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Strategic Plan for MDE Compliance at Patapsco Wastewater Treatment Plant

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STRATEGIC PLAN FOR MDE COMPLIANCE AT PATAPSCO WASTEWATER TREATMENT PLANT

EXECUTIVE SUMMARY

Baltimore City's Department of Public Works (DPW) Patapsco Wastewater Treatment Plant (PWWTP) treats approximately 73 million gallons per day (MGD) of raw sewage for Baltimore City and surrounding counties. The plant consists of a screening facility (SF), grit handling facilities (GF), primary (PST) and secondary (Secondaries) settling basins, and advanced treatment processes like the enhanced nutrient removal (ENR), in addition to other processes.

Over the last two (2) years, the plant has experienced severe staffing shortages and persistent repair and maintenance issues exacerbated by the impact of the 2019 ransomware attack of Baltimore City as well as the COVID-19 pandemic, which has caused a strain on consistent staffing, training, and availability of parts and equipment for maintenance and repair. These issues have resulted in the Maryland Department of the Environment (MDE) raising concerns of non-compliance within the past year regarding excursions, such as, Total Suspended Solids (TSS), Total Nitrogen (TN), and Total Phosphorus (TP).

To ensure that any recent departure¹ from normal performance levels was temporary, the agency has undertaken a comprehensive analysis of root causes and/or contributing factors to any perceived non-compliance. The methodology utilized to define the scope of the problem included data collection and analysis, staffing and field assessments, brainstorming sessions with key personnel, consultations with subject matter experts, and a review of DPW's and MDE's protocols. The results of this assessment provide a roadmap for establishing a critical plan of action or strategy. Implementing this strategy gives us an opportunity to rectify ongoing operational issues and perform the required preventive maintenance for each process area.

BACKGROUND

Wastewater is water that has been used in homes, businesses, or industrial operations that carries dissolved and suspended solids. This water is sent to a wastewater treatment plant for processing to remove contaminants.

In the simplest terms, when you take a shower, shave, use a toilet, clean your dishes, rinse at your dentist, wash your hands, manufacture a product, etc., you use water. From the flush to the spin cycle, that water enters a drain which ultimately leads to a treatment facility.

Baltimore's wastewater treatment system serves approximately 1.6 million people in the metropolitan area.

¹ The plant has historically had compliance percentages in excess of 99%, recently Patapsco has experienced a 1 percentage point drop.

- Two Wastewater Treatment Plants: Back River and Patapsco
- Collects and treats up to 250 million gallons of wastewater daily
 - Back River: 180 MGD
 - Patapsco: 75 MGD
- There are 3,100 miles of sanitary mains in the whole system. DPW maintains the 1,400 miles in Baltimore City.
- Operates twelve (12) major wastewater pumping stations and 10 (ten) minor installations.

Scope of The Problem - Patapsco Wastewater Treatment Plant

During MDE's inspection in May 2021, the MDE inspector also noted reporting violations, business process violations, and most importantly, treatment violations per Patapsco's NPDES permit. The reporting and business process violations have been corrected or acknowledged and attested to per the prescribed corrective measures in the MDE report. See attached MDE Violations Response Summary.

In addition to TSS and nutrients, the treatment violations at Patapsco are related to Fats, Oils, and Grease (FOG) and Enterococcus. While FOG is not a reportable parameter on the NPDES permit, the plant has a requirement to remove FOG per the 2017 FOG Mitigation Plan.

Why did Patapsco exceed the permit limits for TSS?

Similar to Back River, Patapsco has had challenges with sludge handling.

Why has sludge management become a problem?

A key factor for handling sludge is the ability to pump and process the appropriate amount of sludge from the treatment process to our 3rd party vendor. In the recent months, the 3rd party vendor experienced some operational failures in its sludge drying operations that led to reduced amounts of sludge uptake from our process. As a result, sludge inventory has accumulated in various process areas and had multiple impacts on the plant. DPW is currently addressing these issues with the vendor.

In addition, the gravity sludge thickeners (GSTs) are inundated with rags in the center column, which impedes the processing and routing of sludge into the sludge blending tanks (SBT's). The rags are indicative of a problem at the screening facility (SF). The screens remove floatables and FOG from the process water prior to the PST's. At some periods in the past year, 3 out of the 8 screens were in service, which required cleaning and repair to out-of-service screens. Without adequate screening, downstream processes were negatively affected, unexpectedly at times, and causes some equipment failures in various areas.

The liquid oxygen (LOX) plant provides pure oxygen to the oxygen reactor (OR) process that promotes bacterial growth and the consumption/elimination of solids. Over the last few months, the main compressor experienced some failures, and the plant is currently trucking liquid oxygen into the plant to continue the treatment process, as opposed to making its own liquid oxygen. The oxygen being delivered is sub-optimal to that which is generated via the on-site oxygen generation facility because of the lack of precision when administering to the oxygen reactors. This impacts the growth of the bacteria and

subsequently the ability of the bacteria to consume solids from the process flow. This directly impacts the SS, BOD, and Enterococci.

Why has nutrient removal become a problem?

Ferric chloride is a chemical that is used for phosphorus removal. The injection of ferric chloride was modified in late 2020 to allow for four separate insertion points to increase dosing and mixing into the process water to allow for the chemical reaction necessary to remove phosphorus from the process water. In Spring 2021, the double containment piping used to inject ferric chloride broke and the plant was left with only one injection point at the corner of the combined influent (CI) channel. This did not allow for adequate mixing and consequently resulted in sub-optimal nutrient removal (specifically TP).

Furthermore, similar to Back River, Patapsco has an ENR facility that is designed to reduce TN and TP through a denitrification process that filters wastewater through specialized filter media, traps nutrients, converts to nitrogen gas, and releases effluent with sufficiently reduced nutrient levels. The ENR process at Patapsco is comprised of two separate processes, the biological aerated filters (BAF) and the denitrification filters (DNF). The BAF are comprised of a Biostyr media that promotes bacterial growth in order to convert ammonia to nitrites for nitrogen removal. During backwash to clean the filters, BioStyr media has been getting dislodged and lost in the process. This has resulted in reduced ammonia nitrogen removal.

Why has FOG become a problem?

This FOG is treated through the fine screens, PST scum troughs, and chlorine contact chamber (CCC) scum troughs. The scum troughs drain into a pit and are pumped to the gravity sludge thickeners (GST's) for processing prior to storage in the sludge blending tanks (SBT's), a storage area from which a third-party vendor pumps to process the sludge.

A unique issue to Patapsco is the excessive amount of FOG the plant sees in the influent. These large amounts of FOG are likely due to concentrated residential and commercial establishments directly upstream of the plant. The Division's Pollution Control Group will conduct source tracking of the FOG to detect contributors to the problem and develop early intervention and mitigation programs.

There also has been excessive build-up of FOG due to an out-of-service scum trough system. This has been out of service for several years and is slated for a CIP project to rehabilitate in March of 2022. In the interim, FOG removal is still needed, and immediate remedies are discussed below.

Finally, during the site review, the MDE inspector found malfunctioning equipment because of maintenance problems. Maintenance is done to correct existing problems and as a preventive measure to improve treatment reliability by minimizing the time equipment will be out of service. Facility maintenance directly affects the ability of the treatment plant to operate efficiently and to comply with its NPDES permit. Due to recent vacancies, the inability to order equipment and tools for repairs, and the pandemic, the ability to sufficiently address facility maintenance and repairs have been affected.

As noted in the MDE compliance report, sludge handling and FOG removal is a large source of permit violations as it is a direct contributor to all permit metrics. The following plan will address the treatment process deficiencies from the MDE compliance inspection, which also is broken into three (3) categories: Immediate; Short-Term; and Long-Term.

Next Steps to Address Compliance Issues at Patapsco

Immediate

Regarding the ferric chloride line, as of Sept. 3, 2021, plant maintenance personnel have repaired the ferric chloride piping. They are awaiting the secondary piping to create the double containment pipe. In the interim, they are creating a berm containment area and placing the ferric chloride line back in service. This repair will improve the removal of phosphorus from the process water.

Regarding the GSTs, DPW has contracted with a third-party vendor to clean out the center columns, pit, and troughs to allow for adequate sludge flow into the GST's. This preventative maintenance activity will occur every 4-6 months until the PWWTP Headworks CIP project is in service (SC 938) by 2025. The ability of the GST's to process sludge will assist in removing sludge from the plant process areas.

An immediate address to the FOG issues has been implemented at the CCC's. The existing scum troughs, collection pit, and pumps have been placed into service to actively skim the surface of the plant effluent water prior to discharge into the Patapsco River. This is in addition to the current oil booms and manual skimming with a pool net that is in place (since 2018). There is no funding needed for this operation and the use of the scum troughs will directly result in removing FOG from the plant effluent.

Regarding FOG, a third-party vendor also has been mobilized to clean out the existing PST scum pits. Thereafter, the plant personnel will then repair or replace the scum pumps in the pits to pump PST scum and FOG to the GST's for processing into the sludge. In conjunction with the pit cleaning and pump repairs, the scum troughs also will be repaired to allow for manual adjustment into the process flow. These repairs range in severity from shear pin replacements to some actuator repairs. Once completed, the scum troughs will be manually operable and significantly improve the removal of FOG from the process water. The pumps and scum trough repairs will take 6 to 8 weeks due to access and equipment lead times. Pump procurement and scum trough repair will be done via the SC 926 CIP project. Again, I must note that we are manually removing FOG until the completion of the CIP project, SC 983.

Emergency authorization (EA) requests will be issued to contract with vendors that will provide immediate assistance, on an on-call basis, with maintenance needs throughout the plants.

Data management and analysis will be critical to ensure compliance with reporting and business process issues. To that end, we are creating an internal dashboard, with the support of the Office of Asset Management, that will be a repository of all permit and plant performance data, source of up-to-date SOPs and guidelines for business processes, as well as a source for alerts to ensure that MDE reports are submitted in a timely manner, consistently. The dashboard will be implemented and operational by October 2021.

The plant will also implement a sampling program for real-time analysis of samples taken by the in-house laboratory team. This will be used to assist in operational review and decision-making for any necessary adjustments. The plant already has the equipment necessary to accomplish this on site analysis and will implement immediately.

The regular training, and refresher training, for all operations staff is a critical component to not only the plant operation, but to the comprehensive preventive maintenance program. We are revising the current process checklists to include regular cleaning and housekeeping items for each area that will be done in the appropriately defined intervals. This will include removal of all overgrowth, landscaping, and debris removal throughout the plant.

Finally, in this immediate timeframe, we are engaging with a wastewater treatment subject matter expert to perform a gap analysis of the treatment processes and identify any gaps in performance that represent future compliance concerns. This effort will serve to build a proactive layer of governance and ensure that we are ahead of any compliance issues. The gap analysis has begun, and a tentative report will be submitted on or around September 30, 2021.

Short Term (beginning within 2-6 months)

Source tracking of FOG will be critical to conducting any intervention. The Pollution Control Group will utilize resources (internal or external) to begin a source tracking program focused on the target sewersheds that contribute flow to Patapsco through the Brooklyn Pumping Station. Once sources of the FOG have been identified, the team will establish monitoring and an enforcement approach. In conjunction, a community outreach strategy with the Cherry Hill community by the Office of Communications and Strategic Alliances will look to impact residential FOG disposal upstream of the Brooklyn Pumping Station. This source tracking initiative is slated to begin by the end of October 2021.

Furthermore, we are investigating the use of a FOG separation system which would process the FOG into a highly desirable brown grease for commercial use. The remaining liquid post separation would then be released back into the regular plant flow for further treatment. Funding for this is already available and possible vendors are being reviewed.

As noted above, the excess rags and sludge in the GST's have severely impacted the operation and equipment of the GSTs, and so they will be cleaned and repaired to ensure optimal service. The repairs will allow for improved processing of sludge into the SBT's for storage and further processing by our third-party vendor. Thereafter, regular cleaning and maintenance protocol will be utilized to reduce the frequency of major equipment failures. This processing of sludge will reduce the amount of SS in the process water treated downstream of the GST process, thereby, positively impacted BOD and Enterococci in the process water.

The out-of-service fine screens are currently being assessed and repaired by a third-party vendor.

Another vendor is working with the plant personnel and engineer-of-record (EOR) to determine the cause for the media loss (possibly a slow closing backwash valve, broken air filters, etc.). Once the cause is determined, a repair project will be established, and the repairs completed under an emergency or fast-tracked contract. These repairs will provide improved nitrogen removal for permit compliance.

Regarding the LOX plant, DPW will repair the main compressor to allow for the process to be run as intended and maximize the solids consumption and reduce the SS, BOD, and Enterococci. This repair will be done via an emergency authorization.

To assist with the sludge inventory issues at PWWTP, another sludge handling vendor will be procured since our current third-party vendor is experiencing operational issues and we require them remain online to remove sludge from the SBT's. The procuring of the additional vendor will be conducted via an emergency authorization and working until no longer necessary. The reduction in on-hand sludge inventory will prevent the plant from halting the pumping of sludge to the GST's and SBT's; thus, backing up downstream systems with excess sludge inventory.

In addition to the noted repair needs noted above, there is also a need for supplemental operations and maintenance staff to assist the current plant team. The plant has an overall vacancy rate of 38%. Division leadership is aggressively working with DPW Human Resources to recruit, hire, and train staff. To date, 15 new employees have been hired between both plants. Supplemental staffing will be procured via an emergency authorization. The consultant operators will ensure proper facility operation and coverage while training existing personnel to increase performance and certifications.

Long Term (beyond 6 months)

Long-term upgrades and improvements will come via various CIP projects – SC 983, SC 938, and SC 1018. SC 983 will have a NTP in March of 2022 to rehabilitate the PST scum collection system and automate the process. SC 938 that will have a NTP in Spring 2022. This project is for the improvements to Patapsco's headworks, which includes a new screen facility with 6 channels and dual screens in each channel (coarse and fine) to remove floatables to improve grit removal, discharge of H₂S, and a preliminary FOG skimming process, and a rehabilitated grit facility. Currently under design is SC 1018, which is the design of a third SBT and repairs to the existing SBT's to increase available storage space.

Our maintenance program will be revamped. Within 3 years, the treatment plants and pumping stations will use a new Computerized Maintenance Management System (CMMS) – Cityworks. Cityworks will facilitate a more systematic approach to issuing work orders for corrective and preventive maintenance and allow for alerts and better record keeping. Cityworks will be operationalized as the CMMS for our treatment facilities by 2024.

Although Cityworks is an effective maintenance management tool, having an adequate number of trained and competent staff is the most critical factor to a world-class maintenance program. We are working with DPW Human Resources to recruit, hire, and retain personnel and reduce our vacancy rate to no more than 10% by the end of the 2022 calendar year. Additionally, we will incorporate the services of the Office of Safety and Training to ensure that training courses for new and existing employees are available and delivered. In addition, we will focus on training on electrical and instrumentation disciplines. By January 2022, our training courses will be available, if not sooner.

Operator certifications are an important component of continued operational success and compliance. We have implemented a training service with 360Water to provide ongoing trainings which also qualify for continuing education credits. This service is already available with training computers setup on the plant for ease of access. In conjunction, we are restarting the in-person training classes by the Maryland Center for Environmental Training (MCET) which were suspended due to the COVID-19 pandemic.

Finally, DPW will complete a feasibility study and Biosolids Master Plan that covers both Back River and Patapsco. Once finalized, this Master Plan will set the course for the design and implementation of a biosolids (sludge) management system that will increase the quality of sludge produced and decrease the quantity and enhance the efficiency of sludge management such that a build-up of inventory will no longer plague our treatment processes. The full implementation of a biosolids system will likely occur no later than 2026 (if not sooner).

The immediate, short term, and long-term action plans for Patapsco WWTP represent DPW's strategy to significantly reduce the number of excursions and return to the near 100% regulatory compliance. Certain initiatives have already been implemented, namely the repair of the ferric chloride line, the cleaning of the GSTs as well as the reinstatement of the FOG skimming process at the CCC. In parallel, we are currently working on embedding sound business processes through an interactive dashboard and performing gap analyses to identify and proactively address other areas of weakness. Source tracking for FOG and addressing the filter media loss at the BAF will require more time to finalize but the completed fixes on the ferric chloride line and FOG skimming will have an immediate positive impact. Additionally, the corrective maintenance (utilizing a capital project) on our fine screens will further enhance treatment while giving us time to establish an improved long-term preventive maintenance system.

Attachment II includes a Level 1 schedule for the Immediate and Short-term corrective actions.

CONCLUSION

The Wastewater Facilities Division believes that this strategic plan is sound and gives us an opportunity to make fundamental changes that will improve our performance for the future. In the execution of this plan, an agency-wide holistic approach will be critical, and so we have incorporated our external and internal partners (i.e., Bureau of Procurement, DPW Fiscal, DPW Human Resources and DPW Office of Safety and Training, etc.) to perfect this work. DPW will also highlight that it is improving its plant management that is data-driven and rational. DPW will also meet with MDE regularly to update them on the progress of the corrective measures. This will help to reestablish relationships and communicate to all stakeholders that DPW is committed to continuous process improvement enterprise wide.

ATTACHMENT I
Corrective Actions to Noted Violations

ATTACHMENT II
PRELIMINARY SCHEDULE FOR CORRECTIVE MEASURES (Immediate, Short-term, and Long-Term)