WASTEWATER PLANT PERFORMANCE EVALUATION

May 12, 2011 – July 18, 2011

Highland Township Municipal Authority

James City Wastewater Treatment Plant

NPDES #PA0221520

Bureau of Water Standards & Facility Regulation
POTW Optimization Program

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

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1. Optimization Report

The Pennsylvania Department of Environmental Protection (DEP) conducted a Wastewater Plant Performance Evaluation (WPPE) of the Highland Township Municipal Authority's (HTMA) wastewater treatment plant (WWTP) from May 2011 through July 2011. A WPPE is an evaluation of existing operations and practices followed by small-scale operational changes meant to optimize effluent quality. The purpose for optimizing effluent quality is to reduce nutrients in the final effluent, with an overall goal of improving surface water quality.

An overall rating is assigned based on a review of the plants past performance, current operating conditions.

The WPPE was performed by staff of DEP's Operations Monitoring and Training Division, Bureau of Water Standards and Facility Regulation (BWSFR). The WPPE program is conducted under terms of a federal grant administered by the United States Environmental Protection Agency (USEPA). The primary objective of the site study is to determine if wastewater treatment plant optimization through process control is sufficient to reduce nutrient levels in the finished effluent. This is of concern because excess nutrients cause impairments to waterways.

There is a large amount of additional analytical information included on the CD-ROM accompanying this report that has not been included in this written report.

1.1 Operational Strengths

The following items are Operational Strengths that were identified during the WPPE. These include strengths of both the operators and the facility itself. Throughout the project, and this report, references to the operator imply the operator trainee who was directly involved in this project, unless otherwise noted.

- The facility employs one person as the certified operator and one person as an operator trainee who conducts the actual wastewater plant operations. The operator trainee showed great interest in the wastewater plant operations and was instrumental in achieving improvements at the plant.
- The operator trainee modified treatment operations to reduce ammonia, total suspended solids, and fecal coliform in the final effluent resulting in sample results in full compliance with permitted effluent limits
- Final effluent sample collection is by composite sampler after all treatment

1.2. Focus Points for Improvement

The following items have been identified as focus points to assist in optimization efforts, and they are ranked "High," "Medium," and "Low" in terms of their importance to optimized functioning of the treatment facility. Focus points include both operational tactics and physical plant issues that can or do impact optimization efforts. These items generally demand more of the operator's attention and therefore require more of the operator's time to perform. The benefits are expected to be favorable by improving the plants discharge quality and thereby improving downstream water quality. The priority levels are defined as follows:

High- Major impact on plant performance on a repetitive basis and/or has been associated with a regulatory violation

Medium- Minimal impact on plant performance on a repetitive basis

Low- Minimal impact on plant performance on a rare basis or has the potential to impact plant performance

High:

- There is an accumulation of grease in the influent lift station and surge tanks. While there are chemicals available to help address the symptoms of this problem, the fix would be to identify the source and limit the discharge of grease into the sewage collection system. This appears to have begun accumulating more significantly since late July.
- There is a discharge pipe from the influent pump station to the receiving stream, no permit was found for this discharge. Work with the NWRO Operations Section staff for further information on addressing this issue. Don Hanna, Water Quality Specialist, 814-723-3273.
- The Authority should immediately investigate sources available to provide additional training for the operator trainee.
- The operator needs to have sufficient time to perform on site operations such as process control testing and maintenance. More time will need to be allotted for process control testing.
- The Mixed Liquor Suspended Solids levels are very high within the treatment process. This appears to be the main cause of effluent compliance issues at the plant. Maintaining mixed liquor levels that are high prevents effective treatment leading to Ammonia and Suspended Solids violations typically seen at the plant. In addition, suspended solids in the effluent will reduce the effectiveness of the UV light leading to fecal coliform violations. Also, the raw influent BOD levels are high for such a small plant. While they do not exceed the plant loading limits due to low flows, the solids levels in the plant must be maintained at a level much lower than those present during the WPPE. A target is 2000 mg/L MLSS. Once this level is achieved then operations can be modified to either maintain that level or slightly increase as necessary.

- The filters are inoperable and will need to be rebuilt completely before being put back into operation. This will likely be necessary due to the low Suspended Solids limits established in the NPDES permit. At the beginning of the project the sand filters were found to be filled with crushed stone instead of the sand that they were designed to contain. This is contrary to the design criteria of the filters include in the design O&M manual and may have contributed to the under performance of the filters and issues with effluent suspended solids noncompliance. During a backwash cycle only one section of one filter was backwashing. (The entire bed should backwash and rise at one time). If filter replacement is necessary, the Authority should contact its engineer as this is a project that should be performed by a qualified contractor that can provide guaranteed performance. Routine backwashing and a routine maintenance schedule will help prevent future performance issues.

- During sludge wasting only the first section of the clarifier returns sludge to the sludge holding tank. The second hopper section continues to return sludge to the aeration tank. The Authority should consider modifying piping to return sludge, at a reduced rate, to holding tank from the second hopper section also during sludge wasting. This task was completed after the completion of the WPPE.
- Dissolved Oxygen (DO) concentration in the aeration basin is too low. Target levels in general and per the system's Operations & Maintenance (O&M) Manual both suggest target DO ranges of 1.5 to 3.0 mg/L. DO levels during the WPPE averaged 0.2 mg/L. The failure to provide enough DO in the aeration basin will not allow the facility to remove ammonia to levels necessary to comply with permit limits. This can also impact the performance of downstream processes.
- Target Food to Mass ratio (F/M) for an extended aeration treatment plant is .05 to .15. During much of the project the F/M was below .05 indicating there were more bacteria in the mixed liquor than the influent was capable of providing food. Since influent concentrations cannot be adjusted; modifying F/M ratios lies in adjusting the levels of mixed liquor in the aeration basins. Reducing the levels would increase the F/M ratio to the desired levels.
- The target Sludge Volume Index (SVI) is 100. The SVI during the project were near 400; at those levels settling will always be poor. Reduction of solids in the aeration basin should reduce the SVI.
- The authority should purchase an ammonia test kit that can be used by the operator for weekly monitoring of levels in the plant. This kit would be for process control only, not effluent compliance testing. Ensure the range of the kit will encompass the range of values typically present in the plant. A color wheel type kit would give the operator a quick idea of ammonia levels within the plant. The data gathered from this kit could only be used for process monitoring; not to be included with monthly DMR reporting.
- Equipment needs to be maintained on a much more frequent schedule. The diffusers in the aeration basin were not operating effectively during the beginning of the project and the operator trainee quickly replaced the defective equipment.
- Influent BOD samples should be collected as composite samples over the course of the day to provide an accurate representation of the BOD concentrations introduced into the plant. Continue to collect all influent samples as composite samples of the raw wastewater collected at least 4 times over the course of a day during daytime hours when the plant sees its range of flow. More frequent samples provide more representative data which is helpful in preparation of the Annual Wasteload Management Report.
- Billing for sewerage fees is reportedly done on a yearly basis, coinciding with tax assessments. Generally, municipalities bill on a monthly or quarterly basis which provides a more steady income for the authority. The Authority should investigate the feasibility of increasing the frequency of sewerage billing. The Pennsylvania Rural Water Association may provide assistance with this task. The contact person is Robin Montgomery at 1-800-653-7792.
- The flow meter is currently calibrated as required but the chart recorder is not operational. The chart recorder is an essential part of the meter as it allows the operator to identify diurnal flow patterns and, potentially, problems with the collection system or lift station pumps.

- The average pH value of the project was 6.7 S.U., below the desired range for nitrification to occur. The operator has begun supplementing the treatment process with lime for increased alkalinity and pH adjustment.

Medium:

- The headworks at the plant includes a bar screen. This can remove larger pieces of material but most solids will continue through to the plant and pumps creating additional work for the operator in maintain/cleaning equipment. A grit/solids removal system would remove the material from the system improving overall system performance.
- Once the Authority begins participation in the Electronic Discharge Monitoring Report system (eDMR), which is encouraged, it will need to obtain a computer and internet access for submission of monthly DMRs. The permittee is responsible for submission of monthly DMR reports. eDMR data can be submitted from any internet connection including one established at the Authorities office, the Township building, etc…

Low:

- Solids management within the oxidation ditches is one of the most important aspects of treatment at this facility. HTMA should acquire a centrifuge for solids testing by volumetric percentage to assist the operators in managing solids levels. We have reviewed procedures with the operator that assist them in conducting proper solids inventory, tests which require this relatively inexpensive laboratory equipment.
- As part of process control management, the operator should begin using microscopic evaluation of the mixed liquor to assist in examining the health of the biomass. This is discussed in more detail below.

HTMA has made several modifications to the treatment plant and its operations over the course of the WPPE including:

- Rebuild of sand filters, note: sand filters still inoperable
- Modifying the return sludge/waste sludge piping to allow wasting from both clarifier sludge hoppers.
- Increase solids removal from the treatment process
- Increased process monitoring including more frequent settleability testing, alkalinity testing, and use of sludge judge for monitoring solids blanket levels
- Purchase of new DO and pH meter
- Purchase of an ammonia nitrogen field test kit
- Cleaning and use of automatic composite sampler

- Adjustment of blower timer settings for more effective air delivery
- Collection of composite influent samples

1.4 WPPE Rating

The background of the rating system for WPPE is described in Attachment A. As a result of our evaluation and on-site interaction with the plant operators, the Department has assigned a facility rating of **Needs Improvement**, because the plant routinely faces challenges with its wastewater treatment based on limitations that appear to be directly related to solids management and failure of tertiary filters. While the operator trainee has made significant improvements over the course of the WPPE, there is more work to be done.

It must be noted that, both during and after the WPPE, the James City operator trainee acted in a very proactive, professional manner in attempting various treatment methodologies to maximize treatment efficiency. He should continue his attempts to optimize the treatment process as described elsewhere in this report.

The failure of the sand filters and failure to meet effluent limits appears to be a direct result of not properly maintaining equipment or operations for many years. The placement of crushed stone in the sand filters appears to have directly contributed to the filter failure by crushing some of the plastic ports.

Current operations are certain to result in a much improved rating during a future WPPE.

Disclaimers:
The mention of a particular brand of equipment is in no way an endorsement for any specific company. The Department urges the permittee to research available products and select those which are the most applicable for its situation.

The goal of the Department's Wastewater Optimization Program is to improve water quality at drinking water intakes by optimizing upstream wastewater plant effluent quality. This often times involves permittees achieving effluent quality above and beyond any permit requirements

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Attachment A— Program Description

POTW Optimization Program

Description and goals

As part of an EPA-sponsored grant, the DEP has created a Wastewater Optimization Program to enhance surface water quality by improving sewage treatment plant performance beyond that expected by existing limits of the plants' National Pollutant Discharge Elimination System (NPDES) Permits.

The goal of this program is to encourage wastewater treatment facilities to voluntarily produce higher-quality effluent than mandated by the limits set in their NPDES permits and to optimize treatment in such a way that reduces contaminants and pathogens in surface waters that are consumed for drinking water following filtration at facilities downstream. This program is modeled after DEP's Filter Plant Performance Evaluations (FPPEs) conducted at Drinking Water facilities.

The initial focus will be to work with wastewater treatment facilities within ten miles upstream of these drinking water filter plant intakes. DEP will conduct Wastewater Plant Performance Evaluations (WPPEs) to assist municipal wastewater systems in optimizing their wastewater treatment plant processes as part of the Wastewater Optimization Program. Each evaluation is expected to last up to 2 months.

This program is not part of the Field Operations, Monitoring and Compliance Section. Sample collection methods utilized during this evaluation generally do not conform with 40 CFR Part 136, therefore the data collected will not be used, and in some cases is not permitted to be used for determining compliance with a facility's effluent limits established in its NPDES permit.

Wastewater plant performance evaluation

- Department staff will consult with the plant operators to explain the program, the goals, the equipment used, and the expectations for participation.
- Upon arrival at the wastewater plant, Department staff will set up equipment, including meters capable of continuous, in-line monitoring for pH, Oxidation-Reduction Potential, Ammonia, Nitrates, Dissolved Oxygen, Suspended Solids, and other parameters.
- The Department will utilize the equipment to gather data on system performance, show the operator how to gather similar data, and explain the value of gathering the data. The Department will also explain how operators could choose to modify their treatment processes based on interpretation of the data collected.
- Although the Department may show operators how to achieve effective process control by using these process monitoring tools, the operators will continue to make all process control decisions, in conformance to their licensing requirements, and retain responsibility for those changes.
- The Department will also lend the facility additional laboratory equipment which will remain on site during the WPPE to assist in data collection and interpretation.
- During this time, the operator may need to spend more time performing routine testing at the treatment plant than was done previously. This will allow correlations to be made between process modifications and the process response.

- One major goal of the program is to provide the operator with the process monitoring knowledge and experience necessary to gather useful data and utilize it to make beneficial changes in the treatment process and the receiving stream long after the Department and its equipment have been removed.
- There is no charge for the Department's review of the treatment process, setup of all equipment, the process control monitoring that will take place, lending meters to the plant during the WPPE, data collection and explanation of potential effects that process modifications can have on the treatment process.
- The municipality will be responsible for providing laboratory bench space and 120 VAC power for the instrumentation. Any costs associated with process modifications (such as equipment upgrades, chemical purchases, etc.) that the municipality deems appropriate and beneficial as a result of the WPPE remain the responsibility of the municipality. The municipality reserves the right to cease participation in the WPPE at any time.
- Following the equipment set-up, the Department will observe the facilities and review operational practices, treatment processes, chemical treatment, operational data currently collected, and overall system performance.
- During the evaluation, the Department will review monitoring records, laboratory sheets, operations log sheets, and any drawings and specifications for the treatment facility. Also of interest is data currently collected and how it is utilized for daily process modifications. This information is usually available from existing reports.

Program evaluation team will consist of 1 to 2 people: Wastewater Optimization Program Specialists, PA licensed as a wastewater plant operators with operations and compliance assistance experience.

Potential Benefits

- Use of online process control monitoring equipment during the WPPE, use of hand held meters and portable lab equipment during the WPPE, and furthering the operators' knowledge of process control strategies and monitoring techniques,
- Producing a cleaner effluent discharge which minimizes impacts to the environment and downstream water users, and possible identification of process modifications that could result in real cost savings.
- Where the optimization goals may be more stringent than current requirements of your NPDES permit, they are completely voluntary. The WPPE objective is to optimize wastewater treatment plant performance in order to enhance surface water quality, minimizing the effects of pathogen and nutrient loading to downstream drinking water plant intakes.
- Furthermore, pursuit of a good rating in the WPPE program may place the wastewater system in a better position to meet more stringent regulatory requirements in the future, should they occur. For example, regulatory changes over the last ten years have reduced the final effluent Total Chlorine Residual limits requiring dechlorination or optimization of treatment processes to reduce the levels of chlorine added to the process for disinfection. Facilities who have voluntarily maintained lower residuals than listed in their permit have found it easier to comply with the updated regulations.

Potential Obstructions to Success
Many factors may present obstructions to a successful plant optimization. Some of these are listed below:

- Inadequate use or interpretation of regular process monitoring test results
- Inadequate funding of facility operating expenses, including staff training, chemical and energy usage, equipment maintenance
- Miscommunication as to program goals and methodologies
- Obsolete, inadequate, or out-dated treatment equipment and methods

WPPE Rating System

WPPE Staff use the following categories to rate each facility, based on observations and data developed during the evaluation. The ratings are based on the facility's capabilities and the operators' skill levels to maintain optimal performance over the long term. Please note that while WPPEs may discover treatment problems or identify potential or actual violations of regulations, the rating system is not based upon regulatory compliance.

- **"Commendable"**
  Department staff has identified only minor operational, equipment, and / or performance problems that affect the plant's ability to maintain optimized performance. Plant personnel have already taken steps to improve overall facility performance, maintain high effluent quality, and consistently preserve the long-term reliability of the facility.

- **"Satisfactory"**
  Department staff has identified operational, equipment, engineering, and / or performance problems that may affect the facility's ability to maintain optimized performance. Facility personnel appear willing and capable of improving overall performance; however, one or more treatment processes showed areas of weakness in operational, equipment, and/or performance that, if corrected, will improve treatment performance and maintain the long-term reliability of the facility.

- **"Needs Improvement"**
  Department staff has identified considerable operational, equipment, and/or performance problems that are affecting the facility's ability to maintain optimized performance. Limitations are apparent that hinder improvement of overall filter plant performance. Areas of weakness affect the capability and dependability of the plant in producing a quality final effluent, increasing the potential for degradation of the receiving stream through increased nutrient and/or pathogen loading.

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Attachment B— WPPE Team

Highland Twp. Municipal Auth.-James City Wastewater Treatment Plant

WPPE Team

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Attachment C— Plant Description and Treatment Schematic

HTMA is currently operated as an extended aeration treatment process utilizing a package treatment plant constructed of steel. The treatment plant is reportedly under capacity for both hydraulic and organic loadings. The filters, prior to UV disinfection, are not operable. A treatment schematic follows and features of the treatment system are identified below:

Headworks—The headworks include a raw wastewater lift station with submersible pumps and a manual bar screen at the influent end of the surge tank. While the bar screen removes some large debris, most continues through the treatment plant. This is likely a cause of problems with the pumps clogging as described by the operator. One of the first modifications was the lowering of the weir at the distribution box atop the surge tank which eliminated surge flows and provided for a much more steady flow of wastewater through the plant reducing solids washout from the clarifier.

Aeration—There is one aeration tank with an approximate capacity of 0.032 MG. Submerged diffusers provide air and mixing. The DO levels in these units were between 0.0 and 5.8 mg/L over the entire project, however most levels were near 0.0 mg/L. Traditional aeration calls for DO levels between 1.5 and 3.5 mg/L. The diffusers and piping have been replaced in the aeration tank as well as filters on the blowers. If the reduction in solids does not improve DO levels in the aeration basins then further study of the blowers themselves is warranted as their age may have reduced performance over time.

Clarifiers—There is one clarifier with two hopper sections after the aeration tank. There is sludge return and skimming in both sections but it appears only one section, which is nearest the aeration tank, can waste sludge to the holding tank. Modification of the piping layout could provide for wasting from both hopper sections to the sludge holding tank. Target sludge blanket levels should be 3 to 4 feet. Currently, levels are much higher due to excess solids in the treatment process.

Filtration- There are two sand filters after the clarifier for further polishing of the effluent before disinfection. The filters had been filled with crushed stone and were not removing suspended solids as intended. During the WPPE the operator rebuilt the filters with media as defined by the O&M manual. This provided successful operation for approximately two weeks until the filters filled with solids. At this point they clogged and continually backwashed to the mud well, sending flow back to the surge tank, which increased flow through the plant and increased flow to the filters which provided for a continual cycle of non-performance. Further evaluation of the filters identified that the backwash ports were not performing properly and rendered the filters inoperable. To prevent further reduction in effluent quality, the filters have been bypassed. If filter repair is necessary, the Authority should contact their engineer to have the filters evaluated and if necessary repaired by an authorized contractor that can guarantee performance.

Disinfection—The disinfection process is achieved utilizing ultraviolet disinfection. Over the course of the WPPE, the operator adjusted the treatment process and nearly eliminated all fecal coliform exceedances.

Discharge—Final effluent flows from disinfection through a aerated contact tank and V notch weir to its discharge location at Outfall 001 on an unnamed tributary to Wolf Run.

Solids Handling—Solids are wasted from clarifier to a sludge holding tank. Clear water is decanted to the surge tank and solids are removed in liquid form from the holding tank as necessary.

Mass balance calculations were performed based on information provided in the 2010 Annual Wasteload Management Report (Chp 94 Report) and monthly DMRs back to 2006. While it appears that solids removal was vastly low for years 2006-2009, the information available for 2010 and 2011 indicates that solids removal has been increased dramatically. Attachment K outlines the calculations for years 2007 and 2010. There appears to be a large variation between loadings reported in the Chp 94 reports and estimated values based on population and industry accepted values for sludge production. This reinforces the need for a good influent sampling plan including composite samples representative of the actual flows. Using either value for calculating the loadings, there exists a significant difference in the amount of biosolids that were actually removed from the facility and what the facility generated, based on calculations.

Solids accumulate in the waste treatment process both routinely and frequently. They must be wasted to the holding tank and removed from the plant as necessary. It appears that the operator is currently wasting and hauling sludge as needed.

Performance Track Record: Past Performance—The plant has experienced many violations over the past several years including Total Suspended Solids, Ammonia-Nitrogen, and Fecal Coliform.

Current Performance—As of the completion of the WPPE, the facility is currently meeting permitted effluent limits for Ammonia, Total Suspended Solids, and Fecal Coliform in weekly samples collected by the Department. The reduction of solids in the treatment process appears to be the key at maintaining a healthy treatment process capable of meeting permitted effluent limits.

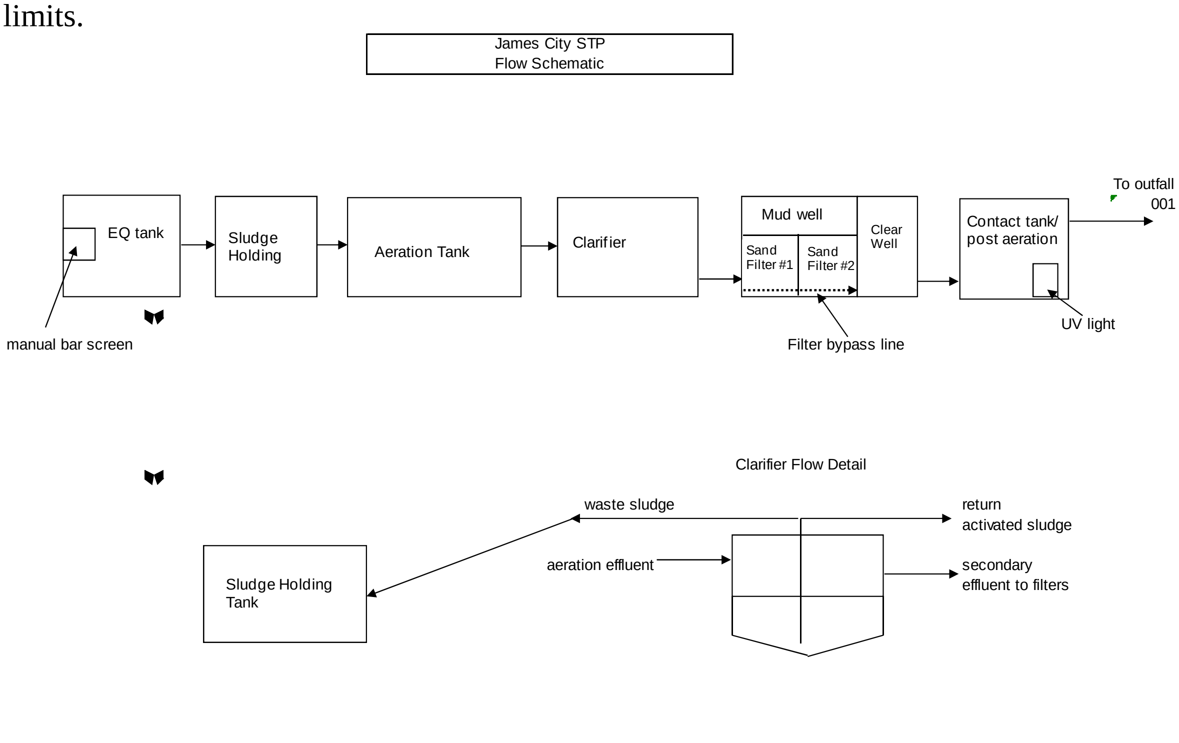

Figure C.1 Highland Township wastewater treatment plant process flow schematic

Attachment D— 2011 Process Monitoring and Control

Equipment Deployment—During May 2011, the Department deployed 6 in-line process monitoring probes to monitor the activated sludge treatment process. These included dissolved oxygen (DO), oxidation/reduction potential (ORP), pH probe, ammonia-nitrogen (NH3-N), and mixed liquor suspended solids probes installed in the aeration tank. .

The probes were installed and calibrated, then gave readings every fifteen minutes to a laboratory computer for the duration of the study. The purpose of these probes was to monitor the conditions and efficiency of the treatment process. The data generated allow the operator to observe trends and the impacts of various process modifications throughout the treatment process over the course of the project. At times during the project the wide range of ammonia values led to fluctuations in the probe readings, providing inflated values, and the need for frequent recalibration. The ammonia probe is intended to serve as a trending device and not for compliance purposes. In general, when the device read 0.0 the ammonia levels were non-detectable. At times, the ammonia probe recorded levels of 60 mg/L; these values are not correct. While it can be safely assume that the ammonia levels were elevated, an exact value cannot be assigned to that parameter. Therefore the ammonia data collected by the probe can only be used to identify the overall trends of nitrification occurring in the aeration tank.

Laboratory Equipment—DEP staff deployed a portable wastewater lab for process monitoring, including: Centrifuge Solids inventory by Volume Percent, Settleometry for Sludge Volume Index (SVI) development, Microscopy with Digital Photography, and a Spectrophotometer for interpreting wet-chemistry tests for nutrients.

Sampling and Off-site Analyses—Weekly samples of the raw wastewater, final effluent, upstream (background) and downstream (impacted) waters were taken for analysis at our off-site laboratory, to characterize the plant operating conditions by assaying several wastewater treatment parameters. In addition, sampling and testing was performed on Mixed Liquor Suspended Solids. A table of test results for these samples follows in Attachment K.

Interpretation of Data—

Permit Modifications— Any modifications to the permitted treatment process may require an amendment to the Water Management Permit. If you are unsure whether a permit modification is necessary, please contact the DEP regional office that supports your wastewater facility prior to making any modifications.

Solids Management

The solids management and inventory control program is based primarily on ½ hour settleability tests performed on mixed liquor samples. Additionally, gravimetric tests are being performed on a monthly basis. The ½ hours settleability tests should be performed at least three times per week and the gravimetric tests (MLSS samples sent to the lab) should be performed at least twice per month, preferably more often until the solids handling issues have been resolved.

The current practices include wasting solids based on settleability test results. Settleability testing alone does not give an accurate picture of the mass of solids present under aeration. While it can be effective, it best represents conditions present in the clarifier.

MLSS vs. Centrifuge Solids comparison charts were prepared for the operator's use should they acquire a centrifuge, which is encouraged. With a centrifuge, an operator can use the attached charts to estimate MLSS levels after performing a % solids test which should give a good indication of solids levels and help with deciding when to waste solids. These charts would need to be updated regularly to ensure changes in plant conditions are considered, especially seasonal considerations. In addition, the values will not be representative if treatment should be impacted.

Table D.1, below, depicts the mixed liquor suspended solids in relation to the respective centrifuge solids reading. By plotting the data and inserting a best fit line, one can use a centrifuge solids reading to estimate the MLSS reading. Attachment I, Figure I.4 graphically depicts the MLSS / % solids relationship. To utilize the chart, find the % solids result along the x axis and draw a line vertically to the black line to find the approximate MLSS result.

While these MLSS results fluctuated over the project, more data points would increase the reliability of the predicted values. Using the chart below, the average of the centrifuge multiplier values for the east oxidation ditch is 715. Therefore, when performing MLSS centrifuge tests, multiplying the resultant % solids value by 715 will give a good approximation of the actual MLSS value for that sample.

	6/21/11	5/11/11	5/17/11	6/23/11	5/24/11	6/30/11	7/6/11	7/21/11	6/2/11	6/9/11
MLSS-BOL	1924	3044	2200	2020	2232	2476	2668	2402	2464	3268
Centrifuge	2.75	3	3	3	3.5	3.5	3.5	3.7	4	5
MLSS/Cent solids ratio:	99.86%	99.90%	99.86%	99.85%	99.84%	99.86%	99.87%	99.85%	99.84%	99.85%
Centrifuge # multiplier	700	1015	733	673	638	707	762	649	616	654

Table D.1: MLSS vs. Centrifuge solids, Aeration Tank

The ½ hour settleability test results were generally on the very high side near 800ml or more per 1000 ml.

On June 21, a ½ hour settleability test of mixed liquor was performed side by side with a 50/50 tap water dilution. While the ½ hr mixed liquor result was 730 ml, the ½ hr dilution sample yielded a 400 ml result suggesting the results are truly due to excess solids in the plant and not excess filaments reducing settleability.

Table I.1 outlines the results of additional process control testing collected over the course of the WPPE.

SOUR/OUR testing—This procedure will tell you how fast the biomass or bugs are metabolizing the available materials in the wastewater. Oxygen uptake rate (OUR) and Specific oxygen uptake rate (SOUR or Respiration Rate) tests are a way to quickly monitor the toxicity or food value of sewage and wastewater to the living and breathing biomass within a wastewater treatment plant. These tests can show the rate at which oxygen is used by the bugs in the activated sludge system. They can indicate if the bugs are consuming the BOD at a normal rate; assuming several tests are done over time to establish a baseline for a particular facility. In general, plants with high MLSS levels will use more oxygen than those with lower MLSS levels. While the OUR test looks at oxygen consumption based on MLSS levels, the SOUR test looks at oxygen consumption based upon the living biomass and its ability to metabolize the wastewater. OUR testing measures milligrams of oxygen used by a liter of mixed liquor per hour and SOUR testing measures milligrams of oxygen used per hour by a gram of mixed liquor volatile suspended solids.

A SOUR less than 12 mgO2/hr/gm MLVSS can be indicative of endogenous respiration and can be accompanied by pin floc. A SOUR in the 12-20 range is usually indicative of a healthier biomass and improved settling. The SOUR rates at the facility changed dramatically over the course of the project, attributed to fluctuations in MLVSS levels.

The SOUR measurements at the HTMA plant were generally under 12 which is attributed to the low DO levels and long detention time within the plant.

Food to Mass Ratio—The target F/M ratio for this type of extended aeration treatment facility is generally 0.05 to 0.15. All samples collected from the aeration tank were generally lower than these target values. Once a consistent influent loading is established then a target mixed liquor solids level can be calculated to maintain a consistent F/M ratio. Using 2010 DMR data for influent loadings of 111.6 mg/L, 0.0095 MGD flow, and a target F/M of 0.05, the desired mixed liquor volatile solids level would be 610 mg/L in the aeration basin. This is extremely low and does not compare to samples collected during the WPPE. The average BOD of grab samples collected during the WPPE was 377 mg/L and the average flow was 0.0095 MGD. Using those numbers and an F/M of 0.05, the desired MLVSS is 2798 mg/L. This value is rather high for this facility, it would equate to a MLSS of approximately 3700 mg/L. A higher F/M ratio will be necessary for this facility based on flow, BOD, and aeration tank size. A target F/M of 0.08 appears to be desirable as resulting MLVSS would be approximately 1400 mg/L and MLSS of 1900 mg/L. These values may be adjusted based upon plant operations given those particular operational conditions. Raw influent sample data identified some elevated influent loadings numbers. The influent loading data is most important is determining the necessary level of solids under aeration and confirms the need to have representative influent sampling data. Generally, MLVSS levels are 70% of MLSS levels; at this facility the average MLVSS level was 80-86% of the MLSS level.

Microscopic Exam— During the WPPE, microscopic evaluation of the mixed liquor identified minimal biological lift in the form of protozoa. The operator should routinely perform microscopic examination of the mixed liquor to observe biomass conditions and look for the presence of indicator organisms. A microscope is present on site and with some practice the operator will be able to make a fast observation of the current mixed liquor quality. Training courses are available from various sources dealing with the microscopic evaluation of mixed liquor as a process monitoring tool.

Indicator organisms can be used to determine relative sludge age: More free swimming ciliates usually indicates a “young sludge”, while the presence of mostly rotifers and nematodes indicate “old sludge.” The presence of equal numbers of free swimming ciliates and stalked ciliates usually suggests a biomass that exhibits good Settleability and optimal conditions for treating wastewater. As seen in the photograph below the aeration basin contained few stalked ciliates during an evaluation on June 9th but near the end of the project the colonies had increased significantly coinciding with increased solids removal and improved settleability at the plant.

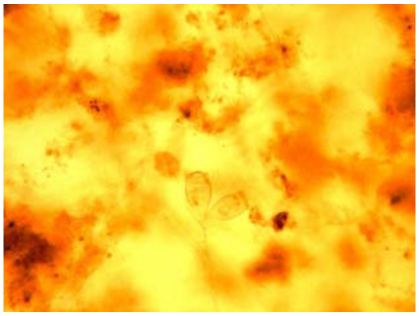

Figure D.1: Microscopic evaluation of aeration tank

Hydraulic Retention Time—The HRT varied greatly between 2 days at 0.014 MGD flow to 15 days at 0.002 MGD. The average HRT was approximately 4.3 days at 0.007 MGD.

DO Findings—DO is usually well under 0.10 mg/L in the aeration tank. This is likely due to the high volume of mixed liquor solids in the treatment system. If further reductions in the mixed liquor do not increase levels, it may be necessary to have the efficiency of the blowers evaluated.

DO Grab Testing—DO was measured in the aeration tank, near the on-line probe, using a hand-held LDO probe. The purpose of this was to confirm readings measured by the in-line process monitoring probes. Additional DO measurements were collected around the tank to profile the pattern of available oxygen. There were no indications of significant variations in the readings.

Flow Measurement—HTMA utilizes effluent flow monitoring in its operation. Yearly calibration of the flow meter is necessary to comply with annual reporting requirements.

Method of Sludge Inventory Control—Weekly observations included Solids by volume, 30-minute Settleability, Sludge Volume Index, and Gravimetric testing.

eDMR—The facility records used in this report were obtained from hard copy data sent to DEP. The Authority should consider the use of the electronic DMR reporting system (eDMR) for future DMR submissions. When submitting documents for eDMR reporting, all supporting documents required by the NPDES permit should be submitted along with the DMR form itself. These include supplemental forms, bio-solids forms, and other forms as required by the Department. The permittee is responsible for all DMR submissions whether hard copy or electronic submissions.

Pathogen Control—The Department studied the occurrence of waterborne pathogens, including Drinking Water Pathogens *Giardia lamblia* cyst and *Cryptosporidium* oocyst, in addition to fecal Coliform testing. There was no definitive statistical correlation between facility optimization and waterborne pathogen reduction.

Raw Influent Data—Current customer base includes: Domestic sewage and 1 business-small bar/restaurant. Plant design data includes 162 EDUs equating to 405 persons. The Chp 94 Report did not include actual service connection/EDU/resident data. Actual customer base is approximately 225 residents. Assuming BOD production of 0.17 lb BOD/person/day, the daily plant loading is expected to be in the vicinity of 38 lb/day.

Oxidation Reduction Potential—Also referred to as ORP, measures the ability of the wastewater to oxidize waste material. The following chart identifies select ranges of measurement.

ORP (mV)	Process	Electron Acceptors	Condition
> +100	1	O2	Aerobic
≤ +100	2	NO3	Anoxic
≥ -100	2	NO3	Anoxic
< -100	3	SO4	Anaerobic

1= Nitrification
2= De-Nitrification
3= Methane Formation

Table D.2: Oxidation Reduction Potential (ORP) ranges for bacterial activity

While the DO levels at Highland were consistently below 0.10 mg/L which is attributed to excess solids in the waste treatment system. ORP levels averaged -79 mV indicating not enough oxygen present in the treatment process, again attributed to excess solids. Reductions in biomass should shift both values upwards to desired levels which should better provide conditions for ammonia reduction.

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Attachment E— Equipment Deployed

Digital, Continuously Monitoring Probes

Laboratory Equipment On-Loan

Digital, Continuously Monitoring Probes:

1 – Laptop computer with signal converter, 2 – SC1000s, 1 – LDO probes, 1– pH probe,

1 – ORP probes, 1 – NH_4D probe w/Cleaning System, 1 – Solitax probe, 1- Sonatax probe

Laboratory Equipment On-loan:

1 – Hach HQ40d handheld pH and LDO meter 1 – LBOD probe 1 – DR2800 spectrophotometer 1 – Wastewater Field Test Kit 1 – Raven centrifuge 1 – Raven Core Taker sampler 1 – Raven settleometers

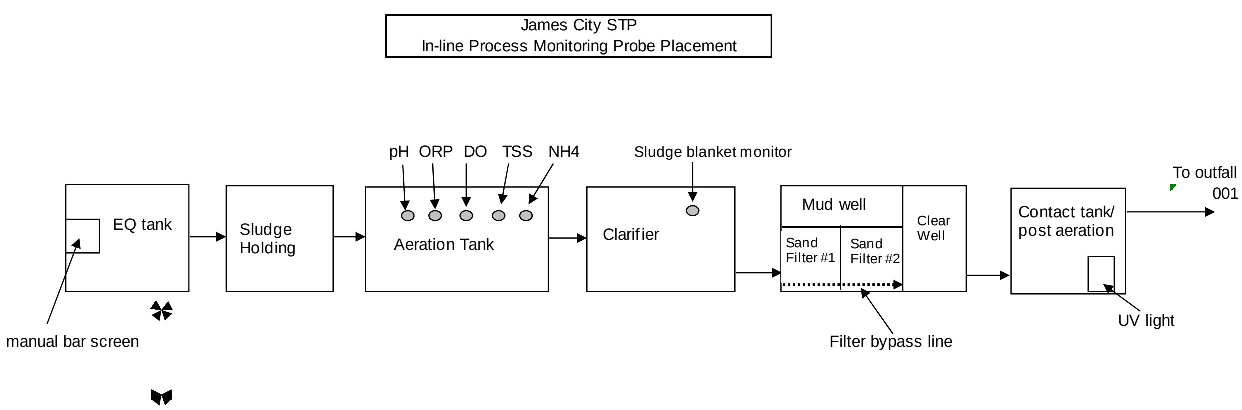

Figure E.1 Locations of on-line process monitoring equipment

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Attachment F—Equipment Placement Photos

Figure F.1: MLSS and pH probes, East Oxidation Ditch

Figure F.2: DO, ORP, and Nitrate probe placement

Figure F.4: SC1000 display of process monitoring data

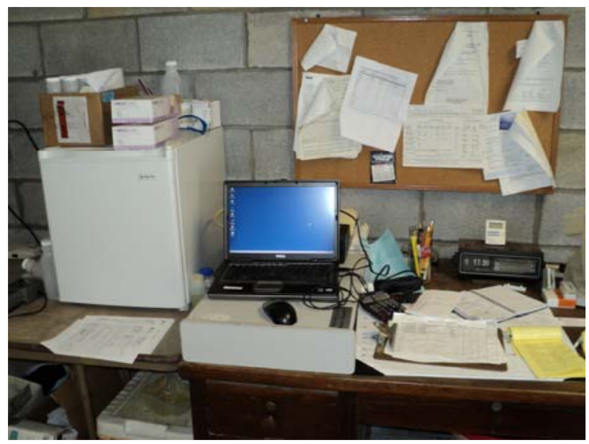

Figure F.5: Laboratory computer linked to SC1000 network

Figure F.6 Outfall 001 to unt Wolf Run

Figure F.7 Pump station overflow pipe to unt Wolf Run

Figure F.8 Influent Pump station

Attachment G— Continuous Digital Monitoring Charts

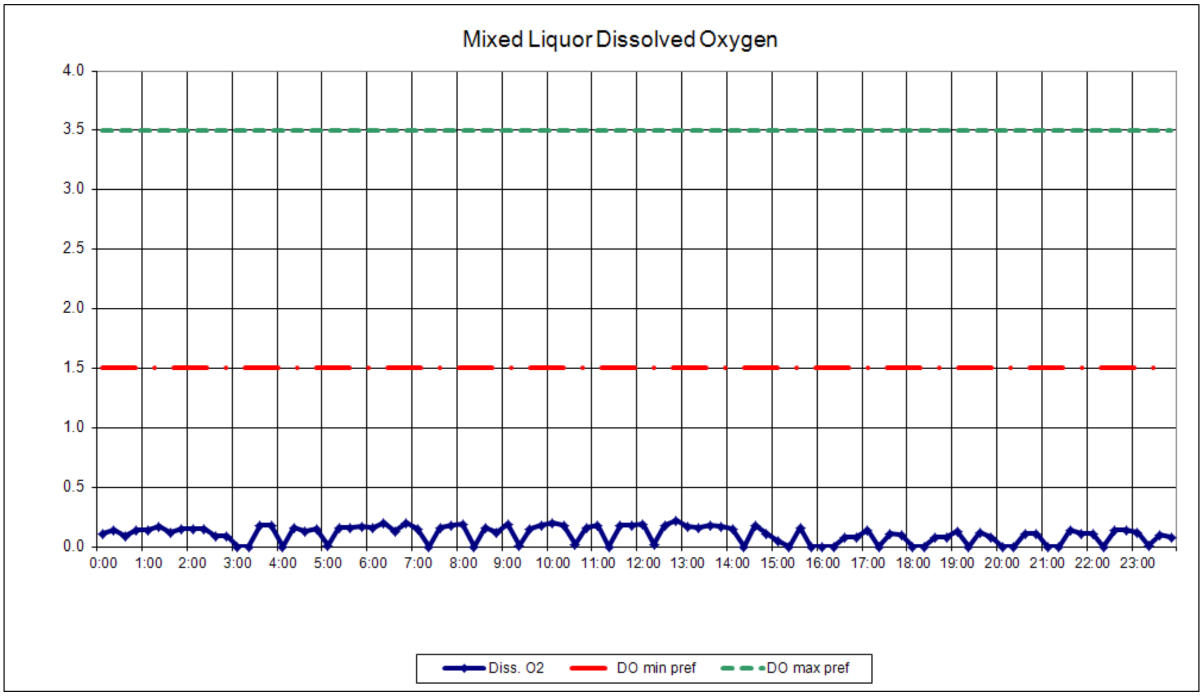

Figure G.1: Sample Dissolved Oxygen monitoring data, 24 hour period – June 28, 2011

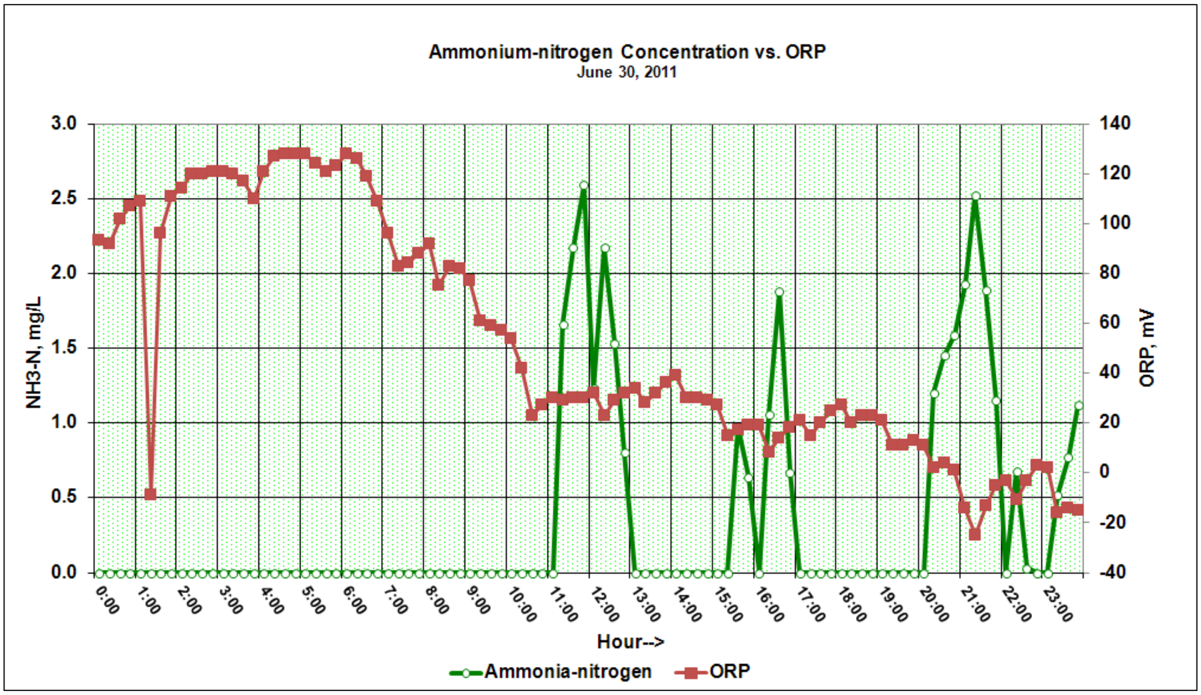

Figure G.2: Sample Ammonia and ORP data

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Attachment H—Process Monitoring Tests: Example WPPE Daily/Weekly Bench Data

James City STP
Bench Sheet

Date: 6/2/2011 Time:

Lab Tech: DiGilarmo

Raw Wastewater (INF)		
COD		mg/L
Flow	0.009	MGD
Influent TSS	175.00	mg/L
Influent BOD	280.00	mg/L
Effluent TSS	8.00	mg/L
Volume waste slugde	0.00075	MG
Desired SRT	25	days

Loc	N-Aer	N clar	N RAS	N WAS				
Spin Solids	4.00		6.25					
Tank vol. (MGD)	0.032							

Location	N-Aer	N-Aer		
Time	SSV	SSC		
0.00	1000.00	4.00		
5.00	1000.00	4.00		
10.00	980.00	4.08		
15.00	970.00	4.12		
20.00	960.00	4.17		
25.00	950.00	4.21		
30.00	940.00	4.26		
40.00	920.00	4.35		
50.00	890.00	4.49		
60.00	860.00	4.65		

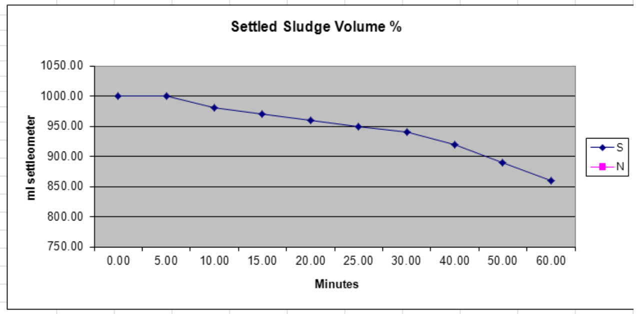
SSC=[(Spin%) x 1000] ÷ SSV

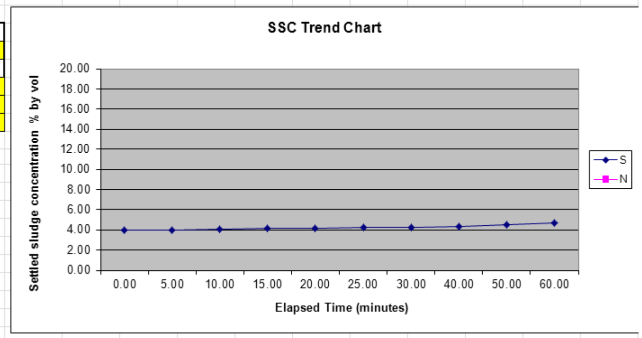
WCR=TSS ÷ Spin%

	N- Aer	
TSS	2464	
WCR	616.00	
MLVSS	1982	
RAS solids	3804	
RAS VSS	2902	

	N-Aer			
SVI	381.49			
HRT-Aeration	85.33	hours		
F/M Ratio	0.04			
MCRT	28.21	days		

	N-Clar		
Surface overflow rate	#NAME?		gpd/sf
Loading rate			lbs/day/sf
HRT	0.00		hours





Bench Tests	INF	N- Aer	N-Aer	N RAS	N Clar	Effl	SC1000	Effl-Lab
Nitrate								
Phosphate-P								
Ammonia-N(to aer)	40.800	13.300				11.300		11.150
Ammonia-N(raw)	30.10							
pH						7.15		
DO								
TRC								
Alkalinity	330.00					89.30		
Blanket Depth								
Temp°C						17.50		
COD-Hg Free								
MLSS								

Notes:
RAS VSS used as WAS sludge VSS for MCRT calculation

Figure H.1: Bench test results, operational test parameters

James City STP
Bench Sheet

Date: 6/2/2011 **Time:**

Lab Tech: DiGilarmo

OUR Testing

Location: Aertaion

Time	D.O.
0	9.13
1	8.67
2	8.28
3	7.89
4	7.52
5	7.13
6	6.73
7	6.35
8	5.95
9	5.57
10	5.17

OUR = slope x 60

slope = $\frac{3.96}{10}$

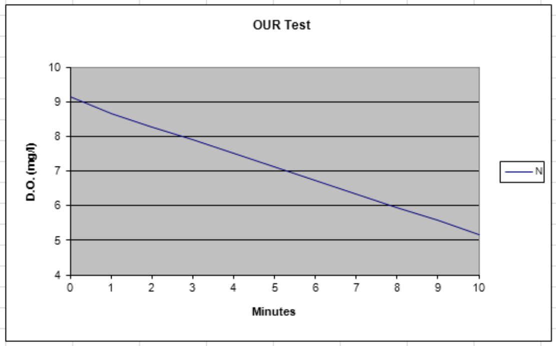
OUR = $\frac{3.96}{10}$ x 60

OUR = 23.76 mg O2/L-h

RR= (1000 x OUR) ÷ VSS

= $\frac{1000}{1982.00}$ x 23.76

RR = 11.99 mg O2/g-MLVSS-h



SOUR >20mgO2/hr/gm MLVSS	SOUR 12-20mgO2/hr/gm MLVSS	Sour <12mgO2/hr/gm MLVSS
Logarithmic growth, Flagellates, dispersed flock	Declining growth, Ciliates, Flocks forming	Endogenous Respiration, Rotifers and higher life
Settling Slow SSV5>750ml/L	Settling normal SSV5=600-750 ml/L	Pin Flock
		Settling Fast, SSV5<600ml/L

Figure H.2: Bench test results, OUR/SOUR testing

Attachment I—Graphs: Process Monitoring Test Results

Highland Township Municipal Authority STP

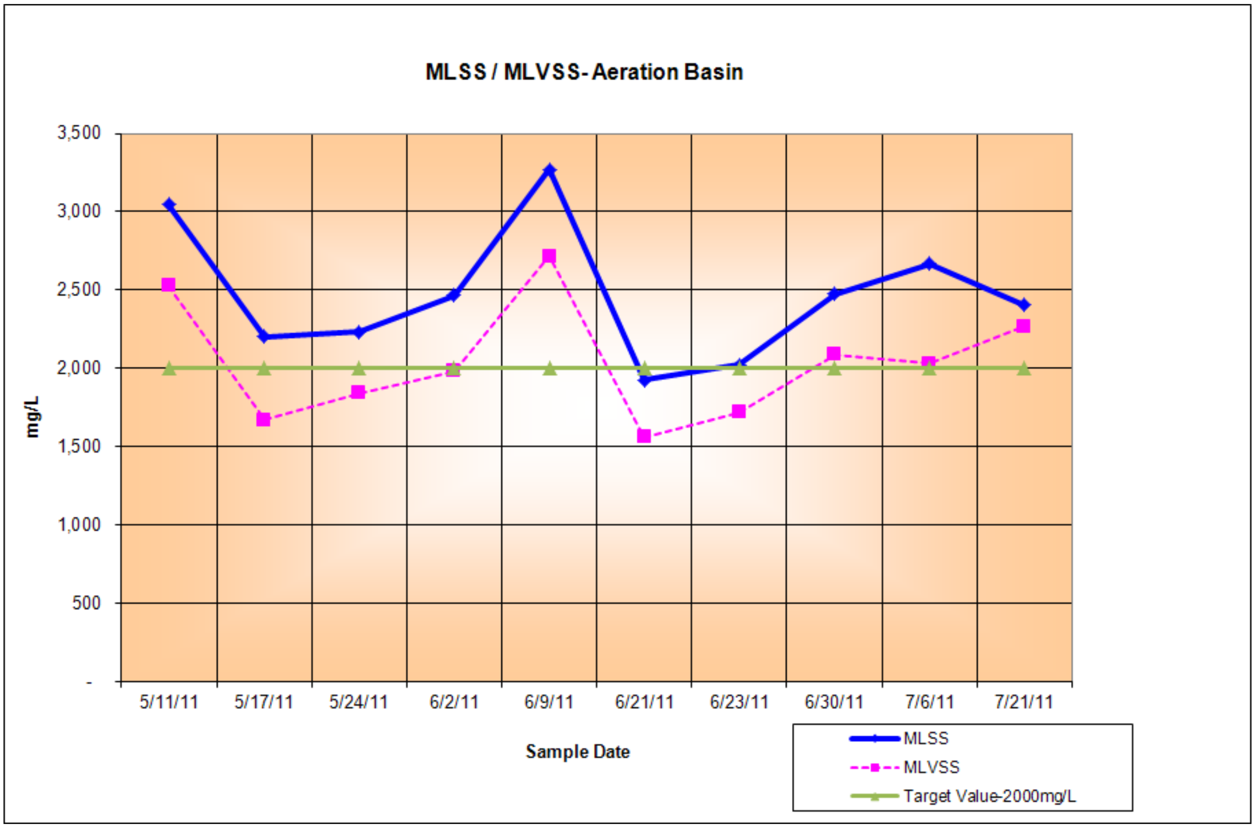


Figure I.1: Aeration Tank, MLSS and MLVSS

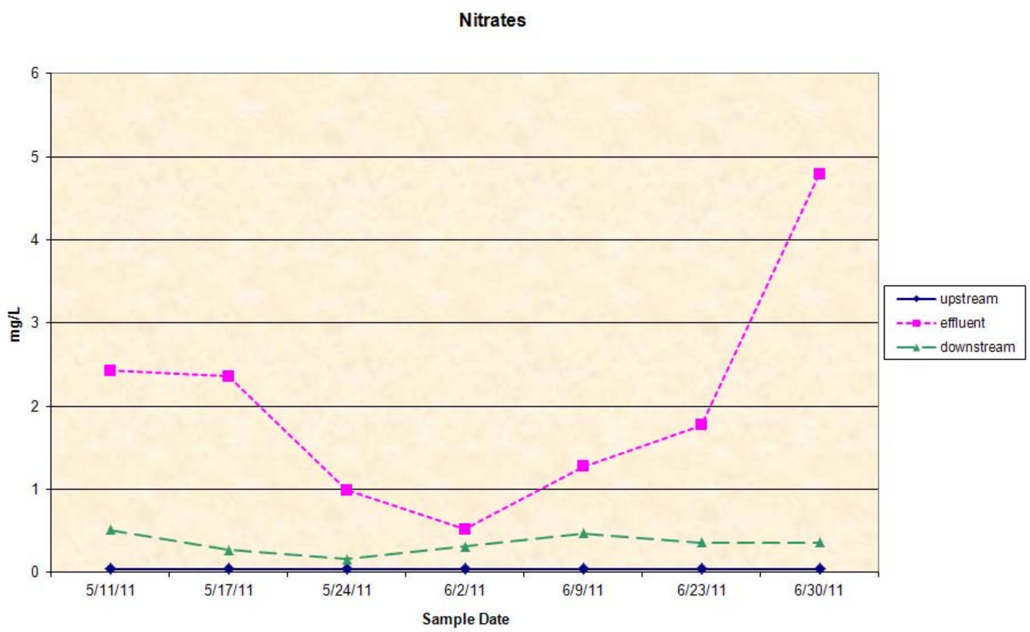


Figure I.2: Nitrate levels from DEP, BOL testing: upstream, effluent, and downstream samples

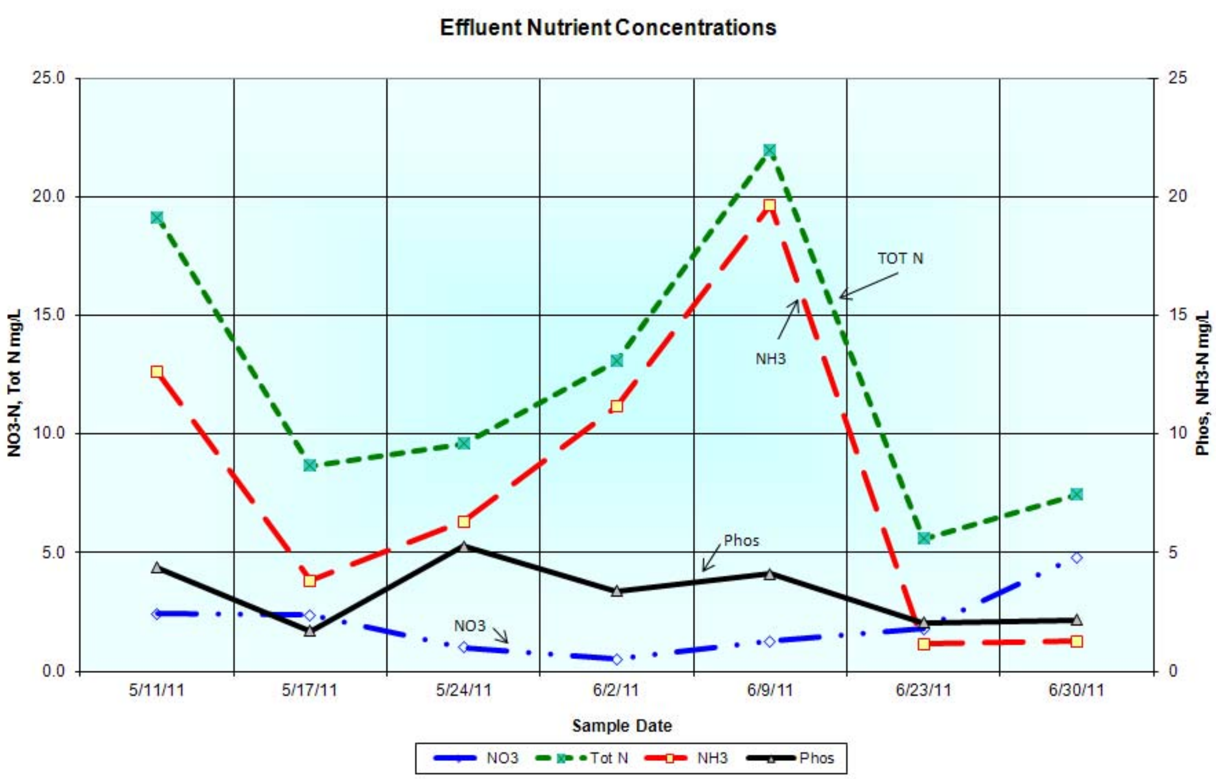


Figure I.3: Highland effluent nutrient levels from DEP, BOL testing

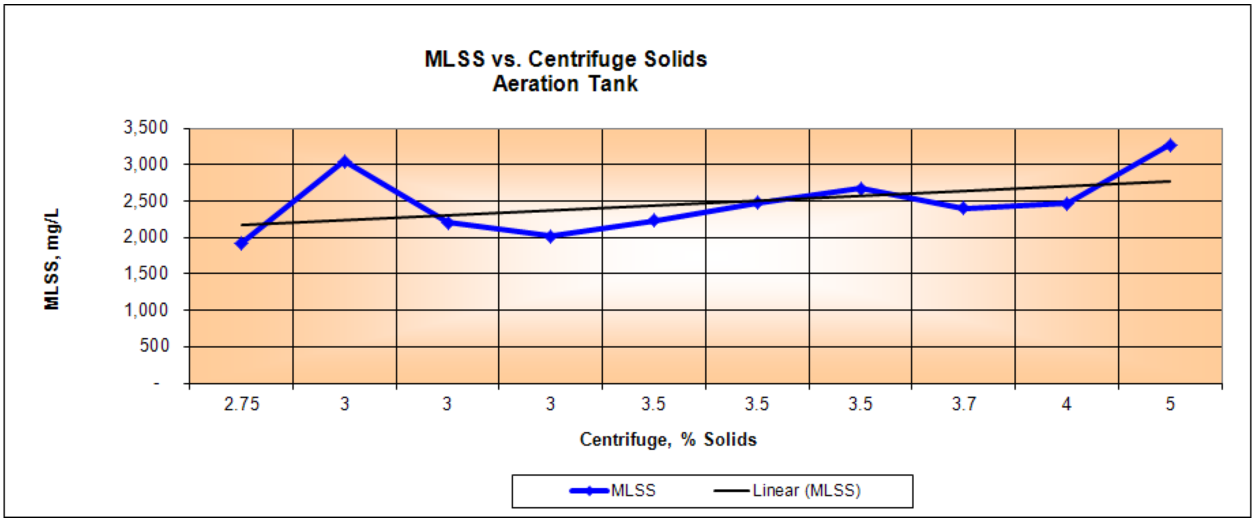


Figure I.4: MLSS vs. Centrifuge Solids process control chart

Date	Flow	1/2 hr	MLSS	MLVSS	SVI	F/M	Cent	OUR	RR	Inf BOD	HRT (days)
5/11	0.004	780	3044	2528	256	0.02	3			341	8.16
5/17	0.016	830	2200	1668	377	0.13	3			445	2
5/19	0.014	750			341		2.6	15.06	9.03		2.29
5/24	0.008	870	2232	1840	390	0.03	3.5			201	4
6/2	0.009	940	2464	1982	381	0.04	4	23.76	11.99	280	3.67
6/9	0.006	970	3268	2716	299	0.04	5	37.62	13.85	617	5.65
6/21	0.002	750	1720	1560	436		2.75	50.28	13.19		15.09
6/23	0.014	820	2020	1720	406		3				2.29
6/30	0.007	860	2476	2088	347	0.08	3.5			692	4.40
7/6	0.0074	850	2668	2032	319	0.04	3.5	31.68	15.59	315	4.30
7/21	0.00358	730	2402	2268	304	0.02	3.7	13.44	5.93	497	8.90

Table I.1: East Basin process monitoring data

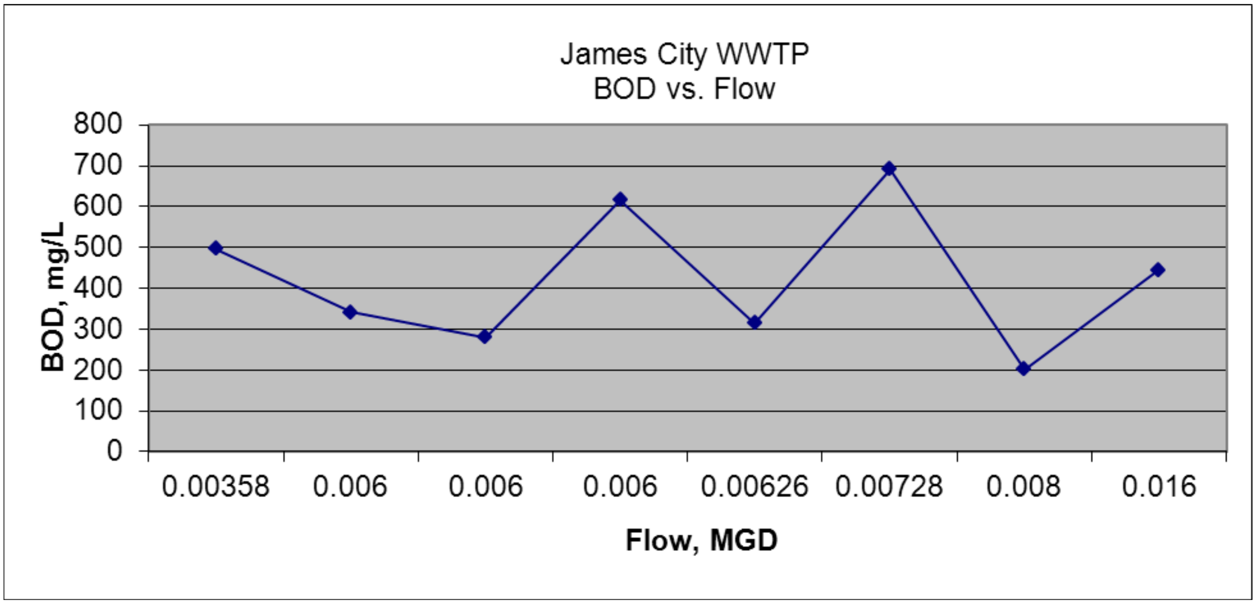


Figure I.5: BOD_5 vs. Flow during the WPPE project

Attachment J—Tables of Data from Bureau of Labs Testing

The following tables summarize all sample data collected during the WPPE.

Lab Resutls-James City WWTP

	5/11/11	5/17/11	5/24/11	6/2/11	6/9/11	6/23/11	6/30/11	7/21/11	Avg.
Effluent-Sample #	0331040	0331046	0331052	0331058	0331065	0331071	0331077	0331085	
CBOD	10.7	1.6	3.9	3.4	7		2.6	1.6	4.4
TSS	37	18	9	8	10	19	***5***	***5***	13.9
Alkalinity	86.4	55	68.6	88	111.4	42.6	42.6	65.8	70.1
NO2-N	0.15	0.14	0.09	0.28	0.49	0.23	0.08	0.03	0.2
NO3-N	2.43	2.36	0.99	0.52	1.27	1.77	4.79	0.54	1.8
NH3-N	12.6	3.8	6.32	11.15	19.64	1.14	1.25	0.15	7.0
TKN	16.54	6.17	8.5	12.27	20.2	3.58	2.56	1.42	8.9
Phos	4.361	1.686	5.278	3.386	4.106	2.057	2.151	5.269	3.5
TOT N(TKN+NO3+NO2)	19.12	8.67	9.58	13.07	21.96	5.58	7.43	1.99	10.9
Fecal Coliform	520	20	***20***	***20***	40		20	***20***	35.2
Chloride	45	44.5	42.4	51.8	45	36.7	56.3	42.4	45.5
pH	7.9	7.9	7.6	7.9	7.8	6.8	7.6	7.6	7.6
Crypto	0								0.0
Giardia	6								6.0
STP Flow, MGD	0.006	0.016	0.008	0.009	0.006	0.014	0.00728		0.0
TDS	242	206	230	218	286	202	244		232.6
Specific Conductivity	410	342	360	432	462	294	404	361	383.1
Sulfate	31.2	22.5	31.02	28.35	30.3	23.6	26.4	30.44	28.0
Bromide	***50***	***50***	***50***	***50***	***50***				50.0
STP Flow x 10000	60	160	80	90	60	140	72.8		94.7
Ratio TDS: Spec Cond.	0.590	0.602	0.639	0.505	0.619	0.687	0.604	0.000	0.531
5/11/11 Effluent crypto and giardia results may be compromised due to excessive sediment in sample									
Upstream-Sample #	0331041	0331047	0331053	0331059	0331066	0331072	0331078		Avg.
BOD	0.4	0.9	0.9	0.8	1.6		0.6		0.9
TSS	11	***5***	10	14	31	16	16		14.7
Alkalinity	61	44.4	64.8	96.8	132.4	138.2	151		98.4
NO2-N	***0.01***	0.01	***0.01***	***0.01***	***0.01***	***0.01***	***0.01***		0.0
NO3-N	***0.04***	***0.04***	***0.04***	***0.04***	***0.04***	***0.04***	***0.04***		0.0
NH3-N	0.07	0.03	0.03	0.04	0.03	1.37	0.03		0.2
TKN	***1***	***1***	***1***	***1***	***1***	***1***	***1***		1.0
Phos	0.013	***0.01***	0.018	0.018	0.022	1.22	0.022		0.2
TOT N(TKN+NO3+NO2)	1.05	1.05	1.05	1.05	1.05	1.05	1.05		1.1
Fecal Coliform	20	20	250	60	500		140		86.5
Chloride	20.7	14	13.7	17.9	19.8	16	21.1		17.6
pH	7.9	7.7	7.8	7.8	8.1	7.9	8.2		7.9
Crypto	0								0.0
Giardia	0								0.0
Specific Conductivity	355	285	346	385	448	457	558		404.9
Sulfate	90.55	57.2	89.95	68.51	83.7	65.6	97.9		79.1
TDS	278	142	272	294	364	356	400		300.9
Bromide	***50***	***50***	***50***	***50***	53.44				50.7
Ratio TDS: Spec Cond.	0.783	0.498	0.786	0.764	0.813	0.779	0.717		0.734
Downstream-Sample #	0331042	0331048	0331054	0331060	0331067	0331073	0331079		Avg.
BOD	0.7	1.4	1.4	0.8	8.5		1.9		2.5
TSS	5	7	5	11	13	12	***5***		8.3
Alkalinity	11.2	10	62.2	14	15.8	31	20		23.5
NO2-N	***0.01***	***0.01***	***0.01***	***0.01***	***0.01***	***0.01***	***0.01***		0.0
NO3-N	0.51	0.27	0.16	0.31	0.47	0.36	0.36		0.3
NH3-N	0.05	0.04	0.22	***0.02***	0.03	0.04	0.05		0.1
TKN	***1***	***1***	***1***	***1***	***1***	***1***	***1***		1.0
Phos	0.045	0.031	0.17	0.039	0.039	0.072	0.038		0.1
TOT N(TKN+NO3+NO2)	1.52	1.28	1.17	1.32	1.48	1.37	1.37		1.4
Fecal Coliform	***20***	30	280	30	***20***		20		35.5
Chloride	10.4	5.5	17.8	9.5	12.5	14.5	13.1		11.9
pH	6.9	6.9	7.8	7.1	7.2	7.4	7		7.2
Crypto	0								0.0
Giardia	0								0.0
Specific Conductivity	113.3	90.2	340	110.5	126.9	176.8	139.8		156.8
Sulfate	19.52	***15***	79.05	16.4	20.9	22.4	***15***		26.9
TDS	60	86	266	72	118	130	100		118.9
Bromide	***50***	***50***	***50***	***50***	***50***				50.0
Ratio TDS: Spec Cond.	0.530	0.953	0.782	0.652	0.930	0.735	0.715		0.757

Bold, italics values are "Less than", meaning belowing detection limit or method limit - Fecal Coliform average is a geometric mean

* 5/24/11 downstream sample collected approx 150 yds downstream of OF 001, all other samples collected approx 1.5 miles downstream of OF 001

Table J.1: DEP, BOL testing results for effluent, upstream, and downstream sampling locations

Lab Resutls-James City WWTP

	5/11/11	5/17/11	5/24/11	6/2/11	6/2/11	6/9/11	6/21/11	6/23/11	6/30/11	7/6/11	7/21/11	
MLSS - Sample #	0331043	0331049	0331055	0331061		0331068	0331074	0331076	0331080	0331088	0331092	Avg.
MLSS	3044	2200	2232	2464		3268	1924	2020	2476	2668	2402	2470
MLVSS	2528	1668	1840	1982		2716	1560	1720	2088	2032	2268	2040
MLSS/MLVSS ratio:	83.0%	75.8%	82.4%	80.4%		83.1%	81.1%	85.1%	84.3%	76.2%	94.4%	82.6%
Alkalinity	124.8	80.8	101.6	123.8		172.6	97.2	102	93.8	172.6	94.6	116
MLSS probe	4000	3500	3500	3440		4080	2672	3120	3100	2800	3000	3321
	0.76	0.63	0.64	0.72		0.80	0.72	0.65	0.80	0.95	0.80	0.75
RAS - Sample #	0331044	0331050	0331056	0331062		0331069	0331075	0331077	0331081	0331089	0331093	Avg.
MLSS	4350	4336	3636	3804		3516	3570	2884	4696	3020	3478	3729
MLVSS	3640	3108	3012	2902		2984	2872	2344	3528	2756	3336	3048
MLSS/MLVSS ratio:	83.7%	71.7%	82.8%	76.3%		84.9%	80.4%	81.3%	75.1%	91.3%	95.9%	82.3%

	5/11/11	5/17/11	5/24/11	6/2/11 Raw Sewage	6/2/11 Into Aeration	6/9/11	6/23/11	6/30/11	7/6/11 Raw Sewage	7/6/11 Into Aeration	7/21/11 Raw Sewage	7/21/11 Into Aeration	
Influent -Sample #	0331039	0331045	0331051	0331057	0331063	0331064	0331070	0331076	0331084	0331090	0331091	0331094	Avg.
BOD	341	445	201	280	887	617		692	315	738	497	417	424
COD	301	709.7	628.3	481		283.7	140.5						481
BOD/COD ratio:	113%	63%	32%	58%		217%							96.7%
TSS	190	248	192	175		910	828	126	256		350	134	364
Alkalinity	152.4	132.6	155.8	163	206.8	116.6	109	106.4	244.6		144.8		147
NO2-N	0.03	0.05	***0.01***	***0.01***		***0.01***	0.01	0.02	***0.01***		***0.01***		0.0
NO3-N	***0.04***	0.36	***0.04***	***0.04***		***0.04***	***0.04***	0.09	***0.04***		***0.04***		0.1
NH3-N	21.86	15.78	21.78	30.06	42.78	18.2	12.01	16.48	51.43	47.79	30.07	35.92	24.2
TKN	46.7	33.91	47.19	51.47		42.84	85.54	35.01	70.72		54		51.9
Phos	5.898	5.122	5.795	6.069		6.975	21.951	4.923	8.389		7.319		8.0
TOT N	46.77	34.32	47.24	51.52		42.89	85.59	35.12	70.77		54.05		52.0
Chloride	40.1	65.8	39	43.6		42.2	43.3	36.2	52.1		38.3		44.5
pH	7.7	7.2	7.3	7.6		6.4	6.6	7	7.6		6.8		7.1
STP Flow, MGD	0.006	0.016	0.008	0.009		0.006	0.014	0.00728	0.00626		0.00358		0.0085
Bromide	***50***	***50***	***50***	***50***		***50***							50

Bold, italics values are "Less than", meaning belowing detection limit or method limit

Table J.2: DEP, BOL testing results for influent and aeration basin

Attachment K—Biosolids production worksheets

Highland Township Municipal Authority STP

Date:	**2010 DMRs**	BOD mass removed by STP					
		influent pounds BOD/day		6.11	lbs/day	*from plant data*	
Plant Name:	**James City STP**	effluent pounds BOD/day	–	0.9	lbs/day	*from DMRs*	
		BOD mass removed by STP	=	5.21	lbs/day		
Design Flow:	**0.035**						
Design Loading:	**69**	pre-digestion sludge mass produced by STP					** sludge production factors*
Avg Daily Flow	0.00761	BOD mass removed by STP		5.21	lbs/day		extended aeration = .65
Months	Actual Sludge Disposed	sludge production factor *	x	0.65			oxidation ditches = .65
Jan		pre-digested sludge mass	=	3.3865	lbs/day		conventional activated sludge = .85
Feb	0.17514						contact stabilization = 1.0
Mar		post-digestion sludge mass produced by STP **					
Apr		***calculate only if plant has a digestor*					*solids reduction in digestors*
May		pre-digestion sludge mass		3.3865	lbs/day		0 days (no digestor)= 1
Jun		% of pre-digestion solids remaining	x	0.8			10 days = .9
Jul		post-digested sludge mass	=	2.7092	lbs/day		15 days = .8 **default value**
Aug							20 days = .7
Sep		estimated amount of sludge to be removed					>30 days = .65
Oct	0.17514	sludge mass (pre or post)		2.7092	lbs/day		
Nov		days per year	x	365	days/yr		
Dec		estimated sludge mass for disposal	=	988.86	lbs/yr		
0	0.35028						
x	2000lbs/ ton	percentage of sludge mass for disposal					
	700.56	actual		700.56	lbs		
	actual lbs removed	estimated	/	988.86	lbs		
				0.70845359			
			x	100	%		
				70.8454	%		Sludge Removal Percentage

Estimated tonnage calculated by:
gallons sludge hauled x 1% solids x 0.0000417
4200 x 1 x 0.0000417 = 0.17514 tons
- loading data from chp 94 and DMRs

Figure K.1 Highland Township Municipal Authority Sludge Volume Calculation for 2010

Date:	**2007 DMRs**	BOD mass removed by STP					
		influent pounds BOD/day		14.47	lbs/day	*from CHP 94 report*	
Plant Name:	**James City STP**	effluent pounds BOD/day	–	0.71	lbs/day	*from DMRs*	
		BOD mass removed by STP	=	13.76	lbs/day		
Design Flow:	**0.035**						
Design Loading:	**69**	pre-digestion sludge mass produced by STP					** sludge production factors*
Avg Daily Flow	0.0085	BOD mass removed by STP		13.76	lbs/day		extended aeration = .65
Months	Actual Sludge Disposed	sludge production factor *	x	0.65			oxidation ditches = .65
Jan		pre-digested sludge mass	=	8.944	lbs/day		conventional activated sludge = .85
Feb							contact stabilization = 1.0
Mar		post-digestion sludge mass produced by STP **					
Apr		***calculate only if plant has a digestor*					*solids reduction in digestors*
May		pre-digestion sludge mass		8.944	lbs/day		0 days (no digestor)= 1
Jun		% of pre-digestion solids remaining	x	0.8			10 days = .9
Jul	0.342	post-digested sludge mass	=	7.1552	lbs/day		15 days = .8 **default value**
Aug							20 days = .7
Sep		estimated amount of sludge to be removed					>30 days = .65
Oct		sludge mass (pre or post)		7.1552	lbs/day		
Nov		days per year	x	365	days/yr		
Dec		estimated sludge mass for disposal	=	2,611.65	lbs/yr		
0	0.342						
	x 2000lbs/ ton	percentage of sludge mass for disposal					
	684.00	actual		684.00	lbs		
	actual lbs removed	estimated	/	2,611.65	lbs		
				0.26190359			
			x	100	%		
				26.1904	%		Sludge Removal Percentage
	Estimated tonnage calculated by:						
	gallons sludge hauled x 1% solids x 0.0000417						
	8200 x 1 x 0.0000417 = 0.17514 tons						
	-effluent loadings estimated using annaul avg flow and 10 mg/L permit limit						

Figure K.2 Highland Township Municipal Authority Sludge Volume Calculation for 2007

Attachment L—NPDES Effluent Discharge Limits

Highland Township Municipal Authority STP
NPDES PA0221520

Discharge Parameter	Effluent Limitations						Monitoring Requirements	
	Mass Units (lbs/day)		Concentrations (mg/L)					
	Average	Maximum	Minimum	Monthly Average	Weekly Average	Maximum	Minimum Measurement Frequency	Required Sample Type
$CBOD_5$ (05/01 – 10/31)	2.9	4.4		10	15	20	2/month	24-hr comp
$CBOD_5$ (11/01 – 04/30)	5.8	8.8		20	30	40	2/month	24-hr comp
Total Suspended Solids (05/01 – 10/31)	2.9	4.4		10	15	20	2/month	24-hr comp
Total Suspended Solids (11/01 – 04/30)	5.8	8.8		20	30	40	2/month	24-hr comp
Ammonia – N (05/01 – 10/31)	0.6			2.0		4.0	2/month	24-hr comp
Ammonia – N (11/01 – 04/30)	1.8			6.0		12.0	2/month	24-hr comp
Total Nitrogen				29			1/year	24-hr comp
Dissolved Oxygen			7.0				Weekly	Grab
pH			6.0			9.0	Weekly	Grab
Fecal Coliform 5/1 - 9/0			200/100 ml as a geometric average, not greater than 1,000/100 ml in more than 10% of the samples tested				2/month	Grab
10/1 - 4/30			2000/100 ml as a geometric average				2/month	Grab

Table L.1. Highland Township Municipal Authority NPDES effluent limitations