW.

According to BIN data for the Syracuse area, there are on average 2056 hours of a year above the temperatures of 55 degrees F to 70 degrees F. Assuming that the desired temperatures in the un-occupied areas is 55 to 58 degrees, if 10 % of the thermostats (10 out of 97) are incorrectly set to the higher temperature of 65 to 70 degrees noted in the audit walkthroughs, an increase in electric consumption would occur:

97 unit heaters x 4.5 kW average x 10% x 2056 hours = 89,744, use 88,000 kWh

Given an electrical usage cost of $0.090 per kWh, the estimated annual cost savings (ACS) is as follows.

$$ACS = \$7900$$

Installation of programmable thermostats with a timed out manual override, which automatically resets itself at the next program cycle, would insure that thermostats are not set and forgotten to the wrong settings. Although there are other simpler methods of securing thermostats such as ventilated lock boxes, the programmable thermostat interferes least with the work flow and maintenance requirements of a facility while insuring good energy conservation practices.

Economics

Vendor and Installation quotes provide a budgetary cost of $54,800. Based on these figures the estimated simple payback (SP) is as follows.

$$SP = 6.9 \ years$$

SECTION 6 – MEASUREMENT & VERIFICATION

6.1 – NYSERDA and Carrier Corporation's M&V Requirements

Carrier's Commercial Service Division is the ESCO for the Onondaga County Energy Project. The following M&V plan is specifically written for this project's participation in NYSERDA's Commercial/Industrial Program, specifically Program Opportunity Notice No. 984 and Carrier Corporation's.

For the purpose of the NYSERDA M&V Plan, the lighting upgrades and variable frequency drive upgrades are included in the M&V scope. The Carrier contact persons M&V information:

Kevin Kimberly and Erin Ordway
Carrier Commercial Service
5 Technology Place
East Syracuse, NY 13057

Telephone: (315) 463-4526
Fax: (315) 432-0852
E-mail: Kevin.Kimberly@carrier.utc.com
Erin.Ordway@carrier.utc.com

The "Sites" are:

Baldwinsville-Seneca Waste Water Treatment Plant
Barbara Lane
Baldwinsville, NY 13027

Brewerton Waste Water Treatment Plant
5225 Guy Young Rd.
Brewerton, NY 13029

Meadow Brook-Limestone Waste Water Treatment Plant
Manlius Center Rd
Manlius, NY 13104

Oak Orchard Waste Water Treatment Plant
Oak Orchard Rd.
Clay, NY 13041

6.1.1 – Energy Conservation Measures

6.1.1a – Lighting Measures

The lighting energy conservation measures provide for the replacement of incandescent lamps with compact fluorescent lamps, replacing standard fluorescent lamps with state of the art T-8 lamps and ballasts. This energy conservation measure will save the facility approximately 65,903 kWh annually, based on observed lighting time of use and assumed time of use based on area function. This energy conservation measure will provide equal or better lighting levels to the areas served.

Measurement and verification method for this ECM shall be in accordance with C/I Performance Program Procedure Method LTG-B-01, "Monitoring Hours of Operation," Option B.

The base-year conditions will be consistent with the prior negotiated base year per the Master Contract Agreement between Carrier and Onondaga County. The EF.L sheets include a description, location, and number of lamps, ballasts and fixtures as required by C/I Performance Procedure Method LTG-B-01. See the completed form EF.L in Appendix A.

Fixture wattages are determined from either of:

- NYSERDA's Table of Standard Fixture Wattages
- Documentation on each fixture/ballast/lamp combination

Adjustments to the baseline demand for non-operating fixtures, remodeling or changes in occupancy/space utilization shall be clearly identified in Section 4 of NYSERDA Form L.1.

6.1.1b – Motor Measures

6.1.1b Variable-Speed Drive Retrofit M&V Plan

The Variable-Speed Drive Retrofit ECM provides for the retrofit of six motors with new high efficiency variable-speed drives (VFDs). These motors drive blowers 1-4. This energy conservation measure will save approximately 282,000 kWh annually, based on observed and assumed run times. This M&V plan is based on C/I Performance Procedure method VSD-B-01, Option B, utilizing "Continuous Post-Installation Metering" for kW and run-time determination. Implementation of the ECM does not include changes to motor run times, and thus motor run times are not expected to change significantly from pre-installation observations.

6.1.2 – Assumptions

6.1.2a – Lighting Measures

a. Assumed pre-retrofit lighting periods of operation are listed on a fixture-by-fixture basis in the EF.L form developed for this project. This information was derived during the lighting survey from discussions with the PSB personnel and observed fixture function. See form EF.L.
b. Lighting operating periods of the post-retrofit period are selected as the common set of conditions for the energy use terms in Equation 1 of Section 4 of this M&V plan.
c. Post-installation monitoring of a sample set of lighting fixtures to verify periods of use shall be conducted for a period of time not less than 3 weeks and not more than 8 weeks in duration. Sample size is determined utilizing NYSERDA Sample Size Calculator. Fixtures to be monitored are chosen at random within each grouping.
d. Compact Fluorescent Lamps (CFLs) used to replace standard incandescent lamps in ceiling mounted fixtures shall have 2% of their installed numbers kept in surplus stock within the facility for the purpose of future anticipated replacement. Initial stock at the time of project implementation shall be supplied by Carrier. The facility shall be responsible for maintaining future lamp stocks after one year of operation.

6.1.2b – Motor Measures

6.1.2b – Variable-Speed Drive Retrofit – Assumptions

a. There are no assumed changes to motor operating schedules due to implementation of the Energy Project's Conservation Measures.
b. The kW (power demand) and nameplate data of existing motors will be spot checked and recorded prior to motor and control removals.
c. Operating hour assumptions and kW (power demand) for the post-installation periods will be verified with short term (6 months) monitoring of motors/VFDs. See Section 3 M&V plan.
d. Motor shaft horsepower and operating RPM are assumed unchanged from existing motor to new replacement.
e. All existing motors were observed to be, and are assumed to remain operational.

6.1.3 – Survey

6.1.3a – Lighting Measures

- Perform pre-installation lighting equipment survey. Utilize CIPP form EF.L.
- Equipment to be changed is inventoried on EF.L form.
- Replacement equipment to be installed is to be specified on the EF.L form.
- Existing equipment and replacement equipment wattages to be determined from CIPP Table of Standard Fixture Wattages or, if not listed, determined from manufacturer's specification data sheets, which will be included in the report.
- Identify all of the buildings existing non-operating fixtures that will be retrofitted or replaced. Three classifications for non-operating fixtures shall be utilized:
    a. De-lamped fixtures should be listed separately, and only for the wattage to be utilized in the new configuration after retrofit.
    b. List non-operating fixtures that are typically operating, but which have broken lamps, ballasts or switches intend for repair.
    c. List fixtures that have been permanently de-lamped, broken, or abandoned, which are not to be repaired or re-lamped, separately to avoid confusion.

  Note: Baseline demand may include fixture wattages for up to 10% of the building's non-operating fixtures by using values from the table of standard fixtures wattages or from fixture wattage measurements. The inclusion of non-operating fixtures is limited to 10% of the buildings total fixture count per building. The number of fixtures that exceed the 1-% shall be included in Form EF.L with a baseline and post-installation fixture wattage of zero.

- Document usage group for each fixture on form EF.L.
- Document the hours of operation for each fixture on form EF.L.
- Document the existing control type for each fixture on form EF.L.

Energy Savings Calculations: The energy savings on form EF.L will be based on hours of operation estimated from observation and from discussions with building staff.

Post-Installation Lighting Equipment Verification: A post-installation lighting verification will be completed and a revised form EF.L will be submitted. The verification will document the actual equipment installed.

6.1.3b – Motor Measures

Variable Speed Drive Retrofit – Survey

Baseline Survey of Motors shall include:

- Nameplate data
- Existing motor controls/starters
- Operating schedule
- Spot metering data while under load recording; kVA, kW, voltage, 3-phase, current draw (amps), power factor and motor speed in RPM.
- Description of motor application.
- Location, including building floor plans if possible.

New Motor (post-installation) with VFD Control shall include:

- Nameplate data
- Spot metering data while under full load recording; kW, voltage, current draw (amps) and power factor.
- Sample size for runtime monitoring shall be 1 of 1 VFD/Motor Retrofits.
- Long-term monitoring period shall be 36 weeks for variable load applications and 24 weeks for constant load applications.
- Monitoring motor run time and current draw shall be performed using ONSET HOBO Model H8 or U12 family loggers and two ONSET compatible split core AC current sensors.

The above information shall be documented in a set format. Motor survey form (EF.M) included in Part A, Section 6, of the C/I Performance Program Procedures Manual may be used as a suitable format.

Baseline demand and energy use are based on:

a. Motor operating hours measured before or after the VSDs are installed.
b. A constant motor kW value determined from pre-installation spot metering.

Post-Installation demand and energy use are based on:

a. Motor operating hours measured after the VSDs are installed, and
b. Motor kW, which is continuously metered or metered at regular intervals during the term of the agreement.

6.1.4 – Calculations and Adjustments

6.1.4a – Lighting Measures

The energy savings resulting from the lighting efficiency retrofit will be calculated using Form EF.L. Monitored data will be used to determine pre- and post-installation hours of operation. For this lighting efficiency retrofit, post-installation hours of operation may be used as a proxy for pre-installation monitored data. The energy savings are calculated as the difference between baseline and post-installation energy usage.

The lighting energy savings are calculated within form EF.: as:

$$\textbf{kWh Savings} = \Sigma_u \left[(\textbf{kW/fixture x quantity x hours})_{\textbf{baseline}} - (\textbf{kW/fixture x quantity x hours})_{\textbf{post}}\right]_u$$

Where:
- kWh Savings = kilowatt-hour savings realized during post-installation time period.
- kWh/Fixture $_{baseline}$ = baseline lighting energy draw per fixture
- kWh/Fixture $_{post}$ = Post-installation lighting energy draw per fixture
- Quantity $_{baseline}$ = baseline number of affected fixture, adjusted for non-operating units.
- Quantity $_{post}$ = post-installation number of affected fixtures.
- Hours $_{baseline}$ = baseline annual hours of operation for usage group u.
- Hours $_{post}$ = post-installation annual hours of operation for usage group u.

Any adjustment to the baseline condition will be clearly noted on Form L.1 or attached as an addendum. If qualifying fixture codes are used in place of existing fixture types then a listing of the adjustments shall be attached to Form L.1.

Equations for Calculating Energy Savings:

- Normalized kW can be calculated using the following equation:

$$kW_{normalized} = \text{instantaneous kW (from spot metering) x normalizing factor}$$

- The kWh savings may be calculated using the following equations:

A) For operating hours which are the same before and after measure installation

$$\text{kWh savings (per each period)} = [\text{period hours}] \times [kW_{baseline,\ normalized} - kW_{post,\ normalized}]$$

B) For operating hours which are different before and after measure installation:

$$\text{kWh savings (per each period)} = (\text{baseline period hours} \times kW_{baseline,\ normalized}) - (\text{Post-installation period hours} \times kW_{post,\ normalized})$$

Where:
- $kW_{baseline,\ normalized}$ = the normalized kilowatts for the baseline motors
- $kW_{post,\ normalized}$ = the normalized kilowatts for the high-efficiency motors.

These values may be corrected for changes in motor speed (slip) as required.

- $kW_{post\ VSD\ installation}$ = kilowatt demand of high-efficiency motor in particular operating scenario
- Operating Scenario = particular mode of operation defined by independent variables, such as motor speed or valve position.

6.1.4b – Motor Measures

Variable Speed Drive Retrofit – Calculations and Adjustments

Baseline Conditions for each motor are identified by Carrier Corporation on the Motor Survey Form (EF.M), through equipment observation and discussions with the facility operations personnel.

Baseline Demand for each motor is established utilizing the equipment survey information, specifically hours of operation, and the measured instantaneous motor draw determined from spot metering.

Baseline Operating Hours are determined after VSD/motor installations, as baseline-operating hours are assumed to be the same as post-installation operating hours. Short-term metering will be used to determine operating hours.

Post-Installation Demand is determined after installation of the new VSD/Motors.

- All the motors will be surveyed using the same reporting format used for the baseline motors. Format to be used is as shown on the Motor Survey Form (EF.M) – See Appendix C.
- All motors will be spot metered using the same meter and procedures as those used for the baseline motors without VSD.
- Energy demand shall be monitored at 15 minute intervals for period outline in Section 2 M&V activities.

Post Installation Operating Hours will be monitored utilizing short-term metering. Short-term metering will be conducted on a randomly selected sample of motors with the same application or operating hours to verify motor operating hours and provide a demand profile of energy demand relative to operating hours.

kWh savings shall be calculated using the following equation:

kWh savings (per each operating scenario) = [hours per each operating scenario] x [kW savings per each operating scenario]

Where:
- kW savings = $kW_{baseline} - kW_{post\ VSD\ installation}$
- $kW_{baseline}$ = kilowatt demand of baseline motor in particular operating scenario
- $kW_{post\ VSD\ installation}$ = kilowatt demand of high-efficiency motor in particular operating scenario
- Operating scenario = particular mode of operation defined by independent variable such as motor speed or valve position.

6.1.5 – Post-Installation Metering

6.1.5a – Lighting Measures: Lighting Hours of Operation &Verification

Post-installation lighting hours of operation verification shall be conducted by monitoring a statistically valid sample of fixtures/room. The sample-size for this facility shall be determined utilizing the NYSERDA sample-size calculator as shown in Table B2-3, CIPP Part B, Section 2: Lighting M&V Plan: Monitoring Hours of Operation. For the monitoring period per fixture group for this facility, see CIPP Part B, Section 2: Lighting M&V Plan: Monitoring Hours of Operation; Table B2-1: Monitoring Periods for Different Building Types. Metering individual groups may occur over multiple metering periods to best utilize metering equipment resources. (e.g. Four 3-4 week metering periods utilizing 10 meters for a total of 40 metered locations over a few four (4) month periods.)

Monitoring equipment utilized to determine hours of operation shall be ONSET HOBO Model HO6-002-02 "light logger" style data loggers. These are photocell light on/off loggers with time of day stamp for each state change. Some features include a programmable start/date, time accuracy: +/- 1 minute per week, internal memory for 2000 state changes, one-year battery life, and PC downloads of data.

Loggers shall be initialized at the time of installation and data downloaded after the prescribed data-logging period, onto a laptop PC or Palm handheld device at the time of removal utilizing ONSET HandCar Data Transport (for in field collection of logged data with a Palm Pilot) and/or BoxCar Pro for direct collection of logged data utilizing a laptop computer. BoxCar Pro software provides for both data acquisition, numerical and graphical display of data and trending analysis.

The light fixture chosen to be data logged shall be noted on the survey report. The HOBO data loggers shall be installed inside the lens of the designated fixture for security purposes and a marker placed on the outside of the lens to aid recovery.

6.1.5b – Motor Measures

Variable Speed Drive Measure – Metering

For each baseline and new motor, spot metering of RPM, volts, instantaneous amperes, kVA, PF, and kW shall be recorded.

Spot metering shall utilize a true RMS meter with accuracy at or approaching +/- 2% of reading.

Baseline motor speed shall be measured utilizing a hand-held stroboscope or tachometer capable of an accuracy of equal to or better than =/- 2% of reading.

Motor speed post VSD installation shall be measured from the VSD.

Short-term metering shall be conducted utilizing either a data logging power meter, or current transducers and data loggers. The equipment utilized must be calibrated against the spot-metering equipment used to determine baseline and post-installation motor survey values. Installing the data logging equipment at the time and location post-installation motor values are being spot metered does this.

Data loggers will record readings at 15-minute intervals or less, for the short-term metering period defined in Section 3, M&V activity.

6.1.6 M&V Plan – Accuracy & Quality Assurance

6.1.6a – Lighting Measures

Under sampling: A Carrier Commercial Services representative shall survey existing light fixtures for accuracy of fixture location, type, and wattage information. Post-installation lighting fixtures, bulbs, and ballasts shall be individually inspected for correct installation by a Carrier Commercial Services representative, and by an owner's representative. This inspection shall be documented on a "fixture by fixture" basis utilizing an extension of the project Lighting Survey Form EF.L with spaces for representative initials after each fixture. Variations in the size of the lighting measure population from that anticipated the M&V plan shall be documented utilizing this manner of installation verification. If there is significantly more lighting measures performed than provided on the survey form (greater than 2% of the population), the sampling size for on/off time verification shall be recalculated.)

Box Time Error: Post-installation on/off time verification data loggers shall be initialized and data downloaded at the point of installation to minimize box time error potential.

Malfunctions: If a logger is damaged or malfunctions during the monitoring period, it shall be identified as malfunctioning and the data shall be disregarded.

Logger Data Error: Suspected data corruption due to a faulty data logger, or a file transfer may be removed from the final analysis with the approval of NYSERDA. The customer and/or NYSERDA representatives shall retain the data for review, with documentation as to why the data is believed to be corrupted and what measures were taken to make-up for the lost data.

Flickering: If a lighting fixture chosen randomly to be monitored is observed to be flickering, an alternative fixture in the same lighting group shall be monitored as an alternative fixture. This change shall be noted on the survey form at the time of logger installation. Any transition in a fixture being monitored less than 5 minutes in duration should be ignored due to the probability the fixture is "flickering."

Duplicate Recording Hours of Operation: Data loggers shall not be located on the same lighting circuit (on/off switch or controller). If two, or more, fixtures which were randomly chosen to be monitored are on the same lighting control circuit, a new fixture within the same lighting group, but not on the same lighting circuit, shall be chosen to be monitored and the change shall be noted on the survey form.

Multiple Monitoring Periods: This facility may be subject to seasonal based changes in occupancy that would affect lighting time of use. There may be provision required for multiple monitoring periods for this project.

Instrument Accuracy & Calibration: Metering and data logging equipment shall be given a unique M&TE identification number at the time of purchase or rental. The Carrier Commercial Services Branch responsible for the energy project shall issue this identification number. Identification numbers are kept in an M&TE calibration log that descries the equipment, manufacturer, model number, serial number, a date of purchase or rental, and date of last calibration to manufacturer's performance specifications. Additionally, the log shall identify usage of the equipment by project name and job number, with log-out and login (to service office) dates. If applicable, re-calibration of the MT&E equipment shall be performed on the equipment at not to exceed 12 month intervals. The equipment shall be provided with a sticker, which identifies the equipment as part of Carrier Commercial Services M&TE program, unique M&TE ID number, and date of last calibration.

6.1.6b – Motor Measures

Instrument Accuracy & Calibration: Metering and data logging equipment shall be given a unique M&TE identification number at the time of purchase or rental. The Carrier Commercial Services Branch responsible for the energy project shall issue this identification number. Identification numbers are kept in an M&TE calibration log that describes the equipment by project name and job number, with a log-out and login (to service office) dates. If applicable, re-calibration of the M&T equipment shall be performed on the equipment at not to exceed 12 month intervals. The equipment shall be provided with a sticker, which identifies the equipment as part of Carrier Commercial Services M&TE program, unique M&TE ID number, and date of last calibration.

Time dependent monitoring shall have logging devices start at pre-determined dates and time to provide for synchronized start times with other loggers, if applicable, and to assure a steady state monitoring environment (loggers are not recording while being set up or handled).

6.1.7 Energy Project NYSERDA C/I Program – Comprehensive

The following forms and reports shall be generated for this M&V Plan:

- NYSERDA FORM SPC.1 – Carrier Corporation and Project Information (updated as necessary)
- NYSERDA FORM SPC.2 – Site Information (updated as necessary)

Specific Energy Conservation Measure reports are listed individually as follows.

The following forms and reports shall be generated for this M&V Plan:

- NYSERDA Form EF.L – Lighting Survey. Updated from version submitted with the Project Installation Report to reflect actual hours of operation derived from monitored data. The revised savings shown in Form EF.L will be used in the calculation of financial incentive paid to Carrier Corporation as the project ESCO.
- Copy of lighting sample calculator for project lighting
- EF.M – high efficiency motor form
- Copy of motor sample calculator for project motors
- An overview of the M&V activities completed for the project, including:
    - Tabular data summary presenting the data for each monitored point
    - Tabular data summary presenting the average hours of operation for each usage group.
    - Graphical presentation of weekday and weekend usage profiles for each monitored point.
    - A marked-up set of floor plans (on 8.5 x 11 sheets) showing the location of each data logger.

6.1.8 – Schedules

6.1.8a – Lighting Measures

The following table represents the projected schedule for performing all metering, analysis, and reporting activities for the lighting measures portion of the energy project.

Table 6.1a Lighting Measures Project Schedule

Milestone	Responsible Party	Anticipated Schedule
Pre-Installation M&V Activities	**Carrier - Kimberly**	**TBD**
Construction	**Carrier - Kimberly**	**TBD**
Project Installation Report (PIR) Submittal	**Carrier - Ordway**	**TBD**
1st – Year M&V Activities	**Carrier - Ordway**	**TBD**
1st – Year M&V Report Submittals	**Carrier - Ordway**	**TBD**

6.1.8b – Motor Measures

The following table represents the projected schedule for performing all metering, analysis, and reporting activities for the motor measures portion of the energy report.

Table 6.1b Motor Measures Project Schedule

Milestone	Responsible Party	Anticipated Schedule
Pre-Installation M&V Activities	**Carrier - Kimberly**	**TBD**
Construction	**Carrier - Kimberly**	**TBD**
Project Installation Report (PIR) Submittal	**Carrier – Kimberly/Ordway**	**TBD**
1st – Year M&V Activities	**Carrier - Kimberly**	**TBD**
1st – Year M&V Report Submittals	**Carrier - Kimberly**	**TBD**

Section 6.2 Carrier Energy Project M&V Plan

Carrier Commercial Services (CCS) will follow Option A & B of the International Performance Measurement and Verification Protocol (IPMVP), monitoring individual pieces of equipment and/or utilizing statistical sampling of numerous similar pieces of equipment to derive the energy baseline and to record the energy savings results. As our primary method for computing the energy baseline and for the on going measurement and verification of the savings results, CCS will also introduce, where applicable, Option C of the IPMVP.

Option A and B
An example of the energy baseline and savings equation under Option A and B are as follows:

For Lighting Measures:

$$kWh\ Savings = \sum [(((W/Fixture_{existing} \times Quantity_{existing} - W/Fixture_{proposed} \times Quantity_{proposed})/1000) \times Hours\ of\ Operation)_t \times Rates]$$

Where:	kWh Savings	=	kilowatt-hour savings realized during the post-installation time period t
	W/Fixture $_{existing}$	=	existing lighting watts per fixture
	W/Fixture $_{proposed}$	=	proposed lighting watts per fixture
	Quantity $_{existing}$	=	existing quantity of affected light fixtures
	Quantity $_{proposed}$	=	proposed quantity of affected lighting fixtures
	Rates	=	average cost per kWh
	Hours of Operation	=	number of operating burn hours during the time period t, assumes operating burn hours are the same for the existing and proposed lighting fixtures

Option A verifies the data and assumptions by metering a statistically calculated number of individual pieces of equipment to provide savings assurance.

Option B verifies the data and assumptions by metering individual pieces of equipment as an individual measure to provide savings assurance.

Option C measures the entire building through the use of utility meters or sub-meters. Option C measures the impact of any type of ECM or ECMs installed in a facility. This option determines the aggregate savings of all ECMs applied to the facility monitored by the energy meter(s). In contract, option A and B focus on the energy use of a piece of equipment, or a statistical sample of similar pieces of equipment for a specific energy conservation measure.

Option C

The measurement of energy consumption associated with our Total Retrofit Solution is a comparison between the energy consumed during each guaranty year and the base year, subject to adjustments and assumptions in the computer software used to analyze the energy consumption, in accordance with reasonable commercial standards. The energy audit software used by CCS is METRIX ^{TM}.

The energy baseline (using 12 months of historical billing data) and savings calculations are derived by performing a statistical analysis of the facility (trend analysis). This is also known as regression. The regression calculation is an equation of the best-fit line through a group of data points (in this case, the twelve months of historical billing data). The equation for a line can be represented as $y = mx + b$.

For example y = kWh (this term represents the baseline)

m = kWh / CDD
x = # CDD (cooling degree days)
b = kWh / day * # days (represents base load or non-temperature sensitive usage)

This equation is equivalent to kWh = constant * # of days + coefficient1 * # of CDD.
To translate, a baseline kWh equals temperature sensitive usage (mx) plus base load (b).
The Audit Software calculates the constant and coefficient using linear regression.

The equation for the coefficient is:

$$coefficient1 = \frac{n\sum(x_i y_i) - \left(\sum x_i\right)\left(\sum y_i\right)}{n\sum x_i^2 - \left(\sum x_i\right)^2}$$

The equation for the constant is:

$$constant = \bar{y} - coefficient1 \times \bar{x}$$

Where:

x_i	=	one data point's x value
x_bar	=	the average x value for the given sample of points
y_i	=	one data point's y value
y_bar	=	the average y value for the given sample of points
n	=	number of points

Listing pairs of points in columns, then summing and averaging the columns calculate this.
An example of linear regression is as follows:

Linear Regression Model

A			B	C	D	E	F	G	H	I
Billing Period			**Number**							
Start		**End**	**Of Days**	**CDD**	**KWh**	**CDD/Day**	**kWh/Day**	**x * y**	**x^2**	**y^2**
5/17/1995	to	6/16/1995	31	227	286,400	7.32258	9,238.70	67,651	53.62	85,353,757
6/17/1995	to	7/17/1995	31	509	326,400	16.41935	10,529.00	172,880	269.59	#########
7/18/1995	to	8/16/1995	30	601	319,520	20.03333	10,650.60	213,368	401.33	#########
4/29/1994	to	9/18/1995	33	585	364,640	17.72727	11,049.70	195,881	314.25	#########
10/19/1995	to	11/16/1995	29	14	244,480	0.48276	8,430.30	4,070	0.23	71,070,714
11/17/1995	to	12/18/1995	32	0	273,120	0	8,535.00	-	-	72,846,225
12/19/1995	to	1/17/1996	30	0	242,720	0	8,090.60	-	-	65,458,887
3/19/1996	to	4/16/1996	29	13	253,760	0.44828	8,750.30	3,923	0.2	76,568,535
4/17/1996	to	5/17/1996	31	189	304,480	6.09677	9,821.90	59,882	37.17	96,470,417
			Formulas:			**C / B**	**D / B**	**E * F**	**E ^2**	**F ^2**
				J	**K**	**L**	**M**	**N**	**O**	**P**
			Sums:	2138	2,615,520	69	85,096	717,655	1,076	#########
				Q	**R**	**S**	**T**			
			Averages:	238	290,613	7.61	9,455			
					U					
			Coefficient 1		**125.6607**	Constant	**8,498.30**			

Coefficient1 formula: **(((9 points * N) - (L * M)) / ((9 Points * O) - L ^2))**
Constant formula: **(T - (U * S))**

Table 8.2

Note: Only nine months (points) were used in this regression analysis. The billing periods 09/19/95-10/18/95, 01/18/96-02/16/96, and 02/17/96-03/18/96 were excluded because of poor correlation in the regression "fit." By excluding these points, the constant base load becomes more accurate. In addition, any anomalies that occur during the regression analysis are corrected for in the Audit Software modification feature "bill matching.

Energy consumption costs vary from year to year due to changes in cost of the energy used (rate changes) and changes in the weather, load, usage, and building thermal efficiencies, among other things. Therefore, although expressed in dollars, adjusting each year's energy consumption to account for changes in the operating environment and then multiplying the resulting adjusted energy usage by the base year's utility rates arrive at the energy savings. This result, when subtracted from the base year's adjusted energy costs, yields a dollar savings. This savings, ideally, would have been the result of reducing energy consumption in the base year where all other variables are held constant.

We will begin tracking the savings from the start of construction through the satisfaction of the savings obligation. As a result, this Onondaga County facility will need to furnish copies of the energy bills each month from the start of construction through such time the energy savings obligation is satisfied.

As part of the reconciliation process, CCS will provide Onondaga County energy savings reports in accordance with the methodology (ies) above. CCS will meet quarterly with this Onondaga County facility to review and discuss the reports. At the conclusion of the quarterly meetings, the county will be presented with a customer acknowledgement letter which acknowledges the county's receipt and acceptance of the figures delineated in the reports. A representative from both CCS and Onondaga County will sign this document.

The energy savings audit may be adjusted to account for factors listed in the TRS agreement and changes in agreed-upon operating practices, which affect energy consumption between the base year and the performance period. If a customer adds equipment or operates outside the parameters defined in the TRS agreement, Carrier will calculate the associated load and make adjustments to the base year. CCS will perform remote monitoring of the select equipment run hours to assess these circumstances.

APPENDIX A

EF.L Forms

Equipment Forms
EF.L: Lighting Survey

Complete one copy of this form for each building where a lighting retrofit is proposed.

ESCO Name: **CARRIER CORP.**
Project Name: **ONONDAGA COUNTY ENERGY PROJECT**
Site Name: **BALDWINSVILLE WWTP**
Building Identifier:

Survey completed by (name): Date(s) Survey completed: **6/1/2004**

INSTRUCTIONS
Use one line for each fixture type in a room or area.

				PRE-INSTALLATION						POST-INSTALLATION										
Line Item	**Building**	**Floor**	**Area Description**	**Usage Group ID**	**Pre Fixt. No.**	**Pre Fixt. Code**	**Pre Watts/Fixt**	**Pre kW/Space**	**Exist Cont**	**Post Fixt No.**	**Post Fixt Code**	**Post Watts/ Fixt**	**Post kW/Space**	**Prop Cont**	**kW Saved**	**NOx Hours**	**Annual Hours**	**NOx kWh Saved**	**Annual kWh Saved**	**blank col no 1**
Integer identifying the line, beginning with one	Building Name	Building floor of the item	Unique description of the location that matches the site map	Descriptive name for the usage group	No. of fixtures before the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Pre Watts/Fixt) * (Pre Fixt No.)	Pre-inst. control device	No. of fixtures after the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Post Watts/Fixt) * (Post Fixt No.)	Post-inst. control device	(Pre kW/Space) - (Post kW/Space)	Estimated hours during NOx Season (May-Sept)	Estimated annual hours for the usage group	(kw saved)* (NOx hours)	(kW Saved) * (Annual Hours)	NOTES
	BALDWINSVILLE WWT																			
1	Baldswinville WWT	A111	Vestibule	Security	6	F42EE	72	0.432	SNAP	6	F42SSILL-R	45	0.27	SNAP	0.16	1,217	2920	197	473	Strip/Parabolic/Perimeter GC
2	Baldswinville WWT	A111	Vestibule	24-hr	4	MH250/1	295	1.18	SNAP	4	F44SIL	148	0.592	SNAP	0.59	1,217	2920	715	1,717	2 x 2 Prismatic MH (2 - 24/7)
3	Baldswinville WWT	A112	Lobby	Security	11	F42EE	72	0.792	SNAP	11	F42SSILL-R	45	0.495	SNAP	0.30	1,217	2920	361	867	Strip/Parabolic/Perimeter
4	Baldswinville WWT	A117	Office	Office	4	F44EE	144	0.576	SNAP	4	F44SSILL-R	86	0.344	SNAP	0.23	1,217	2920	282	677	2 x 4 Prismatic
5	Baldswinville WWT	A117	Office	Office	14	F42EE	72	1.008	SNAP	14	F42SSILL-R	45	0.63	SNAP	0.38	1,217	2920	460	1,104	Strip/Parabolic/Perimeter GC
6	Baldswinville WWT	A116	Switch Gear/MCC	Storage	13	F42EE			SNAP					SNAP			52			Industrial GC LOW HOURS
7	Baldswinville WWT	A127	Corridor	Office	2	FU2EE	72	0.144	SNAP	2	FU2ILL-R	52	0.104	SNAP	0.04	1,217	2920	49	117	2 x 2 Prismatic U-Tube (FU-4-2)
8	Baldswinville WWT	A127	Corridor	Office	8	F42EE	72	0.576	SNAP	8	F42SSILL-R	45	0.36	SNAP	0.22	1,217	2920	263	631	Wall Prismatic
9	Baldswinville WWT	A127	Corridor	24-hr	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	SNAP	0.05	3,640	8736	197	472	Wall Prismatic NL
10	Baldswinville WWT	A127	Corridor	24-hr	1	F22SS	56	0.056	SNAP	1	F22ILL-R	29	0.029	SNAP	0.03	3,640	8736	98	236	Wall Prismatic (20" Lamps)
11	Baldswinville WWT	A127	Corridor	Office	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	SNAP	0.05	1,217	2920	66	158	2 x 4 Prismatic
12	Baldswinville WWT	A127	Corridor	24-hr	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	3,640	8736	98	236	2 x 4 Prismatic NL
13	Baldswinville WWT	A140	Corridor	Office	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	SNAP	0.05	1,217	2920	66	158	Wall Prismatic 3-way
14	Baldswinville WWT	A140	Corridor	24-hr	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	3,640	8736	98	236	Wall Prismatic 3-way NL
15	Baldswinville WWT	A128	Storage	Storage	2	F42EE			SNAP					1-WALL						Wrap-around 1 missing diffuser LOW HOURS
16	Baldswinville WWT	A118	Office	Office	9	F44EE	144	1.296	SNAP	9	F44SSILL-R	86	0.774	1-CLG	0.52	1,217	2920	635	1,524	2 x 4 Prismatic ABS (28 x 14)
17	Baldswinville WWT	A126	Women's Bathroom	Rest	2	F42EE			SNAP					1-WALL			52			Wrap-around EC LOW HOURS
18	Baldswinville WWT	A125	Janitor	Storage	1	I60/1			SNAP					1-WALL			104			Frost Ceiling Mount EC LOW HOURS
19	Baldswinville WWT	A124	Men's Bathroom	Rest	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	1-WALL	0.05	1,217	2920	66	158	Wrap-around EC
20	Baldswinville WWT	A122	Mechanic's Room	Storage	4	F42EE			SNAP					SNAP			52			Industrial Parabolic 3-ways EC (PVC) LOW HOURS
21	Baldswinville WWT	A120	Crew Leader Office	Office	4	F44EE	144	0.576	SNAP	4	F44SSILL-R	86	0.344	SNAP	0.23	1,217	2920	282	677	2 x 4 Prismatic ABS GC (18 x 18)
22	Baldswinville WWT	A139	Lunch Room	Prep	6	F44EE			SNAP					SNAP			730			2 x 4 Prismatic ABS (12 x 18) LOW HOURS
23	Baldswinville WWT	A141	Crew Leader Office	Office	8	F44EE	144	1.152	SNAP	8	F44SSILL-R	86	0.688	SNAP	0.46	1,217	2920	565	1,355	2 x 4 Prismatic ABS (18 x 20)
24	Baldswinville WWT	A144	Shop 17' Aff.	Storage	38	F42EE	72	2.736	SNAP	38	F42SSILL-R	45	1.71	1-WALL	1.03	1,217	2920	1,248	2,996	Industrial Parabolic Gcremote SW
25	Baldswinville WWT	A142	Shop Storage	Storage	2	F42EE			SNAP					SNAP			365			Industrial Parabolic GC 3 ways LOW HOURS
26	Baldswinville WWT	A142	Shop Storage	Storage	2	F42EE			SNAP					1-WALL			365			2 x 4 Prismatic FC LOW HOURS
27	Baldswinville WWT	A147	Locker Room	Rest	9	F42EE	72	0.648	SNAP	9	F42SSILL-R	45	0.405	SNAP	0.24	1,217	2920	296	710	Vapor 3-way EC - Plaster Ceiling
28	Baldswinville WWT	A147	Locker Room	24-hr	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	3,723	8936	101	241	Vapor NL EC - Plaster Ceiling
29	Baldswinville WWT	A150	Locker Room/Bath	Rest	6	F42EE	72	0.432	SNAP	6	F42SSILL-R	45	0.27	1-WALL	0.16	1,217	2920	197	473	Vapor EC (SP = Sin. Pole SW)
30	Baldswinville WWT	A150	Locker Room/Bath	Rest	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	1-WALL	0.03	1,217	2920	33	79	Wall Prismatic
31	Baldswinville WWT	A153	Shop - Electric	Storage	30	F42EE	72	2.16	SNAP	30	F42SSILL-R	45	1.35	SNAP	0.81	1,217	2920	985	2,365	Industrial Parabolic GC 3-ways
32	Baldswinville WWT	A153	Shop - Electric	Storage	6	F42EE	72	0.432	SNAP	6	F42SSILL-R	45	0.27	SNAP	0.16	608	1460	99	237	Industrial Parabolic FC (2 banks separate SW's)
33	Baldswinville WWT	A152	Lunch Room	Prep	4	F44EE	144	0.576	SNAP	4	F44SSILL-R	86	0.344	1-WALL	0.23	456	1095	106	254	2 x 4 Prismatic FC SP

				PRE-INSTALLATION						POST-INSTALLATION										
Line Item	**Building**	**Floor**	**Area Description**	**Usage Group ID**	**Pre Fixt. No.**	**Pre Fixt. Code**	**Pre Watts/Fixt**	**Pre kW/Space**	**Exist Cont**	**Post Fixt No.**	**Post Fixt Code**	**Post Watts/ Fixt**	**Post kW/Space**	**Prop Cont**	**kW Saved**	**NOx Hours**	**Annual Hours**	**NOx kWh Saved**	**Annual kWh Saved**	**blank col no 1**
Integer identifying the line, beginning with one	Building Name	Building floor of the item	Unique description of the location that matches the site map	Descriptive name for the usage group	No. of fixtures before the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Pre Watts/Fixt) * (Pre Fixt No.)	Pre-inst. control device	No. of fixtures after the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Post Watts/Fixt) * (Post Fixt No.)	Post-inst. control device	(Pre kW/Space) - (Post kW/Space)	Estimated hours during NOx Season (May-Sept)	Estimated annual hours for the usage group	(kw saved)* (NOx hours)	(kW Saved) * (Annual Hours)	NOTES
34	Baldswinville WWT	A152	Shop Entry	Office	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	1,217	2920	33	79	Wall Prismatic same SW as Shop
35	Baldswinville WWT	A119	Stairwell	Stairs	4	F42EE	72	0.288	SNAP	4	F42SSILL-R	45	0.18	SNAP	0.11	1,217	2920	131	315	Wall Prismatic
36	Baldswinville WWT	HALF	Stairwell	24-hr/Stairs	3	FU2EE	72	0.216	SNAP	3	FU2ILL-R	52	0.156	SNAP	0.06	3,640	8736	218	524	2 x 4 Prismatic
37	Baldswinville WWT	B	Stairwell	Stairs	4	F42EE	72	0.288	SNAP	4	F42SSILL-R	45	0.18	SNAP	0.11	3,640	8736	393	943	2 x 4 Prismatic (1 unaccessible over stairs)
38	Baldswinville WWT	A201	Vestibule/Hall	Security	2	F44EE	144	0.288	SNAP	2	F44SSILL-R	86	0.172	SNAP	0.12	1,217	2920	141	339	2 x 4 GC PAD?
39	Baldswinville WWT	A204	Data Processing Room	Office	12	F42EE			SNAP					2-WALL			365			1 x 4 Parabolic EC (3-ways SP x 1) (16 x 24) LOW HOURS
40	Baldswinville WWT	A207	Lab	Prep	15	F42EE	72	1.08	SNAP	15	F42SSILL-R	45	0.675	2-WALL	0.41	1,217	2920	493	1,183	1 x 4 Parabolic EC (3-ways SP x 1) (20 x 32)
41	Baldswinville WWT	AS06	Lab Office	Office	6	F42EE	72	0.432	SNAP	6	F42SSILL-R	45	0.27	1-WALL	0.16	1,217	2920	197	473	1 x 4 Parabolic EC (SP)
42	Baldswinville WWT	A205	Lab Supply	Storage	5	F42EE			SNAP					SNAP			52			1 x 4 Parabolic EC (3-ways) (12 x 16) LOW HOURS
43	Baldswinville WWT	202	Control Room	Office	8	F42EE	72	0.576	SNAP	8	F42SSILL-R	45	0.36	SNAP	0.22	1,217	2920	263	631	1 x 4 Parabolic EC (SP x 2 B1 lev.)
44	Baldswinville WWT	203	MCC	Office	12	F42EE			SNAP					SNAP			104			Industrial EC 3-ways SP LOW HOURS
45	Baldswinville WWT	208	Corridor	Office	1	MH250/1			SNAP					SNAP			8736			Wall Pack NO RETRO
46	Baldswinville WWT	208	Mezzanine - Belt Press	Security/24-hr	17	F42EE			SNAP					SNAP			976			Vapor GC 4-ways LOW HOURS
47	Baldswinville WWT	208	Mezzanine - Belt Press	Security	3	MH250/1	295	0.885	SNAP	3	F44SIL	148	0.444	SNAP	0.44	3,640	8736	1,605	3,853	Pendant EC PVC
48	Baldswinville WWT	208	Mezzanine - Belt Press	Security/24-hr	2	MH250/1			SNAP					SNAP			976			Pendant SW'd EC PVC LOW HOURS
49	Baldswinville WWT	208	Mezzanine - Belt Press	Security	8	MH250/1			SNAP					SNAP			976			Wall Pack (2 banks 2 SP) EC LOW HOURS NO RETRO
50	Baldswinville WWT	A135	SW Gear Room (EM)	Storage	8	F42EE			SNAP					SNAP			12			Vapor EC 2nd floor PVC LOW HOURS
51	Baldswinville WWT	A135	SW Gear Room Gen.	Storage	7	F42EE			SNAP					SNAP			365			Vapor EC SP PVC 1st floor LOW HOURS
52	Baldswinville WWT	A135	Stairwell/Corridor	Stairs/Office	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	3,640	8736	98	236	Vapor NL
53	Baldswinville WWT	A135	Stairwell/Corridor	airs/Office/24-	3	F42EE	72	0.216	SNAP	3	F42SSILL-R	45	0.135	SNAP	0.08	1,217	2920	99	237	Vapor 4-ways FC
54	Baldswinville WWT	A133	Oil Storage	Storage	2	F42EE			SNAP					SNAP			52			Vapor SP FC LOW HOURS
55	Baldswinville WWT	A137/129	A137/129	Storage	8	MH250/1			SNAP					SNAP			52			Wall Packs LOW HOURS NO RETRO
56	Baldswinville WWT	A136	Stock Room	Storage	2	F42EE			SNAP					SNAP			52			Vapor SP EC LOW HOURS
57	Baldswinville WWT	A129	Chemical Area	Storage	3	F42EE	72	0.216	SNAP	3	F42SSILL-R	45	0.135	SNAP	0.08	1,217	2920	99	237	Vapor GC PVC
58	Baldswinville WWT	A129	Under Stairs/Over	Stairs/24-hr	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	SNAP	0.05	3,640	8736	197	472	Vapor FC 1 under/1 over stairs PVC
59	Baldswinville WWT	A132	Stock Rm Plumbing	Storage	2	F42EE			SNAP					SNAP			52			Vapor EC SP PVC LOW HOURS
60	Baldswinville WWT	A02	Ground Flr. Pump Rm.	Storage/24-hr	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	3,640	8736	98	236	Vapor FC over work bench PVC
61	Baldswinville WWT	A02	Ground Flr. Pump Rm.	Storage	2	MH250/1			SNAP					SNAP			52			Wall Packs - stairs SW'd PVC LOW HOURS NO RETRO
62	Baldswinville WWT	A02	Ground Flr. Pump Rm.	Storage	4	MH250/1			SNAP					SNAP			52			Wall Packs - SW'd PVC LOW HOURS NO RETRO
63	Baldswinville WWT	A131	Stock Room - Elec.	Storage	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	SNAP	0.05	22	52	1	3	Vapor EC SP PVC LOW HOURS
64	Baldswinville WWT	A134	Screen Room	Storage/24-hr	7	MH250/1			SNAP					SNAP			8736			Explosion Proof Wall PVC (Plunger SW's)NO RETRO
65	Baldswinville WWT	A01	Ground Flr. Screen Rm.	Storage	8	MH250/1			SNAP					SNAP			365			Explosion Proof FC - Dirty PVC (Plunger SW's) LOW HOURS
66	Baldswinville WWT	A07	Storage/Maintenance	Storage	7	F42EE	72	0.504	SNAP	7	F42SSILL-R	45	0.315	SNAP	0.19	1,217	2920	230	552	Vapor GC SP PVC
67	Baldswinville WWT	Basement	Maintenance Office	Office	6	F44EE	144	0.864	SNAP	6	F44SSILL-R	86	0.516	SNAP	0.35	1,217	2920	423	1,016	2 x 4 Prismatic ABS SP & 3-ways 24 x 24 PVC
68	Baldswinville WWT	Basement	Maintenance Office	Office	2	FU2EE	72	0.144	SNAP	2	FU2ILL-R	52	0.104	SNAP	0.04	1,217	2920	49	117	2 x 4 Prismatic SP & 3-ways 24 x 24 PVC
69	Baldswinville WWT	A04	Tunnel	Office	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	SNAP	0.05	1,217	2920	66	158	Vapor FC PVC
70	Baldswinville WWT	A04	Tunnel	Office/24-hr	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	3,640	8736	98	236	Vapor FC PVC NL
71	Baldswinville WWT	Basement	Conference Room	Prep	7	F44EE			SNAP					SNAP			208			2 x 4 Prismatic EC LOW HOURS
72	Baldswinville WWT	Basement	Tunnel	Office/24-hr	2	F42EE	72	0.144		2	F42SSILL-R	45	0.09	SNAP	0.05	3,640	8736	197	472	Vapor GC
73	Baldswinville WWT	Basement	Tunnel	Office	3	F42EE	72	0.216	SNAP	3	F42SSILL-R	45	0.135	SNAP	0.08	1,217	2920	99	237	Vapor GC
74	Baldswinville WWT	Basement	Gallery #2	Office	28	F42EE	72	2.016		28	F42SSILL-R	45	1.26	SNAP	0.76	1,217	2920	920	2,208	Vapor GC 3-ways SP's 28
75	Baldswinville WWT	Basement	Gallery #1	Office	11	F42EE	72	0.792	SNAP	11	F42SSILL-R	45	0.495	SNAP	0.30	1,217	2920	361	867	Vapor GC SP's 11
76	Baldswinville WWT	Basement	Gallery #1	Office/24-hr	4	F42EE	72	0.288	SNAP	4	F42SSILL-R	45	0.18	SNAP	0.11	3,640	8736	393	943	Vapor GC SP's 4
77	Baldswinville WWT	Basement	Gallery #2	Office/24-hr	3	F42EE	72	0.216	SNAP	3	F42SSILL-R	45	0.135	SNAP	0.08	3,640	8736	295	708	Vapor GC SP's 3 Stairs Area
78	Baldswinville WWT		Grit Room	Storage	6	MH250/1			SNAP					SNAP			52			Ceiling Vapor FC Explosion Proof (Plunger SW's) LOW HOURS NO RETRO
79	Baldswinville WWT		Gallery #3 Stairs	Stairs	6	F42EE	72	0.432	SNAP	6	F42SSILL-R	45	0.27	SNAP	0.16	1,217	2920	197	473	Vapor GC
80	Baldswinville WWT	3	Multi-zone Room	Storage	10	F42EE			SNAP					SNAP			104			Vapor GC LOW HOURS
81	Baldswinville WWT	2	Oxygen Room	Storage	8	F42EE	72	0.576	SNAP	8	F42SSILL-R	45	0.36	SNAP	0.22	1,217	2920	263	631	Vapor FC 3-ways
82	Baldswinville WWT	2	Oxygen Room	Storage	14	MH250/1	295	4.13	SNAP	14	F44SIL	148	2.072	SNAP	2.06	1,217	2920	2,504	6,009	Ceiling Wall Mount (Vapor)
83	Baldswinville WWT	2	MCC Room	Office	20	F42EE	72	1.44	SNAP	20	F42SSILL-R	45	0.9	SNAP	0.54	1,217	2920	657	1,577	Vapor FC 3-ways
84	Baldswinville WWT	Basement	Gallery 3/4	Office	20	F42EE	72	1.44	SNAP	20	F42SSILL-R	45	0.9	SNAP	0.54	1,217	2920	657	1,577	Vapor EC (Tunnel Area)
85	Baldswinville WWT	Basement	Gallery 4	Office/24-hr	2	F31EE	38	0.076	SNAP	2	F31ILL-R	27	0.054	SNAP	0.02	3,640	8736	80	192	Cabinet Mount Fixture F-30 Lamp 34"
86	Baldswinville WWT	Basement	Gallery 5	Office/24-hr	4	F42EE	72	0.288	SNAP	4	F42SSILL-R	45	0.18	SNAP	0.11	3,640	8736	393	943	Vapor GC
87	Baldswinville WWT	Basement	Gallery 5	Office	8	F42EE	72	0.576	SNAP	8	F42SSILL-R	45	0.36	SNAP	0.22	1,217	2920	263	631	Vapor GC - FC
88	Baldswinville WWT	Basement	Gallery 5 Access	Office	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	SNAP	0.05	1,217	2920	66	158	Vapor SP 1 over stairs; no access
89	Baldswinville WWT	Basement	Gallery 6	Office	12	F42EE	72	0.864	SNAP	12	F42SSILL-R	45	0.54	SNAP	0.32	1,217	2920	394	946	Vapor FC - PC 3-ways
90	Baldswinville WWT	Basement	Gallery 6 Access	Office	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	SNAP	0.05	1,217	2920	66	158	Vapor FC
91	Baldswinville WWT	Basement	Chemical Storage	Storage	12	F42EE			SNAP	12				SNAP			52			Vapor FC GC (Ferrous room) LOW HOURS

				PRE-INSTALLATION						POST-INSTALLATION										
Line Item	**Building**	**Floor**	**Area Description**	**Usage Group ID**	**Pre Fixt. No.**	**Pre Fixt. Code**	**Pre Watts/Fixt**	**Pre kW/Space**	**Exist Cont**	**Post Fixt No.**	**Post Fixt Code**	**Post Watts/ Fixt**	**Post kW/Space**	**Prop Cont**	**kW Saved**	**NOx Hours**	**Annual Hours**	**NOx kWh Saved**	**Annual kWh Saved**	**blank col no 1**
Integer identifying the line, beginning with one	Building Name	Building floor of the item	Unique description of the location that matches the site map	Descriptive name for the usage group	No. of fixtures before the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Pre Watts/Fixt) * (Pre Fixt No.)	Pre-inst. control device	No. of fixtures after the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Post Watts/Fixt) * (Post Fixt No.)	Post-inst. control device	(Pre kW/Space) - (Post kW/Space)	Estimated hours during NOx Season (May-Sept)	Estimated annual hours for the usage group	(kw saved)* (NOx hours)	(kW Saved) * (Annual Hours)	NOTES
92	Baldswinville WWT	Basement	Gallery 7	Office	12	F42EE	72	0.864	SNAP	12	F42SSILL-R	45	0.54	SNAP	0.32	1,217	2920	394	946	Vapor
93	Baldswinville WWT	Basement	Gallery 7 Cage	Storage	2	F42EE			SNAP					SNAP			12			Vapor FC GC 3-ways LOW HOURS
94	Baldswinville WWT	Basement	Lime Bunkers	Storage	6	F42EE	72	0.432	SNAP	6	F42SSILL-R	45	0.27	SNAP	0.16	1,217	2920	197	473	Vapor FC GC
95	Baldswinville WWT	1	Lime Bunkers Hall	Office/24-hr	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	SNAP	0.05	3,640	8736	197	472	Vapor FC GC Hall/Work Table
96	Baldswinville WWT	2	Lime Area Stairs	Stairs	5	F42EE	72	0.36	SNAP	5	F42SSILL-R	45	0.225	SNAP	0.14	1,217	2920	164	394	Vapor GC
97	Baldswinville WWT	2	Lime Area Stairs	Stairs	2	MH250/1	295	0.59	SNAP	2	F44SIL	148	0.296	SNAP	0.29	1,217	2920	358	858	Vapor Pendant
98	Baldswinville WWT	Basement	Eff Water Room	Storage	9	F42EE	72	0.648	SNAP	9	F42SSILL-R	45	0.405	SNAP	0.24	1,217	2920	296	710	Vapor GC SP
99	Baldswinville WWT	Basement	Eff Water Bath	Rest	1	F42EE			SNAP					SNAP			12			Vapor GC SP LOW HOURS
100	Baldswinville WWT	1	Hypochlorite Bldg.	Storage	11	F42EE	72	0.792	SNAP	11	F42SSILL-R	45	0.495	SNAP	0.30	1,217	2920	361	867	Vapor GC Remote SW
	Baldwinsville WWT		**GRAND TOTALS**		**625**		**6,314**	**39.97**		**460.00**		**3,791.00**	**24.04**		**15.92**			**22,264.79**	**53,435.58**	

Equipment Forms
EF.L: Lighting Survey

Complete one copy of this form for each building where a lighting retrofit is proposed.

ESCO Name: **CARRIER CORP.**
Project Name: **ONONDAGA COUNTY ENERGY PROJECT**
Site Name: **BREWERTON WWTP**
Building Identifier:

Survey completed by (name): Date(s) Survey completed: **5/28/2004**

INSTRUCTIONS
Use one line for each fixture type in a room or area.

				PRE-INSTALLATION						POST-INSTALLATION										
Line Item	**Building**	**Floor**	**Area Description**	**Usage Group ID**	**Pre Fixt. No.**	**Pre Fixt. Code**	**Pre Watts/Fixt**	**Pre kW/Space**	**Exist Cont**	**Post Fixt No.**	**Post Fixt Code**	**Post Watts/ Fixt**	**Post kW/Space**	**Prop Cont**	**kW Saved**	**NOx Hours**	**Annual Hours**	**NOx kWh Saved**	**Annual kWh Saved**	**blank col no 1**
Integer identifying the line,	Building Name	Building floor of the item	Unique description of the location that matches the site map	Descriptive name for the usage group	No. of fixtures before the	Code from Table of Standard Fixture	Value from Table of Standard	(Pre Watts/Fixt) * (Pre Fixt No.)	Pre-inst. control device	No. of fixtures after the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture	(Post Watts/Fixt) * (Post Fixt No.)	Post-inst. control device	(Pre kW/Space) - (Post kW/Space)	Estimated hours during NOx Season (May-Sept)	Estimated annual hours for the usage group	(kw saved)* (NOx hours)	(kW Saved) * (Annual Hours)	NOTES
LEGEND:	EM Exits = Existing EC = Excellent Condition GC = Good Condition PC = Poor Condition OBST = Obstructions																			
1	Day Shift Work	1st Floor	Control Room	Office	4	F82EHS	227	0.908	SNAP	4	F82LHL	160	0.64	1-wall	0.27	975	2340	261	627	Slim Line/Industrial/Guard TS Clean
2	Day Shift Work	1st Floor	Control Room	Office	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	975	2340	26	63	Industrial/OL Clean
3	Day Shift Work	1st Floor	Hallway 3-way	Office	4	F44EE	144	0.576	SNAP	4	F44SSILL-R	86	0.344	SNAP	0.23	1,369	3285	318	762	2 x 4 Prismatic (Only 2 lamps operate)
4	Day Shift Work	1st Floor	Garage	Storage	4	F82EHS	227	0.908	SNAP	4	F82LHL	160	0.64	SNAP	0.27	1,369	3285	367	880	Industrial/Guards
5	Day Shift Work	1st Floor	Stock Room	Storage	1	I200/1			SNAP					1-wall			365			Missing Globe TS LOW HOURS
6	Day Shift Work	1st Floor	Locker Room	Rest	2	F42EE	72	0.144	SNAP	2	F42SSILL-R	45	0.09	1-wall	0.05	975	2340	53	126	Industrial/OL TS Clean
7	Day Shift Work	1st Floor	Locker Room	Rest	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	1-wall	0.03	975	2340	26	63	Wall/Missing Diffuser
8	Day Shift Work	1st Floor	Garage	Storage	3	F44EE	144	0.432	SNAP	3	F44SSILL-R	86	0.258	SNAP	0.17	975	2340	170	407	Industrial Semi-Clean
10	Day Shift Work	1st Floor	Lunch Room	Prep	8	I75/1			SNAP					1-wall			820			Glass Prismatic Diffuser TS 4- 2 LAMP FIXTURES LOW HOURS
11	Day Shift Work	1st Floor	Garage	Storage	2	F42EE			SNAP					SNAP			365			Industrial/OL/Parabolic Diffuser GC Sep. SW LOW HOURS
12	Day Shift Work	1st Floor	MCC/XFMR Room	Office	8	F82EHS	227	1.816	SNAP	8	F82LHL	160	1.28	1-wall	0.54	608	1460	326	783	Industrial/OL/Guard EC TS
13	Day Shift Work	1st Floor	Computer Room	Office	2	F82EHS			SNAP					1-wall			728			Industrial/OL/Guard EC TS LOW HOURS
14	Day Shift Work	1st Floor	Computer Room	Office	1	F42EE			SNAP					1-wall			728			Industrial/OL/Guard EC TS LOW HOURS
15	Control Building	Basement	Control Building	Office	2	F82EHS	227	0.454	SNAP	2	F82LHL	160	0.32	SNAP	0.13	867	2080	116	279	Slim Line/Industrial/OL/Guard EC
16	Control Building	Basement	West Gallery Hall	Security	5	F42EE	72	0.36	SNAP	5	F42SSILL-R	45	0.225	SNAP	0.14	867	2080	117	281	Wall/Prismatic/3-ways GC
17	Control Building	Basement	South Gallery Hall	Security	6	F82EHS	227	1.362	SNAP	6	F82LHL	160	0.96	SNAP	0.40	867	2080	348	836	Industrial/Guards/3-ways EC
18	Control Building	Basement	South Top Ladder	Stairs	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	867	2080	23	56	Wall/Missing Diffuser GC OBST
19	Control Building	Basement	North Gallery	Security	6	F82EHS	227	1.362	SNAP	6	F82LHL	160	0.96	SNAP	0.40	867	2080	348	836	Slim Line/Guard EC OBST
20	Control Building	Basement	North Top Ladder	Stairs	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	867	2080	23	56	Wall/Missing Diffuser 3-ways
21	Control Building	Basement	East Gallery	Security	5	F82EHS	227	1.135	SNAP	5	F82LHL	160	0.8	SNAP	0.34	867	2080	290	697	Slim Line/Guards EC
22	Control Building	Basement	East Stairs Landing	Stairs	1	F42EE	72	0.072	SNAP	1	F42SSILL-R	45	0.045	SNAP	0.03	867	2080	23	56	Wall/Missing Diffuser GC
23	Chemical Building	1st Floor	Chemical Room Bldg	Storage	3	F82EHS	227	0.681	SNAP	3	F82LHL	160	0.48	SNAP	0.20	867	2080	174	418	Industrial/OL/Guard GC
24	Chemical Building	1st Floor	Chemical Room Door	24-hr	1	I200/1	200	0.2	SNAP	1	CFQ26/1	33	0.033	1-wall	0.17	3,650	8760	610	1,463	Missing Globe TS
25	Chemical Building	1st Floor	Chem Lab	Storage	1	F82EHS	227	0.227	SNAP	1	F82LHL	160	0.16	SNAP	0.07	867	2080	58	139	Industrial/Guard EC
26	Chemical Building	2nd Floor	Chemical Room	Storage	1	F82EHS	227	0.227	SNAP	1	F82LHL	160	0.16	SNAP	0.07	3,650	8760	245	587	Slim Line/Industrial GC
27	Chemical Building	2nd Floor	Chemical Room	Storage	7	F82EHS	227	1.589	SNAP	7	F82LHL	160	1.12	1-wall	0.47	455	1092	213	512	Slim Line/Industrial GC TS OSW
28	**All Explosion Proof**	1st Floor	Control Room/MCC	Office	4	F82EHS			SNAP					SNAP			260			Slim Line/Industrial/Guards NGC LOW HOURS
29	Raw Sewage Bldg.	2nd/3rd Floors	Lower Rooms (2)	Prep	8	I150/1	150	1.2	SNAP	8	CFQ26/1	33	0.264	SNAP			260			Vapor/Guards OSW (Motor Rm) LOW HOURS
30	Raw Sewage Bldg.	2nd/3rd Floors	Lower Stairs	Stairs	2	I100/1	100	0.2	SNAP	2	CFQ20/1	23	0.046	2-wall	0.15	867	2080	133	320	Vapor/Guards
31	Raw Sewage Bldg.	1st Floor	Back Room	Storage	4	F43EE			SNAP								365			Vapor/Chlorination room) GC LOW HOURS
32	Raw Sewage Bldg.	1st Floor	Shed (sample)	Storage	1	F42EE			SNAP								12			Wrap-around LOW HOURS
33	Raw Sewage Bldg.	1st Floor	Chlorine Storage	Storage	8	F43EE			SNAP								156			Vapor GC LOW HOURS
34	Raw Sewage Bldg.	1st Floor	Chlorine Storage	24-hr	1	EI20/2	40	0.04	SNAP	1	ELED5/2	10	0.01	SNAP	0.03	3,650	8760	109	263	Not Working NO Emergency Light
35	Raw Sewage Bldg.	1st Floor	Grit Room	Storage	2	I100/1			SNAP					SNAP			260			Explosion Proof GC LOW HOURS
36	Raw Sewage Bldg.	1st Floor	Grit Room	Storage	5	I150/1			SNAP					SNAP			260			Explosion Proof GC LOW HOURS
37	Raw Sewage Bldg.	Basement	Communitor Room	Storage	8	I150/1			SNAP					SNAP			260			Explosion Proof PC LOW HOURS
38	Raw Sewage Bldg.	1st Floor	Storage Room	Storage	1	F82EHS			SNAP					1-wall			12			Slim Line TS LOW HOURS
	BREWERTON		**GRAND TOTALS**		**125**		**3779**	**14.181**		**78**		**2346**	**9.015**		**4.23**	**29,159.12**	**74,833.00**	**4,379.88**	**10,511.73**	

Equipment Forms
EF.L: Lighting Survey

Complete one copy of this form for each building where a lighting retrofit is proposed.

ESCO Name: **CARRIER CORP.**
Project Name: **ONONDAGA COUNTY ENERGY PROJECT**
Site Name: **MEADOWBROOK WWTP**
Building Identifier:

Survey completed by (name): **Date(s) Survey completed:** **5/25/2004**

INSTRUCTIONS
Use one line for each fixture type in a room or area.

			PRE-INSTALLATION						POST-INSTALLATION											
Line Item	**Building**	**Floor**	**Area Description**	**Pre Fixt. No.**	**Pre Fixt. Code**	**Pre Watts/Fixt**	**Pre kW/Space**	**Exist Cont**	**Post Fixt No.**	**Post Fixt Code**	**Post Watts/ Fixt**	**Post kW/Space**	**Prop Cont**	**kW Saved**	**NOx Hours**	**Annual Hours**	**NOx kWh Saved**	**Annual kWh Saved**	**blank col no 1**
Integer identifying the line, beginnin	Building Name	Building floor of the item	Unique description of the location that matches the site map	No. of fixtures before the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Pre Watts/Fixt) * (Pre Fixt No.)	Pre-inst. control device	No. of fixtures after the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Post Watts/Fixt) * (Post Fixt No.)	Post-inst. control device	(Pre kW/Space) - (Post kW/Space)	Estimated hours during NOx Season (May- Sept)	Estimated annual hours for the usage	(kw saved)* (NOx hours)	(kW Saved) * (Annual Hours)	NOTES
1	Administration Building	1st Floor	Lab	6	F44ILL-R			SNAP					SNAP			2920			TS - x2; 2 ckt. T-8 LAMPS
2	Administration Building	1st Floor	Storage	1	I200/1			SNAP					SNAP			52			TS - shade LOW HRS.
3	Administration Building	1st Floor	Corridor	2	F82LHL			SNAP					SNAP			2920			Industrial/Guard T-8 SLIMLINE LAMP
4	Administration Building	1st Floor	Office/Operator	6	F42EE	72	0.432	SNAP	6	F42SSILL-R	45	0.27	SNAP	0.16	1,217	2920	197	473	TS 2 x 4 Prismatic FC
5	Administration Building	1st Floor	Control	3	F42EE	72	0.216	SNAP	3	F42SSILL-R	45	0.135	SNAP	0.08	1,217	2920	99	237	TS 2 x 4 Prismatic FC
6	Administration Building	1st Floor	Bathroom	2	F42EE			SNAP					SNAP			52			TS Wrap-around; 1 missing diffuser LOW HRS.
7	Administration Building	1st Floor	Bathroom	1	F21SS			SNAP					SNAP			52			TS Wall F20T12 CW FC LOW HRS.
8	Administration Building	1st Floor	Electric Room	3	F82ILL			SNAP					SNAP			52			TS Industrial GC T- 8 SLIMLINE LAMPS LOW HRS.
9	Administration Building	1st Floor	Generator Room	3	F82ILL			SNAP					SNAP			52			TS Industrial GC T- 8 SLIMLINE LAMPS LOW HRS.
10	Administration Building	1st Floor	Back Control Panel	1	F82EHS			SNAP					SNAP			30			TS Industrial GC LOW HRS.
11	Administration Building	1st Floor	Stairwell	1	F82EHS			SNAP					SNAP			52			TS Industrial/Guard GC LOW HRS.
12	Administration Building	Basement	Stairwell Landing Top	1	F82EHS			SNAP					SNAP			52			Industrial GC Over stairs - no access LOW HRS.
13	Administration Building	Basement	Stairwell Landing Bottom	1	F82EHS			SNAP					SNAP			52			Industrial GC Access LOW HRS.
14	Administration Building	Basement	Bottom - Pumps	3	F82EHS			SNAP					SNAP			52			Industrial GC Over pumps 14' step LOW HRS.
15	Administration Building	Basement	Admin. Bldg. Basement	1	I100/1			SNAP					SNAP			52			Under Stairs Shade, directional LOW HRS.
16	Administration Building	1st Floor	Grit Room	6	I150/1			SNAP					SNAP			365			Explosion Proof GC LOW HRS.
17	Administration Building	1st Floor	Stair Landing	1	I150/1			SNAP					SNAP			365			Explosion Proof GC LOW HRS.
18	Administration Building	Basement	Screen Room	4	I150/1			SNAP					SNAP			52			Explosion Proof FC Inaccessible LOW HRS.
19	Administration Building	Basement	Grit Room	14	I150/1			SNAP					SNAP			52			Explosion Proof FC No EM LOW HRS.
20	Administration Building	1st Floor	Green Garage	6	F42EE			SNAP					SNAP			36			Vapor TS GC NON HEATED SPACE LOW HRS.
21	Administration Building	1st Floor	Maintenance Garage	8	F82ILL			SNAP					SNAP			2080			Industrial/Guard EC EMS T-8 LAMPS
22	Administration Building	1st Floor	Maintenance Garage	1	I200/1			SNAP					SNAP			52			Pendant/Shade FC EMS LOW HRS.
23	Administration Building	1st Floor	Weld Area	2	F41EE			SNAP					SNAP			52			Vent Hood Mount - EM LOW HRS.
24	Administration Building	1st Floor	Stock/Tool Room	4	F42EE			SNAP					SNAP			730			Industrial/Guard EC TS LOW HRS.
25	Administration Building	1st Floor	Hallway - Connecting	1	F43EE			SNAP					SNAP			0			Industrial/Direct Never On LOW HRS.
26	Administration Building	1st Floor	Hallway - Main	5	F43EE			SNAP					SNAP			365			On winter months; direct/indirect LOW HRS.
27	Administration Building	1st Floor	MCC Room	2	F42EE			SNAP					SNAP			52			Industrial/Guard DC TS No EM LOW HRS.
28	Administration Building	1st Floor	Men's Room/Locker	5	F42ILL-R			SNAP					SNAP			2080			Vapor EC TS - x 2 T-8 LAMPS
29	Maintenance/Garage Bldg	1st Floor	Women's Bath/Locker	5	F42ILL-R			SNAP					SNAP			10			Vapor EC TS - x 2 T-8 LAMPS LOW HRS.
30	Maintenance/Garage Bldg	1st Floor	Steve's Office	4	F42ILL-R			SNAP					SNAP			730			Industrial Rod Hung Direct 6 mos. Operational T-8 LAMPS LOW HRS.

			PRE-INSTALLATION						POST-INSTALLATION										
Line Item	**Building**	**Floor**	**Area Description**	**Pre Fixt. No.**	**Pre Fixt. Code**	**Pre Watts/Fixt**	**Pre kW/Space**	**Exist Cont**	**Post Fixt No.**	**Post Fixt Code**	**Post Watts/ Fixt**	**Post kW/Space**	**Prop Cont**	**kW Saved**	**NOx Hours**	**Annual Hours**	**NOx kWh Saved**	**Annual kWh Saved**	**blank col no 1**
Integer identifying the line, beginnin	Building Name	Building floor of the item	Unique description of the location that matches the site map	No. of fixtures before the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Pre Watts/Fixt) * (Pre Fixt No.)	Pre-inst. control device	No. of fixtures after the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	(Post Watts/Fixt) * (Post Fixt No.)	Post-inst. control device	(Pre kW/Space) - (Post kW/Space)	Estimated hours during NOx Season (May- Sept)	Estimated annual hours for the usage	(kw saved)* (NOx hours)	(kW Saved) * (Annual Hours)	NOTES
31	Maintenance/Garage Bldg	1st Floor	Kitchen/Break	8	F42ILL-R			SNAP					SNAP			52			Industrial Rod Hung Direct TS T-8 LAMPS LOW HRS.
32	Substation	1st Floor	Entry	2	I150/1			SNAP					SNAP			5			Porcelain Keyless, TS LOW HRS.
33	Substation	TC Bldg.	Thickener Control Bldg.	12	F42EE	72	0.864	SNAP	12	F42SSILL-R	45	0.54	SNAP	0.32	1,217	2920	394	946	Vapor Wall GC HO
34	Substation	TC Bldg.	MCC Room	1	F42EE			SNAP					1-WALL			730			Vapor Ceiling TS LOW HOURS
35	Digest/Blow Bldg.	DB Bldg.	Digest/Blow Bldg.	1	F82ILL			SNAP					SNAP			260			Industrial EC TS T-8 SLIMLINE LAMPS LOW HRS.
36	Digest/Blow Bldg.	DB Bldg.	Digest/Blow Bldg.	3	F82ILL			SNAP					SNAP			260			Industrial EC TS T-8 SLIMLINE LAMPS LOW HRS.
37	Sample Sheds x 2	S. Shed	Sample Sheds x 2	2	I100/1			SNAP					SNAP			20			Vapor TS
38	Scum House x 2	S. House	Scum House x 2	2	I100/1			SNAP					SNAP			52			Vapor TS
39	Sludge Recycling Building	1st Floor	Sludge Recycling Building	5	F82ILL			SNAP					SNAP			1460			T-8 SLIMLINE LAMPS
40	Sludge Recycling Building	Basement	Pump Room	5	F82ILL			SNAP					SNAP			365			T-8 SLIMLINE LAMPS
41	Sludge Recycling Building	Basement	Pump Room	1	F42EE			SNAP					SNAP			365			LOW HOURS
42	Sludge Recycling Building	1st Floor	Sodium Hypo Room	5	F42EE			SNAP					SNAP			365			LOW HOURS
43	Sludge Recycling Building	1st Floor	Sodium Hypo Room	1	F82ILL			SNAP					SNAP			365			T-8 SLIMLINE LAMPS/LOW HOURS
45	Sludge Recycling Building	1st Floor	Substation	2	I150/1			SNAP					SNAP			5			LOW HOURS
46	Sludge Recycling Building	1st Floor	MCC Aeration	2	I200/1			SNAP					SNAP			10			LOW HOURS
47	Sludge Recycling Building	1st Floor	Aeration Motor Room	8	F82EE	123	0.984	SNAP	8	F82ILL-R	98	0.784	SNAP	0.20	608	1460	122	292	T-12 HO LAMPS
48	Sludge Recycling Building	1st Floor	Aeration Motor MCC	1	F82EE	123	0.123	SNAP	1	F82ILL-R	98	0.098	SNAP	0.03	152	365	4	9	T-12 HO LAMPS
49	Sludge Recycling Building	1st Floor	Ferrous Chloride Room	8	F42SHS			SNAP					SNAP			2080			NO RETRO T-8 HO 4' LAMPS NOT AVAILABLE
MEADOWBROOK WWTP			**GRAND TOTALS**	**172**		**462.00**	**2.62**		**30**		**331.00**	**1.83**		**0.79**	**4,410.41**		**815.32**	**1,956.77**	

Equipment Forms
EF.L: Lighting Survey

Complete one copy of this form for each building where a lighting retrofit is proposed.

ESCO Name: Carrier Corporation
Project Name: Onondaga County
Site Name: Oak Orchard WWT
Building Identifier:

BR=Bulb Replacement
Ba=Ballast Replacement
Fix=Fixture Replacement
RL/RB=Relamp/Reballast
LED=LED Retrofit

Survey completed by (name): _____ Date(s) Survey completed: _____

INSTRUCTIONS
Use one line for each fixture type in a room or area.

					PRE-INSTALLATION						POST-INSTALLATION								
Line Item	**Building**	**Floor**	**Area Description**	**Usage Group ID**	**Pre Fixt. No.**	**Pre Fixt. Code**	**Pre Watts/Fixt**	**NOP**	**Pre kW/Space**	**Exist Cont**	**Post Fixt No.**	**Post Fixt Code**		**Post Watts/ Fixt**	**Post kW/Space**	**Prop Cont**	**kW Saved**	**Annual Hours**	**Annual kWh Saved**
Integer identifying the line, beginning with one	Building Name	Building floor of the item	Unique description of the location that matches the site map	Descriptive name for the usage group	No. of fixtures before the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	No. of non-operating (broken, intended for repair) fixtures	(Pre Watts/Fixt) * (Pre Fixt No.)	Pre-inst. control device	No. of fixtures after the retrofit	Code from Table of Standard Fixture Wattages	Scope Codes	Value from Table of Standard Fixture Wattages	(Post Watts/Fixt) * (Post Fixt No.)	Post-inst. control device	(Pre kW/Space) - (Post kW/Space)	Estimated annual hours for the usage group	(kW Saved) * (Annual Hours)
1	A Building	1st Floor	Reception/Lobby	Security/24-hr	11	F24SS	112		1.232	SNAP	11	F24ILL-R	RL/RB	55	0.605	SNAP	0.63	8,760	5,493
2	A Building	1st Floor	Reception/Lobby	Security	2	I15/1	15		0.03	SNAP	2	CFQ15/1		20	0.04	SNAP	(0.01)	-	-
3	A Building	103	Lunch Room	Prep/24-hr	1	F44EE	144		0.144	SNAP	1	F44ILL-R	RL/RB	102	0.102	SNAP	0.04	2,080	87
4	A Building	103	Lunch Room	Prep	4	F44EE	144		0.576	SNAP	4	F44ILL-R	RL/RB	102	0.408	1-WALL	0.17	2,080	349
5	A Building	114	Corridor	Office/24-hr	5	F24SS	112		0.56	SNAP	5	F24ILL-R	RL/RB	55	0.275	SNAP	0.29	8,760	2,497
6	A Building	Sewer Control	Sewer Control Room	Storage	4	F44EE	144		0.576	SNAP	4	F44ILL-R	RL/RB	102	0.408	1-WALL	0.17	2,080	349
7	A Building	111	Office	Office	2	F44EE	144		0.288	SNAP	2	F44ILL-R	RL/RB	102	0.204	1-WALL	0.08	2,080	175
8	A Building	112	Vestibule	Security/24-hr	1	F24SS	112		0.112	SNAP	1	F24ILL-R	RL/RB	55	0.055	SNAP	0.06	8,760	499
9	A Building	126	Women's Locker/Tool Room	Rest/Storage	3	F42EE	72		0.216	SNAP	3	F42ILL-R	RL/RB	52	0.156	1-WALL	0.06	2,920	175
10	A Building	104	Women's Bath Room	Rest/24-hr	2	I60/1	60		0.12	SNAP	2	CFQ15/1	B	20	0.04	SNAP	0.08	8,760	701
11	A Building	104	Women's Bath Room	Rest/24-hr	2	I100/1	100		0.2	SNAP	2	CFQ20/1	B	23	0.046	SNAP	0.15	8,760	1,349
12	A Building	104	Women's Bath Room	Rest/24-hr	1	F22SS	56		0.056	SNAP	1	F22ILL-R	RL/RB	29	0.029	SNAP	0.03	8,760	237
13	A Building	109	Men's Bath Room	Rest/24-hr	2	I100/1	100		0.2	SNAP	2	CFQ20/1	B	23	0.046	SNAP	0.15	8,760	1,349
14	A Building	109	Men's Bath Room	Rest/24-hr	1	F42EE	72		0.072	SNAP	1	F42ILL-R	RL/RB	52	0.052	SNAP	0.02	8,760	175
15	A Building	109	Men's Locker Room	Rest/24-hr	4	I100/1	100		0.4	SNAP	4	CFQ20/1	B	23	0.092	SNAP	0.31	8,760	2,698
16	A Building	119	Corridor	Office/24-hr	5	F44EE	144		0.72	SNAP	5	F44ILL-R	RL/RB	102	0.51	SNAP	0.21	8,760	1,840
17	A Building	119	Corridor	Office/24-hr	1	F42EE	72		0.072	SNAP	1	F42ILL-R	RL/RB	52	0.052	SNAP	0.02	8,760	175
18	A Building	129	Corridor to Women's Locker	Office/24-hr	3	I60/1	60		0.18	SNAP	3	CFQ15/1	B	20	0.06	SNAP	0.12	2,080	250
19	A Building	125	Women's Bath Room/Locker	Rest/24-hr	2	I60/1	60		0.12	SNAP	2	CFQ15/1	B	20	0.04	SNAP	0.08	8,760	701
20	A Building	125	Women's Bath Room/Locker	Rest/24-hr	2	I100/1	100		0.2	SNAP	2	CFQ20/1	B	23	0.046	SNAP	0.15	8,760	1,349
21	A Building	125	Women's Bath Room/Locker	Rest/24-hr	4	F22SS	56		0.224	SNAP	4	F22ILL-R	RL/RB	29	0.116	SNAP	0.11	8,760	946
22	A Building	123	Men's Bath Room/Locker	Rest/24-hr	1	I60/1	60		0.06	SNAP	1	CFQ15/1	B	20	0.02	SNAP	0.04	8,760	350
23	A Building	123	Men's Bath Room/Locker	Rest/24-hr	7	I100/1	100		0.7	SNAP	7	CFQ20/1	B	23	0.161	SNAP	0.54	8,760	4,722
24	A Building	123	Men's Bath Room/Locker	Rest/24-hr	3	F22SS	56		0.168	SNAP	3	F22ILL-R	RL/RB	29	0.087	SNAP	0.08	8,760	710
25	A Building		Janitor Closet	Storage	1	F24SS	112		0.112	SNAP	1	F24ILL-R	RL/RB	55	0.055	1-WALL	0.06	104	6
26	A Building		First Aid Room	Storage	3	F44EE	144		0.432	SNAP	3	F44ILL-R	RL/RB	102	0.306	1-WALL	0.13	2,080	262
27	A Building		Small Parts Storage	Storage	19	F42EE	72		1.368	SNAP	19	F42ILL-R	RL/RB	52	0.988	SNAP	0.38	2,920	1,110
28	A Building	132	Corridor/Office Small Parts	Office	2	F24SS	112		0.224	SNAP	2	F24ILL-R	RL/RB	55	0.11	SNAP	0.11	2,080	237
29	A Building		Maintenance Crew Leader	Office	1	F44EE	144		0.144	SNAP	1	F44ILL-R	RL/RB	102	0.102	1-WALL	0.04	2,080	87
30	A Building	136	Corridor	Office/24-hr	1	F24SS	112		0.112	SNAP	1	F24ILL-R	RL/RB	55	0.055	SNAP	0.06	8,760	499
31	A Building	Garage	Maintenance Garage	Storage	6	F42EE	72		0.432	SNAP	6	F42ILL-R	RL/RB	52	0.312	SNAP	0.12	2,920	350
32	A Building	Garage	Maintenance Garage	Storage	2	F42EE	72		0.144	SNAP	2	F42ILL-R	RL/RB	52	0.104	SNAP	0.04	2,920	117
33	A Building	Garage	Stairway	Security/24-hr	7	I150/1	150		1.05	SNAP	7	CFQ26/1	B	33	0.231	SNAP	0.82	8,760	7,174

					PRE-INSTALLATION						POST-INSTALLATION								
Line Item	**Building**	**Floor**	**Area Description**	**Usage Group ID**	**Pre Fixt. No.**	**Pre Fixt. Code**	**Pre Watts/Fixt**	**NOP**	**Pre kW/Space**	**Exist Cont**	**Post Fixt No.**	**Post Fixt Code**		**Post Watts/ Fixt**	**Post kW/Space**	**Prop Cont**	**kW Saved**	**Annual Hours**	**Annual kWh Saved**
Integer identifying the line, beginning with one	Building Name	Building floor of the item	Unique description of the location that matches the site map	Descriptive name for the usage group	No. of fixtures before the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	No. of non-operating (broken, intended for repair) fixtures	(Pre Watts/Fixt) * (Pre Fixt No.)	Pre-inst. control device	No. of fixtures after the retrofit	Code from Table of Standard Fixture Wattages	Scope Codes	Value from Table of Standard Fixture Wattages	(Post Watts/Fixt) * (Post Fixt No.)	Post-inst. control device	(Pre kW/Space) - (Post kW/Space)	Estimated annual hours for the usage group	(kW Saved) * (Annual Hours)
34	A Building	138	Corridor Vending	Retail/Office/24-hr	6	F24SS	112		0.672	SNAP	6	F24ILL-R	RL/RB	55	0.33	SNAP	0.34	8,760	2,996
35	A Building	Elevator Rm	Elevator Room	Storage	5	F42EE	72		0.36	SNAP	5	F42ILL-R	RL/RB	52	0.26	1-WALL	0.10	52	5
36	A Building	Elevator	Elevator	Office/24-hr	2	F41EE	43		0.086	SNAP	2	F41LL-R	RL/RB	27	0.054	SNAP	0.03	8,760	280
37	A Building	Plant Control Rm	Plant Control Room	Office/24-hr	10	F44EE	144		1.44	SNAP	10	F44ILL-R	RL/RB	102	1.02	SNAP	0.42	8,760	3,679
38	A Building	236	Corridor	Security/24-hr	8	F24SS	112		0.896	SNAP	8	F24ILL-R	RL/RB	55	0.44	SNAP	0.46	8,760	3,995
39	A Building	236	Corridor	Security/24-hr	7	F24SS	112		0.784	SNAP	7	F24ILL-R	RL/RB	55	0.385	SNAP	0.40	8,760	3,495
40	A Building	206	Corridor	Office/24-hr	3	F24SS	112		0.336	SNAP	3	F24ILL-R	RL/RB	55	0.165	SNAP	0.17	8,760	1,498
41	A Building		Superintendent's Office	Office	8	F44EE	144		1.152	SNAP	8	F44ILL-R	RL/RB	102	0.816	SNAP	0.34	2,080	699
42	A Building	202	Office	Office	6	F44EE	144		0.864	SNAP	6	F44ILL-R	RL/RB	102	0.612	SNAP	0.25	2,080	524
43	A Building	2nd Floor	Men's Room	Rest/24-hr	1	F32EE	66		0.066	SNAP	1	F32ILL-R	RL/RB	46	0.046	1-WALL	0.02	8,760	175
44	A Building	2nd Floor	Men's Room	Rest/24-hr	1	F42EE	72		0.072	SNAP	1	F42ILL-R	RL/RB	52	0.052	1-WALL	0.02	8,760	175
45	A Building	2nd Floor	Women's Room	Rest/24-hr	3	F42EE	72		0.216	SNAP	3	F42ILL-R	RL/RB	52	0.156	SNAP	0.06	8,760	526
46	A Building	2nd Floor	Women's Room	Rest/24-hr	1	F32EE	66		0.066	SNAP	1	F32ILL-R	RL/RB	46	0.046	SNAP	0.02	8,760	175
47	A Building	2nd Floor	Conference Room	Prep	8	F44EE	144		1.152	SNAP	8	F44ILL-R	RL/RB	102	0.816	SNAP	0.34	260	87
48	A Building	2nd Floor	Records Storage	Storage	4	F44EE	144		0.576	SNAP	4	F44ILL-R	RL/RB	102	0.408	SNAP	0.17	2,080	349
49	A Building	2nd Floor	Maintenance Crew Leader	Office	5	F44EE	144		0.72	SNAP	5	F44ILL-R	RL/RB	102	0.51	SNAP	0.21	2,920	613
50	A Building	2nd Floor	Equipment Room/Multi-Zone	Storage	8	I150/1	150		1.2	SNAP	8	CFQ26/1	B	33	0.264	SNAP	0.94	12	11
51	A Building	2nd Floor	Emergency Power Room	Storage	7	F42EE	72		0.504	SNAP	7	F42ILL-R	RL/RB	52	0.364	SNAP	0.14	2,080	291
52	A Building	2nd Floor	Stairwell 2	Security/24-hr	2	F24SS	112		0.224	SNAP	2	F24ILL-R	RL/RB	55	0.11	SNAP	0.11	2,080	237
53	A Building	2nd Floor	I&E Group	Prep	3	F44EE	144		0.432	SNAP	3	F44ILL-R	RL/RB	102	0.306	1-WALL	0.13	2,080	262
54	A Building	2nd Floor	Storage Instrument Shop	Storage	4	F44EE	144		0.576	SNAP	4	F44ILL-R	RL/RB	102	0.408	1-WALL	0.17	2,080	349
55	A Building	2nd Floor	Lab	Storage	9	F44EE	144		1.296	SNAP	9	F44ILL-R	RL/RB	102	0.918	1-WALL	0.38	2,080	786
56	A Building	2nd Floor	Lab Office	Office	1	F44EE	144		0.144	SNAP	1	F44ILL-R	RL/RB	102	0.102	1-WALL	0.04	2,080	87
57	A Building	2nd Floor	Lab - Hoods	Storage	3	I150/1	150		0.45	SNAP	3	CFQ26/1	B	33	0.099	SNAP	0.35	2,080	730
58	A Building	2nd Floor	Lab Storage	Storage	2	F44EE	144		0.288	SNAP	2	F44ILL-R	RL/RB	102	0.204	1-WALL	0.08	260	22
59	A Building	2nd Floor	Parts Storage	Storage	7	F42EE	72		0.504	SNAP	7	F42ILL-R	RL/RB	52	0.364	1-WALL	0.14	260	36
60	A Building	2nd Floor	Electric Equipment Room	Storage	4	F42EE	72		0.288	SNAP	4	F42ILL-R	RL/RB	52	0.208	1-WALL	0.08	52	4
61	A Building	2nd Floor	Janitor Closet	Storage	1	F24SS	112		0.112	SNAP	1	F24ILL-R	RL/RB	55	0.055	1-WALL	0.06	104	6
62	B BUILDING	1st Floor	Vestibule	Security/24-hr	1	F44EE	144		0.144	SNAP	1	F44ILL-R	RL/RB	102	0.102	SNAP	0.04	8,760	368
63	B Building	1st Floor	Sludge Process Cage	Storage	10	F82EE	123		1.23	SNAP	10	F82ILL-R	RL/RB	98	0.98	SNAP	0.25	360	90
64	B Building	1st Floor	Control Room MCC	Storage	3	F44EE	144		0.432	SNAP	3	F44ILL-R	RL/RB	102	0.306	1-WALL	0.13	12	2
65	B Building	1st Floor	Control Room MCC	Storage	2	FU2EE	72		0.144	SNAP	2	FU2ILL-R	RL/RB	52	0.104	1-WALL	0.04	12	0
66	B Building	1st Floor	Chemical Sodium Hypo.	Storage/24-hr	4	F42EE	72		0.288	SNAP	4	F42ILL-R	RL/RB	52	0.208	SNAP	0.08	8,760	701
67	B Building	1st Floor	Men's Room	Rest	2	I60/1	60		0.12	SNAP	2	CFQ15/1	B	20	0.04	1-WALL	0.08	52	4
68	B Building	1st Floor	Men's Room	Rest	1	F22SS	56		0.056	SNAP	1	F22ILL-R	RL/RB	29	0.029	1-WALL	0.03	52	1
69	B Building	1st Floor	Garage	Storage	1	F42EE	72		0.072	SNAP	1	F42ILL-R	RL/RB	52	0.052	SNAP	0.02	52	1
70	B Building	2nd Floor	Vestibule	Security/24-hr	2	F24SS	112		0.224	SNAP	2	F24ILL-R	RL/RB	55	0.11	SNAP	0.11	8,760	999
71	C BUILDING	2nd Floor	Stairwell 11	Stairs/24-hr	1	F42EE	72		0.072	SNAP	1	F42ILL-R	RL/RB	52	0.052	SNAP	0.02	8,760	175
72	C Building	"H" Structure	"H" Structure	Storage/24-hr	10	F42EE	72		0.72	SNAP	10	F42ILL-R	RL/RB	52	0.52	SNAP	0.20	8,760	1,752
73	C Building	"K" Structure	"K" Structure	Storage/24-hr	8	F42EE	72		0.576	SNAP	8	F42ILL-R	RL/RB	52	0.416	SNAP	0.16	8,760	1,402
74	C Building	"I" Building	"I" Building	Storage/24-hr	1	F41EE	43		0.043	SNAP	1	F41LL-R	RL/RB	27	0.027	SNAP	0.02	8,760	140
75	C Building	Basement	S Secondary Gallery	Storage/24-hr	7	F42EE	72		0.504	SNAP	7	F42ILL-R	RL/RB	52	0.364	SNAP	0.14	8,760	1,226
76	C Building	Basement	N Secondary Gallery	Storage/24-hr	4	F42EE	72		0.288	SNAP	4	F42ILL-R	RL/RB	52	0.208	SNAP	0.08	8,760	701
77	C Building	Basement	Secondary Gallery	Storage/24-hr	9	F42EE	72		0.648	SNAP	9	F42ILL-R	RL/RB	52	0.468	SNAP	0.18	8,760	1,577
78	C Building	Basement	Aeration Gallery	Storage/24-hr	10	F42EE	72		0.72	SNAP	10	F42ILL-R	RL/RB	52	0.52	SNAP	0.20	8,760	1,752
79	C Building	Basement	Primary Gallery	Storage/24-hr	7	F42EE	72		0.504	SNAP	7	F42ILL-R	RL/RB	52	0.364	SNAP	0.14	8,760	1,226
80	C Building	Basement	Compressor Room	Storage	7	F42EE	72		0.504	SNAP	7	F42ILL-R	RL/RB	52	0.364	1-WALL	0.14	52	7
81	C Building	Basement	Compressor Room	Storage/24-hr	1	F42EE	72		0.072	SNAP	1	F42ILL-R	RL/RB	52	0.052	SNAP	0.02	8,760	175
82	C Building	Basement	S Primary Gallery	Storage/24-hr	9	F42EE	72		0.648	SNAP	9	F42ILL-R	RL/RB	52	0.468	SNAP	0.18	8,760	1,577
83	C Building	Basement	Thick Sludge Pump	Storage/24-hr	8	F42EE	72		0.576	SNAP	8	F42ILL-R	RL/RB	52	0.416	SNAP	0.16	8,760	1,402
84	C Building	Basement	"F" Structure	Storage/24-hr	2	F42EE	72		0.144	SNAP	2	F42ILL-R	RL/RB	52	0.104	SNAP	0.04	8,760	350
85	C Building	Basement	N Primary Gallery	Storage/24-hr	13	F42EE	72		0.936	SNAP	13	F42ILL-R	RL/RB	52	0.676	SNAP	0.26	8,760	2,278
86	C Building	Basement	N Primary Gallery Stairs	Storage/24-hr	1	F42EE	72		0.072	SNAP	1	F42ILL-R	RL/RB	52	0.052	SNAP	0.02	8,760	175
87	C Building	Basement	Oxidize Sludge Room	Storage	11	F42EE	72		0.792	SNAP	11	F42ILL-R	RL/RB	52	0.572	SNAP	0.22	8,760	1,927

					PRE-INSTALLATION						POST-INSTALLATION								
Line Item	**Building**	**Floor**	**Area Description**	**Usage Group ID**	**Pre Fixt. No.**	**Pre Fixt. Code**	**Pre Watts/Fixt**	**NOP**	**Pre kW/Space**	**Exist Cont**	**Post Fixt No.**	**Post Fixt Code**		**Post Watts/ Fixt**	**Post kW/Space**	**Prop Cont**	**kW Saved**	**Annual Hours**	**Annual kWh Saved**
Integer identifying the line, beginning with one	Building Name	Building floor of the item	Unique description of the location that matches the site map	Descriptive name for the usage group	No. of fixtures before the retrofit	Code from Table of Standard Fixture Wattages	Value from Table of Standard Fixture Wattages	No. of non-operating (broken, intended for repair) fixtures	(Pre Watts/Fixt) * (Pre Fixt No.)	Pre-inst. control device	No. of fixtures after the retrofit	Code from Table of Standard Fixture Wattages	Scope Codes	Value from Table of Standard Fixture Wattages	(Post Watts/Fixt) * (Post Fixt No.)	Post-inst. control device	(Pre kW/Space) - (Post kW/Space)	Estimated annual hours for the usage group	(kW Saved) * (Annual Hours)
88	C Building	Basement	Elevator Machine Room	Storage	1	F42EE	72		0.072	SNAP	1	F42ILL-R	RL/RB	52	0.052	1-WALL	0.02	12	0
89	C Building	1st Floor	Truck Bay	Storage	2	I60/1	60		0.12	SNAP	2	CFQ15/1	B	20	0.04	SNAP	0.08	365	29
90	Blower Building	1st Floor	Blower Room	Storage	6	I200/1	200		1.2	SNAP	6	CFQ26/1	B	33	0.198	SNAP	1.00	12	12
91	Blower Building	1st Floor	Blower Room/Elec.	Storage	4	I200/1	200		0.8	SNAP	4	CFQ26/1	B	33	0.132	2-WALL	0.67	12	8
92	Blower Building	1st Floor	Blower Room Bathroom	Rest	1	I200/1	200		0.2	SNAP	1	CFQ26/1	B	33	0.033	1-WALL	0.17	12	2
93	Blower Building	1st Floor	MCC Room	Storage	2	F42EE	72		0.144	SNAP	2	F42ILL-R	RL/RB	52	0.104	1-WALL	0.04	52	2
94	Blower Building	1st Floor	Sidewalk	Prep	2	I60/1	60		0.12	SNAP	2	CFQ15/1	B	20	0.04	SNAP	0.08	12	1
	A Building	Sewer Garage	Sewer Crew Garage	Storage	5	MH250/1	295		1.475	SNAP	5	F44SIL	Fix	148	0.74	SNAP	0.74	2,920	2,146
	A Building	Garage	Maintenance Garage	Storage	10	MH250/1	295		2.95	SNAP	10	F44SIL	Fix	148	1.48	SNAP	1.47	2,920	4,292
	B Building	1st Floor	Sludge Process Room	Storage/24-hr	8	MH175/1	215		1.72	SNAP	8	F43ILL-V	Fix	112	0.896	SNAP	0.82	8,760	7,218
	B Building	1st Floor	Sludge Process Room	Storage	10	MH175/1	215		2.15	SNAP	10	F43ILL-V	Fix	112	1.12	SNAP	1.03	260	268
	B Building	1st Floor	Boiler Room	Storage/24-hr	10	MH175/1	215		2.15	SNAP	10	F43ILL-V	Fix	112	1.12	SNAP	1.03	8,760	9,023
	B Building	1st Floor	Chemical Storage SOUTH	Storage/24-hr	6	MH175/1	215		1.29	SNAP	6	F43ILL-V	Fix	112	0.672	SNAP	0.62	8,760	5,414
	B Building	1st Floor	Chemical Storage NORTH	Storage	6	MH175/1	215		1.29	SNAP	6	F43ILL-V	Fix	112	0.672	SNAP	0.62	52	32
	B Building	1st Floor	Garage /Chemical 2	Storage	6	MH175/1	215		1.29	SNAP	6	F43ILL-V	Fix	112	0.672	SNAP	0.62	52	32
	B Building	1st Floor	Garage	Storage	12	MH175/1	215		2.58	SNAP	12	F43ILL-V	Fix	112	1.344	SNAP	1.24	52	64
	B Building	2nd Floor	Mezzanine Filter Room	Office	18	MH175/1	215		3.87	SNAP	18	F43ILL-V	Fix	112	2.016	SNAP	1.85	12	22
	C Building	2nd Floor	Odor Control Room	Storage	5	MH250/1	295		1.475	SNAP	5	F44SIL	Fix	148	0.74	SNAP	0.74	5,824	4,281
	C Building	1st Floor	Screen Room	Storage/24-hr	18	MH250/1	295		5.31	SNAP	18	F44SIL	Fix	148	2.664	SNAP	2.65	8,760	23,179
	C Building	"I" Building	"I" Building	Storage/24-hr	14	MH250/1	295		4.13	SNAP	14	F44SIL	Fix	148	2.072	SNAP	2.06	8,760	18,028
	C Building	1st Floor	Truck Bay	Storage	7	MH150/1	190		1.33	SNAP	7	F43ILL-V	Fix	112	0.784	SNAP	0.55	365	199
	Blower Building	1st Floor	Sodium Hypo Chloride	Storage/24-hr	6	MH250/1	295		1.77	SNAP	6	F44SIL	Fix	148	0.888	SNAP	0.88	8,760	7,726
				TOTAL	**538.0**			**0.0**	**74.7**		**538.0**				**41.5**		**33.20**		**161,102**

NOP	0%

If NOPs are greater than 10%, NOPs must be subtracted from the baseline.

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
		Compact Fluorescent Fixtures				
CF10/2D	CFD10W	Compact Fluorescent, 2D, (1) 10W lamp	Mag-STD	1	10	16
CF11/1	CF11W	Compact Fluorescent, (1) 11W lamp	Mag-STD	1	11	13
CF11/2	CF11W	Compact Fluorescent, (2) 11W lamp	Mag-STD	2	11	26
CF16/2D	CFD16W	Compact Fluorescent, 2D, (1) 16W lamp	Mag-STD	1	16	26
CF18/3	CF18W	Compact Fluorescent, (3) 18W lamp	Electronic	3	18	60
CF21/2D	CFD21W	Compact Fluorescent, 2D, (1) 21W lamp	Mag-STD	1	21	26
CF23/1	CF23W	Compact Fluorescent, (1) 23W lamp	Electronic	1	23	25
CF26/4	CF26W	Compact Fluorescent, (4) 26W lamp	Electronic	4	26	108
CF26/8	CF26W	Compact Fluorescent, (8) 26W lamp	Electronic	8	26	216
CF28/2D	CFD28W	Compact Fluorescent, 2D, (1) 28W lamp	Mag-STD	1	28	35
CF32/3	CF32W	Compact Fluorescent, (3) 32W lamp	Electronic	3	32	114
CF32/4	CF32W	Compact Fluorescent, (4) 32W lamp	Electronic	4	32	152
CF32/6	CF32W	Compact Fluorescent, (6) 32W lamp	Electronic	6	32	228
CF32/8	CF32W	Compact Fluorescent, (8) 32W lamp	Electronic	8	32	304
CF38/2D	CFD38W	Compact Fluorescent, 2D, (1) 38W lamp	Mag-STD	1	38	46
CF42/1	CF42W	Compact Fluorescent, (1) 42W lamp	Electronic	1	42	48
CF42/2	CF42W	Compact Fluorescent, (2) 42W lamp	Electronic	2	42	100
CF42/3	CF42W	Compact Fluorescent, (3) 42W lamp	Electronic	3	42	141
CF42/4	CF42W	Compact Fluorescent, (4) 42W lamp	Electronic	4	42	188
CF42/6	CF42W	Compact Fluorescent, (6) 42W lamp	Electronic	6	42	282
CF42/8	CF42W	Compact Fluorescent, (8) 42W lamp	Electronic	8	42	376
CFQ10/1	CFQ10W	Compact Fluorescent, quad, (1) 10W lamp	Mag-STD	1	10	15
CFQ13/1	CFQ13W	Compact Fluorescent, quad, (1) 13W lamp	Mag-STD	1	13	17
CFQ13/1-L	CFQ13W	Compact Fluorescent, quad, (1) 13W lamp, BF=1.05	Electronic	1	13	15
CFQ13/2	CFQ13W	Compact Fluorescent, quad, (2) 13W lamp	Mag-STD	2	13	31
CFQ13/2-L	CFQ13W	Compact Fluorescent, quad, (2) 13W lamp, BF=1.0	Electronic	2	13	28
CFQ13/3	CFQ13W	Compact Fluorescent, quad, (3) 13W lamp	Mag-STD	3	13	48
CFQ15/1	CFQ15W	Compact Fluorescent, quad, (1) 15W lamp	Mag-STD	1	15	20
CFQ15/1-L	CFQ15W	Compact Fluorescent, quad, (1) 15W lamp	Electronic	1	15	15
CFQ17/1	CFQ17W	Compact Fluorescent, quad, (1) 17W lamp	Mag-STD	1	17	24
CFQ17/2	CFQ17W	Compact Fluorescent, quad, (2) 17W lamp	Mag-STD	2	17	48
CFQ18/1	CFQ18W	Compact Fluorescent, quad, (1) 18W lamp	Mag-STD	1	18	26
CFQ18/1-L	CFQ18W	Compact Fluorescent, quad, (1) 18W lamp, BF=1.0	Electronic	1	18	20
CFQ18/2	CFQ18W	Compact Fluorescent, quad, (2) 18W lamp	Mag-STD	2	18	45
CFQ18/2-L	CFQ18W	Compact Fluorescent, quad, (2) 18W lamp, BF=1.0	Electronic	2	18	38
CFQ18/4	CFQ18W	Compact Fluorescent, quad, (4) 18W lamp	Mag-STD	2	18	90
CFQ20/1	CFQ20W	Compact Fluorescent, quad, (1) 20W lamp	Mag-STD	1	20	23
CFQ20/2	CFQ20W	Compact Fluorescent, quad, (2) 20W lamp	Mag-STD	2	20	46
CFQ22/1	CFQ22W	Compact Fluorescent, quad, (1) 22W lamp	Mag-STD	1	22	24
CFQ22/2	CFQ22W	Compact Fluorescent, quad, (2) 22W lamp	Mag-STD	2	22	48
CFQ22/3	CFQ22W	Compact Fluorescent, quad, (3) 22W lamp	Mag-STD	3	22	72
CFQ25/1	CFQ25W	Compact Fluorescent, quad, (1) 25W lamp	Mag-STD	1	25	33
CFQ25/2	CFQ25W	Compact Fluorescent, quad, (2) 25W lamp	Mag-STD	2	25	66
CFQ26/1	CFQ26W	Compact Fluorescent, quad, (1) 26W lamp	Mag-STD	1	26	33
CFQ26/1-L	CFQ26W	Compact Fluorescent, quad, (1) 26W lamp, BF=0.95	Electronic	1	26	27
CFQ26/2	CFQ26W	Compact Fluorescent, quad, (2) 26W lamp	Mag-STD	2	26	66
CFQ26/2-L	CFQ26W	Compact Fluorescent, quad, (2) 26W lamp, BF=0.95	Electronic	2	26	50
CFQ26/3	CFQ26W	Compact Fluorescent, quad, (3) 26W lamp	Mag-STD	3	26	99
CFQ26/6-L	CFQ26W	Compact Fluorescent, quad, (6) 26W lamp, BF=0.95	Electronic	6	26	150
CFQ28/1	CFQ28W	Compact Fluorescent, quad, (1) 28W lamp	Mag-STD	1	28	33
CFQ9/1	CFQ9W	Compact Fluorescent, quad, (1) 9W lamp	Mag-STD	1	9	14
CFQ9/2	CFQ9W	Compact Fluorescent, quad, (2) 9W lamp	Mag-STD	2	9	23
CFT13/1	CFT13W	Compact Fluorescent, twin, (1) 13W lamp	Mag-STD	1	13	17
CFT13/2	CFT13W	Compact Fluorescent, twin, (2) 13W lamp	Mag-STD	2	13	31
CFT13/3	CFT13W	Compact Fluorescent, twin, (3) 13 W lamp	Mag-STD	3	13	48
CFT18/1	CFT18W	Compact Fluorescent, long twin., (1) 18W lamp	Mag-STD	1	18	24
CFT22/1	CFT22W	Compact Fluorescent, twin, (1) 22W lamp	Mag-STD	1	22	27
CFT22/2	CFT22W	Compact Fluorescent, twin, (2) 22W lamp	Mag-STD	2	22	54
CFT22/4	CFT22W	Compact Fluorescent, twin, (4) 22W lamp	Mag-STD	4	22	108

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
CFT24/1	CFT24W	Compact Fluorescent, long twin, (1) 24W lamp	Mag-STD	1	24	32
CFT28/1	CFT28W	Compact Fluorescent, twin, (1) 28W lamp	Mag-STD	1	28	33
CFT28/2	CFT28W	Compact Fluorescent, twin, (2) 28W lamp	Mag-STD	2	28	66
CFT32/1-L	CFM32W	Compact Fluorescent, twin or multi, (1) 32W lamp	Electronic	1	32	34
CFT32/2-L	CFM32W	Compact Fluorescent, twin or multi, (2) 32W lamp	Electronic	2	32	62
CFT32/6-L	CFM32W	Compact Fluorescent, twin or multi, (2) 32W lamp	Electronic	6	32	186
CFT36/1	CFT36W	Compact Fluorescent, long twin, (1) 36W lamp	Mag-STD	1	36	51
CFT36/4-BX	CFT36W	Compact Fluorescent, Biax, (4) 36W lamp	Electronic	4	36	148
CFT36/6-BX	CFT36W	Compact Fluorescent, Biax, (6) 36W lamp	Electronic	6	36	212
CFT36/6-L	CFT36W	Compact Fluorescent, long Twin, (6) 36W lamp	Electronic	6	36	198
CFT36/6-L	CFT36W	Compact Fluorescent, long Twin, (6) 36W lamp/ High Ballast Factor	Electronic	6	36	210
CFT36/8-BX	CFT36W	Compact Fluorescent, Biax, (8) 36W lamp	Electronic	8	36	296
CFT36/8-L	CFT36W	Compact Fluorescent, long Twin, (8) 36W lamp	Electronic	8	36	270
CFT36/8-L	CFT36W	Compact Fluorescent, long Twin, (8) 36W lamp/ High Ballast Factor	Electronic	8	36	286
CFT36/9-BX	CFT36W	Compact Fluorescent, Biax, (9) 36W lamp	Electronic	9	36	318
CFT40/1	CFT40W	Compact Fluorescent, twin, (1) 40W lamp	Mag-STD	1	40	46
CFT40/12-BX	CFT40W	Compact Fluorescent, Biax, (12) 40W lamp	Electronic	12	40	408
CFT40/1-BX	CFT40W	Compact Fluorescent, Biax, (1) 40W lamp	Electronic	1	40	46
CFT40/1-L	CFT40W	Compact Fluorescent, long twin, (1) 40W lamp	Electronic	1	40	43
CFT40/2	CFT40W	Compact Fluorescent, twin, (2) 40W lamp	Mag-STD	2	40	85
CFT40/2-BX	CFT40W	Compact Fluorescent, Biax, (2) 40W lamp	Electronic	2	40	72
CFT40/2-L	CFT40W	Compact Fluorescent, long twin, (2) 40W lamp	Electronic	2	40	72
CFT40/3	CFT40W	Compact Fluorescent, twin, (3) 40 W lamp	Mag-STD	3	40	133
CFT40/3-BX	CFT40W	Compact Fluorescent, Biax, (3) 40W lamp	Electronic	3	40	102
CFT40/3-L	CFT40W	Compact Fluorescent, long twin, (3) 40W lamp	Electronic	3	40	105
CFT40/4-BX	CFT40W	Compact Fluorescent, Biax, (4) 40W lamp	Electronic	4	40	144
CFT40/5-BX	CFT40W	Compact Fluorescent, Biax, (5) 40W lamp	Electronic	5	40	190
CFT40/6-BX	CFT40W	Compact Fluorescent, Biax, (6) 40W lamp	Electronic	6	40	204
CFT40/6-L	CFT40W	Compact Fluorescent, long Twin, (6) 40W lamp	Electronic	6	40	220
CFT40/6-L	CFT40W	Compact Fluorescent, long Twin, (6) 40W lamp/ High Ballast Factor	Electronic	6	40	233
CFT40/8-BX	CFT40W	Compact Fluorescent, Biax, (8) 40W lamp	Electronic	8	40	288
CFT40/8-L	CFT40W	Compact Fluorescent, long Twin, (8) 40W lamp	Electronic	8	40	300
CFT40/8-L	CFT40W	Compact Fluorescent, long Twin, (8) 40W lamp/ High Ballast Factor	Electronic	8	40	340
CFT40/9-BX	CFT40W	Compact Fluorescent, Biax, (9) 40W lamp	Electronic	9	40	306
CFT5/1	CFT5W	Compact Fluorescent, twin, (1) 5W lamp	Mag-STD	1	5	9
CFT5/2	CFT5W	Compact Fluorescent, twin, (2) 5W lamp	Mag-STD	2	5	18
CFT50/12-BX	CFT50W	Compact Fluorescent, Biax, (12) 50W lamp	Electronic	12	50	648
CFT50/1-BX	CFT50W	Compact Fluorescent, Biax, (1) 50W lamp	Electronic	1	50	54
CFT50/2-BX	CFT50W	Compact Fluorescent, Biax, (2) 50W lamp	Electronic	2	50	108
CFT50/3-BX	CFT50W	Compact Fluorescent, Biax, (3) 50W lamp	Electronic	3	50	162
CFT50/4-BX	CFT50W	Compact Fluorescent, Biax, (4) 50W lamp	Electronic	4	50	216
CFT50/5-BX	CFT50W	Compact Fluorescent, Biax, (5) 50W lamp	Electronic	5	50	270
CFT50/6-BX	CFT50W	Compact Fluorescent, Biax, (6) 50W lamp	Electronic	6	50	324
CFT50/8-BX	CFT50W	Compact Fluorescent, Biax, (8) 50W lamp	Electronic	8	50	432
CFT50/9-BX	CFT50W	Compact Fluorescent, Biax, (9) 50W lamp	Electronic	9	50	486
CFT55/12-BX	CFT55W	Compact Fluorescent, Biax, (12) 55W lamp	Electronic	12	55	672
CFT55/2-BX	CFT55W	Compact Fluorescent, Biax, (2) 55W lamp	Electronic	2	55	112
CFT55/3-BX	CFT55W	Compact Fluorescent, Biax, (3) 55W lamp	Electronic	3	55	168
CFT55/4-BX	CFT55W	Compact Fluorescent, Biax, (4) 55W lamp	Electronic	4	55	224
CFT55/5-BX	CFT55W	Compact Fluorescent, Biax, (5) 55W lamp	Electronic	5	55	280
CFT55/6-BX	CFT55W	Compact Fluorescent, Biax, (6) 55W lamp	Electronic	6	55	336
CFT55/6-L	CFT55W	Compact Fluorescent, long Twin, (6) 55W lamp	Electronic	6	55	352
CFT55/6-L	CFT55W	Compact Fluorescent, long Twin, (6) 55W lamp/ High Ballast Factor	Electronic	6	55	373
CFT55/8-BX	CFT55W	Compact Fluorescent, Biax, (8) 55W lamp	Electronic	8	55	448
CFT55/8-L	CFT55W	Compact Fluorescent, long Twin, (8) 55W lamp	Electronic	8	55	468
CFT55/8-L	CFT55W	Compact Fluorescent, long Twin, (8) 55W lamp/ High Ballast Factor	Electronic	8	55	496
CFT55/9-BX	CFT55W	Compact Fluorescent, Biax, (9) 55W lamp	Electronic	9	55	504
CFT7/1	CFT7W	Compact Fluorescent, twin, (1) 7W lamp	Mag-STD	1	7	10
CFT7/2	CFT7W	Compact Fluorescent, twin, (2) 7W lamp	Mag-STD	2	7	21
CFT9/1	CFT9W	Compact Fluorescent, twin, (1) 9W lamp	Mag-STD	1	9	11

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
CFT9/2	CFT9W	Compact Fluorescent, twin, (2) 9W lamp	Mag-STD	2	9	23
CFT9/3	CFT9W	Compact Fluorescent, twin, (3) 9W lamp	Mag-STD	3	9	34
		EXIT Sign Fixtures				
ECF5/1	CFT5W	EXIT Compact Fluorescent, (1) 5W lamp	Mag-STD	1	5	9
ECF5/2	CFT5W	EXIT Compact Fluorescent, (2) 5W lamp	Mag-STD	2	5	20
ECF7/1	CFT7W	EXIT Compact Fluorescent, (1) 7W lamp	Mag-STD	1	7	10
ECF7/2	CFT7W	EXIT Compact Fluorescent, (2) 7W lamp	Mag-STD	2	7	21
ECF8/1	F8T5	EXIT T5 Fluorescent, (1) 8W lamp	Mag-STD	1	8	12
ECF8/2	F8T5	EXIT T5 Fluorescent, (2) 8W lamp	Mag-STD	2	8	24
ECF9/1	CFT9W	EXIT Compact Fluorescent, (1) 9W lamp	Mag-STD	1	9	12
ECF9/2	CFT9W	EXIT Compact Fluorescent, (2) 9W lamp	Mag-STD	2	9	20
EI10/2	I10	EXIT Incandescent, (2) 10W lamp		2	10	20
EI15/1	I15	EXIT Incandescent, (1) 15W lamp		1	15	15
EI15/2	I15	EXIT Incandescent, (2) 15W lamp		2	15	30
EI20/1	I20	EXIT Incandescent, (1) 20W lamp		1	20	20
EI20/2	I20	EXIT Incandescent, (2) 20W lamp		2	20	40
EI25/1	I25	EXIT Incandescent, (1) 25W lamp		1	25	25
EI25/2	I25	EXIT Incandescent, (2) 25W lamp		2	25	50
EI34/1	I34	EXIT Incandescent, (1) 34W lamp		1	34	34
EI34/2	I34	EXIT Incandescent, (2) 34W lamp		2	34	68
EI40/1	I40	EXIT Incandescent, (1) 40W lamp		1	40	40
EI40/2	I40	EXIT Incandescent, (2) 40W lamp		2	40	80
EI5/1	I5	EXIT Incandescent, (1) 5W lamp		1	5	5
EI5/2	I5	EXIT Incandescent, (2) 5W lamp		2	5	10
EI50/2	I50	EXIT Incandescent, (2) 50W lamp		2	50	100
EI7.5/1	I7.5	EXIT Tungsten, (1) 7.5 W lamp		1	7.5	8
EI7.5/2	I7.5	EXIT Tungsten, (2) 7.5 W lamp		2	7.5	15
ELED0.5/1	LED0.5W	EXIT Light Emmitting Diode, (1) 0.5W lamp, Single Sided		1	0.5	0.5
ELED0.5/2	LED0.5W	EXIT Light Emmitting Diode, (2) 0.5W lamp, Dual Sided		2	0.5	1
ELED1.5/1	LED1.5W	EXIT Light Emmitting Diode, (1) 1.5W lamp, Single Sided		1	1.5	1.5
ELED1.5/2	LED1.5W	EXIT Light Emmitting Diode, (2) 1.5W lamp, Dual Sided		2	1.5	3
ELED10.5/1	LED10.5W	EXIT Light Emmitting Diode, (1) 10.5W lamp, Single Sided		1	10.5	10.5
ELED10.5/2	LED10.5W	EXIT Light Emmitting Diode, (2) 10.5W lamp, Dual Sided		2	10.5	21
ELED2/1	LED2W	EXIT Light Emmitting Diode, (1) 2W lamp, Single Sided		1	2	2
ELED2/2	LED2W	EXIT Light Emmitting Diode, (2) 2W lamp, Dual Sided		2	2	4
ELED3/1	LED3W	EXIT Light Emmitting Diode, (1) 3W lamp, Single Sided		1	3	3
ELED3/2	LED3W	EXIT Light Emmitting Diode, (2) 3W lamp, Dual Sided		2	3	6
ELED5/1	LED5W	EXIT Light Emmitting Diode, (1) 5W lamp, Single Sided		1	5	5
ELED5/2	LED5W	EXIT Light Emmitting Diode, (2) 5W lamp, Dual Sided		2	5	10
ELED8/1	LED8W	EXIT Light Emmitting Diode, (1) 8W lamp, Single Sided		1	8	8
ELED8/2	LED8W	EXIT Light Emmitting Diode, (2) 8W lamp, Dual Sided		2	8	16
		Linear Fluorescent Fixtures				
F1.51LS	F15T8	Fluorescent, (1) 18" T8 lamp	Mag-STD	1	15	19
F1.51SS	F15T12	Fluorescent, (1) 18" T12 lamp	Mag-STD	1	15	19
F1.52LS	F15T8	Fluorescent, (2) 18" T8 lamp	Mag-STD	2	15	36
F1.52SS	F15T12	Fluorescent, (2) 18", T12 lamp	Mag-STD	2	15	36
F21HS	F24T12/HO	Fluorescent, (1) 24", HO lamp	Mag-STD	1	35	62
F21ILL-RL	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast,LOW WATT (ADVANCE OPTIANIUM)	Electronic	1	17	17
F21ILL	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	1	17	20
F21ILL/T2	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	17	17
F21ILL/T2-R	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, RLO (BF<.85), Tandem 2 Lamp Ballast	Electronic	1	17	15
F21ILL/T3	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 3 Lamp Ballast	Electronic	1	17	16
F21ILL/T3-R	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, RLO (BF<.85), Tandem 3 Lamp Ballast	Electronic	1	17	14
F21ILL/T4	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	1	17	15
F21ILL/T4-R	F17T8	Fluorescent, (1) 24", T-8 lamp, Instant Start Ballast, RLO (BF<.85), Tandem 4 Lamp Ballast	Electronic	1	17	14
F21LL	F17T8	Fluorescent, (1) 24", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	1	17	16
F21LL/T2	F17T8	Fluorescent, (1) 24", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	17	16
F21LL/T3	F17T8	Fluorescent, (1) 24", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 3 Lamp Ballast	Electronic	1	17	17
F21LL-RL	F17T8	Fluorescent, (1) 24", T-8 lamp, Rapid Start Ballast,LOW WATT (ADVANCE OPTIANIUM)	Electronic	1	17	15
F21LL-R	F17T8	Fluorescent, (1) 24", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	1	17	15

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
F21LS	F17T8	Fluorescent, (1) 24", T8 lamp, Standard Ballast	Mag-STD	1	17	24
F21SS	F20T12	Fluorescent, (1) 24", STD lamp	Mag-STD	1	20	28
F22HS	F24T12/HO	Fluorescent, (2) 24", HO lamp	Mag-STD	2	35	90
F22ILE	F17T8	Fluorescent, (2) 24", T-8 Instant Start lamp, Energy Saving Magnetic Ballast	Mag-ES	2	17	45
F22ILL	F17T8	Fluorescent, (2) 24", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	2	17	33
F22ILL/T4	F17T8	Fluorescent, (2) 24", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	2	17	31
F22ILL/T4-R	F17T8	Fluorescent, (2) 24", T-8 lamp, Instant Start Ballast, RLO (BF<.85), Tandem 4 Lamp Ballast	Electronic	2	17	28
F22ILL-RL	F17T8	Fluorescent, (2) 24", T-8 lamp, Instant Start Ballast,LOW WATT(ADVANCE OPTIANIUM)	Electronic	2	17	27
F22ILL-R	F17T8	Fluorescent, (2) 24", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	2	17	29
F22LL	F17T8	Fluorescent, (2) 24", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	2	17	31
F22LL/T4	F17T8	Fluorescent, (2) 24", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	2	17	34
F22LL-R	F17T8	Fluorescent, (2) 24", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	2	17	28
F22SS	F20T12	Fluorescent, (2) 24", STD lamp	Mag-STD	2	20	56
F23ILL	F17T8	Fluorescent, (3) 24", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	3	17	47
F23ILL-H	F17T8	Fluorescent, (3) 24", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1)	Electronic	3	17	49
F23ILL-R	F17T8	Fluorescent, (3) 24", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	3	17	43
F23LL	F17T8	Fluorescent, (3) 24", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	3	17	52
F23LL-R	F17T8	Fluorescent, (3) 24", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	3	17	41
F23SS	F20T12	Fluorescent, (3) 24", STD lamp	Mag-STD	3	20	62
F24ILL	F17T8	Fluorescent, (4) 24", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	4	17	61
F24ILL-R	F17T8	Fluorescent, (4) 24", T-8 lamp, Instant Start Ballast,LOW WATT (ADVANCE OPTIANIUM)	Electronic	4	17	50
F24ILL-R	F17T8	Fluorescent, (4) 24", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	4	17	55
F24LL	F17T8	Fluorescent, (4) 24", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	4	17	68
F24LL-R	F17T8	Fluorescent, (4) 24", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	4	17	57
F24SS	F20T12	Fluorescent, (4) 24", STD lamp	Mag-STD	4	20	112
F26SS	F20T12	Fluorescent, (6) 24", STD lamp	Mag-STD	6	20	146
F31EE	F30T12/ES	Fluorescent, (1) 36", ES lamp	Mag-ES	1	25	38
F31EE/T2	F30T12/ES	Fluorescent, (1) 36", ES lamp, Tandem wired	Mag-ES	1	25	33
F31EL	F30T12/ES	Fluorescent, (1) 36", ES lamp	Electronic	1	25	26
F31ES	F30T12/ES	Fluorescent, (1) 36", ES lamp	Mag-STD	1	25	42
F31ES/T2	F30T12/ES	Fluorescent, (1) 36", ES lamp, Tandem wired	Mag-STD	1	25	37
F31ILL	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	1	25	26
F31ILL/T2	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	25	23
F31ILL/T2-H	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, HLO (BF: .96-1.1), Tandem 2 Lamp Ballast	Electronic	1	25	24
F31ILL/T2-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, RLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	25	23
F31ILL/T3	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 3 Lamp Ballast	Electronic	1	25	22
F31ILL/T3-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, RLO (BF<.85), Tandem 3 Lamp Ballast	Electronic	1	25	22
F31ILL/T4	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	1	25	22
F31ILL/T4-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, RLO (BF<.85), Tandem 4 Lamp Ballast	Electronic	1	25	22
F31ILL-H	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1)	Electronic	1	25	28
F31ILL-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	1	25	27
F31LL	F25T8	Fluorescent, (1) 36", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	1	25	24
F31LL/T2	F25T8	Fluorescent, (1) 36", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	25	23
F31LL/T3	F25T8	Fluorescent, (1) 36", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 3 Lamp Ballast	Electronic	1	25	24
F31LL/T4	F25T8	Fluorescent, (1) 36", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	1	25	22
F31LL-H	F25T8	Fluorescent, (1) 36", T-8 lamp, Rapid Start Ballast, HLO (BF:.96-1.1)	Electronic	1	25	26
F31LL-R	F25T8	Fluorescent, (1) 36", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	1	25	23
F31SE/T2	F30T12	Fluorescent, (1) 36", STD lamp, Tandem wired	Mag-ES	1	30	37
F31GHL	F36T5/HO	Fluorescent, (1) 36", STD HO T5 lamp	Electronic	1	39	43
F31SHS	F36T12/HO	Fluorescent, (1) 36", HO lamp	Mag-STD	1	50	70
F31SL	F30T12	Fluorescent, (1) 36", STD lamp	Electronic	1	30	31
F31GL	F36T5	Fluorescent, (1) 36", STD T5 lamp	Electronic	1	21	27
F31SS	F30T12	Fluorescent, (1) 36", STD lamp	Mag-STD	1	30	46
F31SS/T2	F30T12	Fluorescent, (1) 36", STD lamp, Tandem wired	Mag-STD	1	30	41
F32EE	F30T12/ES	Fluorescent, (2) 36", ES lamp	Mag-ES	2	25	66
F32EL	F30T12/ES	Fluorescent, (2) 36", ES lamp	Electronic	2	25	50
F32ES	F30T12/ES	Fluorescent, (2) 36", ES lamp	Mag-STD	2	25	73
F32ILL	F25T8	Fluorescent, (2) 36", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	2	25	46
F32ILL/T4	F25T8	Fluorescent, (2) 36", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	2	25	44
F32ILL/T4-R	F25T8	Fluorescent, (2) 36", T-8 lamp, Instant Start Ballast, RLO (BF<.85), Tandem 4 Lamp Ballast	Electronic	2	25	43

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
F32ILL-H	F25T8	Fluorescent, (2) 36", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1)	Electronic	2	25	48
F32ILL-R	F25T8	Fluorescent, (2) 36", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	2	25	46
F32LL	F25T8	Fluorescent, (2) 36", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	2	25	46
F32LL/T4	F25T8	Fluorescent, (2) 36", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	2	25	45
F32LL-H	F25T8	Fluorescent, (2) 36", T-8 lamp, Rapid Start Ballast, HLO (BF:.96-1.1)	Electronic	2	25	50
F32LL-R	F25T8	Fluorescent, (2) 36", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	2	25	42
F32LL-V	F25T8	Fluorescent, (2) 36", T-8 lamp, Rapid Start Ballast, VHLO (BF>1.1)	Electronic	2	25	70
F32SE	F30T12	Fluorescent, (2) 36", STD lamp	Mag-ES	2	30	74
F32GHL	F36T5/HO	Fluorescent, (2) 36", STD HO T5 lamp	Electronic	2	39	85
F32SHS	F36T12/HO	Fluorescent, (2) 36", HO, lamp	Mag-STD	2	50	114
F32SL	F30T12	Fluorescent, (2) 36", STD lamp	Electronic	2	30	58
F32GL	F36T5	Fluorescent, (2) 36", STD T5 lamp	Electronic	2	21	52
F32SS	F30T12	Fluorescent, (2) 36", STD lamp	Mag-STD	2	30	81
F33ES	F30T12/ES	Fluorescent, (3) 36", ES lamp	Mag-STD	3	25	115
F33ILL	F25T8	Fluorescent, (3) 36", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	3	25	67
F33ILL-R	F25T8	Fluorescent, (3) 36", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	3	25	66
F33LL	F25T8	Fluorescent, (3) 36", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	3	25	72
F33LL-R	F25T8	Fluorescent, (3) 36", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	3	25	62
F33SE	F30T12	Fluorescent, (3) 36", STD lamp, (1) STD ballast and (1) ES ballast	Mag-ES	3	30	120
F33SS	F30T12	Fluorescent, (3) 36", STD lamp	Mag-STD	3	30	127
F34ILL	F25T8	Fluorescent, (4) 36", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	4	25	87
F34ILL-R	F25T8	Fluorescent, (4) 36", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	4	25	86
F34LL	F25T8	Fluorescent, (4) 36", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	4	25	89
F34LL-R	F25T8	Fluorescent, (4) 36", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	4	25	84
F34SE	F30T12	Fluorescent, (4) 36", STD lamp	Mag-ES	4	30	148
F34SL	F30T12	Fluorescent, (4) 36", STD lamp	Electronic	4	30	116
F34SS	F30T12	Fluorescent, (4) 36", STD lamp	Mag-STD	4	30	162
F36EE	F30T12/ES	Fluorescent, (6) 36", ES lamp	Mag-ES	6	25	198
F36ILL-R	F25T8	Fluorescent, (6) 36", T-8 lamp, Instant Start Ballast, RLO (BF<.85)	Electronic	6	25	134
F36SE	F30T12	Fluorescent, (6) 36", STD lamp	Mag-ES	6	30	238
F40EE/D1	None	Fluorescent, (0) 48" lamp, Completely delamped fixture with (1) hot ballast	Mag-ES	0	0	4
F40EE/D2	None	Fluorescent, (0) 48" lamp, Completely delamped fixture with (2) hot ballast	Mag-ES	0	0	8
F41EE	F40T12/ES	Fluorescent, (1) 48", ES lamp	Mag-ES	1	34	43
F41EE/D2	F40T12/ES	Fluorescent, (1) 48", ES lamp, 2 ballast	Mag-ES	1	34	43
F41EE/T2	F40T12/ES	Fluorescent, (1) 48", ES lamp, tandem wired, 2-lamp ballast	Mag-ES	1	34	36
F41EHS	F48T12/HO/ES	Fluorescent, (1) 48", ES HO lamp	Mag-STD	1	55	80
F41EIS	F48T12/ES	Fluorescent, (1) 48" ES Instant Start lamp. Magnetic ballast	Mag-STD	1	30	51
F41EL	F40T12/ES	Fluorescent, (1) 48", T12 ES lamp, Electronic Ballast	Electronic	1	34	32
F41EL/T2	F40T12/ES	Fluorescent, (1) 48", T-12 ES lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	34	32
F41ES	F40T12/ES	Fluorescent, (1) 48", ES lamp	Mag-STD	1	34	50
F41EVS	F48T12/VHO/ES	Fluorescent, (1) 48", VHO ES lamp	Mag-STD	1		123
F41IAL	F25T12	Fluorescent, (1) 48", F25T12 lamp, Instant Start Ballast	Electronic	1	25	25
F41IAL/T2-R	F25T12	Fluorescent, (1) 48", F25T12 lamp, Instant Start, Tandem 2-Lamp Ballast, RLO (BF<0.85)	Electronic	1	25	19
F41IAL/T3-R	F25T12	Fluorescent, (1) 48", F25T12 lamp, Instant Start, Tandem 3-Lamp Ballast, RLO (BF<0.85)	Electronic	1	25	20
F41ILL-RL	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast,LOW WATT (ADVANCE OPTIANIUM)	Electronic	1	32	30
F41ILL-RLLW	F32T8/XEW	(1) 48", T-8 25 WATTS lamp, Instant Start Ballast,Low Watt (ADVANCE OPTANIUM)	Electronic	1	25	23
F41ILL	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	1	32	31
F41ILL/T2	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	32	30
F41ILL/T2-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1), Tandem 4 Lamp Ballast	Electronic	1	32	33
F41ILL/T2-R	F32T8	Fluorescent, (1) 48", T-8 lamp, IS Ballast, RLO (BF<0.85), Tandem 2 Lamp Ballast	Electronic	1	32	26
F41ILL/T3	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 3 Lamp Ballast	Electronic	1	32	30
F41ILL/T3-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1), Tandem 4 Lamp Ballast	Electronic	1	32	31
F41ILL/T3-R	F32T8	Fluorescent, (1) 48", T-8 lamp, IS Ballast, RLO (BF<0.85), Tandem 3 Lamp Ballast	Electronic	1	32	26
F41ILL/T4	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	1	32	28
F41ILL/T4-R	F32T8	Fluorescent, (1) 48", T-8 lamp, IS Ballast, RLO (BF<0.85), Tandem 4 Lamp Ballast	Electronic	1	32	26
F41ILL-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1)	Electronic	1	32	36
F41LE	F32T8	Fluorescent, (1) 48", T-8 lamp	Mag-ES	1	32	35
F41LL	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	1	32	32
F41LL/T2	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	32	30
F41LL/T2-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, HLO (BF:.96-1.1), Tandem 2 Lamp Ballast	Electronic	1	32	39

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
F41LL/T2-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85), Tandem 2 Lamp Ballast	Electronic	1	32	27
F41LL/T3	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 3 Lamp Ballast	Electronic	1	32	31
F41LL/T3-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, HLO (BF:.96-1.1), Tandem 3 Lamp Ballast	Electronic	1	32	33
F41LL/T3-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85), Tandem 3 Lamp Ballast	Electronic	1	32	25
F41LL/T4	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	1	32	30
F41LL/T4-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85), Tandem 4 Lamp Ballast	Electronic	1	32	26
F41LL-H	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, HLO (BF:.96-1.1)	Electronic	1	32	39
F41LL-R	F32T8	Fluorescent, (1) 48", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	1	32	27
F41SE	F40T12	Fluorescent, (1) 48", STD lamp	Mag-ES	1	40	50
F41GHL	F48T5/HO	Fluorescent, (1) 48", STD HO T5 lamp	Electronic	1	54	59
F41SHS	F48T12/HO	Fluorescent, (1) 48", STD HO lamp	Mag-STD	1	60	85
F41SIL	F48T12	Fluorescent, (1) 48", STD IS lamp, Electronic ballast	Electronic	1	39	46
F41SIL/T2	F48T12	Fluorescent, (1) 48", STD IS lamp, Electronic ballast, tandem wired	Electronic	1	39	37
F41SIS	F48T12	Fluorescent, (1) 48", STD IS lamp	Mag-STD	1	39	60
F41SIS/T2	F48T12	Fluorescent, (1) 48", STD IS lamp, tandem to 2-lamp ballast	Mag-STD	1	39	52
F41GL	F48T5	Fluorescent, (1) 48", STD T5 lamp	Electronic	1	28	32
F41SL/T2	F40T12	Fluorescent, (1) 48", T-12 STD lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	40	36
F41SS	F40T12	Fluorescent, (1) 48", STD lamp	Mag-STD	1	40	57
F41SVS	F48T12/VHO	Fluorescent, (1) 48", STD VHO lamp	Mag-STD	1	110	135
F41TS	F40T10	Fluorescent, (1) 48", T-10 lamp	Mag-STD	1	40	51
F42EE	F40T12/ES	Fluorescent, (2) 48", ES lamp	Mag-ES	2	34	72
F42EE/D2	F40T12/ES	Fluorescent, (2) 48", ES lamp, 2 Ballasts (delamped)	Mag-ES	2	34	76
F42EHS	F48T12/HO/ES	Fluorescent, (2) 42", HO lamp (3.5' lamp)	Mag-STD	2	55	135
F42EIS	F48T12/ES	Fluorescent, (2) 48" ES Instant Start lamp. Magnetic ballast	Mag-STD	2	30	82
F42EL	F40T12/ES	Fluorescent, (2) 48", T12 ES lamps, Electronic Ballast	Electronic	2	34	60
F42ES	F40T12/ES	Fluorescent, (2) 48", ES lamp	Mag-STD	2	34	80
F42EVS	F48T12/VHO/ES	Fluorescent, (2) 48", VHO ES lamp	Mag-STD	2		210
F42IAL/T4-R	F25T12	Fluorescent, (2) 48", F25T12 lamp, Instant Start, Tandem 4-Lamp Ballast, RLO (BF<0.85)	Electronic	2	25	40
F42IAL-R	F25T12	Fluorescent, (2) 48", F25T12 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	2	25	39
F42ILL	F32T8	Fluorescent, (2) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	2	32	59
F42ILL/T4	F32T8	Fluorescent, (2) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	2	32	56
F42ILL/T4-R	F32T8	Fluorescent, (2) 48", T-8 lamp, Instant Start Ballast, RLO (BF<0.85), Tandem 4 Lamp Ballast	Electronic	2	32	51
F42ILL-H	F32T8	Fluorescent, (2) 48", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1)	Electronic	2	32	65
F42ILL-RL	F32T8	Fluorescent, (2) 48", T-8 lamp, Instant Start Ballast,Low Watt (ADVANCE OPTANIUM)	Electronic	2	32	48
F42ILL-RLLW	F32T8/XEW	(2) 48", T-8 25 WATTS lamp, Instant Start Ballast,Low Watt (ADVANCE OPTANIUM)	Electronic	2	25	34
F42ILL-R	F32T8	Fluorescent, (2) 48", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	2	32	52
F42ILL-V	F32T8	Fluorescent, (2) 48", T-8 lamp, Instant Start Ballast, VHLO (BF>1.1)	Electronic	2	32	79
F42LE	F32T8	Fluorescent, (2) 48", T-8 lamp	Mag-ES	2	32	71
F42LL	F32T8	Fluorescent, (2) 48", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	2	32	60
F42LL/T4	F32T8	Fluorescent, (2) 48", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	2	32	59
F42LL/T4-R	F32T8	Fluorescent, (2) 48", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85), Tandem 4 Lamp Ballast	Electronic	2	32	53
F42LL-H	F32T8	Fluorescent, (2) 48", T-8 lamp, Rapid Start Ballast, HLO (BF:.96-1.1)	Electronic	2	32	70
F42LL-R	F32T8	Fluorescent, (2) 48", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	2	32	54
F42LL-V	F32T8	Fluorescent, (2) 48", T-8 lamp, Rapid Start Ballast, VHLO (BF>1.1)	Electronic	2	32	85
F42SE	F40T12	Fluorescent, (2) 48", STD lamp	Mag-ES	2	40	86
F42GHL	F48T5/HO	Fluorescent, (2) 48", STD HO T5 lamp	Electronic	2	54	117
F42SHS	F48T12/HO	Fluorescent, (2) 48", STD HO lamp	Mag-STD	2	60	145
F42SIL	F48T12	Fluorescent, (2) 48", STD IS lamp, Electronic ballast	Electronic	2	39	74
F42SIS	F48T12	Fluorescent, (2) 48", STD IS lamp	Mag-STD	2	39	103
F42GL	F48T5	Fluorescent, (2) 48", STD T5 lamp	Electronic	2	28	63
F42SS	F40T12	Fluorescent, (2) 48", STD lamp	Mag-STD	2	40	94
F42SVS	F48T12/VHO	Fluorescent, (2) 48", STD VHO lamp	Mag-STD	2	110	242
F43EE	F40T12/ES	Fluorescent, (3) 48", ES lamp	Mag-ES	3	34	115
F43EHS	F48T12/HO/ES	Fluorescent, (3) 48", ES HO lamp (3.5' lamp)	Mag-STD	3	55	215
F43EIS	F48T12/ES	Fluorescent, (3) 48" ES Instant Start lamp. Magnetic ballast	Mag-STD	3	30	133
F43EL	F40T12/ES	Fluorescent, (3) 48", T12 ES lamps, Electronic Ballast	Electronic	3	34	92
F43ES	F40T12/ES	Fluorescent, (3) 48", ES lamp	Mag-STD	3	34	130
F43EVS	F48T12/VHO/ES	Fluorescent, (3) 48", VHO ES lamp	Mag-STD	3		333
F43IAL-R	F25T12	Fluorescent, (3) 48", F25T12 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	3	25	60
F43ILL	F32T8	Fluorescent, (3) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	3	32	89

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
F43ILL/2	F32T8	Fluorescent, (3) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), (2) ballast	Electronic	3	32	90
F43ILL-H	F32T8	Fluorescent, (3) 48", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1)	Electronic	3	32	93
F43ILL-R	F32T8	Fluorescent, (3) 48", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	3	32	78
F43ILL-V	F32T8	Fluorescent, (3) 48", T-8 lamp, Instant Start Ballast, VHLO (BF>1.1)	Electronic	3	32	112
F43LE	F32T8	Fluorescent, (3) 48", T-8 lamp	Mag-ES	3	32	110
F43LL	F32T8	Fluorescent, (3) 48", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	3	32	93
F43LL/2	F32T8	Fluorescent, (3) 48", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), (2) ballast	Electronic	3	32	92
F43LL-H	F32T8	Fluorescent, (3) 48", T-8 lamp, Rapid Start Ballast, HLO (BF:.96-1.1)	Electronic	3	32	98
F43LL-R	F32T8	Fluorescent, (3) 48", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	3	32	76
F43SE	F40T12	Fluorescent, (3) 48", STD lamp	Mag-ES	3	40	136
F43GHL	F48T5/HO	Fluorescent, (3) 48", STD HO T5 lamp	Electronic	3	54	177
F43SHS	F48T12/HO	Fluorescent, (3) 48", STD HO lamp	Mag-STD	3	60	230
F43SIL	F40T12	Fluorescent, (3) 48", STD IS lamp, Electronic ballast	Electronic	3	39	120
F43SIS	F48T12	Fluorescent, (3) 48", STD IS lamp	Mag-STD	3	39	162
F43SS	F40T12	Fluorescent, (3) 48", STD lamp	Mag-STD	3	40	151
F43SVS	F48T12/VHO	Fluorescent, (3) 48", STD VHO lamp	Mag-STD	3	110	377
F44EE	F40T12/ES	Fluorescent, (4) 48", ES lamp	Mag-ES	4	34	144
F44EE/D4	F40T12/ES	Fluorescent, (4) 48", ES lamp, 4 Ballasts (delamped)	Mag-ES	4	34	152
F44EHS	F48T12/HO/ES	Fluorescent, (4) 48", ES HO lamp	Mag-STD	4	55	270
F44EIS	F48T12/ES	Fluorescent, (4) 48" ES Instant Start lamp, Magnetic ballast	Mag-STD	4	30	164
F44EL	F40T12/ES	Fluorescent, (4) 48", T12 ES lamps, Electronic Ballast	Electronic	4	34	120
F44ES	F40T12/ES	Fluorescent, (4) 48", ES lamp	Mag-STD	4	34	160
F44EVS	F48T12/VHO/ES	Fluorescent, (4) 48", VHO ES lamp	Mag-STD	4		420
F44IAL-R	F25T12	Fluorescent, (4) 48", F25T12 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	4	25	80
F44ILL	F32T8	Fluorescent, (4) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	4	32	112
F44ILL/2	F32T8	Fluorescent, (4) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), (2) ballast	Electronic	4	32	118
F44ILL-RL	F32T8	Fluorescent, (4) 48", T-8 lamp, Instant Start Ballast,LOW WATT ADVANCE OPTIANIUM)	Electronic	4	32	96
F44ILL-R	F32T8	Fluorescent, (4) 48", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	4	32	102
F44LE	F32T8	Fluorescent, (4) 48", T-8 lamp	Mag-ES	4	32	142
F44LL	F32T8	Fluorescent, (4) 48", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95)	Electronic	4	32	118
F44LL/2	F32T8	Fluorescent, (4) 48", T-8 lamp, Rapid Start Ballast, NLO (BF: .85-.95), (2) ballast	Electronic	4	32	120
F44LL-R	F32T8	Fluorescent, (4) 48", T-8 lamp, Rapid Start Ballast, RLO (BF<0.85)	Electronic	4	32	105
F44SE	F40T12	Fluorescent, (4) 48", STD lamp	Mag-ES	4	40	172
F44GHL	F48T5/HO	Fluorescent, (4) 48", STD HO T5 lamp	Electronic	4	54	234
F44SHS	F48T12/HO	Fluorescent, (4) 48", STD HO lamp	Mag-STD	4	60	290
F44SIL	F48T12	Fluorescent, (4) 48", STD IS lamp, Electronic ballast	Electronic	4	39	148
F44SIS	F48T12	Fluorescent, (4) 48", STD IS lamp	Mag-STD	4	39	204
F44GL-H	F48T5	Fluorescent, (4) 48", STD T5 lamp, HLO Ballast	Electronic	4	40	170
F44SS	F40T12	Fluorescent, (4) 48", STD lamp	Mag-STD	4	40	188
F44SVS	F48T12/VHO	Fluorescent, (4) 48", STD VHO lamp	Mag-STD	4	110	484
F45ILL	F32T8	Fluorescent, (5) 48", T-8 lamp, (1) 3-lamp IS ballast and (1) 2-lamp IS ballast, NLO (BF: .85-.95)	Electronic	5	32	148
F46EE	F40T12/ES	Fluorescent, (6) 48", ES lamp	Mag-ES	6	34	216
F46EL	F40T12/ES	Fluorescent, (6) 48", ES lamp	Electronic	6	34	186
F46ILL	F32T8	Fluorescent, (6) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	6	32	175
F46ILL-R	F32T8	Fluorescent, (6) 48", T-8 lamp, Instant Start Ballast, RLO (BF< .85)	Electronic	6	32	156
F46LL	F32T8	Fluorescent, (6) 48", T-8 lamp, NLO (BF: .85-.95)	Electronic	6	32	182
F46GHL	F48T5/HO	Fluorescent, (6) 48", STD HO T5 lamp	Electronic	6	54	351
F46SS	F40T12	Fluorescent, (6) 48", STD lamp	Mag-STD	6	40	282
F48EE	F40T12/ES	Fluorescent, (8) 48", ES lamp	Mag-ES	8	34	288
F48ILL	F32T8	Fluorescent, (8) 48", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	8	32	224
F48ILL-R	F32T8	Fluorescent, (8) 48", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	8	32	204
F51ILHL	F60T12/HO	Fluorescent, (1) 60", T-8 HO lamp, Instant Start Ballast	Electronic	1	55	59
F51ILL	F40T8	Fluorescent, (1) 60", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	1	40	36
F51ILL/T2	F40T8	Fluorescent, (1) 60", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	40	36
F51ILL/T3	F40T8	Fluorescent, (1) 60", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 3 Lamp Ballast	Electronic	1	40	35
F51ILL/T4	F40T8	Fluorescent, (1) 60", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 4 Lamp Ballast	Electronic	1	40	34
F51ILL-R	F40T8	Fluorescent, (1) 60", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	1	40	43
F51SHE	F60T12/HO	Fluorescent, (1) 60", STD HO lamp	Mag-ES	1	75	88
F51SHL	F60T12/HO	Fluorescent, (1) 60", STD HO lamp	Electronic	1	75	69
F51SHS	F60T12/HO	Fluorescent, (1) 60", STD HO lamp	Mag-STD	1	75	92

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
F51SL	F60T12	Fluorescent, (1) 60", STD lamp	Electronic	1	50	44
F51SS	F60T12	Fluorescent, (1) 60", STD lamp	Mag-STD	1	50	63
F51SVS	F60T12/VHO	Fluorescent, (1) 60", VHO ES lamp	Mag-STD	1	135	165
F52ILHL	F60T12/HO	Fluorescent, (2) 60", T-8 HO lamp, Instant Start Ballast	Electronic	2	55	123
F52ILL	F40T8	Fluorescent, (2) 60", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	2	40	72
F52ILL/T4	F40T8	Fluorescent, (2) 60", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	2	40	67
F52ILL-H	F40T8	Fluorescent, (2) 60", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1)	Electronic	2	40	80
F52ILL-R	F40T8	Fluorescent, (2) 60", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	2	40	73
F52SHE	F60T12/HO	Fluorescent, (2) 60", STD HO lamp	Mag-ES	2	75	176
F52SHL	F60T12/HO	Fluorescent, (2) 60", STD HO lamp	Electronic	2	75	138
F52SHS	F60T12/HO	Fluorescent, (2) 60", STD HO lamp	Mag-STD	2	75	168
F52SL	F60T12	Fluorescent, (2) 60", STD lamp	Electronic	2	50	88
F52SS	F60T12	Fluorescent, (2) 60", STD lamp	Mag-STD	2	50	128
F52SVS	F60T12/VHO	Fluorescent, (2) 60", VHO ES lamp	Mag-STD	2	135	310
F53ILL	F40T8	Fluorescent, (3) 60", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	3	40	106
F53ILL-H	F40T8	Fluorescent, (3) 60", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1)	Electronic	3	40	108
F54ILL	F40T8	Fluorescent, (4) 60", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	4	40	134
F54ILL-H	F40T8	Fluorescent, (4) 60", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1)	Electronic	4	40	126
F61ISL	F72T12	Fluorescent, (1) 72", STD lamp, IS electronic ballast	Electronic	1	55	68
F61SE	F72T12	Fluorescent, (1) 72", STD lamp	Mag-ES	1	55	76
F61SHS	F72T12/HO	Fluorescent, (1) 72", STD HO lamp	Mag-STD	1	85	120
F61SS	F72T12	Fluorescent, (1) 72", STD lamp	Mag-STD	1	55	90
F61SVS	F72T12/VHO	Fluorescent, (1) 72", VHO lamp	Mag-STD	1	160	180
F62ILHL	F72T8	Fluorescent, (2) 72", T-8 HO lamp, Instant Start Ballast	Electronic	2	65	147
F62ISL	F72T12	Fluorescent, (2) 72", STD lamp, IS electronic ballast	Electronic	2	55	108
F62SE	F72T12	Fluorescent, (2) 72", STD lamp	Mag-ES	2	55	122
F62SHE	F72T12/HO	Fluorescent, (2) 72", STD HO lamp	Mag-ES	2	85	194
F62SHS	F72T12/HO	Fluorescent, (2) 72", STD HO lamp	Mag-STD	2	85	220
F62SL	F72T12	Fluorescent, (2) 72", STD lamp	Electronic	2	55	108
F62SS	F72T12	Fluorescent, (2) 72", STD lamp	Mag-STD	2	55	145
F62SVS	F72T12/VHO	Fluorescent, (2) 72", VHO lamp	Mag-STD	2	160	330
F63ISL	F72T12	Fluorescent, (3) 72", STD lamp, IS electronic ballast	Electronic	3	55	176
F63SS	F72T12	Fluorescent, (3) 72", STD lamp	Mag-STD	3	55	202
F64ISL	F72T12	Fluorescent, (4) 72", STD lamp, IS electronic ballast	Electronic	4	55	216
F64SE	F72T12	Fluorescent, (4) 72", STD lamp	Mag-ES	4	55	230
F64SHE	F72T12/HO	Fluorescent, (4) 72", STD HO lamp	Mag-ES	4	85	388
F64SS	F72T12	Fluorescent, (4) 72", STD lamp	Mag-STD	4	55	244
F81EE/T2	F96T12/ES	Fluorescent, (1) 96", ES lamp, tandem to 2-lamp ballst	Mag-ES	1	60	62
F81EHL	F96T12/HO/ES	Fluorescent, (1) 96", ES HO lamp	Electronic	1	95	80
F81EHL/T2	F96T12/HO/ES	Fluorescent, (1) 96", ES HO lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	95	85
F81EHS	F96T12/HO/ES	Fluorescent, (1) 96", ES HO lamp	Mag-STD	1	95	125
F81EL	F96T12/ES	Fluorescent, (1) 96", ES lamp	Electronic	1	60	60
F81EL/T2	F96T12/ES	Fluorescent, (1) 96", ES lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	60	55
F81ES	F96T12/ES	Fluorescent, (1) 96", ES lamp	Mag-STD	1	60	83
F81ES/T2	F96T12/ES	Fluorescent, (1) 96", ES lamp, tandem to 2-lamp ballast	Mag-STD	1	60	64
F81EVS	F96T12/VHO/ES	Fluorescent, (1) 96", ES VHO lamp	Mag-STD	1	185	200
F81ILL	F96T8	Fluorescent, (1) 96", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	1	59	58
F81ILL/T2	F96T8	Fluorescent, (1) 96", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	59	55
F81ILL/T2-R	F96T8	Fluorescent, (1) 96", T-8 lamp, Instant Start Ballast, RLO (BF<.85), Tandem 2 Lamp Ballast	Electronic	1	59	49
F81ILL-H	F96T8	Fluorescent, (1) 96", T-8 lamp, Instant Start Ballast, HLO (BF:.96-1.1)	Electronic	1	59	68
F81ILL-R	F96T8	Fluorescent, (1) 96", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	1	59	57
F81ILL-V	F96T8	Fluorescent, (1) 96", T-8 lamp, Instant Start Ballast, VHLO (BF>1.1)	Electronic	1	59	71
F81LHL/T2	F96T8/HO	Fluorescent, (1) 96", T8 HO lamp, tandem wired to 2-lamp ballast	Electronic	1	86	80
F81SHL/T2	F96T12/HO	Fluorescent, (1) 96", STD HO lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	110	98
F81SL	F96T12	Fluorescent, (1) 96", STD lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	1	75	70
F81SL/T2	F96T12	Fluorescent, (1) 96", STD lamp, Rapid Start Ballast, NLO (BF: .85-.95), Tandem 2 Lamp Ballast	Electronic	1	75	67
F81SS	F96T12	Fluorescent, (1) 96", STD lamp	Mag-STD	1	75	100
F81SVS	F96T12/VHO	Fluorescent, (1) 96", STD VHO lamp	Mag-STD	1	215	230
F82EE	F96T12/ES	Fluorescent, (2) 96", ES lamp	Mag-ES	2	60	123
F82EHE	F96T12/HO/ES	Fluorescent, (2) 96", ES HO lamp	Mag-ES	2	95	207

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
F82EHL	F96T12/HO/ES	Fluorescent, (2) 96", ES HO lamp	Electronic	2	95	170
F82EHS	F96T12/HO/ES	Fluorescent, (2) 96", ES HO lamp	Mag-STD	2	95	227
F82EL	F96T12/ES	Fluorescent, (2) 96", ES lamp	Electronic	2	60	110
F82ES	F96T12/ES	Fluorescent, (2) 96", ES lamp	Mag-STD	2	60	138
F82EVS	F96T12/VHO/ES	Fluorescent, (2) 96", ES VHO lamp	Mag-STD	2	185	390
F82ILL	F96T8	Fluorescent, (2) 96", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	2	59	109
F82ILL-R	F96T8	Fluorescent, (2) 96", T-8 lamp, Instant Start Ballast, RLO (BF<0.85)	Electronic	2	59	98
F82LHL	F96T8/HO	Fluorescent, (2) 96", T8 HO lamp	Electronic	2	86	160
F82SE	F96T12	Fluorescent, (2) 96", STD lamp	Mag-ES	2	75	158
F82SHE	F96T12/HO	Fluorescent, (2) 96", STD HO lamp	Mag-ES	2	110	237
F82SHL	F96T12/HO	Fluorescent, (2) 96", STD HO lamp	Electronic	2	110	195
F82SHS	F96T12/HO	Fluorescent, (2) 96", STD HO lamp	Mag-STD	2	110	257
F82SL	F96T12	Fluorescent, (2) 96", STD lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	2	75	134
F82SS	F96T12	Fluorescent, (2) 96", STD lamp	Mag-STD	2	75	173
F82SVS	F96T12/VHO	Fluorescent, (2) 96", STD VHO lamp	Mag-STD	2	215	450
F83EE	F96T12/ES	Fluorescent, (3) 96", ES lamp	Mag-ES	3	60	210
F83EHE	F96T12/HO/ES	Fluorescent, (3) 96", ES HO lamp, (1) 2-lamp ES Ballast, (1) 1-lamp STD Ballast	Mag-ES/STD	3	95	319
F83EHS	F96T12/HO/ES	Fluorescent, (3) 96", ES HO lamp	Mag-STD	3	95	352
F83EL	F96T12/ES	Fluorescent, (3) 96", ES lamp	Electronic	3	60	179
F83ES	F96T12/ES	Fluorescent, (3) 96", ES lamp	Mag-STD	3	60	221
F83EVS	F96T12/VHO/ES	Fluorescent, (3) 96", ES VHO lamp	Mag-STD	3	185	590
F83ILL	F96T8	Fluorescent, (3) 96", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	3	59	167
F83SHS	F96T12/HO	Fluorescent, (3) 96", STD HO lamp	Mag-STD	3	110	392
F83SS	F96T12	Fluorescent, (3) 96", STD lamp	Mag-STD	3	75	273
F83SVS	F96T12/VHO	Fluorescent, (3) 96", STD VHO lamp	Mag-STD	3	215	680
F84EE	F96T12/ES	Fluorescent, (4) 96", ES lamp	Mag-ES	4	60	246
F84EHE	F96T12/HO/ES	Fluorescent, (4) 96", ES HO lamp	Mag-ES	4	95	414
F84EHL	F96T12/HO/ES	Fluorescent, (4) 96", ES HO lamp	Electronic	4	95	340
F84EHS	F96T12/HO/ES	Fluorescent, (4) 96", ES HO lamp	Mag-STD	4	95	454
F84EL	F96T12/ES	Fluorescent, (4) 96", ES lamp	Electronic	4	60	220
F84ES	F96T12/ES	Fluorescent, (4) 96", ES lamp	Mag-STD	4	60	276
F84EVS	F96T12/VHO/ES	Fluorescent, (4) 96", ES VHO lamp	Mag-STD	4	185	780
F84ILL	F96T8	Fluorescent, (4) 96", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	4	59	219
F84LHL	F96T8/HO	Fluorescent, (4) 96", T8 HO lamp	Electronic	4	86	320
F84SE	F96T12	Fluorescent, (4) 96", STD lamp	Mag-ES	4	75	316
F84SHE	F96T12/HO	Fluorescent, (4) 96", STD HO lamp	Mag-ES	4	110	474
F84SHL	F96T12/HO	Fluorescent, (3) 96", STD HO lamp	Electronic	4	110	390
F84SHS	F96T12/HO	Fluorescent, (4) 96", STD HO lamp	Mag-STD	4	110	514
F84SL	F96T12	Fluorescent, (4) 96", STD lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	4	75	268
F84SS	F96T12	Fluorescent, (4) 96", STD lamp	Mag-STD	4	75	346
F84SVS	F96T12/VHO	Fluorescent, (4) 96", STD VHO lamp	Mag-STD	4	215	900
F86EHS	F96T12/HO/ES	Fluorescent, (6) 96", ES HO lamp	Mag-STD	6	95	721
F86ILL	F96T8	Fluorescent, (6) 96", T-8 lamp, Instant Start Ballast, NLO (BF: .85-.95)	Electronic	6	59	328
		Circline Fluorescent Fixtures				
FC12/1	FC12T9	Fluorescent, (1) 12" circular lamp, RS ballast	Mag-STD	1	32	31
FC12/2	FC12T9	Fluorescent, (2) 12" circular lamp, RS ballast	Mag-STD	2	32	62
FC16/1	FC16T9	Fluorescent, (1) 16" circular lamp	Mag-STD	1	40	35
FC20	FC6T9	Fluorescent, Circlite, (1) 20W lamp, Preheat ballast	Mag-STD	1	20	20
FC22/1	FC8T9	Fluorescent, Circlite, (1) 22W lamp, preheat ballast	Mag-STD	1	22	20
FC22/32/1	FC22/32T9	Fluorescent, Circlite, (1) 22W/32W lamp, preheat ballast	Mag-STD	1	22/32	58
FC32/1	FC12T9	Fluorescent, Circline, (1) 32W lamp, preheat ballast	Mag-STD	1	32	40
FC32/40/1	FC32/40T9	Fluorescent, Circlite, (1) 32W/40W lamp, preheat ballast	Mag-STD	1	32/40	80
FC40/1	FC16T9	Fluorescent, Circline, (1) 32W lamp, preheat ballast	Mag-STD	1	32	42
FC44/1	FC44T9	Fluorescent, Circlite, (1) 44W lamp, preheat ballast	Mag-STD	1	44	46
FC6/1	FC6T9	Fluorescent, (1) 6" circular lamp, RS ballast	Mag-STD	1	20	25
FC8/1	FC8T9	Fluorescent, (1) 8" circular lamp, RS ballast	Mag-STD	1	22	26
FC8/2	FC8T9	Fluorescent, (2) 8" circular lamp, RS ballast	Mag-STD	2	22	52
		U-Tube Fluorescent Fixtures				
FU1EE	FU40T12/ES	Fluorescent, (1) U-Tube, ES lamp	Mag-ES	1	34	43
FU1ILL	FU31T8/6	Fluorescent, (1) U-Tube, T-8 lamp, Instant Start ballast	Electronic	1	32	31

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
FU1LL	FU31T8/6	Fluorescent, (1) U-Tube, T-8 lamp	Electronic	1	32	32
FU1LL-R	FU31T8/6	Fluorescent, (1) U-Tube, T-8 lamp, RLO (BF<0.85)	Electronic	1	31	27
FU2EE	FU40T12/ES	Fluorescent, (2) U-Tube, ES lamp	Mag-ES	2	34	72
FU2ES	FU40T12/ES	Fluorescent, (2) U-Tube, ES lamp	Mag-STD	2	34	82
FU2ILL	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamp, Instand Start Ballast	Electronic	2	32	59
FU2ILL/T4	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamp, Instand Start Ballast, tandem wired	Electronic	2	32	56
FU2ILL/T4-R	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamp, Instand Start Ballast, RLO, tandem wired	Electronic	2	32	51
FU2ILL-H	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamp, Instand Start HLO Ballast	Electronic	2	32	65
FU2ILL-R	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamp, Instand Start RLO Ballast	Electronic	2	32	52
FU2LL	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamp	Electronic	2	32	60
FU2LL/T2	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamp, Tandem 4 lamp ballast	Electronic	2	32	59
FU2LL-R	FU31T8/6	Fluorescent, (2) U-Tube, T-8 lamp, RLO (BF<0.85)	Electronic	54	31	54
FU3EE	FU40T12/ES	Fluorescent, (3) U-Tube, ES lamp	Mag-ES	3	35	115
FU3ILL	FU31T8/6	Fluorescent, (3) U-Tube, T-8 lamp, Instand Start Ballast	Electronic	3	32	89
FU3ILL-R	FU31T8/6	Fluorescent, (3) U-Tube, T-8 lamp, Instand Start RLO Ballast	Electronic	3	32	78

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
		Halogen Incandescent Fixtures				
H100/1	H100	Halogen Incandescent, (1) 100W lamp		1	100	100
H1000/1	H1000	Halogen Incandescent, (1) 1000W lamp		1	1000	1000
H1200/1	H1200	Halogen Incandescent, (1) 1200W lamp		1	1200	1200
H150/1	H150	Halogen Incandescent, (1) 150W lamp		1	150	150
H150/2	H150	Halogen Incandescent, (2) 150W lamp		2	150	300
H1500/1	H1500	Halogen Incandescent, (1) 1500W lamp		1	1500	1500
H200/1	H200	Halogen Incandescent, (1) 200W lamp		1	200	200
H250/1	H250	Halogen Incandescent, (1) 250W lamp		1	250	250
H300/1	H300	Halogen Incandescent, (1) 300W lamp		1	300	300
H35/1	H35	Halogen Incandescent, (1) 35W lamp		1	35	35
H350/1	H350	Halogen Incandescent, (1) 350W lamp		1	350	350
H40/1	H40	Halogen Incandescent, (1) 40W lamp		1	40	40
H400/1	H400	Halogen Incandescent, (1) 400W lamp		1	400	400
H42/1	H42	Halogen Incandescent, (1) 42W lamp		1	42	42
H425/1	H425	Halogen Incandescent, (1) 425W lamp		1	425	425
H45/1	H45	Halogen Incandescent, (1) 45W lamp		1	45	45
H45/2	H45	Halogen Incandescent, (2) 45W lamp		2	45	90
H50/1	H50	Halogen Incandescent, (1) 50W lamp		1	50	50
H50/2	H50	Halogen Incandescent, (2) 50W lamp		2	50	100
H500/1	H500	Halogen Incandescent, (1) 500W lamp		1	500	500
H52/1	H52	Halogen Incandescent, (1) 52W lamp		1	52	52
H55/1	H55	Halogen Incandescent, (1) 55W lamp		1	55	55
H55/2	H55	Halogen Incandescent, (2) 55W lamp		2	55	110
H60/1	H60	Halogen Incandescent, (1) 60W lamp		1	60	60
H72/1	H72	Halogen Incandescent, (1) 72W lamp		1	72	72
H75/1	H75	Halogen Incandescent, (1) 75W lamp		1	75	75
H75/2	H75	Halogen Incandescent, (2) 75W lamp		2	75	150
H750/1	H750	Halogen Incandescent, (1) 750W lamp		1	750	750
H90/1	H90	Halogen Incandescent, (1) 90W lamp		1	90	90
H90/2	H90	Halogen Incandescent, (2) 90W lamp		2	90	180
H900/1	H900	Halogen Incandescent, (1) 900W lamp		1	900	900
HLV20/1	H20/LV	Halogen Low Voltage Incandescent, (1) 20W lamp		1	20	30
HLV25/1	H25/LV	Halogen Low Voltage Incandescent, (1) 25W lamp		1	25	35
HLV35/1	H35/LV	Halogen Low Voltage Incandescent, (1) 35W lamp		1	35	45
HLV42/1	H42/LV	Halogen Low Voltage Incandescent, (1) 42W lamp		1	42	52
HLV50/1	H50/LV	Halogen Low Voltage Incandescent, (1) 50W lamp		1	50	60
HLV65/1	H65/LV	Halogen Low Voltage Incandescent, (1) 65W lamp		1	65	75
HLV75/1	H75/LV	Halogen Low Voltage Incandescent, (1) 75W lamp		1	75	85
		High Pressure Sodium				
HPS100/1	HPS100	High Pressure Sodium, (1) 100W lamp	CWA	1	100	138
HPS1000/1	HPS1000	High Pressure Sodium, (1) 1000W lamp	CWA	1	1000	1100
HPS150/1	HPS150	High Pressure Sodium, (1) 150W lamp	CWA	1	150	188
HPS200/1	HPS200	High Pressure Sodium, (1) 200W lamp	CWA	1	200	250
HPS225/1	HPS225	High Pressure Sodium, (1) 225W lamp	CWA	1	225	275
HPS250/1	HPS250	High Pressure Sodium, (1) 250W lamp	CWA	1	250	295
HPS310/1	HPS310	High Pressure Sodium, (1) 310W lamp	CWA	1	310	365
HPS35/1	HPS35	High Pressure Sodium, (1) 35W lamp	CWA	1	35	46
HPS360/1	HPS360	High Pressure Sodium, (1) 360W lamp	CWA	1	360	414
HPS400/1	HPS400	High Pressure Sodium, (1) 400W lamp	CWA	1	400	465
HPS50/1	HPS50	High Pressure Sodium, (1) 50W lamp	CWA	1	50	66
HPS600/1	HPS600	High Pressure Sodium, (1) 600W lamp	CWA	1	600	675
HPS70/1	HPS70	High Pressure Sodium, (1) 70W lamp	CWA	1	70	95
HPS750/1	HPS750	High Pressure Sodium, (1) 750W lamp	CWA	1	750	835
		Standard Incandescent Fixtures				
I100/1	I100	Incandescent, (1) 100W lamp		1	100	100
I100/2	I100	Incandescent, (2) 100W lamp		2	100	200
I100/3	I100	Incandescent, (3) 100W lamp		3	100	300
I100/4	I100	Incandescent, (4) 100W lamp		4	100	400
I100/5	I100	Incandescent, (5) 100W lamp		5	100	500

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
I1000/1	I1000	Incandescent, (1) 1000W lamp		1	1000	1000
I100E/1	I100/ES	Incandescent, (1) 100W ES lamp		1	90	90
I100EL/1	I100/ES/LL	Incandescent, (1) 100W ES/LL lamp		1	90	90
I120/1	I120	Incandescent, (1) 120W lamp		1	120	120
I120/2	I120	Incandescent, (2) 120W lamp		2	120	240
I125/1	I125	Incandescent, (1) 125W lamp		1	125	125
I135/1	I135	Incandescent, (1) 135W lamp		1	135	135
I135/2	I135	Incandescent, (2) 135W lamp		2	135	270
I15/1	I15	Incandescent, (1) 15W lamp		1	15	15
I15/2	I15	Incandescent, (2) 15W lamp		2	15	30
I150/1	I150	Incandescent, (1) 150W lamp		1	150	150
I150/2	I150	Incandescent, (2) 150W lamp		2	150	300
I1500/1	I1500	Incandescent, (1) 1500W lamp		1	1500	1500
I150E/1	I150/ES	Incandescent, (1) 150W ES lamp		1	135	135
I150EL/1	I150/ES/LL	Incandescent, (1) 150W ES/LL lamp		1	135	135
I170/1	I170	Incandescent, (1) 170W lamp		1	170	170
I20/1	I20	Incandescent, (1) 20W lamp		1	20	20
I20/2	I20	Incandescent, (2) 20W lamp		2	20	40
I200/1	I200	Incandescent, (1) 200W lamp		1	200	200
I200/2	I200	Incandescent, (2) 200W lamp		2	200	400
I2000/1	I2000	Incandescent, (1) 2000W lamp		1	2000	2000
I200L/1	I200/LL	Incandescent, (1) 200W LL lamp		1	200	200
I25/1	I25	Incandescent, (1) 25W lamp		1	25	25
I25/2	I25	Incandescent, (2) 25W lamp		2	25	50
I25/4	I25	Incandescent, (4) 25W lamp		4	25	100
I250/1	I250	Incandescent, (1) 250W lamp		1	250	250
I300/1	I300	Incandescent, (1) 300W lamp		1	300	300
I34/1	I34	Incandescent, (1) 34W lamp		1	34	34
I34/2	I34	Incandescent, (2) 34W lamp		2	34	68
I36/1	I36	Incandescent, (1) 36W lamp		1	36	36
I40/1	I40	Incandescent, (1) 40W lamp		1	40	40
I40/2	I40	Incandescent, (2) 40W lamp		2	40	80
I400/1	I400	Incandescent, (1) 400W lamp		1	400	400
I40E/1	I40/ES	Incandescent, (1) 40W ES lamp		1	34	34
I40EL/1	I40/ES/LL	Incandescent, (1) 40W ES/LL lamp		1	34	34
I42/1	I42	Incandescent, (1) 42W lamp		1	42	42
I448/1	I448	Incandescent, (1) 448W lamp		1	448	448
I45/1	I45	Incandescent, (1) 45W lamp		1	45	45
I50/1	I50	Incandescent, (1) 50W lamp		1	50	50
I50/2	I50	Incandescent, (2) 50W lamp		2	50	100
I500/1	I500	Incandescent, (1) 500W lamp		1	500	500
I52/1	I52	Incandescent, (1) 52W lamp		1	52	52
I52/2	I52	Incandescent, (2) 52W lamp		2	52	104
I54/1	I54	Incandescent, (1) 54W lamp		1	54	54
I54/2	I54	Incandescent, (2) 54W lamp		2	54	108
I55/1	I55	Incandescent, (1) 55W lamp		1	55	55
I55/2	I55	Incandescent, (2) 55W lamp		2	55	110
I60/1	I60	Incandescent, (1) 60W lamp		1	60	60
I60/2	I60	Incandescent, (2) 60W lamp		2	60	120
I60/3	I60	Incandescent, (3) 60W lamp		3	60	180
I60/4	I60	Incandescent, (4) 60W lamp		4	60	240
I60/5	I60	Incandescent, (5) 60W lamp		5	60	300
I60E/1	I60/ES	Incandescent, (1) 60W ES lamp		1	52	52
I60EL/1	I60/ES/LL	Incandescent, (1) 60W ES/LL lamp		1	52	52
I65/1	I65	Incandescent, (1) 65W lamp		1	65	65
I65/2	I65	Incandescent, (2) 65W lamp		2	65	130
I67/1	I67	Incandescent, (1) 67W lamp		1	67	67
I67/2	I67	Incandescent, (2) 67W lamp		2	67	134
I67/3	I67	Incandescent, (3) 67W lamp		3	67	201
I69/1	I69	Incandescent, (1) 69W lamp		1	69	69

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
I7.5/1	I7.5	Tungsten exit light, (1) 7.5 W lamp, used in night light application		1	7.5	8
I7.5/2	I7.5	Tungsten exit light, (2) 7.5 W lamp, used in night light application		2	7.5	15
I72/1	I72	Incandescent, (1) 72W lamp		1	72	72
I75/1	I75	Incandescent, (1) 75W lamp		1	75	75
I75/2	I75	Incandescent, (2) 75W lamp		2	75	150
I75/3	I75	Incandescent, (3) 75W lamp		3	75	225
I75/4	I75	Incandescent, (4) 75W lamp		4	75	300
I750/1	I750	Incandescent, (1) 750W lamp		1	750	750
I75E/1	I75/ES	Incandescent, (1) 75W ES lamp		1	67	67
I75EL/1	I75/ES/LL	Incandescent, (1) 75W ES/LL lamp		1	67	67
I80/1	I80	Incandescent, (1) 80W lamp		1	80	80
I85/1	I85	Incandescent, (1) 85W lamp		1	85	85
I90/1	I90	Incandescent, (1) 90W lamp		1	90	90
I90/2	I90	Incandescent, (2) 90W lamp		2	90	180
I90/3	I90	Incandescent, (3) 90W lamp		3	90	270
I93/1	I93	Incandescent, (1) 93W lamp		1	93	93
I95/1	I95	Incandescent, (1) 95W lamp		1	95	95
I95/2	I95	Incandescent, (2) 95W lamps		2	95	190
		LED Traffic Signal Fixtures				
LED10/PH	LED10W	LED Traffic Signal Light, (1) 10W lamp, Pedestrian Head - Hand		1	10	10
LED14/12RB	LED14W	LED Traffic Signal Light, (1) 14W lamp, 12" Red Ball		1	14	14
LED15/12RB	LED15W	LED Traffic Signal Light, (1) 15W lamp, 12" Red Ball		1	15	15
LED16.7/12GB	LED16.7W	LED Traffic Signal Light, (1) 16.7W lamp, 12" Green Ball		1	16.7	17
LED17/12RB	LED17W	LED Traffic Signal Light, (1) 17W lamp, 12" Red Ball		1	17	17
LED20/12RB	LED20W	LED Traffic Signal Light, (1) 20W lamp, 12" Red Ball		1	20	20
LED24/12RB	LED24W	LED Traffic Signal Light, (1) 24W lamp, 12" Red Ball		1	24	24
LED5.1/12GA	LED5.1W	LED Traffic Signal Light, (1) 5.1W lamp, 12" Green Arrow		1	5.1	5
LED6/PH	LED6W	LED Traffic Signal Light, (1) 6W lamp, Pedestrian Head - Hand		1	6	6
LED8/8GB	LED8W	LED Traffic Signal Light, (1) 8W lamp, 8" Green Ball		1	8	8
LED9.7/12RA	LED9.7W	LED Traffic Signal Light, (1) 9.7W lamp, 12" Red Arrow		1	9.7	10
LED9.7/8RB	LED9.7W	LED Traffic Signal Light, (1) 9.7W lamp, 8" Red Ball		1	9.7	10
LED9/PH	LED9W	LED Traffic Signal Light, (1) 9W lamp, Pedestrian Head - Hand		1	9	9
		Metal Halide Fixtures				
MH100/1	MH100	Metal Halide, (1) 100W lamp	CWA	1	100	128
MH1000/1	MH1000	Metal Halide, (1) 1000W lamp	CWA	1	1000	1080
MH150/1	MH150	Metal Halide, (1) 150W lamp	CWA	1	150	190
MH1500/1	MH1500	Metal Halide, (1) 1500W lamp	CWA	1	1500	1610
MH175/1	MH175	Metal Halide, (1) 175W lamp	CWA	1	175	215
MH1800/1	MH1800	Metal Halide, (1) 1800W lamp	CWA	1	1800	1875
MH250/1	MH250	Metal Halide, (1) 250W lamp	CWA	1	250	295
MH32/1	MH32	Metal Halide, (1) 32W lamp	CWA	1	32	43
MH360/1	MH360	Metal Halide, (1) 360W lamp	CWA	1	360	430
MH400/1	MH400	Metal Halide, (1) 400W lamp	CWA	1	400	458
MH400/2	MH400	Metal Halide, (2) 400W lamp	CWA	2	400	916
MH50/1	MH50	Metal Halide, (1) 50W lamp	CWA	1	50	72
MH70/1	MH70	Metal Halide, (1) 70W lamp	CWA	1	70	95
MH750/1	MH750	Metal Halide, (1) 750W lamp	CWA	1	750	850
MHPS/LR/100/1	MHPS100	Metal Halide Pulse Start, (1) 100W lamp w/ Linear Reactor Ballast	LR	1	100	118
MHPS/LR/150/1	MHPS150	Metal Halide Pulse Start, (1) 150W lamp w/ Linear Reactor Ballast	LR	1	150	170
MHPS/LR/175/1	MHPS175	Metal Halide Pulse Start, (1) 175W lamp w/ Linear Reactor Ballast	LR	1	175	194
MHPS/LR/200/1	MHPS200	Metal Halide Pulse Start, (1) 200W lamp w/ Linear Reactor Ballast	LR	1	200	219
MHPS/LR/250/1	MHPS250	Metal Halide Pulse Start, (1) 250W lamp w/ Linear Reactor Ballast	LR	1	250	275
MHPS/LR/300/1	MHPS300	Metal Halide Pulse Start, (1) 300W lamp w/ Linear Reactor Ballast	LR	1	300	324
MHPS/LR/300/1	MHPS300	Metal Halide Pulse Start, (1) 300W lamp w/ Linear Reactor Ballast	LR	1	300	324
MHPS/LR/320/1	MHPS320	Metal Halide Pulse Start, (1) 320W lamp w/ Linear Reactor Ballast	LR	1	320	349
MHPS/LR/350/1	MHPS350	Metal Halide Pulse Start, (1) 350W lamp w/ Linear Reactor Ballast	LR	1	350	380
MHPS/LR/400/1	MHPS400	Metal Halide Pulse Start, (1) 400W lamp w/ Linear Reactor Ballast	LR	1	400	435
MHPS/LR/450/1	MHPS450	Metal Halide Pulse Start, (1) 450W lamp w/ Linear Reactor Ballast	LR	1	450	485
MHPS/LR/750/1	MHPS750	Metal Halide Pulse Start, (1) 750W lamp w/ Linear Reactor Ballast	LR	1	750	805
MHPS/SCWA/100/1	MHPS100	Metal Halide Pulse Start, (1) 100W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	100	128

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FIXTURE CODE	LAMP CODE	DESCRIPTION	BALLAST	LAMP/ FIXT	WATT/ LAMP	WATT/ FIXT
MHPS/SCWA/1000/1	MHPS1000	Metal Halide Pulse Start, (1) 1000W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	1000	1080
MHPS/SCWA/150/1	MHPS150	Metal Halide Pulse Start, (1) 150W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	150	190
MHPS/SCWA/175/1	MHPS175	Metal Halide Pulse Start, (1) 175W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	175	208
MHPS/SCWA/200/1	MHPS200	Metal Halide Pulse Start, (1) 200W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	200	232
MHPS/SCWA/250/1	MHPS250	Metal Halide Pulse Start, (1) 250W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	250	288
MHPS/SCWA/300/1	MHPS300	Metal Halide Pulse Start, (1) 300W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	300	342
MHPS/SCWA/300/1	MHPS300	Metal Halide Pulse Start, (1) 300W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	300	342
MHPS/SCWA/320/1	MHPS320	Metal Halide Pulse Start, (1) 320W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	320	368
MHPS/SCWA/350/1	MHPS350	Metal Halide Pulse Start, (1) 350W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	350	400
MHPS/SCWA/400/1	MHPS400	Metal Halide Pulse Start, (1) 400W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	400	450
MHPS/SCWA/450/1	MHPS450	Metal Halide Pulse Start, (1) 450W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	450	506
MHPS/SCWA/750/1	MHPS750	Metal Halide Pulse Start, (1) 750W lamp w/ Super Constant Wattage Autotransformer Ballast	SCWA	1	750	815
		Mercury Vapor Fixtures				
MV100/1	MV100	Mercury Vapor, (1) 100W lamp	CWA	1	100	125
MV1000/1	MV1000	Mercury Vapor, (1) 1000W lamp	CWA	1	1000	1075
MV175/1	MV175	Mercury Vapor, (1) 175W lamp	CWA	1	175	205
MV250/1	MV250	Mercury Vapor, (1) 250W lamp	CWA	1	250	290
MV40/1	MV40	Mercury Vapor, (1) 40W lamp	CWA	1	40	50
MV400/1	MV400	Mercury Vapor, (1) 400W lamp	CWA	1	400	455
MV400/2	MV400	Mercury Vapor, (2) 400W lamp	CWA	2	400	910
MV50/1	MV50	Mercury Vapor, (1) 50W lamp	CWA	1	50	74
MV700/1	MV700	Mercury Vapor, (1) 700W lamp	CWA	1	700	780
MV75/1	MV75	Mercury Vapor, (1) 75W lamp	CWA	1	75	93
		Removed Fixture				
Removed	None	Fixture completely removed from service		0	0	0
		T5 HO FIXTURES				
F36GHL*	F36T5/HO	Fluorescent, (6) 36", STD HO T5 Lamp	Electronic	6	39	234

Appendix B

Lighting Product Information

GE Lighting
Compact Fluorescent Lamps

outstanding energy efficiencies ...
just add imagination.

GE compact fluorescent lamps offer efficient lighting options for most incandescent sockets.

GE's compact fluorescent lamps bring all the advantages of fluorescent lighting to incandescent sockets. With a variety of wattages, shapes and sizes, they'll fit in applications where incandescent bulbs currently exist or would be considered.

The featured advantages:

- ***Outstanding energy efficiencies**–over 70% energy cost savings vs. incandescent lamps.*
- ***Long life.** Anywhere from 6,000 hours to 15,000 hours rated life. Up to 20 times longer than incandescent bulbs replaced.*
- ***Screw-in base, self-ballasted**–fits standard incandescent sockets.*
- ***Warm, pleasing incandescent-like color** (2700K). Other color temperatures available on some products.*
- ***Excellent color rendering** -rare earth phosphors provide bright, vibrant colors. Excellent CRI of ≥ 82.*
- ***Flicker-free instant start**–starts in less than one second.*
- ***Reliable starting to as low as -10°F (-23°C).***
- ***GE quality and reliability throughout.***

As an Energy Star partner, GE has determined that most CFL lamps offered by GE meet the Energy Star guidelines for energy efficiency.

Energy savings with GE's 42 Watt Spiral® CFL.

Below is a chart showing projected energy savings using GE's 42 watt Spiral® CFL versus a 150 watt incandescent lamp, based on energy rate:

Electricity Cost Savings*

Kilowatt Hour Rate	$0.06	$0.08	$0.10	$0.12
Savings with 42 Watt Spiral®	$65	$86	$108	$130

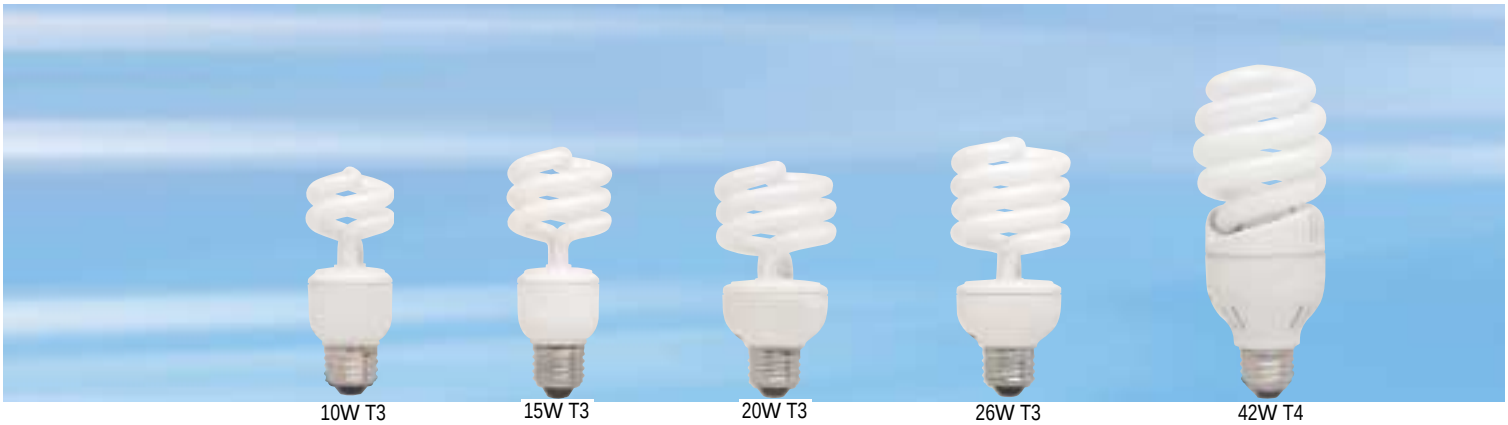
*cost savings calculated over the 10,000 hour rated life of the 42 Watt Spiral® CFL.

A typical customer paying $0.10 per KWH could expect to save $108 over the life of the compact fluorescent lamp!

Note: This brochure does not showcase all screw-in compact fluorescent lamps offered by GE. Please see our on-line catalog at www.gelighting.com for a full listing.

Long Life Spiral® lamps

High lumen output with great energy savings too!



		Compact Fluorescent Replacement									
Wattage Replaced	Incandescent Lamp Replaced	Description	Product Code	Product Features	Watts	Rated Watts Saved	Rated Life (hours)	Life vs. Incandescent	Estimated Energy Savings*	Initial Lumens	Lumens vs. Incandescent
40	Soft White A-line	FLE10HT3/2/827	15829	T3 Spiral; reduced size; instant start	10	30	8,000	8X	$ 24	520	106%
60	Soft White A-line	FLE15HT3/2/827	15831	T3 Spiral; reduced size; instant start	15	45	8,000	8x	$ 36	950	113%
75	Soft White A-line	FLE20HT3/2/827	15834	T3 Spiral; reduced size; instant start	20	55	8,000	10x	$ 44	1200	103%
100	Soft White A-line	FLE26HT3/2/827	15836	T3 Spiral; reduced size; instant start	26	74	8,000	10x	$ 59	1700	101%
150	Soft White Reader	FLE42HLX/VT/827	16107	T4 Spiral; high lumen output; fits an 8.5" harp; instant start	42	108	10,000	13x	$108	2650	100%

* Energy savings based on CFL lamp rated life at 10 cents per KWH.

- *New T3 Mini Spirals are reduced size and longer life than previous Spiral lamps.*
  - *Up to 1" shorter length than previous Spiral lamps.*
  - *33% longer life at 8,000 hours.*
- *New 42 Watt Spiral is the first one-piece CFL to provide true 150 watt equivalent light output that fits a standard 8.5" harp!*
- *All Spiral lamps are listed on the Energy Star® website.*
- *High performance with flicker-free instant-on.*

Super Long Life Biax™ lamps

Big energy savings with the longest life.

12W T3 | 15W T3 | 15W T4 | 20W T3 | 20W T4 | 24W T4 | 28W T4 | 29W T4 3 Way/Dimming

		Compact Fluorescent Replacement									
Wattage Replaced	Incandescent Lamp Replaced	Description	Product Code	Product Features	Watts	Rated Watts Saved	Rated Life (hours)	Life vs. Incandescent	Estimated Energy Savings*	Initial Lumens	Lumens vs. Incandescent
40	Soft White A-line	FLE12TT3/827	TBD	T3 Triple Biax; longest life; small size *Available Q3 2003*	12	28	15,000	15X	$ 42	600	122%
60	Soft White A-line	FLE15TBX/L/SPX27	12544	T4 Triple Biax; long life	15	45	12,000	12x	$ 54	900	107%
60	Soft White A-line	FLE15TT3/827	12004	T3 Triple Biax; longest life; small size	15	45	15,000	15x	$ 68	900	107%
75	Soft White A-line	FLE20TBX/L/SPX27	12545	T4 Triple Biax; long life	20	55	12,000	16x	$ 66	1200	103%
75	Soft White A-line	FLE20TT3/827	TBD	T3 Triple Biax; longest life; small size *Available Q3 2003*	20	55	15,000	20X	$ 83	1200	103%
90	A-line Watt-Miser	FLE 24TBX/A/827	46269	T4 Triple Biax; long life	24	66	12,000	16x	$ 79	1520	104%
100	Soft White A-line	FLE28QBX/A/827	46270	T4 Quadruple Biax; long life	28	72	12,000	16x	$ 86	1750	104%
30/100	Soft White 3-Way	FLE29QBX/D3/827	41327	3-way lamp; T4 Quadruple Biax; long life	12/18/29	18/52/71	10,000	7x	$ 71	1750	135%
100	Soft White A-line	FLE29QBX/DV/827	41457	Dimmable; T4 Quadruple Biax; long life	29	71	10,000	13x	$71	1750	104%

- *Super Long Life Biax lamps extend energy savings out to as much as 15,000 hours.*
- *New T3 Triple Biax lamps provide the same great lumen output in a smaller size with the longest life ratings available.*
- *29 watt Quadruple Biax available in both 3-way and dimmable options...extending the applications for compact fluorescent lamps.*
- *Amalgam technology allows for consistent light output in a variety of applications and a wide temperature range*
- *All Super Long Life Biax lamps are listed on the Energy Star® website.*

Reflectors

New designs provide improved aesthetics with energy savings!

11W R20 | 15W R30 | 23W R40 | 15W R30 Dimming | 26W R40 Dimming | Genura®

		Compact Fluorescent Replacement									
Wattage Replaced	Incandescent Lamp Replaced	Description	Product Code	Product Features	Watts	Rated Watts Saved	Rated Life (hours)	Life vs. Incandescent	Estimated Energy Savings*	Initial Lumens	Lumens vs. Incandescent
50	Soft White R20	FLE11/R20	TBD	R20 Glass Reflector for diffuse downlighting; *Available Q3 2003*	11	39	10,000	5X	$ 39	380	100%
50	Reflector R30	FLE15/A2/R30	49917	R30 Glass Reflector for diffuse downlighting	15	35	10,000	5x	$ 35	550	105%
65	Indoor Flood R30	FLE15/2/A2/DV/R30	TBD	Dimmable R30 Glass reflector *Available Q4 2003*	15	50	TBD			700	97%
65	Indoor Flood R30	EL23/R25/SW	25418	Genura®; longest life CFL reflector 2700K	23	42	15,000	8x	$ 63	1100	150%
65	Indoor Flood R30	EL23/R25/WW	12273	Genura®; longest life CFL reflector 3000K	23	42	15,000	8x	$ 63	1100	150%
90	Indoor Flood R40	FLE23/A4/R40	15382	R40 Glass reflector for diffuse downlighting	23	67	10,000	5x	$ 67	950	90%
90	Indoor Flood R40	FLE26/2/A4/DV/R40	TBD	Dimmable R40 Glass reflector *Available Q4 2003*	26	64	TBD			1200	114%

- *All new reflectors feature soft light for diffuse downlighting in an attractive glass reflector design.*
- *Improved smaller size makes these compact reflectors perfect for retrofitting incandescent sockets.*
- *New dimming reflectors will provide high quality dimming performance in an all glass reflector shape.*
- *Genura reflectors offer the longest rated life and high lumen performance utilizing an electrodeless design.*

Decorative Shapes

Providing more compact fluorescent lighting options for decorative applications.

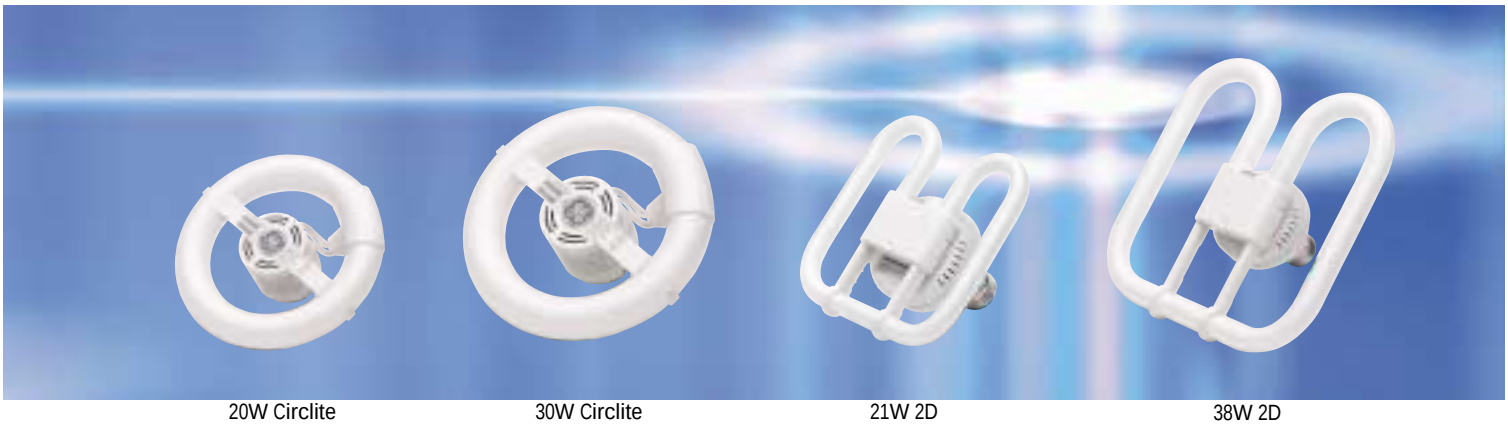
Candle Medium Base | Candle Candelabra Base | T3 A-line | T4 A-line | Globe | Post

Wattage Replaced	Incandescent Lamp Replaced	Compact Fluorescent Replacement: Description	Product Code	Product Features	Watts	Rated Watts Saved	Rated Life (hours)	Life vs. Incandescent	Estimated Energy Savings*	Initial Lumens	Lumens vs. Incandescent
15	Blunt tip candle	FLE5/2/CAC/827	16098	Candle shape; candelabra base	5	10	6,000	3X	$ 6	200	100%
15	Blunt tip candle	FLE5/2/CAM/827	16099	Candle shape; medium base	5	10	6,000	3X	$ 6	200	100%
25	Blunt tip candle	FLE7/2/CAC/827	16103	Candle shape; candelabra base	7	18	6,000	3X	$ 11	370	100%
25	Blunt tip candle	FLE7/2/CAM/827	16104	Candle shape; medium base	7	18	6,000	3X	$ 11	370	100%
40	Blunt tip candle	FLE9/2/CAC/827	16105	Candle shape; candelabra base	9	31	6,000	3X	$ 19	430	100%
40	Blunt tip candle	FLE9/2/CAM/827	16106	Candle shape; medium base	9	31	6,000	3X	$ 19	430	100%
40	Soft White A-line	FLE12/A19/827	TBD	T3 A-line; reduced size, extra life *Available Q3 2003*	12	28	10,000	10X	$ 28	550	112%
60	G30 White	FLE15TBX/L/G29	12501	Globe shape; extended life	15	45	12,000	5x	$ 45	750	112%
60	G30 White	FLE15/A3/G30	41546	Globe shape; reduced overall length *Available Q3 2003*	15	45	10,000	4x	$ 45	750	112%
60	Soft White A-line	FLE 15/A19/827	12010	T3 A-line shape; reduce size, extra life	15	45	10,000	10x	$ 45	815	97%
60	Soft White A-line	FLE15/A2/A23/827	41455	T4 A-line shape	15	45	6,000	6x	$ 27	825	98%
60	Soft White A-line	FLE15/L/TC16/827	41464	Post light for outdoor fixture use	15	45	12,000	12x	$ 54	850	101%
75	Soft White A-line	FLE20/A2/A24/827	41455	T4 A-line shape	20	55	6,000	8x	$ 33	1125	96%

- *GE offers a wide variety of shapes to expand the application of compact fluorescent lamps.*
- *New candle shaped CFL's are available in both medium and candelabra base.*
- *Familar A-line shape is offered in several wattages and in both T3 and T4 formats.*
- *All medium based decorative shape CFL's are listed on the Energy Star® website.*

Lamps with Adapters

Great lumen output with long lasting adapters!



20W Circlite | 30W Circlite | 21W 2D | 38W 2D

		Compact Fluorescent Replacement									
Wattage Replaced	Incandescent Lamp Replaced	Description	Product Code	Product Features	System Watts	Rated Watts Saved	Rated Life (hours)	Life vs. Incandescent	Estimated Energy Savings*	Initial Lumens	Lumens vs. Incandescent
75	Soft White A-line	FEA20CIR/827/B	41950	Circlite	21	54	10,000**	13X	$ 54	1300	111%
75	Soft White A-line	FEA212D/827/B	25805	2D	22	53	10,000**	13X	$ 53	1300	111%
100	Soft White A-line	FEA30CIR/827/B	41645	Circlite	31	69	10,000**	13x	$ 69	1900	112%
150	Soft White A-line	FEA382D/827/B	25807	2D	39	111	10,000**	13x	$111	2780	100%
150	Soft White A-line	FEA382D/835/B	25808	2D	39	111	10,000**	13x	$111	2780	100%
50/150	Soft White 3-Way	FEA382D/3W/827/B	25809	3-Way 2D	39	124	10,000**	7x	$124	2780	129%
50/150	Soft White 3-Way	FEA382D/3W/835/B	25812	3-Way 2D	39	124	10,000**	7x	$124	2780	129%

*Energy savings based on CFL rated life at 10 cents per KWH.

**Adapter rated at 40,000 hours life.

- *Lamp with adapter options provide a screw-in ballast adapter rated at 40,000 hours paired with a lamp rated at 10,000 hours.*
- *2D and Circlite designs provide bright light all around any fixture.*
- *Great efficacy!*
- *Replacement lamps available from GE.*

imagination at work

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GE Consumer & Industrial Lighting

Lighting Specification Bulletin

T8 Ecolux - TCLP Compliant (2', 3', and 4') w/ Starcoat

Product Code: 45748
Description: F17T8/SP41/ECO

Specification:
Firm Name :
Job Name :

General	
Product Code	45748
Description	F17T8/SP41/ECO
Subcategory	T8 Ecolux - TCLP Compliant (2', 3', and 4') w/ Starcoat
Physical	
Bulb Type	T8
Base Type	Medium BiPin (G13)
Nominal Length (In.)	24.00
Nominal Length (mm)	610
Max Overall Length (In.)	23.78
Bulb Nominal Diameter in inches	1
Max bulb diameter	1.1
Min bulb diameter	.94
Photometric	
Lumens (Initial)	1325
Lumens (Mean)	1260
Color Temperature (K)	4100
Electrical	
Average Rated Life	20000
Watts	17
Nominal Lamp Volts	70
Minimum Starting Temp (deg F)	50
Miscellaneous	
TCLP Regulated	Y
Additional Information	S/P Ratio: 1.6

GE Consumer & Industrial Lighting

Lighting Specification Bulletin

T8 Ecolux - TCLP Compliant (2', 3', and 4') w/ Starcoat

Product Code: 45756
Description: F25T8/SP41/ECO

Specification:
Firm Name :
Job Name :

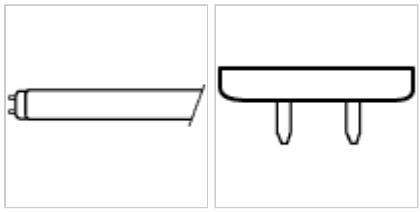
General	
Product Code	45756
Description	F25T8/SP41/ECO
Subcategory	T8 Ecolux - TCLP Compliant (2', 3', and 4') w/ Starcoat
Physical	
Bulb Type	T8
Base Type	Medium BiPin (G13)
Nominal Length (In.)	36.00
Nominal Length (mm)	915
Max Overall Length (In.)	35.78
Bulb Nominal Diameter in inches	1
Max bulb diameter	1.1
Min bulb diameter	.94
Photometric	
Lumens (Initial)	2080
Lumens (Mean)	1970
Color Temperature (K)	4100
Electrical	
Average Rated Life	20000
Watts	25
Nominal Lamp Volts	100
Minimum Starting Temp (deg F)	50
Miscellaneous	
TCLP Regulated	Y
Additional Information	S/P Ratio: 1.6

GE Consumer & Industrial Lighting

Lighting Specification Bulletin

T8 Ecolux - TCLP Compliant (2', 3', and 4') w/ Starcoat

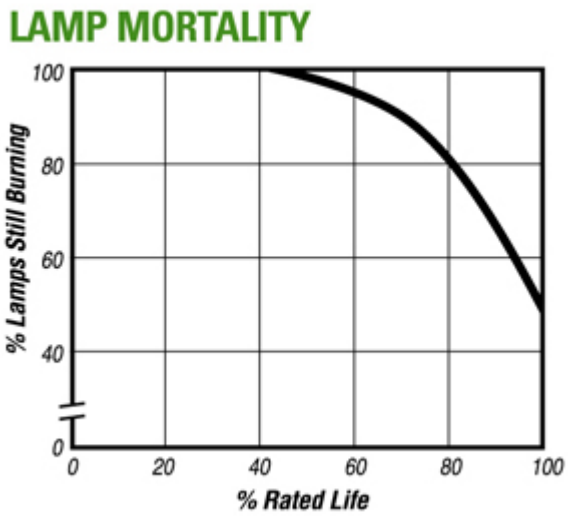
Product Code: 26668
Description: F32T8/SP41/ECO



Specification:
Firm Name :
Job Name :

General	
Product Code	26668
Description	F32T8/SP41/ECO
Subcategory	T8 Ecolux - TCLP Compliant (2', 3', and 4') w/ Starcoat
Physical	
Bulb Type	T8
Base Type	Medium BiPin (G13)
Bulb Material	SODA LIME
Nominal Length (In.)	48.00
Nominal Length (mm)	1220
Max Overall Length (In.)	47.78
Min Overall Length (In.)	47.67
Bulb Nominal Diameter in inches	1
Max bulb diameter	1.1
Min bulb diameter	.94
Max Face to End of Opposing Pin (B)	47.5
Min Face to End of Opposing Pin (B)	47.4
Photometric	
Lumens (Initial)	2800
Lumens (Mean)	2660
Color Temperature (K)	4100
Nominal Efficacy (Lumens/Watt)	89
Electrical	
Average Rated Life	20000
Watts	32
Nominal Lamp Volts	137
Nominal Lamp Operating	60

Lamp Mortality



Frequency (Hz)	
Minimum Starting Temp (deg F)	50
Min. Terminal to Terminal Starting Lamp Voltage (Vrms)- Rapid Start at 10°C	315
Max Cathode Resistance Ratio (Rh/Rc)	6.5
Min Cathode Resistance Ratio (Rh/Rc)	4.25
Miscellaneous	
TCLP Regulated	y
Additional Information	S/P Ratio: 1.6

All values are design values or typical values when measured under laboratory conditions.Information provided is subject to change w
notice. Where applicable, values are based on guidelines published in ANSI. For more information see Terms and Conditions in the li

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GE Lighting North America

We Bring Good Things To Life

Item Comparison Page

Product Code	15831	15834	15836
Product Description	FLE15HT3/2/827	FLE20HT3/2/827	FLE26HT3/2/827
Product SubCategory	Self-Ballasted Lamps Spiral®	Self-Ballasted Lamps Spiral®	Self-Ballasted La Spiral®
Bulb Shape	HLX	HLX	HLX
Bulb size	(T3)	(T3)	(T3)
Base type	Med	Med	Med
Volts	120	120	120
Nominal Length (In.)	4.8000	4.7000	5.2000
Nominal Length (mm)	122.000	119.000	
Lamp Watts	15	20	26
Life Average	8000	8000	8000
Lumen - Init	950	1200	1700
Lumen - Mean	765	965	1365
Color Temperature (Kelvins)	2700	2700	2700
Color Rendering Index (CRI)	82	82	82
Total Harmonic Distortion (THD)	145	135	120
Power Factor	0	0	0
Number of lamps in a case	10	10	10
Reduced Wattage	Y	Y	Y
Product Additional Information	RE 827 Phosphor, T3 Spiral?, Boxed	RE 827 Phosphor, T3 Spiral?, Boxed	RE 827 Phosphor Spiral?, Boxed
Footnotes	Fluorescent lamp lumens decline during life.Most one piece self ballasted lamps for incandescent sockets and plug-in lamps with screw-in adapters do not work with clip-on shades.Lumens on one piece self ballasted lamp systems are measured base up.Best performance if operated base up and at 77? F (25? C) ambient temperature.Use only on 120V 60Hz circuits. Do not use on dimming circuits or timers. Do not use in wet locations.	Fluorescent lamp lumens decline during life.Most one piece self ballasted lamps for incandescent sockets and plug-in lamps with screw-in adapters do not work with clip-on shades.Lumens on one piece self ballasted lamp systems are measured base up.Best performance if operated base up and at 77? F (25? C) ambient temperature.Use only on 120V 60Hz circuits. Do not use on dimming circuits or timers. Do not use in wet locations.	Fluorescent lamp decline during life. piece self ballaste for incandescent and plug-in lamps screw-in adapters work with clip-on shades.Lumens o piece self ballaste systems are mea up.Best performa operated base up F (25? C) ambient temperature.Use 120V 60Hz circuit use on dimming ci timers. Do not us locations.

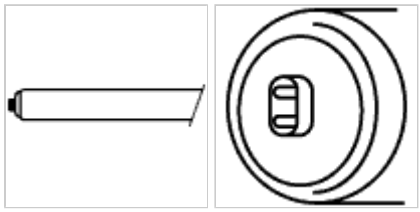
Return to Product List

GE Consumer & Industrial Lighting

Lighting Specification Bulletin

8' T8 High Output

Product Code: 12538
Description: F96T8/SP41/HO



Specification:
Firm Name :
Job Name :

General	
Product Code	12538
Description	F96T8/SP41/HO
Subcategory	8' T8 High Output
Physical	
Bulb Type	T8
Base Type	R17d
Bulb Material	SODA LIME
Nominal Length (In.)	96.00
Nominal Length (mm)	2440
Max Overall Length (In.)	93.91
Min Overall Length (In.)	93.72
Bulb Nominal Diameter in inches	1
Max bulb diameter	1.1
Min bulb diameter	.94
Photometric	
Lumens (Initial)	8000
Lumens (Mean)	7600
Color Temperature (K)	4100
Nominal Efficacy (Lumens/Watt)	93
Electrical	
Average Rated Life	18000
Watts	86
Nominal Lamp Volts	210
Nominal Lamp Operating Frequency (Hz)	60
Max Cathode Resistance Ratio (Rh/Rc)	6.5
Min Cathode Resistance Ratio (Rh/Rc)	4.25
Miscellaneous	
TCLP Regulated	n

All values are design values or typical values when measured under laboratory conditions.Information provided is subject to change w
notice. Where applicable, values are based on guidelines published in ANSI. For more information see Terms and Conditions in the li

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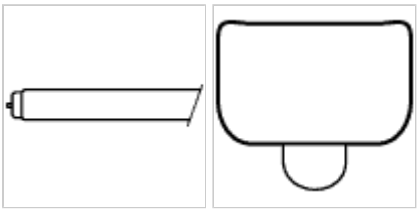
GE Consumer & Industrial Lighting

Lighting Specification Bulletin

8' T8

Product Code: 23412
Description: F96T8/SP41



Specification:
Firm Name :
Job Name :

General	
Product Code	23412
Description	F96T8/SP41
Subcategory	8' T8
Physical	
Bulb Type	T8
Base Type	Single Pin (Fa8)
Bulb Material	SODA LIME
Nominal Length (In.)	96.00
Nominal Length (mm)	2440
Max Overall Length (In.)	94
Min Overall Length (In.)	93.74
Bulb Nominal Diameter in inches	1
Max bulb diameter	1.1
Min bulb diameter	.94
Max Face to End of Opposing Pin (B)	93.5
Min Face to End of Opposing Pin (B)	93.42
Photometric	
Lumens (Initial)	5800
Lumens (Mean)	5500
Color Temperature (K)	4100
Nominal Efficacy (Lumens/Watt)	98
Electrical	
Average Rated Life	15000
Watts	59
Nominal Lamp Volts	268
Nominal Lamp Operating Frequency (Hz)	60
Minimum Starting Temp (deg F)	50
Max Cathode Resistance Ratio (Rh/Rc)	6.5
Min Cathode Resistance Ratio (Rh/Rc)	4.25

Miscellaneous	
TCLP Regulated	n

LSB Data Available Meets Federal Minimum Efficiency Standards

GE Ballasts

GE-232-MAX-N/Ultra

APPLICATION and PERFORMANCE SPECIFICATION

Description: High frequency electronic ballasts for 2 or 1 F32T8 lamps (and others as indicated below)
GE Product Code: 49772

- Line Voltage: Multi-Voltage 120 to 277 VAC, ±10%, 60Hz
- Parallel Lamp Operation
- Anti-Striation Control
- Instant Start
- Active Power Factor Correction

Lamps		Input	Input	Nominal	Power	Ballast	Harmonic	Crest
Type	#	Volts	Watts	Line Amps	Factor	Factor	Total	Factor
F28T8/UMX	2	120	49	0.42	> .99	.87	< 10%	<1.5
F28T8/UMX	2	277	48	0.19	> .96	.87	< 15%	<1.5
F32T8/WM	2	120	53	0.45	> .99	.87	< 10%	<1.5
F32T8/WM	2	277	52	0.20	> .96	.87	< 15%	<1.5
F32T8 and U	2	120	54	0.47	> .99	.87	< 10%	<1.5
F32T8 and U	2	277	53	0.21	> .96	.87	< 15%	<1.5
F25T8	2	120	45	0.38	> .99	TBD	< 10%	<1.5
F25T8	2	277	45	0.17	> .95	TBD	< 16%	<1.5
F17T8	2	120	32	0.27	> .99	TBD	< 10%	<1.5
F17T8	2	277	32	0.12	> .94	TBD	< 20%	<1.5
FE15T8	2	120	26	0.22	> .99	TBD	< 10%	<1.5
FE15T8	2	277	26	0.11	> .93	TBD	< 22%	<1.5
F25T12	2	120	48	0.41	> .99	TBD	< 10%	<1.5
F25T12	2	277	48	0.18	> .97	TBD	< 16%	<1.5
F28T8/UMX	1	120	27	0.24	> .99	.87	< 10%	<1.5
F28T8/UMX	1	277	27	0.11	> .93	.87	< 21%	<1.5
F32T8/WM	1	120	29	0.25	> .99	.87	< 10%	<1.5
F32T8/WM	1	277	29	0.12	> .94	.87	< 21%	<1.5
F32T8 and U	1	120	31	0.26	> .99	.87	< 10%	<1.5
F32T8 and U	1	277	31	0.12	> .94	.87	< 20%	<1.5
F25T8	1	120	26	0.23	> .99	TBD	< 10%	<1.5
F25T8	1	277	26	0.11	> .93	TBD	< 21%	<1.5
F17T8	1	120	19	0.17	> .99	TBD	< 12%	<1.5
F17T8	1	277	19	0.08	> .90	TBD	< 23%	<1.5
FE15T8	1	120	16	0.14	> .98	TBD	< 13%	<1.5
FE15T8	1	277	16	0.07	> .88	TBD	< 27%	<1.5
F25T12	1	120	27	0.24	> .99	TBD	< 10%	<1.5
F25T12	1	277	27	0.11	> .93	TBD	< 22%	<1.5

Application and performance specification information subject to change without notification.

Performance:
- Meets ANSI Standard C82.11-Cons 2002
- Meets ANSI Standard C62.41-1991
- Meets FCC Part 18 (Class A) for EMI and RFI Non-Consumer Limits

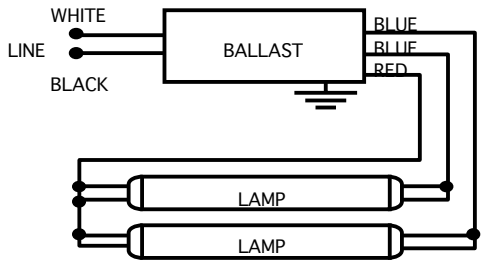
Safety:
- No PCB's
- UL Listed (Class P, Type 1 Outdoor)
- Type CC
- Type HL

Application:
- Minimum Starting Temperature: 0°F, -18° C
- Maximum Ambient Temperature: 105° F, 40° C
- Sound Rated: A
- Remote Mounting: 18 ft. max. lead length, 18 AWG min wire size

Physical Parameters

Length:	9.50"
Width:	1.70"
Height:	1.2"
Weight:	1.4 lbs.

Lead Length	(± 1")	25	25	41	34	
Lead Color:		White	Black	Red	Blue	



Warranty: GE Lighting warrants to the purchaser that each electronic ballast will be free from defects in material or workmanship for a period of 5 years from the date of manufacture when properly installed and under normal conditions of use

Install and Ground Per National Electric Code

For 1 lamp application, cap unused blue lead, insulate for 600 Vrms

GE Ballasts

GE-332-MAX-N/Ultra

APPLICATION and PERFORMANCE SPECIFICATION

Description: High frequency electronic ballasts for 3 or 2 F32T8 lamps (and others as indicated below)
GE Product Code: 49773

- Line Voltage: Multi-Voltage 120 to 277 VAC, ±10%, 60Hz
- Parallel Lamp Operation
- Anti-Striation Control
- Instant Start
- Active Power Factor Correction

Lamps		Input	Input	Nominal	Power	Ballast	Harmonic	Crest
Type	#	Volts	Watts	Line Amps	Factor	Factor	Total	Factor
F28T8/UMX	3	120	72	0.63	> .99	.87	< 10%	<1.5
F28T8/UMX	3	277	71	0.28	> .98	.87	< 13%	<1.5
F32T8/WM	3	120	78	0.66	> .99	.87	< 10%	<1.5
F32T8/WM	3	277	77	0.29	> .98	.87	< 13%	<1.5
F32T8 and U	3	120	82	0.70	> .99	.87	< 10%	<1.5
F32T8 and U	3	277	80	0.30	> .98	.87	< 13%	<1.5
F25T8	3	120	67	0.56	> .99	TBD	< 10%	<1.5
F25T8	3	277	66	0.24	> .98	TBD	< 13%	<1.5
F17T8	3	120	48	0.40	> .99	TBD	< 10%	<1.5
F17T8	3	277	48	0.18	> .97	TBD	< 17%	<1.5
FE15T8	3	120	39	0.33	> .99	TBD	< 10%	<1.5
FE15T8	3	277	39	0.15	> .96	TBD	< 23%	<1.5
F25T12	3	120	72	0.61	> .99	TBD	< 10%	<1.5
F25T12	3	277	71	0.27	> .98	TBD	< 13%	<1.5
F28T8/UMX	2	120	51	0.44	> .99	.87	< 10%	<1.5
F28T8/UMX	2	277	51	0.20	> .97	.87	< 16%	<1.5
F32T8/WM	2	120	55	0.46	> .99	.87	< 10%	<1.5
F32T8/WM	2	277	55	0.21	> .97	.87	< 15%	<1.5
F32T8 and U	2	120	58	0.49	> .99	.87	< 10%	<1.5
F32T8 and U	2	277	58	0.22	> .97	.87	< 14%	<1.5
F25T8	2	120	48	0.42	> .99	TBD	< 10%	<1.5
F25T8	2	277	48	0.19	> .97	TBD	< 17%	<1.5
F17T8	2	120	35	0.31	> .99	TBD	< 10%	<1.5
F17T8	2	277	35	0.14	> .95	TBD	< 19%	<1.5
FE15T8	2	120	28	0.25	> .99	TBD	< 10%	<1.5
FE15T8	2	277	29	0.12	> .93	TBD	< 23%	<1.5
F25T12	2	120	49	0.44	> .99	TBD	< 10%	<1.5
F25T12	2	277	49	0.19	> .97	TBD	< 16%	<1.5

Application and performance specification information subject to change without notification.

Performance:
- Meets ANSI Standard C82.11-Cons 2002
- Meets ANSI Standard C62.41-1991
- Meets FCC Part 18 (Class A) for EMI and RFI Non-Consumer Limits

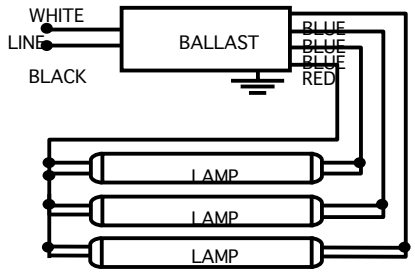
Safety:
- No PCB's
- UL Listed (Class P, Type 1 Outdoor)
- Type CC
- Type HL

Application:
- Minimum Starting Temperature: 0°F, -18° C
- Maximum Ambient Temperature: 105° F, 40° C
- Sound Rated: A
- Remote Mounting: 18 ft. max. lead length, 18 AWG min wire size

Physical Parameters

Length:	9.50"
Width:	1.70"
Height:	1.2"
Weight:	1.4 lbs.

Lead Length	(± 1")	25	25	41	34	
Lead Color:		White	Black	Red	Blue	



Warranty: GE Lighting warrants to the purchaser that each electronic ballast will be free from defects in material or workmanship for a period of 5 years from the date of manufacture when properly installed and under normal conditions of use

Install and Ground Per National Electric Code

For 2 lamp application, cap unused blue lead, insulate for 600 Vrms

GE Ballasts

GE-432-MAX-N/Ultra

APPLICATION and PERFORMANCE SPECIFICATION

Description: High frequency electronic ballasts for 4 or 3 F32T8 lamps (and others as indicated below)
GE Product Code: 49774

- Line Voltage: Multi-Voltage 120 to 277 VAC, ±10%, 60Hz
- Parallel Lamp Operation
- Anti-Striation Control
- Instant Start
- Active Power Factor Correction

Lamps		Input	Input	Nominal	Power	Ballast	Harmonic	Crest
Type	#	Volts	Watts	Line Amps	Factor	Factor	Total	Factor
F28T8/UMX	4	120	98	0.84	> .99	.87	< 10%	<1.5
F28T8/UMX	4	277	96	0.37	> .98	.87	< 13%	<1.5
F32T8/WM	4	120	105	0.90	> .99	.87	< 10%	<1.5
F32T8/WM	4	277	103	0.39	> .98	.87	< 13%	<1.5
F32T8 and U	4	120	109	0.94	> .99	.87	< 10%	<1.5
F32T8 and U	4	277	107	0.40	> .98	.87	< 13%	<1.5
F25T8	4	120	91	0.76	> .99	TBD	< 10%	<1.5
F25T8	4	277	89	0.33	> .98	TBD	< 14%	<1.5
F17T8	4	120	65	0.54	> .99	TBD	< 10%	<1.5
F17T8	4	277	64	0.24	> .97	TBD	< 18%	<1.5
FE15T8	4	120	51	0.43	> .99	TBD	< 13%	<1.5
FE15T8	4	277	51	0.20	> .96	TBD	< 13%	<1.5
F25T12	4	120	96	0.81	> .99	TBD	< 10%	<1.5
F25T12	4	277	95	0.35	> .98	TBD	< 13%	<1.5
F28T8/UMX	3	120	76	0.67	> .99	.87	< 10%	<1.5
F28T8/UMX	3	277	75	0.29	> .97	.87	< 16%	<1.5
F32T8/WM	3	120	81	0.68	> .99	.87	< 10%	<1.5
F32T8/WM	3	277	80	0.30	> .97	.87	< 15%	<1.5
F32T8 and U	3	120	85	0.72	> .99	.87	< 13%	<1.5
F32T8 and U	3	277	84	0.32	> .99	.87	< 13%	<1.5
F25T8	3	120	72	0.64	> .99	TBD	< 10%	<1.5
F25T8	3	277	71	0.28	> .97	TBD	< 17%	<1.5
F17T8	3	120	52	0.46	> .99	TBD	< 10%	<1.5
F17T8	3	277	52	0.20	> .96	TBD	< 18%	<1.5
FE15T8	3	120	41	0.36	> .99	TBD	< 11%	<1.5
FE15T8	3	277	41	0.17	> .94	TBD	< 23%	<1.5
F25T12	3	120	72	0.63	> .99	TBD	< 10%	<1.5
F25T12	3	277	71	0.28	> .98	TBD	< 13%	<1.5

Application and performance specification information subject to change without notification.

Performance:

- Meets ANSI Standard C82.11-Cons 2002
- Meets ANSI Standard C62.41-1991
- Meets FCC Part 18 (Class A) for EMI and RFI Non-Consumer Limits

Safety:

- No PCB's
- UL Listed (Class P, Type 1 Outdoor)
- Type CC
- Type HL

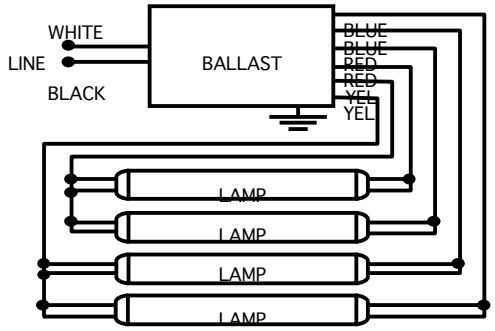
Application:

- Minimum Starting Temperature: 0°F, -18° C
- Maximum Ambient Temperature: 105° F, 40° C
- Sound Rated: A
- Remote Mounting: 18 ft. max. lead length, 18 AWG min wire size

Physical Parameters

Length:	9.50"
Width:	1.70"
Height:	1.2"
Weight:	1.43 lbs.

Lead Length	(± 1")	25	25	41	34	34
Lead Color:		White	Black	Yellow	Red	Blue



Warranty: GE Lighting warrants to the purchaser that each electronic ballast will be free from defects in material or workmanship for a period of 5 years from the date of manufacture when properly installed and under normal conditions of use

Install and Ground Per National Electric Code

For 3 lamp application, cap unused blue lead, insulate for 600 Vrms

GE Ballasts

GE-259-MAX-N/Ultra

APPLICATION and PERFORMANCE SPECIFICATION

Description: High frequency electronic ballasts for 2 or 1 F96T8 lamps (and others as indicated below)
GE Product Code: 49767

- Line Voltage: Multi-Voltage 120 to 277 VAC, ±10%, 60Hz
- Parallel Lamp Operation
- Anti-Striation Control
- Instant Start
- Active Power Factor Correction

Lamps		Input	Input	Nominal	Power	Ballast	Harmonic	Crest
Type	#	Volts	Watts	Line Amps	Factor	Factor	Total	Factor
F96T8/WM	2	120	102	0.87	> .99	.87	< 10%	<1.5
F96T8/WM	2	277	100	0.38	> .98	.87	< 15%	<1.5
F96T8	2	120	107	0.91	> .99	.87	< 10%	<1.5
F96T8	2	277	105	0.40	> .98	.87	< 15%	<1.5
F40T8	2	120	77	0.66	> .97	TBD	< 10%	<1.5
F40T8	2	277	76	0.29	> .97	TBD	< 18%	<1.5
F96T8/WM	1	120	59	0.50	> .99	.87	< 10%	<1.5
F96T8/WM	1	277	59	0.23	> .97	.87	< 20%	<1.5
F96T8	1	120	62	0.53	> .99	.87	< 10%	<1.5
F96T8	1	277	62	0.24	> .97	.87	< 20%	<1.5
F40T8	1	120	46	0.39	> .99	TBD	< 10%	<1.5
F40T8	1	277	46	0.18	> .95	TBD	< 20%	<1.5

Application and performance specification information subject to change without notification.

Performance:
- Meets ANSI Standard C82.11-Cons 2002
- Meets ANSI Standard C62.41-1991
- Meets FCC Part 18 (Class A) for EMI and RFI
  Non-Consumer Limits

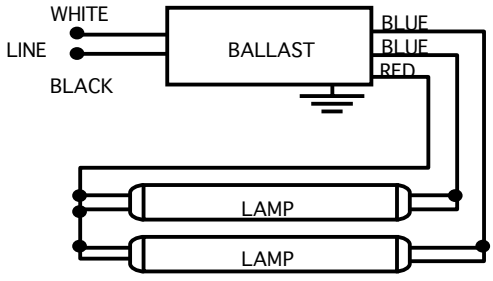
Safety:
- No PCB's
- UL Listed (Class P, Type 1 Outdoor)
- Type HL
- Type CC on F96 lamps

Application:
- Minimum Starting Temperature: 0°F, -18° C
- Maximum Ambient Temperature: 105° F, 40° C
- Sound Rated: A
- Remote Mounting: 18 ft. max. lead length, 18 AWG

Physical Parameters

Length:	9.50"
Width:	1.70"
Height:	1.2"
Weight:	1.4 lbs.

Lead Length	(± 1")	25	25	66	58	
Lead Color:		White	Black	Red	Blue	



Warranty: GE Lighting warrants to the purchaser that each electronic ballast will be free from defects in material or workmanship for a period of 5 years from the date of manufacture when properly installed and under normal conditions of use

Install and Ground Per National Electric Code

For single lamp operation, insulate unused blue lead for 600 VRMS.

EXIT SIGNS-THERMOPLASTIC

- **AC ONLY OR SELF-POWERED**
- **SIDE MOUNTED LIGHTING HEADS AVAILABLE**
- **INCANDESCENT OR L.E.D. MODELS**
- **UNIVERSAL EXIT**
- **ETL LISTED TO UL 924**
- **MEETS NFPA LIFE SAFETY, OSHA, NEC, LOCAL AND STATE CODES**
- **25 YR LIGHT SOURCE ON LED and BP-LED MODELS**

P Series

.55pf 120/277 vac

Application

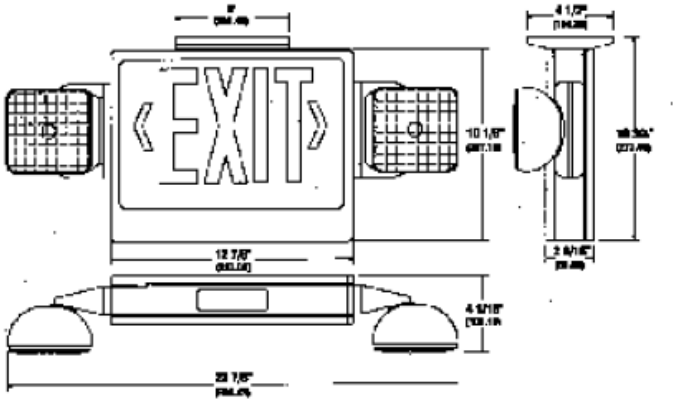
High-Lites P-Series exit signs features thermoplastic construction and a contemporary design that will blend in and enhance any decor. Each sign is universal and is equipped with all the necessary parts to provide for any mounting configuration encountered.

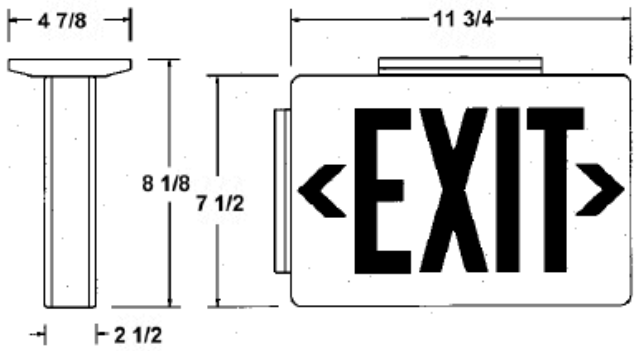
Ordering Information

AC ONLY MODELS - 120 or 277 VAC INPUT

MODEL NUMBER	DESCRIPTION	*FRAME DIMENSIONS	WEIGHT	STANDARD LAMPS
PLED-5-**	A.C. only universal L.E.D. exit sign	12 ½" L x 8 ½" H x 1 ¾" W	4 lbs.	L.E.D.
BP-PLED-5-**	Self-powered universal L.E.D. exit sign	12 ½" L x 8 ½" H x 1 ¾" W	5 lbs.	L.E.D.
HBP-PLED-5-** DEH	Self-powered universal L.E.D. exit sign with two side mouted heads	23 ⅞" L x 10 ⅛" H x 4 ⅛" D	8 lbs.	L.E.D. (2) 5 Watt (1-25) incandescent lamps
P-5-**	A.C. only universal incandescent exit sign	12 ⅞" L x 10 ⅛" H x 2 ⅜" W	4 lbs.	AC - (2) 7 Watt 7C7-120-CS (-131) incandescent lamps
BP-P-5-**	Self-powered universal incandescent exit sign	12 ⅞" L x 10 ⅛" H x 2 ⅜" W	6 lbs.	AC - same DC:(2) 5.0 watt (-25) incandescent lamps
HBP-P-5-** DEH	Self-powered universal incandescent exit sign with two side mounted heads	23 ⅞" L x 10 ⅛" H x 4 ⅛" D	8 lbs.	AC - same DC - same Heads - same

**Red (R) or Green (G) Letter Face
*Add ⅞" for mounting canopy





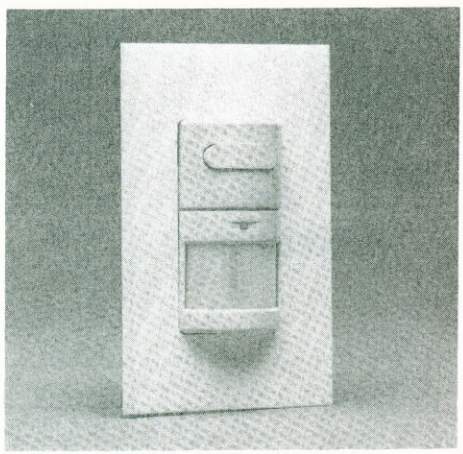
NOTE: Dimensions are in inches and (millimeters).
Specifications are subject to change without notice.

Factory Installed Options

Add	Description
-DL	Damp Location Application
-TCI	Twin Circuit Input

Decorator Automatic Wall Switches

- Small, decorator design
- Auto-On and Manual-On models
- Adjustable sensitivity & time delay
- Built-in light-level sensor on WS models
- 180° coverage, maximum of 900 sq ft; 300 sq ft for typical desk-top activity
- Compatible with all electronic ballasts
- No minimum load requirement
- 30% to 60% energy savings
- UL and CUL Listed; Five year warranty



System Information

The Watt Stopper is a decorator style automatic wall switch which replaces an existing wall switch and fits behind a standard decorator wall plate. Watt Stoppers turn lighting on when a person enters a room or office and off when the space is vacated. They have an attractive, low-profile appearance that suits even the most modern office environment.

Operation

Watt Stoppers utilize advanced Passive Infrared technology to detect occupancy. Detection occurs when the unit senses the difference between infrared energy from a human body and the background space. Watt Stoppers use a custom 2-level Fresnel lens which adds to the sensor's ability to sense smaller amounts of activity at the desk top level. They achieve a 180° detection coverage and up to 900 square feet of walking motion. With the WS (auto-on) models, lighting systems automatically turn on when occupancy is detected. For the WM (manual-on) models, the user must manually switch lighting on each time the controlled area is entered. For all models, after a user-specified length of time when no occupancy is detected, lighting automatically switches off. Watt Stoppers can also be used with multiple switches for multi-level lighting. In this case, the Watt Stopper acts as the master on/off switch and the remaining switches control the level of illumination.

Features

The Watt Stopper auto-on model features a built-in light level sensor. This feature holds lighting systems off in the Auto mode when natural light levels are above the pre-set level. The user can override this function by placing his hand in front of the sensor. Once lights are switched on, the light level sensor will not switch them off even if daylight levels increase. The light level setting is adjustable by the user allowing for the option of lighting always turning on when an area is entered, regardless of existing light levels. All models feature adjustable sensitivity and time delay settings.

Applications & Economics

Their small, decorator style and superior performance give the Watt Stopper the flexibility to work in a variety of applications. Commercial uses include offices, conference rooms, break rooms and utility rooms. Residential uses include kitchens, small bathrooms, bedrooms, or any room that provides a clear view of the entire area to be covered. Energy savings for these areas can be as much as 60% since lighting will no longer remain on once the room is vacant. Watt Stopper's style fits in with any decor and will complement even the most modern architectural designs. Due to a competitive price, low installation cost, and high energy savings, paybacks for Watt Stoppers are usually well under 2 years.

The Watt Stopper®, Inc.
2800 De La Cruz Blvd.
Santa Clara, CA 95050
Tel: (408) 988-5331
Fax: (408) 988-5373
National Technical Support
Plano, Texas: (800) 879-8585

WS, WM Technical Information

Specifications

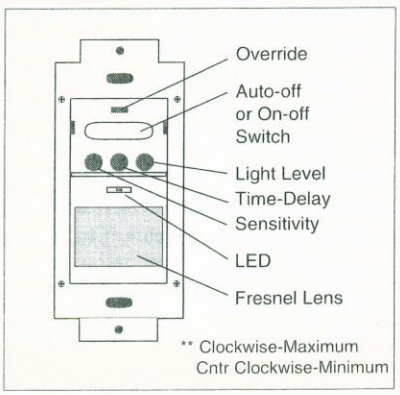
- Coverage of 180 degrees, maximum 900 sq ft; 300 sq ft for desk-top activity
- Digital time delay adjustable from 30 seconds up to 30 minutes
- Adjustable unit sensitivity from 20% to 100%
- Integrated light level sensor – works from 2.7 to 200+ footcandles
- LED for sensitivity calibration
- Small size: 2.7" x 1.8" x 2.2" (68mm x 45mm x 56mm) L x W x D
- Compatible with all electronic ballasts and PL lamp ballasts
- Voltage drop protection – Patent Pending
- For safety, there is no leakage to load in off mode; Sensor is safety grounded
- Available in White, Ivory, Grey or Black
- Includes one single-gang cover plate ASP-211 (bulk-packed)

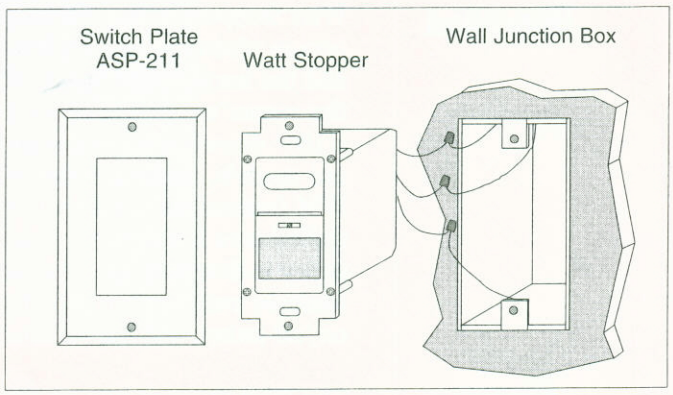
Order Information

Catalog No.	Description	Voltage	Load Requirements	Coverage
WS-120	auto-on	120 VAC	0-800 Watt Ballast	180°, up to 900 sq ft
WS-277	auto-on	277 VAC	0-1200 Watt Ballast	180°, up to 900 sq ft
WS-230	auto-on	220-240 VAC	0-1200 Watt Ballast	180°, up to 900 sq ft
WS-347	auto-on	347 VAC	0-1500 Watt Ballast	180°, up to 900 sq ft
WS-R7P*	auto-on	24 VDC Halfwave	3 RR7 Relays	180°, up to 900 sq ft
WM-120/277	manual-on	120/277 VAC	0-800/1200 Watt Ballast	180°, up to 900 sq ft
ASP-211	Cover plate for single gang box			
ASP-422	Blank cover plate for 2-gang box			
ASP-432	Cover switch plate for 2-gang box with switch option			

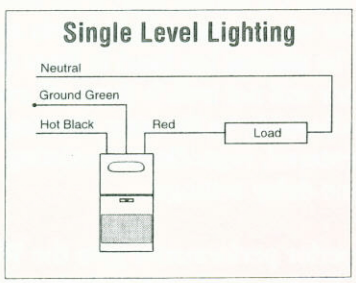
Notes: Add an **-I** to Catalog No. for Ivory, **-W** for White, **-G** for Grey, **-B** for Black
One ASP-211 is included with each sensor (bulk-packed)
* For halfwave, low-voltage lighting systems

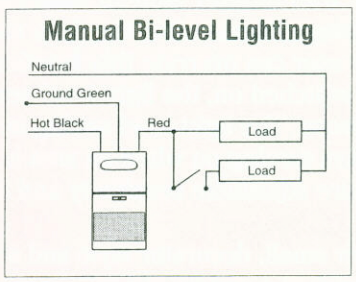
Product Controls and Installation

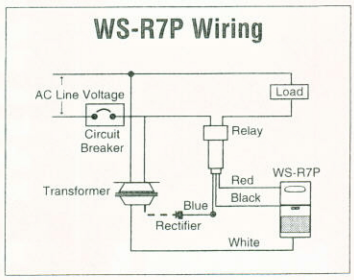




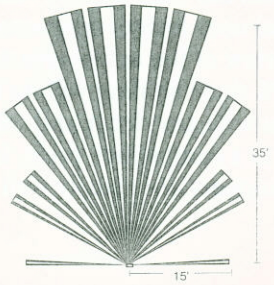
Circuit Schematics



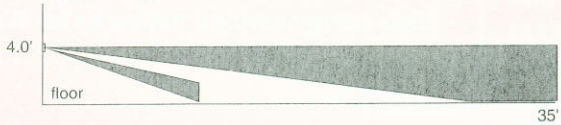




Coverage



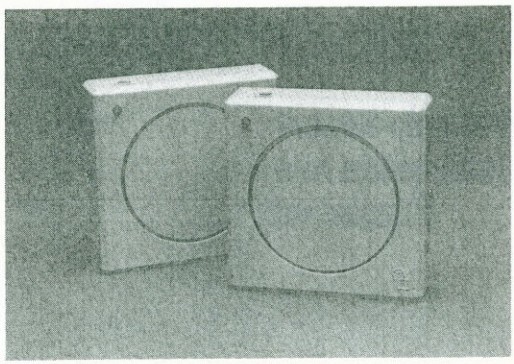
The 2-level lens provides superior coverage at a desk-top level by allowing the sensor to detect vertical as well as horizontal motion. Coverage shown is for walking motion. Under optimum conditions with a high level of activity and with no barriers or obstacles, coverage can reach a maximum of 900 square feet.
Under a typical, desk-top level of activity, when mounted at 4 feet, coverage is 300 square feet.



The Watt Stopper®. Inc.
Recycled Paper
Pub. No. 3203

Ultrasonic Occupancy Sensors

- Proven 30% to 60% savings; Turns lighting on only when needed
- 500, 1000, 2000 sq ft, and hallway coverages available
- Adjustable sensitivity & time delay
- Fully-integrated product line
- UL and CSA Listed; Five year warranty



System Information

The Watt Stopper ultrasonic sensors are versatile motion detectors which control lighting in a wide variety of applications. These sensors can be used individually or as part of an integrated system of Watt Stopper lighting control products.

Operation

The Watt Stopper ultrasonic sensors utilize advanced, omni-directional, Doppler technology to sense occupancy. When an ultrasonic sensor detects movement in a controlled area, it switches lighting on through a Watt Stopper Power or Slave Pack. The sensor controls the power pack through low-voltage wiring. Once the controlled area is vacated and the user-adjustable time delay (15 seconds to 15 minutes) has elapsed, lighting systems automatically switch off.

Features

All Watt Stopper ultrasonic sensors feature adjustable time delay, adjustable sensitivity and a logic key/ON bypass. Also, they feature omni-directional volumetric coverage with models that range from 500 to 2000 square feet of total coverage. The sensors contain an LED detection indicator which makes sensitivity adjustments simple.

Applications & Economics

The Watt Stopper ultrasonic sensors are designed to work together to effectively control offices, restrooms, utility areas, open office spaces and warehouses. The W-500A is perfect for offices, conference rooms, restrooms and other areas up to 500 sq ft. The W-1000A fits in larger spaces such as classrooms and storage areas. The W-2000A is ideal for open office areas or large warehouses and can control partitioned open office spaces when configured in highly-versatile zone patterns. In addition, the W-2000H reliably covers hallways with walls. All Watt Stopper ultrasonic sensors are designed to detect motion of people writing, reaching for phones, typing, etc. In addition, they can be used with Watt Stopper Sentry Switches for manual-on/auto-off function when automatic-on is not desired. Ultrasonic sensors reduce utility costs by turning lighting off when it is not needed. Their easy installation and low initial cost provide fast paybacks.

Specifications

- Solid State, crystal-controlled (25 kHz ± 0.005%)
- Omni-directional transmission (360° coverage)
- Temperature and humidity-resistant 25 kHz receivers, W-500A contains 1 receiver, other models contain 2 receivers.
- Advanced Signal Processing Circuitry
- Logic Key/ON bypass
- 4.5" x 4.5" x 1.25" (115mm x 115mm x 32mm) (W x L x D)
- Time delay adjustable from 15 seconds to 15 minutes
- Available in white

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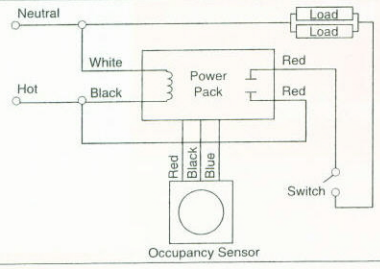
Ultrasonic Sensor Technical Information

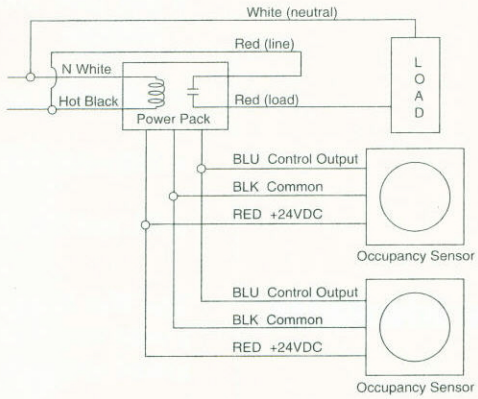
Ordering Information

Catalog No.	Description/Type	Voltage	Current/Load	Coverage	Notes
W-500A	Ceiling Sensor	24 VDC	16 mA	500 sq ft; 360°	1
W-1000A	Ceiling Sensor	24 VDC	16 mA	1000 sq ft; 360°	1
W-2000A	Ceiling Sensor	24 VDC	16 mA	2000 sq ft; 360°	1
W-2000H	Hallway Sensor	24 VDC	16 mA	90 linear ft	1,2

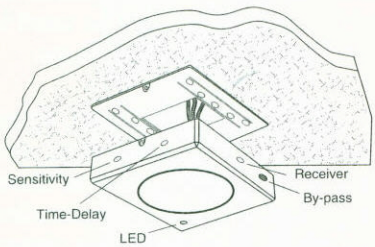
Notes: 1 - Used with Watt Stopper Power Pack
2 - Coverage for enclosed hallway is 10' x 90', see pattern below

Ultrasonic Sensor Schematics and Placement



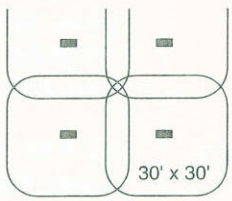


Ultrasonic Sensor Installation



For standard installation, use appropriate hardware to attach mounting plate to ceiling tile. Always try to attach sensor to a vibration-free surface. Mount the sensors with the receivers facing the area of coverage.

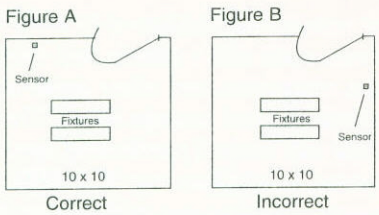
Open Office Sensor Placement



Example of sensor placement in an open office area

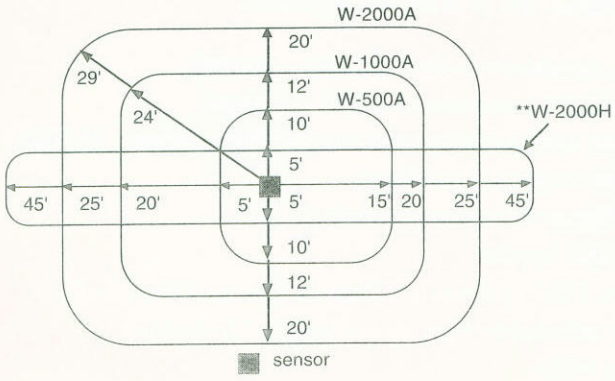
For open office spaces, the W-2000A is most often used because of its 360º coverage and capability to bounce ultrasound off of partitions, walls, floors and other reflecting objects to better sense motion. A typical layout for an open office space would be to place the ultrasonic sensors so they control the office area in zones that overlap. The coverage can be for a 20' x 20' zone and can go up to a maximum of 40' x 40'. A typical zone is about 25' x 25' for the lighting fixtures with an overlap on the sensor coverages that senses motion up to 30' x 30'.

Enclosed Office Sensor Placement



For enclosed spaces, sensors should be placed as in Figure A. Sensors placed as in Figure B may see out the door and cause false triggers.

Coverage



Coverages shown represent half-step walking motion. Actual coverages can vary for each application depending on the shape and the use of space and the obstacles present.

**The W-2000H drawing is not drawn to scale. Coverage is 10' x 90' in a hallway; enclosed spaces enhance coverage. For open (or enclosed) hallways, the CI-100-1 or DT-100L-1 are equally good choices.

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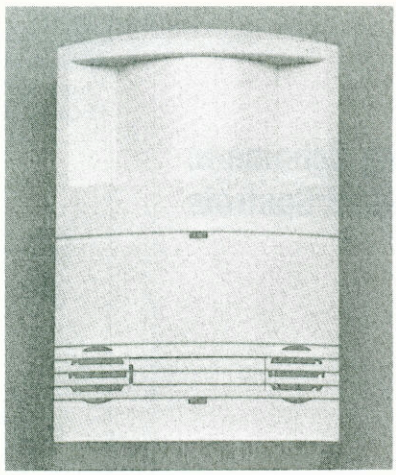
Dual Technology Sensor



- Infrared, Ultrasonic, and Photecell technologies all in one unit
- Eliminates false "ons" and false "offs"
- Highest degree of coverage and highest energy savings of all occupancy sensors
- Adjustable sensitivity & time delay settings
- Contains an isolated relay for use with HVAC or other building systems
- 40kHz + .006% frequency
- UL and CSA Listed; Five year warranty

System Information

The Watt Stopper Dual Technology Sensor (DT-100L) is the most advanced occupancy sensor developed for lighting control. The DT-100L's Patented Dual Technology combines advanced passive infrared and ultrasonic technologies into one sensor for unsurpassed performance. As part of an integrated system of lighting or energy control, the DT-100L uses the advantages of each technology to achieve precise coverage and huge energy savings.

Operation

The DT-100L is a 24 VDC occupancy sensor which controls lighting systems through a Watt Stopper power pack. In the standard mode, the unit operates by turning lighting on when both technologies sense occupancy. After this occurs, detection by either technology holds lighting on. When no occupancy is detected for a user-specified time (15 seconds to 15 minutes) lighting is switched off. Other options are available which need only one technology to trigger or both technologies to hold lighting on. The DT-100L's dual sensing verification principle enables it to eliminate false triggers, allowing users to maximize the sensitivity of each technology and use shorter time out cycles than single technology sensors. For example, it is possible to shorten the time out cycle from 15 minutes to 5 minutes thereby saving 10 minutes each time a space is vacated.

Features

The DT-100L features adjustable sensitivity settings for each technology and an adjustable time delay. The DT-100L also features a built-in light level sensor which can be used to prevent selected sections of lighting from turning on if natural light levels are above a user-specified level (adjustable from 2.5 to 430 footcandles). User-adjustable controls are accessible beneath a swing cover. The DT-100L contains a single-pole, double-throw isolated relay that can be used to interface with HVAC, EMS systems, monitoring systems, or with an additional lighting load. It has normally open and normally closed outputs and is rated for 1 Amp at 24 VDC and 1/2 Amp at 120 VAC. Another feature of the DT-100L is the choice of three different lens patterns. This enables the user to choose the pattern that is best suited for each building space and will result in superior coverage.

Applications

The Watt Stopper DT-100L has the flexibility to work in a variety of applications, both individually and as part of a larger system. The unit can cover up to 1500 square feet when mounted at 10 feet above floor level. Because the DT-100L utilizes both ultrasonic and infrared technologies, it is ideally suited for applications such as classrooms, warehouses, large offices, open office spaces, computer rooms, and other spaces where complete coverage is needed. By combining both sensing technologies into one unit, the DT-100L is able to operate in difficult areas that pose problems for single technology sensors.

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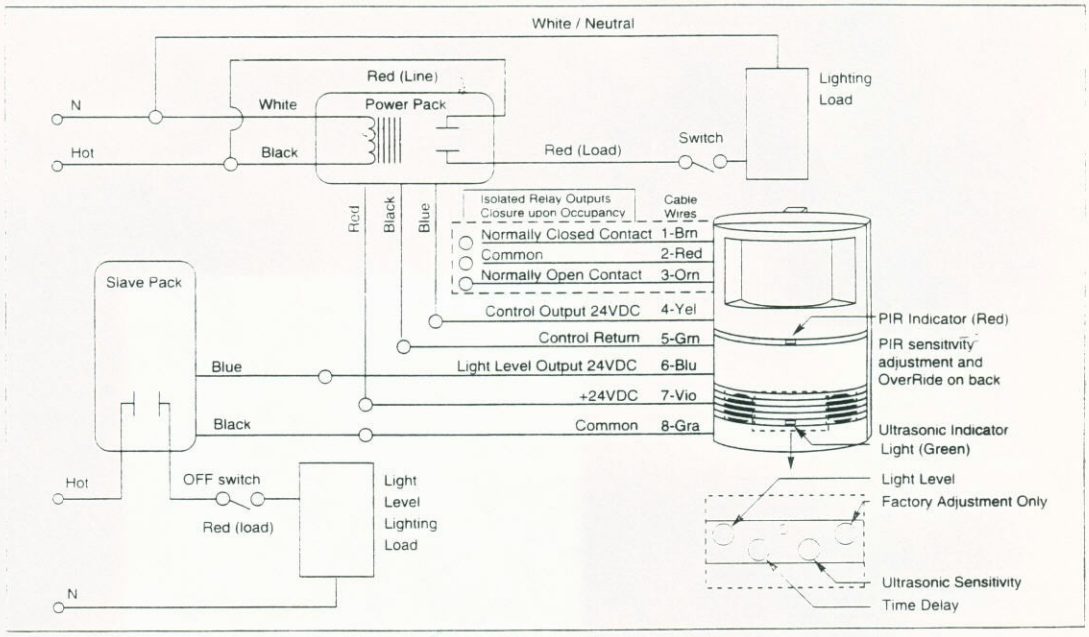
DT-100L Technical Information

Ordering Information

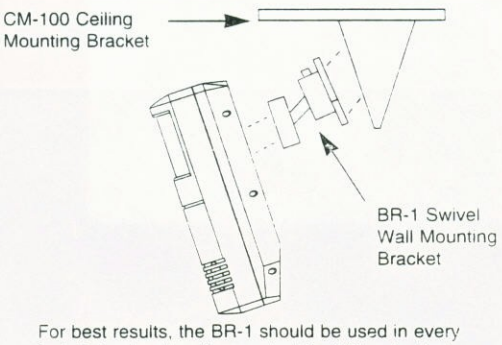
Catalog No.	Description	Voltage	Current*	Coverage
DT-100L	DT Sensor with Dense Wide Angle Lens (standard)	24 VDC	25 mA	up to 1200 sq ft; see below
DT-100L-1	DT Sensor with Long Range Lens	24 VDC	25 mA	up to 90 linear ft; see below
DT-100L-H	DT Sensor with Aisle Way Lens	24 VDC	25 mA	up to 134 linear ft; see below
CM-100**	Ceiling Mounting Attachment Bracket			
BR-1**	Swivel Wall Mounting Bracket			

All Units are white and use Watt Stopper Power Packs
* Current draw is 25 mA for typical use and 33 mA when internal isolated relay is used.
** One CM-100 and one BR-1 are included with each unit

Wiring Schematic & Product Controls



Installation & Control Options

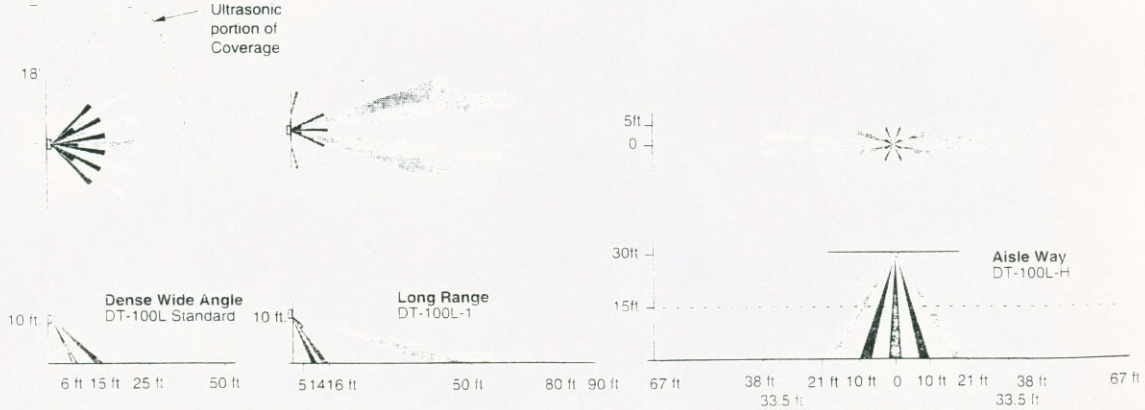


For best results, the BR-1 should be used in every installation to allow for greatest flexibility of adjustment. Brackets are included with each unit.

Technology Control Options - Adjustable by user

	Standard	Option 1	Option 2	Option 4	Option 5
To Trigger Lights On	Both Ultra and PIR	Either One	PIR Only	Ultra Only	Both Ultra and PIR
To Keep Lights On	Either One	Either One	PIR Only	Ultra Only	Both Ultra and PIR
To retrigger within 5 sec of off signal	Either One	Either One	PIR Only	Ultra Only	Both Ultra and PIR
JP4	○ ○	▭	▭	▭	○ ○
JP3	▭	○ ○	○ ○	○ ○	○ ○
JP2	▭	▭	▭	○ ○	▭
JP1	▭	▭	○ ○	▭	▭

PIR Coverage Patterns



Note: Coverages shown are maximum and represent coverage for half-step, walking motion. For ... ing spaces with lower levels of activity or with ...facles and barriers, coverage size may decrease. Ultrasonic coverage is the same on ... els of the DT-100L

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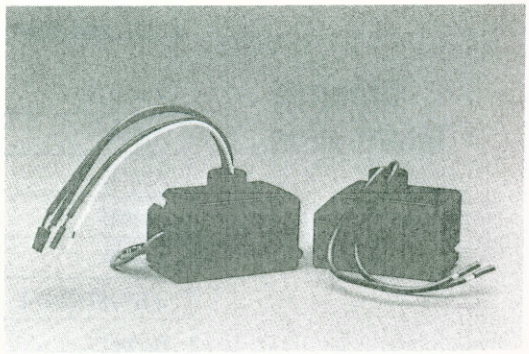
Power and Slave Packs

- Essential part of ceiling mounted occupancy sensor system
- Fully self-contained transformer and relay
- Part of a fully-integrated system
- Easy installation
- Can be used as a low-voltage switch for other applications or as stand-alone low voltage switch
- UL and CSA Listed; Five year warranty



Complete Systems Integration

Power packs provide 24VDC operating voltage to all Watt Stopper 24VDC sensors and are capable of switching 20 Amps of electrical load. Slave packs are similar to power packs but have no transformer power supply, only an isolated relay. Power and slave packs can be combined to control almost any lighting or HVAC load in an area controlled by Watt Stopper occupancy sensors and LightSaver Controllers. It can also operate as a low voltage switching system.

Operation

Power packs consist of a transformer and high-current relay combined in one small, powerful package. The transformer has a primary high voltage input and a secondary 24VDC, 100 mA's output. The secondary voltage provides operating power to Watt Stopper sensors. When the occupancy sensors detect motion or light sensors detect inadequate ambient light, they electrically close an internal circuit which sends 24 VDC back to the power or slave packs which control lighting systems.

Features

Power packs are available for 120, 220 to 240, 277 and 347 Volt systems. They are housed in an ABS, UL-rated 94V-0 plastic enclosure. The power packs' 1/2-inch snap-in nipple attaches to standard electrical enclosures through 1/2-inch knockouts. Leads are teflon coated for use in plenum applications.

Applications

Since The Watt Stopper sensors are designed to work over an extremely wide range of applications, the Watt Stopper power packs are designed to be very flexible. For example, power packs can control lighting circuits, self-contained air conditioners, pumps, fans, motors, VAV systems, motorized damper controls and setback thermostats. They are excellent for any application which requires high-voltage switching through low-voltage controls. The use of power and slave packs eliminates the need for expensive high-voltage switching. Watt Stopper power packs can operate up to three ultrasonic and up to four infrared sensors. By linking power packs and sensors, an almost unlimited number of configurations can be obtained. Power packs can also be used as stand alone 24 VDC low voltage switching systems.

Economics

Power packs provide a cost-effective method of powering Watt Stopper sensors while controlling lighting systems. They are also excellent for any application which requires high-voltage load switching through low-voltage controls. Their easy installation, versatility and low cost provide for fast paybacks on control systems.

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Power and Slave Pack Technical

Power Pack Specifications

- Self-contained transformer relay system
- Secondary voltage: 24 VDC Secondary output: 100 mA
- Enclosure: UL-rated 94V-0 plastic enclosure
- Size: 1.6" x 2.75" x 1.6" (41mm x 70mm x 41mm) with a 1/2-inch snap-in nipple
- Used with Watt Stopper 24VDC ceiling mount occupancy sensors
- Can be used as stand-alone low voltage switch
- UL and CSA Listed; Five-year warranty

Ordering Information

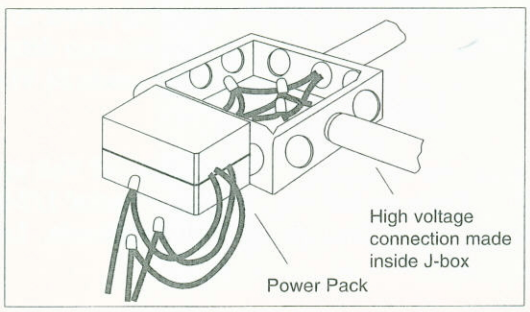
			Load Ratings (Amps)				
Catalog No.	Description/Type	Voltage	Ballast	Incan.	General	Motor	Output VDC
A120-E	Power Pack	120	20	13	13	1 HP	24 VDC; 100 mA*
A277-E	Power Pack	277	20	-	13	1 HP	24 VDC; 100 mA*
A230-D	Power Pack	220-240	15	10	13	1 HP	24 VDC; 100 mA*
A347-D	Power Pack	347	15	-	13	1 HP	24 VDC; 100 mA*
S-120/277/347-E	Slave Pack	120/277/347	20	13	13	1 HP	
AT-100**	Transformer	24 VDC					up to 1000 mA

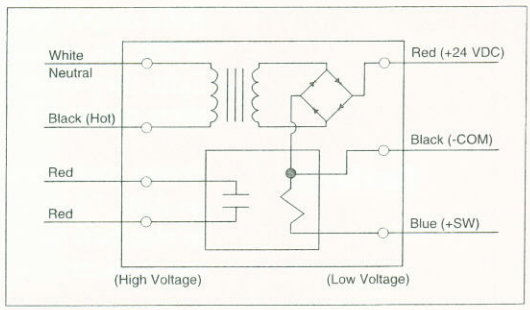
* The power pack output is 100mA before relay is connected and 64mA after relay is connected.
** For installations where many sensors are used, the AT-100 will provide up to 1000mA of 24VDC to power sensors. Note that this is just a transformer and Watt Stopper power/slave packs are still needed to do the switching.

Installation Notes

1) All Watt Stopper power packs should be installed in accordance with state, local and national electrical codes and requirements.
2) Power packs are designed to attach to existing or new electrical enclosures with 1/2 inch knockouts. In plenum ceilings, install power packs in approved electrical enclosures. (Check electrical codes in your area.)
3) Most applications require UL listed, 18-22 AWG, 3-conductor, Class 2 cable for low voltage wiring. For plenum return ceilings use UL listed plenum-approved cables.

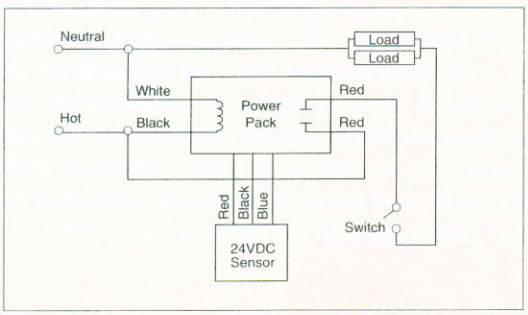
Installation Diagram & Schematic



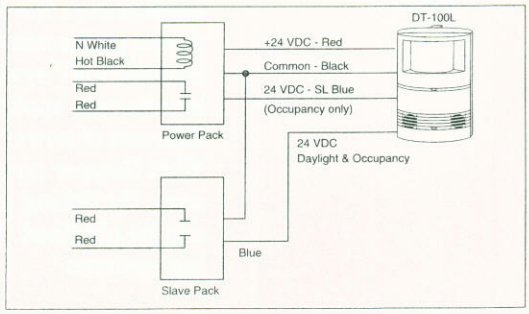


Electrical Schematic Sensor System

Ceiling Sensor with Power Pack

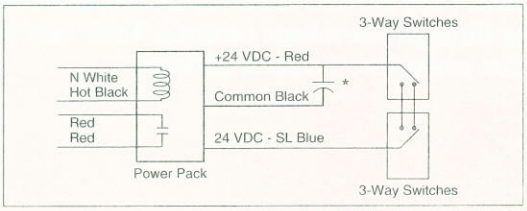


DT-100L Schematic with Slave Pack

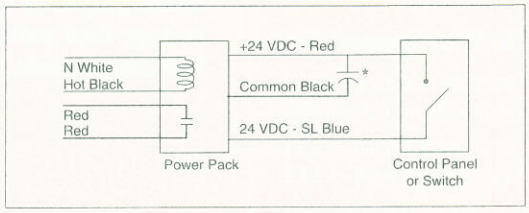


Low Voltage Switching

3-Way Low Voltage Switching



Low Voltage System Control



Note: *Capacitor between Red and Black - 100 µf, 35 V

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Appendix C

Variable Frequency Drive Product Information

ABB drives for HVAC applications

ACH550, 0.75 to 355 kW

Drive^{IT} Low Voltage AC Drive

ABB drives for HVAC: Wide power range

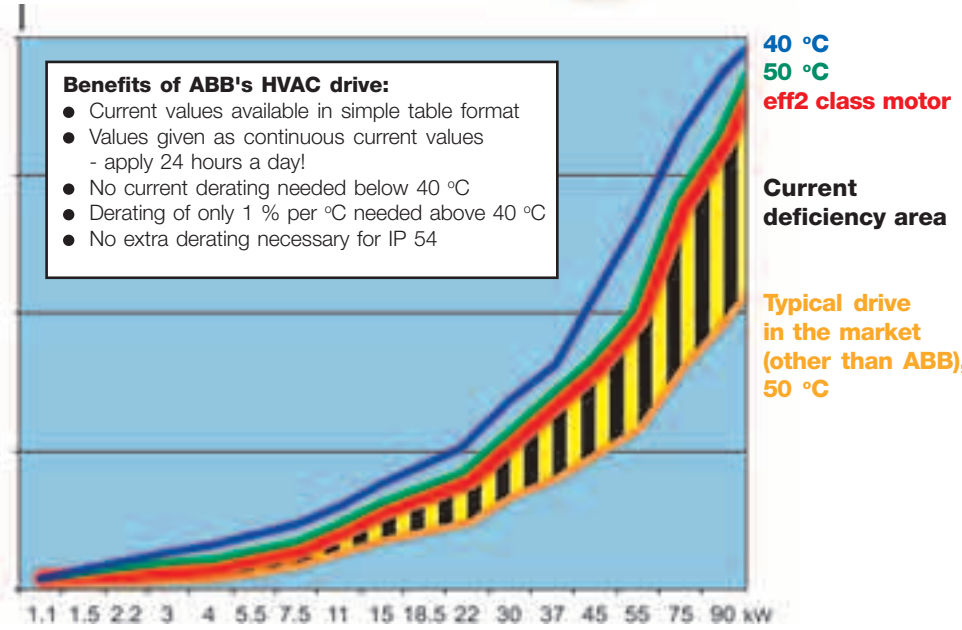
The introduction of a dedicated ABB drive for HVAC marks a significant milestone in the development of AC drives. Macros for the most common applications are built into the new drive as standard. Selecting the application takes only seconds. The rest of the start-up is intuitive, with a user interface as simple to use as a mobile phone.

The drive is programmed with several HVAC applications, including supply and return fans, cooling tower fans, booster pumps and condensers. The intelligence within the HVAC control panel means that the user is given direct and understandable instructions in clear text at all times.

Harmonics and RFI emissions are major concerns in many HVAC installations. The ABB drive for HVAC fulfils demanding requirements for electromagnetic compatibility. A patent pending, swinging DC choke cuts harmonics emissions by up to 25 %.

Full output at 40 °C and above!

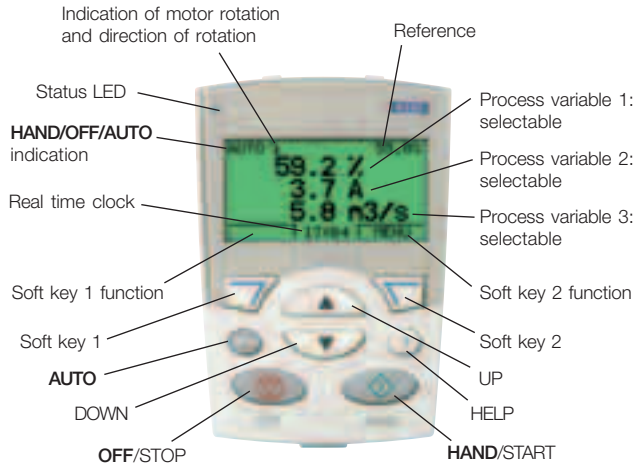
Ambient temperatures affect the output performance of each drive. The hotter it is outside - or inside the cabinet in which the drive is installed - the less current the drive can deliver. This means that the designer has to select the drive according to the peak temperature.



The figure shows output currents of the HVAC drive at ambient temperatures of 40 °C and 50 °C. The thick red curve illustrates the required nominal motor current, while the orange curve shows the output current of a typical drive (other than ABB) in the market.

Tailor-made control panel for HVAC applications

- Guides the user through installation and start-up
- Help button always available
- Up- and downloading of parameters from one frequency converter to another
- Easily detachable by hand (both IP 21 and IP 54)
- Built-in real-time clock
- 14 languages available



"We specify ABB drives and have them running in more than 3,000 buildings. Their simplicity and reliability allow me to concentrate on my job without having to worry about the HVAC installation."

"When I call ABB, I know I get the right answer."

"With ABB's energy saving tools, I can prove that the money saved helps justify the investment. Some people like the general idea of saving energy, some people want to go into the smallest detail. Either is possible with ABB's HVAC drive."

"I don't have to look for external components like timers and PID controllers and then worry about their compatibility."

"The ABB HVAC drive does precisely what it is engineered to do - when the building gets hot the drive delivers air flow to suit."

"ABB HVAC drive documentation is simple and clear to understand. For the first time in a long while I never get calls from our personnel on site."

"Once the ABB HVAC drive is installed, that's the last time I hear about it."

Peace of mind

Wide power range
from 0.75 to 355 kW, 200/240 V or 380/480 V, covering the vast majority of HVAC applications.

Built-in EMC filter
EMC filter for 1st environment, built-in as standard, eliminates the need for any external filtering in building technology.

Real-time clock and calendar
The built-in real-time clock and calendar function provides true time and date stamps to drive events. Information is displayed clearly on the control panel.

Built-in timers
External timer circuits are no longer needed. Built-in timers - utilizing the real-time clock - allow starting and stopping the drive or changing the speed according to the time of day or night. Relay outputs can be operated with timers to control any auxiliary equipment on site.

The motor can deliver full output at 40 °C - shouldn't the frequency converter do the same?
ABB's HVAC drive is rated for continuous operation to 40 °C with full current, without being compromised by temperature variations within any 24-hour period. Full circulation is available, precisely when needed - usually, when it is hot outside. Similarly, IP 54 units can be operated without the need for de-rating up to 40 °C. At a temperature of 50 °C, only 10 % de-rating is required for both IP 21 and IP 54.

IP 21

BACnet, N2, FLN and Modbus embedded
Commonly used HVAC fieldbuses are embedded into the memory of the drive, ensuring that they are always there if you need them. ABB has a long history in building automation with more than 25,000 installed and running applications of N2 solutions alone.

LonWorks and Profibus
LonWorks, Profibus and other plug-in modules fit under the cover of the drive. A single twisted pair avoids great lengths of conventional cabling, reducing cost and increasing system reliability.

- as standard!

Swinging DC chokes - up to 25 % less harmonics
ABB's patent pending swinging DC choke lets the HVAC drive deliver up to 25 % less harmonics at partial loads, compared to a conventional choke of equal size. There is no need to oversize the supply cables.

Multilingual control panel with hand-off-auto
If you can use a mobile phone, you can use the control panel of the HVAC drive, which features intuitive handling in 14 languages. Three process variables in engineering units or as a bar-chart are supported. Both IP 21 and IP 54 panels are detachable and able to copy parameters from one frequency converter to another. The panel can also be installed on the cabinet door with a fixing kit.

Pre-configured HVAC application macros
14 different HVAC application macros are pre-programmed into the HVAC drive. Application macros for supply and return fans, cooling tower fans, booster pumps and condensers are available, just to name a few. The user can create two additional application macros, selectable manually or through a digital input. To illustrate this, the user can create "summer" and "winter" application macros and select between these according to the time of the year.

IP 54

HELP button always available
The control panel has a built-in help function to guide the user, enabling clear text advice without the need to refer to manuals.

Interactive start-up assistant
The HVAC drive has an interactive start-up assistant that expertly guides the user through the start-up, without the need to refer to manuals.

Tailor-made HVAC software features without compromises
ABB's HVAC drive delivers a complete solution with a tailor-made configuration that will save you time and money. For example, actual process values like differential pressure signals can be converted inside the frequency converter and displayed in engineering units like bar, l/s and °C.

Motor protection with PTC or PT 100

"A great feature is the start-up assistant. It guides me through the start-up routine of the drive, very quickly and easily, enabling me to put a less experienced person on the job."

"The ABB HVAC drive speaks my language - even in full sentences! I save time and money."

"Thanks to smart design, control and power cables are extremely easy to connect."

"The ABB HVAC drive has all the functionality I need, built-in. So I don't have to check for the order handling to see if all add-ons have been included. One less thing to worry about."

"With the timer function I can leave out Building Management System (BMS) automation completely on smaller jobs."

"ABB's no-quibble warranty means just that - no questions are asked, so paperwork is kept to a minimum."

"The energy saving capability of the HVAC drive means it pays back in less than two years. After that the drive provides profit straight to my bottom line."

"My system delivers the output I require, when I need it, and especially when it is hot outside."

"Reaction to load-change is fast and I only pay for the peak-capacity when it is needed."

"I love the Help button. I call it my panic button - it quite simply is always available to guide me."

"The ABB HVAC drive's silence is music to my ears!"

"With the swinging DC choke taking care of harmonics, I only pay for the electricity that works for me and not for the electricity that just causes losses."

"Tripless operation is a great feature - for me it means no trips by my maintenance personnel."

"In case of an alarm or fault situation, the diagnostic assistant automatically tells me in clear language what to do."

"With built-in and plug-on fieldbusses I'm flexible for all future automation needs."

"The maintenance assistant is another great feature of the ABB HVAC drive. I simply do not have to worry about when to service the equipment. The drive tells me when it is time to send people to do maintenance."

"ABB will be here in 10 years time and beyond. That is the biggest guarantee you can give me."

Peace of mind

Interactive maintenance assistant
Maintenance scheduling no longer requires guesswork. The HVAC drive alerts you when maintenance is required based on your individual requirements.

Interactive diagnostic assistant
Should a fault occur, the diagnostic assistant displays, in plain language, possible causes and potential solutions.

Fault logger
The fault logger of the HVAC drive is especially useful in tracking down drive failures through its use of the real-time clock.
In addition to recording both time and date, the fault logger also takes a snapshot of 7 diagnostic values - like motor speed and output current. You know what happened and when.

Versatile software tools
DriveWindow Light 2 further facilitates commissioning and maintenance. Pump & Fan Save helps calculate energy savings and pay-back times. DriveSize optimizes the selection of the drive (frequency converter plus motor) according to the load requirements.

- as standard!

Flange mounting
The HVAC drive can be flange-mounted to the side of an air duct or integrated with an air handling unit (AHU). By placing the heat sink of the HVAC drive in the air flow, additional cooling is achieved efficiently.

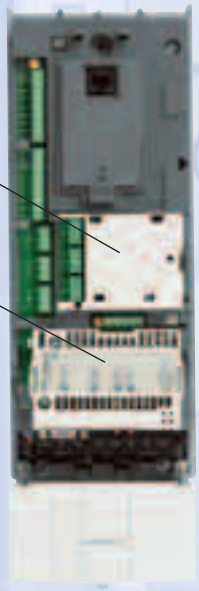
Flux optimization
With flux optimization, the magnitude of the flux varies depending on the actual load. This results in reduced energy consumption and lower noise levels. Silent operation functions further reduce noise in domestic applications.

Two PID controllers as standard
The HVAC drive has two independent PID controllers built in. As an example: one PID controller works with the frequency converter to maintain the duct static pressure. Simultaneously, the other PID controller can be used to control a separate external device, e.g. a chilled water valve. All of this can, of course, be monitored and controlled through serial communications.

Panel mounting side by side
ABB's HVAC drive is optimized for building into cabinets: no space is needed between the units, whether IP 21 or IP 54, even with the covers on.

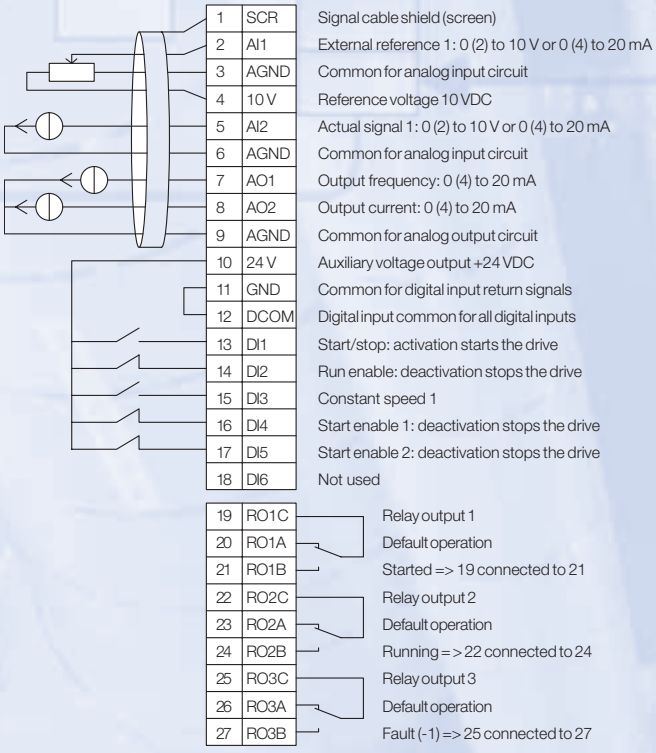
Options

- Relay extension module for three additional outputs (module fits under the cover of the HVAC drive).
- Fieldbus adapter modules (fit under the cover of the HVAC drive) for LonWorks (LonMark approved), Profibus, DeviceNet, etc.
- Control panel mounting kit for cabinet door mounting.
- Output filters, please contact ABB.



Inputs and outputs

The diagram below shows the inputs and outputs of the HVAC drive. The sample connections are suitable for a number of HVAC applications like supply and return fans, condensers and booster pumps.



- All inputs and outputs are short-circuit protected.
- All connectors are individually numbered, reducing possible causes of misunderstandings and errors.

Technical data and types

Technical specification

Mains connection

Voltage and power range	3-phase, 380 to 480 V, +10/-15 % (0.75 to 355 kW) 3-phase, 200 to 240 V, +10/-15 % (0.75 to 75 kW) 1-phase, 200 to 240 V, +10/-15 % (50 % derating) auto-identification of input line
Frequency	48 to 63 Hz
Power factor	0.98

Motor connection

Voltage	3-phase, from 0 to U_N
Frequency	0 to 500 Hz
Rated currents (apply to both IP 21 and IP 54) Current at ambient temperature of -15 to +40 °C: rated output current (I_{2N}), no de-rating needed Current at ambient temperature of +40 to +50 °C: de-rating of 1 %/°C above 40 °C, max. derating 10 %	
Switching frequency	selectable 0.75 to 110 kW 1 kHz, 4 kHz, 8 kHz, 12 kHz 132 to 355 kW 1 kHz or 4 kHz

Environmental limits

Ambient temperature	
Transportation and storage	-40 to 70 °C
Operation	-15 to 50 °C (no frost allowed)
Altitude	
Output current	rated current available at 0 to 1000 m reduced by 1 % per 100 m over 1000 to 2000 m
Relative humidity	lower than 95 % (without condensation)
Protection classes	IP 21 or IP 54 IP 21 for wall mounted and free standing units IP 54 for wall mounted units

Inputs and outputs

2 analog inputs	selectable both for current and voltage
Voltage signal	0 (2) to 10 V, Rin > 312 kΩ single-ended
Current signal	0 (4) to 20 mA, Rin = 100 Ω single-ended
Potentiometer reference value	10 V ±2 % max. 10 mA, R < 10 kΩ
2 analog outputs	0 (4) to 20 mA, load < 500 Ω
Internal auxiliary voltage	24 V DC ±10 %, max. 250 mA
6 digital inputs	12 V to 24 V DC with internal or external supply
3 relay outputs	Maximum switching voltage 250 V AC/30 V DC Maximum continuous current 2 A rms
PTC and PT 100	PTC any of the 6 digital inputs or analog inputs can be configured for PTC PT 100 both analog outputs can be used to feed the sensor
Fieldbuses	Built-in as standard (RS 485) BACnet, Modbus, N2 and FLN Available as plug-in options LonWorks, Profibus, DeviceNet etc.

Protection functions

Overvoltage controller
Undervoltage controller
Earth-leakage supervision
Motor short-circuit protection
Output and input switch supervision
Overcurrent protection
Phase-loss detection (both motor & line)
Underload supervision - can be used also for belt-loss detection
Overload supervision
Stall protection

Product compliance

Low Voltage Directive 73/23/EEC with supplements
Machinery Directive 98/37/EC
EMC Directive 89/336/EEC with supplements
Quality assurance system ISO 9001 and Environmental system ISO 14001
CE, UL and cUL approvals
Galvanic isolation according to PELV

EMC (according to EN61800-3)
1st environment restricted distribution as standard

Ratings, types and voltages

P_N kW	I_{2N} A	Frame size	Type code (order code)
U_N = 380 to 480 V (380, 400, 415, 440, 460, 480 V) HVAC control panel and EMC filter are included.			
0.75	2.4	R1	ACH550-01-02A4-4
1.1	3.3	R1	ACH550-01-03A3-4
1.5	4.1	R1	ACH550-01-04A1-4
2.2	5.4	R1	ACH550-01-05A4-4
3	6.9	R1	ACH550-01-06A9-4
4	8.8	R1	ACH550-01-08A8-4
5.5	11.9	R1	ACH550-01-012A-4
7.5	15.4	R2	ACH550-01-015A-4
11	23	R2	ACH550-01-023A-4
15	31	R3	ACH550-01-031A-4
18.5	38	R3	ACH550-01-038A-4
22	44	R4	ACH550-01-044A-4
30	59	R4	ACH550-01-059A-4
37	72	R4	ACH550-01-072A-4
45	96	R5	ACH550-01-096A-4
55	124	R6	ACH550-01-124A-4
75	157	R6	ACH550-01-157A-4
90	180	R6	ACH550-01-180A-4
110	195	R6	ACH550-01-195A-4
132	245	R7	ACH550-02-245A-4
160	289	R7	ACH550-02-289A-4
200	368	R8	ACH550-02-368A-4
250	486	R8	ACH550-02-486A-4
280	526	R8	ACH550-02-526A-4
315	602	R8	ACH550-02-602A-4
355	645	R8	ACH550-02-645A-4

I_{2N} = nominal output current. ABB's HVAC drive can deliver I_{2N} continuously at an ambient temperature of 40 °C. In addition, 1,1 x I_{2N} overload is allowed for 1 minute every 10 minutes through the entire speed range.
P_N = typical motor power
U_N = nominal supply voltage

Dimensions and weights

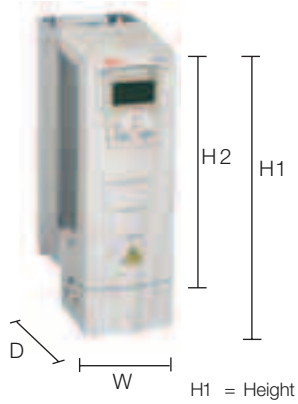
Wall mounted units

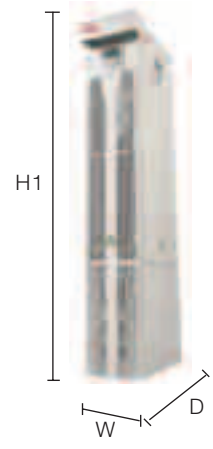
Frame size	Dimensions and weights								
	IP 21 / UL type 1					IP 54 / UL type 12			
	H1 mm	H2 mm	W mm	D mm	Weight kg	H mm	W mm	D mm	Weight kg
R1	369	330	125	212	6.5	449	213	234	8.2
R2	469	430	125	222	9	549	213	245	11.2
R3	583	490	203	231	16	611	257	253	18.5
R4	689	596	203	262	24	742	257	284	26.5
R5	739	602	265	286	34	776	369	309	38.5
R6	880	700	300	400	69	924	410	423	86

Free standing units

R7	1507	N/A	250	520	115
R8	2024	N/A	347	617	230

N/A = not applicable





H1 = Height with cable connection box
H2 = Height without cable connection box
W = Width
D = Depth

ABB Oy
Drives
P. O. Box 184
FIN - 00381 Helsinki
Finland
Telephone +358 10 22 11
Telefax +358 10 222 2681
E-mail hvac@fi.abb.com
Internet http://www.abb.com/motors&drives

3AFE 68295378 REV C EN 24.6.2004 Specifications subject to change without notice.

Ad agency Piirtek Oy #11373

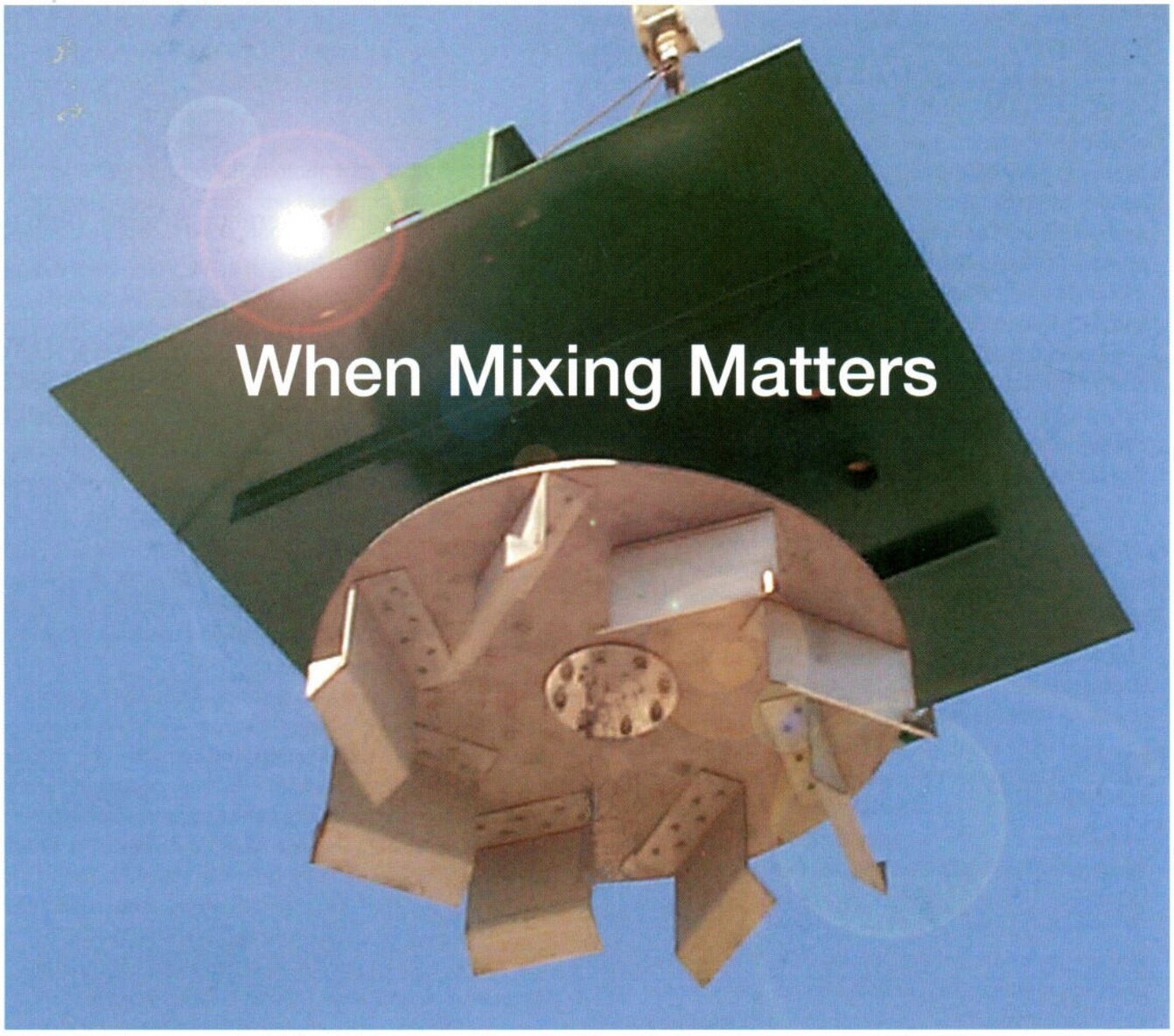
Appendix D

Surface Aerator Product Information

m²t technologies

The HI-FLO Surface Aeration System™

for wastewater treatment



Mixing & Mass Transfer Technologies

The HI-FLO Surface Aeration System™ putti

The HI-FLO Surface Aeration System™ is a significant technical advancement in wastewater treatment surface aeration. The improvement is embodied in both the patented HI-FLO Surface Aerator turbine design (Figure 1) and its mode of operation. Independent, large-scale ASCE standardized testing has shown that the HI-FLO Surface Aeration System™ is 15% to 40% more efficient (as measured by Standard Aeration Efficiency, SAE) than any other surface aerator. In addition, liquid pumping rates are significantly higher.

Dramatic Energy Savings

How does the HI-FLO Surface Aeration System™ attain these efficiencies? The HI-FLO turbine's performance is due to both the blade design and the way the aerator operates. Each blade of the HI-FLO turbine, as seen in Figure 1, consists of pitched lower portion attached to a vertical plate. All the blades are attached to a disk which then mounts to the gearbox output shaft. The HI-FLO turbine is physically similar in appearance to disk-type surface aerators, and operates at similar rotational speeds. However, the HI-FLO turbine's mode of operation and performance are significantly different.

Although the HI-FLO Surface Aeration System™ may look like other slow speed disk-type surface aerators, the mixing and mass transfer performance of the HI-FLO System is far superior to these conventional surface aerators. That's because of the way it operates. The HI-FLO Surface Aeration System™ turbine is rotated in the up-pumping direction, which means that the turbine's lower blade edges in Figure 1 are the leading edge. This is unlike other slow speed surface aerators, which rotate in the opposite direction, or in an inefficient down-pumping mode.

Improved Process Performance

Novel Operating Mode

Rotating in the up-pumping direction, the HI-FLO Surface Aeration System™ turbine becomes a positive pumping impeller. This is unlike more conventional surface aerator turbines, whose direction of rotation makes them induced flow devices. As such, the liquid pumping rate of the HI-FLO Surface Aerator System™ far exceeds

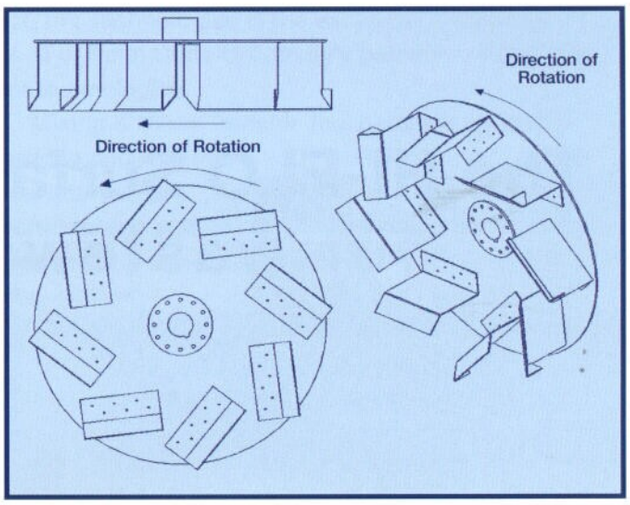


Figure 1
The HI-FLO Surface Aeration System™ Turbine

the pumping rates of conventional surface aerators. In fact, HI-FLO Surface Aeration System's liquid pumping rates are approximately two to three times those of other slow speed surface aerator turbines, given equivalent horsepower draws. Consequently, the mixing capabilities of the HI-FLO Surface Aeration System™ far exceed those of conventional surface aerators. In many cases, the HI-FLO surface aerator's mixing capabilities can only be matched by adding bottom impellers to conventional surface aerators, which significantly increases the power consumption and capital cost of those conventional surface aerator designs.

Superior Pumping Capacity

So, if you're using conventional surface aerators, you're going in the wrong direction! On the following pages you'll find the technical data proving our mass transfer and mixing performance claims. And to add to your further overall comfort level concerning performance, the HI-FLO Surface Aeration System™ is already installed at some of the largest wastewater treatment plants in the world, including Boston's Deer Island facility, the Detroit Wastewater Treatment Plant, and the JWPCP in Los Angeles County. The HI-FLO Surface Aeration System™ from Mixing & Mass Transfer Technologies is more energy efficient than any surface aerator design on the market today! We'll guarantee

g a new spin on surface aeration

that. Let us prove it to you on your next retrofit or new plant design.

Energy Efficiency

For public and private utilities today, efficiency is the name of the game. Mixing & Mass Transfer Technologies' exhaustive testing programs have shown over and over again that the HI-FLO Surface Aeration System™ is more energy efficient than any other surface aerator design on the market today!

The HI-FLO Surface Aeration System™ was developed in the chemical engineering laboratories of Penn State University during the late 1980s and 1990s. Although the conceptual design evolved from theoretical considerations and simulations that were first tested in small laboratory models, the testing rapidly moved to full scale systems. This is because small scale testing of wastewater aeration equipment can produce specious results. And by "full scale," we mean large test basins. We've tested in basins with surface dimensions up to 84 ft x 84 ft, and up to liquid depths of 30 feet. Recent ASCE standardized tap water testing results conducted in a 49 ft x 49 ft tank with 17 ft liquid depth are shown in Table 1.

Table 1
Hi-Flo Surface Aeration System™ ASCE Tap Water Test Results (with bottom impeller)

Turbine Diameter, in.	RPM	sHp	SOTR	SAE
75	56	45	202.5	4.5
75	56	52	229.0	4.4
80	56	63	271.0	4.3
83	56	81	332.0	4.1

Our testing has definitively established that the HI-FLO Surface Aeration System™ is superior to other surface aeration equipment from both an oxygen transfer and liquid mixing standpoint. Table 2 shows comparative SAEs for the HI-FLO Surface Aeration System™ and slow speed, conventional PBT and multi-vaned disk-type surface aerators. Depending on actual operating conditions in the aeration tank, the HI-FLO Surface Aeration System™ is as much as 40% more energy efficient than other slow speed surface aerators. And this improvement applies regardless of tank geometry or whether the aerators are being used in atmospheric air or high purity oxygen wastewater treatment systems.

Save Operating Costs

Comparing surface aerators with diffused air systems, as all process designers realize, is somewhat more difficult to do. This is because diffused systems express oxygen transfer efficiency on a different basis than surface aeration systems. Diffused system efficiencies are expressed as an SOTE (Standard Oxygen Transfer Efficiency, %), while surface aeration system efficiencies are expressed as an SAE (Standard Aeration Efficiency, lbs O_2/hp-hr). Also, in actual wastewater treatment operation the two systems are affected differently by other wastewater parameters such as alpha and beta factors and whether the diffuser units are clean or dirty. The point is that comparing ASCE defined standard condition efficiencies between these two systems is meaningless at best, or downright misleading at worst.

Therefore, Table 2 lists the aeration efficiency (AE, lbs O_2/hp-hr) for each type of aeration system. To the process designer or plant manager, this is the most important parameter, since it is a direct measure of the actual power used to deliver a unit of oxygen to the

Table 2
Comparative Aeration Efficiencies

	HI-FLO Surface Aeration System	Conventional PBT Surface Aerators	Multi-vaned Disk-type Surface Aerators	Coarse Bubble Diffusers	Fine Bubble Diffusers
Nominal Power Density, sHp/1000 gal.	0.15– 0.25	0.15– 0.25	0.15 – 0.25	—	—
SAE, lbs. O_2/sHp-hr. or SOTE, %	4.0	3.1	3.4	17%	40%
Aeration Efficiency (AE), lbs. O_2/bHp-hr.	**3.3 – 3.4**	**2.1 – 2.4**	**2.2 – 2.5**	**1.4 – 1.7**	**3.3 – 3.4**

The HI-FLO Surface Aeration System™ Pump It Up a Notch

biomass in actual wastewater. Table 2 was prepared using optimal aeration tank geometry for each type of aeration system, a liquid depth of 20 feet, air as the aerating gas, generally accepted magnitudes for alpha and beta factors for each system, and the same design dissolved oxygen concentration for each system. Lack of space here prevents a complete explanation of each system design, but our design calculations for each type of aeration system are available upon request. As the efficiency magnitudes indicate in Table 2, the HI-FLO Surface Aeration System™ is definitely competitive with any type of diffused aeration system. And surface aerators are generally cheaper to install and aren't plagued by the maintenance/repair and significant cleaning costs associated with diffusers.

Reduced Maintenance Costs

The Company

Mixing & Mass Transfer Technologies is a U.S. corporation with home offices in State College, Pennsylvania. Dr. John R. McWhirter, an internationally recognized expert in the field of mass transfer and fluid mixing processes, founded the company in 2001 with other recognized experts in the wastewater industry. The company is presently staffed by experts in Wastewater Treatment and the Chemical Process Industries. Much of the company's unique and proprietary technology comes from many years of research and development by Dr. McWhirter in the Chemical Engineering Department of The Pennsylvania State University. In fact, m²t Technologies is the exclusive marketing agent for all of Penn State University's patented mixing system technologies.

Technical Innovators

Mixing & Mass Transfer Technologies' technical portfolio consists of proprietary, engineered mixing and mass transfer systems, nutrient removal processes (SHARON™ and InNitri™), an MBBR-type system (Linpor™) for simple plant expansions, ATAD, UNOX®, and LOTEPRO® Environmental Services. All of the company's products are designed to significantly improve upon existing technologies. The mixer systems consist of the HI-FLO Surface Aeration System™ for wastewater treatment aeration and the Draft Tube Mixing System for many types of industrial mixing and mass transfer processes. The Draft Tube Mixing System is used mostly in high intensity mixing and gas-liquid mass transfer applications involving non-Newtonian shear-thinning liquids found in the fermentation, chemical/petrochemical, and food processing industries.

Next Generation Technology

If you've got a mass transfer and/or mixing dilemma or need state-of-the-art wastewater process technology, we're confident we can help. For next generation processes and services, contact the experts at Mixing & Mass Transfer Technologies.

Mixing & Mass Transfer Technologies
PO Box 315
State College, PA 16804
Phone: 888-715-9600 Fax: 814-466-8761
On the web: www.m2ttech.com

LOTEPRO
Environmental Systems Group

C&S Engineers
499 Col. Eileen Collins Blvd.
Syracuse, NY 13212

March 1, 2006

Attn: Mr. Adam Knapp

Mr. Knapp:

It was good to talk to you on Tuesday. We have discussed upgrade possibilities with the County over our long term relationship since startup of their UNOX high purity oxygen systems.

The Mixing & Mass Transfer Technologies (m^2t) state-of-the-art HI-FLO Surface Aeration System^{sm} provides a significant technical advancement in wastewater treatment surface aeration in both Standard Aeration Efficiency (SAE) and liquid pumping. Independent, large-scale, ASCE testing has shown a 20% to 40% higher SAE as compared to conventional surface aerators, as well as higher liquid pumping rates. Our HI-FLO Surface Aeration System is currently installed at the Deer Island WTP in Boston; the JWPCP plant in Carson, CA; the Moccasin Bend WTP in Chattanooga, TN; the Yuba City, CA WTP; the Detroit, MI WTP; the Two Bridges, NJ WTP; the Salem, MA WTP and the Grand Island NY WTP. The bottom line for the Onondaga County facilities is;

- Higher efficiency – lower energy cost
- Higher liquid velocities and improved bio-solids suspension and mixing throughout the aeration tank
- More uniform dissolved oxygen levels throughout the aeration tank

Facilities now have the choice of (a) maintaining current oxygen mass transfer rates with significantly reduced energy, or (b) operating at current energy levels with increased oxygen mass transfer capability (capacity increase).

A. Upgrade Considerations

Relative to the Baldwinsville facility, Figure 1 provides a general arrangement of the UNOX and Aerobic Digestion Systems. Issues considered in my proposed scope of supply for upgrade include;

- The facility typically operates three of the five reactor trains,
- The facility only operates one of the two digester tanks,
- The facility indicates satisfaction with mechanical condition of the existing gear reducers, so I am not proposing to replace the gear reducers,
- m^2t will be able to provide an impeller for mounting on the existing shafts.
- The facility indicates an electric cost of 11 ¢/kwh

I do not have any details on operating kw, however, if we assume that the existing equipment on-line (1@75 HP, 3@25HP and 6@15 HP) is operating at 85% of

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http://www.m2ttech.com

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Pawcatuck, CT 06379
Telephone (860) 599-5381
Fax (860) 599-8073

nameplate, the operating kw would be approximately 152 (240 HP x .746 x .85). From the enclosed papers and reports, a 20% reduction in energy would be a very conservative value. This would translate to a 30 kw savings, or approximately $30,000 per year at 11 ¢/kwh. The 20 year Net Present Value of this energy savings would be $396,000 (11 ¢/kwh, 5% rate, 1% per year energy cost escalation)

For the Oak Orchard facility, the plant indicates that all 12 aerators (30 HP) are in operation. I do not have details on total kw, however, if the units are 85% loaded, a conservative 20% energy savings (45 kw) would translate to an annual savings of $43,000. The 20 year NPV of this energy savings would be $585,000.

B. Proposed Supply

After preliminary review of drawings of your existing aeration units, we will be able to provide HI-FLO impellers for attachment to the existing shafts and operate at the existing reducer output speeds. For the Baldwinsville facility we propose to provide new impellers for one 75 HP unit (digester), three 25 HP units and six 15 HP units.

For the Oak Orchard facility we propose to provide new HI FLO impellers for all twelve 30 HP units.

The surface impeller will be removable from the shaft through a coupling or hub. Material of construction of the impeller will be epoxy coated carbon steel.

Budgetary price for the twelve (12) impellers for the Oak Orchard facility is $170,000. This also would include 2 on-site workshifts support during installation and startup.

D. Additional information

Additional information I previously provided to Amir Yazdi on a CD included;

- HI-FLO Aerator Brochure
- Brief Summaries of similar tests and upgrades at Grand Island, NY; Salem, MA; Two bridges, NJ; and The Upper Blackstone WPAD, MA.
- Test Report on ASCE Clean Water Testing of three impellers – the m^2t HI-FLO, a Smith & Loveless, and a Peabody Welles unit. The HI-FLO impeller demonstrated a 30-40% higher efficiency and significantly higher liquid velocities than the S&L and P-W units.
- Copies of the Chattanooga, TN and Yuba City, CA WEFTEC papers on the very positive results of upgrade to the HI-FLO Aeration System.
- It is important to note that the Grand Island project was partially funded by NYSERDA and the Salem, MA and upcoming Erving, MA projects are partially funded by Massachusetts Electric.

Mr. Knapp, I would appreciate the opportunity to answer any questions you have and assist C&S and the County in moving forward with upgrade our UNOX system aeration equipment.

Sincerely,

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Mixing & Mass Transfer Technologies – *Lotepro Environmental Systems*

Thomas P. Gilligan, P.E.
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#860-460-1973 cell
Email: tgilligan@m2ttech.com

Cc: Mr. Tim Cass, County
Mr. Randy Ott, County
E. Ordway, Carrier
C. Cammer, J. Andrew Lange Inc.
Mr. Ralph Eschborn, m^2t-Lotepro

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Appendix E

Mechanical Scope of Work

INSTALL HIGH EFFICIENCY AERATORS- BALDWINSVILLE & OAK ORCHARD

Currently, the Baldwinsville waste water treatment plant contains ten aerators. The Oak Orchard plant also contains twelve aerators. A typical aerator is shown in Figure 1.

Figure 1, Typical Aerator

It is proposed that the impellers on each of these aerators be replaced with high efficiency impellers. A general scope of work for this measure is as follows.

- Disconnect electrical connections
- Remove aerator with a crane
- Remove existing impeller
- Install new impeller
- Replace aerator with crane
- Reconnect all electrical connections

Appendix F

Electric Thermostat Product Information

LineVoltPRO™ 8000

7-Day Programmable Electric Heat Thermostat

Honeywell

Honeywell's LineVoltPRO™ 8000 is one of the most advanced thermostats for electric heating on the market. It features precise comfort control, a sophisticated design and high-end programming features. Begin lowering your heating bill immediately with the pre-programmed 7-day schedule, or modify the programming to suit your lifestyle. With LineVoltPRO 8000, you'll see substantial savings and feel consistently comfortable.

LineVoltPRO™ 8000

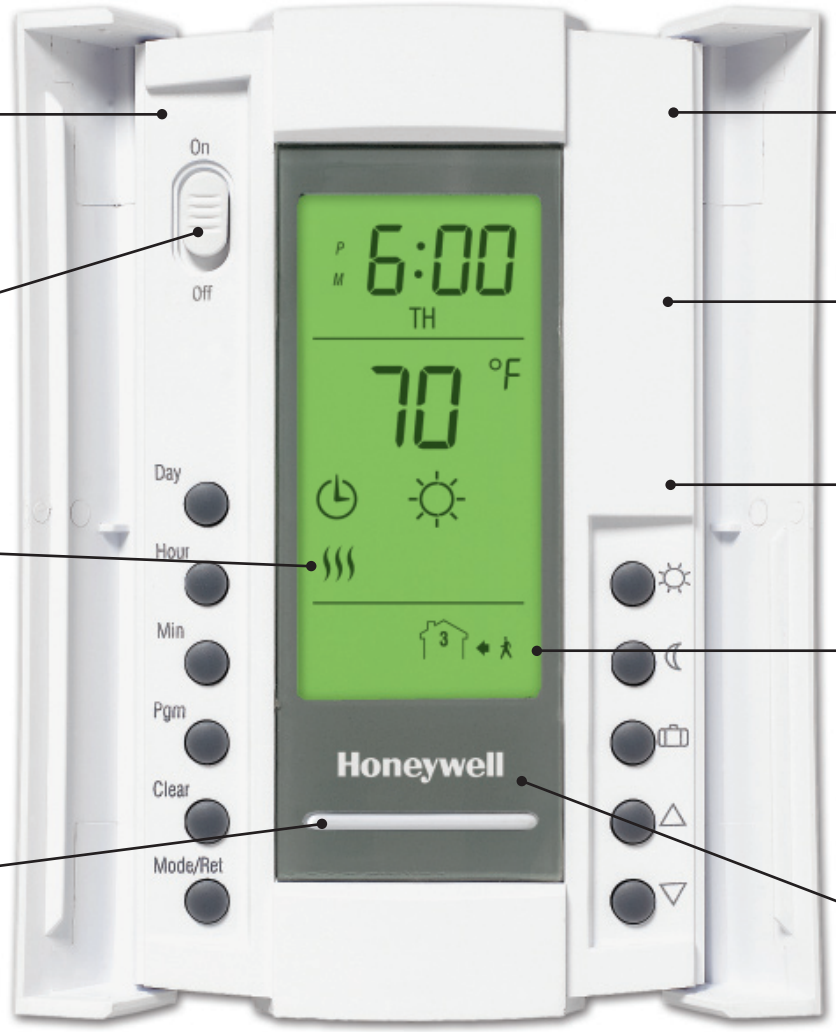
CONSISTENT COMFORT. SUBSTANTIAL ENERGY SAVINGS.

Soundproofed for Quiet Operation — Reduces the clicking noise commonly heard with conventional thermostats.

Peace of Mind — On/Off switch allows you to turn the thermostat off at the end of the heating season.

Heating Indicator — At-a-glance confirmation that the heat is on.

On-Demand Backlight — Easy to read in various lighting conditions.



Electronic Temperature Control — Precision of ± 1°F.

Early Start — Ensures programmed temperature is reached by programmed time.

5-Year Limited Warranty

Pre-Set 7-Day Program — Maintain the pre-set program schedule for up to 15%* energy savings, or modify the schedule to fit your lifestyle.

#1 Choice of Homeowners — Honeywell is the leading brand in temperature control.

ENERGY STAR

PART #	PRODUCT SPECIFICATIONS
TL8230A1003	15-min. heating cycles

*If used as directed, programmable electric heat thermostats can save up to 15% on annual heating costs. Savings may vary based on geographic region and usage.

Learn More

Call toll-free 1-800-328-5111

E-mail info@honeywell.com

Automation and Control Solutions

Honeywell

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Golden Valley, MN 55422-3992

www.honeywell.com

5-YEAR LIMITED WARRANTY

50-9288

February 2005

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