FINAL REPORT

FOR THE

GROWING GREENER INNOVATIVE TECHNOLOGY GRANT

GREGG TOWNSHIP MUNICIPAL AUTHORITY
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PART I

PROJECT SUMMARY/OVERVIEW

Like all treatment plants, the oxygen demand varies greatly over the course of the day at the Gregg Township Treatment Facility. This is mainly caused by fluctuations in the influent wastewater strength and volume. Of particular concern is the fact that there were times during the day of high oxygen demand and very little demand overnight. The main contributors to the Gregg Township Treatment Facility are three (3) Federal Prisons whose wastewater strength fluctuated over a twenty-four (24) hour period.

The projects goals were to satisfy the oxygen demand at all times during the day and night, promote BOD_5, nitrogen, phosphorus removal and to minimize peak electric usage demand charges.

PART II

WATER/WASTEWATER CHARACTERISTICS AND FLOW

Influent

	Design	Present Monthly Average	Present Monthly Maximum
Flow MGD	0.980	0.674	0.712
BOD5 mg/l	500	327	416
TSS mg/l	400	347	404
Ph	6-8	6.7	7.1
TKN mg/l	50	35	55
Total P mg/l	na	5.3	8.0

Effluent:	Permit	Present Monthly Average	Present Monthly Maximum
BOD5 mg/l	25	3.6	6.2
lbs /day	205	20.8	32
TSS mg/l	30	3.2	12.8
lbs/day	245	17.5	66
Ph	6-9	6.6	6.8
TKN mg/l	na	4.3	13.2
lbs/day		23.7	57
Total P mg/l	na	1.3	1.6
lbs/day		5.2	11
NH3 mg/l	na	2.4	9.8
lbs/day		13.2	55
Fecal C. /100	200/2000	13.5	45

The treatment plant presently receives flow from 182 residential users and 3 federal prisons.

PART III

SITE DESCRIPTION

I. Wastewater Treatment Plant General Description

A. Description

The Gregg Township Municipal Authority Wastewater Treatment Plant (WWTP) provides the Village of Allenwood and the Allenwood Federal Correctional Complex (FCC) with centralized treatment of wastewater. The WWTP was permitted at a design loading for BOD of 500 mg/l at a design flow of 0.8 mgd. Based on the plant's performance as a result of system upgrades and lower BOD concentrations of 336 mg/l a rerating of 0.98 mgd was permitted in January 2000. The WWTP services a new system constructed in 1992. The majority of the system was constructed by the Federal Bureau of Prisons (FBOP) to service the FCC. The rerating of the WWTP permitted the continued operation of the plant within the permit level while allowing for planned growth of the area. This growth is consistent with the Township's Act 537 official sewage facilities plan utilization of the FCC reserved capacity. A major WWTP expansion project is presently being planned to accommodate additional future growth. The plant currently operates under Part I (NPDES) permit No. PA0114821 and Part II (BWQM).

The location for the treatment plant lies 500 feet south of PA Route 44, between the abandoned railroad and the West Branch of the Susquehannna River.

B. Process Summary

The process for the plant design is the sequencing batch reactor modification of the activated sludge process. The WWTP facilities consist of the following units:

UNIT	QUANTITY
Influent Pumping Station	1
Sequencing Batch Reactors (SBR)	2
Aerobic Digesters	2
Chlorine Contact Tanks	2
Sludge Holding Tank	1
Belt Filter Press	1

Main Office Building Containing:

- Board Meeting Room
- Business Offices
- Garage Bays

Control Building Containing:

- Operations Office
- Laboratory
- Mechanical Room (Blowers)
- Motor Control Center Room
- Emergency Power Generator
- Chlorine Room
- Bathroom Facilities with Shower

Belt Filter Press Building Containing:

- Belt Filter Press Bay
- Dewatered Sludge Holding Bay
- Garage Bays (2)
- Chemical Storage Area
- Workbench Area

The following is a brief description of each of the process units or buildings that make up the WWTP:

1. Influent Pumping Station

The influent pumping station is below-grade design utilizing three (3) constant speed submersible pumps of approximately 850 gpm capacity. Two (2) pumps operate simultaneously to meet the pumping demands of the peak flow condition. The pumping station provides an automatically-cleaned screening device, and a bypass to a manually-cleaned bar screen. The pumping station also contains an automatic grit chamber. Construction of the pumping station is cast-in-place concrete.

2. Sequencing Batch Reactors

These units are the main process units for the treatment process. There are two (2) identical units each processing one-half of the flow. The units are designed for a peak hourly flow rate of 2.5 times the average daily flow. The units are 16.5 feet deep, and of cast-in-place concrete construction. The reactor's basins are divided by baffle walls into three sections: selector zone, secondary aeration zone, and main aeration. This configuration permits the biological selector process to be used for biological nutrient removal and filamentous sludge bulking control.

3. Chlorine Contact Tanks

These units are the final step in the treatment process. These units provide contact time for the chlorine solution to disinfect the WWTP effluent prior to the discharge to the river. There are two (2) in-ground concrete tanks. These units discharge to a common outfall pipe, and the effluent is metered by a weir, to meet the PADEP monitoring requirements, prior to discharge. A submersible pump is placed in each tank to provide a non-potable plant utility water supply for wash-down and spray purposes.

4. Aerobic Digester

The aerobic digester accepts waste activated sludge from the SBR reactors and is the beginning of the treatment loop for process sludge. The solids retention time for these units is 25 days.

5. Sludge Holding Tank

This unit accepts digested sludge from the aerobic digesters and stores the sludge until transferred to the Belt Filter Press for dewatering, or removed as liquid sludge by tank truck . The tank is designed for a solids retention time of approximately 42 days.

6. Belt Filter Press

This unit provides mechanical dewatering of sludge when conditions do not permit land application of liquid sludge. This unit is located in a room designed especially for the purpose, located in the Belt Filter Press Building.

C. Basis for Process Operation

1. Headworks:

A. Influent Flow Meter
B. Grit Removal
C. Continuous self-cleaning screen
D. Influent Pump Station: 3 non-clog 850 gpm submersible (constant speed)

2. Aeration Tanks:

A. 2 tanks with a maximum volume of 561,000 gallons each.
B. 2 anoxic selectors
C. Stainless steel wide band non-clog course bubble diffusers
D. 2 submersible pumps rated at 212 gpm for waste and nitrate

return

3. Chlorine Contact Tanks

   A. 2 tanks with a volume of 65,730 gallons each
   B. 2 pumps rated at150 gpm for utility water
   C. Gas feed chlorination
   D. Effluent flow meter

4. Aerobic Digesters:

   A. 2 tanks with a volume of 190,000 gallons each
   B. 25 day retention time
   C. 2 submersible sludge transfer pumps rated at 100 gpm
   D. Course air diffusers

5. Sludge Holding Tank:|

   A. Total volume of 5000,000 gallons
   B. 42 day retention time
   C. Course air diffusers

6. Belt Filter Press

   A. 1.8 meter tower press
   B. Design 18 percent solids, average cake is 14 percent
   C. Landfill disposal

D. Nature and Volume of Waste

<u>Village of Allenwood</u>	<u>Design</u>	<u>Present</u>
Average Daily Flow	0.064 mgd	0.033
Peak Flow	2.5 x	0.050
BOD_5	250 mg/l	225 mg/l
TSS	250 mg/l	200 mg/l

<u>Federal Prison</u>		
Average Daily Flow	0.736 mgd	0.641mgd
Peak Flow	2.5 x	1.296mgd
BOD_5	425 mg/l	325 mg/l
TSS	375 mg/l	342 mg/l

<u>Total Facilities Design</u>		
BOD5 lbs/day	3700	1839
Domestic per capita flow	100/350	66/230

FBOP gal/day/inmate	250	169
Total Flow	0.98MGD	0.674MGD

E. Five Year Projected Sewage Flows

Growth Area	Gal/Day	EDUs
Great Stream Commons		
1. Business Park	10,850	31
2. Residential Park	24,150	69
FBOP	101,500	290
Township Growth	8,750	25

F. Problems and Violations

The Gregg Township Municipal Authority Wastewater Treatment Plant has not had an NPDES permit violation in the past five years. The plant does experience the normal problems with filamentous bulking an occasional FOG slug from the FBOP.

PART IV

INNOVATIVE TECHNOLOGY DESCRIPTION

1) PROCESS CONTROL SYSTEM CONFIGURATION

a) General Description

i) Gregg Township Municipal Authority's WWTP in Allenwood, PA utilizes sequencing batch reactors for the main secondary treatment process. Three 100 HP constant speed positive displacement blowers supply process air to the SBRs. The normal batch process consists of aerate, settle, decant & idle phases. The operator can adjust the timing and duration of these phases, but the focus of the project is the aerate phase of the batch cycle. Prior to this project being completed, the aeration blowers operated at full speed for the entire duration of the aerate phase, which normally was 150 minutes.

Like all treatment plants, the oxygen demand varies greatly over the course of the day, due primarily to fluctuations in the raw wastewater flow into the plant, but also because of changes in the influent strength during the day. Of particular concern is the fact that there is very little oxygen demand overnight. The primary contributor is the Allenwood Prison Complex, and they have minimal activity at night.

ii) The project added automated dissolved oxygen control for the two SBRs. The dual purposes were to reduce electricity consumption, and thereby operating costs, while improving effluent quality. A VFD was also provided for one (1) blower so its air supply can fluctuate with demand.

The blowers operate in a lead/lag/lag arrangement, with the lag blowers starting and stopping when needed. However the program is designed to minimize lag blower starts and stops, to minimize peak electric usage demand charges. For this purpose, the program is slow to start a lag blower, and quick to stop it.

One (1) dissolved oxygen probe was installed in each SBR. The DO probes send a variable signal back to the existing SBR Control System including the programmable logic controller (PLC) which controls the blowers operation.

The PLC turns the blowers on during the aerate phase of the batch cycle. The VFD-controlled blower turns on first, operating at full speed for a period of time to resuspend the mixed liquor suspended solids. After that interval the PLC ramps the VFD faster and slower as needed to modify the blower speed in response to the DO levels in the SBR being aerated. If the DO levels remain too low the PLC starts the first constant speed blower. If the DO level remains too low, after that blower has operated for a certain time period, the PLC starts the second constant speed blower.

The existing SBR process was entirely time dependent with the operator having the capability to adjust the operating times for all SBR functions. The Contractor has extended this capability to the new VFD, providing the new variable frequency drive and DO probes, modifying the SBR process controls as needed in the SBR control panel, programmable logic controller, the human-machine interface (personal computer) and the process control software, all of which are integrated to form a complete dissolved oxygen control system.

iii) Two (2) sequencing batch reactors exist to treat the raw wastewater by reducing the biochemical oxygen demand (BOD), nitrifying and denitrifying, and remove phosphorus. Each SBR is a single completely mixed concrete tank. Each SBR has a small anoxic (selector) zone built into it. The anoxic selector is unaerated. The remainder of the SBR has air diffusers in it.

Three (3) blowers are dedicated to providing air for both reactors through a common air header. Air flow to each SBR is controlled by a motor-operated butterfly valve. The SBRs normally operate at opposite points on the cycle, so one is settling or decanting while the other is aerating. However, the process can be controlled in a storm flow mode where they can both receive air at the same time. In this case both air supply valves will be open. There are also times during the cycle when neither SBR is being aerated and the blowers are shut down.

iv) One (1) installed, on-line spare blower was provided as a common spare to back up both primary SBR blowers. The SBRs have never needed all three (3) blowers running to supply air, but they can operate simultaneously if needed.

v) The two (2) existing rotary lobe positive displacement blowers supplying air to the SBRs continue in their existing function and they were physically unchanged by this Contract. They start, run and stop as commanded by the PLC. The motor starters and blower monitoring systems located in the MCC for these two (2) blowers also continues in its existing function and they were also physically unchanged by the Contract. Only the timing of the operation for these two blowers was changed under this contract.

2) PROJECT WORK COVERED BY CONTRACT

The Project provided the Authority with a dissolved Oxygen (DO) Control System by revising the existing control system, adding DO Probes and converting one 100 HP blower to Variable Speed.

The system provided the following equipment and capabilities:

a) Two (2) DO Analyzer and Sensor systems, one (1) for each SBR.

b) One (1) Motor Control Center (MCC) with a variable Frequency Drive to operate the existing 100 HP, NEMA B class motor.

c) Modification to the existing PC-based Intellution control system to integrate the DO control logic.

d) All power and control wiring, conduit, etc. To integrate the new DO system into the existing Control Panel, Power Supply and new MCC panel.

Since the modifications have been completed and put into service we have been able to determine that at numerous times during the day the treatment process was not receiving enough oxygen and during the night receiving too much. There are periods during the day that the lead blower into the process is brought up to full speed by the automatic dissolved oxygen controls and at times the lag blower will come on line to meet the oxygen demand in the SBR process tanks. There is also periods during the day that the oxygen demand from the biomass in the SBR's is low and the blower will slow down to maintain the proper oxygen levels.

This project was completed just before the winter months and we have had only six months to evaluate the effect it has had on the electrical usage in the Treatment Facility.

We will have a better understanding how the modifications affect the electrical demand on the system once we get into the hot days of summer and the oxygen demand of the process reaches its peak.

As for the objective of better nitrogen and phosphorus removal we have seen some improvement. The Gregg Treatment Facility has in the past obtained pretty good nitrogen and phosphors removal. This was mainly due to modifications that were made to the treatment process in the past. Gregg Township had installed anoxic selectors in their SBR's to control filamentous bacteria growth and enhance floc formation. The treatment system most of the time nitrified and denitrified. What was noted were periods of peaks in the amount of nitrogen in the effluent. Since the installation of the automated dissolved oxygen control system testing of the effluent has indicated that there is an improvement of total nitrogen and from the facility and we are not seeing the fluctuations of nitrogen being discharged. As for the Phosphorus we are still seeing fluctuations in the effluent samples taken during the evaluation period. (See attachments 1, 2, 3)

The environmental benefits of this project has been the improvement in the over all operation of the Gregg Township facility. The project has reduced the amount of nitrogen being discharged into the stream, improved the over all quality of the effluent, and possibly in the long term reduced power consumption. We have also seen some improvement in the percent solids being wasted to the aerobic digesters. This in turn reduces the volume being wasted to the digesters and holding tank and allows for longer stabilization.

1.01 PROCESS CONTROL SYSTEM CONFIGURATION

A. General Description

1. As stated previous, like all treatment plants, the oxygen demand varies greatly over the course of the day, due primarily to fluctuations in the raw wastewater flow into the plant, but also because of changes in the influent strength during the day. Of particular concern is the fact that there is very little oxygen demand overnight. The primary contributor is the Allenwood Prison Complex, and they have minimal activity at night.

   Oxygen demand also varies seasonally due to biological activity, with it peaking in the summer and early fall when the wastewater temperature is the highest. The GTMA can satisfy the oxygen demand during most of the year with one blower operating. During the hottest month their is a need to operate two (2) blowers.

2. Modifications: This project added automated dissolved oxygen control for the two (2) (SBR's). The dual purpose was to reduce electricity consumption, and thereby operating costs, while improving effluent quality. A VFD was provided for one blower so its air supply can fluctuate with demand.

   The blowers operate in a lead/lag/lag arrangement, with the lag blowers starting and stopping when needed. However, the program is designed to minimize lag blower starts and stops, to minimize peak electric usage demand charges. For this purpose, the program is slow to start a lag blower, and quick to stop it.

   The project furnished two dissolved oxygen probes installed, with one (1) in each SBR. The DO probes send a variable signal back to the existing SBR Control System including the programmable logic controller (PLC) which controls the blowers operation.

   The project also furnished one (1) variable frequency drive (VFD) and install it in the designated location in the Control Building. The project changed the power supply for one (1) of the blowers from the existing motor starter located in the Control Room to the new VFD.

   The project modified the operating software for the SBR Control System and for the personal computer used as the Human-Machine Interface (HMI) in order to achieve the process functionality identified in this Description of Operation.

The process control system is described in greater detail in the following sections, but in general the PLC turns the blowers on during the aerate phase of the batch cycle. The VFD-controlled blower turns on first, operating at full speed for a period of time to resuspend the mixed liquor suspended solids. After that interval the PLC ramps the VFD faster and slower as needed to modify the blower speed in response to the DO levels in the SBR being aerated. If the DO levels remain too low the PLC starts the first constant speed blower. If the DO level remains too low, after that blower has operated for a certain time period, the PLC starts the second constant speed blower.

The SBR process is entirely time dependent and the operator has the capability to adjust the operating times for all existing SBR functions. The project extended the capability to the new VFD controlled blower, and the new operating sequence for the three (3) blowers.

Control work consisted of eliminating one motor starter in the motor control center, extending power supply from the MCC to the new VFD, providing the new variable frequency drive and DO probes, modifying the SBR process controls as needed in the SBR control panel, programmable logic controller, the human-machine interface (personal computer) and the process control software, all of which are integrated to form a complete dissolved oxygen control system.

1.02 POSITIVE DISPLACEMENT BLOWERS

A. General Description

1. Two (2) Sequencing Batch reactors exist to treat the raw wastewater by reducing the biochemical oxygen demand (BOD), nitrifying and denitrifying, and remove phosphorus. Each SBR is a single completely mixed concrete tank. Each SBR has a small anoxic (selector) zone built into it. The anoxic selector is unaerated. The remainder of the SBR has air diffusers in it.

   Three (3) blowers are dedicated to providing air for both reactors through a common air header. Air flow to each SBR is controlled by a motor-operated butterfly valve. Normally the SBR’s only receive air during the aerated react phase of the Batch cycle, and the settle, decant, and idle phases of the cycle are unaerated. The two (2) SBR’s normally operate at opposite points on the cycle, so one (1) is settling or decanting while the other is aerating. However, the process can be controlled in a storm flow mode where they can both receive air at the same time. In this case both air supply valves will be open. There are also times during the cycle when neither SBR is being aerated and the blowers are shut down.

2. One (1) installed, on-line spare blower was provided as a common spare to back up both primary SBR blowers. The SBR's have never needed all three (3) blowers running to supply air, but they can operate simultaneously if needed.

B. Variable Frequency Drive

1. Under the project an AC variable frequency drive was provided to power one blower designated Sequencing Batch Reactor Blower SBR-3. It is used to vary the airflow rate that blower discharges to the reactors. All three (3) are rotary lobe positive displacement blowers, so the air flow rate is directly proportional to the blower speed.

C. Sequencing Batch Reactor Blowers SBR-1 and SBR-2 Motor Controls

1. The two (2) existing rotary lobe positive displacement blowers supplying air to the SBR's continue in their existing function and they were physically unchanged by this project. They start, run and stop as commanded by the PLC. The motor starters and blower monitoring systems located in the MCC for these two (2) blowers also continue in their existing function and they were also physically unchanged by the project. Only the timing of the operation for these two (2) blowers was changed during the project.

D. Description of Operation – SBR Blowers

1. The three (3) SBR blowers are controlled by their respective H/O/A switches located on the MCC and VFD. The "hand" and "off" positions of each H/O/A switch provide manual start/stop control of the blowers. When the H/O/A switches are in the "auto" position, the SBR blowers are automatically controlled by [the programmable controller (the PLC)] as the primary control and by [the DO probe in SBR being aerated] as the secondary control:

   a. The project reprogrammed the PLC so it continuously monitors the DO in both SBR's as measured by the DO probes. The project reconfigured the process monitoring software graphic to display both DO values on the HMI monitor.

b. The PLC controls the phases of the cycle in each SBR. When the aerate phase begins in a SBR, the project reprogrammed the PLC so it starts the variable frequency drive for blower SBR-3 and it opens the air supply valve to that SBR. The VFD starts the blower at 100% full speed, and it operates for an interval at full speed. The blower operates at full speed for a time so the air being diffused into the SBR is re-suspending the mixed liquor solids that have settled out during the settle, decant and idle phases of the batch.

c. In reprogramming the process control system the project gave the operator the capability of adjusting, through either the HMI or the PLC, the time duration of this interval and all other intervals noted in this specification. Likewise, the project provided the operator the means to vary the percentage increase or decrease in blower speed and utilize a 24-hour clock to provide adjustable Day/Night operational modes. For the initial process control system set-up, the operator can set this interval at 15 minutes, and he can also set the other intervals listed below for the number of minutes and percentages listed in the specification.

    1) In Night Mode, the SBR-3 blower will automatically decrease to 50% speed (adjustable parameter) following the initial full speed start-up. The system waits 10 minutes after decreasing speed before performing DO readings.

d. The project configures a DO control loop in the programmable controller to manage the dissolved oxygen level in the SBR. The project configures a graphic display of the controller faceplate in the process monitoring software. The plant operator can enter into the computer the desired DO concentration setpoint to be maintained in the batch reactor.

   The value entered will be the DO setpoint for the control loop.

e. The programmable controller compares the DO reading to the DO setpoint concentration and output a 4-20mA positioning signal to the variable frequency drive for blower SBR-3 to increase or decrease the amount of air discharged by the blower(s) as required to meet the DO setpoint. This DO setpoint has a pre-defined operating range of +/- 0.1 mg/l.

f. A graphic display of the SBR blowers exists in the process monitoring software for display on the HMI. The project modified the display to allow the plant operator to select either blower SBR-1 or SBR-2 as the first lag SBR blower or select automatic alternation of the first lag blower. Based on which blower is selected as the first lag blower the other blower automatically becomes the second lag SBR blower

g. When blower SBR-3 is running in order to meet the oxygen demand (in the reactor operating in the aerate phase), its variable frequency drive increases and decreases the blower speed as needed to maintain the DO level at the DO setpoint input by the operator.

   1) In Night Mode, the SBR-3 blower automatically decreases to 50% speed (adjustable parameter) following the initial full speed start-up. The system waits 10 minutes after decreasing speed before checking DO readings.

h. If the DO reading is too high after [the initial phase when blower SBR-3 operates at full speed], the programmable controller reduces the blower's speed by 10%.

i. If the DO reading is too low after the initial phase the PLC starts the lag blower, and it reduces blower SBR-3 to its minimum speed.

j. After waiting 10 minutes, if the DO reading is still high, the programmable controller reduces blower SBR-3's speed by an additional 10%.

   This pattern, with the PLC checking the DO every 10 minutes and decreasing the blower's speed by 10%, is repeated until the DO setpoint is achieved, or until the minimum blower speed is reached.

k. When the DO setpoint is achieved the time clock will be cleared. As long as the DO reading remains at the setpoint (or within the acceptable range set by the operator) the blower speed remains unchanged.

l. If the DO level rises above the setpoint, the PLC starts an internal time clock. After waiting 10 minutes, if the DO reading still is too high, the programmable controller reduces blower SBR-3's speed by 10%. This cycle, described in paragraph 10 will be repeated as long as necessary.

m. On the other hand, if the DO level drops below the setpoint, the PLC starts an internal time clock. After waiting 10 minutes, if the DO reading still is too low, the programmable controller increases blower SBR-3's speed by 10%. This cycle, described in paragraph 17 is repeated as long as necessary.

n. If the DO reading remains too high for 20 minutes after blower SBR-3 has reached minimum speed, the programmable controller stops blower SBR-3 and clear the internal clock.

o. As soon as the DO drops below the setpoint, which may be some time after the blower has stopped, the PLC starts an internal time clock. If the DO reading remains too low for 20 minutes after it drops below the setpoint the programmable controller re-starts blower SBR-3 at 70% of full speed.

   1) In Night Mode, the SBR-3 blower re-starts at 50% speed.

p. After waiting 10 minutes, if the DO reading still is too low, the programmable controller increases blower SBR-3's speed by 10%.

q. After waiting 10 minutes, if the DO reading still is too low, the programmable controller increases blower SBR-3's speed by another 10%. This pattern, with the PLC checking the DO every 10 minutes and increasing the blower's speed by 10%, is repeated until the DO setpoint is achieved, or until the maximum blower speed is reached.

r. If the DO reading remains too low for 20 minutes after blower SBR-3 has reached full speed, the programmable controller starts the lag blower, and it reduces blower SBR-3 to its minimum speed.

s. When two (2) blowers are running in order to meet the oxygen demand in the reactors, as indicated by the DO readings, the lag blower operates at full speed. The variable frequency drive for the lead blower increases and decreases its speed as needed to maintain the DO levels at the setpoint. Blower SBR-3 operates as described above under the single blower operation.

t. If the DO reading remains too high for 20 minutes after the lead blower has reached minimum speed, the programmable controller stops the lag blower and increases blower SBR-3 to 70% of full speed. Normal single blower operation as described above resumes.

    1) In Night Mode, the SBR-3 blower increases to 50% speed.

u. With two (2) blowers running, if the DO reading remains too low for one-half hour after the lead blower has reached full speed, the programmable controller starts the second lag blower, and it reduces blower SBR-3 to its minimum speed.

v. When three (3) blowers are running in order to meet the oxygen demand in the reactors, as indicated by the DO readings, blowers SBR-1 and SBR-2 operates at full speed.

    The variable frequency drive for blower SBR-3 increases and decrease its speed as needed to maintain the DO levels at the DO setpoint. Blower SBR-3 operates as described above under the single blower operation.

w. If the DO reading remains too high for 20 minutes after blower SBR-3 has reached minimum speed, the programmable controller stops the second lag blower and it increases blower SBR-3 to 70% of full speed. Normal two blower operation as described above will resume.

x. When three (3) blowers are running, if the DO reading remains too low for one-half hour after blower SBR-3 has reached full speed, the programmable controller sends out a low DO alarm.

y. The SBR's can be operated with both SBR's operating at the same time in the aerate phase. In cases such as this, both SBR air supply valves are open. The PLC designates the SBR that first entered the aerate phase as the primary SBR. If both SBR's begin the aerate phase simultaneously, the northern SBR is designated as the primary SBR. When both SBR's are aerating, the DO probe in the primary SBR controls the blowers' operation.

z. If the secondary SBR begins the aerate phase after the primary SBR the PLC increase blower SBR-3 to 100% full speed and operate at full speed for 15 minutes. After that time the blower operation is regulated by the DO probe in the primary SBR until that unit ends its aerate phase.

aa. When the aerate phase ends for the primary SBR, the PLC checks if the secondary SBR is in its aerate phase. If so the PLC tags that SBR as the primary unit, and the DO probe in the primary SBR controls the blowers operation.

bb. After the aerate phase has ended in the primary reactor, or in both reactors if they are on the same time cycle, the programmable controller stops all blowers. The blowers do not operate until the next aerate phase begins.

2. The Contractor project modified the programmable controller to provide failure monitoring for each SBR blower as follows:

    a. When a blower H/O/A switch is in the “auto” position and the blower gets a signal to start, a failure timer in the programmable controller is started. If this timer times out and the motor starter is not energized, a “SBR blower failure” alarm will be generated.

3. If either SBR blower SBR-1 or SBR-2 is taken out of “auto”, or experiences a failure or shutdown alarm, the programmable controller designates the remaining constant speed SBR blower as the lag blower. The lead and lag blower operates as described in the paragraphs above The blower that has been switched to hand operation is locked out of the blower sequence until it is placed back into “auto”, or until its alarm condition is cleared.

    a. In this case when two (2) blowers are running, if the DO reading remains too low for one-half hour after blower SBR-3 has reached full speed, the programmable controller sends out a low DO alarm.

4. If blower SBR-3 is taken out of “auto”, or experiences a failure or shutdown alarm, the programmable controller designates blower SBR-2 as the lead blower. Blower SBR-3 is locked out of the blower sequence until it is placed back into “auto”, or until its alarm condition is cleared. The two (2) constant speed blowers will cycle on and off in response to dissolved oxygen demand.

a. The PLC controls the phases of the cycle in each SBR. When the aerate phase begins in an SBR, the project reprogrammed the PLC so it starts the designated lead blower and it opens the air supply valve to that SBR.

b. So long as the DO is at or below the setpoint the lead blower shall continue operating.

c. If the DO level rises above the setpoint, the PLC starts an internal time clock. After 30 minutes, if the DO reading still is too high, the programmable controller shuts the lead blower off. However, if the DO drops to the setpoint at any time during this interval, the time clock resets to zero.

d. On the other hand, if the DO reading fails to reach the setpoint within 30 minutes of the lead blower starting, the PLC starts the lag blower.

e. If the DO level rises above the setpoint with both blowers operating, the PLC starts an internal time clock. After waiting 20 minutes, if the DO reading still is too high, the programmable controller shuts the lag blower off. The DO control cycle then resets at Step 3 listed above.

E. SBR Blower Alarms

1. The following alarm messages for the SBR blower alarms are displayed on the HMI and printed on the printer connected to the HMI:

a. SBR Blower No. SBR-1 Failure
b. SBR Blower No. SBR-1 Overload
c. SBR Blower No. SBR-2 Failure
d. SBR Blower No. SBR-2 Overload
e. SBR Blower No. SBR-3 Failure
f. SBR Blower No. SBR-3 Overload
g. SBR No. 1 Air Supply Valve Failed to Open
h. SBR No. 1 Air Supply Valve Failed to Close
i. SBR No. 2 Air Supply Valve Failed to Open
j. SBR No. 2 Air Supply Valve Failed to Close
k. SBR No. 1 DO Probe Fault
l. SBR No. 2 DO Probe Fault
m. SBR No. 1 DO Probe High DO Failure
n. SBR No. 2 DO Probe High DO Failure

1.03 SBR DISSOLVED OXYGEN MONITORING

A. General Description

1. A dissolved oxygen DO probe was provided in Sequencing Batch Reactors No. 1 and No. 2.

2. Each DO probe is utilized to monitor the dissolved oxygen content of the mixed liquor, and to provide for automatic control of the SBR blowers as described in Section B.

3. Each DO probe is wired to a DO transmitter which is backboard mounted adjacent to the probe. The DO transmitters indicate the DO in the SBR and outputs a 4-20mA analog signal proportional to the DO to PLC I/O Cabinet. The DO signals is utilized by the programmable controller in the control algorithm for the SBR blowers.

4. The DO transmitter monitors the DO probes for faults and send an alarm condition if any are detected. If the DO transmitter detects a fault the running status for the blowers (on/off for all three and speed of blower SBR-3) remains at the same operating condition that existed before the fault occurred.

5. The Plant Control System indicates and records the DO in each reactor.

1.04 SBR Air Supply Valves

A. General Description

1. The two (2) air supply valves for the SBR’s continue in their existing function unchanged by the project. They open and close as commanded by the PLC. The Valve Position Indication Limit Switches send a signal to the PLC which is relayed to the HMI, and Open and Closed Position Indication Symbols are constantly displayed on the monitor.

PART V

OPERATIONAL CONDITIONS FOR INNOVATIVE TECHNOLOGY

Operating conditions for this project is totally dependent on the oxygen requirements of the treatment process. Oxygen levels are set by the operator in order to maintain a predetermined oxygen level in the process tanks. The computer monitors the DO levels and makes the necessary changes to maintain those levels.

As an example if a sudden increase in the organic loading into the process tanks creates an increase in the oxygen demand the computer program would slowly increase the blower speed until the demand is met. (See part IV for description of process control)

There is very little maintenance required for this installation. Maintenance tasks consist of an inspection and cleaning if required of the DO controller every 90 days and replacement of the sensor cap annually.

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PART VI

MONITORING AND SAMPLING PLAN FOR INNOVATION TECHNOLOGY PROCESS

At the start-up of the project samples were collected of the Influent and Effluent for the following parameters and frequency.

BOD5	weekly
TSS	weekly
TKN	monthly
NH3	monthly
Total P	monthly
Nitrate	monthly
Nitrite	monthly

April 2004 sampling and analysis was increased to once per week for all parameters.

Influent and Effluent samples are collected by Isco refrigerated composite samplers. All samples are flow proportional.

Samples collected are analyzed in house or sent out to Wilson Testing Laboratories Inc.

The following methods were used to analysis each parameter.

BOD5	18 ed. SM5210 B
TSS	EPA 160.2
TKN	EPA 351.3
NH3	18ed. SM4500E
Total P	EPA 365.1
Nitrate	EPA 353.2
Nitrite	EPA 353.2

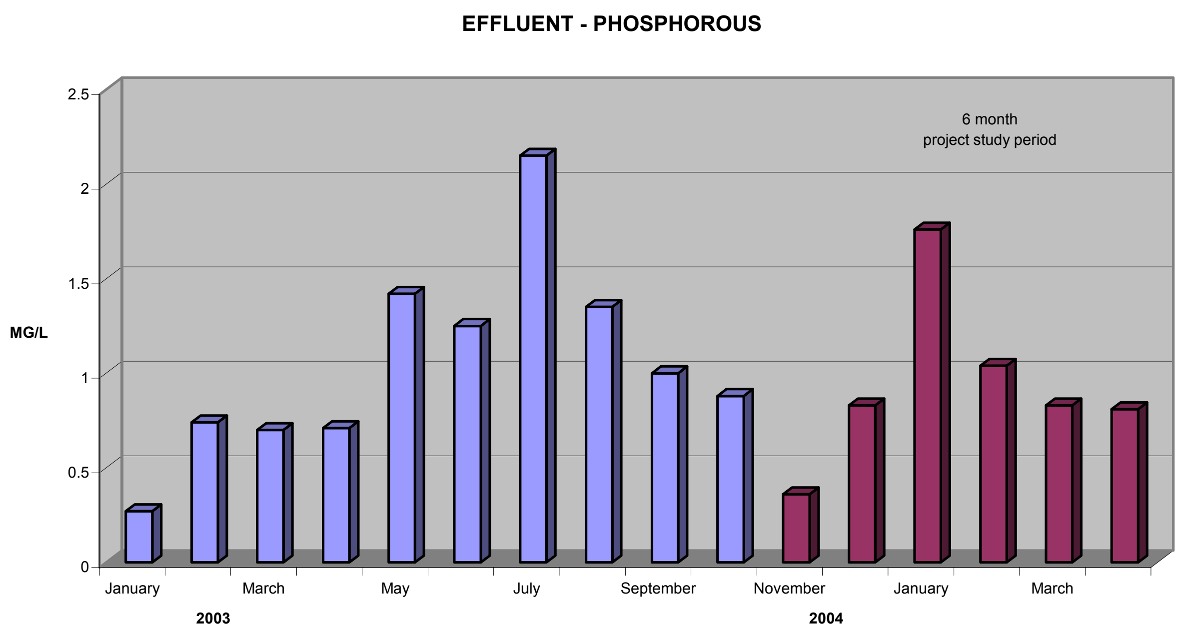
PART VII

ANALYTICAL RESULTS

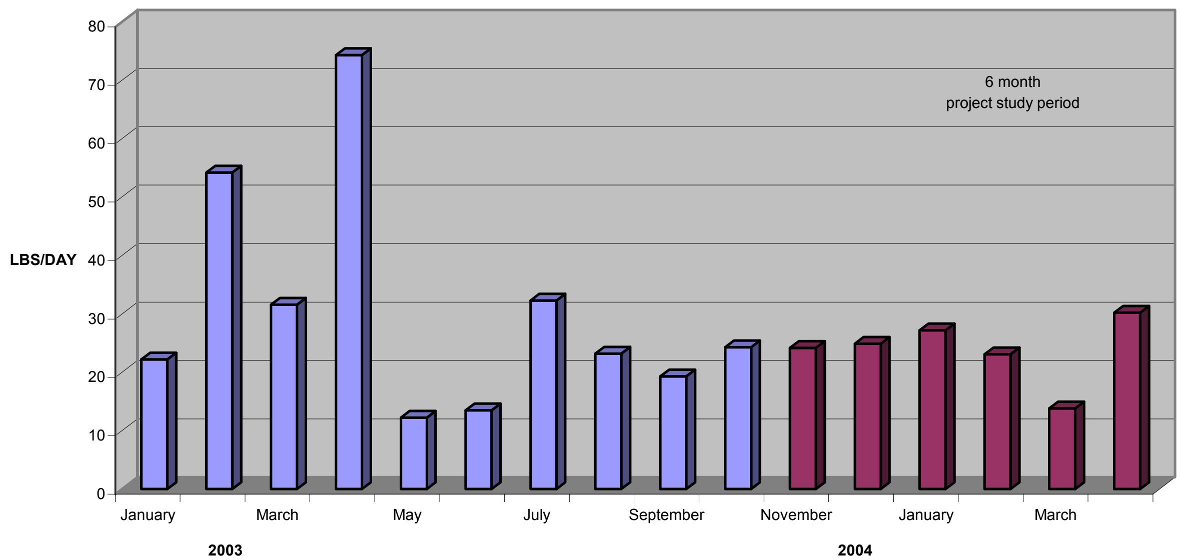
Sampling of the treatment effluent since the installation of the innovative technology process has shown some improvement in the ability of the treatment process to remove total nitrogen. As stated earlier in this report the treatment process has in the past obtained some nitrogen and phosphors removal. The problem was that the results were never consistent. In the past six months since the modification were done testing has indicated a more consistent removal of total nitrogen and almost a total removal on NH3.

We haven't seen the same results with phosphorus to this point.

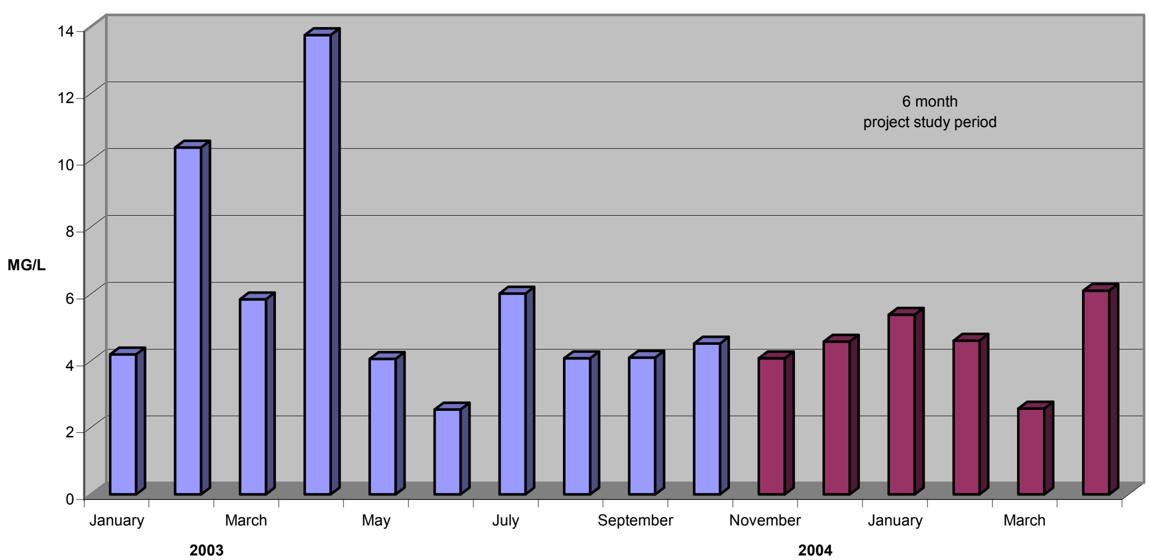
Results of the testing can be seen in the attached graphs (NH3, Total Phosphorous, Total Nitrogen lbs/day, Total Nitrogen mg/l) and Influent and Effluent Data tables.



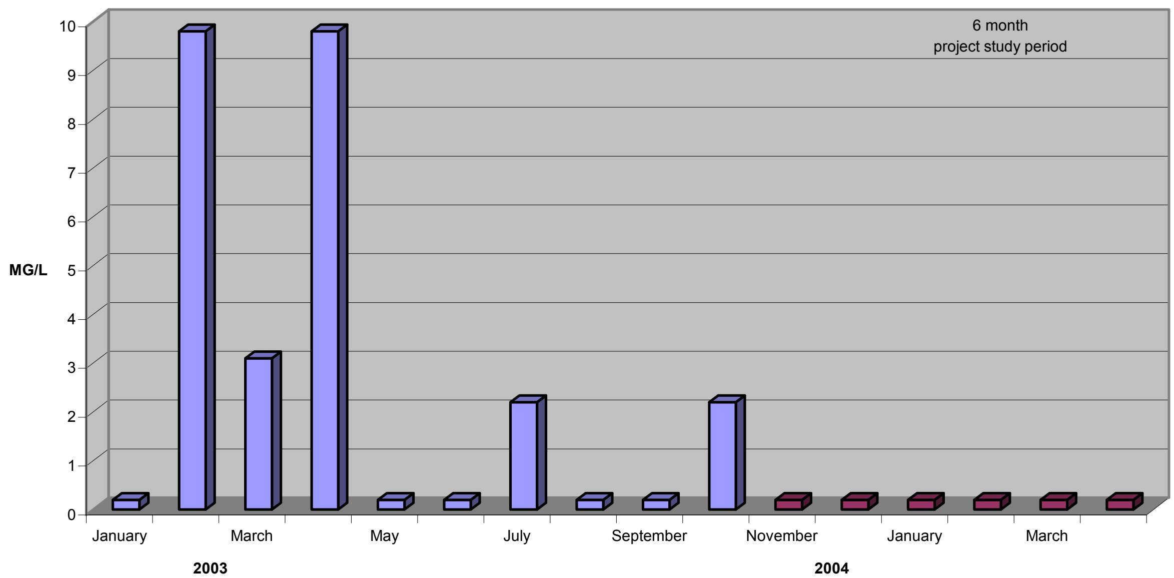
EFFLUENT - TOTAL NITROGEN (LBS/DAY)



EFFLUENT - TOTAL NITROGEN (MG/L)



EFFLUENT - NH3



GTMA Influent Data
2003-2004

	BOD5		TSS		FLOW	TKN		NH3		Total P	
2003	mg/l	lbs/day	mg/l	lbs/day	MGD	mg/l	lbs/day	mg/l	lbs/day	mg/l	lbs/day
January	307.6	1773.0	327.0	1887.0	0.689	35.3	201.0	17.1	97.0	5.3	30.0
February	338.0	1959.0	306.0	1734.0	0.679	30.5	182.0	18.5	111.0	4.5	27.0
March	276.8	1581.0	341.2	1944.0	0.704	30.2	175.0	17.0	99.0	5.1	29.0
April	307.6	1803.0	327.0	1871.0	0.692	33.6	188.0	19.6	110.0	4.5	25.0
May	349.5	1888.0	381.3	2054.0	0.660	39.5	212.0	19.6	105.0	5.4	29.0
June	308.3	1713.0	371.3	2058.0	0.672	37.6	209.0	18.8	104.0	5.4	30.0
July	340.8	1943.0	345.2	1973.0	0.673	34.5	186.0	17.4	94.0	5.8	31.0
August	357.5	2138.0	288.8	1727.0	0.712	33.0	203.0	15.4	94.5	5.4	33.0
September	332.0	1870.0	361.3	2042.0	0.674	30.5	180.0	17.6	104.0	4.4	26.0
October	325.8	1777.0	399.0	2183.0	0.647	55.2	296.0	17.5	94.0	8.1	43.0
November	333.3	1839.0	316.3	1732.0	0.636	31.4	161.0	18.2	93.0	5.1	26.1
December	330.2	1777.0	404.0	2170.0	0.646	28.2	144.0	14.1	72.0	5.2	26.7
2004											
January	328.5	1831.0	377.5	2104.0	0.670	36.7	213.0	19.3	112.0	5.5	32.0
February	334.5	1857.0	366.3	2031.0	0.660	36.7	199.0	21.0	114.0	5.9	32.0
March	353.0	2055.0	424.0	2467.0	0.693	35.2	220.0	19.0	119.0	7.5	47.0
April	287.0	1592.0	292.5	1625.0	0.663	36.4	193.1	21.0	111.4	3.9	20.9

GTMA Effluent Data
2003-2004

YEAR	TKN		NH3		TOTAL N		TOTAL P		CBOD5		TSS		PH	FECAL
	MG/L	LBS	MG/L	LBS	MG/L	LBS	MG/L	LBS	MG/L	LBS	MG/L	LBS		COLIFORM
2003														
January	1.4	8	0.2	1	4.19	22.2	0.27	1.5	4	22	1	7	6.7	10/100
February	9.8	57	9.8	57	10.38	54.2	0.74	4	3.4	18.8	1.9	10.5	6.6	10/100
March	5.1	28	3.1	17	5.84	31.6	0.7	3.8	4.2	23	2.7	14	6.7	10/100
April	13.2	74	9.8	55	13.99	74.3	0.71	4	5	27	5	28	6.6	45/100
May	1.7	9	0.2	1	2.36	12.2	1.42	7	6.2	32	12.8	66	6.7	11.9/100
June	2	11	0.2	1	2.54	13.5	1.25	7	3.6	19	2.8	15	6.6	10/100
July	5	26	2.2	2.15	6.02	32.3	2.15	11	3.5	19	3.2	18	6.5	15.2/100
August	2.2	13.9	0.2	1.35	4.08	23.2	1.35	8.5	3.7	21	1.5	8.6	6.5	10/100
September	2.5	15	0.2	1	3.65	19.3	1	6	3	16.3	1.5	8.3	6.5	10/100
October	3.4	17	2.2	11	4.8	24.3	0.88	4	3.1	16	2.8	14.9	6.5	10/100
November	2.8	13.2	0.2	0.927	4.88	24.2	0.36	1.6	3.6	18.8	1.2	6.4	6.3	10/100
December	2.5	12.3	0.2	1	4.9	24.9	0.827	4	3.3	17	2	13	6.4	10/100
2004														
January	2.8	15	0.2	1.76	5.38	27.2	1.76	9.6	2.7	13.9	1.6	8.4	6.4	25/100
February	2.8	14.9	0.2	1.1	4.61	23.1	1.04	5.5	2.7	14	3	15	6.4	13/100
March	1.1	5.9	0.2	1.1	2.57	13.8	0.83	4.5	3.4	18	1.9	10.3	6.7	10/100
April	3.6	17.9	0.2	1	5.67	30.2	0.81	4.02	3.4	18.2	2	10.9	6.8	49.3/100

PART VIII

COST OF TECHNOLOGY

The total construction cost of this project was $61,361.84. This cost includes all equipment, installation and start-up.

This particular system was chosen due to its' cost effectiveness; therefore, the operation and maintenance cost will be minimal.

PART IX

CONCLUSIONS

As stated earlier in this report the Gregg Township Municipal Authority has been making improvements to its treatment facility over the last few years to improve the quality of its effluent. This project was just another step in that direction. The modifications made during this project have proven to be very effective in maintaining the proper amount of oxygen in the process which in turn improved the nutrient reduction capabilities of the process.

We have seen the following benefit from the project. The GTMA treatment facility is only manned eight (8) hours per day and a few hours on the weekends and holidays. In the past we were aware that during the night the facility was receiving very little demand for oxygen from the incoming waste. Therefore we were over aerating at times. After the project was put online it was noted that there were periods during the day that the process was deficient in oxygen. The facility now has the capabilities of maintaining the proper amount of oxygen into the process tanks automatically twenty-four (24) hours per day no matter what the oxygen demand is with little or no operator intervention.