Full-Scale Demonstration of Selector-Contact Stabilization Process at Town of Rosendale Wastewater Treatment Plant, Ulster County, New York

Final Report 05-07
August 2005

New York State
Energy Research and
Development Authority

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Final Report

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New York State Energy Research and Development Authority

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NOTICE

TABLE OF CONTENTS

Section Page

1 DESCRIPTION OF STUDY 1-1

2 STUDY GOALS AND OBJECTIVES 2-1

3 ROSENDALE WWTP 3-1

4 TECHNOLOGY DESCRIPTION 4-1

5 ENGINEERING DESIGN 5-1
- Design Package 1 – Retrofitting Influent Pumps with VFD 5-1
- Design Package 2 – Modifications to the Aeration Basin 5-2
- Design Package 3 – RAS Pump and Piping 5-9

6 CONSTRUCTION 6-1

7 DEMONSTRATION PLAN 7-1

8 DEMONSTRATION RESULTS 8-1
- Baseline Operating Data 8-1
- Demonstration Operating Data 8-2

9 ENERGY USE AND COST INFORMATION 9-1

10 CONCLUSIONS 10-1

11 RECOMMENDATIONS 11-1

APPENDICES

A DMR Data A-1

B Demonstration Data B-1

TABLES

Table		Page
7-1	Sampling Schedule during SCS Startup	7-2
7-2	Sample Schedule during Initial SCS Demonstration	7-3
7-3	Sample Schedule during Actual SCS Demonstration	7-4
8-1	Baseline Operating Data, January 2000 through December 2002	8-1
8-2	Average Influent/Effluent Data for Side-by-Side Demonstration (Nov ’03 – Jan ’04)	8-3
8-3	Average Operating Parameters for Side-by-Side Demonstration (Nov ’03 – Jan ’04)	8-5

FIGURES

Figure		Page
3-1	Rosendale WWTP, Two Parallel Extended Aeration Treatment Trains	3-2
4-1	Process Flow Schematic of Selector-Contact-Stabilization Process	4-2
4-2	Rosendale WWTP during SCS Demonstration	4-4
5-1	Influent Pump Control Panel (in background) and Flow Splitter Box (in foreground)	5-3
5-2	V-Notch Weir Plates in Flow Splitter Box	5-4
5-3	Selector Zone Baffle Spacing	5-6
5-4	Aeration Header in SCS Modified Tank	5-7
5-5	Modified Influent Piping for SCS Demonstration	5-8
5-6	RAS Pump Enclosure	5-11
6-1	Selector Zone Baffles	6-2
6-2	Highlight of Gap at Bottom of Baffle Wall	6-4
6-3	Installing Plastic Sheathing on the Baffle Wall Face	6-5
6-4	Installing Fiberglass Sheeting on the Baffle Wall Face	6-6
8-1	Sludge Volume Index	8-4
8-2	Solids Loading Rate to Final Clarifiers	8-6
8-3	Effluent TSS Concentration Versus Clarifier Solids Loading Rate	8-8
8-4	Clarifier Surface Overflow Rate	8-9
8-5	Effluent TSS Concentration Versus Clarifier Surface Overflow Rate	8-10

DESCRIPTION OF STUDY

This study was conducted in accordance with the New York State Energy Research and Development Authority (NYSERDA) Program Opportunity Notice (PON) 623-01, "Joint NYSERDA/NYSEFC Funding for Innovative and Energy-Efficient Wastewater Technologies." The Town of Rosendale, New York (Town), with assistance from O'Brien & Gere Engineers, Inc., performed a full-scale demonstration of the Selector-Contact-Stabilization (SCS) process, an innovative technology for wastewater treatment. This report describes the design phase activities to retrofit one-half of the biological treatment system with the SCS process at Town's wastewater treatment plant (WWTP) and the results of the subsequent full-scale demonstration.

The Town owns and operates a WWTP that is permitted to discharge treated effluent to the Rondout Creek under New York State Pollutant Discharge Elimination System (SPDES) Permit number NY0109061. The Rosendale WWTP includes two parallel treatment trains that use the extended aeration process (without primary clarification) to treat influent wastewater. The plant has a rated capacity of 0.1 million gallons per day (MGD) average daily flow. The discharge limits include 30-day averages of 30 milligrams per liter (mg/L) for five-day biochemical oxygen demand (BOD_5) and 30 mg/L for total suspended solids (TSS). The plant's SPDES permit does not currently include limits for nitrogen or phosphorus.

In discussions with the New York State Department of Environmental Conservation (NYSDEC) regarding WWTP performance problems and a potential need for additional treatment capacity, the Town was referred to O'Brien & Gere. NYSDEC suggested that the possibility of improving WWTP performance and providing additional WWTP capacity via the SCS process be evaluated for this facility. O'Brien & Gere was retained by the Town to conduct an evaluation of the Rosendale WWTP and prepare an engineering report to address performance problems including a plan for increasing WWTP capacity.

The engineering report prepared by O'Brien & Gere dated September 4, 2001 for the Town of Rosendale, (1) estimated future wastewater flows and loadings, (2) reviewed existing WWTP facilities, (3) identified alternative methods to improve WWTP performance, and (4) provided recommendations for providing additional capacity to meet future needs. The evaluation included computer based biological process modeling, which reviewed and compared the performance of extended aeration activated sludge and selector-contact-stabilization activated sludge processes.

The report recommended retrofitting fifty percent of the biological treatment system at the WWTP with SCS technology followed by a full-scale operating evaluation of the technology prior to implementation (design and construction) of a full-scale SCS system retrofit with clarifier improvements (if necessary).

This recommendation was based on the results of the Village of Fredonia, New York SCS experience where a change to the SCS process resulted in the following benefits:

- doubled BOD_5 capacity – without construction of additional process tanks,
- halved construction costs (from approx. $3,000,000 to $1,200,000),
- offered $3 million life-cycle cost savings over 20 years,
- improved aeration efficiency (15% oxygen transfer efficiency increase),
- halved energy use,
- enhanced mixed liquor settleability (SVI < 120) and process stability, and
- improved final clarifier performance.

In October 2001, the Town applied to NYSERDA under PON 623-01 to jointly fund the project in order to demonstrate that the innovative SCS process would increase the treatment capacity of the Town's WWTP at minimal capital construction cost. The project proposed constructing temporary SCS components in one of two aeration basins followed by a side by side demonstration to show increased treatment capacity with the SCS process while achieving compliance with effluent permit discharge limits. The increased loading to the modified treatment train was achieved by changing the flow split between the two trains from 50/50 to an appropriate ratio consistent with the project objectives discussed below. NYSERDA awarded funding for seventy five percent of the total project cost in January 2002 and a contract between NYSERDA and the Town of Rosendale was signed in March 2002.

STUDY GOALS AND OBJECTIVES

The goals of the full-scale demonstration that were made a part of the project included:

1. Documenting performance of the SCS process to the Town and NYSDEC
2. Documenting the response and performance of the final clarifiers
3. Providing the plant operators with first hand operational experience with the SCS process
4. Providing the information necessary to fine tune the SCS process design for permanent installation.

The primary objective of this study was to demonstrate the increased capacity and improved process performance of the SCS process at the Town of Rosendale WWTP. The implementation of the SCS process was expected to increase the plant's treatment capacity to at least 0.105 million gallons per day (MGD) and improve the quality of the treated effluent with minimal capital outlay.

Based on discussions with plant operating personnel, the plant has experienced, from time to time, filamentous growth as well as solids carryover from the secondary clarifiers resulting in exceedance of the effluent permit limits for TSS. The plant also receives ammonia loadings that are atypical for a mostly residential service area. The sizing of the existing unit processes and the atypical ammonia load affects the stability of the plant's treatment performance.

The secondary objective of this study was to demonstrate the ability of the SCS process to suppress involuntary nitrification and improve solids settleability. The plant is nitrifying although the current SPDES permit does not require ammonia removal. The suppression of involuntary nitrification will improve the ability of the existing air delivery equipment to provide sufficient aeration to the wastewater treatment process. The improvement in solids settleability will improve the quality of the treated effluent and is expected from the suppression of filamentous growth by the selector, which will be measured by the sludge volume index (SVI).

The purpose of the full-scale demonstration was to provide real-time data for analysis of the performance of the SCS process. During the demonstration, one half of the treatment plant was operated in the SCS mode and the other half was operated in the extended aeration mode (it's current mode of operation), which allowed for side-by-side comparison of the performance of the two processes.

ROSENDALE WWTP

The Town of Rosendale, Ulster County, New York owns and operates a municipal wastewater treatment plant, which serves a sewer district in a largely residential area of the town along NYS Route 213 and Route 32. The sewer district is bisected by Rondout Creek. The WWTP, constructed and placed into service in 1981, provides secondary treatment with seasonal effluent disinfection.

The facility currently includes two parallel extended aeration (EA) activated sludge process trains to achieve secondary treatment (see Figure 3-1). Influent sewage is macerated and screened, then pumped to a splitter box where flow is distributed to each of the two parallel EA trains. Each train contains an aeration basin and a final clarifier. Air is supplied to the EA reactors through coarse bubble diffusers by a rotary lobe, positive displacement blower. Wastewater flows by gravity from the splitter box to the aeration tank to the final clarifier. Settled solids from the final clarifiers (i.e. return activated sludge) are conveyed to the head of each aeration tank using an air-lift pumping arrangement. Skimmings from the final clarifiers are also returned to the head of each EA reactor using an air-lift pumping configuration. Excess biosolids are wasted by diverting the return activated sludge (RAS) flow to an aerated sludge holding tank where conditioning chemicals are added before the sludge is conveyed to a filter press for biosolids dewatering. Clarified effluent flows by gravity to a chlorine contact tank for seasonal disinfection then discharge to the creek.

The plant is currently loaded to approximately seventy five percent of its rated design capacity based on annual average influent flow and loading. The WWTP is currently loaded to approximately one hundred percent of its rated design capacity based on maximum month loading. For the four year period of January 2000 to January 2004, the plant loading was:

	Annual Daily Average	Maximum Monthly Average	Rated Capacity
Flow (MGD)	0.078	0.120	0.100
Influent BOD_5 (lb/d)	128	229	240
Influent TSS (lb/d)	130	372	200

The maximum monthly flow occurred in December 2003, while the maximum monthly BOD_5 and TSS loadings occurred in July 2000. A tabulation of the daily values for these parameters, along with historical graphs of these parameters, for the period of January 2000 through January 2004 is included in Appendix A, DMR Data.

Figure 3-1. Rosendale WWTP, Two Parallel Extended Aeration Treatment Trains

The permitted effluent limitations for the Rosendale WWTP are as follows:

- Influent flow, 30-day average of 0.1 MGD,
- Effluent BOD_5, 30-day average of 30 mg/L and 25 lb/day,
- Effluent BOD_5, 7-day maximum of 45 mg/L and 38 lb/day,
- Minimum BOD_5 percent removal of 85%,
- Effluent TSS, 30-day average of 30 mg/L and 25 lb/day,
- Effluent TSS, 7-day maximum of 45 mg/L and 38 lb/day,
- Minimum TSS percent removal of 85%,
- Maximum effluent pH of 9.0 standard units,
- Minimum effluent pH of 6.0 standard units,
- Maximum effluent settleable solids of 0.3 ml/L,
- Effluent fecal coliform count of 200 per 100 ml on a 30-day geometric mean, and
- Effluent fecal coliform count of 400 per 100 ml on a maximum 7-day geometric mean.

The Rosendale WWTP is required to monitor influent BOD_5, TSS, settleable solids, pH, and temperature, as well as effluent temperature and total residual chlorine. The plant does not have discharge limits for nutrients such as ammonia-nitrogen and phosphorus.

During the period of January 2000 through January 2004 (49 months), the plant experienced the following permit limit exceedances for flow, effluent BOD_5 and effluent TSS:

- average influent flow 4 times
- average effluent BOD5 concentration 1 time
- average effluent TSS concentration 4 times
- average effluent TSS quantity 3 times
- maximum effluent TSS concentration 3 times
- maximum effluent TSS quantity 1 time

It should be noted that two of the average effluent TSS concentration and quantity exceedances and all of the maximum effluent TSS concentration and quantity exceedances were likely due to construction associated with the installation of the components for the SCS process, as they occurred during the period of SCS installation.

TECHNOLOGY DESCRIPTION

The Selector-Contract-Stabilization Process (SCS) was developed by O'Brien & Gere Engineers as a method to increase the capacity and improve the performance of activated sludge biological wastewater treatment processes. Activated sludge processes, incorporated into the majority of municipal WWTPs in the United States, are typically limited by the size of the system's clarifiers, the oxygenation system, the ability of the system to achieve BOD and TSS removal efficiencies necessary to meet discharge permit requirements, performance difficulties during peak wet weather flows or high organic loadings, or any combination of these limitations.

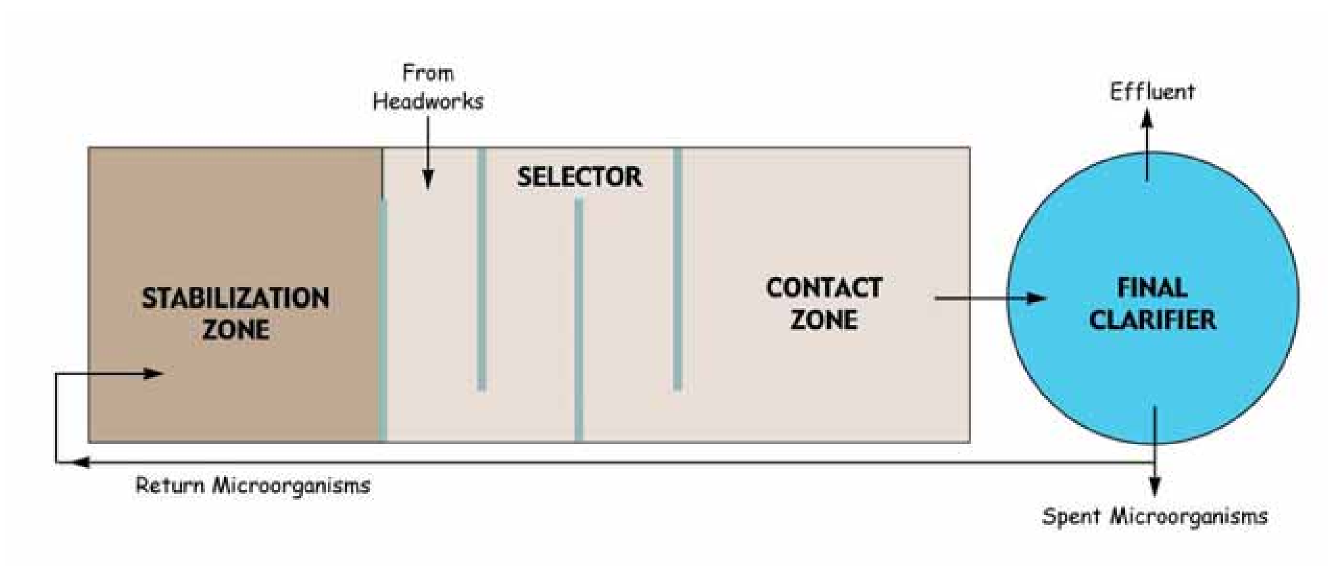
When WWTPs reach or exceed their limiting (or rated) capacity, the most common approach to correct this situation involves construction of additional tankage and/or upgrades to internal activated sludge system components. The SCS process is designed to optimize the capacity of the existing activated sludge process tankage to avoid construction of costly new tankage. As the activated sludge process is typically the most costly component of a municipal WWTP, which includes tankage, blowers, RAS pumps and waste activated sludge (WAS) pumps, large capital expenditures for wastewater treatment infrastructure may be avoided (or at least delayed) via implementation of the SCS process.

The SCS process is an innovative modification of the conventional contact-stabilization activated sludge process. As shown in Figure 4-1, the contact tank is divided into zones or compartments where anoxic or oxic conditions and biological "selector" functions are maintained. A high food-to-microorganism (F:M) ratio is maintained in the anoxic zone (selector) to degrade (or adsorb) organic carbon in the influent by rapid growth of organisms (or by floc-forming organisms) recirculated from the stabilization tank. Mixed liquor suspended solids (MLSS) may also be recirculated from the Contact Zone to the Selector Zone to maintain appropriate contact loading. The contact loading is the ratio of influent soluble BOD_5 to the flux of MLSS into the selector.

An evaluation of alternatives suggests that the SCS process offers the potential to realize substantial benefits. These benefits include increased wastewater treatment capacity without construction of new process tankage, aeration energy cost savings, and enhanced process stability, particularly as a result of enhanced biological mixed liquor settleability.

The Rosendale WWTP has traditionally experienced poor mixed liquor settleability, likely due to low dissolved oxygen (DO) concentrations. The plant operators typically resort to chlorinating RAS to kill filamentous organisms and avoid solids wash-out under critically high BOD_5 loading and sustained wet weather flows.

Figure 4-1. Process Flow Schematic of Selector-Contact-Stabilization Process



The SCS process had not been applied to small size (less than 1 MGD, Class 2A) extended aeration activated sludge facilities. The plant class designation system that was developed by NYSDEC on a scale of one to four is a measure of the size and complexity of a WWTP. The system is used to determine the training and certification level for the operator of the treatment plant. More complex WWTPs have a higher classification number and the less complex ones have low number designations.

For the Town of Rosendale, the SCS process was expected to result in construction cost savings of about sixty percent in comparison to a conventional project approach.

The full-scale evaluation of the SCS process converted one train of the existing extended aeration activated sludge process to the SCS process mode of operation. This meant incorporating an anoxic biological Selector Zone at the inlet end of the Contact Zone, and modifying piping and aeration diffusers to configure the SCS process. Figure 4-2 shows the SCS modified aeration basin on the right side of the photo and the EA basin on the left side. The wood partitions towards the middle of the SCS aeration basin are the Selector Zone baffles. The Contact Zone is shown in the background and the Stabilization Zone is shown in the foreground.

Figure 4-2. Rosendale WWTP during SCS Demonstration

ENGINEERING DESIGN

O'Brien & Gere provided three separate design packages to assist the Town with the installation of the SCS process components in one of the two treatment trains at their WWTP. Design details were provided in August and September 2002. The three design packages included:

1. Retrofitting the influent pumps to include variable frequency drive (VFD)
2. Modifications to the aeration basin for the construction of the Selector Zone baffles
3. Installation of return activated sludge pump and piping

Design Package 1 - Retrofitting Influent Pumps With VFD

The engineering report recommended installing variable speed pumping in the influent lift station to provide a more uniform influent wastewater flow in order to dampen the hydraulic surging the plant was experiencing.

Three influent pump modification options were examined:

1. Installing variable frequency drives (VFDs) on two of the existing influent pumps.
2. Replacing one the existing influent pumps with a new pump of the same capacity with a VFD.
3. Installing a new smaller pump rated for the average plant influent flow.

The motors on the existing influent pumps were old and would be prone to failure if used with VFDs. It was recommended that the Town replace one of the existing Hydromatic influent pumps with a new VFD compatible Hydromatic S3 submersible pump that could be mounted in the existing wet well without piping modifications. A smaller pump to handle average influent flows without VFD was ruled out because the installation would require wet well piping modifications.

The design details included the following items:

- The new Hydromatic influent pump is used to handle average flows to the plant. The two existing influent pumps were left in place to assist with pumping peak flows and to provide the necessary redundancy.

- The existing pump control floats in the wet well were left in place to turn the various pumps on and off. A new level control transducer was recommended to pace the VFD for the new influent pump.

- The influent wet well is located beneath the existing Pump Station Control Building. Since, the access hatch to the influent wet well is located inside the building, current code required an explosion-proof control panel for the new influent pump if this panel were to be located next to the existing ones. As an alternative to the costly option of explosion-proof equipment, O'Brien & Gere recommended that the new pump control panel be installed on the outside wall of the Pump Station Control Building (see Figure 5-1).

- The new pump had a three inch discharge with a capacity of 210 gpm at a total dynamic head of 26 feet at 1750 RPM. The required options included a VFD, a hydraulic sealing flange (to attach the new pump to the existing pump base), a level control transducer, and a NEMA 4 control panel.

O'Brien & Gere provided schematics for the required electrical & control modifications and catalog cuts for one influent submersible pump with a variable frequency drive (VFD), and related equipment.

O'Brien & Gere also recommended that the existing adjustable weir plates in the existing Flow Splitter Box be replaced with adjustable 3/8th-inch thick aluminum, 45 degree V-Notch Weir plates (see Figure 5-2). The V-Notch Weir plates allowed for more accurate flow control between each treatment train.

Design Package 2 - Modifications to the Aeration Basin

The modifications to the aeration basin to accommodate the installation of temporary components for the SCS process involved:

1. Layout of modifications to the aeration basin drawing.
2. Interior baffle sectional view drawing.
3. Mixer mounting bracket detail drawing.
4. Catalog cut for the submersible mixers.

The design details included the following items:

- The Selector Zone for the Rosendale WWTP aeration tank was designed for a hydraulic residence time (HRT) of one hour at a flow of 0.135 MGD (maximum monthly flow). A selector volume of 3,000 gallons per basin (12 ft wide by 3.6 ft long by 9.5 ft deep) satisfied the sizing criteria.

Figure 5-1. Influent Pump Control Panel (in background) and Flow Splitter Box (in foreground)

Figure 5-2. V-notch Weir Plates in Flow Splitter Box

- The Selector Zone was divided into three passes via the installation of four baffles. The baffles were spaced evenly throughout the zone with a spacing of 15 inches apart (see Figure 5-3). The placement of the baffles was shown on the layout drawing of the modification to the aeration basin. A cross sectional detail of the baffles was shown on the interior baffle section. Detail drawings showing the connection of the wooden baffles to the existing cast-in-place concrete tank, as well as a materials list, were provided.

- The air piping and diffusers in the region of the Selector Zone were disabled and removed. The air distribution drop pipe was capped (see Figure 5-4). Two submersible mixers positioned at the end of the first and second pass provided mixing in the Selector Zone.

- The influent piping was modified to direct influent wastewater to the entrance of the Selector Zone (see Figure 5-5). An 8-inch schedule 40 PVC pipe with socket fused fittings was used to extend the existing influent pipe to the Selector Zone. It was recommended that the extended influent piping be suspended from 4” x 4” x 12’-0” timber supports at 6’-0” on center using galvanized pipe straps. Each timber support would rest on the outside concrete wall of the aeration basin at one end and on the concrete walkway at the other end.

O’Brien & Gere recommended the Town purchase and install two (2) Flygt 4610 submersible mixers with jet rings. Each mixer was to be rated for a flow of 1,444 gpm. The recommended options included two (2) manual NEMA 4 control panels and two (2) adjustable stainless steel adjustable brackets. It was recommended that the manual control panels be mounted at least ten feet away from the extended aeration basin, otherwise explosion proof equipment would be required.

In order to measure and control the dissolved oxygen levels in the anoxic zone, it was recommended that the Town purchase a YSI Environmental model # 550 dissolved oxygen probe and meter with a 25 foot length of cable.

Figure 5-3. Selector Zone Spacing of Baffles

Figure 5-4. Aeration Header in SCS Modified Tank

Figure 5-5. Modified Influent Piping for Selector-Contact-Stabilization Demonstration

Design Package 3 - RAS Pump and Piping

The engineering report recommended installing a pump for return sludge to achieve more positive control on the RAS flow rate. The modifications for the RAS pump installation and piping included:

1. RAS pump layout drawing
2. RAS pump pad detail drawing
3. Catalog cuts for the RAS pump and the RAS flow meter
4. Installation details for the RAS flow meter.

The design details included the following items:

- O'Brien & Gere recommended the Town purchase and install a Penn Valley 3-inch double disk pump. The recommended options included a pump mounted VFD, a discharge pressure sensor assembly, low temperature grease for the motor, and a space heater within the motor.

- The Penn Valley pump was to be installed on a concrete pad adjacent to the final clarifiers as shown in the RAS pump layout drawing. The suction line was to be a 3-inch hose, while the discharge side of the RAS pump was to be connected to 3-inch galvanized steel piping to allow for the installation of heat tracing, if required.

- The recommended pump model with VFD was suitable for outdoor installation with a low temperature limit of 32°F. To insure proper operation of the VFD during the winter, a heated floor mounted panel was recommended.

- Once the new RAS pump installation was complete, the Town needed to take the sludge airlift system for the SCS retrofitted treatment train off line.

- A flow meter to accurately measure the RAS flow was recommended to be installed in the discharge piping. O'Brien & Gere recommended a 3-inch flanged BadgerMeter Magnetoflow Mag Meter with mounted signal amplifier/LED display. The flow meter was to be installed at the location shown on the RAS pump layout drawing.

- The flow meter was to be NEMA 4 rated with an amplifier/LED display rated NEMA 4X, with both devices suitable for outdoor installation. However, the low operating temperature limit of this equipment is -4°F. To insure proper operation of the flow meter during the winter, a heated instrument enclosure panel was recommended.

- The Penn Valley pump installation was recommended to be at least ten feet away from the aeration basin, otherwise explosion proof equipment would be required.

- As an alternative to heated instrument panels, it was recommended that the RAS pump and flow meter be housed in an insulated and heated enclosure to prevent freezing. The Town constructed their own enclosure for the RAS pump using 2x4 lumber, plywood, and ¾-inch thick rigid Styrofoam for insulation (see Figure 5-6).

Figure 5-6. RAS Pump Enclosure

CONSTRUCTION

The Town was responsible for constructing some components of the SCS process and retaining contractors to perform the other portion of the necessary work including electrical, mechanical, etc., associated with the project.

The Town also provided operation and maintenance activities during the demonstration, as well as repairs and replacements associated with the operation and maintenance of the WWTP. The Town had limited resources to undertake additional specialized projects due to work load availability and the actual project schedule reflected these limitations.

Procurement and construction of the SCS components began in November 2002. Due to the long delivery time for the submersible mixers and manpower scheduling limitations, the installation of the SCS components was not complete until April 2003. During the interim, the remainder of the SCS components were installed and put into service. The aeration basin was dewatered and the Selector Zone baffles were constructed in the aeration basin by town personnel (see Figure 6-1). During this construction activity, the other aeration basin was used to treat all the wastewater received by the plant. After re-filling the modified aeration basin with wastewater and a portion of the mixed liquor from non-modified aeration basin, the modified aeration basin was returned to operation in an EA mode since all the necessary components for the SCS process were not installed and available for use. During this period, the Selector Zone was mixed by aeration, similar to the remainder of the basin. When the mixers arrived on site, they were installed in the Selector Zone without draining the aeration basin and the aeration piping in the Selector Zone was removed. The startup of the SCS process commenced when the mixers were installed and anoxic conditions were established in the Selector Zone.

The startup of the SCS process commenced in late April 2003 and lasted for thirty days. During the startup period, the biomass in the aeration basin was allowed to acclimate to the SCS process. The twelve week demonstration period was initiated in late May 2003. During early July 2003, it was noted that the MLSS concentration in the Stabilization Zone was not increasing as expected given that return activated sludge was supposed to be the only input into this portion of the activated sludge reactor. Following examination, it was found that skimmer return water from the final clarifier had been directed into the Stabilization Zone. To correct this situation, this line was relocated so as to discharge into the Contact Zone. However, this change did not lead to an increase in the MLSS within the Stabilization Zone.

In late July 2003, it was apparent that the MLSS concentration in the Stabilization Zone was still not able to achieve to a level consistent with the design basis (2,600 mg/l). The problem was eventually identified to be a result of the manner in which the baffle walls were constructed. The baffle walls had been constructed

Figure 6-1. Selector Zone Baffles

above a concrete fillet that ran along the bottom edge of the sides of the aeration basin, which left a large gap underneath each baffle wall (see Figure 6-2). Short-circuiting between the different zones was occurring through these gaps.

In late August 2003, the SCS modified aeration tank was emptied and the baffle wall between the Stabilization Zone and Selector was covered with a heavy duty plastic liner to provide a more positive barrier between the two zones (see Figure 6-3). The large gap at the bottom of the baffle wall was also occluded. The baffle wall between the Selector and the Contact Zone was also modified in the same manner. The two interior baffle walls were not modified. Following this modification, the MLSS concentration in the Stabilization Zone increased with respect to the MLSS in the Contact Zone, which was the desired result. The concentration differential before the repair was running around 200-300 mg/L. After the repair, the concentration differential increased to 1,300 mg/L. This differential slowly started to decrease, which was contrary to the desired trend. The integrity of the baffle was again suspect.

After the initial attempt to bolster the segregation integrity of the baffle walls was found to be insufficient, the aeration tank was again dewatered and a more permanent solution was constructed. Fiberglass reinforced plastic panels was attached to the plywood face of the baffles (see Figure 6-4). The baffles were suitably modified in mid October 2003, and the demonstration re-commenced in late October 2003.

During the last week of October, the MLSS concentration in the Stabilization Zone exceeded the MLSS concentration in the Contact Zone by a factor of 2.2, which was consistent with the SCS design basis. The demonstration was re-initiated in the beginning of November 2003.

Figure 6-2. Highlight of Gap at Bottom of Baffle Wall

Figure 6-3. Installing Plastic Sheathing on the Baffle Wall Face

Figure 6-4. Installing Fiberglass Sheeting on the Baffle Wall Face

DEMONSTRATION PLAN

The demonstration plan included the operation of both WWTP biological treatment trains; one train operating in the extended aeration activated sludge mode (current practice) and the other operating in the SCS mode. The SCS mode of operation was expected to show the following process advantages:

- Biological ammonia removal (nitrification) suppression in the SCS mode.

- Improved clarifier operation as the settleability of the SCS train biomass is enhanced via the biological selector.

The suppression of involuntary nitrification would result in reduced oxygen demand and reduced alkalinity consumption. Previously, the WWTP experienced some nitrification, which was unnecessary, as there is no ammonia limit in the plant's current SPDES permit. The WWTP has limited installed aeration capacity and the raw wastewater has insufficient alkalinity to adequately support nitrification. These limitations result in operating problems, which include the growth of filamentous organisms resulting from low dissolved oxygen levels in the reactor and process upsets resulting from pH depression due to insufficient alkalinity.

The Town was responsible for acquiring and maintaining records as necessary to document the success of the WWTP SCS demonstration project. Laboratory analyses were performed by the plant personnel and STL Laboratories, which is located in Newburgh, NY, in accordance with the testing and monitoring plan. Progress reports were prepared on a routine basis and submitted to NYSERDA.

The demonstration plan consisted of:

- Startup of the SCS process
- Twelve week demonstration period with frequent sample collection

The initial startup commenced in late April 2003 and samples were collected according to the schedule provided in Table 7-1 to assess the progress and stability of the two treatment processes. Additional measurements of dissolved oxygen (DO) were made to identify daily patterns. The majority of DO measurements were made in the morning hours with additional measurements made in the afternoon hours that typically showed the limitations of the air delivery system to provide sufficient oxygen in the aeration tanks because low DO measurements were frequently recorded at that time of day. This phenomenon could be partly attributed to the effect of temperature changes on the solubility of oxygen causing a higher demand as the day warmed up.

Table 7-1. Sampling Schedule during SCS Startup

Parameter	Frequency	Sampling Location	Analytical Laboratory
Dissolved Oxygen	M, T, W, Th, F	#1 Stabilization Zone #1 Selector Zone #1 Contact Zone #2 Aeration Tank	Treatment Plant
Settleometer	M, T, W, Th, F	#1 Contact Zone #2 Aeration Tank	Treatment Plant
MLSS	M, T, W, Th	#1 Stabilization Zone #1 Contact Zone #1 Return Sludge #2 Aeration Tank #2 Return Sludge	Treatment Plant
Ammonia	T, Th	Clarifier Effluent #1 Clarifier Effluent #2	Treatment Plant
BOD_5	T, Th	Influent Clarifier Effluent #1 Clarifier Effluent #2	STL Newport
TSS	T, Th	Influent Clarifier Effluent #1 Clarifier Effluent #2	STL Newport

The target values for the key process control parameters were:

- Dissolved oxygen concentration in Stabilization Zone $\geq$ 2.0 mg/L
- Dissolved oxygen concentration in Selector Zone < 0.5 mg/L
- Dissolved oxygen concentration in Contact Zone $\geq$ 3.0 mg/L
- MLSS concentration in the Stabilization Zone $\approx$ 2,600 mg/L
- MLSS concentration in the Contact Zone $\approx$ 1,200 mg/L
- RAS pumping rate $\approx$ 15,000 gpd (10-11 gpm)
- Influent flow rate (to SCS train) $\geq$ 55,000 gpd

The initial twelve week demonstration period commenced at the end May 2003. Table 7-2 shows the sampling schedule that was followed for this part of the demonstration. For the first two weeks, the influent wastewater flow was split evenly between the two sides. During week 3, a greater proportion of the flow was directed to the SCS modified side to target a flow of at least 55,000 gallons per day (gpd).

Table 7-2. Sampling Schedule during Initial SCS Demonstration

Parameter	**Frequency**	**Sampling Location**	**Analytical Laboratory**
Dissolved Oxygen	M, W, F	#1 Stabilization Zone #1 Selector Zone #1 Contact Zone #2 Aeration Tank	Treatment Plant
Settleometer	M, T, W, Th, F	#1 Contact Zone #2 Aeration Tank	Treatment Plant
MLSS	M, W, F	#1 Stabilization Zone #1 Contact Zone #1 Return Sludge #2 Aeration Tank #2 Return Sludge	Treatment Plant
Ammonia	T, Th	Clarifier Effluent #1 Clarifier Effluent #2	Treatment Plant
BOD_5	T, Th	Influent Clarifier Effluent #1 Clarifier Effluent #2	STL Newport
TSS	T, Th	Influent Clarifier Effluent #1 Clarifier Effluent #2	STL Newport

In early July 2003, a problem with the build up of the MLSS concentration within the Stabilization Zone was identified. The mixed liquor concentration in the Stabilization Zone had not increased to expected levels. In addition, rising sludge was observed in the clarifier of the SCS train. The problem was eventually identified as shortcomings in the baffle walls that were constructed to separate the three SCS zones. An initial attempt to bolster the segregation ability of the baffle walls, which was installed in

August 2003, was found to be insufficient to resolve the performance issue. The baffles were suitably modified in late October 2003, and the demonstration re-commenced in the beginning of November 2003.

Table 7-3 shows the sampling schedule that was followed during the second demonstration. The major difference is the frequency that samples were sent to the outside laboratory for analysis. The demonstration period was twelve weeks during which the SCS process was operated according to the design parameters. The average influent flow to the SCS side was 58,900 gallons per day, which exceeded the target value of 55,000 gpd. The treated effluent quality from the SCS side was within permitted limits during this portion of the demonstration. The collection of samples and compilation of data for this demonstration ceased on January 31, 2004.

Table 7-3. Sampling Schedule during Actual SCS Demonstration

Parameter	Frequency	Sampling Location	Analytical Laboratory
Dissolved Oxygen	M, W, F	#1 Stabilization Zone #1 Selector Zone #1 Contact Zone #2 Aeration Tank	Treatment Plant
Settleometer	M, T, W, Th, F	#1 Contact Zone #2 Aeration Tank	Treatment Plant
MLSS	M, W, F	#1 Stabilization Zone #1 Contact Zone #1 Return Sludge #2 Aeration Tank #2 Return Sludge	Treatment Plant
Ammonia	M, T, W, Th, F	Clarifier Effluent #1 Clarifier Effluent #2	Treatment Plant
BOD_5	W	Influent Clarifier Effluent #1 Clarifier Effluent #2	STL Newport
TSS	W	Influent Clarifier Effluent #1 Clarifier Effluent #2	STL Newport

DEMONSTRATION RESULTS

Baseline Operating Data

Monthly discharge monitoring reports (DMR) for the three year period of January 2000 to December 2002 preceding the SCS demonstration were tabulated and used to establish a baseline performance for the EA process at the Rosendale WWTP. Table 8-1 lists the average performance of the WWTP for this period. These numbers will be used to compare the results from the twelve week demonstration of the SCS process.

Table 8-1. Baseline Operating Data, January 2000 through December 2002

Parameter	**Units**	**Average**	**Minimum**	**Maximum**
Influent Flow	gpd	74,200	47,500	213,300
Influent BOD_5	mg/L	216	105	390
Influent BOD_5	lb/d	125	56	229
Effluent BOD_5	mg/L	8.8	2.0	27
Effluent BOD_5	lb/d	5.2	1.0	16
BOD_5 removal	%	96	85	99
Influent TSS	mg/L	226	85	663
Influent TSS	lb/d	129	43	372
Effluent TSS	mg/L	22	2.5	45
Effluent TSS	lb/d	13	1.3	27
TSS removal	%	90	80	99
Influent Settleable Solids	ml/L	9.5	0	500
Effluent Settleable Solids	ml/L	0.6	0	157
Influent Ammonia-nitrogen	mg/L	63	29	88
Effluent Ammonia-nitrogen	mg/L	0.8	0.1	2.7
Influent Temperature	deg. C	16	5	25
Effluent Temperature	deg. C	16	3	26
Influent pH	S.U.	7.3 (1)	5.6	8.9
Effluent pH	S.U.	6.8 (1)	5.4	8.1

(1) median value

During the three year baseline period, the average wastewater flow rate was 74,200 gpd with an average effluent BOD_5 concentration of 8.8 mg/L and TSS concentration of 22 mg/L. The maximum flow rate during this period was 213,300 gpd while the maximum effluent BOD_5 concentration was 27 mg/L and the maximum effluent TSS concentration was 45 mg/L. The tabulation of the DMR data and historical graphs of several parameters are included in Appendix A, DMR Data.

Demonstration Operating Data

The twelve week side-by-side demonstration commenced on November 1, 2003 and ended on January 31, 2004. The SCS and EA processes were sampled according to the schedule shown in Table 7-3. The tabulation of the data collected during the demonstration is included in Appendix B, Demonstration Data.

Effluent Quality

Table 8-2 lists the average performance of each process for the demonstration period as well as the corresponding baseline data. During the demonstration, the influent BOD_5 and TSS concentrations were less than the average baseline values while the total flow to the WWTP was greater than the baseline. The SCS process treated an average of 58,900 gpd while the EA process treated an average of 44,900 gpd, which means that the SCS process treated thirty percent more flow and load than the EA process during the demonstration. The SCS process was able to treat the extra load and still produce an effluent quality that was within permit limitations.

The SCS process was also able to suppress involuntary nitrification as evidenced by the greater effluent ammonia-nitrogen concentration, while the EA process continued to nitrify even in colder temperatures. Nitrification consumes a significant amount of air supplied by the blowers to keep the requisite dissolved oxygen concentration in the aeration basins, and therefore, requires more energy. When insufficient aeration is provided, low DO concentrations can be experienced in the basin, which gives rise to filamentous organisms that adversely affect the settleability of the biosolids in the final clarifier and can lead to solids washout conditions.

Table 8-2. Average Influent/Effluent Data for Side-by-Side Demonstration, November 2003 through January 2004

Parameter	Units	Baseline (EA)	Side #1 (SCS)	Side #2 (EA)
Influent Flow	gpd	74,200	58,900	44,900
Influent BOD_5	mg/L	216	178	178
Influent BOD_5	lb/d	125	87	67
Effluent BOD_5	mg/L	8.8	21	17
Effluent BOD_5	lb/d	5.2	10	6.4
BOD_5 removal	%	96	88	90
Influent TSS	mg/L	226	156	156
Influent TSS	lb/d	129	77	58
Effluent TSS	mg/L	22	16	29
Effluent TSS	lb/d	13	7.9	11
TSS removal	%	90	90	81
Influent Ammonia-nitrogen	mg/L	63	20	20
Effluent Ammonia-nitrogen	mg/L	0.8	12.3	0.5
Influent Temperature	deg. C	16	13	13
Effluent Temperature	deg. C	16	12	12
Influent pH	S.U.	7.3 (1)	7.6 (1)	7.6 (1)
Effluent pH	S.U.	6.8 (1)	7.4 (1)	7.4 (1)

(1) median value

TSS Settleability

Figure 8-1 is a plot of the SVI values during the demonstration period. The SVI of the biosolids in the SCS process averaged 102 ml/g while the SVI for the EA process was 114 ml/g. This difference is statistically not significant, however the maximum SVI experienced with the SCS process was 127 ml/g as compared to a maximum SVI for the EA process of 170 ml/g. In addition, the RAS in the EA process was periodically chlorinated to kill filamentous organisms and improve biosolids settleability, while the RAS in the SCS process was not chlorinated. Based on these observations, the SCS process appears to produce a better settling sludge than the EA process at the Town of Rosendale WWTP.

Figure 8-1. Sludge Volume Index

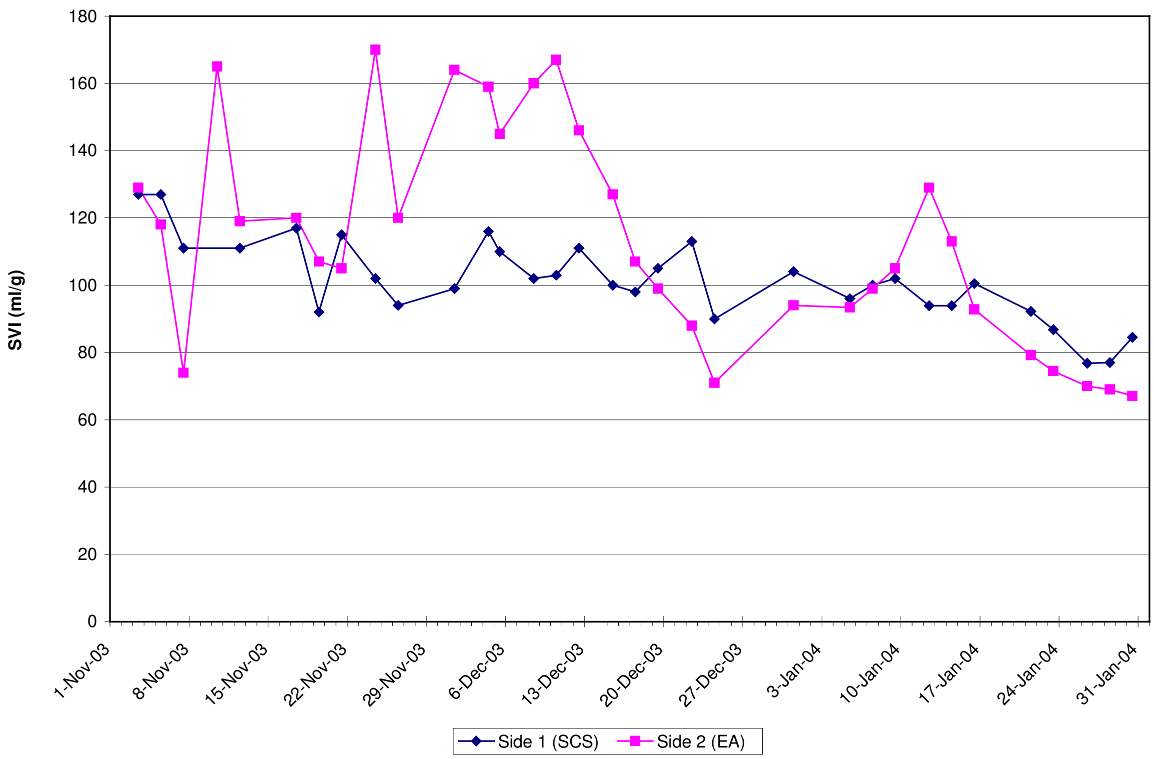


Table 8-3 lists the operating parameters for the aeration basins and final clarifiers during the demonstration period. The two processes operated with similar inventory of mixed liquor solids under aeration and the SCS process had higher removal rates for BOD_5 and TSS. However, the major benefit of the SCS process was in the dramatically lower solids loading rate (SLR) to the final clarifiers. The SCS process averaged a SLR of 8.8 pounds per day per square foot (ppd/ft^2) of clarifier area as compared to an average SLR of 35.4 ppd/ft^2 for the EA process. The lower SLR to the final clarifier on the SCS side resulted in lower effluent TSS even under greater hydraulic loading, i.e. higher surface overflow rate (SOR) as shown in Table 8-3.

Table 8-3. Average Operating Parameters for Side-by-Side Demonstration, November 2003 through January 2004

Parameter	Units	Side #1 (SCS)	Side #2 (EA)
Aeration			
MLSS Inventory	lb	1,308	1,313
BOD_5 Removed	lb/d	77	61
Final Clarifier			
Surface Overflow Rate	gpd/ft^2	409	312
Solids Loading Rate	lb/d/ft^2	8.8	35
TSS Removal	lb/d	69	47
Effluent TSS concentration	mg/L	16	29

Figure 8-2 is a plot of the solids loading rate values during the demonstration period. As stated previously, the SLR for the SCS process was dramatically less than the SLR for EA process even though the SCS process was treating thirty percent more flow and loading than the EA process. Typically, it is desirable to have a SLR value in the range of 10-15 ppd/ft^2 under average conditions and 30-35 ppd/ft^2 under peak conditions. The Ten States Design Standard that is followed by the NYSDEC lists a peak SLR for extended aeration process of 35 ppd/ft^2. During this evaluation, the peak SLR for the EA process was 43.4 ppd/ft^2 and the peak SLR for the SCS process was 15.6 ppd/ft^2, while the average SLR was 35.4 ppd/ft^2 for the EA process and 8.8 ppd/ft^2 for the SCS process.

Figure 8-2. Solids Loading Rate to Final Clarifiers

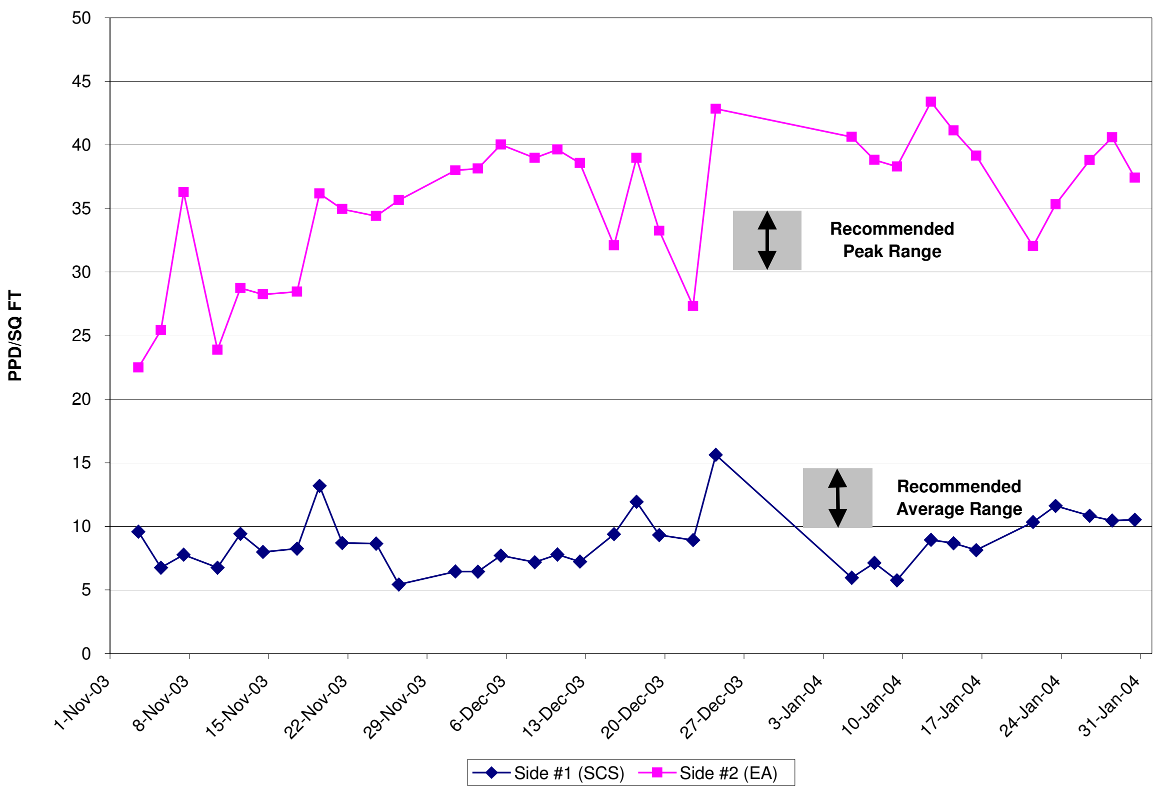


Figure 8-3 is a plot of the effluent TSS concentration versus the SLR for both processes. The final clarifier for the SCS process consistently had a lower TSS concentration with a significantly lower solids loading flux as compared to the EA process. It is important to note that the higher quality effluent achieved by the SCS process occurred while the SCS process was loaded thirty percent higher than the EA process.

Figure 8-4 is a plot of the final clarifier surface overflow rate (SOR) values in gallons per day per square foot (gpd/ft^2) during the demonstration. Since the SCS process treated a higher influent flow, the SOR values for the SCS were greater than the values for the EA process. The Ten States Design Standard lists a value of 1,000 gpd/ft^2 for the SOR under peak hourly conditions for the EA process.

Figure 8-5 is a plot of the effluent TSS concentrations versus the SOR for both processes. On this graph, it can be noted that the effluent TSS concentration from the SCS process maintained a high quality even at very high overflow rates while the effluent from the EA process had poor quality under low overflow rates.

Figure 8-3. Effluent TSS Concentration versus Clarifier Solids Loading Rate

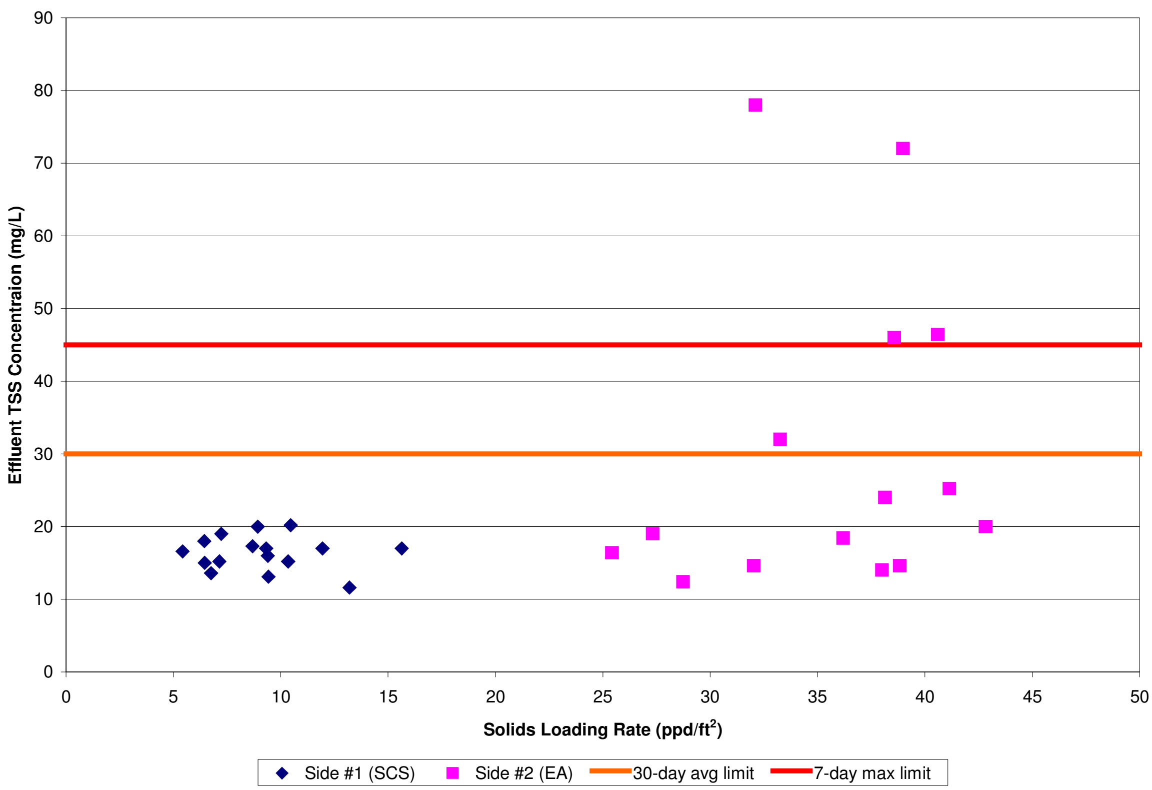


Figure 8-4. Clarifier Surface Overflow Rate

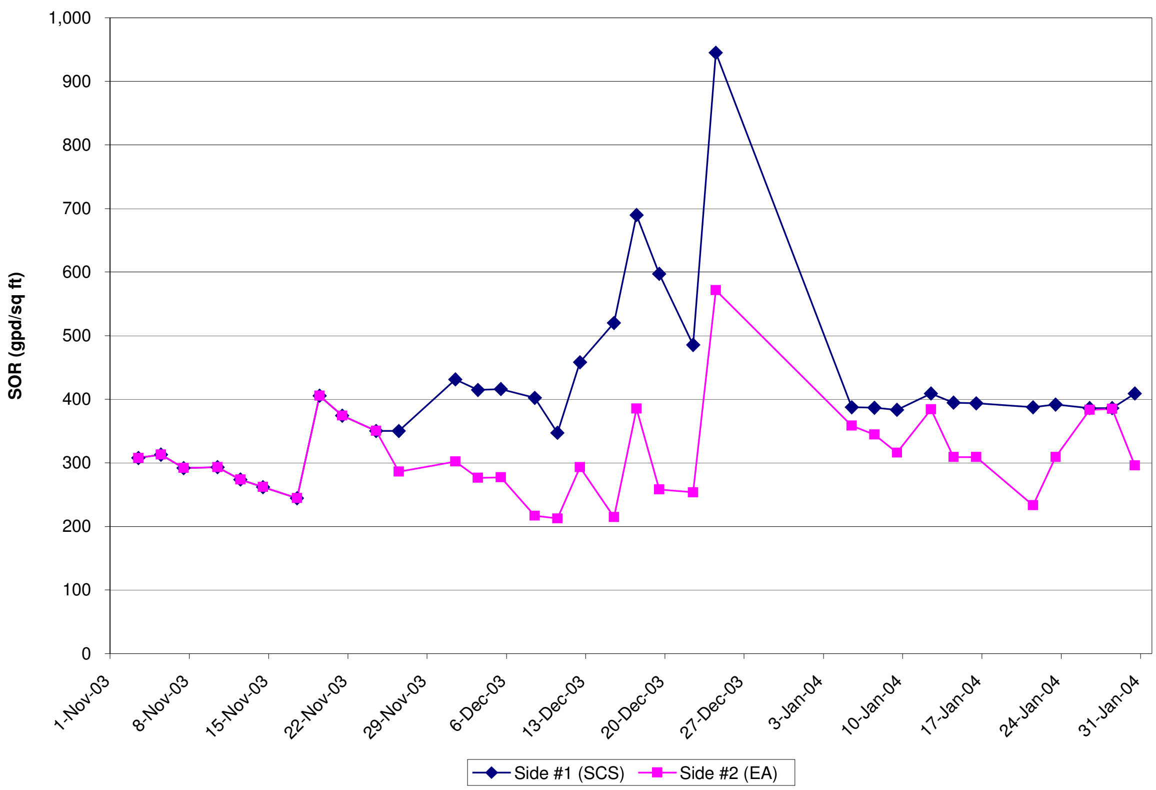
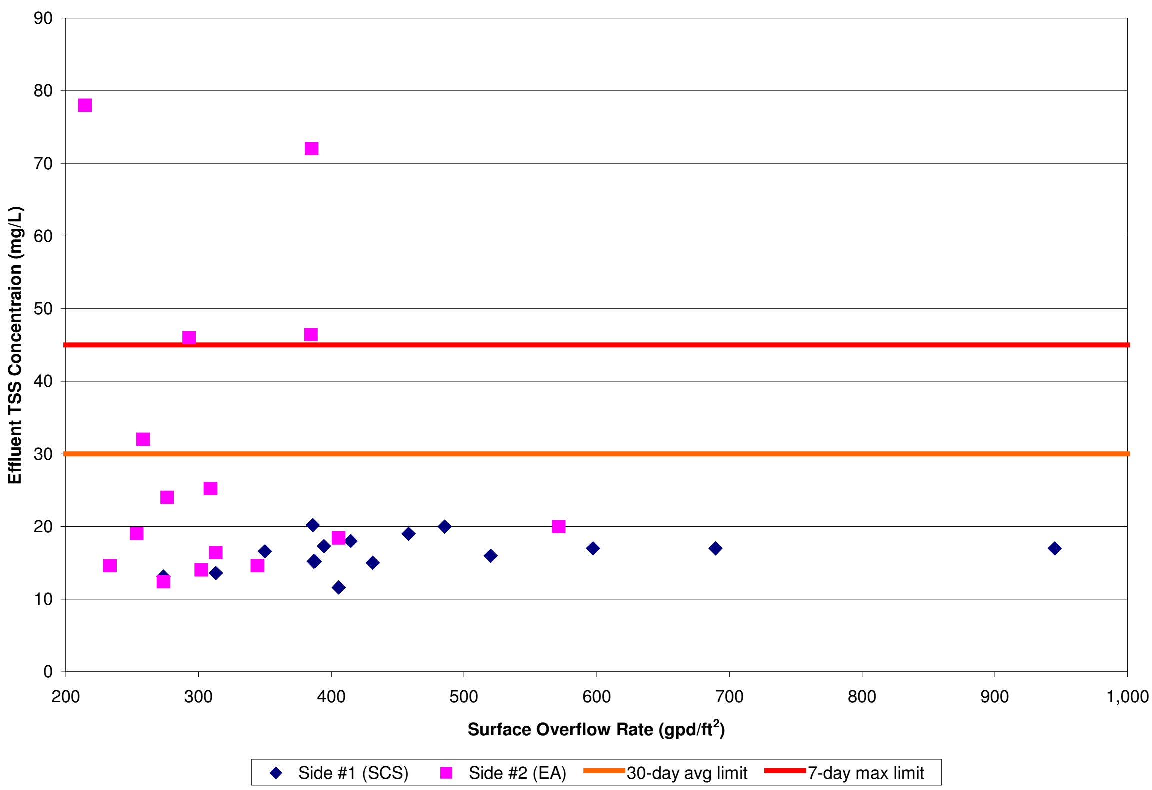


Figure 8-5. Effluent TSS Concentration versus Clarifier Surface Overflow Rate



ENERGY USE AND COST INFORMATION

The energy savings for the SCS process are the result of better utilization of the existing tankage, pumping and aeration equipment. The SCS process demonstrated higher capacity compared to the EA process by treating thirty percent more flow and load using the same amount of energy as the EA process.

Direct measurements of the energy consumption for each process were not made during the demonstration. Therefore, the energy savings were determined based on measured treatment performance for each system. The Rosendale WWTP has two 15-hp blowers for the diffused aeration system with one blower in service and the other usually idle. The airflow from the blower is not measured, but pressure observations indicate the air is distributed evenly between each aeration tank. Based on the treatment capacity for each process, it is estimated that the energy consumption for the SCS process is about 30% less than the EA process. This is equivalent to approximately 2 hp or 1.5 kW. With an electricity cost of $0.10 per kWh, this saving is equivalent to $1,300 per year.

The estimated construction cost to convert the WWTP to the SCS process is $160,000. This cost includes:

Baffles	$30,000
Piping & Valves	$22,000
RAS Pumps with VFDs	$35,000
Submersible Mixers	$48,000
Subtotal	$135,000
Contingency	$25,000
Total	$160,000

Some of the equipment from the demonstration may be re-used for the permanent installation, such as the submersible mixers and the positive displacement RAS pump with VFD. The use of this equipment would reduce the estimated construction cost.

CONCLUSIONS

The four goals of this demonstration were:

1. Document performance of the SCS process to the Town and NYSDEC.
2. Document the response and performance of the final clarifiers.
3. Provide the plant operators with first hand operational experience with the SCS process.
4. Provide the information to fine tune the SCS process design for permanent installation.

These goals were satisfied during this project. This report contains the documentation of the SCS performance as well as the response and performance of the clarifiers when handling the mixed liquor from the SCS process. The operation of the SCS process during the demonstration provided the operators with first hand knowledge of the benefits of the process. The information collected during the demonstration can be used to prepare a detailed engineering design for a permanent conversion of the Rosendale WWTP to the SCS process.

The demonstration showed the SCS process can sufficiently treat 59,000 gpd in one half the plant, which is equivalent to a full plant capacity of 118,000 gpd. This capacity is in excess of the targeted capacity of 105,000 gpd.

The primary objectives of this study were to demonstrate the increased capacity and improved process performance of the SCS process at the Town of Rosendale WWTP. These objectives were achieved. The demonstration results showed the SCS process treated thirty percent more flow and load than the EA process. It was also shown that the SCS process achieved this higher treatment capacity while improving the performance of the final clarifiers by reducing the solids loading to these units and by reducing the effluent TSS in the treatment plant effluent. The results also show that the EA process poses significant risk of compliance with TSS limitations.

The secondary objectives of this study were to demonstrate the ability of the SCS process to suppress involuntary nitrification and improve solids settleability. These objectives were achieved during the demonstration. The effluent ammonia-nitrogen concentration for the SCS process showed that nitrification was suppressed, which allowed more of the dissolved oxygen to be used for carbonaceous removal. The demonstration results showed that the SCS process could maintain good settling mixed liquor solids with good SVI values, while the EA process was only able to maintain similar settling characteristics when routine chlorination was practiced.

RECOMMENDATIONS

The SCS demonstration achieved all project goals and objectives. The Selector-Contact-Stabilization process was found to be superior to the extended aeration process for the Town of Rosendale wastewater treatment plant.

It is recommended that the Town modify the design of their WWTP to incorporate the SCS process. This can be done by simply replacing the temporary SCS demonstration components (like the selector baffles) with permanent components and installing permanent components in the other aeration basin.

APPENDICES

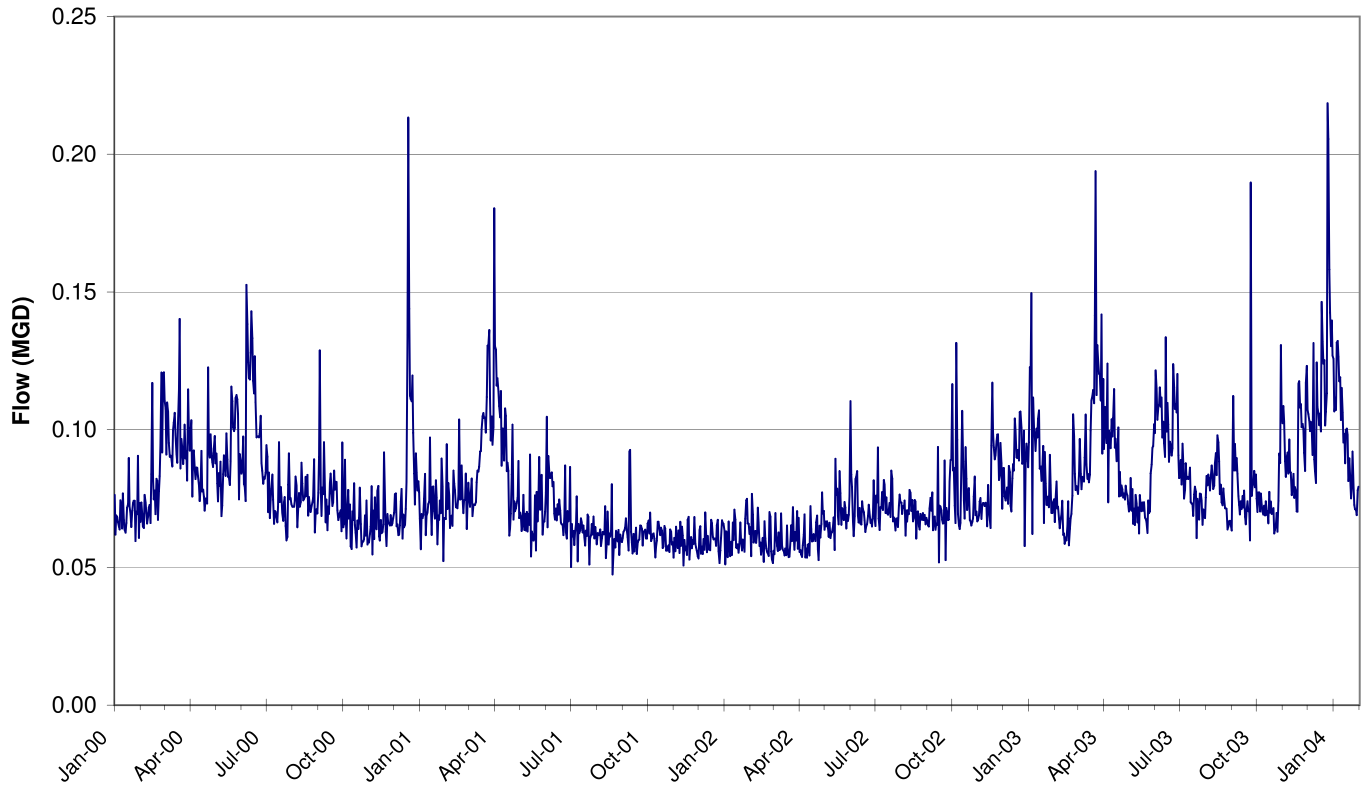
APPENDIX A

DMR Data

January 1, 2000 through January 31, 2004

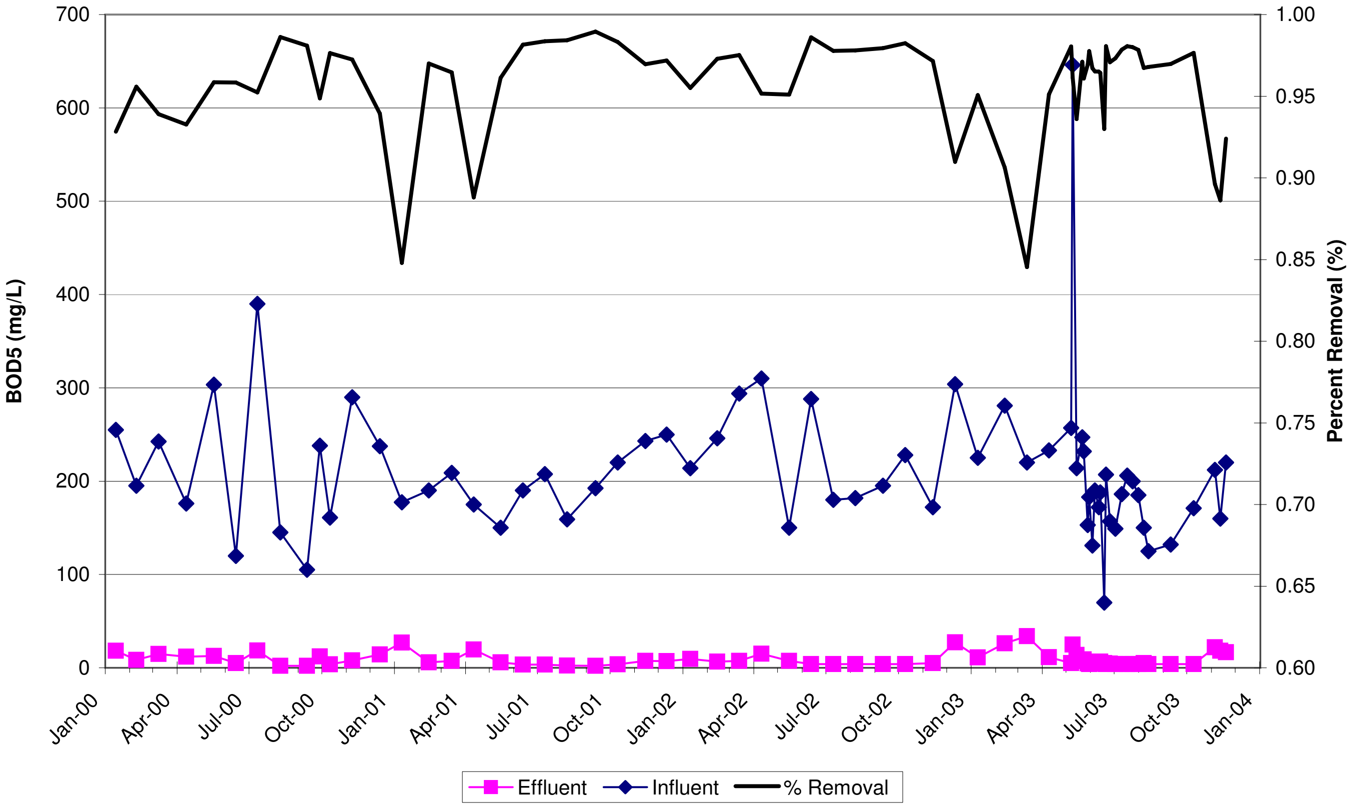
	Monthly Average							Annual Average							Weekly Maximum			
Date	Flow	BOD5	BOD5	BOD5	TSS	TSS	TSS	Flow	BOD5	BOD5	BOD5	TSS	TSS	TSS	BOD5	BOD5	TSS	TSS
	MGD	inf lb/d	eff mg/L	eff lb/d	inf lb/d	eff mg/L	eff lb/d	MGD	inf lb/d	eff mg/L	eff lb/d	inf lb/d	eff mg/L	eff lb/d	eff mg/L	eff lb/d	eff mg/L	eff lb/d
Jan-00	0.0702	133.2	18.3	9.6	52.2	16.1	8.4								18.3	9.6	16.1	8.4
Feb-00	0.0810	107.2	8.6	4.7	111.6	24.5	13.5								8.6	4.7	24.5	13.5
Mar-00	0.0984	183.2	14.8	11.2	158.7	15.0	11.3								14.8	11.2	15.0	11.3
Apr-00	0.0865	108.8	11.9	7.3	84.7	23.5	14.5								11.9	7.3	23.5	14.5
May-00	0.0909	209.6	12.6	8.7	158.8	14.2	9.8								12.6	8.7	14.2	9.8
Jun-00	**0.1040**	133.3	5.0	5.6	155.5	24.7	**27.4**								5.0	5.6	24.7	27.4
Jul-00	0.0749	229.3	18.6	10.9	372.1	13.5	7.9								18.6	10.9	13.5	7.9
Aug-00	0.0748	93.1	2.0	1.3	109.2	5.5	3.5								2.0	1.3	5.5	3.5
Sep-00	0.0779	98.0	7.1	4.1	145.6	15.0	7.9								12.2	7.2	15.0	7.9
Oct-00	0.0664	76.2	3.8	1.8	66.2	15.0	7.1								3.8	1.8	15.0	7.1
Nov-00	0.0671	182.6	8.0	5.0	241.1	23.8	13.4								8.0	5.0	34.0	18.6
Dec-00	0.0878	127.9	14.4	7.8	102.3	29.2	17.4	0.08162	136.95	10.17	6.32	146.50	22.29	13.62	14.4	7.8	35.0	20.6
Jan-01	0.0716	103.5	27.0	15.7	147.7	29.5	16.6								27.0	15.7	44.0	25.7
Feb-01	0.0760	113.9	5.7	3.4	101.9	26.8	16.6								5.7	3.4	40.0	21.3
Mar-01	0.0969	160.6	7.4	5.7	146.0	27.0	20.7								7.4	5.7	35.0	27.2
Apr-01	0.0917	146.0	19.6	16.4	129.9	27.7	23.1								19.6	16.4	27.7	23.1
May-01	0.0688	78.9	5.8	3.0	84.1	20.5	11.6								5.8	3.0	30.0	17.2
Jun-01	0.0741	106.8	3.5	2.0	98.3	20.1	12.2								3.5	2.0	35.0	24.7
Jul-01	0.0628	113.8	3.4	1.9	90.5	16.4	7.7								3.4	1.9	22.0	9.4
Aug-01	0.0613	80.4	2.5	1.3	43.0	15.0	7.0								2.5	1.3	27.0	10.7
Sep-01	0.0634	94.8	2.0	1.0	72.7	10.4	5.1								2.0	1.0	10.4	5.1
Oct-01	0.0613	98.4	3.7	1.7	79.4	11.0	4.9								3.7	1.7	11.0	4.9
Nov-01	0.0592	121.4	7.4	3.7	143.6	**34.0**	17.0								7.4	3.7	34.0	17.0
Dec-01	0.0604	115.8	7.1	3.3	120.4	**32.5**	15.0	0.07056	111.19	7.92	4.91	110.93	22.80	13.66	7.1	3.3	32.5	15.0
Jan-02	0.0614	97.4	9.6	4.4	84.6	18.8	8.6								9.6	4.4	18.8	8.6
Feb-02	0.0606	121.1	6.7	3.3	100.4	19.3	9.5								6.7	3.3	19.3	9.5
Mar-02	0.0600	137.1	7.3	3.4	134.3	20.6	9.6								7.3	3.4	20.6	9.6
Apr-02	0.0612	138.4	15.0	6.7	145.7	23.2	11.1								15.0	6.7	45.0	20.1
May-02	0.0689	95.5	7.4	4.7	71.3	22.9	14.6								7.4	4.7	22.9	14.6
Jun-02	0.0721	172.0	4.0	2.4	138.5	11.3	6.7								4.0	2.4	11.3	6.7
Jul-02	0.0724	106.4	4.0	2.4	156.1	13.2	7.8								4.0	2.4	13.2	7.8
Aug-02	0.0696	107.3	4.0	2.4	143.9	10.8	6.4								4.0	2.4	10.8	6.4
Sep-02	0.0708	103.6	4.0	2.1	193.4	4.5	2.4								4.0	2.1	4.5	2.4
Oct-02	0.0789	123.9	4.0	2.2	98.9	11.0	6.0								4.0	2.2	11.0	6.0
Nov-02	0.0811	114.6	4.9	3.3	125.3	26.0	17.3								4.9	3.3	26.0	17.3
Dec-02	0.0870	178.2	27.4	16.1	161.8	28.0	16.4	0.07040	124.63	8.18	4.43	131.82	18.28	9.90	27.4	16.1	28.0	16.4
Jan-03	0.0898	173.2	11.1	8.5	112.4	24.0	18.5								11.1	8.5	24.0	18.5
Feb-03	0.0718	146.1	26.3	13.7	109.2	**50.5**	**26.3**								26.3	13.7	**50.5**	26.3
Mar-03	**0.1043**	150.8	**34.0**	23.3	86.4	**53.0**	**36.3**								34.0	23.3	**53.0**	36.3
Apr-03	0.0900	181.2	11.4	8.9	298.7	16.4	12.8								11.4	8.9	16.4	12.8
May-03	0.0742	173.7	9.8	6.1	153.0	14.7	9.2								24.8	15.8	27.7	17.6
Jun-03	**0.1046**	134.7	5.3	4.5	146.1	15.5	13.1								6.7	6.0	21.2	18.2
Jul-03	0.0771	114.9	4.0	2.5	123.8	21.2	15.0								4.0	3.0	**64.0**	**47.5**
Aug-03	0.0786	99.3	4.5	3.2	116.3	12.6	9.1								4.9	3.4	12.6	9.5
Sep-03	0.0815	80.0	4.0	2.4	63.7	7.1	4.3								4.0	2.4	7.1	4.3
Oct-03	0.0750	98.6	4.0	2.3	58.2	10.7	6.2								4.0	2.3	10.7	6.2
Nov-03	0.0933	125.7	19.0	12.2	105.9	14.3	9.1								22.0	15.2	15.0	10.4
Dec-03	**0.1197**	124.7	17.0	13.3	110.5	19.4	15.6	0.08842	137.13	9.88	6.73	131.89	18.21	12.80	17.5	14.2	24.3	20.9
Jan-04	0.0969	144.5	18.0	13.9	103.6	21.1	15.8								24.7	20.3	33.3	19.7
average	0.0781	127.7	9.9	6.2	125.7	20.0	12.4	0.0778	127.5	9.0	5.6	130.3	20.4	12.5	10.6	6.7	24.0	14.8
stdev	0.0143	35.0	7.6	5.0	58.3	9.6	6.6	0.0088	12.3	1.1	1.1	14.6	2.5	1.8	8.1	5.6	13.0	8.9
minimum	0.0592	76.2	2.0	1.0	43.0	4.5	2.4	0.0704	111.2	7.9	4.4	110.9	18.2	9.9	2.0	1.0	4.5	2.4
median	0.0749	121.1	7.3	4.4	112.4	19.3	11.3	0.0761	130.8	9.0	5.6	131.9	20.3	13.2	7.4	4.7	22.9	13.5
maximum	0.1197	229.3	34.0	23.3	372.1	53.0	36.3	0.0884	137.1	10.2	6.7	146.5	22.8	13.7	34.0	23.3	64.0	47.5
count	49	49	49	49	49	49	49	4	4	4	4	4	4	4	49	49	49	49

Town of Rosendale
Daily Average Flow

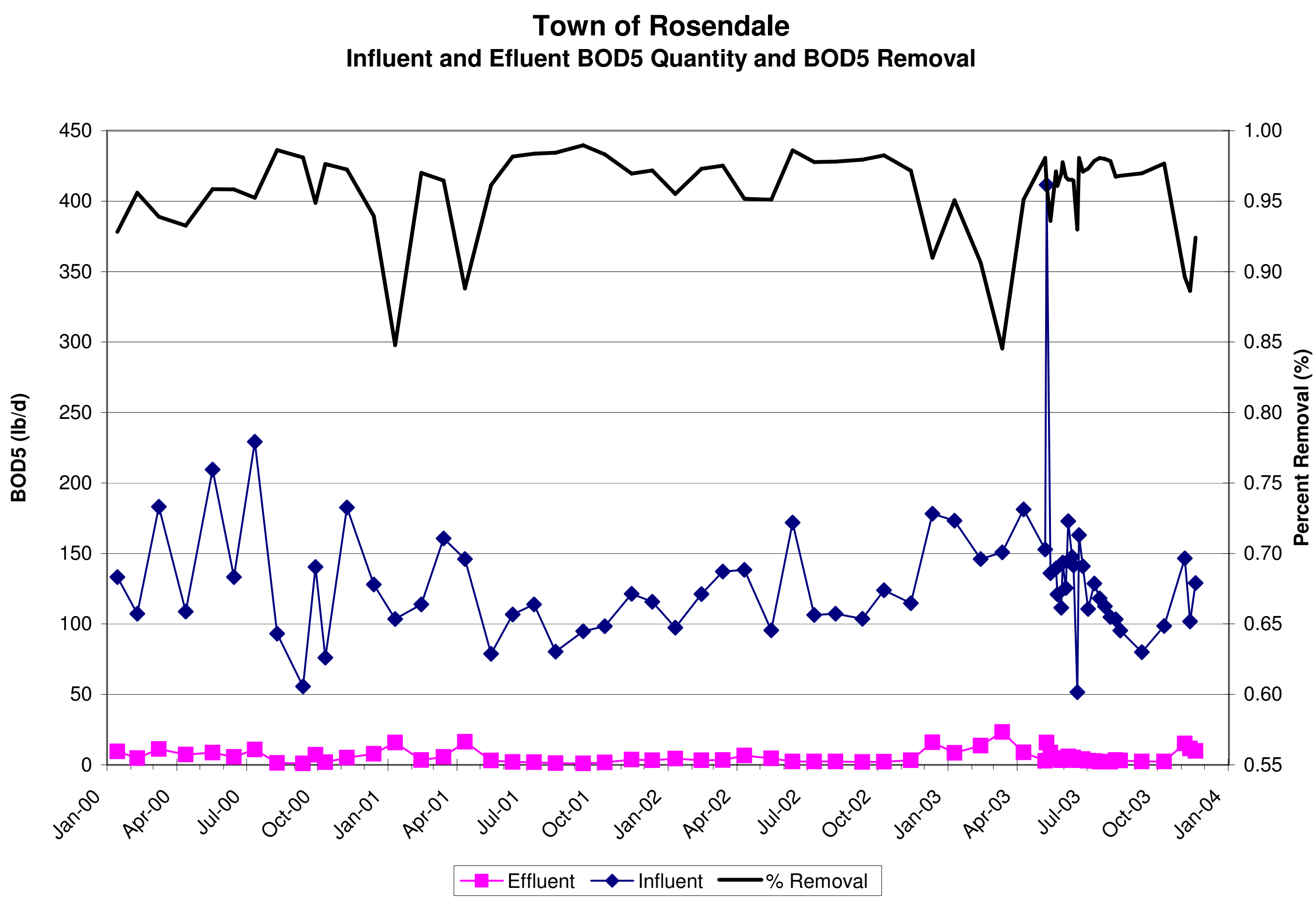


from DMR reports

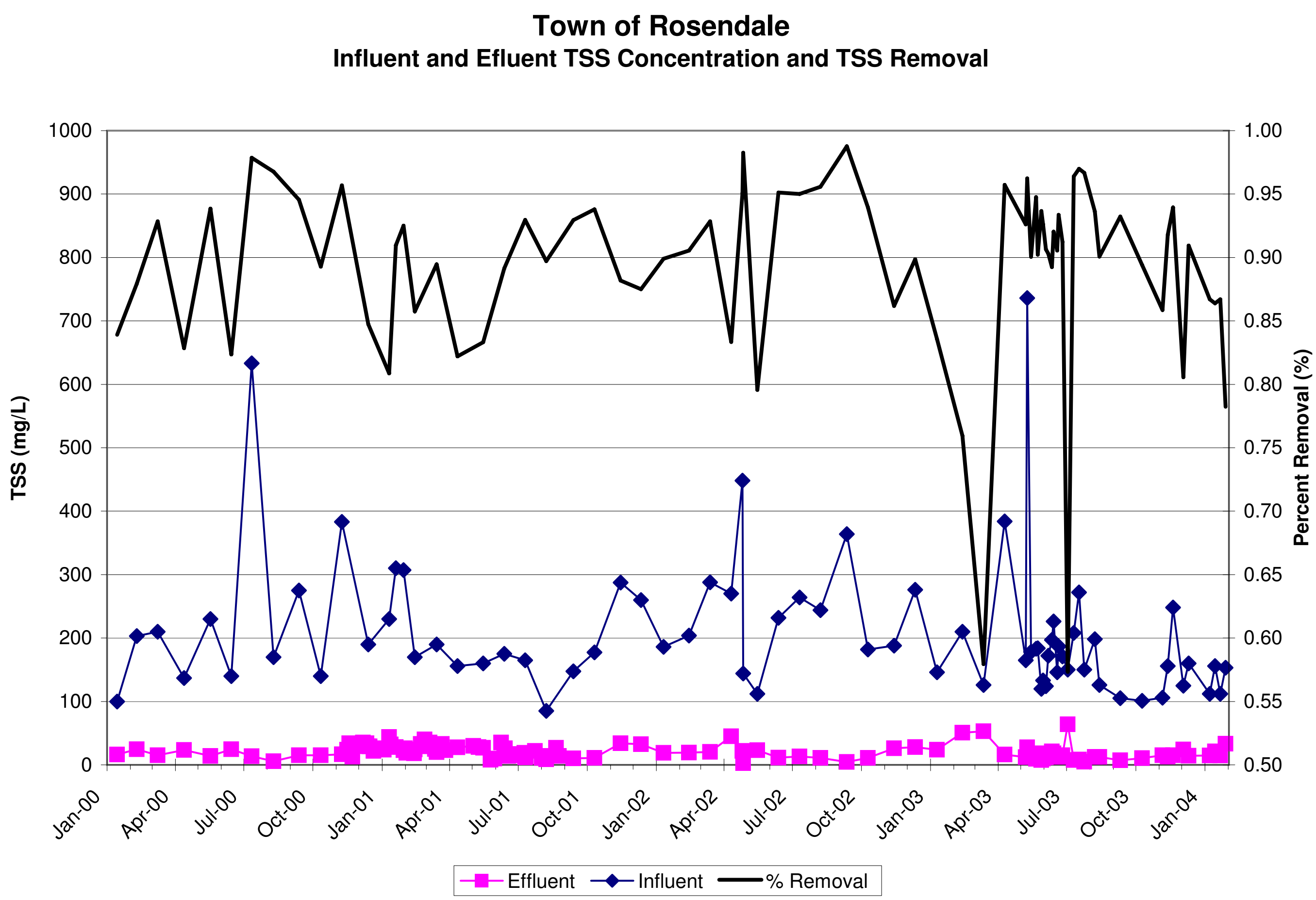
Town of Rosendale
Influent and Efluent BOD5 Concentration and BOD5 Removal



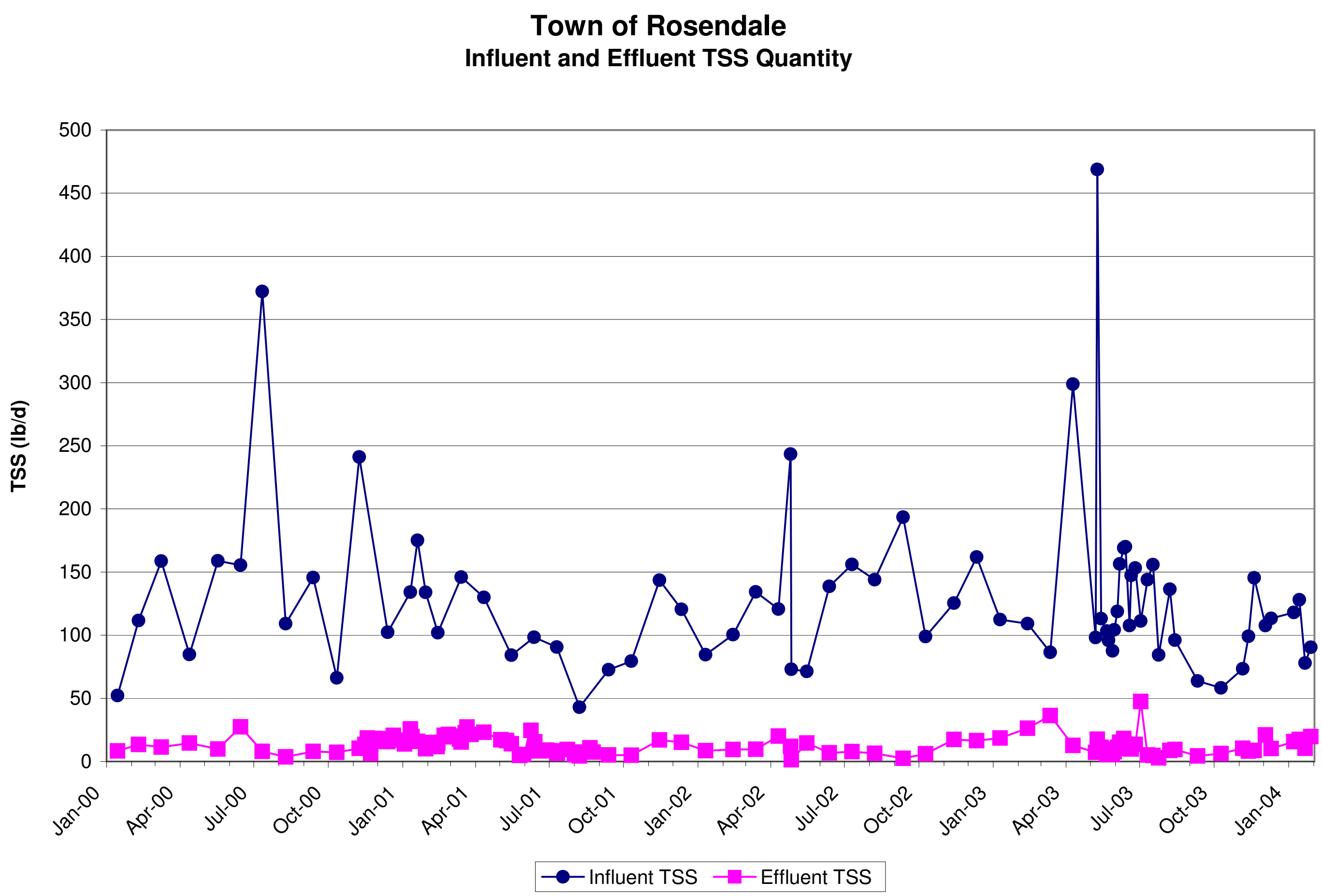
from DMR data



from DMR reports

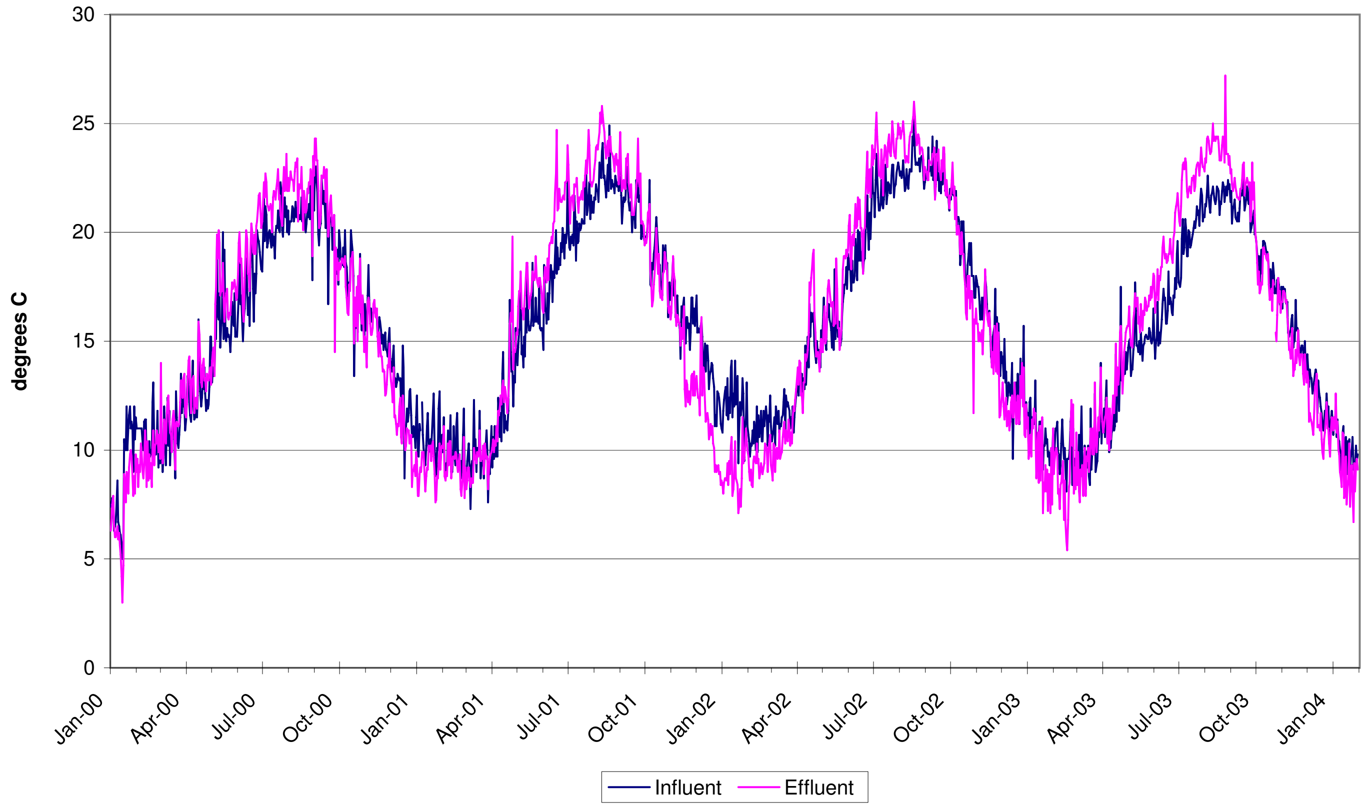


from DMR data



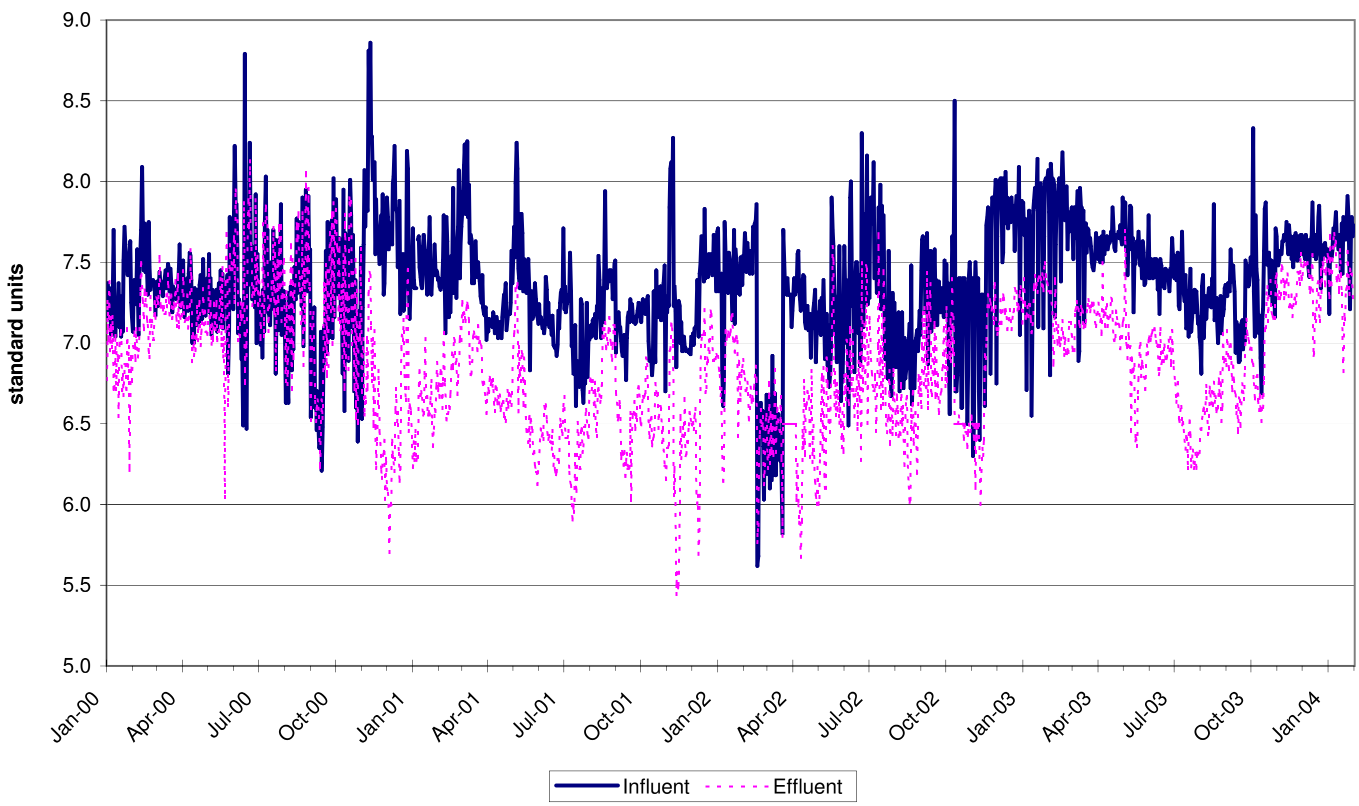
from DMR data

Town of Rosendale
Influent and Effluent Temperature

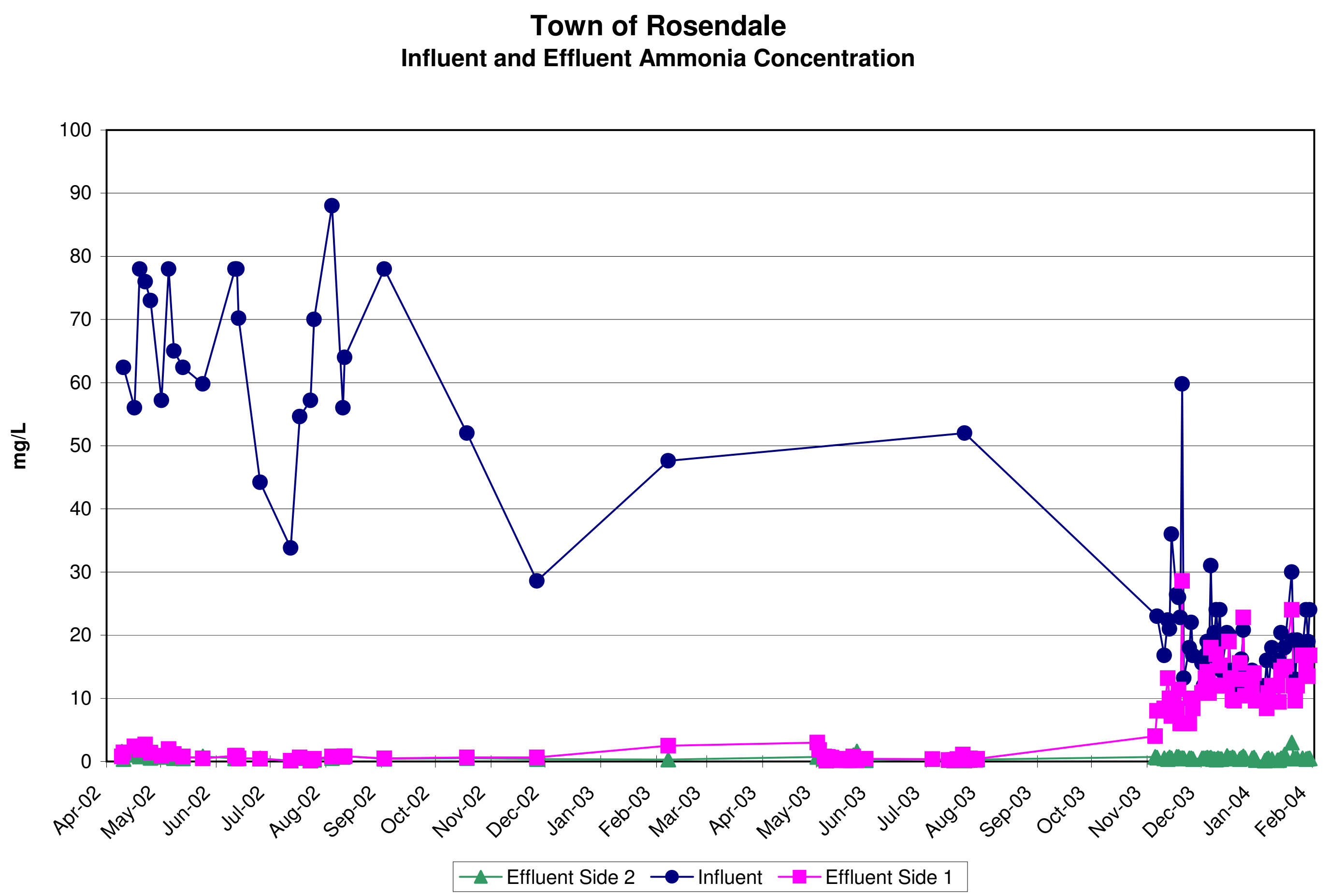


from DMR data

Town of Rosendale
Influent and Effluent pH

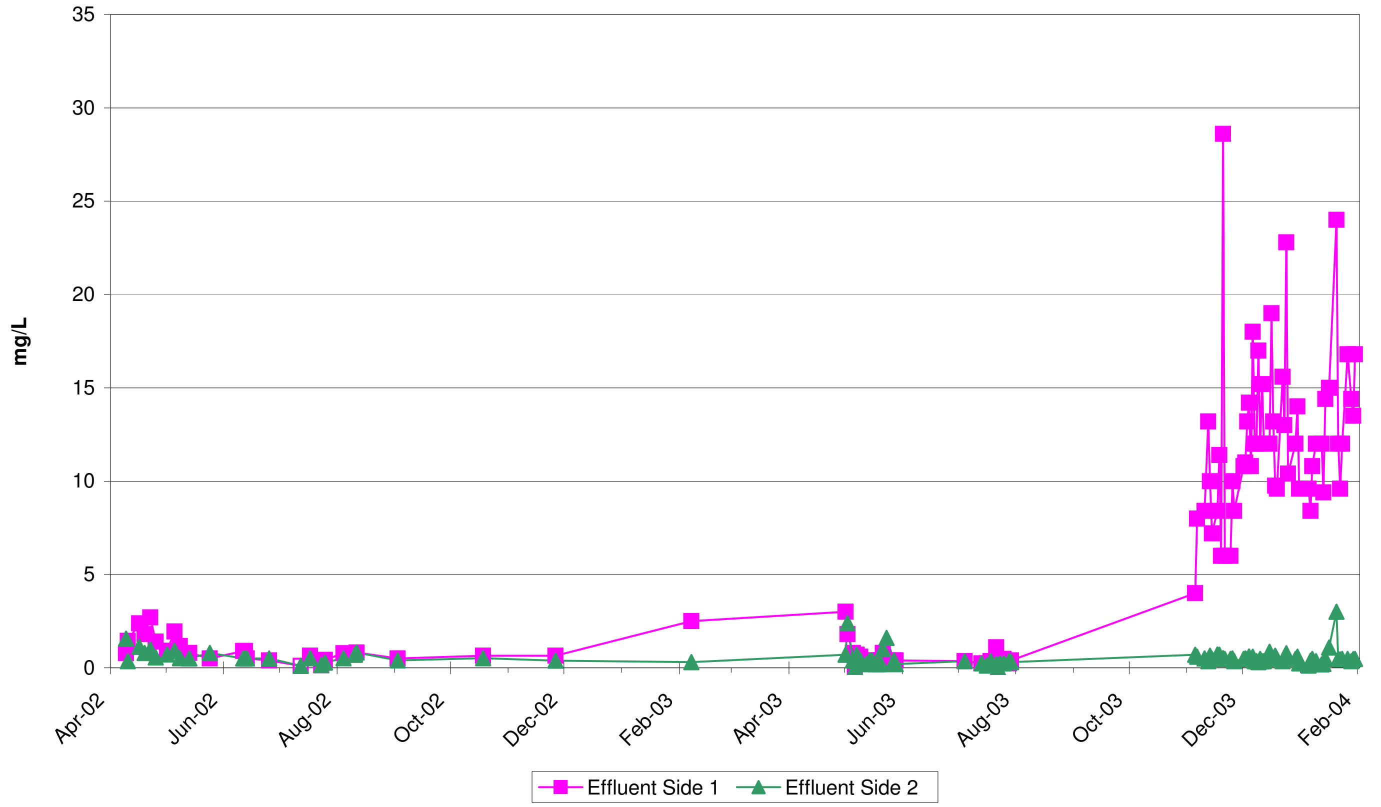


from DMT data



from DMR data

Town of Rosendale
Effluent Ammonia Concentration



from DMR data

APPENDIX B

Demonstration Data

November 1, 2003 through January 31, 2004

Date	Side #1 (SCS Converted)												
	Flow MGD	Stab MLSS mg/L	Contact MLSS mg/L	RAS TSS mg/L	WAS Flow gpd	sludge depth ft	Selector F:M lb BOD/lb MLSS/d	Contact F:M lb BOD/lb MLSS/d	MLSS Inventory lb	MCRT day	RAS Flow MGD	SOR gpd/ft2	SLR lb/ft2/d
1-Nov-03													
2-Nov-03													
3-Nov-03	0.0443	4,660	1,890	5,510	1,400	6.0			1,307	19.0	0.0432	308	9.6
4-Nov-03													
5-Nov-03	0.0451	4,600	1,500	5,510	1,400		2.06	0.75	1,255	18.3	0.0326	313	6.7
6-Nov-03													
7-Nov-03	0.0420	4,300	1,800	5,250	890	4.0			1,211	28.5	0.0326	292	7.8
8-Nov-03													
9-Nov-03													
10-Nov-03	0.0422	4,080	1,560	5,870		3.5			1,135		0.0326	293	6.8
11-Nov-03													
12-Nov-03	0.0394	4,440	2,260	4,570	1,414	5.0	0.90	0.33	1,289	21.9	0.0326	274	9.4
13-Nov-03													
14-Nov-03	0.0377	4,260	1,960	5,870	1,669	4.0			1,217	13.8	0.0326	262	8.0
15-Nov-03													
16-Nov-03													
17-Nov-03	0.0352	4,260	2,130	5,710	1,400				1,233	17.7	0.0317	244	8.3
18-Nov-03													
19-Nov-03	0.0584	3,940	2,510	3,710	1,600	4.0	1.65	0.60	1,193	21.0	0.0324	406	13.2
20-Nov-03													
21-Nov-03	0.0539	3,570	1,740	4,460	1,750	3.0			1,029	14.7	0.0324	374	8.7
22-Nov-03													
23-Nov-03													
24-Nov-03	0.0504	4,060	1,770	5,080	1,420	4.0			1,150	18.0	0.0340	350	8.7
25-Nov-03													
26-Nov-03	0.0504	4,060	1,220	5,290	1,642	2.0	1.80	0.66	1,097	14.0	0.0264	350	5.4
27-Nov-03													
28-Nov-03													
29-Nov-03													
30-Nov-03													
1-Dec-03	0.0621	4,450	1,260	4,670	1,420	2.5			1,195	18.9	0.0264	431	6.5
2-Dec-03													
3-Dec-03	0.0597	4,120	1,290	5,650	1,605	4.0	2.16	0.79	1,119	13.2	0.0265	415	6.4
4-Dec-03													
5-Dec-03	0.0599	4,060	1,540	5,610		4.5			1,128		0.0265	416	7.7
6-Dec-03													
7-Dec-03													
8-Dec-03	0.0579	4,770	1,470	6,330	658	3.5			1,293	30.4	0.0265	402	7.2
9-Dec-03													
10-Dec-03	0.0500	3,910	1,750	5,030	1,182	4.0	1.62	0.59	1,112	21.0	0.0269	347	7.8
11-Dec-03													
12-Dec-03	0.0660	4,170	1,350	6,230	1,386	3.0			1,136	13.8	0.0265	458	7.2
13-Dec-03													
14-Dec-03													
15-Dec-03	0.0749	4,190	1,600	4,650	650	3.0			1,165	36.3	0.0265	520	9.4
16-Dec-03													
17-Dec-03	0.0993	5,040	1,640	6,790	1,350	5.0			1,374	15.2	0.0265	690	11.9
18-Dec-03													
19-Dec-03	0.0860	4,450	1,430	5,836	1,311	4.0			1,212	15.9	0.0265	597	9.3
20-Dec-03													
21-Dec-03													
22-Dec-03	0.0699	5,070	1,600	5,760	1,420	5.0			1,378	17.2	0.0265	485	8.9

							Side #1 (SCS Converted)						
Date	Flow	Stab MLSS	Contact MLSS	RAS TSS	WAS Flow	sludge depth	Selector F:M	Contact F:M	MLSS Inventory	MCRT	RAS Flow	SOR	SLR
	MGD	mg/L	mg/L	mg/L	gpd	ft	lb BOD/lb MLSS/d	lb BOD/lb MLSS/d	lb	day	MGD	gpd/ft2	lb/ft2/d
23-Dec-03													
24-Dec-03	0.1361	5,530	1,660	5,560		7.0			1,494		0.0265	945	15.6
25-Dec-03													
26-Dec-03													
27-Dec-03													
28-Dec-03													
29-Dec-03													
30-Dec-03													
31-Dec-03													
1-Jan-04													
2-Jan-04													
3-Jan-04													
4-Jan-04													
5-Jan-04	0.0558	5,360	1,250	5,580	2,040	6.0			1,414	13.7	0.0265	388	6.0
6-Jan-04													
7-Jan-04	0.0557	4,980	1,500	4,920	1,842	7.0	1.96	0.72	1,346	16.4	0.0265	387	7.1
8-Jan-04													
9-Jan-04	0.0552	5,050	1,220	6,250	1,920	5.0			1,336	12.6	0.0265	383	5.8
10-Jan-04													
11-Jan-04													
12-Jan-04	0.0589	5,500	1,810	6,150	1,810	7.0			1,502	15.4	0.0265	409	8.9
13-Jan-04													
14-Jan-04	0.0568	5,300	1,800	6,350	1,374	6.5	2.12	0.77	1,452	13.7	0.0265	394	8.7
15-Jan-04													
16-Jan-04	0.0567	4,940	1,690	5,110	2,207	6.5			1,355	13.8	0.0265	394	8.1
17-Jan-04													
18-Jan-04													
19-Jan-04													
20-Jan-04													
21-Jan-04	0.0558	5,840	2,170	6,750	2,170	6.5	1.72	0.63	1,618	12.8	0.0265	388	10.3
22-Jan-04													
23-Jan-04	0.0564	5,580	2,420	7,030	2,420	5.5			1,580	10.1	0.0265	392	11.6
24-Jan-04													
25-Jan-04													
26-Jan-04	0.0556	5,270	2,280	7,310	4,815	8.0			1,492	4.9	0.0265	386	10.8
27-Jan-04													
28-Jan-04	0.0556	5,330	2,200	6,040	2,200	6.0	1.25	0.46	1,498	12.4	0.0265	386	10.5
29-Jan-04													
30-Jan-04	0.0589	6,760	2,130	7,610	2,440	7.5			1,837	10.3	0.0265	409	10.5
31-Jan-04													
From 11/1/03 to 1/31/04													
Average	0.0589	4,724	1,739	5,698	1,694	4.9	1.72	0.63	1,308	16.8	0.0287	409	8.8
Std Dev	0.0189	693	362	854	740	1.6	0.40	0.15	180	6.3	0.0038	131	2.2
Maximum	0.1361	6,760	2,510	7,610	4,815	8.0	2.16	0.79	1,837	36.3	0.0432	945	15.6
Median	0.0558	4,600	1,690	5,650	1,510	5.0	1.76	0.64	1,289	15.3	0.0265	388	8.7
Minimum	0.0352	3,570	1,220	3,710	650	2.0	0.90	0.33	1,029	4.9	0.0264	244	5.4
Count	33	33	33	33	30	31	10	10	33	30	33	33	33

Date					Side #2 (Control)						
	Flow	MLSS	RAS TSS	WAS Flow	sludge depth	F:M	MLSS Inventory	MCRT	RAS Flow	SOR	SLR
	MGD	mg/L	mg/L	gpd	ft	lb BOD/lb MLSS/d	lb	day	MGD	gpd/ft2	lb/ft2/d
1-Nov-03											
2-Nov-03											
3-Nov-03	0.0443	2,480	4,600		8.0		838		0.112	308	22.5
4-Nov-03											
5-Nov-03	0.0451	2,790	4,610			0.08	942		0.112	313	25.4
6-Nov-03											
7-Nov-03	0.0420	4,060	10,510	1,670	8.0		1,371	9	0.112	292	36.3
8-Nov-03											
9-Nov-03											
10-Nov-03	0.0422	2,670	4,480		10.0		902		0.112	293	23.9
11-Nov-03											
12-Nov-03	0.0394	3,270	4,970	640	9.0	0.05	1,105	35	0.112	274	28.7
13-Nov-03											
14-Nov-03	0.0377	3,250	5,280	320	7.0		1,098	53	0.112	262	28.2
15-Nov-03											
16-Nov-03											
17-Nov-03	0.0352	3,330	5,050	320	9.0		1,125	52	0.112	244	28.5
18-Nov-03											
19-Nov-03	0.0584	3,660	4,210		10.0	0.09	1,236		0.112	406	36.2
20-Nov-03											
21-Nov-03	0.0539	3,630	5,170		9.0		1,226		0.112	374	34.9
22-Nov-03											
23-Nov-03											
24-Nov-03	0.0504	3,650	5,280	320	10.0		1,233	67	0.112	350	34.4
25-Nov-03											
26-Nov-03	0.0412	4,010	3,970		10.0	0.03	1,354		0.112	286	35.7
27-Nov-03											
28-Nov-03											
29-Nov-03											
30-Nov-03											
1-Dec-03	0.0435	4,210	6,470	200	11.0		1,422	90	0.112	302	38.0
2-Dec-03											
3-Dec-03	0.0398	4,330	6,640		10.0	0.03	1,463		0.112	276	38.1
4-Dec-03											
5-Dec-03	0.0399	4,540	6,030		11.0		1,533		0.112	277	40.0
6-Dec-03											
7-Dec-03											
8-Dec-03	0.0312	4,690	6,940		11.0		1,584		0.112	217	39.0
9-Dec-03											
10-Dec-03	0.0306	4,790	6,660	960	11.0	0.03	1,618	28	0.112	213	39.6
11-Dec-03											
12-Dec-03	0.0422	4,310	6,040		12.0		1,456		0.112	293	38.6
13-Dec-03											
14-Dec-03											
15-Dec-03	0.0309	3,870	5,750		12.0		1,307		0.112	215	32.1
16-Dec-03											
17-Dec-03	0.0555	4,010	5,360	960	12.0		1,354	18	0.112	385	39.0
18-Dec-03											
19-Dec-03	0.0372	3,840	4,700		8.0		1,297		0.112	258	33.3
20-Dec-03											
21-Dec-03											
22-Dec-03	0.0365	3,170	4,640	640	7.0		1,071	35	0.112	253	27.3

Date					Side #2 (Control)						
	Flow	MLSS	RAS TSS	WAS Flow	sludge depth	F:M	MLSS Inventory	MCRT	RAS Flow	SOR	SLR
	MGD	mg/L	mg/L	gpd	ft	lb BOD/lb MLSS/d	lb	day	MGD	gpd/ft2	lb/ft2/d
23-Dec-03											
24-Dec-03	0.0823	3,800	3,200		8.0		1,284		0.112	572	42.8
25-Dec-03											
26-Dec-03											
27-Dec-03											
28-Dec-03											
29-Dec-03											
30-Dec-03											
31-Dec-03											
1-Jan-04											
2-Jan-04											
3-Jan-04											
4-Jan-04											
5-Jan-04	0.0516	4,280	6,240	1,371	10.0		1,446	19	0.112	358	40.6
6-Jan-04											
7-Jan-04	0.0496	4,140	5,510	352	10.0	0.05	1,398	67	0.112	344	38.8
8-Jan-04											
9-Jan-04	0.0455	4,190	6,310	850	10.0		1,415	30	0.112	316	38.3
10-Jan-04											
11-Jan-04											
12-Jan-04	0.0553	4,470	6,050		10.0		1,510		0.112	384	43.4
13-Jan-04											
14-Jan-04	0.0445	4,530	5,170	2,146	10.5	0.05	1,530	15	0.112	309	41.1
15-Jan-04											
16-Jan-04	0.0445	4,310	5,180	2,695	10.0		1,456	11	0.112	309	39.1
17-Jan-04											
18-Jan-04											
19-Jan-04											
20-Jan-04											
21-Jan-04	0.0336	3,790	4,920		8.0	0.05	1,280		0.112	233	32.0
22-Jan-04											
23-Jan-04	0.0445	3,890	5,160		9.0		1,314		0.112	309	35.3
24-Jan-04											
25-Jan-04											
26-Jan-04	0.0552	4,000	5,300		8.0		1,351		0.112	383	38.8
27-Jan-04											
28-Jan-04	0.0554	4,180	5,070	640	8.0	0.05	1,412	38	0.112	385	40.6
29-Jan-04											
30-Jan-04	0.0426	4,170	5,560	640	8.0		1,409	40	0.112	296	37.4
31-Jan-04											
From 11/1/03 to 1											
Average	0.0449	3,888	5,486	920	9.5	0.05	1,313	38	0.112	312	35.4
Std Dev	0.0102	568	1,222	715	1.4	0.02	192	23	0.0	71	5.5
Maximum	0.0823	4,790	10,510	2,695	12.0	0.09	1,618	90	0.112	572	43.4
Median	0.0435	4,010	5,280	640	10.0	0.05	1,354	35	0.112	302	37.4
Minimum	0.0306	2,480	3,200	200	7.0	0.03	838	9	0.112	213	22.5
Count	33	33	33	16	32	10	33	16	33	33	33

Date	Dissolved Oxygen Concentration							
	#1 Stab AM	#1 Selec AM	#1 Cont AM	#2 Aer AM	#1 Stab PM	#1 Selec PM	#1 Cont PM	#2 Aer PM
1-Nov-03								
2-Nov-03								
3-Nov-03	1.41	0.06	3.55	0.98				
4-Nov-03								
5-Nov-03	1.96	0.18	4.95	0.56				
6-Nov-03								
7-Nov-03	2.26	0.09	4.82	4.54				
8-Nov-03								
9-Nov-03								
10-Nov-03	3.56	0.74	5.70	3.10				
11-Nov-03								
12-Nov-03	3.88	0.67	7.50	4.50				
13-Nov-03								
14-Nov-03	6.10	0.80	8.00	5.10				
15-Nov-03								
16-Nov-03								
17-Nov-03	5.40	1.20	6.90	2.30				
18-Nov-03								
19-Nov-03	7.10	0.50	6.60	4.10	3.60	0.30	8.40	5.60
20-Nov-03								
21-Nov-03	3.95	0.42	4.05	0.48				
22-Nov-03								
23-Nov-03								
24-Nov-03	3.86	0.97	4.68	0.67				
25-Nov-03								
26-Nov-03	3.13	0.95	6.55	4.99				
27-Nov-03								
28-Nov-03								
29-Nov-03								
30-Nov-03								
1-Dec-03	1.38	0.13	4.53	4.01	0.45	0.12	4.75	4.25
2-Dec-03								
3-Dec-03	3.61	0.55	5.44	6.35				
4-Dec-03								
5-Dec-03	3.19	0.14	4.55	6.95				
6-Dec-03								
7-Dec-03								
8-Dec-03	1.99	0.50	5.95	6.99				
9-Dec-03								
10-Dec-03	2.68	0.17	4.16	7.10				
11-Dec-03								
12-Dec-03	2.50	0.21	5.77	5.68				
13-Dec-03								
14-Dec-03								
15-Dec-03	3.44	0.13	6.55	7.50				
16-Dec-03	2.53	0.14	9.90	6.40	0.79	0.12	4.41	5.48
17-Dec-03								
18-Dec-03	3.10	0.00	5.20	5.70	2.40	0.00	2.90	4.40
19-Dec-03	0.24	0.19	4.02	3.28	0.52	0.36	1.80	2.51
20-Dec-03								
21-Dec-03								
22-Dec-03	0.22	0.15	3.60	2.44				

Date	Dissolved Oxygen Concentration							
	#1 Stab AM	#1 Selec AM	#1 Cont AM	#2 Aer AM	#1 Stab PM	#1 Selec PM	#1 Cont PM	#2 Aer PM
23-Dec-03								
24-Dec-03	0.00	0.00	2.90	2.90				
25-Dec-03								
26-Dec-03								
27-Dec-03								
28-Dec-03								
29-Dec-03								
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26-Jan-04								
27-Jan-04								
28-Jan-04								
29-Jan-04								
30-Jan-04								
31-Jan-04								
From 11/1/03 to 1								
Average	2.93	0.39	5.47	4.20	1.55	0.18	4.45	4.45
Std Dev	1.76	0.35	1.64	2.24	1.39	0.15	2.51	1.24
Maximum	7.10	1.20	9.90	7.50	3.60	0.36	8.40	5.60
Median	3.10	0.19	5.20	4.50	0.79	0.12	4.41	4.40
Minimum	0.00	0.00	2.90	0.48	0.45	0.00	1.80	2.51
Count	23	23	23	23	5	5	5	5

Date	BOD-IN mg/L	TSS-IN mg/L	NH3-IN mg/L	#1 BOD-OUT mg/L	#1 TSS-OUT mg/L	#2 BOD-OUT mg/L	#2 TSS-OUT mg/L	#1 NH3-OUT mg/L	#2 NH3-OUT mg/L
				Analytical Data					
1-Nov-03									
2-Nov-03									
3-Nov-03									
4-Nov-03									
5-Nov-03	212	106		24.7	13.6	19.3	16.4	3.6	0.7
6-Nov-03			23.0					8.0	0.6
7-Nov-03									
8-Nov-03									
9-Nov-03									
10-Nov-03			16.8					8.4	0.5
11-Nov-03									
12-Nov-03	160	156	24.0	23.8	13.1	12.5	12.4	13.2	0.4
13-Nov-03			21.0					10.0	0.7
14-Nov-03			36.0					7.2	0.5
15-Nov-03									
16-Nov-03									
17-Nov-03			26.4					8.4	0.7
18-Nov-03			26.0					11.4	0.7
19-Nov-03	220	248	22.8	20.1	11.6	13.2	18.4	6.0	0.5
20-Nov-03			59.8					28.6	0.5
21-Nov-03			13.2					6.0	0.5
22-Nov-03									
23-Nov-03									
24-Nov-03			18.0					6.0	0.5
25-Nov-03			22.0					10.0	0.5
26-Nov-03	135	188	16.8	15.0	16.6			8.4	0.4
27-Nov-03									
28-Nov-03									
29-Nov-03									
30-Nov-03									
1-Dec-03			15.6		15.0		14.0	10.8	
2-Dec-03			12.0					11.0	0.5
3-Dec-03	145	125	16.8	23.0	18.0		24.0	13.2	0.5
4-Dec-03			19.0					14.2	0.6
5-Dec-03			18.0					10.8	0.5
6-Dec-03			31.0					18.0	0.6
7-Dec-03			16.8					12.0	0.4
8-Dec-03			20.4					12.0	0.4
9-Dec-03			24.0					17.0	0.3
10-Dec-03	176	160	19.2					12.0	0.5
11-Dec-03			24.0					15.2	0.4
12-Dec-03			14.4		19.0		46.0	12.0	0.4
13-Dec-03									
14-Dec-03									
15-Dec-03			20.4		16.0		78.0	12.0	0.9
16-Dec-03			20.0					19.0	0.5
17-Dec-03			14.4		17.0		72.0	13.2	0.5
18-Dec-03			12.4					9.8	0.7
19-Dec-03			12.0		17.0		32.0	9.6	0.5
20-Dec-03									
21-Dec-03									
22-Dec-03			14.4		20.0		19.0	15.6	0.4

Date	BOD-IN mg/L	TSS-IN mg/L	NH3-IN mg/L	#1 BOD-OUT mg/L	#1 TSS-OUT mg/L	#2 BOD-OUT mg/L	#2 TSS-OUT mg/L	#1 NH3-OUT mg/L	#2 NH3-OUT mg/L
	Analytical Data								
23-Dec-03			16.2					13.0	0.6
24-Dec-03			20.8		17.0		20.0	22.8	0.8
25-Dec-03			11.7					10.4	0.5
26-Dec-03									
27-Dec-03									
28-Dec-03									
29-Dec-03			14.4					12.0	0.5
30-Dec-03			13.0					14.0	0.6
31-Dec-03			9.6		7.0		7.0	9.6	0.2
1-Jan-04									
2-Jan-04									
3-Jan-04									
4-Jan-04									
5-Jan-04			12.0					9.6	0.1
6-Jan-04			16.0					8.4	0.4
7-Jan-04	164	112	11.4		15.2		14.6	10.8	0.5
8-Jan-04									
9-Jan-04			18.0					12.0	0.4
10-Jan-04									
11-Jan-04									
12-Jan-04			15.6					12.0	0.2
13-Jan-04			16.0					9.4	0.2
14-Jan-04	208	156	20.4	30.4	17.3	19.1	25.2	14.4	0.5
15-Jan-04									
16-Jan-04			18.0					15.0	1.1
17-Jan-04									
18-Jan-04									
19-Jan-04									
20-Jan-04			30.0					24.0	3.0
21-Jan-04	207	153	19.2	12.9	15.2	21.7	14.6	12.0	0.5
22-Jan-04			18.0					9.6	0.5
23-Jan-04			19.2					12.0	0.5
24-Jan-04									
25-Jan-04									
26-Jan-04			18.0					16.8	0.5
27-Jan-04									
28-Jan-04	153	153	24.0		20.2		46.4	14.4	0.4
29-Jan-04			19.0					13.5	0.5
30-Jan-04			24.0					16.8	0.5
31-Jan-04									
From 11/1/03 to 1									
Average	178	156	19.5	21.4	15.8	17.2	28.8	12.3	0.5
Std Dev	31	41	7.7	6.0	3.2	4.1	21.2	4.5	0.4
Maximum	220	248	59.8	30.4	20.2	21.7	78.0	28.6	3.0
Median	170	155	18.0	23.0	16.6	19.1	19.5	12.0	0.5
Minimum	135	106	9.6	12.9	7.0	12.5	7.0	3.6	0.1
Count	10	10	53	7	17	5	16	54	53

Date	Loads							
	BOD-IN lb/d	#1 BOD-OUT lb/d	#2 BOD-OUT lb/d	TSS-IN lb/d	#1 TSS-OUT lb/d	#2 TSS-OUT lb/d	#1 WAS lb/d	#2 WAS lb/d
1-Nov-03								
2-Nov-03								
3-Nov-03							64.3	
4-Nov-03								
5-Nov-03	79.7	9.29	7.26	39.9	5.11	6.17	64.3	
6-Nov-03								
7-Nov-03							39.0	146.4
8-Nov-03								
9-Nov-03								
10-Nov-03								
11-Nov-03								
12-Nov-03	52.6	7.82	4.11	51.3	4.30	4.07	53.9	26.5
13-Nov-03								
14-Nov-03							81.7	14.1
15-Nov-03								
16-Nov-03								
17-Nov-03							66.7	13.5
18-Nov-03								
19-Nov-03	107.2	9.79	6.43	120.8	5.65	8.96	49.5	
20-Nov-03								
21-Nov-03							65.1	
22-Nov-03								
23-Nov-03								
24-Nov-03							60.2	14.1
25-Nov-03								
26-Nov-03	56.7	6.31		79.0	6.98		72.4	
27-Nov-03								
28-Nov-03								
29-Nov-03								
30-Nov-03								
1-Dec-03					7.77	7.25	55.3	10.8
2-Dec-03								
3-Dec-03	72.2	11.45		62.2	8.96	11.95	75.6	
4-Dec-03								
5-Dec-03								
6-Dec-03								
7-Dec-03								
8-Dec-03							34.7	
9-Dec-03								
10-Dec-03	73.4			66.7			49.6	53.3
11-Dec-03								
12-Dec-03					10.46	25.32	72.0	
13-Dec-03								
14-Dec-03								
15-Dec-03					9.99	48.72	25.2	
16-Dec-03								
17-Dec-03					14.08	59.63	76.4	42.9
18-Dec-03								
19-Dec-03					12.19	22.95	63.8	
20-Dec-03								
21-Dec-03								
22-Dec-03					11.66	11.08	68.2	24.8

Date	Loads BOD-IN lb/d	#1 BOD-OUT lb/d	#2 BOD-OUT lb/d	TSS-IN lb/d	#1 TSS-OUT lb/d	#2 TSS-OUT lb/d	#1 WAS lb/d	#2 WAS lb/d
23-Dec-03								
24-Dec-03					19.30	22.70		
25-Dec-03								
26-Dec-03								
27-Dec-03								
28-Dec-03								
29-Dec-03								
30-Dec-03								
31-Dec-03								
1-Jan-04								
2-Jan-04								
3-Jan-04								
4-Jan-04								
5-Jan-04							94.9	71.3
6-Jan-04								
7-Jan-04	76.2			52.0	7.06	6.78	75.6	16.2
8-Jan-04								
9-Jan-04							100.1	44.7
10-Jan-04								
11-Jan-04								
12-Jan-04							92.8	
13-Jan-04								
14-Jan-04	98.5	14.40	9.05	73.9	8.20	11.94	72.8	92.5
15-Jan-04								
16-Jan-04							94.1	116.4
17-Jan-04								
18-Jan-04								
19-Jan-04								
20-Jan-04								
21-Jan-04	96.3	6.00	10.10	71.2	7.07	6.79	122.2	
22-Jan-04								
23-Jan-04							141.9	
24-Jan-04								
25-Jan-04								
26-Jan-04							293.5	
27-Jan-04								
28-Jan-04	70.9			70.9	9.37	21.52	110.8	27.1
29-Jan-04								
30-Jan-04							154.9	29.7
31-Jan-04								
From 11/1/03 to								
Average	78.4	9.29	7.39	68.8	9.26	18.39	83.1	46.5
Std Dev	17.7	2.97	2.33	21.9	3.77	16.24	49.2	40.5
Maximum	107.2	14.40	10.10	120.8	19.30	59.63	293.5	146.4
Median	74.8	9.29	7.26	68.8	8.58	11.94	72.2	28.4
Minimum	52.6	6.00	4.11	39.9	4.30	4.07	25.2	10.8
Count	10	7	5	10	16	15	30	16

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Full-Scale Demonstration of Selector-Contact Stabilization Process at Town of Rosendale Wastewater Treatment Plant Ulster County, New York

Final Report 05-07

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