MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION FOR SOUTH FALLSBURG WASTEWATER TREATMENT PLANT

Agreement No. 7185

Prepared for

THE NEW YORK STATE ENERGY RESEARCH AND DEVELOPMENT AUTHORITY
Albany, NY

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Final
October 2005

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INTRODUCTION

1.1 OVERALL PROJECT DESCRIPTION

The New York State Energy Research and Development Authority (NYSERDA) is currently sponsoring a research program to evaluate submetering at wastewater treatment plants (WWTPs) throughout New York State. The purpose of the monitoring is to obtain detailed electric power usage information through submetering various unit processes and equipment and to determine if that information is a cost-effective tool for identifying electric energy conservation measures. In addition to evaluating the usefulness of submetering, a secondary goal of the program is to identify and evaluate other energy cost savings measures at WWTPs and make the findings available to facilities across New York State.

Over the years, the Town of Fallsburg has evaluated energy-savings measures at its South Fallsburg Wastewater Treatment Plant (WWTP). However, energy-savings opportunities still exist, and therefore, the Town of Fallsburg agreed to participate in this submetering study as conducted by the Research Team consisting of Malcolm Pirnie and Siemens Building Technology.

1.2 FACILITY BACKGROUND

The South Fallsburg WWTP is located in Fallsburg, NY and is a 3.26 million gallon per day (MGD) secondary treatment plant, treating wastewater from the unincorporated communities of Woodbourne, Hurleyville, and Old Falls (Fallsburg). The WWTP also receives industrial wastewater mainly from the food-processing industry, including a poultry processing facility and a dairy facility. Monthly average flows through the plant vary from 1.36 MGD to over 2.31 MGD, with the higher flows primarily due to infiltration and inflow during wet weather.

The facility was originally constructed in 1971 as a secondary treatment trickling filter plant. The plant was upgraded with the addition of rotating biological contactors (RBCs) in 1981.

The treatment processes at the South Fallsburg WWTP include the following:

- Preliminary and primary treatment, consisting of manually-cleaned screening, horizontal channel grit collectors, and rectangular primary clarifiers.
- Secondary biological treatment through single-stage trickling filters, followed by RBCs and rectangular secondary clarifiers.

- Disinfection, consisting of chlorination and de-chlorination.
- Solids handling facilities, consisting of gravity thickener, anaerobic digesters, and belt filter press dewatering.

The New York State Electric and Gas Corporation (NYSEG) provided both delivery and supply of the electricity commodity until March 2003, when the facility switched to NYSEG Solutions for the electric commodity. Main service is provided at 480-kilovolt-ampere (kVa) to the facility. Lighting panels within the facility use 120-volt to 208-volt service, and power panels use 277-volt to 480-volt service. One 640-kilowatt (kW) Caterpillar diesel emergency generator provides emergency back-up power for the facility and can handle 100 percent (%) of the existing electric energy load. Buildings are heated by fuel oil and/or propane. Fuel oil also is used to heat the digester.

The facility is staffed with five employees, including two operators. The operators also share assignments with two other plants operated by the Town, Loch Sheldrake and Mountaindale. The South Fallsburg WWTP is staffed eight hours per day each weekday and four hours per day on weekends. During July and August, the WWTP is staffed for eight hours per day on weekends.

1.3 SCOPE AND OBJECTIVES

This study involved the following activities as part of the overall electric and fuel energy usage assessment and electric submetering program:

1.3.1 Review of Historical Plant Performance and Energy Usage Data

Data were obtained from the WWTP to establish a baseline for plant performance and energy usage. The baseline seeks to separate improvements related to power savings from those that result from exogenous effects, such as changes in influent water quality, seasonal and weekly cycles, and/or energy market changes.

Data obtained from the WWTP included:

- Influent and final effluent total suspended solids (TSS) and biochemical oxygen demand (BOD_5).
- Daily influent flow.
- Sludge handling operating records (percent solids thickened sludge, percent solids dewatered sludge, and sludge volume).

- Historical electric energy usage, including available time-of-use monitoring data, two years of utility bills, and any process changes recently undertaken or contemplated.
- Recent energy consumption data for non-electric accounts, including fuel oil, propane, etc.
- Preventive and corrective maintenance records.

1.3.2 Electric Submetering

Continuous submetering and instantaneous power draw measurements were completed to assess the typical electric usage of some of the larger motors [greater than 5 horsepower (hp)] at the WWTP. Continuous submetering locations were selected based on information gathered during a site energy audit such that the larger and most energy-intensive motors could be metered. Instantaneous power draw measurements were also obtained on additional motors, particularly those that operated on a set schedule at a constant speed.

The continuous submetering data were used to capture diurnal variations in electric energy demand for major pieces of equipment, as well as to provide a representative sample of electric energy usage, including electric energy demand as equipment cycles on and off. The following data were recorded at each location:

- Load factor
- Power factor
- Demand (kW)
- Usage (kWh)

Instantaneous submetering was conducted during a one-day site visit and the data were used to verify expected electric energy demand at the facility, as well as monitor changes in electric energy demand as equipment is cycled on and off.

In addition, process data were collected for the duration of the submetering period including the following:

- Influent flow rate.
- Influent, primary effluent, trickling filter effluent and final effluent BOD_5.
- Influent, primary effluent, and final effluent TSS.
- Digesters feed rate and percent solids.
- Belt filter press feed rate and percent solids.

- Dissolved oxygen (DO) in RBCs.

The process data collected were used to correlate energy usage to process parameters to ultimately develop alternatives for energy savings as well as to compare the WWTP's energy performance to other WWTPs in New York State.

1.3.3 Identification of Energy Saving Opportunities through Equipment Replacement or Modification

Energy savings opportunities resulting from equipment replacement and/or process modification were identified based on review of the submetering data.

1.3.4 Identification of Energy Savings Opportunities through Operational Changes

The submetering data were further reviewed to assess the impact of equipment operations on total plant energy demand throughout the course of the day and examined for energy savings opportunities through load shifting, peak shaving, and greater use of real-time data in energy-related decision-making.

Load shifting would involve changing the time of use of certain electric loads to reduce the total facility electric energy demand during peak periods in an attempt to reduce electric energy demand charges. Peak shaving is the practice of dispatching on-site generating assets to reduce dependence on the grid during peak electric energy demand periods. As a result, on-site generating assets were evaluated to identify potential curtailable electric energy loads.

This report summarizes the evaluation and offers recommendations for opportunities to reduce energy usage, and thereby costs, at the South Fallsburg WWTP.

Section 2

CURRENT AND HISTORICAL OPERATIONS

This section presents a brief description of the existing treatment processes at the WWTP, historical implementation of energy saving measures, and the effect on the effluent quality.

2.1 EXISTING TREATMENT PROCESSES

A site plan of the WWTP is shown on FIGURE 2-1. FIGURES 2-2 and 2-3 present schematics for the wastewater treatment and solids handling processes respectively. A brief description of the various treatment processes that are currently implemented at the plant is presented below.

2.1.1 Preliminary Treatment

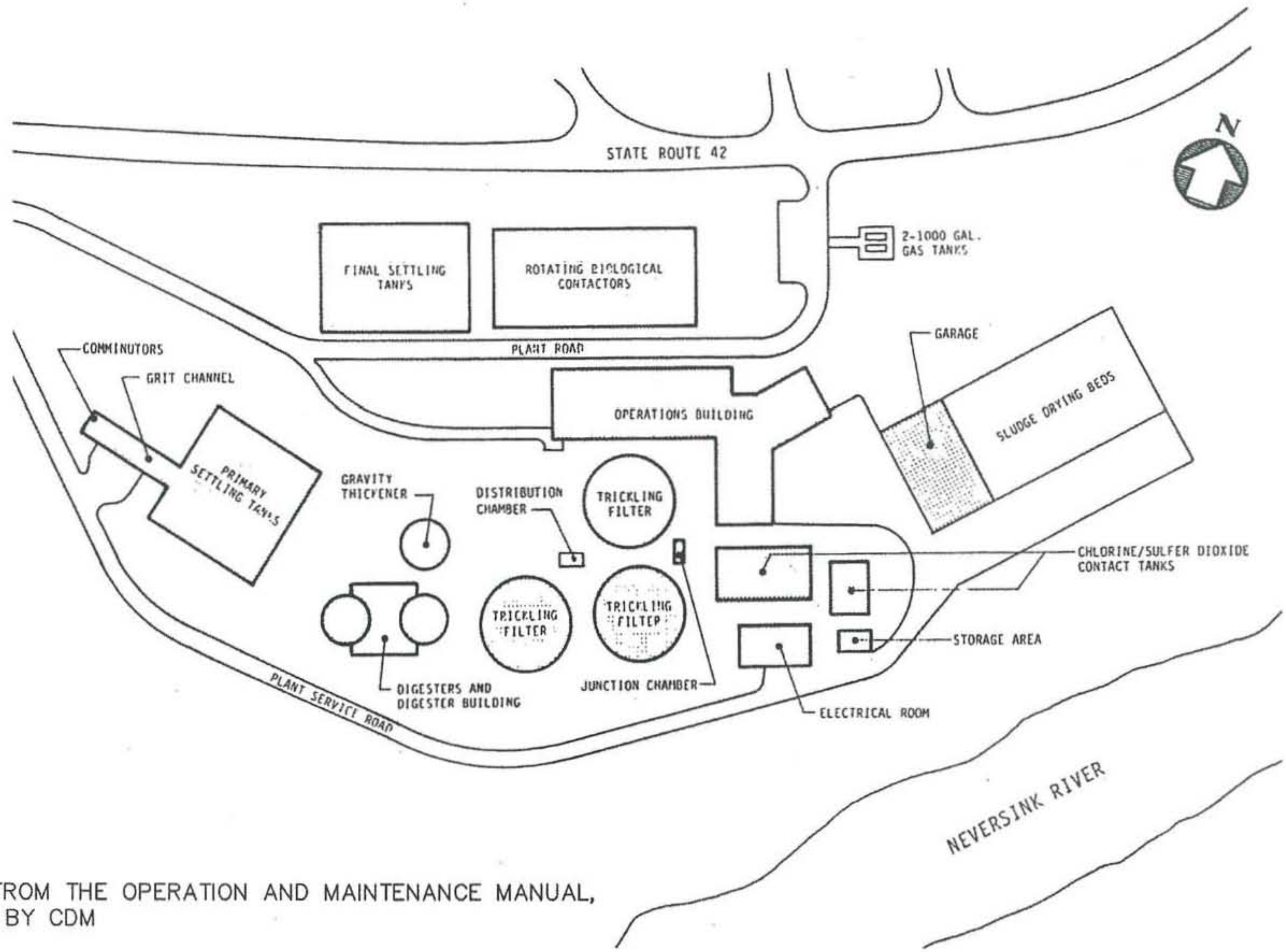
Preliminary treatment at the WWTP is accomplished through the use of manually-cleaned screens that remove large material and debris from the wastewater flow. Removal of grit is accomplished in horizontal channel grit collectors.

2.1.2 Primary Treatment

Five primary settling tanks remove settleable solids, grease, and scum from the wastewater. Approximately 25 percent (%) to 35% of the biochemical oxygen demand (BOD_5) and 40% to 60% of the total suspended solids (TSS) are removed during primary treatment.

2.1.3 Secondary Treatment

After passing through the primary settling tanks, the wastewater is conveyed to three trickling filters where 75% to 85% of the remaining BOD_5 is removed. The effluent from the trickling filters is pumped through the intermediate wastewater pumps to two trains of rotating biological contactors (RBCs), each containing four standard density media shafts and four high density media shafts, where additional organics removal takes place. The RBCs are equipped with an aeration system. After biological treatment, the wastewater is settled in secondary clarifiers. The sludge produced in the secondary clarifiers is wasted. The secondary sludge is mixed with primary sludge to form a combined sludge that is subsequently thickened and then dewatered.



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MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 2–1 SITE PLAN

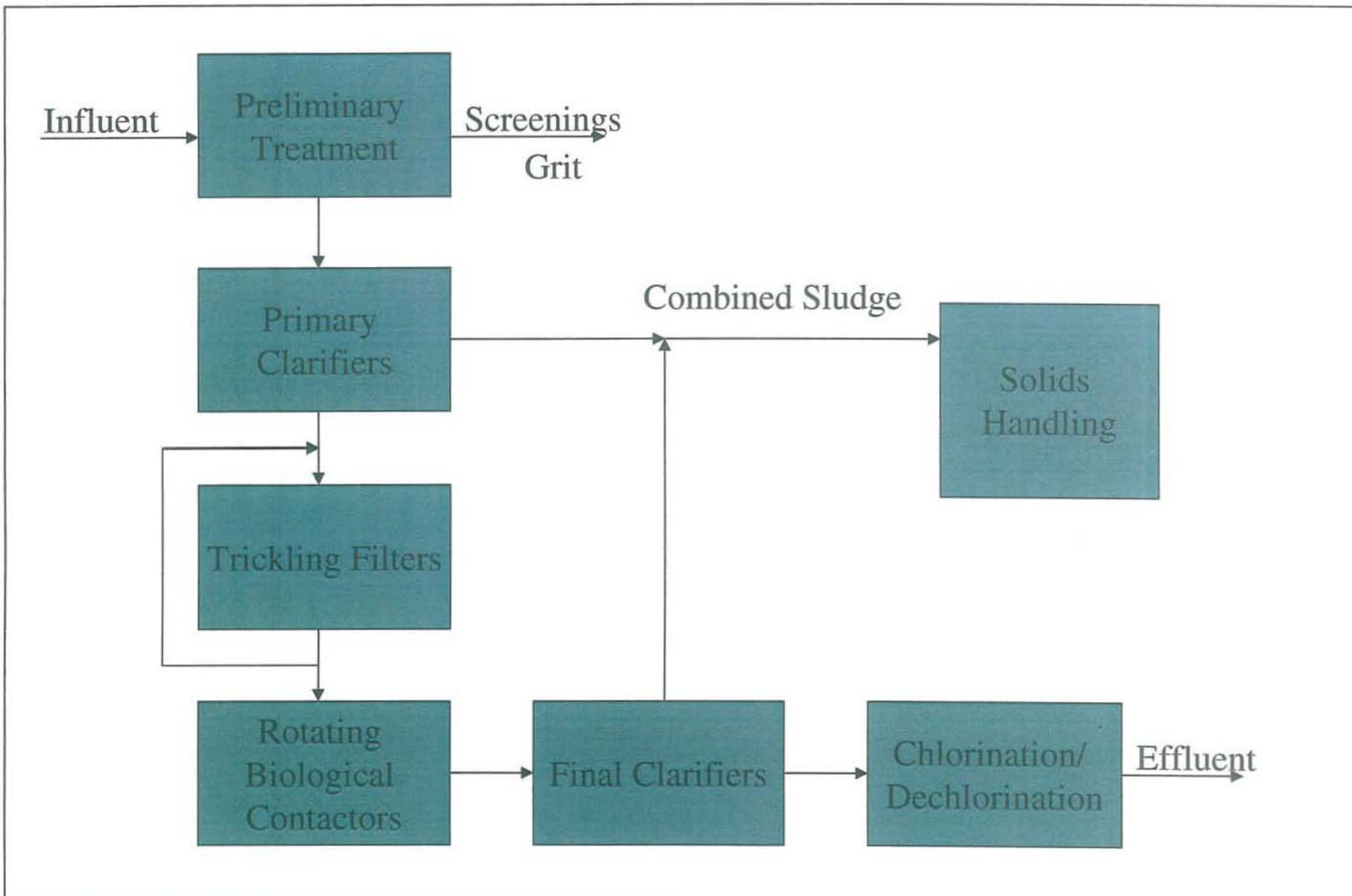

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FIGURE 2-2
WASTEWATER FLOW SCHEME

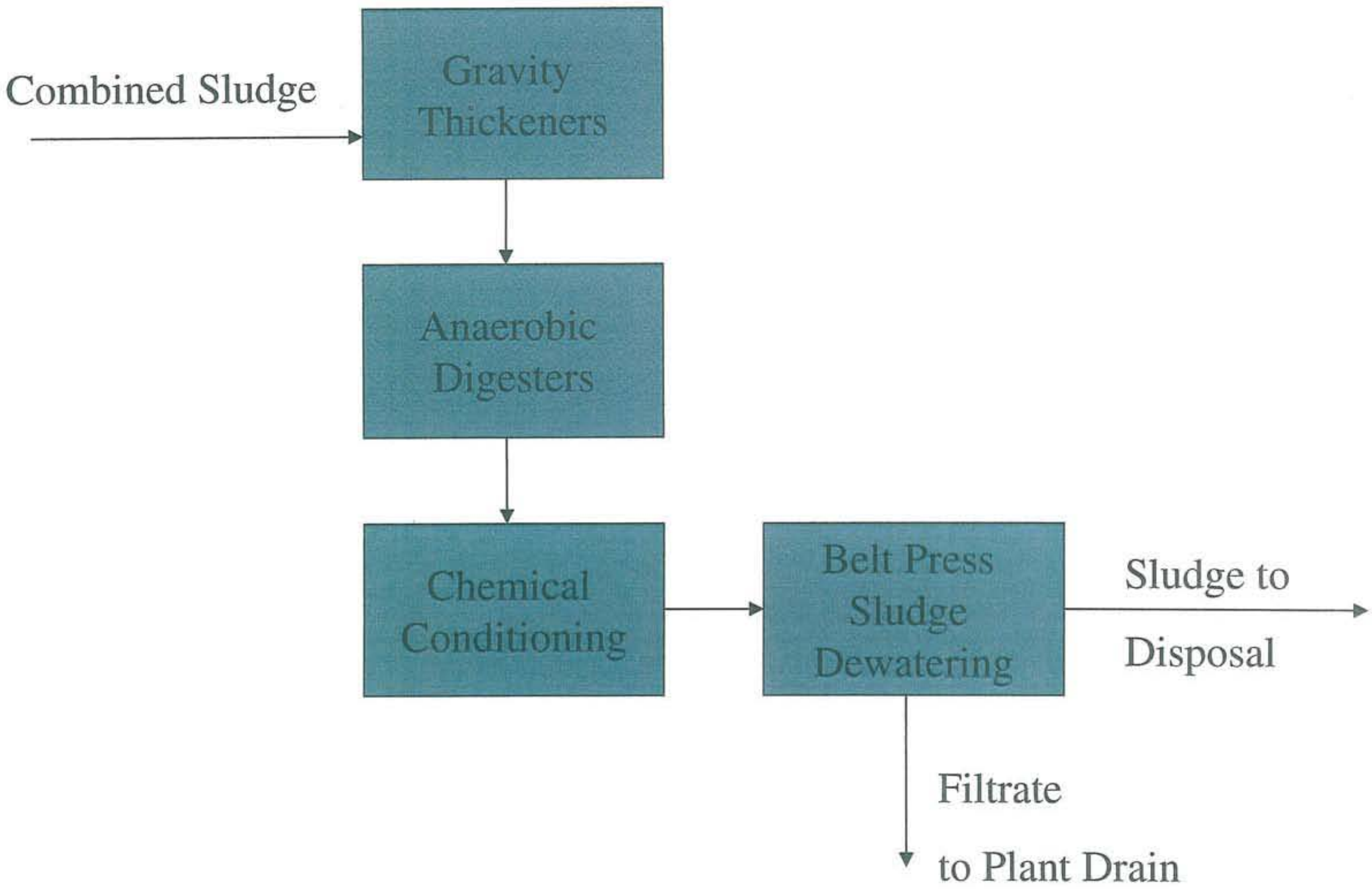

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FIGURE 2-3
SOLIDS HANDLING SCHEME

2.1.4 Chlorination and Dechlorination

The WWTP effluent is chlorinated using a chlorine tablet chlorinator for further removal or inactivation of pathogenic organisms. Residual chlorine is removed by dechlorination using sulfur dioxide before the discharge to the Neversink River. Chlorination and dechlorination are required from May 15 to October 15 only.

2.1.5 Solids Handling

Sludge generated from primary and secondary treatment flows by gravity to the gravity thickener. The thickened sludge is pumped to the anaerobic digesters, where sludge is stabilized by destroying pathogenic organisms and reducing up to 75% of volatile suspended solids (VSS). Anaerobic digestion also produces digester gas, which is composed primarily of methane.

The digested sludge is dewatered using a belt filter press. Polymer is used to enhance the dewatering process. The belt press is able to dewater the sludge to approximately 16% to 23% solids.

The dewatered sludge is ultimately disposed of at a landfill site.

2.2 HISTORICAL ENERGY USAGE AND UTILITY BILLING

In the past decade, South Fallsburg WWTP has performed a few projects that were focused on energy savings. Some of the notable efforts toward implementation of energy saving measures include:

- New York State Electric and Gas (NYSEG) Program (1993).
- Study of Energy Conservation through Anaerobic Digester Improvements (2004).

2.2.1 New York State Electric and Gas Program (1993)

The NYSEG program involved improvements associated with RBC motors and intermediate pumps. High efficiency motors (7.5 hp each) were installed on the RBCs, and variable frequency drives (VFDs) were installed on the intermediate pumps motor (75 hp each). Also, the 30 hp blowers were replaced.

2.2.2 Study of Energy Conservation through Anaerobic Digester Improvements (2004)

This study evaluated the existing digester facility and developed alternatives to improve digester operations, increase digester gas storage, and utilize the gas for digester heating.

2.3 HISTORICAL UTILITY BILLING

Data on electric energy usage and billing were obtained from the South Fallsburg WWTP for 2001 through 2003. FIGURE 2-4 shows the monthly electric energy demand and usage for 2001 through 2003. Billing for the WWTP is based on the electric energy demand, electric energy usage, and a charge for reactive power. Since the reactive power charge was only 1% to 2% of the total electric energy bill, it was considered negligible and only the electric energy demand and usage were included in the evaluation.

The 2002 data set shows an increase in both the electric energy demand and usage from the 2001 data set, with an average increase of 3.4% in electric energy demand and a 7.4% increase in overall electric energy usage. The 2003 data set shows an additional increase in both the electric energy demand and usage from the 2002 data set, with an average increase of 10.7% in electric energy demand and a 2.5% increase in overall electric energy usage. FIGURES 2-5 and 2-6 illustrate the changes in electric energy demand and usage, respectively for 2001, 2002, and 2003. The electric power charges, however, decreased 10% in 2002 (down from $119,833 in 2001 to $108,610 in 2002). This was due to a decrease in the electric energy usage cost per kWh (from $0.1031 per kWh in 2001 to $0.0873 per kWh in 2002).

The cost of electric energy increased in 2003 to an average cost of $ 0.102 per kWh, resulting in a 17% increase in electric power charges to $ 130,763.

2.4 FUEL USAGE

FIGURE 2-7 shows a monthly comparison of fuel oil and propane usage with changes in temperature for 2001 and 2002. It can be seen that during lower temperature months, the quantity of fuel used was higher than months with higher temperatures, as expected. The average temperature for 2001 was 46 degrees Fahrenheit (°F) with a total usage of 3,142 million of British Thermal Units (MBTUs) of oil and propane. The average temperature for 2002 was 47°F with a total usage of 3,534 MBTUs. There was an 11% increase in the amount of MBTUs delivered in 2002 when compared to 2001.

Data from the WWTP indicate that the anaerobic digesters use approximately 69% of the fuel oil delivered to the plant, with a total annual usage of 1,111 MTBUs, or 11,113 therms.

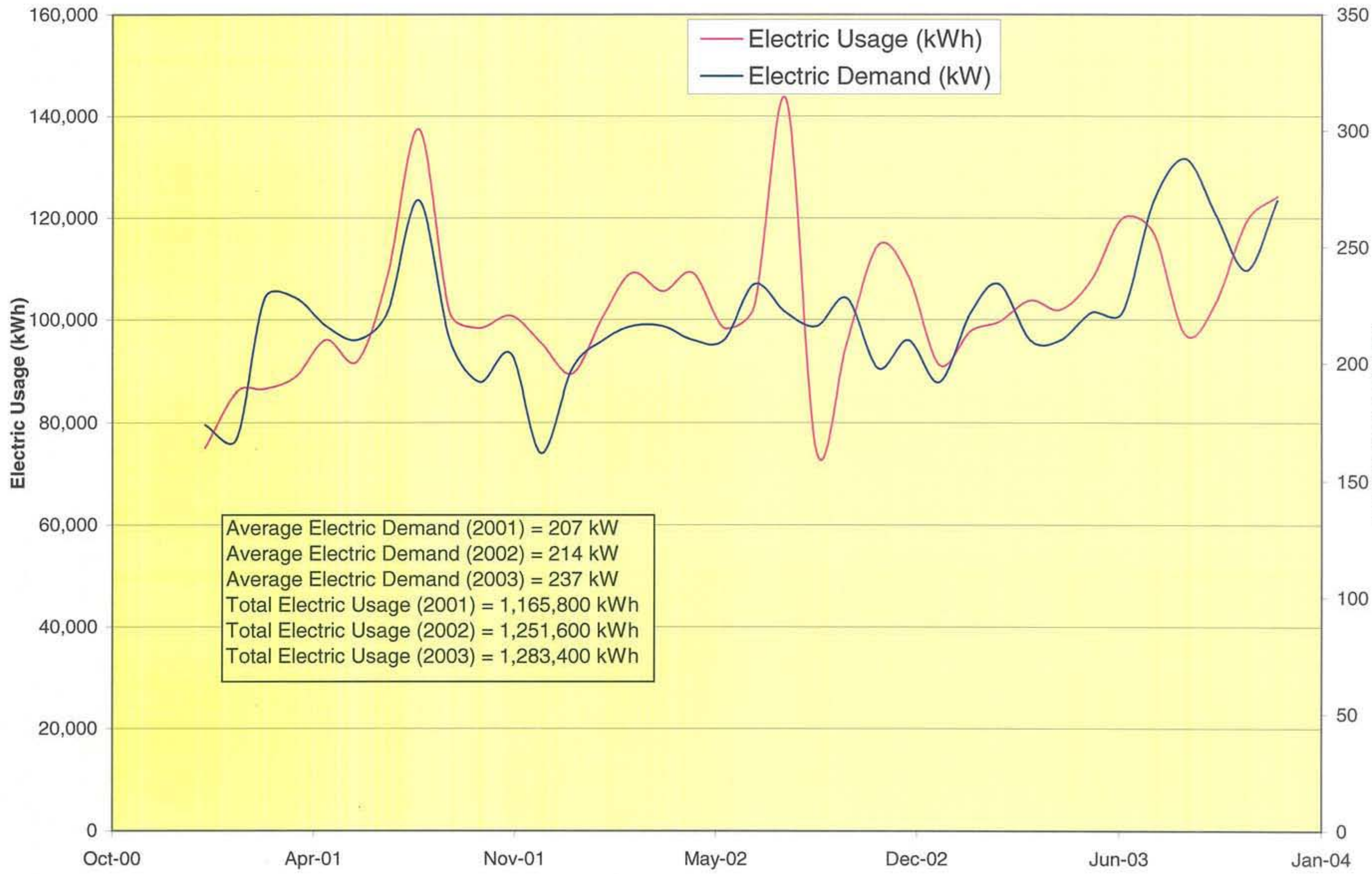

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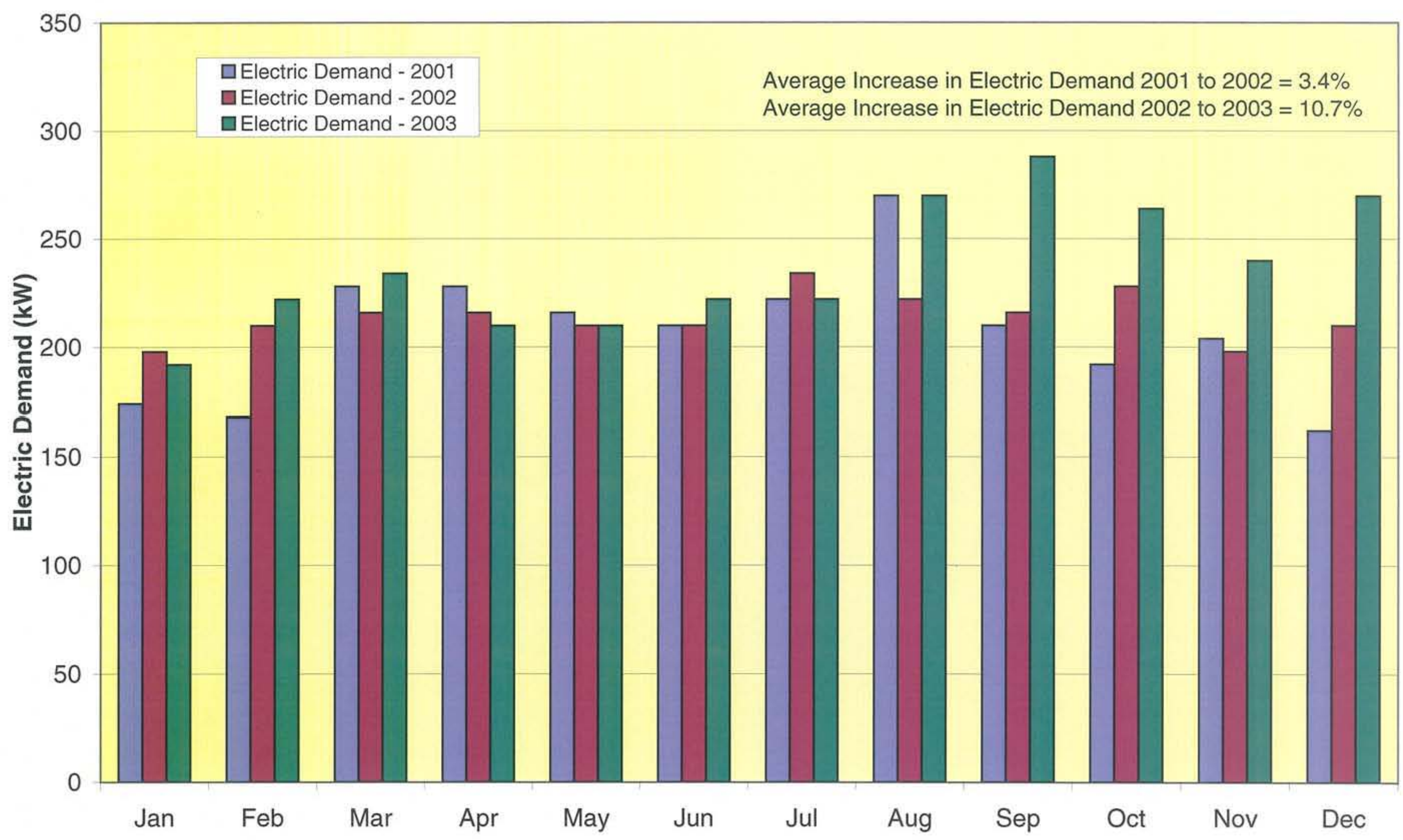
FIGURE 2-4
ELECTRIC DEMAND AND USAGE



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 2-5 CHANGE IN ELECTRIC DEMAND (2001 TO 2003)

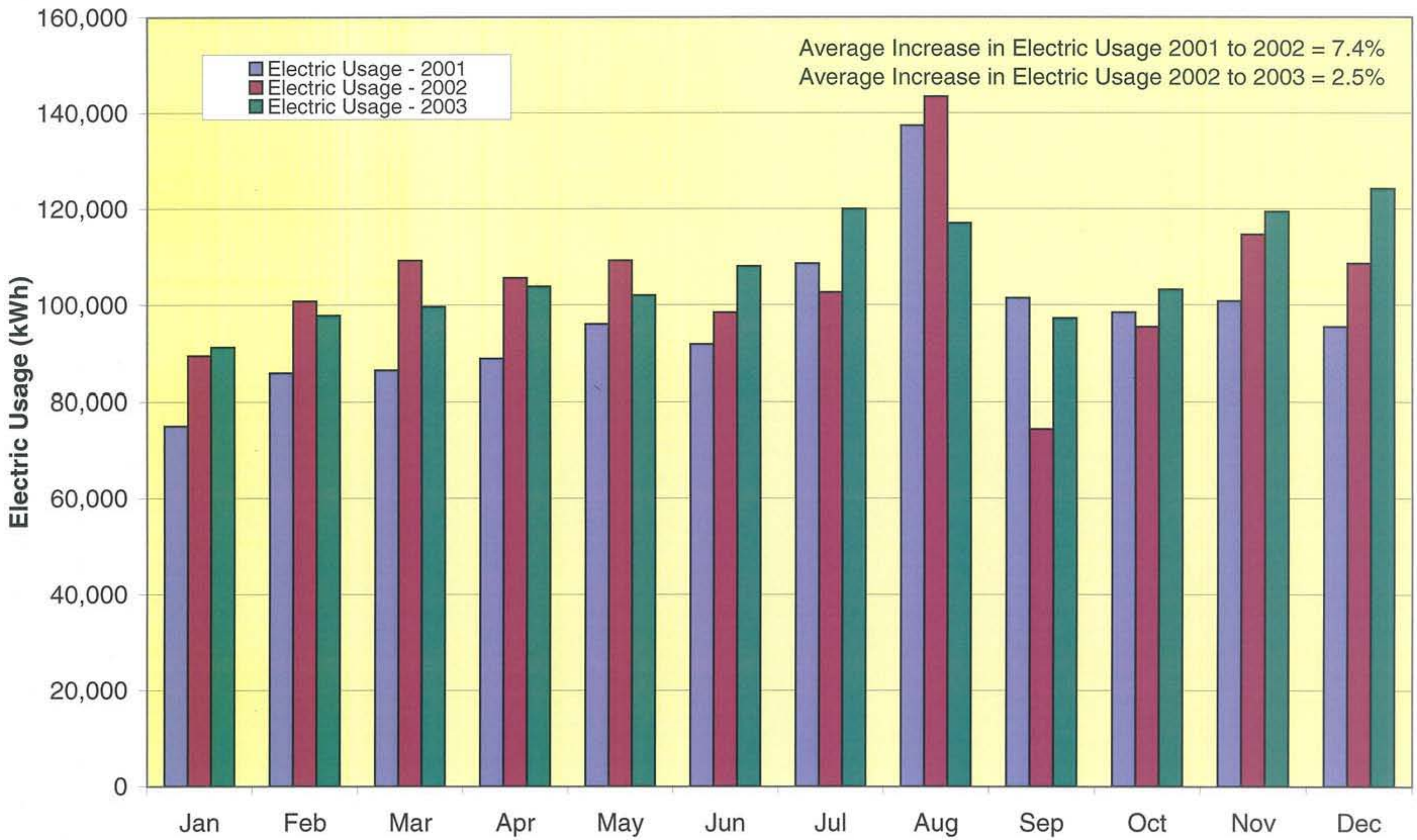


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FIGURE 2-6
CHANGE IN ELECTRIC USAGE
(2001 TO 2003)

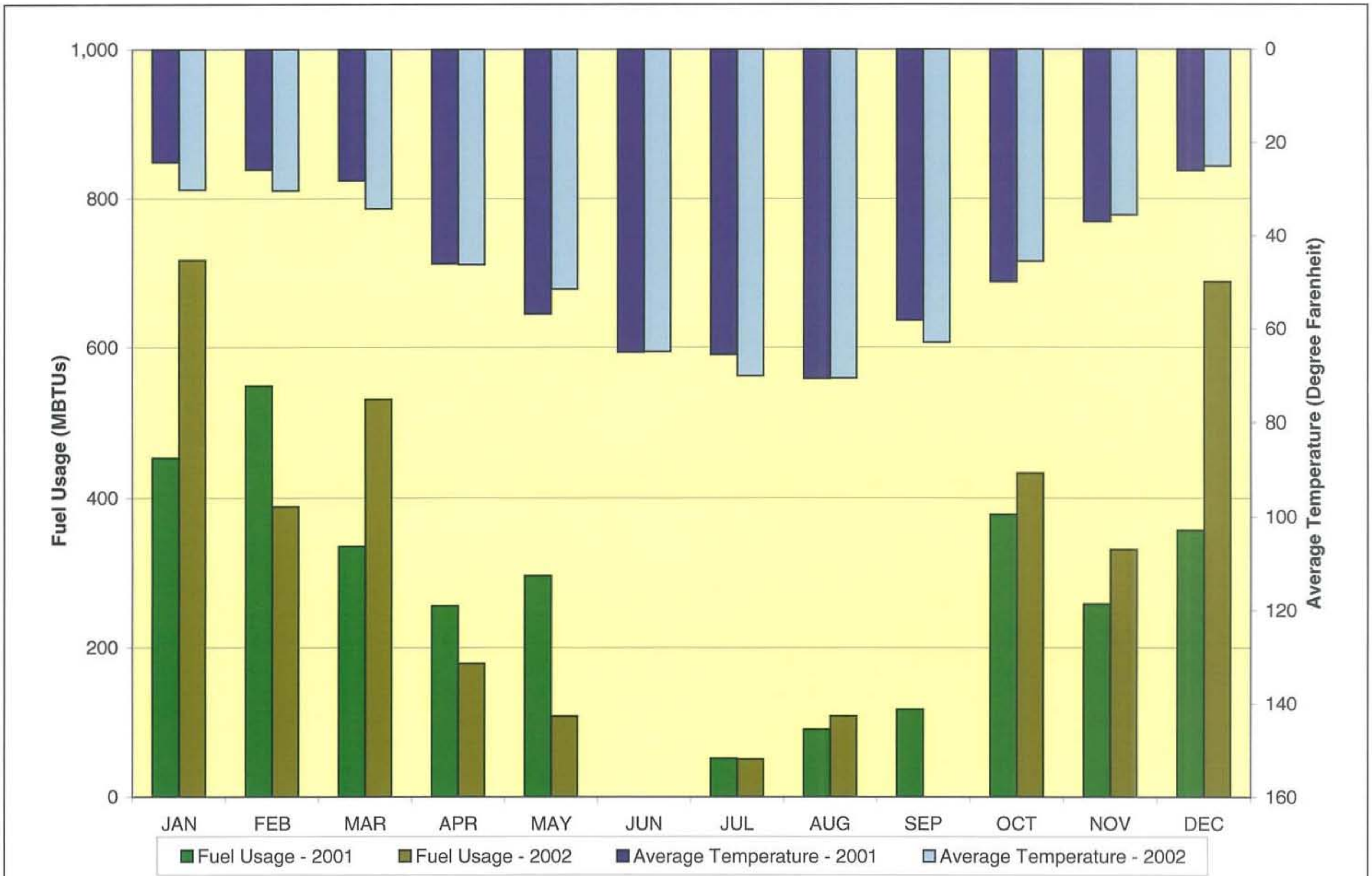

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FIGURE 2-7
FUEL OIL AND PROPANE USAGE
(2001 TO 2002)

Total plant fuel usage on a per square foot basis can be calculated as a benchmark performance parameter by dividing the annual fuel usage by the square footage of the buildings. There are 24,000 estimated square feet of roof area spread over four buildings. The estimated fuel usage per square foot of plant averages approximately 1.4 therms per square foot.

2.5 SUMMARY OF ENERGY COSTS

TABLE 2-1 summarizes the energy costs for 2001 through 2003 based on data from the plant and the annual reports, and offers estimates for 2004.

Table 2-1: Summary of Energy Costs

Year		2001	2002	2003	Estimated 2004[1]
Average Flow (MGD)		1.77	1.89	2.41	2.41
Electricity	Annual Usage (kWh)	1,165,800	1,251,600	1,283,400	1,283,400
	Rate ($/kWh) [2]	0.103	0.087	0.102	0.106
	Annual Costs	$ 119,833	$ 108,610	$ 130,763	$136,040
	Average Usage (kWh/MGD)	1,804	1,814	1,458	1,458
	Average Costs ($/MGD)	$185.48	$157.44	$148.65	$154.65
Fuel	Annual Usage (therms)	31,422	35,346	34,279	34,279
	Rate ($/therm)	$0.76	$0.66	$0.83	$1.00
	Annual Costs	$23,838	$23,340	$28,711	$34,279
	Average Usage (therms/MGD)	49	51	39	39
	Average Costs ($/MGD)	$36.90	$33.83	$32.64	$38.97
Total Energy Costs of Electricity and Fuel		$143,671	$131,950	$159,474	$170,319
Total Energy Costs per MGD		$222.38	$191.27	$181.29	$193.62

Notes:
[1] 2004 estimated as follows:
- 2004 average flow and therms assumed equal to 2003.
- Electric rate assumed to increase 4% in 2004 (from NYSERDA average energy prices).
- Propane and #2 oil rates assumed to increase 20% in 2004 (from NYSERDA average energy prices).

[2] Rate ($/kWh) includes demand charges, reactive power and system benefits.

2.6 SUMMARY OF HISTORICAL LOADINGS AND EFFLUENT QUALITY

Monthly plant flow and process data provided by the WWTP for 2001 through 2003 are summarized in TABLE 2-2.

Table 2-2: Summary of South Fallsburg WWTP Performance - Wet Stream Process

Wastewater Parameter	2001	2002	2003
Influent Plant Flow	1.77 MGD	1.89 MGD	2.41 MGD
Influent BOD_5 Concentration	120 mg/L	122 mg/L	139 mg/L
Influent BOD_5 Loading	1,783 lb/d	1,915 lb/d	2,840 lb/d
Average BOD_5 Removal	92%	93%	91%
Influent TSS Concentration	142 mg/L	139 mg/L	146 mg/L
Influent TSS Loading	2,092 lb/d	2,169 lb/d	2,981 lb/d
Average TSS Removal	89 %	90 %	89 %
Influent Total Kjeldahl Nitrogen (TKN)	NA	NA	25 mg/L
Influent TKN Loading	NA	NA	441 lb/d
Average TKN Removal	NA	NA	71 %

FIGURE 2-8 shows the relationship of influent BOD_5 and TSS loadings versus plant flow. As flow increases, loadings typically increase. BOD_5 and TSS loadings tend to be higher in the summer months.

The WWTP has consistently achieved BOD_5 and TSS removal efficiencies in excess of 90% and effluent concentrations of both are well below the discharge permit limit of 25.0 mg/L.

In order to evaluate the energy usage at the WWTP, the electric usage and demand data were compared to process data to ascertain the effects on varying wastewater conditions on energy usage. FIGURES 2-9 and 2-10 show the average monthly plant influent flows along with electric energy demand and usage, respectively. Both electric energy demand and usage appear to be significantly influenced by influent flows, as both figures show that when plant influent flows increase, electric energy demand and usage also increase.

FIGURE 2-11 shows fuel consumption along with WWTP flows. From FIGURE 2-8 and FIGURE 2-11, it is evident that the main factor influencing fuel consumption is outdoor temperature rather than plant flows, as fuel consumption increases during the winter months and decreases in the summer months.

Based on data from 2001 through 2003, approximately 1,141 lb/d BOD_5 are removed. Therefore, the estimated electric energy usage averages 2.96 kWh per lb of BOD_5 removed. The average fuel usage is approximately 0.080 therms per lb of BOD_5 removed. Based on the 2001 through 2003 data, approximately 2,157 lb/d TSS are removed, resulting in an estimated electric energy usage of 1.58 kWh per lb of TSS removed.

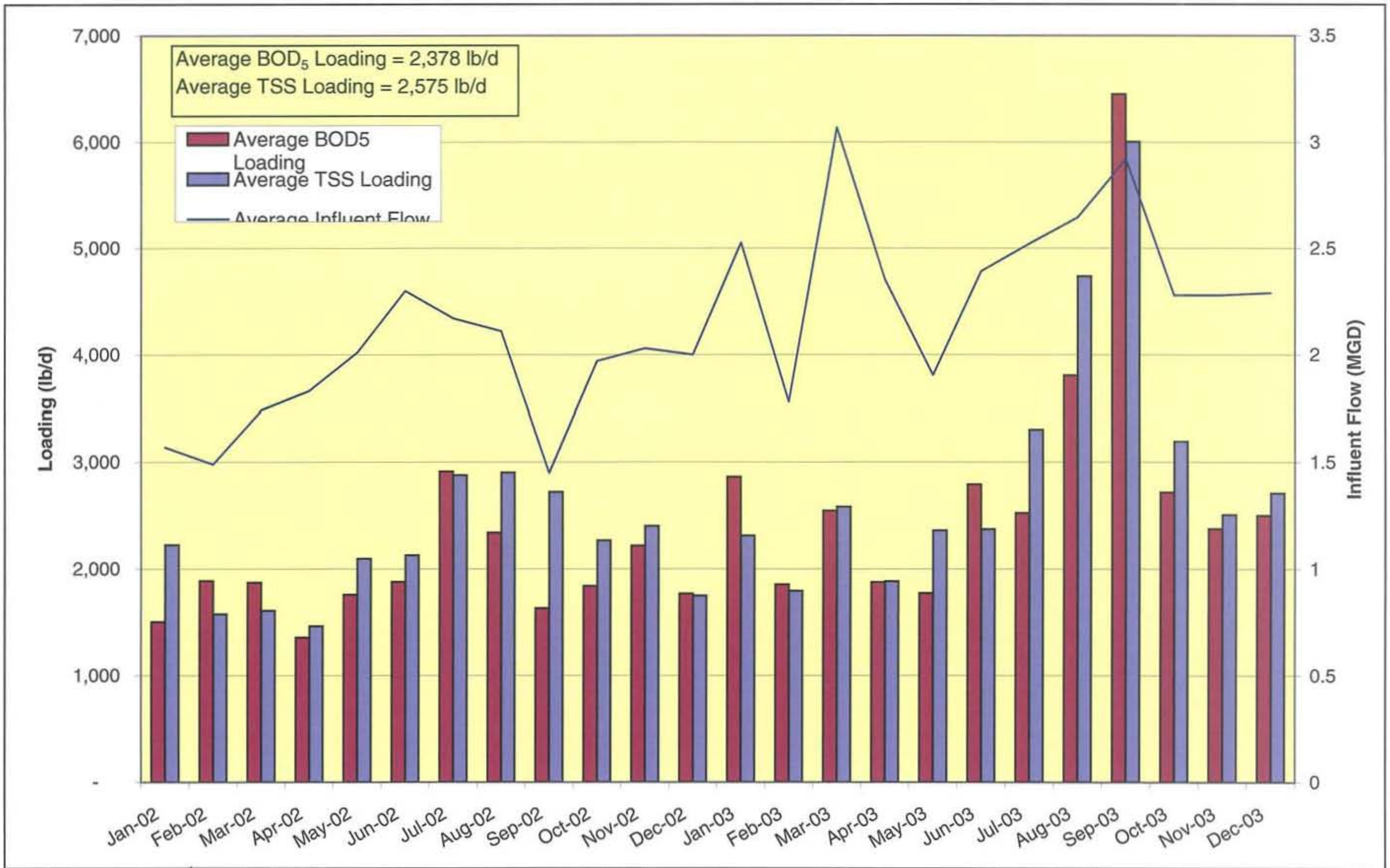

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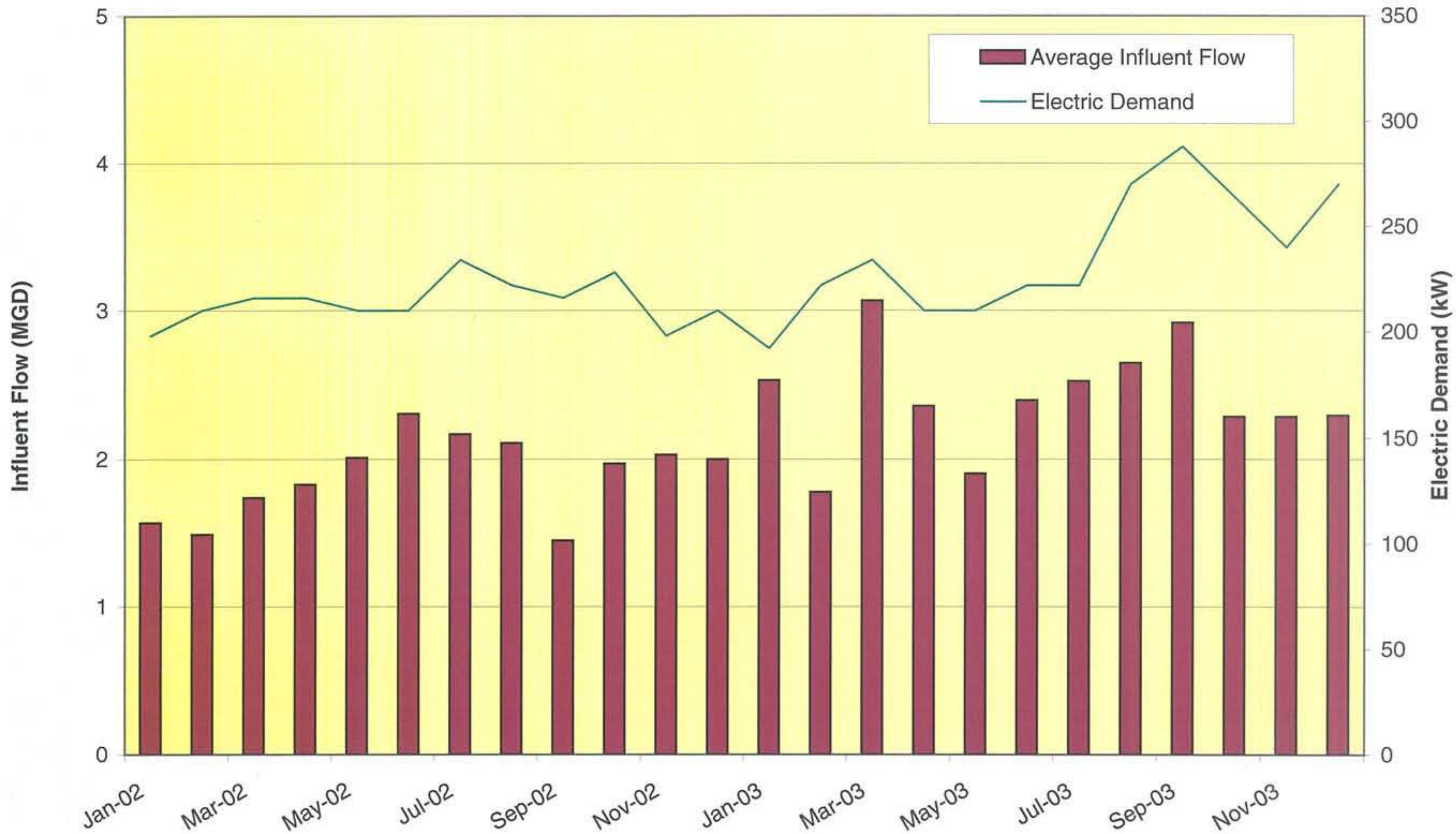
FIGURE 2-8
INFLUENT TSS AND BOD$_5$ LOADING



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 2-9 ELECTRIC DEMAND VS. INFLUENT FLOW

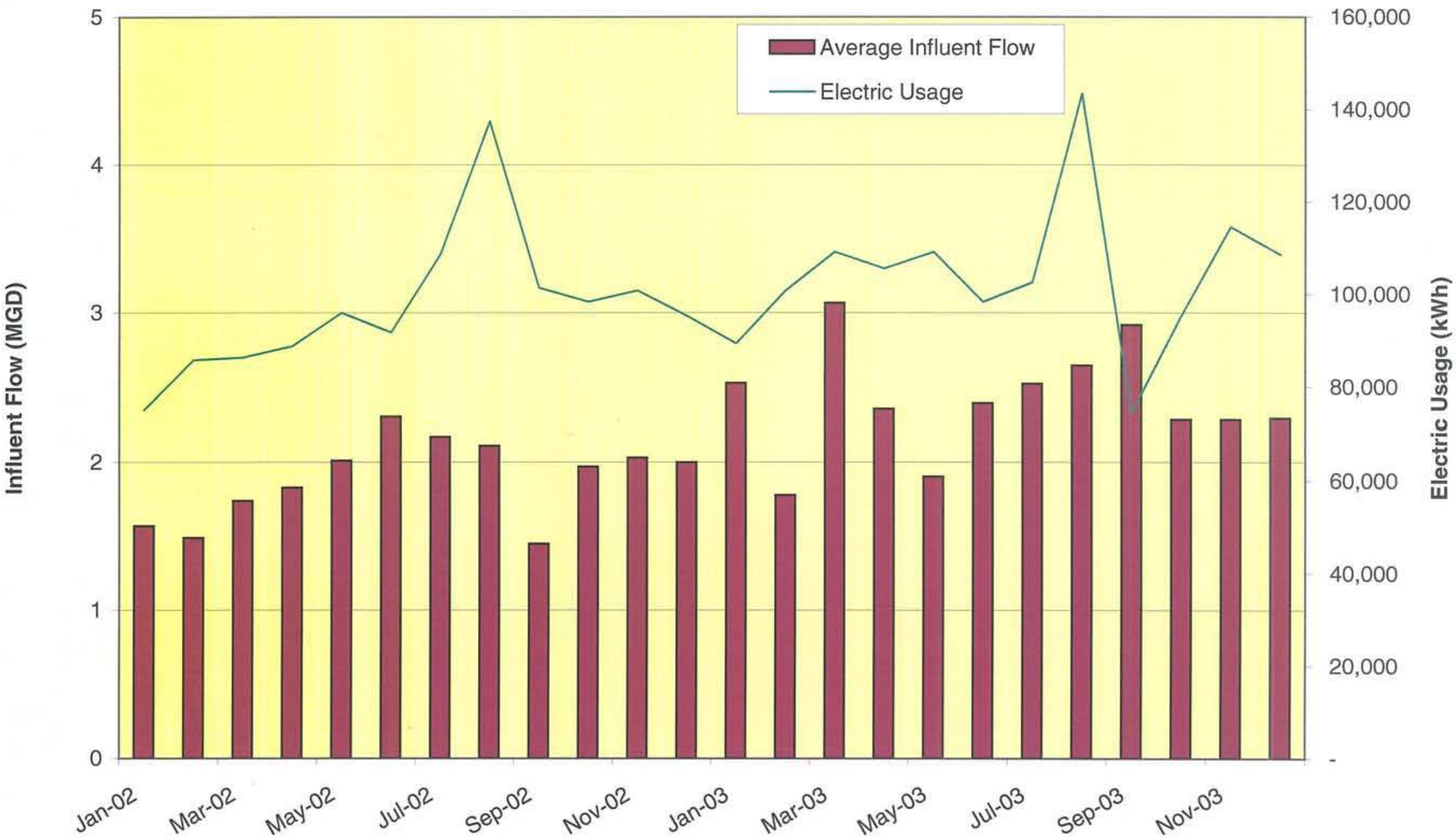


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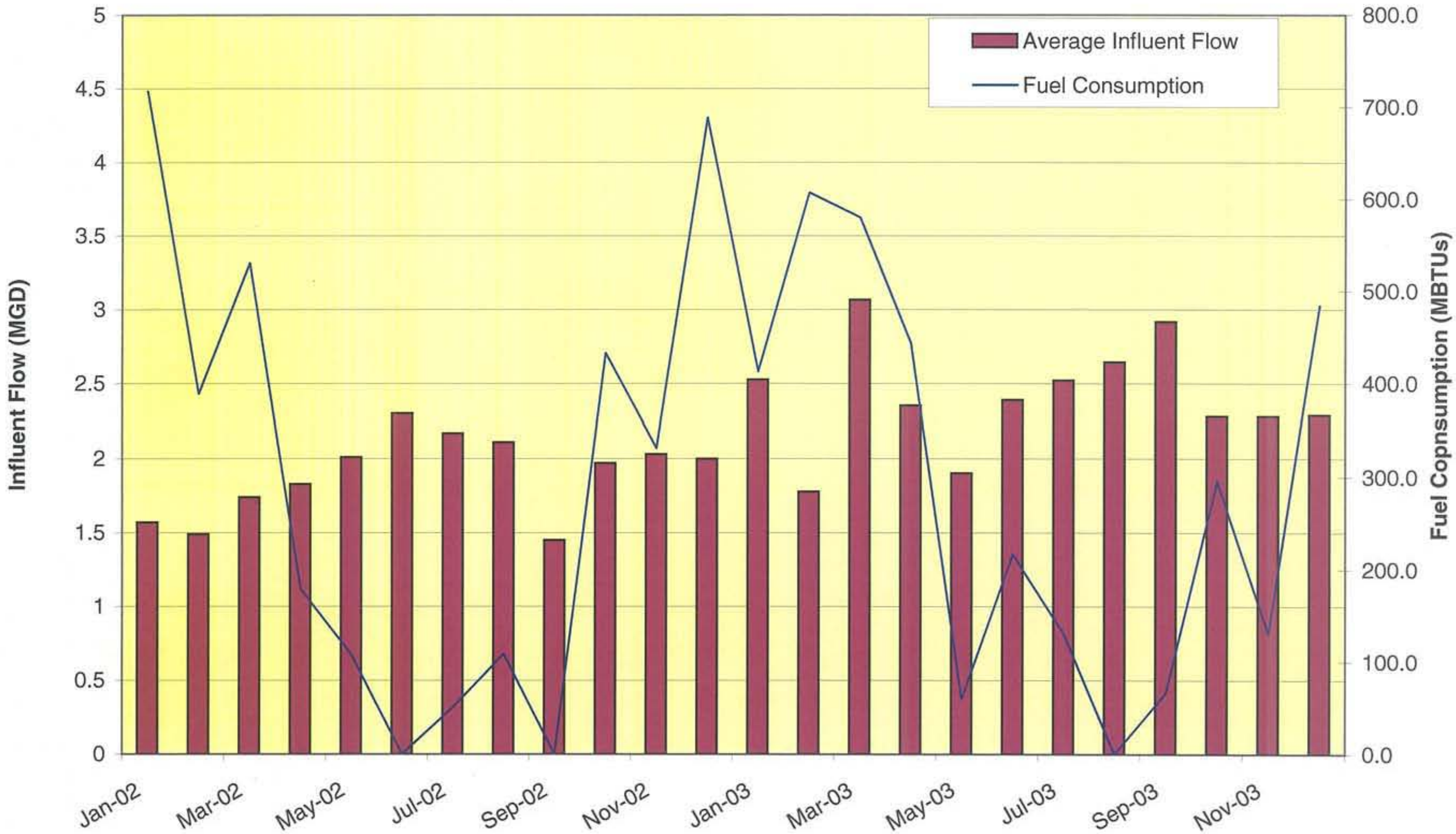
FIGURE 2-10
ELECTRIC USAGE VS. INFLUENT FLOW



MALCOLM PIRNIE	**NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION** **SOUTH FALLSBURG WASTEWATER TREATMENT PLANT**	**FIGURE 2-11** **FUEL CONSUMPTION VS.** **INFLUENT FLOW**

TABLE 2-3 summarizes the performance of the solids handling process at the plant, based on 2001 through 2003 data.

Table 2-3: Summary of South Fallsburg WWTP Performance - Solids Handling Processes

Parameter	2001	2002	2003
Belt Press Feed Percent Solids	NA	NA	2.3%
Average Cake Percent Solids	20.7%	21.8%	19.9%
Dry Tons to Landfill	396 ton/year	553 ton/year	520 ton/year
Average Dry Tons per Day	1.1 ton/d	1.5 ton/d	1.4 ton/d
Belt Press Polymer	9.1 lb/dry ton	7.8 lb/dry ton	7.4 lb/dry ton

Section 3

ELECTRIC SUBMETERING PROGRAM

3.1 DESCRIPTION OF SUBMETERING PROGRAM AND SUBMETER LOCATIONS

3.1.1 Description of Program

Continuous submetering was conducted through installation of submeters with continuous recording electronic data loggers (CREDLs). Continuous submetering was used to capture diurnal variations in electric energy demand for major pieces of equipment, as well as provide a representative sample of electric energy usage, including measuring electric energy demand as equipment cycles on and off.

In conjunction with the continuous submetering program, daily process data were collected for the wet stream and solids handling processes. The summary of process data is further detailed in Section 4 of this report.

Instantaneous submetering was also conducted on representative pieces of equipment, usually those that operated at a constant speed according to a set schedule and driven by motors rated at 5 horsepower (hp) or greater. TABLE 3-1 summarizes the motors greater than 5 hp. The instantaneous readings and estimated operating hours were then used to calculate estimated total electric energy usage for the particular piece of equipment.

3.1.2 Submeter Locations

Based on a plant walk-through and existing plant information, continuously recording submeters were installed in the following locations:

- Two meters on the intermediate pumps, one meter at each pump in operation.
- One meter at the rotating biological contactors (RBCs) blower.
- One meter at the thickener supernatant pumps.
- One meter at the digester facility.
- One meter at the plant water pumps.

South Fallsburg Wastewater Treatment Plant

Table 3-1 List of Motors Over 5 hp[1]

Process	Use	MCC Location	Quantity	Size (hp)	Constant/ Variable Speed	Voltage
Wastewater Pumping	Intermediate pumps	Operations Building	3	75	V	480
Wastewater Recirculation	Trickling filter pumps	Operations Building	2	7.5	C	240
Secondary Treatment	RBC drive motors	Operations Building	16	7.5	C	240
Secondary Treatment	RBC blowers	Operations Building	3	30	C	480
Solids Handling, Thickening	Thickener overflow pump	Digester Building	2	7.5	C	240
Solids Handling, Sludge Pumping	Digester feed pumps	Digester Building	2	7.5	C	240 to 480
Solids Handling, Sludge Pumping	Digester mixing pumps	Digester Building	2	15	C	240 to 480
Solids Handling, Digestion	Gas mixing compressors	Digester Building	2	7.5	C	240 to 480
Solids Handling, Sludge Pumping	Sludge transfer pump	Digester Building	1	10	C	240 to 480
Plant Water Pumping	Plant water pump #1	Operations Building	1	10	C	240
Plant Water Pumping	Plant water pump #2	Operations Building	1	15	C	240
Plant Drain Pumping	Plant sewer wetwell	Operations Building	2	7.5	C	480
Other Processes	Garage air compressor	Operations Building	1	10	C	240
Other Processes	Plant air compressor	Operations Building	1	7.5	C	480

Notes:

[1] All equipment listed is 3-phase

The submeters were installed from May 12, 2004 to June 23, 2004, with the exception of the meter on the thickener supernatant pumps, which was installed from May 21, 2004 to June 23, 2004. The meters were reinstalled on the intermediate pumps from August 6, 2004 to August 13, 2004 for additional data.

3.2 SUMMARY OF SITE AUDIT

A one-day on-site survey was conducted to:

- Document existing equipment operations.
- Survey lighting and HVAC equipment.
- Finalize the list of opportunities for energy improvements.
- Finalize the submetering approach.

In addition, the site survey assessed the existing equipment at the plant with motors 5 hp or greater. As shown by the data in TABLE 3-1, the motors using the most energy are those on the intermediate pumps, the RBC blowers, the plant water pumps, and the sludge transfer pumps. The intermediate pumps have motors with variable frequency drives (VFDs).

3.3 SUMMARY OF CONTINUOUS SUBMETERING

The following sections summarize the results from continuous submetering activities. The overall electric energy demand for the wastewater treatment plant (WWTP) is shown on FIGURE 3-1. The overall electric energy demand was obtained as the sum of the submetered motors only and does not represent the total electric energy demand at the WWTP. Significant electric energy demand peaks were not observed in the data during the submetered period. Dips in electric energy demand may correspond with the submetered equipment not being in operation.

3.3.1 Intermediate Pumps

Two continuous submeters were installed on two of the 75-hp intermediate pumps. One of the meters malfunctioned and data were collected for Pump No. 3 only. Additional data for both pumps were obtained from August 6, 2004 to August 13, 2004. These data were taken in one minute intervals. There is one additional 75-hp pump that was not part of the continuous submetering program because two pumps meet most flow conditions. These pumps convey flow from the trickling filters effluent to the RBCs. The intermediate pumps represent the single largest electric energy consumer at the WWTP.

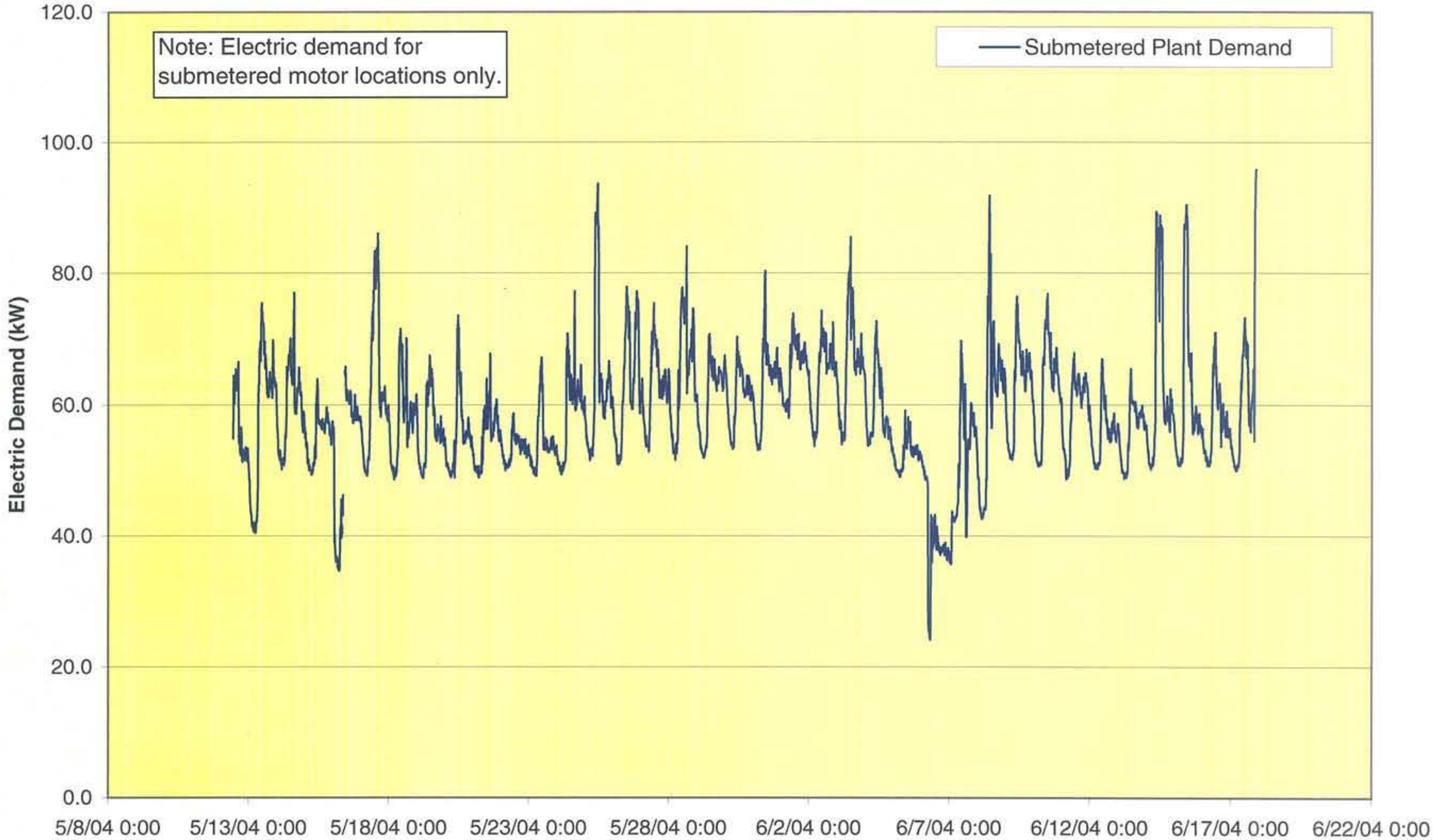


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FIGURE 3-1
SUBMETERED PLANT DEMAND

Each pump is sized to handle approximately 2,825 gallons per minute (gpm) at a total discharge head (TDH) of 70 feet.

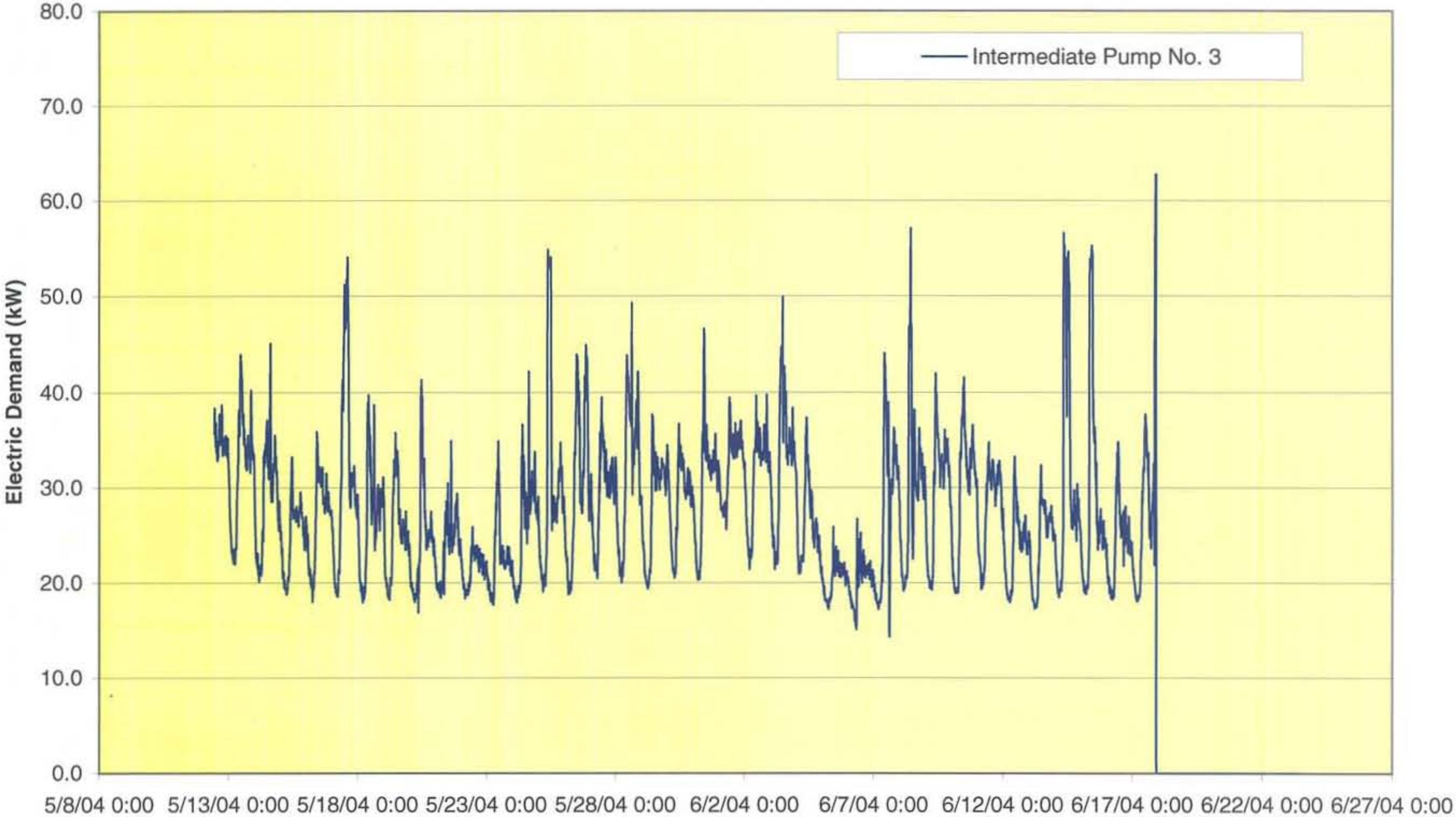
The pattern of use of Pump No. 3 during the submetering period is shown on FIGURE 3-2. The pump was operational during the first five weeks of submetering. During the last week, data indicate that the pump was shut off and most probably Pump No. 2 operated as the lead pump. However, it is difficult to estimate the operation of the intermediate pumps without simultaneous data. New data were obtained for both pumps at the same time. The pattern of use for both pumps is shown in FIGURE 3-3. These data illustrate that Intermediate Pump No. 3 was operational for the whole week of the submetering. Intermediate Pump No. 2 operated during high peaks of Pump No. 3 operation, corresponding to higher flows.

The operation of the intermediate pumps is as follows: Pump No. 3 (lead pump) starts operating at low speed when the wetwell reaches a minimum level. As the level continues to rise, the lead pump's speed will increase proportionally to wet well level. When it reaches an intermediate level, the lead pump will be at maximum speed and Pump No.2 (lag pump) will start. At this time, both the lead and lag pumps will be operating automatically with their speeds adjusted based on changing wet well level. If the level were to continue to rise to a maximum level, Pump No. 1 (wet weather pump) will start. This standby pump will stop running when the level drops below the maximum. When the level drops below the intermediate level, the lag pump will stop. If the level were to continue to drop below the minimum level, the lead pump would also stop and not restart until the level reaches the minimum level.

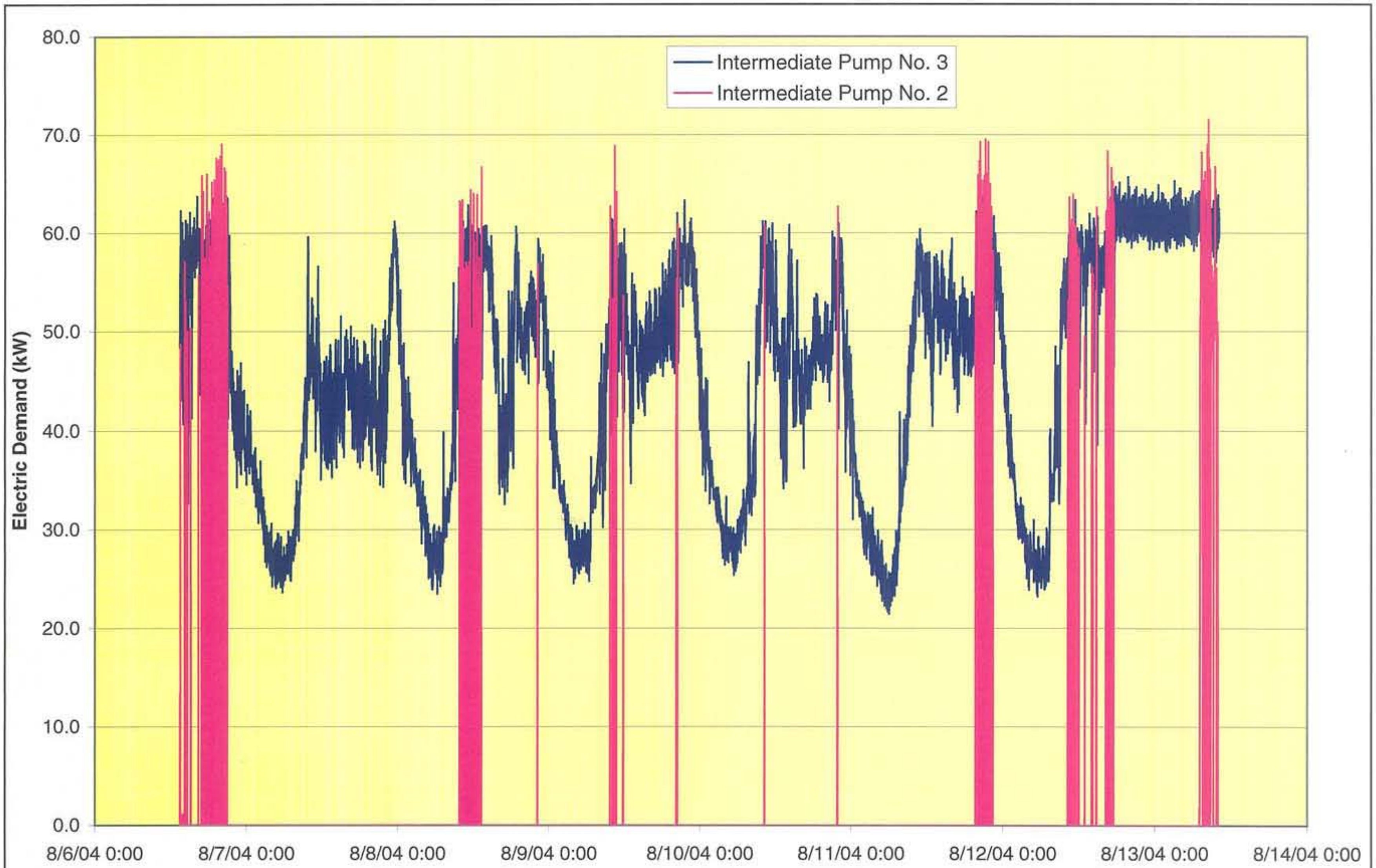
The average power draw value for Pump No. 3 during the May 12 to June 23 submetering period was 27.7 kW, corresponding to the pump running at approximately 50% of full speed. The average influent flow to the plant during this period was 1.47 MGD.

During the August 6 to August 13 submetering period, the average power draw values for Pumps Nos. 3 and 2 (when in operation) were 45.6 kW and 45.0 kW, respectively. This corresponds to each pump running at 81% and 80% of full speed, respectively. The average influent flow to the plant during this period was 3.19 MGD, higher than the yearly average flow.

From submetering data, it is estimated that the lead pump runs continuously, and the lag pump runs approximately 5% of the time. Pump No. 1 was not monitored during the submetering period; from flow data, it is estimated that this pump runs approximately 2% of the time, when the plant has high influent flows.



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 3-2 SUBMETERING - INTERMEDIATE PUMP NO.3



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SOUTH FALLSBURG WASTEWATER TREATMENT PLANT

FIGURE 3-3
SUBMETERING-INTERMEDIATE PUMPS

TABLE 3-2 summarizes the electric energy usage and estimated cost for the intermediate pumps extrapolated to the full year. Based on yearly average flows, pumps run at an average of 36.6 kW. It is estimated that the total annual electric energy usage of the intermediate pumps is 341,112 kWh and the total estimated cost is $ 28,551 or approximately 27% of the total WWTP average annual electric cost.

Table 3-2: Summary of Intermediate Pumps

Intermediate Pump No.	Electric Usage (kWh)	Estimated Cost*
3 lead	320,616	$ 32,703
2 lag	16,836	$ 1,717
1 wet weather	3,660	$ 373
TOTAL	341,112	$ 34,793

Note:

* Estimated using 10.2 cents per kWh, which was average cost per kWh from 2003 data.

3.3.2 RBC Blower

FIGURE 3-4 summarizes the operation of the RBC blower. Three 30-hp blowers are installed to provide air to the RBCs for the biological treatment process. Typically, one of the blowers is in operation at any time with a second as a standby unit. Therefore, for the submetering program, a submeter was installed on the operating blower.

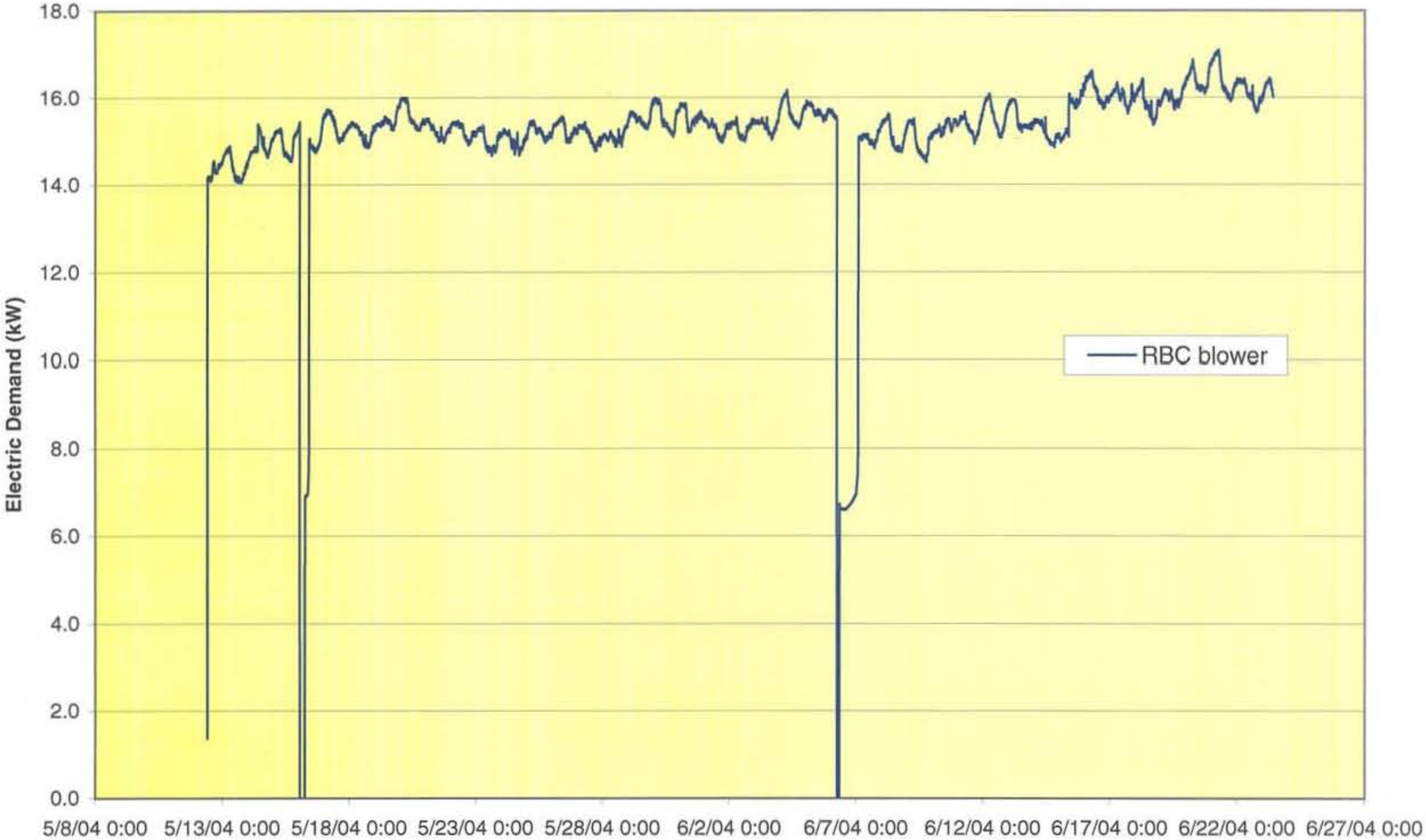
The RBC blower runs continuously 365 days per year. During the submetering period, the RBC blower ran continuously at an average power draw of 15 kW. It is estimated that at this average demand, the annual power usage is 131,400 kWh with a total annual cost of $13,403.

3.3.3 Thickener Overflow Pump

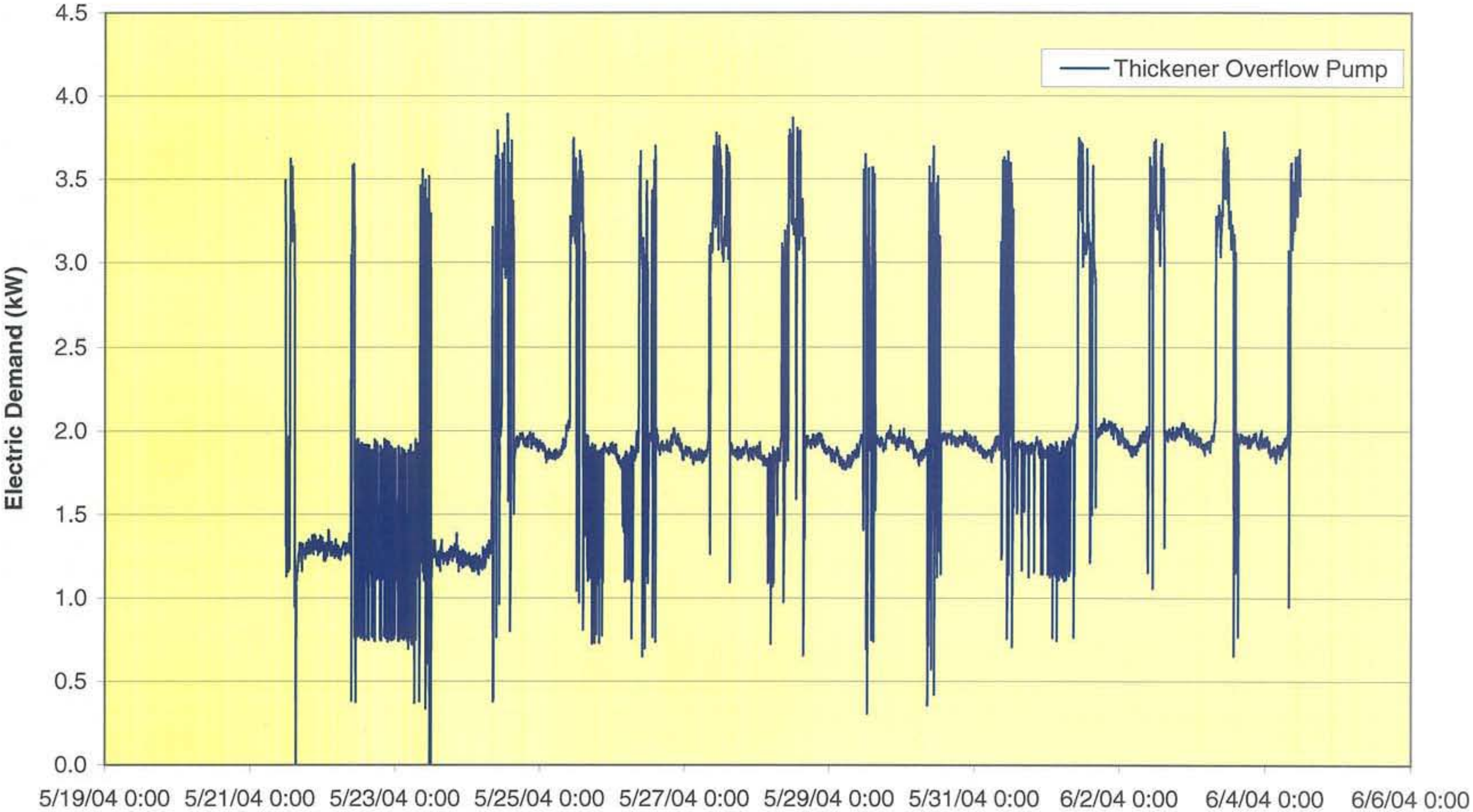
FIGURE 3-5 summarizes the operation of the thickener overflow pump. The pump runs at a baseline of 1.7 kW, with a peak over 3.5 kW for about 4 hours per day. The average electric energy demand for the thickener overflow pump during the monitored period was 2.05 kW. Extrapolating to the full year, it is estimated that the total annual electric energy usage of the thickener overflow pump is 17,958 kWh and the total estimated cost is $ 1,832 per year.

3.3.4 Digester Facility

The digester facility "old MCC" houses the following equipment:



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 3-4 SUBMETERING - RBC BLOWER



MALCOLM PIRNIE	**NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION** **SOUTH FALLSBURG WASTEWATER TREATMENT PLANT**	**FIGURE 3-5** **SUBMETERING -** **THICKENER OVERFLOW PUMP**

- Digester feed pumps.
- Digester mixing pumps.
- Sludge transfer pumps.

FIGURE 3-6 summarizes the operation of the digester facility. One digester mixing pump (15 hp) runs constantly, one digester feed pump (7.5 hp) runs for approximately 5 hours every week, and one sludge transfer pump (10 hp) runs approximately 10 minutes every hour. From the submetering data, the digester facility had an average power draw of 3.3 kW and an estimated 3,300 kWh were used during the course of the submetering. The estimated annual power usage was estimated for each equipment, based on instantaneous submetering data.

3.3.5 Plant Water Pumps

FIGURE 3-7 summarizes the operation of the plant water pumps. The average power draw for the submetering period was 11.6 kW. The total annual electric energy usage is estimated as 101,616 kWh, at an approximate cost of $10,365 per year.

3.4 SUMMARY OF INSTANTANEOUS SUBMETERING

Instantaneous power draw measurements were obtained from motors greater than 5 hp at the plant for equipment that is either in continuous use or operated on a set schedule. The resulting information was collected to verify electric energy demand at the facility, as well as to monitor changes in demand as the equipment is cycled on and off.

The instantaneous measurements were obtained using hand-held meters. TABLE 3-3 summarizes the instantaneous power draw and estimated operating hours for each piece of equipment over 5 hp.

Based on the instantaneous power draw measurements and the estimated operating hours, TABLE 3-4 shows the estimated annual electric energy usage and associated costs. The table presents both the usage and costs based on instantaneous power draw measurements along with estimates provided by plant staff as to equipment operating hours. Intermediate Pump No. 3 was monitored under both the continuous and instantaneous submetering programs. In estimating electric energy usage for the intermediate pump, the continuous submetering data were used. For equipment for which instantaneous or continuous readings were not available, power ratings were estimated.

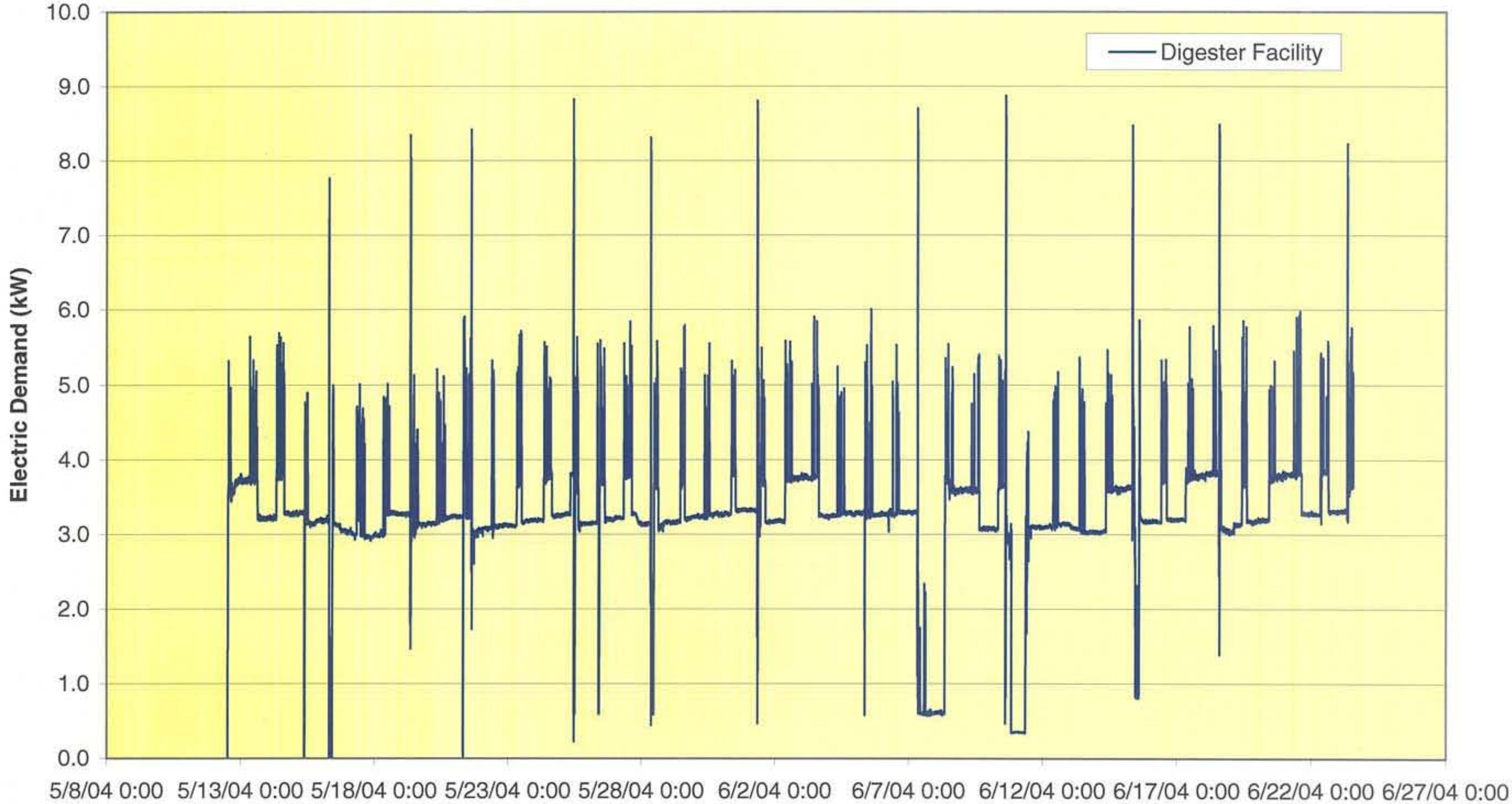


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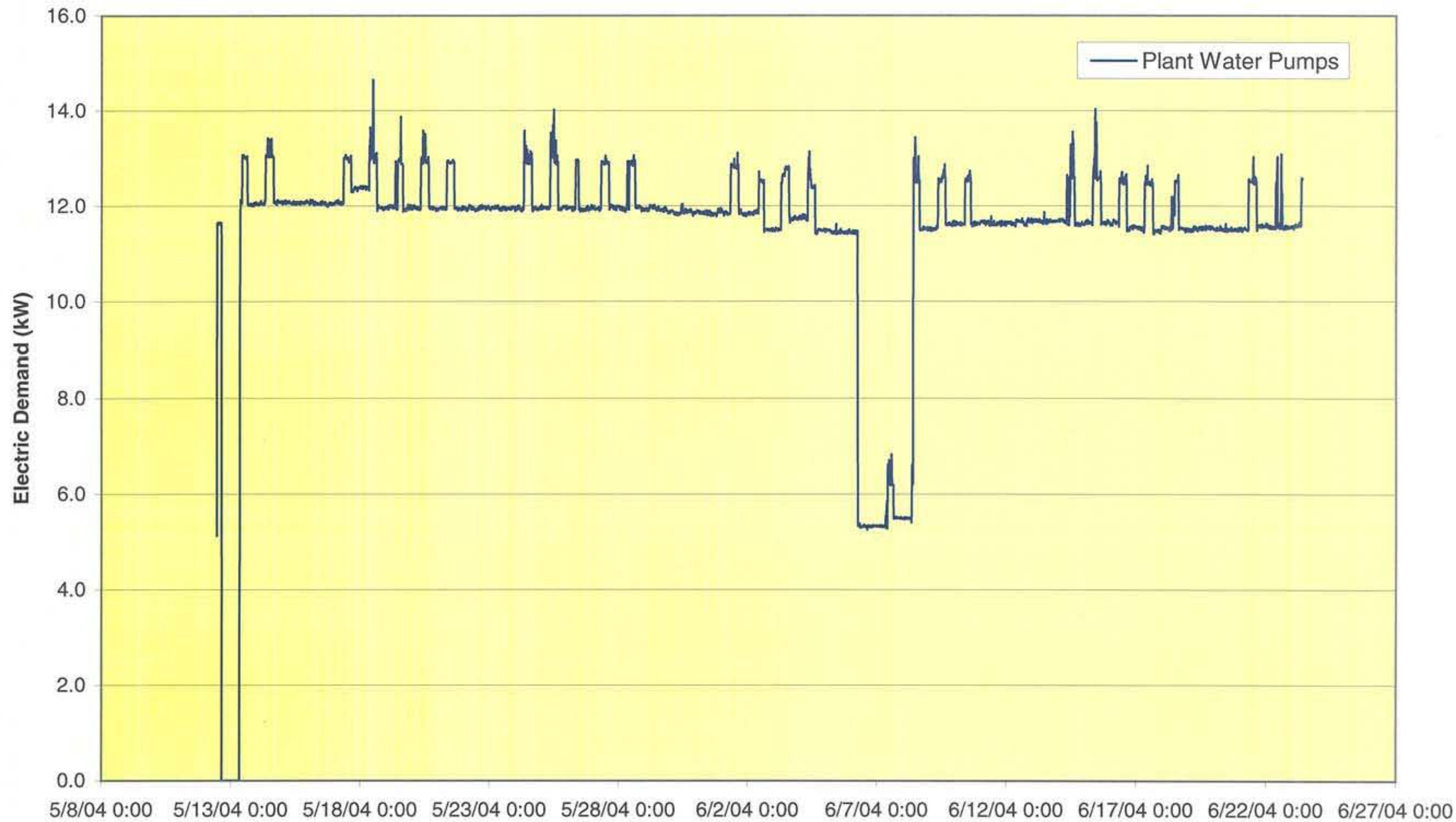
FIGURE 3-6
SUBMETERING - DIGESTER FACILITY



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 3-7 SUBMETERING - PLANT WATER PUMPS

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Municipal Wastewater Treatment Plant Energy Evaluation

South Fallsburg Wastewater Treatment Plant

Table 3-3 Instantaneous Power Draw Measurement and Estimates of Hours in Operation

Process	Use	MCC Location	Quantity	Size (hp)	Constant/ Variable Speed	Voltage[1]	Efficiency Rating[2]	Estimated Hours per Year	Continuous (C) / Instantaneous (I) / Estimated (E) Power Ratings[3]	Power Draw (kW) per Motor[4]	Notes
Wastewater Pumping	Intermediate Pump #3	Operations Building	1	75	V	480	94.5	8760	*I/C*	44.3 / *36.6*	Lead pump
Wastewater Pumping	Intermediate Pump #2	Operations Building	1	75	V	480	94.5	460	*C*	*36.6*	Lag pump
Wastewater Pumping	Intermediate Pump #1	Operations Building	1	75	V	480	94.5	175	E	36.6	Wet weather
Wastewater Recirculation	Trickling filter pumps	Operations Building	2	7.5	C	240	82.5	7500	I	6.3	
Secondary Treatment	RBC drive motors	Operations Building	16	7.5	C	240	84.9	110500	I	3.65	Run constantly
Secondary Treatment	RBC blowers	Operations Building	3	30	C	480	86.5	8760	*C*	*15*	Run one constantly
Solids Handling, Thickening	Thickener overflow pump	Digester Building	2	7.5	C	240	85	8760	*C*	2.05	
Solids Handling, Sludge Pumping	Digester feed pumps	Digester Building	2	7.5	C	240-480	81.5	260	E	4.5	Run one 5 hrs/ week
Solids Handling, Sludge Pumping	Digester mixing pumps	Digester Building	2	15	C	240-480	81.5	8760	I	13.1	Run 1 constantly
Solids Handling, Digestion	Gas mixing compressors	Digester Building	2	7.5	C	240-480	85.5	0	-	0	Not running
Solids Handling, Sludge Pumping	Sludge transfer pump	Digester Building	1	10	C	240-480	85	7200	I	8.0	Run one
Plant Water Pumping	Plant water Pump #1	Operations Building	1	10	C	240	86.5	8760	*C*	*4.4*	
Plant Water Pumping	Plant water Pump #2	Operations Building	1	15	C	240	86.5	8760	*C*	*7.2*	
Plant Drain Pumping	Plant sewer wetwell	Operations Building	2	7.5	C		85.5	2500	E	4.8	
Other Processes	Garage air compressor	Operations Building	1	10	C	240	87.0	520	I	5.6	
Other Processes	Plant air compressor	Operations Building	1	7.5	C	480	86.5	730	I	4.2	

Notes:

[1]All equipment listed is 3-phase

[2]Efficiency rating for motors based on motor size, using standard efficiencies.

[3]Power ratings were estimated when instantaneous or continuous readings were not available.

[4]If determined through continuous submetering, values will be displayed in italics; otherwise, values estimated from available information and instantaneous power draw readings.

South Fallsburg Wastewater Treatment Plant

Table 3-4 Estimates of Electric Energy Usage and Costs

Process	Use	MCC Location	Size (hp)[1]	Efficiency Rating[2]	Estimate of Electric Energy Usage[3] Estimated Hours per Year	Power Draw (kW) per Motor	Estimated Annual Usage (kWh)	Estimated Cost[4]	Notes
Wastewater Pumping	Intermediate Pump #3	Operations Building	75	94.5	8760	36.6	320,616	$ 32,703	Lead pump
Wastewater Pumping	Intermediate Pump #2	Operations Building	75	94.5	460	*36.6*	16,836	$ 1,717	Lag pump
Wastewater Pumping	Intermediate Pump #1	Operations Building	75	94.5	100	36.6	3,660	$ 373	Wet weather pump
Wastewater Recirculation	Trickling filter pumps	Operations Building	7.5	82.5	7500	6.3	47,250	$ 4,820	
Secondary Treatment	RBC drive motors	Operations Building	7.5	84.9	110500	3.65	403,325	$ 41,139	Run constantly
Secondary Treatment	RBC blowers	Operations Building	30	86.5	8760	*15*	131,400	$ 13,403	Run 1 constantly
Solids Handling, Thickening	Thickener overflow pump	Digester Building	7.5	85	8760	2.05	17,958	$ 1,832	
Solids Handling, Sludge Pumping	Digester feed pumps	Digester Building	7.5	81.5	260	4.5	1,170	$ 119	Run one 5 hrs/ week
Solids Handling, Sludge Pumping	Digester mixing pumps	Digester Building	15	81.5	8760	13.1	114,756	$ 11,705	Run 1 constantly
Solids Handling, Digestion	Gas mixing compressors	Digester Building	7.5	85.5	0	0	0	$ -	Not running
Solids Handling, Sludge Pumping	Sludge transfer pump	Digester Building	10	85	7200	8.0	57,600	$ 5,875	Run one
Plant Water Pumping	Plant water Pump #1	Operations Building	10	86.5	8760	4.4	38,544	$ 3,931	
Plant Water Pumping	Plant water Pump #2	Operations Building	15	86.5	8760	7.2	63,072	$ 6,433	
Plant Drain Pumping	Plant sewer wetwell	Operations Building	7.5	85.5	2500	4.8	12,000	$ 1,224	
Other Processes	Garage air compressor	Operations Building	10	87.0	520	5.6	2,912	$ 297	
Other Processes	Plant air compressor	Operations Building	7.5	86.5	730	4.2	3,066	$ 313	
						TOTALS	**1,234,165**	**$ 125,885**	

Notes:

[1] All equipment listed is 3-phase.

[2]Efficiency Rating for Motors based on motor size, using standard efficiencies.

[3]Energy demand determined by instantaneous power draw measurement and plant reports of operating hours. Shaded boxes indicate equipment in both instantaneous and continuous submetering programs.

[4]Costs based on 2003 cost of $ 0.102/kWh

3.5 SUMMARY OF ENTIRE SUBMETERING PROGRAM

FIGURE 3-8 summarizes the apparent energy usage distribution among the larger motors at the WWTP. TABLE 3-5 also shows the corresponding percentages of total electric energy usage.

Table 3-5: Summary of Major Equipment Total Estimated Electric Energy Usage and Costs at the WWTP

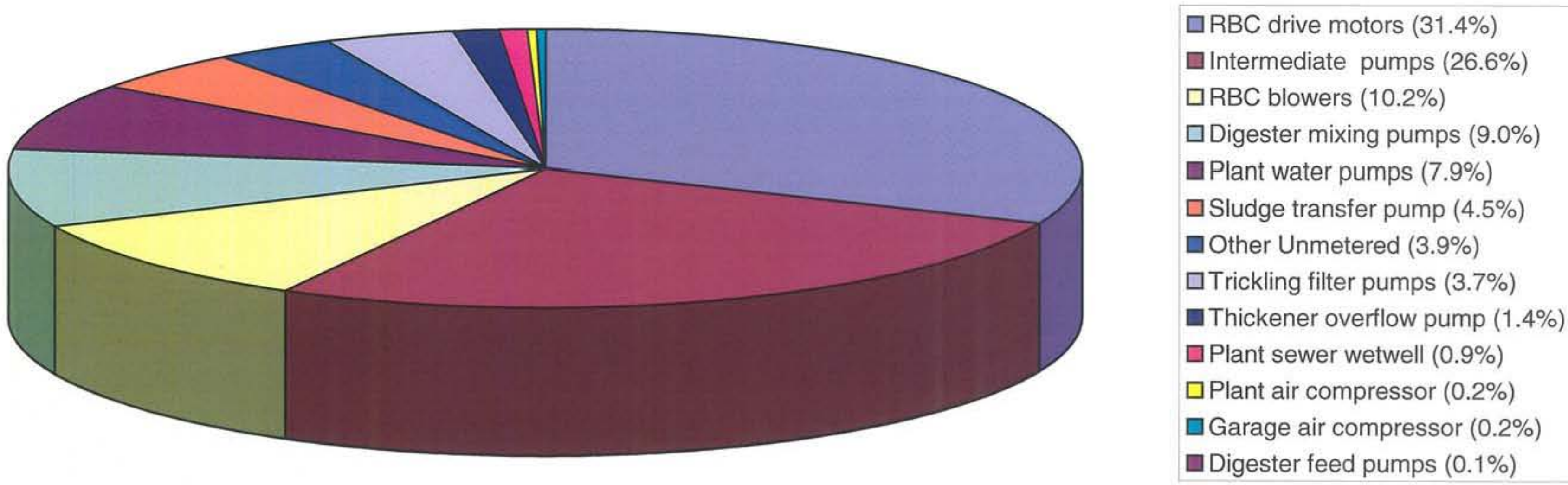
Equipment	Usage (kWh)*	Cost	Percentage of Total Cost
RBC drive motors	403,325	$41,139	31.4%
Intermediate pumps	341,112	$34,793	26.6%
RBC blowers	131,400	$13,403	10.2%
Digester mixing pumps	114,756	$11,705	9.0%
Plant water pumps	101,616	$10,365	7.9%
Sludge transfer pump	57,600	$5,875	4.5%
Trickling filter pumps	49,235	$5,022	3.7%
Thickener overflow pump	17,958	$1,832	1.4%
Plant sewer wetwell	12,000	$1,224	0.9%
Plant air compressor	3,066	$313	0.2%
Garage air compressor	2,912	$297	0.2%
Digester feed pumps	1,170	$119	0.1%
Other Unmetered	49,235	$5,022	3.9%
TOTALS	1,283,400	$130,907	100%

Note:
* Power usage based on both instantaneous and continuous (for those pieces of equipment continuously submetered) measurements.

From FIGURE 3-8 and TABLE 3-5, it is apparent that the largest identified uses of electric energy at the plant are the RBC drive motors, which account for approximately 31% of the total electric energy usage, followed by the intermediate pumps (27%) and RBC blowers (10%). Approximately 1.7% of the total electric energy usage is accounted for as "Other Unmetered" which would involve equipment such as heating and ventilating fans, lights, lab equipment, and other plant equipment with electric motors less than 5 hp that were not included as part of the submetering program.

FIGURE 3-9 shows the energy distribution of estimated energy usage among the major processes at the plant. Equipment were grouped into processes as follows:

- Wastewater Pumping - intermediate pumps only.



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 3-8 ESTIMATED DISTRIBUTION OF ELECTRIC USAGE AND COST

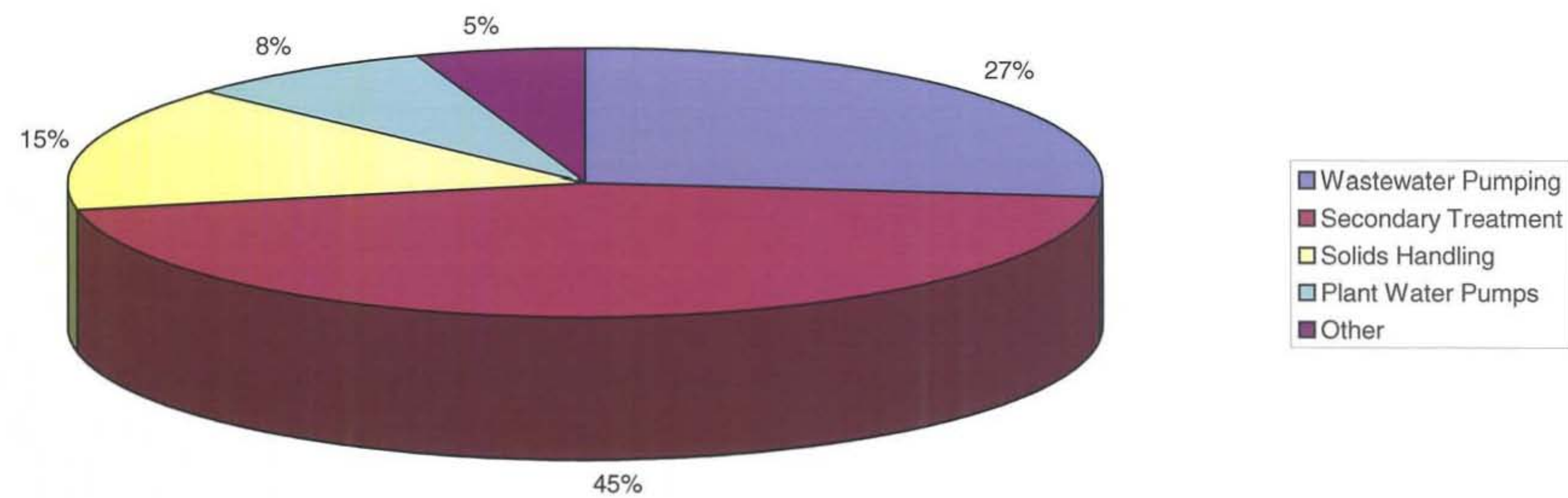


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FIGURE 3-9
DISTRIBUTION OF ELECTRIC USAGE AMONG PROCESSES

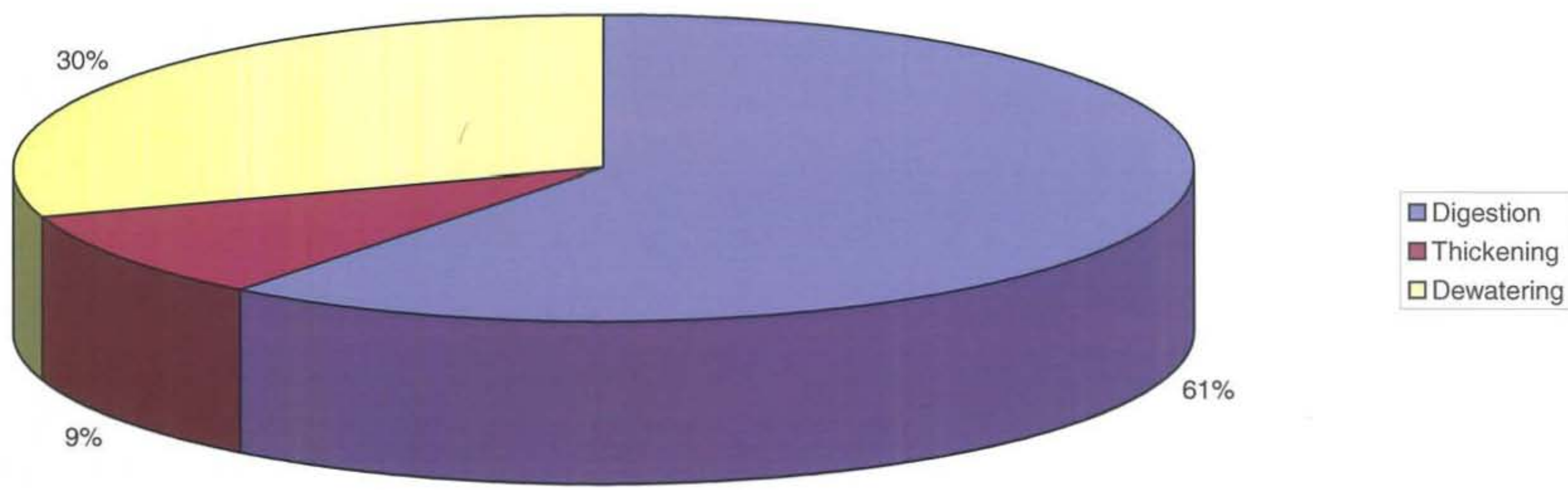
- Secondary Treatment – RBC drive motors, RBC blowers, trickling filter pumps.
- Solids Handling – digester mixing pumps, sludge transfer pumps, thickener overflow pumps, digester feed pumps.
- Plant Water Pumps.
- Other – air compressors, process drain pumps.

By far, the secondary treatment process consumes the most electric energy at the South Fallsburg WWTP. It is estimated that approximately 2.2 kWh of electric energy is consumed per lb of biochemical oxygen demand (BOD_5) removed in the secondary process.

The distribution of estimated electric energy usage in the solids handling process is shown in FIGURE 3-10. The solids handling equipment was categorized as follows:

- Digestion – digester feed pumps, digester recirculation pumps.
- Thickening – thickener overflow pumps.
- Dewatering – sludge transfer pumps.

The sludge digestion process consumes the majority of the electric energy in the solids handling treatment process.



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SOUTH FALLSBURG WASTEWATER TREATMENT PLANT

FIGURE 3-10
DISTRIBUTION OF ELECTRIC USAGE IN SOLIDS HANDLING

Section 4

PROCESS PERFORMANCE DURING SUBMETERING

Process data were collected during the continuous submetering. These data were compared with historical plant data to determine if the operation during submetering and corresponding energy usage could be considered typical for the WWTP.

4.1 SUMMARY OF PROCESS PARAMETER MONITORING

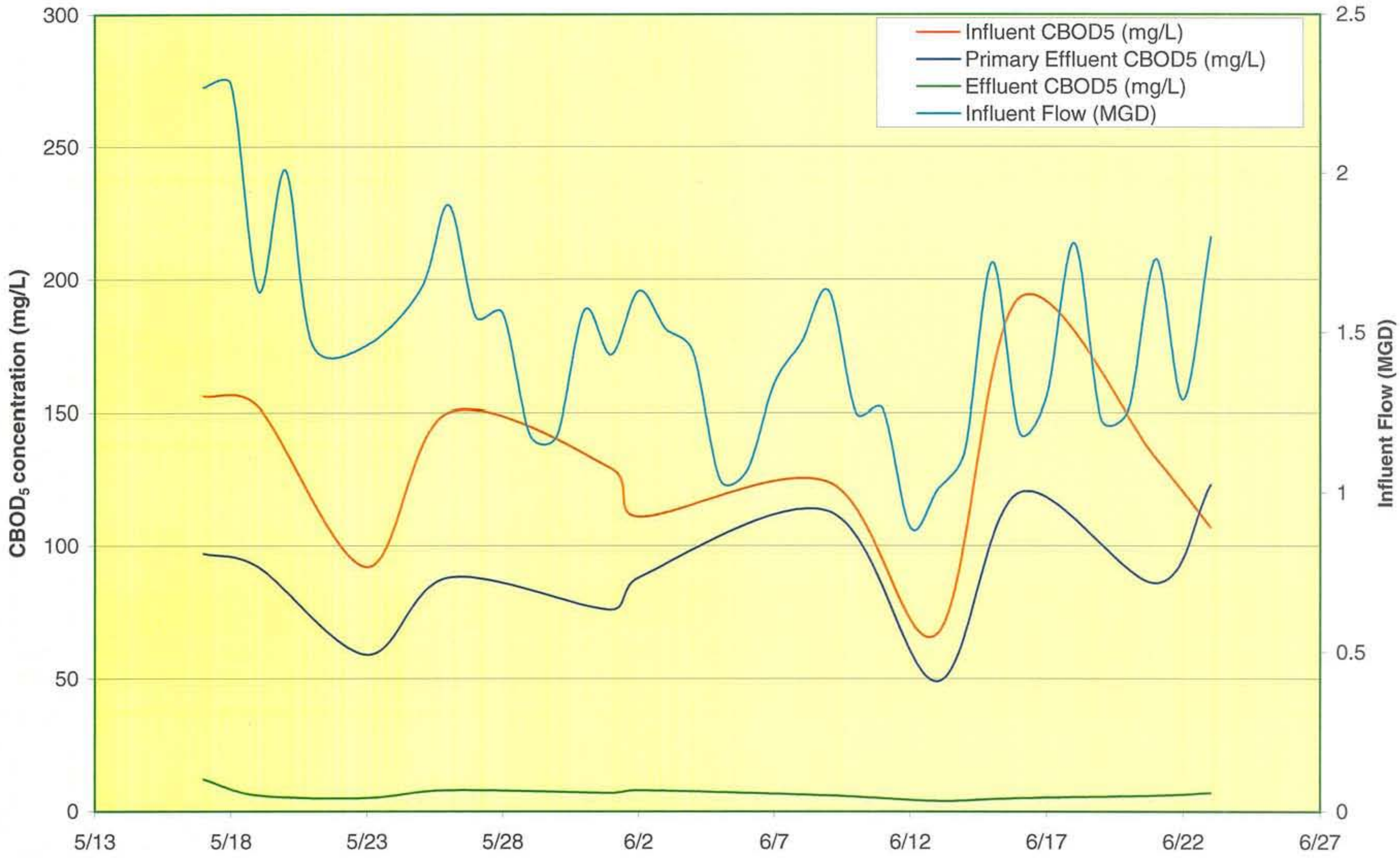
The following daily process performance data were collected for the duration of the submetering program:

- Influent, primary effluent, and plant effluent 5-day carbonaceous biochemical oxygen demand ($CBOD_5$).
- Influent, primary effluent, and effluent total suspended solids (TSS).
- Trickling filter effluent $CBOD_5$ and dissolved oxygen (DO).
- Rotating biological contactors (RBC) effluent $CBOD_5$ and DO.
- Waste Activated Sludge (WAS) flow rate and suspended solids.

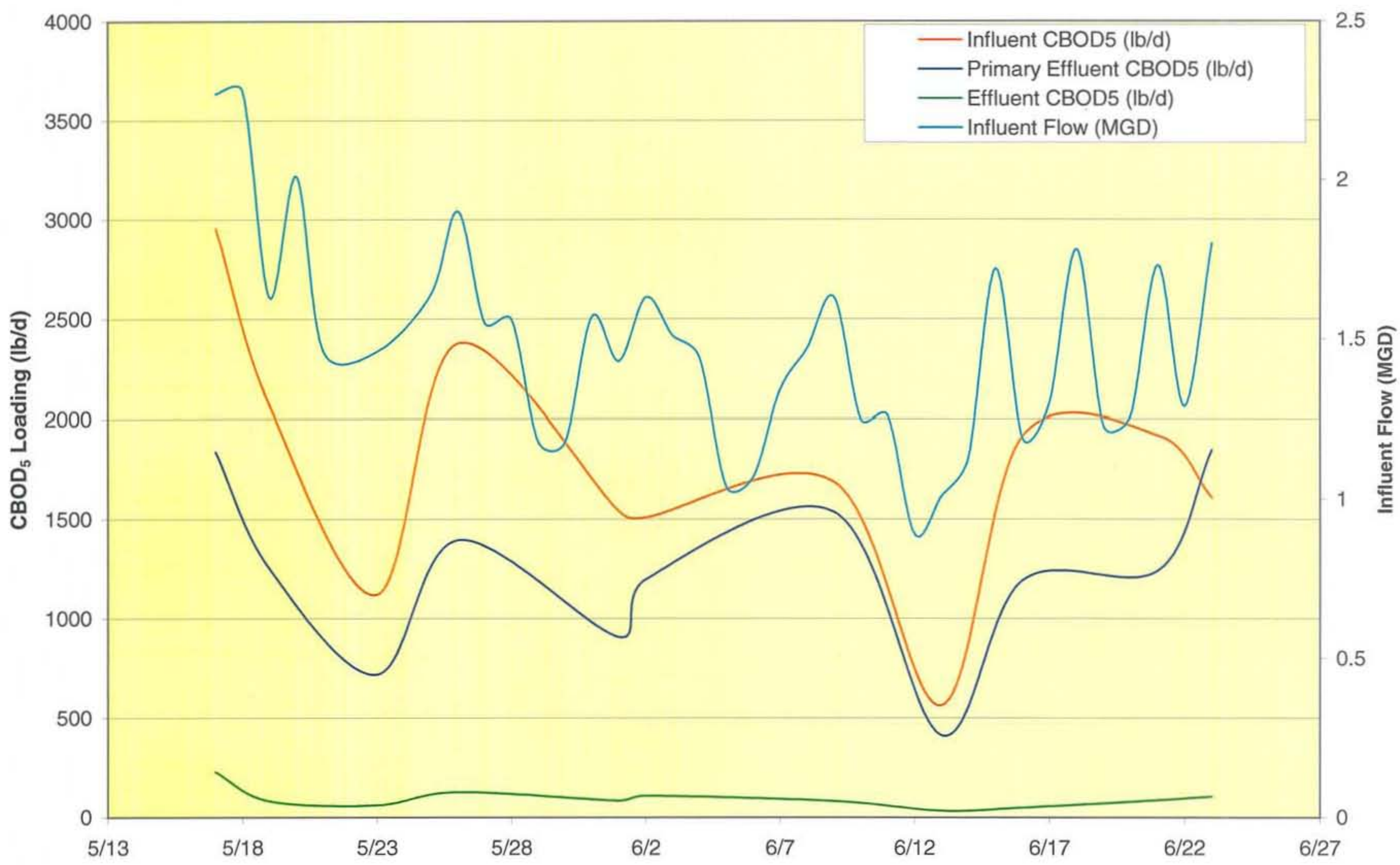
FIGURE 4-1 shows the influent, primary effluent, and plant effluent $CBOD_5$ concentrations during the course of the submetering program. $CBOD_5$ concentrations are only measured two or three times per week. There appears to be a correlation between $CBOD_5$ concentrations and plant influent flow. FIGURE 4-2 shows the relationship between $CBOD_5$ loading (in pounds per day) and influent plant flow. The loading data more closely show a relationship with plant influent flow, with days of higher flow contributing more $CBOD_5$ loading than days with lower flow.

FIGURES 4-3 and 4-4 show the TSS concentrations and loadings (respectively) for the influent, primary effluent, and plant effluent flows. TSS concentrations and loadings appear to follow trends similar to the BOD_5 concentrations and loadings.

The most relevant process data are summarized in TABLE 4-1. Parameters were compared to historical values.



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 4-1 SUBMETERING - CBOD5 CONCENTRATION VS. INFLUENT FLOW



MALCOLM PIRNIE	**NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION** **SOUTH FALLSBURG WASTEWATER TREATMENT PLANT**	**FIGURE 4-2** **SUBMETERING - CBOD5 LOADING VS. INFLUENT FLOW**

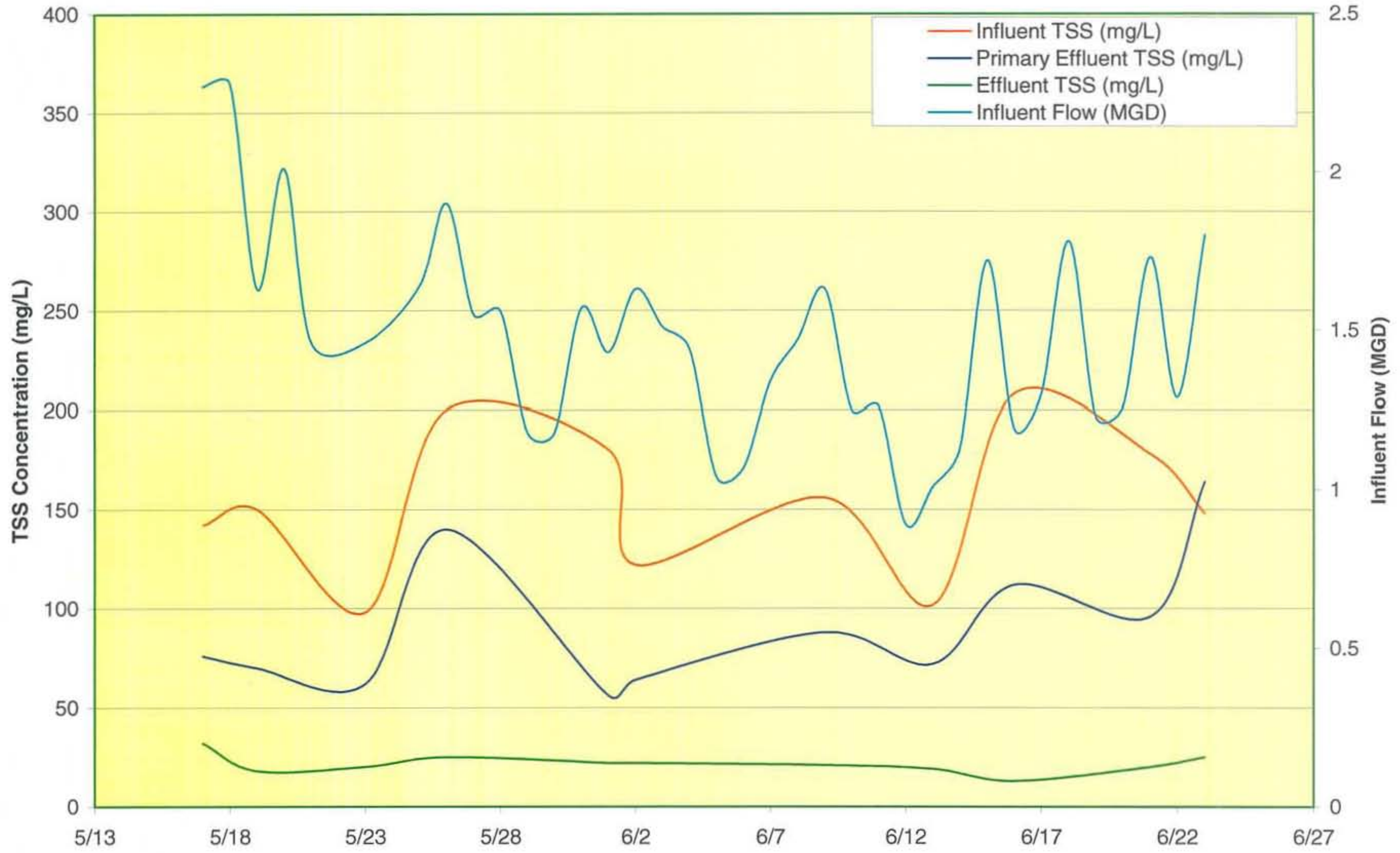


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FIGURE 4-3
SUBMETERING - TSS CONCENTRATION VS. INFLUENT FLOW

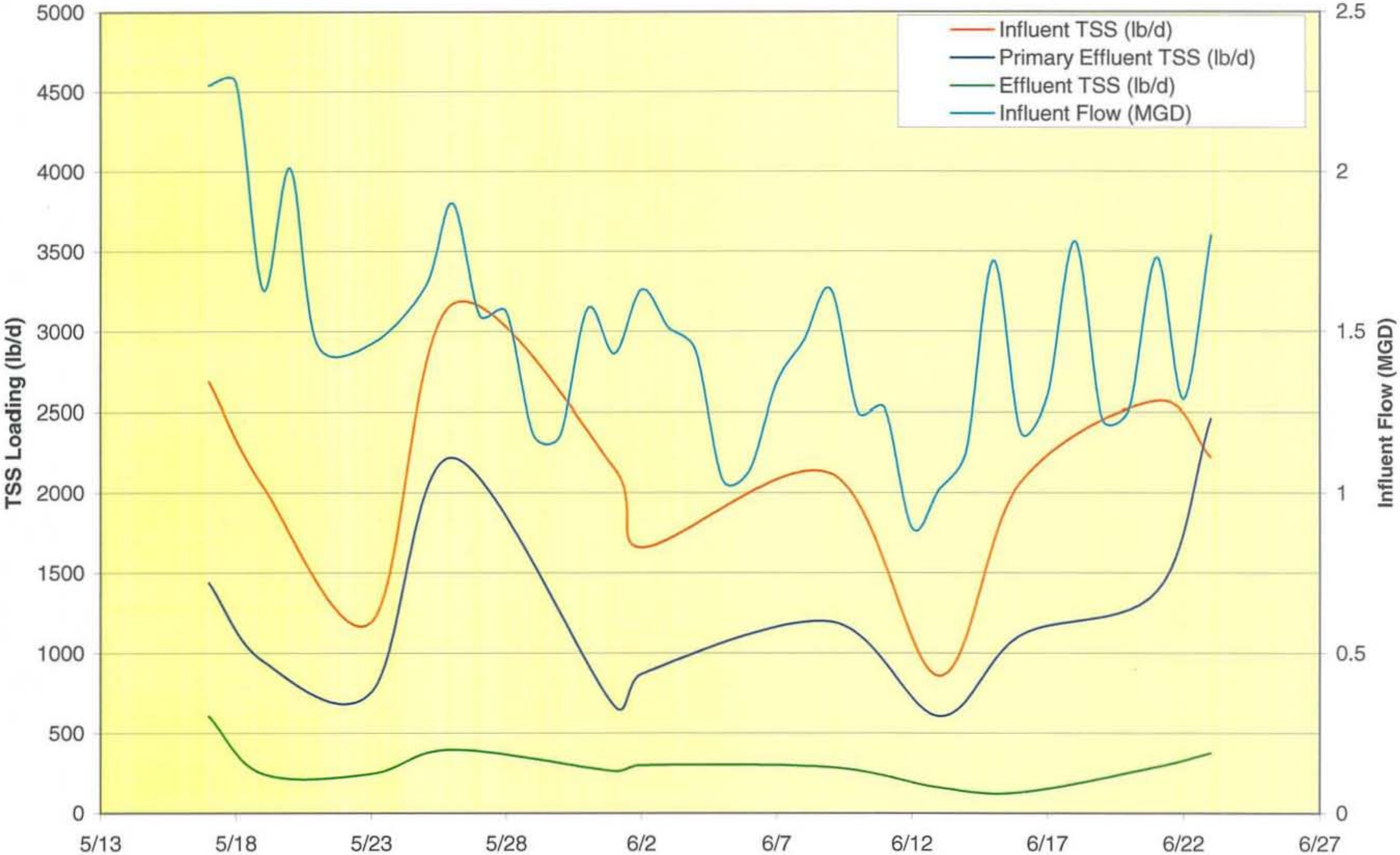

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FIGURE 4-4
SUBMETERING - TSS LOADING VS. INFLUENT FLOW

Table 4-1: Summary of South Fallsburg WWTP Performance: Monitoring Period Compared to Historical Data

Parameter	Unit	Monitoring		Historical	
		Average	Maximum	Average	Maximum
Influent Plant Flow	MGD	1.52	2.28	2.00	3.07
Influent $CBOD_5$ Concentration	mg/L	129	193	126	265
Influent $CBOD_5$ Loading	lb/d	1,750	2,953	1,625	2,914
Effluent $CBOD_5$ Concentration	mg/L	7	12	9	16
Average $CBOD_5$ Removal	%	95%	97%	92%	96%
Influent TSS Concentration	mg/L	153	208	142	247
Influent TSS Loading	lb/d	2,066	3,169	1,861	3,012
Effluent TSS Concentration	mg/L	22	32	14	20
Average TSS Removal	%	85%	94%	89%	95%

As demonstrated in TABLE 4-1, the hydraulic and organic loadings to the facility during the monitoring period were similar to the historical values.

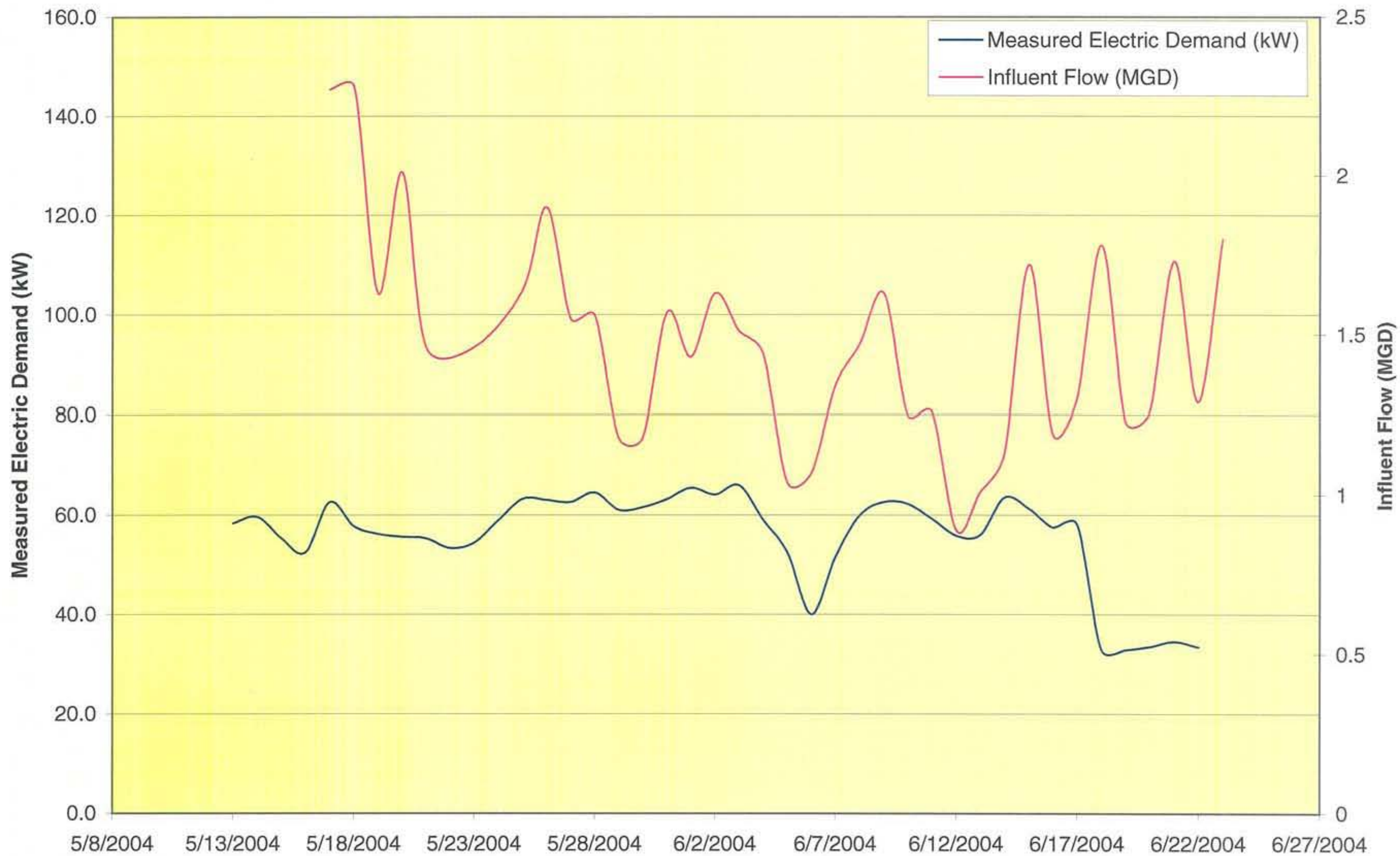
4.2 RELATIONSHIP BETWEEN PLANT PROCESS DATA AND SUBMETERING DATA

Process data for the monitoring period were compared to the electric energy demand measured with the submeters. Demand was recorded in 5-minute or 15-minute intervals; data were averaged for each day to compare them to daily plant process data.

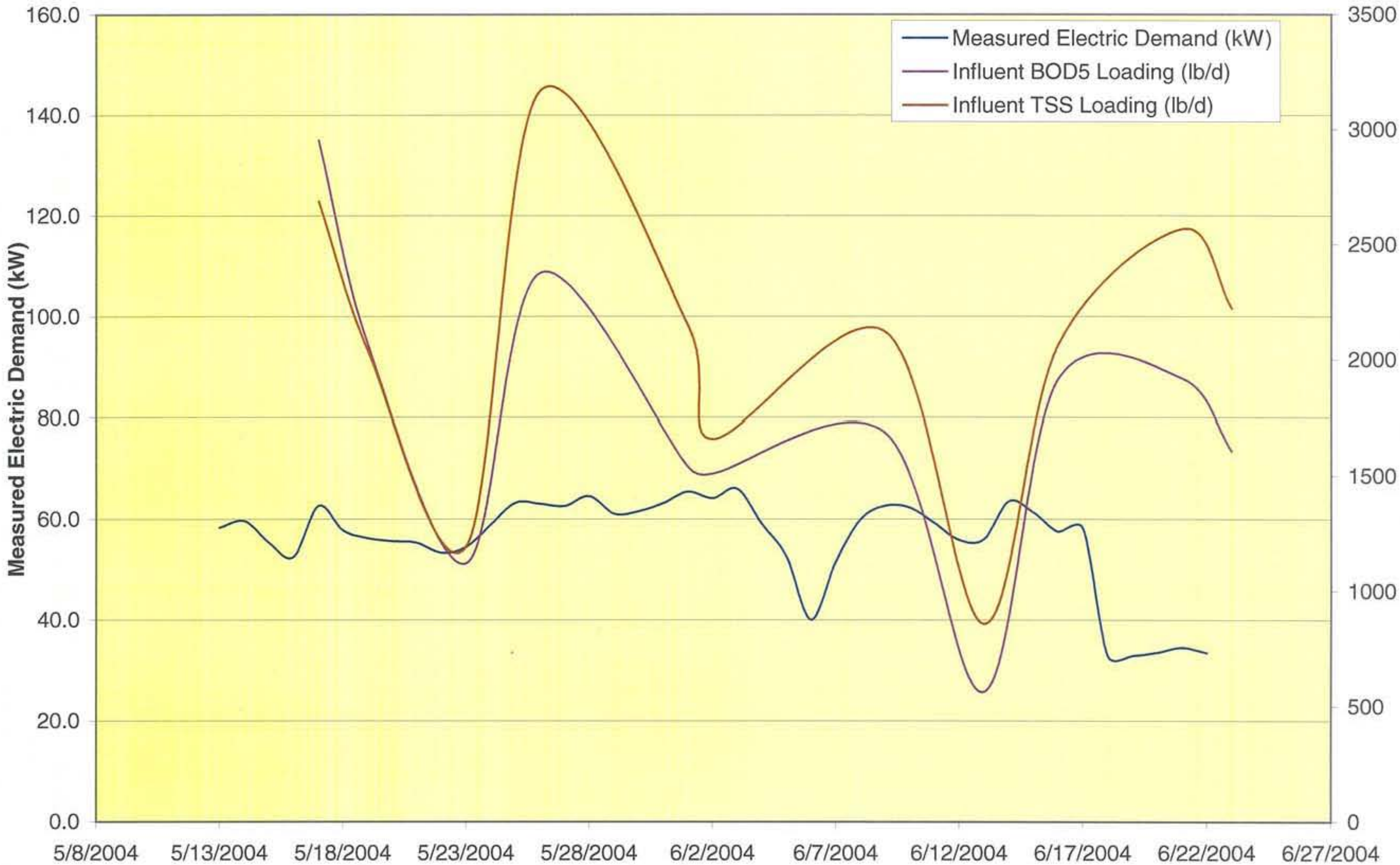
4.2.1 Plant Performance

FIGURE 4-5 shows the total electric energy demand for the metered processes at the plant versus influent flow. The electric energy demand for the plant is the sum of all measured electric energy demands from the intermediate pumps, RBC blower, thickener supernatant pump, digester facility, and plant water pumps. Demand data obtained every 5 minutes or 15 minutes from the submeters were averaged for each day for a closer comparison with daily plant data. No correlation between influent flow and energy usage can be noted. This could be due to the lack of reliable data for one of the intermediate pumps, which would be operational during the high flow conditions.

FIGURE 4-6 shows the total measured energy demand for the plant versus influent BOD_5 and TSS loading. Again, no real correlation to flow data can be identified.



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 4-5 INFLUENT FLOW VS. TOTAL ELECTRIC DEMAND



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 4-6 ELECTRIC DEMAND VS. PLANT LOADING

4.2.2 Intermediate Pumps

Total electric energy demand for the intermediate pumps is the algebraic sum of the energy demand for Intermediate Pumps No. 3 and 2. FIGURE 4-7 shows a comparison of the average daily flow and the total energy demand for the two intermediate pumps during the submetering period of August 6 to 13, 2004. During this period, flow ranged from 2.1 MGD to a peak of 5.4 MGD on August 13. This figure shows a good correlation between influent flow and electric energy usage indicating that the electric energy usage by the intermediate pumps is dependent upon flow rate, i.e., the greater the influent flow, the greater the pumps' energy usage.

Higher than normal electric energy usage by the intermediate pumps was observed on August 13. This correlates to high influent plant flow. A review of rain data collected by the plant indicates a total precipitation of 1.85 inches for that day, indicating that wet weather events contribute to a substantial increase in plant influent flow, and subsequently, electric energy usage by the intermediate pumps.

Pumps are currently on variable frequency drives (VFDs) to allow the pumps to operate at their most efficient points. One additional pump (Intermediate Pump No. 1) is available and is typically used when the capacity of the two pumps is exceeded. With an average pump capacity of 4 MGD (2,825 gpm) at 70 ft. TDH each, the plant can handle approximately 8 MGD with Pumps No. 2 and 3. When the peak hourly flow exceeds this value, Pump No. 1 starts operating.

4.2.3 RBC Blower

Process performance data for influent, primary effluent, and trickling filter effluent were recorded to correlate the process performance data with the electric usage.

As observed in FIGURE 4-8, the use of the RBC blower does not show any appreciable dependence on secondary process $CBOD_5$ loadings or plant flows during the submetering period. This was expected, as the blower supplies air to the RBC tanks to keep solids from settling and to contribute to the biomass sloughing-off.

4.2.4 Thickener Overflow Pump

FIGURE 4-9 summarizes the operation of the thickener overflow pumps compared to the solids loading to the plant. The figure shows a good correlation between the thickener overflow pumps operation and the solids loading to the plant during the period from June 2, 2004 to June 22, 2004.

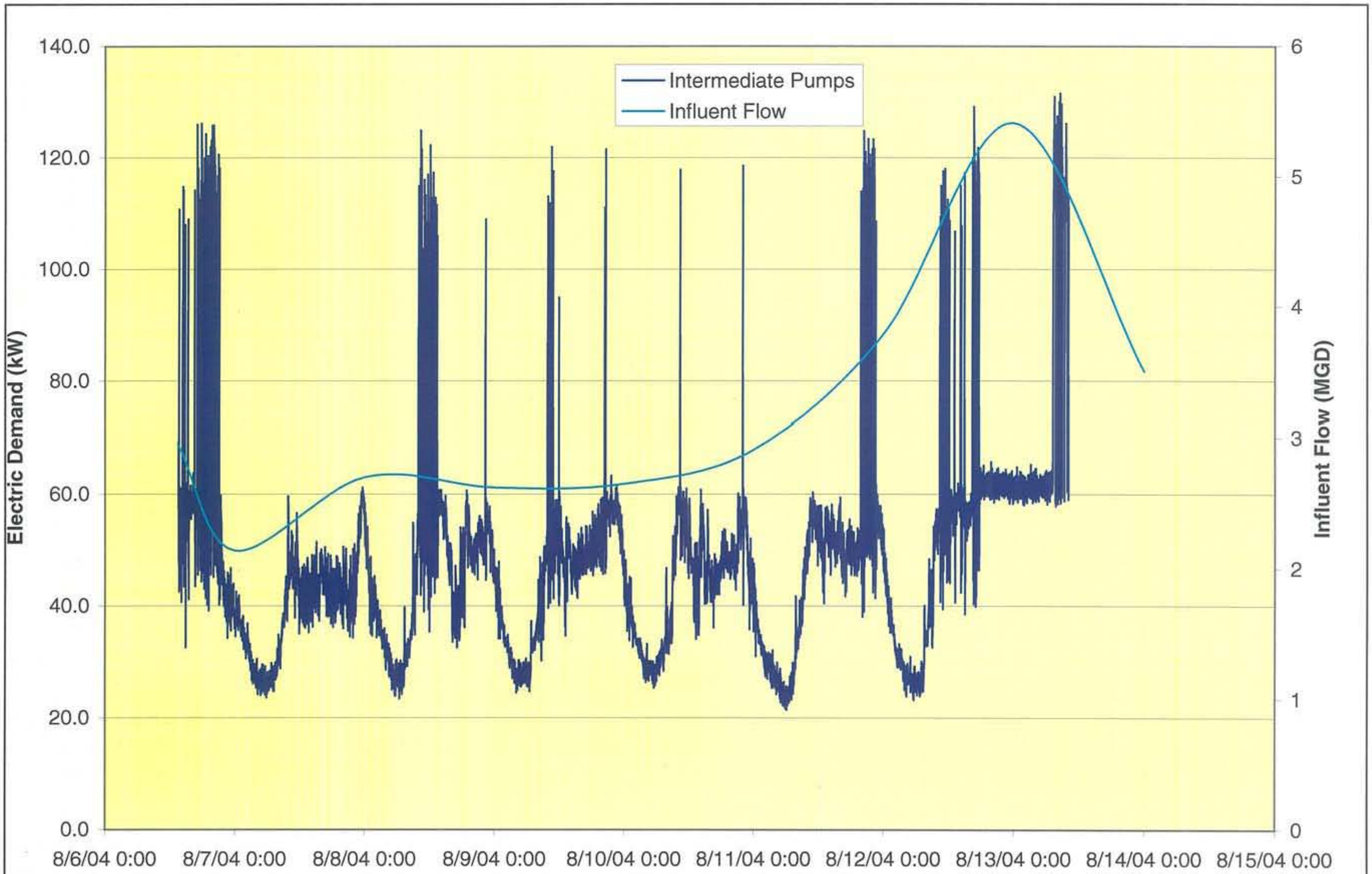


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FIGURE 4-7
ELECTRIC DEMAND VS. PLANT FLOWS: INTERMEDIATE PUMPS

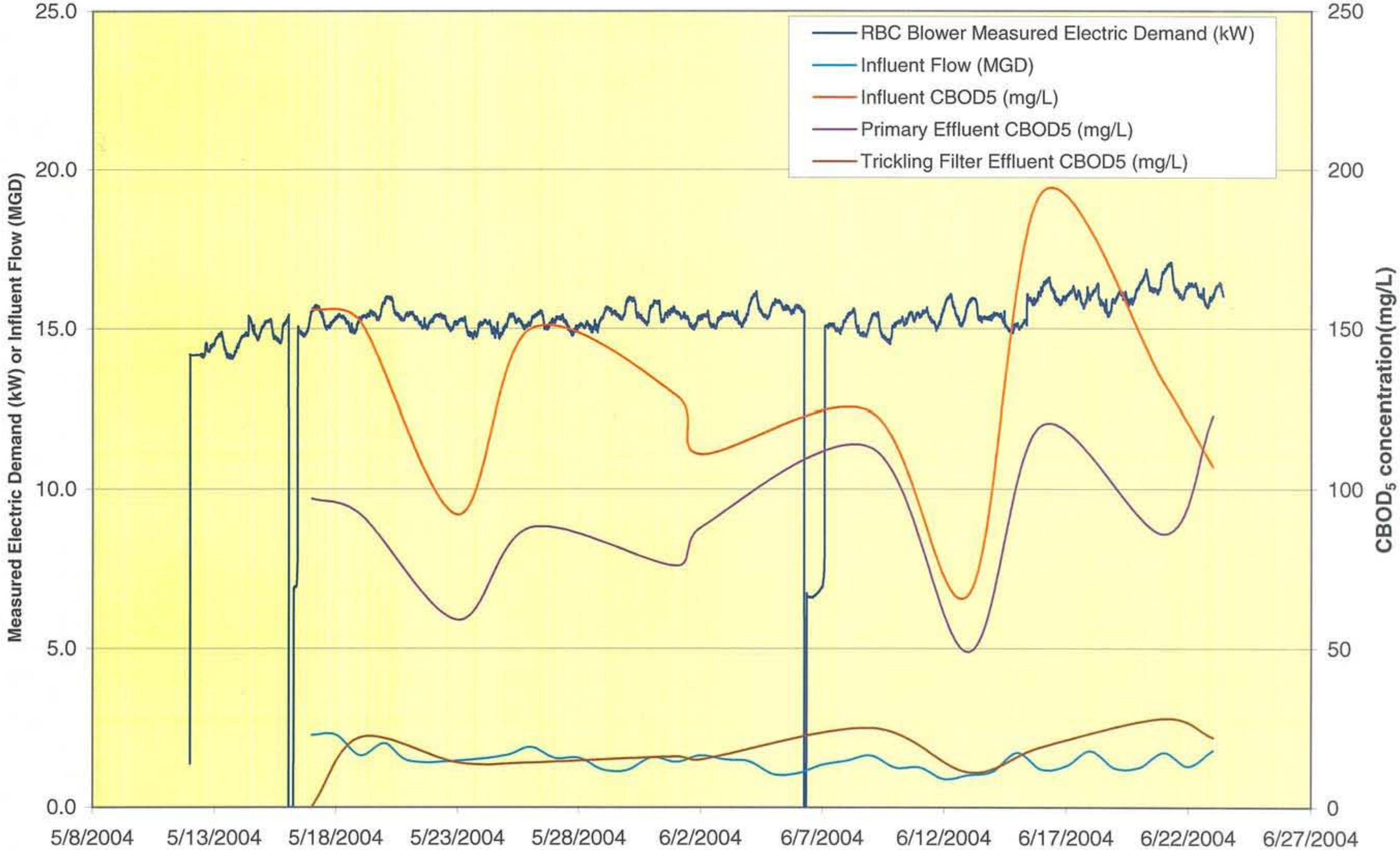

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FIGURE 4-8
$CBOD_5$ CONCENTRATION VS. ELECTRIC USAGE BY RBC BLOWERS

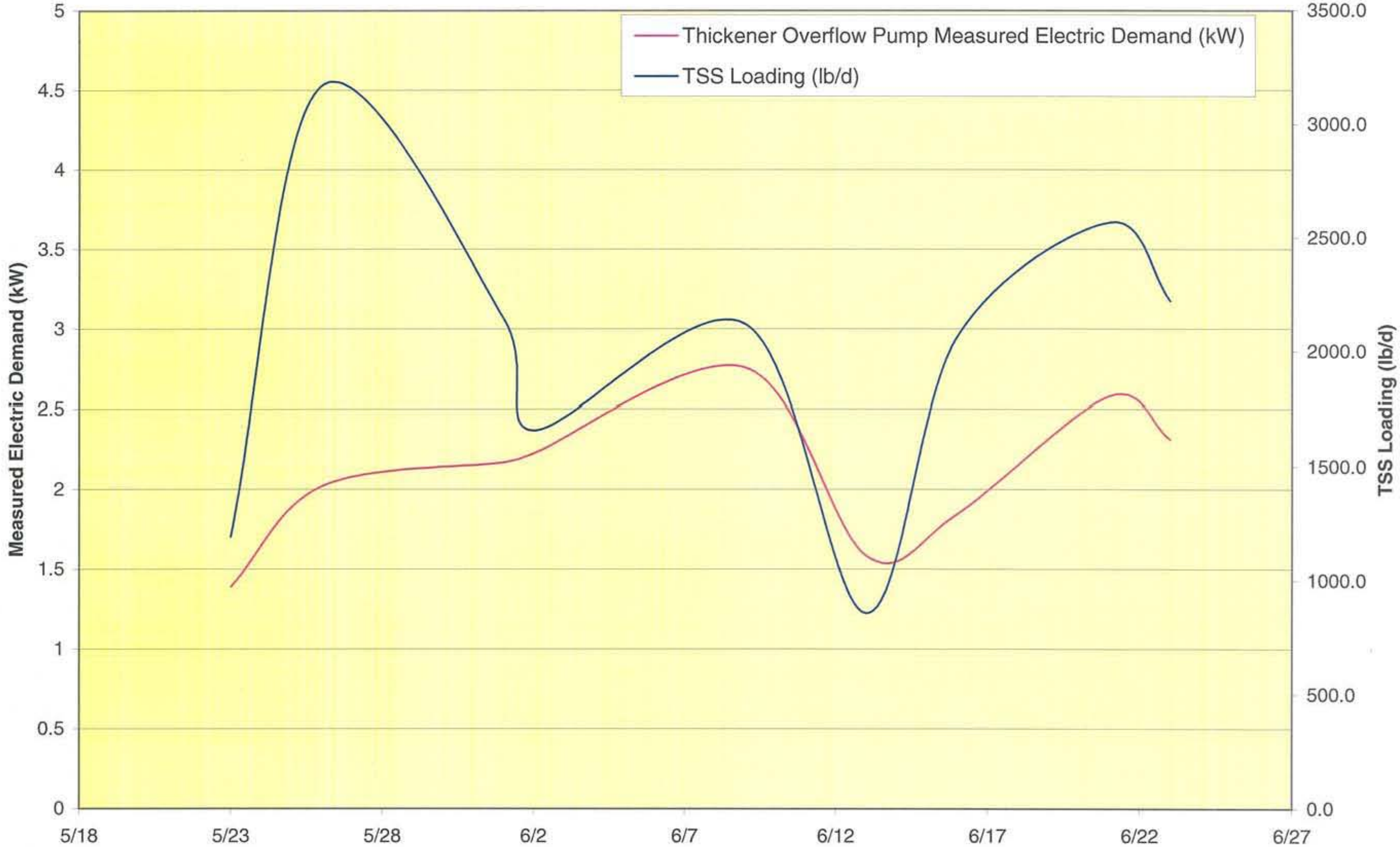

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FIGURE 4-9
THICKENER OVRFLOW PUMP ELECTRIC DEMAND VS. PLANT LOADING

4.2.5 Digester Facility

FIGURE 4-10 shows the operation of the digester facility, which includes digester feed pumps, digester mixing pumps, and sludge transfer pumps, compared to the solids loading to the plant. There is no apparent correlation between the digester facility and the solids loading to the plant.

4.2.6 Plant Water Pumps

Two constant-speed pumps supply treated secondary effluent to the plant water system as required by the treatment process, providing 80 to 90 psig in water pressure. During the summer, pumps run constantly to provide water to the chlorine tablets system. During the winter, pumps are switched on as needed when the solids dewatering is in operation, approximately every day or every other day during the weekdays.

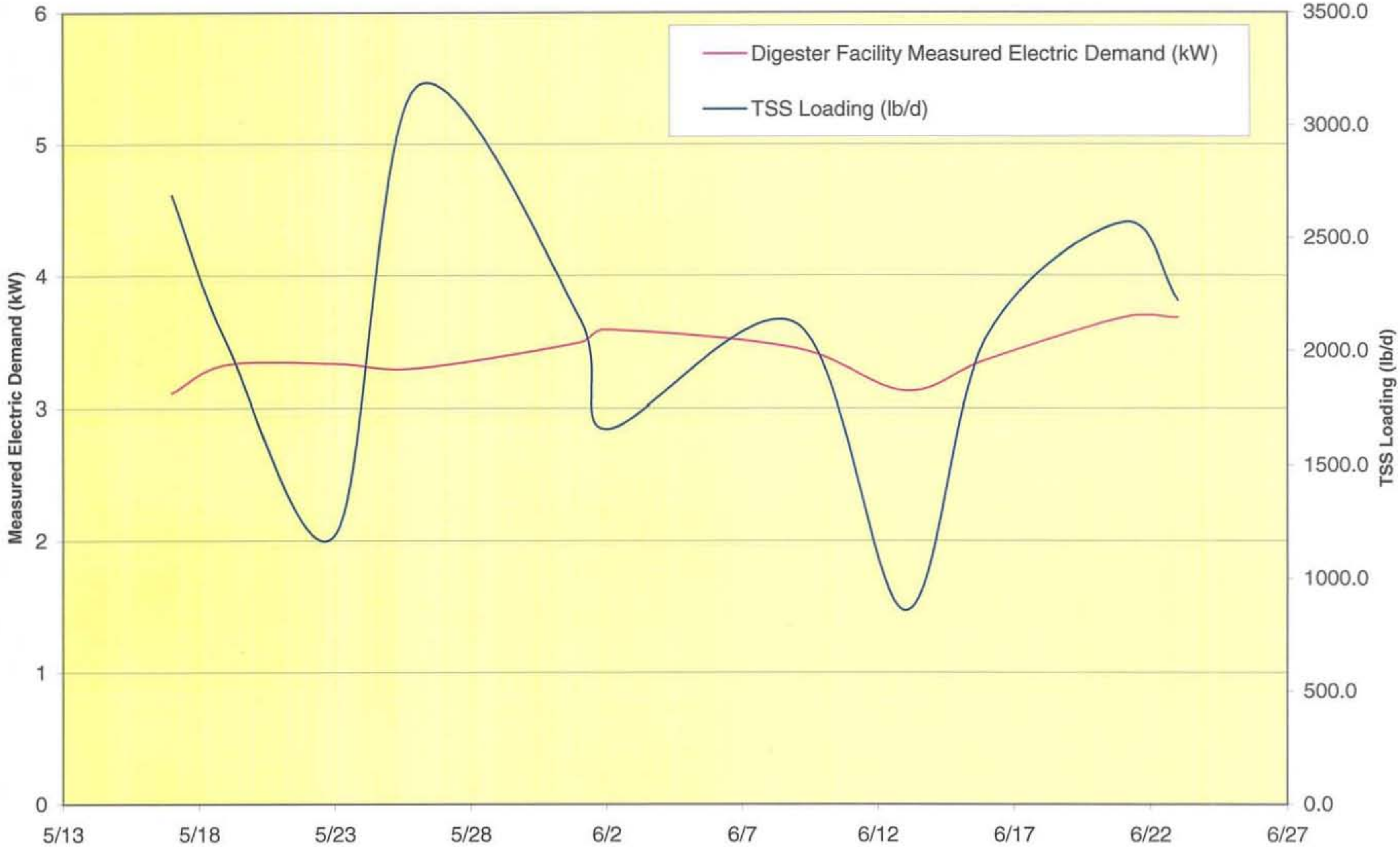
4.3 SUMMARY OF PROCESS PERFORMANCE

The electric energy demand measured at the selected equipment was compared to the plant process performance during the monitoring period. Overall, the plant performance was good with $CBOD_5$ and TSS removal efficiencies above 95% and 85%, respectively.

As previously discussed in Section 3, the RBC drives are the largest energy consumer at the WWTP and operate continuously. The intermediate pumps are the second largest energy consumer at the WWTP. These pumps correlate to the influent flow to the plant. The remaining processes did not show apparent correlations to the WWTP data.

During the submetering period, the WWTP consumed an average of 2,176 kWh per day, with an average influent flow of 1.52 MGD. The standardized electric energy consumption of the major unit processes at the plant (metered during this period), or energy used per MG of wastewater treated, was 1,432 kWh/MG.

The plant removed 1,655 lb/d $CBOD_5$. The energy used per pound of $CBOD_5$ removed was 1.31 kWh/lb $CBOD_5$.



MALCOLM PIRNIE	NYSERDA MUNICIPAL WASTEWATER TREATMENT PLANT ENERGY EVALUATION SOUTH FALLSBURG WASTEWATER TREATMENT PLANT	FIGURE 4-10 DIGESTER FACILITY ELECTRIC DEMAND VS. TSS LOADING

Section 5

ENERGY SAVING MEASURES THROUGH CAPITAL IMPROVEMENTS

5.1 CAPITAL IMPROVEMENT ALTERNATIVES TO REDUCE ENERGY USAGE AND COSTS

Section 4 evaluated the major equipment in use at the plant and compared it to process performance. The detailed process and electric energy usage information collected during the monitoring period was then used to identify and evaluate energy conservation opportunities at the WWTP. The intermediate pumps were identified for further investigation. Additionally, replacement of standard efficiency motors with new premium efficiency motors was considered for some equipment.

5.1.1 Replacement of Constant-Speed Standard Efficiency Motors with Premium Efficiency Motors

For reduction of electric energy usage and cost for constant speed motors, the switch from a standard efficiency motor to a premium efficiency motor can create significant cost savings, especially for those motors which may run all or a majority of the time. Motors at the WWTP which could potentially be eligible for replacement with premium efficiency motors include the following:

- Trickling filter pumps.
- Thickener overflow pumps.
- Digester mixing pumps.
- Sludge transfer pumps.
- Plant water pumps.
- Plant sewer wetwell pump.

5.1.2 Odors Control in Dewatering Facility

The belt filter press is located in the Operations Building, which houses the administration offices, the dewatering facility, and the electric room. Currently, the belt filter press room is kept at negative pressure and air is exhausted outside to prevent odors from migrating into the administration offices. Installing a vapor hood over the belt filter press would collect a smaller volume of air at the source of odor production; this would reduce the ventilation requirement for the whole room to the minimum rates allowed by the standards and reduce energy.

Another method of odor control is addition to the belt filter press sludge of a chemical oxidizer, which reduces the odor source therefore reducing the ventilation requirement for the belt filter press room. Improvements resulting from chemical addition will be discussed in Section 6.

5.1.3 Install Flow Control System on Trickling Filter Recycling Pumps

There are two trickling filter recycling pumps. The purpose of recirculation is to prevent possible drying or freezing of the filter growth during times of low wastewater flow, to prevent possible septic conditions during low wastewater flow, and to ensure a uniform rate of filter application.

One pump is constantly in operation and runs at 200 gpm at a 43 ft TDH. At an average influent flow of 2.41 MGD, the ratio of recirculation rate versus average influent flow is 12%. At a peak flow of 6.16 MGD, the ratio is 5%. The recycle pump can be shut off during periods of high flows. Installing flow controls to the trickling filter recirculation pumps can reduce usage of the pumps, therefore saving electric energy usage costs.

5.2 ESTIMATE OF ENERGY USAGE, DEMAND, AND COST SAVINGS

The following section summarizes the estimated energy usage of the described alternatives, as well as estimates of energy and cost savings associated with the improvements.

5.2.1 Replacement of Constant-Speed Standard Efficiency Motors with Premium Efficiency Motors

TABLE 5-1 summarizes the current and future electric energy usage and cost savings associated with upgrading motors on select equipment. By replacing the constant-speed standard efficiency motors with premium efficiency motors, it is estimated that approximately 31,608 kWh and $3,224 in electric energy usage will be saved each year.

5.2.2 Installing Hood over Belt Filter Press

The proposed installation of a hood over the belt filter press will improve odor control at the dewatering facility and will result in electric energy savings. The majority of electric energy cost savings will be realized through reducing the existing fan draw. Currently, four fans are operated to keep the dewatering room and adjacent rooms under negative pressure:

- Belt filter press room fan (2 hp).

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Table 5-1 Replacement of Select Motors with Premium Efficiency Motors

Process	Use	MCC Location	Quantity	Size (hp)[1]	Estimated Hours per Year	Current Motor Operation: Efficiency Rating[2]	Power Draw (kW) per Motor	Estimated Annual Usage (kWh)	Estimated Energy Cost[4]	Premium Efficiency Motor Operation: Premium Efficiency Rating[2]	Power Draw (kW) per Motor	Estimated Annual Usage (kWh)	Estimated Energy Cost[4]	Energy Savings: Estimated Annual Usage Savings (kWh)	Estimated Annual Cost Savings[4]
Wastewater Recirculation	Trickling filter pumps	Operations Building	2	7.5	7500	82.5%	6.3	47,250	$ 4,820	91%	6.3	42,837	$ 4,369	4,413	$ 450
Solids Handling, Thickening	Thickener overflow pump	Digester Building	2	7.5	8760	85%	2.05	17,958	$ 1,832	91%	2.05	16,774	$ 1,711	1,184	$ 121
Solids Handling, Sludge Pumping	Digester mixing pumps	Digester Building	2	15	8760	82%	13.1	114,756	$ 11,705	93%	13.1	100,566	$ 10,258	14,190	$ 1,447
Solids Handling, Sludge Pumping	Sludge transfer pump	Digester Building	1	10	7200	85%	8.0	57,600	$ 5,875	92%	8.0	53,217	$ 5,428	4,383	$ 447
Plant Water Pumping	Plant Water Pump #1	Operations Building	1	10	8760	87%	4.4	38,544	$ 3,931	92%	4.4	36,240	$ 3,696	2,304	$ 235
Plant Water Pumping	Plant Water Pump #2	Operations Building	1	15	8760	87%	7.2	63,072	$ 6,433	93%	7.2	58,664	$ 5,984	4,408	$ 450
Plant Drain Pumping	Plant sewer wetwell	Operations Building	2	7.5	2500	86%	4.8	12,000	$ 1,224	91%	4.8	11,275	$ 1,150	725	$ 74
								351,180	$ 35,820			319,572	$ 32,596	31,608	$ 3,224

Notes:

[1] All equipment listed is 3-phase.

[2] Efficiency rating for motors based on motor size, using standard efficiencies.

[3] Premium efficiency rate obtained from motor manufacturer

[4] Costs based on 2003 cost of $ 0.102/kWh

- Belt filter press room fan (0.75 hp).
- Soda ash room fan (0.33 hp).
- Blower room fan (0.33 hp).

Installing a 0.33-hp hood fan directly over the press will remove most of the odors. Approximately 3,600 cfm of air are required to supply 6 air changes per hour to the dewatering room. This can be accomplished by the 0.75-hp fan, which currently draws 4,500 cfm.

Electric cost savings are estimated as shown in TABLE 5-2.

Table 5-2: Summary of Electric Energy Usage and Savings for Installation of Belt Filter Press Hood

Fan Operating Condition	Exhaust Rates (cfm)	Annual Electric Usage (kWh)	Annual Electric Cost
Existing	15,000	22,284	$ 2,273
Proposed Hood Fan	3,000	2,150	$ 219
Proposed Room Fan	10,500	11,436	$1,166
Estimated Savings	**1,500**	**8,698**	**$ 887**

5.2.3 Install Flow Control System on Trickling Filter Recycling Pumps

The proposed installation of controls for the trickling filter recycling pumps will allow to operate the pumps during low-flow periods and will result in electric energy savings. From flow data, it was estimated that the pumps would operate 25% of the time. The electric energy cost savings are estimated as shown in TABLE 5-3.

Table 5-3: Summary of Electric Energy Usage and Savings for Installation of Trickling Filter Recycling Pumps Controls

Operating Condition	Annual Electric Energy Usage (kWh)	Annual Electric Energy Cost
Existing	47,250	$ 4,819
With Controls	11,813	$ 1,205
Estimated Savings	**35,437**	**$ 3,615**

5.3 ESTIMATE OF CAPITAL COSTS AND SIMPLE PAYBACK

5.3.1 Replacement of Constant-Speed Standard Efficiency Motors with Premium Efficiency Motors

TABLE 5-4 shows the capital cost for replacing select existing motors as shown in TABLE 5-1 with premium efficiency motors. The estimated capital cost for replacing the constant speed standard efficiency motors with premium efficiency motors is $23,427. With annual estimated savings of $3,224, this results in a payback period of approximately 7.3 years. The payback period is longer than typically desirable, therefore this improvement is not recommended.

5.3.2 Installing Hood over Belt Filter Press

The estimated capital cost for installing a hood over the belt filter press has been estimated in TABLE 5-5. With annual estimated savings of $ 887, this results in a payback period of approximately 17.4 years. The payback period is longer than typically desirable, therefore this improvement is not recommended. An additional concern is given by the location of the hood, which could interfere with the rail system located over the belt filter press for equipment replacement.

5.3.3 Install Flow Control System on Trickling Filter Recycling Pumps

The estimated capital cost for installing controls for the trickling filter recycling pumps has been estimated in TABLE 5-6. With annual estimated savings of $ 3,615, this results in a payback period of approximately 3.3 years.

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Table 5-4 Capital Costs of Replacing Select Motors with Premium Efficiency Motors

Process	Use	MCC Location	Quantity	Size (hp)	Costs				
					Materials		Labor		Total
					Unit	Total	Unit	Total	
Equipment									
Wastewater Recirculation	Trickling filter pumps	Operations Building	2	7.5	$ 815.00	$1,630.00	$ 243.50	$ 487.00	$ 2,117
Solids Handling, Thickening	Thickener overflow pump	Digester Building	2	7.5	$ 815.00	$1,630.00	$ 243.50	$ 487.00	$ 2,117
Solids Handling, Sludge Pumping	Digester mixing pumps	Digester Building	2	15	$1,475.00	$2,950.00	$ 441.50	$ 883.00	$ 3,833
Solids Handling, Sludge Pumping	Sludge transfer pump	Digester Building	1	10	$1,045.00	$1,045.00	$ 312.50	$ 312.50	$ 1,358
Plant Water Pumping	Plant Water Pump #1	Operations Building	1	10	$1,045.00	$1,045.00	$ 312.50	$ 312.50	$ 1,358
Plant Water Pumping	Plant Water Pump #2	Operations Building	1	15	$1,475.00	$1,475.00	$ 441.50	$ 441.50	$ 1,917
Plant Drain Pumping	Plant sewer wetwell	Operations Building	2	7.5	$ 815.00	$1,630.00	$ 243.50	$ 487.00	$ 2,117
		Equipment Subtotal				**$ 11,405**		**$ 3,411**	**$ 14,816**
Electrical and Instrumentation (25% of Total Equipment Costs)									**$ 3,704**
Subtotal of Equipment, Electrical, and Instrumentation									**$ 18,519**
Contractor Overhead and Profit (15%)									**$ 2,778**
Subtotal									**$ 21,297**
Miscellaneous (10%)									**$ 2,130**
Total									**$ 23,427**

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Table 5-5 Capital Costs for Belt Filter Press Hood

Description	Quantity	Costs				
		Materials		Labor		Total
		Unit	Total	Unit	Total	
Hood Enclosure	1	6,500	6,500	3,250	3,250	$ 9,750
Subtotal						$ 9,750
Contractor Overhead and Profit (15%)						$ 1,463
Subtotal						$ 11,213
Contingency (10%)						$ 1,121
Total Construction						$ 12,334
Engineering, Construction, and Administration (25%)						$ 3,083
TOTAL						*$ 15,417*

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Table 5-6 Capital Costs for Trickling Filter Recycling Pumps Controls

Description	Quantity	Costs				
		Materials		Labor		Total
		Unit	Total	Unit	Total	
Trickling Filter Recycling Pumps Controls	1	5,000	5,000	2,500	2,500	$ 7,500
	Subtotal					**$ 7,500**
Contractor Overhead and Profit (15%)						**$ 1,125**
	Subtotal					**$ 8,625**
Contingency (10%)						**$ 863**
Total Construction						**$ 9,488**
Engineering, Construction, and Administration (25%)						**$ 2,372**
	TOTAL					***$ 11,859***

Section 6

ENERGY SAVING MEASURES THROUGH OPERATION MODIFICATIONS

6.1 OPERATIONAL MODIFICATIONS TO REDUCE ENERGY USAGE AND COSTS

Typically, the major operational changes that can be made to reduce electric energy usage and costs are load shifting, peak shaving, and greater use of real-time data in energy-related decision making. Load shifting is the practice of changing the time of use of certain loads to reduce the total facility demand during peak periods. Peak shaving is the practice of dispatching on-site generating assets to reduce dependence on the grid during peak demand periods. The increased use of real-time data by the installation and monitoring of permanent submeters can assist the facility in making informed decisions regarding electric energy usage and offer alternatives for further reducing electric energy usage and costs.

6.1.1 Load Shifting

Electric energy demand data collected at the wastewater treatment plant (WWTP) were used to provide typical daily power draw information. These data were then used to provide an estimate of when peak electric energy demand occurs at the plant. FIGURE 6-1 shows the hourly electric energy demand for the submetered equipment for several representative days. As seen in the figure, a similar power draw is observed, with higher draw during the day, when equipment requiring staff supervision is operated. Significant peaks are typically not observed. As a result, there do not appear to be significant opportunities for further load shifting.

6.1.2 Peak Shaving

Peak shaving refers to the practice of reducing demand during peak demand periods by using on-site generation capabilities. Peak shaving opportunities through capital improvements is discussed in Section 5. The use of a microturbine for on-site generation has been evaluated in Section 8.

6.1.3 Reduction in Operating Hours of RBC Blower

The purpose of the rotating biological contactors (RBC) blower is to supply air to the diffusers located beneath each RBC, and to the influent, effluent, and bypass channels to help prevent suspended materials from settling out in the tanks and channels. The air supply also contributes to the "sloughing-off" of the biomass and to the dissolved oxygen (DO) concentration in the tanks.

DO was measured during the submetering period in the following processes:

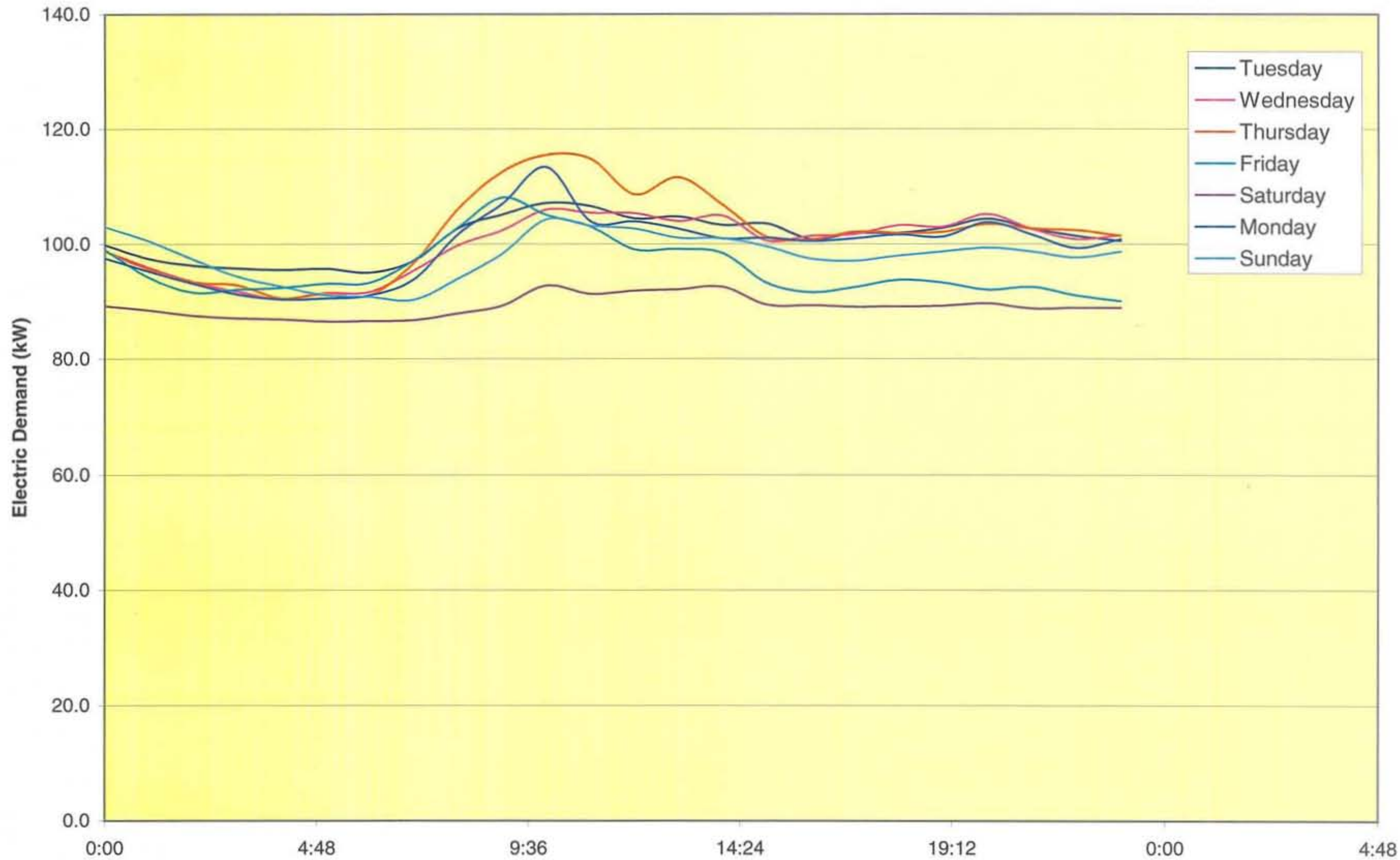

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FIGURE 6-1
PLANT HOURLY ELECTRIC DEMAND

- Primary Effluent.
- Trickling Filter Effluent.
- RBC Tanks.
- RBC Effluent.
- Plant Effluent.

FIGURE 6-2 shows the measured DO during the submetering period. The DO concentration in the RBC tanks averaged around 5.6 mg/L, which is well above the DO concentration of 2 mg/L required for 5-day biochemical oxygen demand (BOD_5) and ammonia removal. Higher DO concentrations do not improve operations significantly, but increase the aeration costs considerably.

DO concentrations could be maintained at the required level by cycling the RBC blower on and off. Approximately 15 kWh could potentially be saved for each hour the RBC blower is switched off. Communication with the plant staff indicated that running the blower on timers has been tried in the past with poor results, due to the tendency of the suspended solids in the RBC tanks to settle and clog the coarse-bubble air diffusers. Also, it was noted that the settled solids in the tanks tend to go septic if not aerated. Improvements to the cyclic operation of the RBC blower include running a shorter cycle (20 or 30 minutes) or turning off the RBC blower when the RBC influent flows are higher and there is enough velocity in the tanks to prevent settling.

6.1.4 Chemical Addition to Belt Filter Press Sludge

The addition of chemicals to the belt filter press sludge would reduce the potential for odors at the dewatering facility. Savings will be realized through reducing the existing fans draw. Estimating 6 air changes per hour in the dewatering room, approximately 3,600 cfm of air are required. The 0.75-hp fan in the room can be operated for this purpose, while the 2-hp fan can be switched off.

6.1.5 Infiltration and Inflow Study

As identified in Section 4, operation of the intermediate pumps, the second largest electric energy user at the plant, is directly correlated to plant influent flows. Flows increase substantially as a result of wet weather, indicating the possibility of a substantial amount of infiltration from precipitation to the collection system. An infiltration and inflow (I/I) study is recommended to identify and make recommendations to reduce I/I contributions to the plant influent.

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FIGURE 6-2
MEASURED DO CONCENTRATIONS

6.2 ESTIMATE OF ENERGY USAGE, DEMAND, AND COST SAVINGS

6.2.1 Reduction in Operating Hours of RBC Blower

TABLE 6-1 summarizes the current electric energy usage and cost saving associated with cycling the RBC blower on and off.

Table 6-1: Summary of Electric Energy Usage and Savings for Cycling RBC Blower On/Off.

Operating Condition	Annual Electric Energy Usage (kWh)	Annual Electric Energy Cost
Existing RBC Blower Operation	131,400	$ 13,400
Proposed RBC Blower Operation	67,500	$ 6,700
Estimated Savings	**67,500**	**$ 6,700**

By operating the blower on cycles of 20 to 30 minutes, 65,700 kWh and $ 6,700 could be saved each year.

6.2.2 Chemical Addition to Belt Filter Press Sludge

Estimated cost savings for chemical addition to the belt filter press sludge are shown in TABLE 6-2.

Table 6-2: Summary of Electric Energy Usage and Savings for Chemical Addition to Belt Filter Press Sludge

Fan Operating Condition	Annual Electric Energy Usage (kWh)	Annual Electric Energy Cost
Existing Room Fans Operation	22,284	$ 2,273
Proposed Room Fans Operation	11,436	$ 1,166
Estimated Savings	**10,848**	**$ 1,106**

By adding odor-reducing chemicals to the sludge and switching off the 2-hp fan, 10,848 kWh and $ 1,106 could be saved each year.

6.3 ESTIMATE OF CAPITAL COSTS AND SIMPLE PAYBACK

6.3.1 Reduction in Operating Hours of RBC Blower

Timers are already installed on the blowers, therefore there are no capital costs associated with this operation modification.

6.3.2 Chemical Addition to Belt Filter Press Sludge

The annual cost for chemical addition to the sludge is estimated as $11,400. The cost to implement this alternative largely exceeds the cost savings for reduction in fans operation. The WWTP might want to implement this alternative for the advantage of odors reduction, non-quantifiable in terms of economic benefits.

Section 7

ENERGY SAVING MEASURES THROUGH LIGHTING/HVAC MODIFICATIONS

7.1 HEATING, VENTILATING, AND AIR CONDITIONING OVERVIEW

The South Fallsburg Wastewater Treatment Plant (WWTP) is comprised of approximately four primary buildings. The plant was constructed in the 1970s with improvements in 1981. The administration building is occupied from 7:00 a.m. through 4:00 p.m. by office staff. Two operators and three maintenance personnel staff the facility. The facility is staffed from 7:00 a.m. to 3:30 p.m. Monday through Friday. During weekends and holidays the facility is staffed four hours per day.

Except for the administration building, the primary function of the heating and cooling systems is not for comfort conditioning. The thermostats for the majority of the plant are set at 60 degrees Fahrenheit (°F) for heating. The heating systems are mainly comprised of individual hot water coil hanging unit heaters with some air-handling equipment. Comfort air-conditioning (AC) at the facility, other than for the administration building, is minimal. There are three York rooftop dual heating / cooling systems that are propane-fueled. These units are over 20 years old (installed between 1982 and 1983). These rooftop units, of approximately three tons of cooling capacity each, provide comfort cooling to the offices, lab, and control room (one ton of cooling is equal to 12,000 British thermal units [Btus]). The rooftop unit serving the lab area does not provide sufficient cooling in the peak summer months. Numerous service calls to-date to maintain internal temperatures required to properly conduct laboratory testing have not been successful. The maintenance shop and break room / locker rooms have a one-ton through-the-wall AC unit.

Original H.B. Smith central hot water boilers rated at 750,000 Btu/hr (MBH) low-fire and 2,100 high-fire with a 0.25-horsepower (hp) blower heat the administration building. Three zones supply the facility hot water for heating, and the boiler controls include hot water temperature reset based on outside air temperature. Comfort heating is supplied through baseboard fin-tube units or hanging fan units with a hot water coil.

A propane-fired, Bradford White, 40-gallon hot water heater provides domestic hot water. A diesel-fired boiler provides heat for the digester. Other than thermostats for each area, there is no central energy management system at this facility.

Odors were present during the site visit in the belt filter press area. The ventilation in this area may require balancing and/or upgrading. Ventilation improvements have been discussed in Section 6.

Lighting throughout the facility is primarily T-12 34-watt fluorescent. The belt filter press room and the digester building contain metal halide pendant-mount fixtures. Numerous incandescent bulbs are installed. The facility is not equipped with occupancy sensors.

7.2 HVAC AND LIGHTING ALTERNATIVES TO REDUCE ENERGY USAGE AND COSTS: ESTIMATE OF COSTS AND SIMPLE PAYBACK

7.2.1 Replace Rooftop Units

The rooftop units are at the end of their useful lives, and therefore, should be replaced. Based on preliminary information, replacing the rooftop units would yield a payback of 20 years, based on energy savings alone. If an annual maintenance cost of $500 per unit is included in the estimate, the payback is more favorable at approximately 11.4 years, as detailed in TABLE 7-1. However, additional factors to consider in recommending replacement is that the existing units will continue to deteriorate and become increasingly costly to repair. The units may degrade to the point where safety becomes a greater concern than economics.

Table 7-1: Estimate of Payback for Replacement of Rooftop Units

Cost Savings / Unit	
Cooling Savings	$210
Heating Savings	$441
Total Energy Savings	$651
Maintenance Savings	$500
Total Savings	$1,151
Install Cost / Unit	
Unit @ $1,986 / Ton	$5,958
Labor *	$7,150
Total Cost	$13,108
Simple Payback / Unit (years)	11.4

Notes:
*Rigging, Duct Work, Electrical, Labor
Five Ton Unit Recommended to Provide Greater Cooling Capacity in Lab
All Savings and Cost Estimates are Preliminary

7.2.2 Convert Incandescent to Compact Fluorescent Lighting

Incandescent lighting throughout the facility could be replaced with compact fluorescents lamps. TABLE 7-2 summarizes the estimated payback for the conversion.

Table 7-2: Estimate of Payback for Conversion of Incandescent to Fluorescent Lighting

Costs:	$ 1,050
Savings:	$ 1,025
Payback:	1.0 year

7.2.3 Convert Exit Signs to Light Emitting Diode

Exit signs operated with compact fluorescent lamps can be replaced with light emitting diode (LED) exit signs that would consume much less power and operate relatively maintenance-free for 25 years. TABLE 7-3 summarizes the estimated payback for the conversion.

Table 7-3: Estimate of Payback for Conversion of Exit Signs to LED

Costs:	$ 750
Savings:	$ 54
Payback:	14.0 years

7.2.4 Upgrade T-12 to T-8 Lighting

Fixtures throughout the facility contain T-12 lamps that should be upgraded to T-8 technology. The lighting upgrade should be performed simultaneously as opposed to on an as-needed basis. Performing the upgrade in its entirety would decrease the potential for improper voltage and current conditions that would lead to flicker and burn out in a relatively short number of hours. TABLE 7-4 summarizes the estimated payback for the upgrade.

Table 7-4: Estimate of Payback for Upgrade of T-12 to T-8 Lighting

Costs:	$ 17,300
Savings:	$ 995
Payback:	17.4 years

7.2.5 Summary of All Lighting Measures Combined

An estimate of the costs and savings for all the lighting improvements is shown in TABLE 7-5.

Table 7-5: Summary of Costs and Savings for All Lighting Measures

Costs:	$ 19,100
Savings:	$ 2,073
Payback:	9.2 years

Section 8
ON-SITE GENERATION

8.1 ESTIMATE OF ENERGY USAGE, DEMAND, AND COST SAVINGS

The best candidates for on-site generation are facilities with a simultaneous demand for both low-temperature heat and electric power. It is seldom economical for a plant to generate its own electricity unless the heat rejected from the electric generation process can also be used on-site. Moreover, because of the relatively high cost of co-generation equipment, the equipment must run for most of the year in order to be economical. Cogeneration is typically most cost-effective in applications where:

- Demand for both heat and electricity is substantial.
- Demand for heat and electricity is nearly continuous.
- Cost of electricity is relatively high.
- Cost of natural gas or other fuel source is relatively low and digester gas is generated on-site.
- All heat and electricity generated by the system can be used on-site.

The South Fallsburg WWTP is currently designed to collect and utilize digester gas for heating the digester. However, the system does not perform as intended and fuel oil is used as the sole fuel for heating the digester. The digester facility has been recently evaluated under a NYSERDA FlexTech study (Study of Energy Conservation through Anaerobic Digester Improvements, 2004) to determine existing process performance, evaluate alternatives to improve performance, and optimize utilization of digester gas for digester heating.

The study estimated between 300 and 1,350 cf/hr with an average of 600 cf/hr, or 10 cfm of gas expected to be produced from the digestion process and the estimated gas use for the digester heating is 570 cf/hr during cold weather at maximum digester feed.

It is estimated that the digester cannot produce enough gas to operate a microturbine system successfully. During periods of high flows, the microturbine would be supplied with sufficient gas to generate power and could be used to shave some of the peak demand at the facility. There would also be some fossil fuel savings from reclaiming waste heat from the microturbine and not operating the existing boiler system for the digester. During periods of lesser digester gas production, however, the system would either not operate at all or would need supplemental fuel such as liquid propane. This would negate any savings due to the relatively high cost of liquid propane.

Also the peak demand for the facility is based more on flow than temperature or occupancy. The peak may occur during periods other than those typically considered peak, such as midday summer as an example. If sufficient gas storage does not coincide with the need to reduce peak demand, the savings will not be realized.

If a gas storage system is installed to supplement the existing oil / gas boiler in the digester building, monitoring the gas production at that time is recommended to determine if a microturbine could be operated successfully.

Recommendations included in the 2004 study were:

- Digesters operation recommendation: Malcolm Pirnie recommended converting the secondary digester to primary high-rate digester during the warm season, which corresponds to the high-loading season. This operation will increase solids detention time, therefore increasing overall digesters operation and gas production.

- Additional gas storage recommendation: considered that the existing anaerobic digesters covers are approaching their life end, the installation of a new gasholder cover was recommended based on a 9 years payback and an expected cover life greater than 30 years.

- Heating system recommendation: improving the operation of the digesters and providing additional gas storage will allow the existing boiler to run on digester gas only, with estimated annual savings of $ 11,255.

Section 9
FINAL RECOMMENDATIONS

9.1 SUMMARY OF EVALUATIONS

This report has identified numerous alternatives to reduce energy usage at the wastewater treatment plant (WWTP). These alternatives include:

- Installation of premium efficiency motors on some of the constant speed standard efficiency motors.
- Installing a hood over the belt filter press or chemical addition to belt filter press sludge.
- Installing controls on trickling filter recycle pumps.
- Reduction in operating hours of the RBC blower.
- Lighting improvements.

TABLE 9-1 summarizes the estimated energy savings, implementation costs, and simple payback periods for these alternatives.

9.2 SUMMARY OF RECOMMENDATIONS

Using the results of the evaluation summarized in TABLE 9-1, the following alternatives are recommended for implementation:

- Installing controls on trickling filter recycle pumps.
- Reduction in operating hours of RBC blower.

The remaining alternatives are not recommended due to long payback periods. The replacement of the existing standard efficiency motors with new premium efficiency motors, while not cost effective at present time, should be considered on a "burn-out" basis, when the existing motors require replacement.

TABLE 9-2 contains a summary of the costs to implement the recommended alternatives only, as well as provides a summary of potential savings. The recommended alternatives offer a reasonable payback of 0.9 years, if implemented together, with the resulting savings representing approximately 6% of total energy costs.

South Fallsburg Wastewater Treatment Plant

Table 9-1 Summary of Energy Savings Alternatives Presented in Sections 5, 6, and 7

ECM #	MEASURE DESCRIPTION	Non-Energy Related Benefits	FUEL TYPE SAVED[1]	ENERGY SAVED (Elec kWh)	TOTAL ENERGY SAVED (mmBTU)[2]	TOTAL ANNUAL DOLLARS SAVED	IMPLEMENTATION COSTS	SIMPLE PAYBACK PERIOD (years)
1	Installation of premium efficiency motors		Elec	31,608	2.72	$3,224	$23,427	7.3
2	Installing hood over belt filter press	Odor Control	Elec	8,698	0.75	$887	$15,417	17.4
3	Installing controls on trickling filter recycle pumps		Elec	35,437	3.05	$3,615	$11,859	3.3
4	Reduction in operating hours of RBC blower		Elec	65,700	5.66	$6,701	$0	0.0
5	Chemical addition to belt filter press sludge	Odor Control	Elec	10,848	0.94	$1,106	$ 11,400/yr	-
6	Lighting/HVAC improvements		Elec	24,767	2.14	$2,073	$19,100	9.2

Notes:

[1] Fuel Saved: Elec, Ngas, Oil 1, Oil 2, Oil 4, Oil 6, Coal, LPG.

[2] mmBTU = 1,000,000 BTU
Electric = 11,600 BTU/kWh

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Table 9-2 Summary of Recommended Alternatives

ECM #	MEASURE DESCRIPTION	FUEL TYPE SAVED[1]	ENERGY SAVED (Elec kWh)	TOTAL ENERGY SAVED (mmBTU)[2]	TOTAL ANNUAL DOLLARS SAVED	IMPLEMENTATION COSTS	SIMPLE PAYBACK PERIOD (years)
3	Installing controls on trickling filter recycle pumps	Elec	35,437	3.05	$3,615	$9,488	2.6
4	Reduction in operating hours of RBC blower	Elec	65,700	5.66	$6,701	$0	0.0
	TOTALS OF RECOMMENDED ALTERNATIVES		**101,137**	**8.72**	**$10,316**	**$9,488**	**0.9**

Notes:

[1] Fuel Saved: Elec, Ngas, Oil 1, Oil 2, Oil 4, Oil 6, Coal, LPG.

[2] mmBTU = 1,000,000 BTU
Electric = 11,600 BTU/kWh