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Strategic Plan for MDE Compliance at Back River Wastewater Treatment Plant

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STRATEGIC PLAN FOR MDE COMPLIANCE AT BACK RIVER WASTEWATER TREATMENT PLANT

EXECUTIVE SUMMARY

Baltimore City's Department of Public Works (DPW) Back River Wastewater Treatment Plant (BRWWTP) treats approximately 180 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 Back River has experienced a 2-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 - Back River Wastewater Treatment Plant

During MDE’s inspection in June 2021, the MDE inspector noted reporting violations, business process violations, and treatment violations per Back River’s National Pollution Discharge Elimination System (NPDES) permit. The reporting and business process violations have been or will be corrected soon. See attached MDE Violations Response Summary.

The Effluent violations are related to Total Suspended Solids (TSS), Biological Oxygen Demand (BOD) and nutrients (measured as Total Phosphorus and Total Nitrogen). Suspended solids are undissolved particles that are related to BOD in that the presence of high TSS exerts a demand on oxygen, thereby decreasing oxygen in the water, and subsequently reducing the quality of the effluent. Nutrients are components of wastewater that must be reduced in the treatment process to prevent the depletion of oxygen in water.

Why did Back River’s effluent exceed the limitations for TSS?

TSS levels can be traced back to the plant’s solids handling process. When wastewater influent enters the plant, solids are separated from the liquid, through settling of heavier solids, in which the solids are handled separately as sludge; thus, allowing the liquid to undergo further refinement through additional settling, micro-biological treatment, and nutrient removal. The sludge is handled in separate facilities through processes that thicken, dry, and digest and/or dispose safely. When sludge is not managed effectively, an inventory of solids begins to grow and enter the liquid portion of the treatment process. As a result, downstream treatment facilities become overwhelmed and TSS levels increase along with related parameters like BOD, TP, and TN. Furthermore, the excess TSS requires more sodium hypochlorite (Hypo) to disinfect the process water from excess enterococci bacteria. ***Please be advised that no sludge was discharged into the receiving water bodies from Back River or Patapsco.***

Why has sludge management become a problem?

A key step in sludge management is further separating solids from the liquid by using a centrifuge and conveyor belts that develop a solid ‘cake’ that is delivered to an on-site 3rd party vendor for further processing². In January 2021, the centrifuges in the dewatering facility failed and were taken offline for only a few months, which led to an excess of sludge inventory that had some impact on the downstream liquid processing.

² At Back River, a portion of the solids are sent to composting at Quarantine Road Landfill.

In addition, 8 out of 11 of Back River's Primary Settling Tanks (PSTs) were non-operational. Due to these equipment failures, which receive screened influent and allow solids to separate by settling, an excess of sludge occurred downstream in the process that forced the operational equipment to overstress, outside of the designed operating parameters, resulting in more frequent repairs.

The sludge build-up in the PSTs was also related to another upstream process that failed to process grit adequately due to some maintenance issues of the Grit Facility.³ The inflow of unmitigated grit overwhelmed the PSTs. When the PSTs began to fail mechanically, plant personnel executed a cleaning contract with a third-party vendor because the volume of sludge was beyond the capacity of the plant maintenance personnel to handle. However, maintenance issues with the Grit Facility have been remedied pursuant to DPW SC 918 (Headwork) Project that provided for a new grit facility, thereby, mitigating this sludge issue.

Why did Back River effluent exceed limitations for nutrients?

Back River has an Enhanced Nutrient Removal (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 aforementioned treatment challenges related to TSS have served to exacerbate the issues at the ENR facility. The removal of solids upstream of the ENR is critical to the nitrification process in which the bacteria convert the nitrates to nitrites which then allows for the release of nitrogen from the process water during the denitrification process.

Why has treatment at the ENR become a problem?

A component of the ENR is the denitrification facility (DNF), which is currently operating below standards due to a multitude of factors including electrical, instrumentation, blower, and pump issues. The DNF directly impacts the removal of nitrogen from the process water and some impact on phosphorus removal.

It should be noted that the aforementioned root causes serve to highlight challenges with maintenance (corrective and preventive). The high vacancy rates in the division due to retirements and separations, particularly the maintenance sections, means that both plants have excessive maintenance backlog levels that are being addressed as described below.

Next Steps to Address Compliance Issues at Back River

The following plan is meant to address the alleged deficiencies in the treatment process pursuant to MDE's compliance inspection and is separated into three (3) categories: Immediate; Short-Term; and Long-Term.

Immediate

Since May 2021, the City has procured two (2) portable centrifuges to remove sludge from the plant processes. In June 2021, one centrifuge was sent out, repaired, and placed back into service. In July 2021, a second centrifuge was returned to service. A third of the four (4) centrifuges is currently out for repair

³ The old grit facility is no longer in use as the SC 918 (Headworks) project included a new grit facility.

and is expected back in service within 2-3 weeks, and then the last centrifuge will be repaired immediately and back in service by November 2021. Therefore, the entire dewatering facility will be back in full operation by this Fall. These repairs are being done by DPW's current third-party vendor.

Repair of the centrifuges will greatly assist in removing the sludge from the treatment processes, thereby, reducing the amount of TSS in the downstream processes, lowering the effluent parameter results. These centrifuges, as well as other critical equipment, will undergo preventive maintenance by augmented staffing and/or enhanced internal procedures to ensure reliability.

Currently, the third-party vendor has been hired to clean and repair 4 PST's. Two have been completed which have increased the plant operation to 3 in-service PST's. There are two more in process of being cleaned and repaired. These two PST's are slated to be completed in late November 2021.

Cleaning and repair of the PST's will greatly improve the ability to settle out solids from the process water to be processed in the dewatering facility, thus, not being present downstream in the process. Reducing solids in the process water will have a direct impact on the TSS, BOD, and the ability of ferric chloride to react for phosphorus removal. In this immediate time frame, we are engaged in a period of 'catch-up' using all the resources (both internal and external) at DPW's disposal to address maintenance backlogs. Emergency authorization (EA) requests have and 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 standard procedures. To that end, we are now in the process of 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 should be ready for use by the beginning of 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 do 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 will begin the week of September 6, 2021 with a report to be submitted by September 30, 2021.

Short Term (Beginning within 2-6 months)

The Office of Engineering and Construction (OEC) has a new sanitary contract, SC 954, with a notice to proceed in late September 2021. The Scope of Work (SOW) for SC 954 is to remove all sludge, to clean, and provide comprehensive repairs to 5 PSTs. This will continue to improve the process water in a similar fashion to the work currently being done by a third-party vendor noted in the section above. This work is funded through the OEC capital improvement program (CIP) and should be completed within the next 2 years.

In addition to the dewatering process and PST repairs, an engineering review of the DNF will be conducted. This review will assess the individual mechanical processes and the inter-connectivity of the supervisory control and data acquisition (SCADA) controls equipment. The engineering review will be funded via an emergency authorization of an on-call task with a consultant. All necessary repairs noted by the review analysis will be funded through an emergency authorization and two current OEC contracts, SC 927 and SC 954. A fully functional DNF will improve the plant effluent by providing a filter to remove more SS from the process and the reduction of TN and TP from the process water. As you might see, DPW has sought to optimize procurement procedures to immediately address concerns raised by MDE.

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 25%, including a 45-50% vacancy rate in the maintenance department alone. The existing maintenance staff services the Back River plant and all of the satellite pumping stations, and so division leadership team is aggressively seeking to recruit, hire, and retain 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 also helping to train existing personnel to increase performance and certifications.

Long Term (beyond 6 months)

For long-term treatment process improvement, upgrades to some existing facilities are required. The improvements include the rehabilitation of the sand filters that assists in the removal of SS from the process water, improvements to the egg-shaped digesters for better digestion resulting in the reduction of sludge requiring process, and upgrades to improve the sludge processing area for more reliable sludge handling. These improvements will be done via three CIP projects currently under review by OEC. These three projects will be funded via the CIP and construction should begin within 2 years.

Our maintenance program will be revamped. Within 3 years, the treatment plants and pumping stations will be using a new Computerized Maintenance Management System (CMMS) – Cityworks. Cityworks will facilitate a modern and systematic approach to issuing work orders for corrective and preventive maintenance as well as provide alerts, via email and the compliance dashboard, to plant personnel for timely reporting and better record keeping. DPW projects that Cityworks will be implemented and operational in the treatment facilities by 2024.

Although Cityworks is an effective tool for maintenance management, having an adequate number of trained and competent staff is the most critical factor to a world-class maintenance program. We will be

working with DPW Human Resources to recruit, hire, and retain personnel to reduce our vacancy rate to no more than 10% by the close calendar year 2022. Additionally, we will incorporate the training of the Office of Safety and Training to ensure that training courses for new and existing employees are readily available and delivered to our staff. We will focus on training for electrical and instrumentation disciplines since, historically, they were not a priority. By January 2022, training classes will be available for the staff.

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 is completing 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, which will increase the quality of sludge produced while decreasing the quantity and enhance the efficiency of sludge management such that a buildup of inventory will no longer plague our treatment processes. The full implementation of a biosolids system should occur by 2026 (but sooner if feasible).

The immediate, short term, and long-term action plans for Back River 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 cleaning of PSTs, and we have seen positive impacts on effluent characteristics. 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. Even though handling Nutrients at the DNF will require a little time fix, DPW now is utilizing emergency authorization contracts to expedite these fixes and significantly reduce the backlog of maintenance issues through a long-term initiative to revamp our maintenance management 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)