FACILITY AND RESILIENCY PLAN UPDATE

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COMMITMENT & INTEGRITY DRIVE RESULTS

Sewer Department
Hull, MA
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Facility and Resiliency Plan Update

Hull, Massachusetts

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Hull Sewer Department

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1. INTRODUCTION

The Town of Hull Water Pollution Control Facility (WPCF) was built in 1978 (designed in 1974) to service wastewater flows from the Town of Hull, MA. Original design rated the plant for an average capacity of 3.07 MGD with primary and secondary treatment and disinfection, though the plant currently operates at approximately 1.6 MGD under average annual conditions. Future conditions such as the potential for increased flow from buildout within Hull, potential regionalization efforts with the neighboring Towns of Scituate, Cohasset, and Hingham, as well as aging infrastructure have prompted the Town to evaluate their existing facilities condition and capabilities. Technical topics that are addressed in this Facility and Resiliency Plan Update include:

- Flows and loads to the WPCF;
- Process equipment condition assessment;
- Control building condition assessment;
- Process performance and capacity assessment;
- Process alternatives evaluation;
- Electrical resiliency approaches at the WPCF;
- Plant diversion evaluation;
- Vactor and CCTV equipment acquisition; and
- Collection system pump station evaluation.

This Facility and Resiliency Plan Update assimilates and builds upon these evaluations to present recommendations for prioritized improvements and a Capital Improvement Plan (CIP) that reflects both facility needs and available Town funding. Projects primarily focused on expanding capacity to address increased contributions from regionalization are noted to highlight those capital improvements that made necessary by the increased contributions from beyond Hull.

2. BACKGROUND

2.1 FACILITY DESCRIPTION

The Hull Wastewater Pollution Control Facility is situated in the northern part of the Town at the intersection of Spring Street and Nantasket Avenue. The WPCF currently services the Town of Hull and a small section of Hingham and Cohasset through an intermunicipal agreement. Flow is conveyed to the plant through a sewer network primarily joined by an interceptor sewer running the length of Hull with seven remote pump stations in Hull and one in Hingham contributing to the network.

Figure 1: Hull Sewer Network

2.2 HISTORY

Construction for the WPCF and sewer collection system started in 1976. Lift Station A and Pump Stations 1, 3, 4, and 9 were built in the same time period. Pump Station 5 was constructed in 1977 and Pump Station 6 was constructed in 1987. The original WPCF was built with primary, secondary, and disinfection processes. The original facility had two vacuum filters for sludge processing. The combined primary and waste sludge was intended to be processed in an incinerator, but the incinerator was never successfully commissioned. The original gas chlorination system was replaced with liquid sodium hypochlorite for effluent disinfection in 1996. The vacuum filters were replaced in 1994 with a rotary drum thickener. An upgrade in 2002 added influent and effluent pumping capacity to manage higher than expected peak flow events as well as other minor process improvements.

Figure 2: Construction in May 1977

The original collection system was designed to flow by gravity directly to the ocean in many locations with some of that system combined with storm water as well. The collection system upgrades were made in the late 1970s to separate the storm water from the wastewater system as well as divert all the wastewater flow to the new wastewater treatment facility. Plant and collection system conditions have worsened over time, with a high number of equipment failures being related to aging infrastructure in the presence of a highly corrosive environment. Much of the equipment is still original to the plant, with Operations staff taking on incremental improvements to replace failing components in order to keep the system functioning as well as incorporating upgrades to facilities and operational approaches to improve resiliency and system efficiency.

The WPCF and collection system's location on a peninsula between Massachusetts Bay and Hull Bay makes the wastewater system susceptible to damage and operational issues due to extreme storm events and sea level rise. Storm events have posed issues early in the plant's history, with the Blizzard of 1978 causing yard flooding that totally flooded the control building and the equipment within it one month before the plant was commissioned. In response to this early flooding flood gates and concrete flood walls around the control building were added to the design. In addition, an influent sluice gate was installed as well as a hydraulic system to control the new influent gate and the three

Figure 3: Overflowing Chlorine Contact Tanks During 2018 Blizzard

original effluent wet well sluice gates; with the goal to be able to isolate/throttle flows to protect the Control Building. The influent sluice gate was removed around 2006-2007 and was not in place during the 2013 control building equipment failure. A new electrically actuated and immersible influent sluice gate was installed in 2017. Notable extreme flooding events also occurred in 1989, 1991, and 1992, with the WPCF suffering from extreme flooding that damaged major processes and pumping facilities. Internal flooding concerns were partially alleviated in 2002 with the addition of more pumping capacity and even further reduced in 2016 with the purchase of a portable auxiliary pump. These improvements do not however, address the equipment location nor the equipment type located in flood-prone areas. Remote pump stations are similarly at risk with non-submersible pumps and electrical equipment being located below design flood elevations, as well as structural construction that cannot withstand high waters or wave action.

Construction standards and understanding of sea level rise have changed since the WPCF and pump stations were originally designed and constructed. It is now known that predicted storm events can overtop the flood barriers installed after the 1978 flooding. A 2019 study by Woods Hole Group identified design flood elevations to use as a basis for design when considering resiliency at the WPCF and pump stations that account for larger storms and sea level rise.

2.3 RELEVANT ONGOING AND RECENT PROJECTS

The Town has several ongoing projects to address failing infrastructure across the plant and collection systems. Ongoing operations and maintenance work has been addressing failed equipment that is within Operations staffs' capacity to replace under yearly operational asset management and capital improvement funds. This has addressed critical equipment at the facility to some extent to maintain functional systems as best as possible including failing pumps, valves, piping, building components, as well as larger equipment such pumping station rebuilds, the influent gate, above ground fuel tank, and clarifier drives currently in process. Operations has ongoing efforts to incorporate Reliability Centered Maintenance (RCM) efforts into their facility maintenance programs to better identify system components that have the potential to affect critical plant operations while helping drive overall maintenance budgets down.

Hull's Criticality and RCM Project recently concluded and key excerpts from the final report are included as Appendix L. The purpose of the Criticality portion of the project was to define and determine the systems that were critical to safe and reliable operation of the WPCF. The RCM analysis was used to "define the minimum required safe amount of maintenance, engineering, and other risk management strategies to ensure a tolerable level of safety, environmental integrity and cost-effective operational capability" (*Hull WWTP Reliability Centered Maintenance Report*, March 2020). Reliability Centered Design (RCD) was performed for several of the systems to determine potential design approaches for any future improvements and used to support the Facility and Resiliency Plan where appropriate.

One of the resources created through the Criticality & RCM/RCD Project was documentation of the current Operating Context. This documentation describes how the existing equipment is used under a range of scenarios. This understanding is critical to evaluation of the current capabilities and assessment of deficiencies for current and future conditions. For future designs it also will provide insight into operations when evaluating processes, approach, and controls, as well as requirements for bypass and integration.

Coming out of both the RCM and RCD portions of the WPCF analysis were recommendations for one-time changes and engineering evaluations. Some of these projects are reflected in the recommendations described later in this report; some of the projects will be incorporated into future designs for the capital improvements; and some of the projects may be implemented by Operations staff where appropriate to do so. The recommendations provide guidance for how to make the WPCF more reliable in a safe, cost-effective manner.

Ongoing engineering efforts include plant wide Heating Ventilation and Air Conditioning (HVAC) upgrades, structural concrete repairs, sewer system evaluation studies, outfall and underground yard pipe investigations, and designing a berm to protect the plant from extreme storm events. These efforts both inform and serve as a foundation for the improvements recommended in this document. Below is a brief summary of each.

- The HVAC Upgrades Project will replace the control building HVAC system that was flooded out during a plant containment failure in 2013 due to the equipment's location in the basement. The upgrades will relocate critical components to the upper levels, as well as creating create the initial space for a new electrical room on the second floor. The electrical space will be used in future upgrades as electrical equipment is relocated to the second floor.

- The Structural Concrete Repair Project is addressing high priority structural deficiencies in Lift Station A, Pump Station 1, Pump Station 4, and Pump Station 9. The Headworks influent channels may also be part of the work if awarded by the Town. Work in the pump stations will improve safety and allow other improvements to move forward. Work in the influent channels would repair damaged concrete and provide protection against hydrogen sulfide (H_2S) attack.

- Pipe investigations include the collection system, underground yard piping, and the outfall. The Sewer System Evaluation Study (SSES) is focused on identifying sources of high infiltration and inflow so that the Town can focus on those assets that most significantly contribute to high peak flows at the WPCF. The yard pipe investigations will evaluate the condition of the existing yard piping and, where possible, provide a sense for remaining life of those pipes. The outfall investigation evaluates the condition of the outfall and diffusers to understand any performance limitations. All these investigations may lead to recommendations that may require incorporation into proposed capital projects, additional capital projects, or changes in maintenance approach.

- The Town is currently permitting and designing a ring berm around the WPCF. The intent of this project is to increase facility resiliency and offers a way to protect the plant against yard flooding and impact from severe storms. Additional discussion about this project is included later in this report as part of the facility approach to resiliency.

2.4 REGIONALIZATION

Hull and the neighboring Towns of Scituate and Cohasset have expressed interest in regionalizing their treatment and collection systems to serve areas of failing onsite septic systems and increasing development within the area. Scituate and Cohasset have more stringent National Pollutant Discharge Elimination System (NPDES) discharge permit limits than Hull due to discharge locations to a tidal creek and coastal basin, respectively. The Hull WPCF is operating below the original average design flow, which makes it a feasible location to send regional flows. Discussions on the scope and timeline of regionalization are ongoing, but interim regional planning measures are being evaluated for Hull to start taking flow diverted from Cohasset's wastewater system, thus allowing Scituate to utilize capacity at the Cohasset Wastewater Treatment Facility. The Town of Hingham is also participating in regional discussions for service to its World's End area. Hull has included this flow in its build-out scenario for future consideration. Cohasset and Hingham are currently co-permittees and Hull currently receives flow from both Towns though Intermunicipal Agreements (IMA).

Regionalization has the potential to bring plant flows up from the current 1.6 MGD average up closer to the 3.07 MGD average design condition, thus necessitating upgrades to some of the treatment systems. Collection system changes would involve the extension of the interceptor sewer running through Hull and/or capacity changes at Pump Station 3. Modifications to Pump Station 3 will depend on regional flow routing. Flow to Pump Station 3 would require a capacity increase if regional flows are directed to it, whereas extension of the interceptor sewer would allow a capacity reduction since contributions from Pump Station 1 and Lift Station A would be eliminated and redirected to the extended interceptor.

The Interceptor sewer along Nantasket Avenue conveying the majority of flow through Hull is 36" between the WPCF and Draper Avenue. The Interceptor is 30" from Draper Avenue until it ends at Bay Street. The smaller 30" upstream portion of the interceptor has a maximum hydraulic capacity of approximately 9 MGD. Peak flows from regional locations will likely not be able to be conveyed into the system without increased interceptor capacity or infiltration within Hull reduced. Equalization in the regional systems will likely be required to ensure the Hull interceptor does not run over capacity.

3. BASIS OF DESIGN

3.1 FLOWS, LOADS, AND PLANT CAPACITY

The *Flows and Loads* memorandum established the basis for influent flows and constituent loading into the plant for current conditions, at Hull build-out conditions, and assuming additional flow from the regionalization planning effort with Hingham, Scituate, and Cohasset. Despite the original plant being rated for a design average flow of 3.07 mgd, this Facility Plan is based on providing hydraulic and loading capacities for average flows of 1.6 MGD under current conditions and 2.5 MGD with full regionalization at buildout and a future peak flow of 13.5 MGD. This future peak flow is based on the Hull build-out scenario. Peak flows from regional partners exceeding this value will need to be attenuated with storage and equalization upstream of the interceptor to avoid higher flows. Influent loads were recognized as having been reduced due to a number of collection system improvements made since 2018, though due to the short timescale of data collection and for conservative assumptions, both the high- and low-end BOD and TSS values are used for process sizing in the *Process Performance Capacity Assessment*. The more conservative values are presented in Table 1. The Town may also wish to evaluate in the future whether the peak flows can be reduced based on collection system improvements to reduce inflow and infiltration. It is recommended that any reduction be based on a long-term flow record and with full recognition of the impact flooding may have on the flows reaching the WPCF.

Table 1: Current and Future Influent Flows and Loads

Parameter	Design*	Current	Hull Buildout	Regionalization	Regionalization + Buildout
Average Flow (MGD)	3.07	1.6	1.8	2.0	2.5
Peak Flow (MGD)	7.8	12	13.5	13.7**	16.3**
Average Influent BOD (lbs/day)	5,850	2,862	3,200	3,500	4,300
Average Influent TSS (lbs/day)	6,120	4,896	5,200	5,600	6,500

** Source: Evaluation of Sewerage Facilities for Hull, Massachusetts – Appendix E (Black and Veatch Consulting Engineers, December 1983)*
*** Note: Peak flows from the region will require equalization to hold peak flows at the plant below 13.5 MGD. Hydraulic limitations in the interceptor will prevent more than 9 MGD from being contributed downstream.*

Plant capacity was evaluated in the *Process Performance Capacity Assessment* based on the current and future flows and loads and under the assumption that the effluent NPDES permit levels will not be changed in the foreseeable future. The maximum treatment capacity of each process was compared to the projected required treatment for the scenarios summarized above to identify limitations of the plant. Processes were also evaluated to determine if more efficient technology might be implemented. Potential process improvements were identified where current treatment efficiency could be improved or where more treatment or hydraulic capacity would be needed. One of the conclusions of the capacity assessment was that the plant can provide treatment through a secondary and disinfection processes without the need for primary clarification.

One avenue considered, but not pursued was derating the WPCF from 3.07 MGD to meet just Hull's needs. The goal of this approach would be to reduce the Town's capital and operational costs in the short and long term. The savings, if any, would be marginal as facilities are designed to treat a broad range of flows and loads. Derating the plant would constrain the Town's options for regionalization, but would not reduce the capacity need, and associated costs, of the WPCF. As the Town reduces its peak flows over time through collection system improvements, there may be some future operational savings associated with reduced maintenance requirements, but these savings would be realized independent of an official de-rating. As established during the RCM work, the greater the difference between the design capacity and required capacity, the lower the maintenance burden.

3.2 RESILIENCY APPROACH

Resiliency against rising sea levels, extreme storms, and ocean tide events are a key concern for the Town's wastewater facilities due to the proximity to the ocean and bay. Existing facilities are prone to failure from structural, electrical, and process disruptions from high water level events. Current best engineering practices comply with TR-16 Guidelines by elevating all critical electrical equipment at least three feet above the FEMA design flood elevation (DFE). Due to Hull's extreme proximity to the ocean, independent flood and wave analyses have been performed for a few facilities by Woods Hole Group that establish even more conservative resiliency design criteria. Recommendations in this Facility Plan incorporate the Woods Hole Group guidance to design retrofits and rehabilitations to elevate critical components to the required elevation for at least the 50-year design life and all new structures to the required elevation for a 75-year design life. This design approach looks towards replacing equipment critical to maintaining the forward flow and treatment capability of the plant with submersible or immersible components and moving flood prone equipment and electrical gear to higher elevations. Components not impacted by flooding or not critical to maintaining basic plant functionality are not required to meet these standards.

As part of the Town's approach for resiliency, the Town is developing plans to construct a berm around the WPCF. While the timing of the berm completion is uncertain, the assumption for this Facility Plan is that the berm will be built and will provide protection from ocean flood events. The addition of a berm does not change major process recommendations however, as there is still a possibility that flooding may occur within the plant and critical electrical components should still be elevated. The berm is expected to provide better structural protection against wave action as well as potentially protecting lower level office, garage, and yard spaces not critical to the forward flow and treatment of the plant. The berm would also provide protection to the biological treatment processes that have been established at the WPCF. Should they be flooded, it may take some time to re-establish and could degrade water quality should solids escape containment.

Table 2: Summary of Design Elevations

Facility	MA State Building Code (ft, NAVD88)	TR-16 DFE (ft, NAVD88)	Woods Hole Recommended DFE (ft, NAVD88) 50-year Service Life	Woods Hole Recommended DFE (ft, NAVD88) 75-year Service Life	Wave Action
WPCF Control Building*	15	16	18.3	24.3	Yes
Lift Station A	38	39	22.9	26.0	Yes
Pump Station 1	13	14	18.8	24.8	Yes
Pump Station 3	12	13	17.8	23.8	No
Pump Station 4	12	13	17.8	23.8	Yes
Pump Station 5	12	13	17.8	23.8	No
Pump Station 6	12	13	17.8	23.8	No
Pump Station 9	18	19	19.1	24.9	Yes

**Note: DFEs were analyzed and established for other specific sections of the WPCF site in the Woods Hole Group Memorandum for Additional Engineering Services for the Town of Hull WPCF and Pump Stations.*
Source: Woods Hole Group 'Additional Engineering Services for the Town of Hull WPCF and Pump Stations' Memorandum.

3.3 PERMITTING AND REGULATORY APPROVAL

Permitting and regulatory approval will be required for many of the upgrades across the facilities. A close partnership will be required with the Massachusetts Department of Environmental Protection (MassDEP), Massachusetts Coastal Zone Management (CZM) South Shore Region, and local departments for building and planning. Discharge permits are intended to be left unchanged through all the proposed modifications, and thus would not require modifications to the NPDES permit. Massachusetts Environmental Policy Act (MEPA) filings are not anticipated at this time.

Coordination with MassDEP is necessary to ensure that modifications to the plant are approved by the state board, particularly if using State Revolving Funds (SRF) for additional funds for projects. Few anticipated projects make drastic changes to the current treatment system, but input will still be needed to make sure that modifications follow best practices for environmental protection.

Although a permit and federal consistency review may not be needed, coordination with CZM is strongly recommended at all sites wherever new exterior construction is taking place to ensure that the work is not unnecessarily disturbing coastal and marine resources. This coordination will be particularly important when making modifications to exterior structures or replacing aging structures throughout the wastewater network.

Local agencies requiring coordination include the Hull Building Department, which will require review of many of the structural modifications made within the facilities. The Planning Board will be important to coordinate with early on projects that could impact the community regarding construction impacts, setbacks, building height, etc. The Conservation Commission will be involved for any project that impacts environmental resource areas.

4. RECOMMENDED IMPROVEMENTS

4.1 RECOMMENDED IMPROVEMENTS OVERVIEW

Most systems within the plant and remote pump station facilities need improvements. Recommendations are driven by aging equipment, loss of capacity over time, change in design requirements, system efficiency, reliability and maintainability, and resiliency concerns. This section summarizes the driving factors and recommended improvements for affected systems and areas, highlighted in Figure 4. These improvements would all improve the WPCF, but not all are affordable at this time based on current capital budget constraints. Subsequent sections in this Facility and Resiliency Plan Update projects and prioritize the most critical ones within the available budget. In Figure 4, facilities in pink are those that are recommended for demolition, abandonment, or repurposing.

4.2 HEADWORKS

The Headworks area has a high amount of corrosion and resiliency risk because it is the first step in handling the influent flow. Ongoing projects are potentially addressing structural degradation concerns in the area and channel coating to increase the structural lifespan as well as replacement of temporary floor mats and odor piping with permanent floor plating and odor control ducting to reduce structural hydrogen sulfide damage to the room. Permanent changes to pull air more efficiently from the channels is recommended to protect equipment in the room from corrosion.

The grit system is a high-risk component recommended for replacement. The system provides grit removal to ensure longer equipment life in the rest of the plant. The near-failed system is recommended to be replaced with a modern, stacked tray grit removal system. The stacked tray system will remove grit more efficiently with more flood resilient equipment and safer maintenance procedures that do not rely on confined space entry. If the grit system fails prior to replacement, provisions exist for grit removal via a vactor truck connection point. In this scenario operations staff would be able to manually vacuum grit out of the lower portion of the grit chamber. This scenario is less safe than the recommended approach and should not be relied upon for prolonged periods of time.

The influent screen and influent gate are operating as intended and are not in need of improvement. The influent screen is noted to have high corrosion despite its new age. The influent flume is inaccurate at high flows and should be replaced or supplemented with flow meters on the discharge of the influent pump station.

4.3 INFLUENT PROCESS

The Influent Pump Station is incapable of conveying existing peak flows with the current pumping and piping scheme. An auxiliary diesel portable pump is set up for temporary use for additional capacity and/or pumping redundancy. Both the portable and permanent pumps pose a resiliency risk to the plant. The portable pump is prone to damage from yard flooding, whereas the permanently installed pumps within the pump station are non-submersible and have electrical components; both below the design flood elevation and below wet well operating levels, presenting a risk from plant containment failures.

Resiliency concerns can largely be addressed with the replacement of the influent pumps with dry pit submersible pumps, allowing the plant to convey the flow even while flooded. Flow capacity issues can largely be resolved with the addition of a parallel influent force main. The parallel force main will increase pump capacity by lowering system losses by increasing the conveyance area of the force mains and reconfiguring how pumps are connected to the force mains. Discharge head requirements and associated energy costs can be reduced by pumping directly to the Aeration Tanks, which are built at a lower operating elevation than the Primary Clarifiers. Marginal pump power increases may be required to convey extreme peak flows in addition to the force main changes. Critical electrical gear including switchgear and VFDs should be relocated to the new second floor electrical room to address current resiliency concerns about electrical components located below flood elevations.

Hull WPCF
Major Site and Control Building Modifications

1 Abandon Gravity Thickener
Potentially convert to sludge holding tank

2 Odor Control
Install seashell media air scrubbers

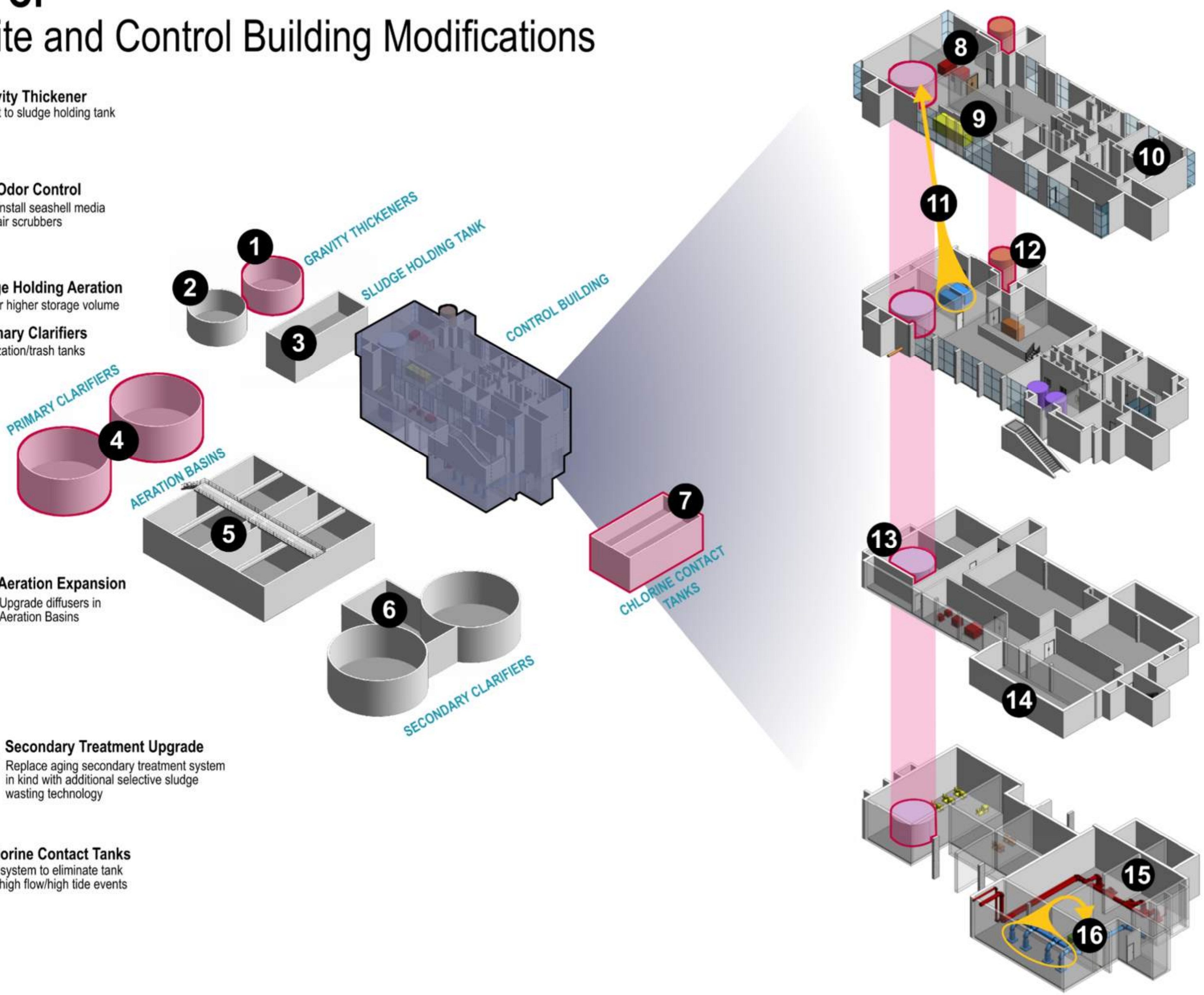
3 Expand Sludge Holding Aeration
Added aeration for higher storage volume

4 Abandon Primary Clarifiers
Convert to equalization/trash tanks

5 Aeration Expansion
Upgrade diffusers in Aeration Basins

6 Secondary Treatment Upgrade
Replace aging secondary treatment system in kind with additional selective sludge wasting technology

7 Demolish Chlorine Contact Tanks
Replace with UV system to eliminate tank overflows during high flow/high tide events



8 Jockey Blower
Added with potential energy grant to reduce annual aeration energy usage

9 Centrifuge
Improved solids handling process for system flexibility and volume reduction

10 Relocate Electrical Equipment
Relocate main switchgear and critical MCCs to second floor for added resiliency

11 Relocate Generators
Move to second floor for added resiliency

12 Demolish Above Ground Sludge Tank
Replace with new solids handling system to eliminate sludge tank freezing issues

13 Demolish Incinerator (all floors)
Makes space for other improvements at the plant

14 Ultraviolet Disinfection
Replacement disinfection for chlorine contact tanks

15 Upgrade Influent Pump Station
Replace pumps with dry pit submersibles

16 Upgrade Effluent Pump Station
Relocate station and convert to dry pit submersible

Figure 4: Major Site and Control Building Modifications

Overarching electrical changes are recommended to move the plant main switchgear out of the basement. Not only would this improve WPCF resiliency, but it would allow a floor hatch above Influent Pump No. 5 to be installed to aid in safer removal of the pump during maintenance.

4.4 PRIMARY TREATMENT

Primary treatment through the Primary Clarifiers is not favored by plant operations due to odor generation of the process. Furthermore, treatment using the Primary Clarifiers is not necessary to meet permit requirements. Contrastingly, operation of the Primary Clarifiers is required in winter months due the freezing potential of the above-ground sludge storage tank. To bypass that tank, operations staff use the Gravity Thickener, which requires primary sludge.

The BOD and TSS reduction that primary treatment would provide is currently achieved in the collection system by In-Pipe bacteria. Additional capacity to treat increased buildout and regional BOD and TSS loads, can be provided by repairing and upgrading secondary treatment systems. With these approaches, operating the Primary Clarifiers would be unnecessary. Primary Clarifiers can be repurposed as equalization/trash tanks as soon as solids handling upgrades are made. By changing the function of the primary tanks, odor issues and equipment maintenance requirements would be reduced.

4.5 AERATION

The aeration tanks have sufficient capacity for existing loads but may require increased capacity for future loads assuming full regionalization. Replacing the fine bubble diffusers in Tanks 1 and 3 in the near term will improve the reliability of aging infrastructure. This technology is still viewed as a modern, cost-effective approach to aeration, and replacing the existing diffusers can improve the system's efficiency. Tanks 2 and 4 still have functioning mechanical aerators that are easy to maintain, but the equipment is older and not as efficient as fine bubble diffusers. Replacement with fine bubble diffusers would increase reliability through redundancy and increase overall capacity of the aeration system. Regionalization or eliminating current upstream In-Pipe bacterial treatment would require use of Tanks 2 and 4 on a regular basis instead of only during high-flow scenarios.

The existing aeration blowers are in good working condition and are not a priority for replacement. They are currently oversized however, and a jockey blower option should be considered in the future if aeration demands are not expected to increase. A jockey blower would provide more efficient aeration without replacement of both existing aeration blowers.

4.6 SECONDARY CLARIFIERS

The secondary clarifiers are currently in poor condition. Extremely deteriorated or failed equipment has rendered the system incapable of meeting the original design capacity mainly due to degraded clarifier mechanisms, RAS, WAS, and scum pumps, and failed RAS piping. Replacing this equipment is critical to ensuring continued permit compliance and restoring design capacity and redundancy and eliminate cavitation issues in the RAS pumps.

Pairing alternative technology with the existing process is recommended if flow capacity is increased in the future so that treatment capacity is maximized while limiting plant footprint. Conversion to granular activated sludge via a selective sludge wasting process will help maintain a consistently low sludge volume index (SVI). Solids can settle more quickly due to the higher average particle density, allowing the clarifier to operate effectively even at higher flows. This would eliminate the need for a third clarifier even under future buildout and regionalization scenarios. It is recommended to install this equipment proactively while replacing the degraded equipment if funds allow, as it is a relatively low-cost addition that can increase treatment capacity while likely fitting in the existing space. This improvement can also be pushed to the future closer to when it would be needed with expanded regionalization efforts.

Electrical gear is recommended to be replaced and raised to the second floor of the control building to increase system reliability and resiliency.

4.7 EFFLUENT PROCESS

Replacement of existing Effluent Process infrastructure is recommended to improve system performance, resiliency, and potentially increase capacity. However, the WPCF will need to be able to stop forward flow from the Secondary Clarifiers to the Effluent Pump Station prior or concurrent to any such improvement. Doing so will allow complete bypass of the pump station during construction of improvements. There are several different approaches to controlling flow into the Effluent Pump Station. These include installing a special sluice gate in plant water manhole S-2, installing a new stop box structure with a gate along the existing piping, and installing a buried gate valve. These options vary in cost, but all provide the ability to isolate the Effluent Pump Station during emergencies, maintenance, and capital improvements. The recommended approach should be determined as part of the design process.

Rehabilitation recommendations for the Effluent Pump Station are based on criticality and available funding. In the short term, effluent valving should be replaced to improve reliability and resiliency by removing stuck-open check valves. Other improvements to the existing Effluent Pump Station include:

- Isolation of the effluent pump station;
- Relocate junction boxes and electrical controls to higher elevations to eliminate flood vulnerability and improve resiliency of the system;
- Improve operator safety by installing hatches with fall protection over existing pump access openings;
- Replace the slide gates between wet wells to restore the ability to isolate sections of the Effluent Pump Station for maintenance and improvement; and
- Complete HVAC work to reduce humidity in the Effluent Pump Room to slow long term corrosion of the piping and valves; repair concrete to reduce structural corrosion.

Ultimately, some of these longer-term fixes may not be required if the Town is able to prioritize the replacement of the existing station with a new dry pit submersible station.

In lieu of upgrades to and rehabilitation of the existing submersible pump station, the long-term recommendation for the Effluent Pump Station is to replace the existing submersible pump station with a dry pit submersible station. This recommendation is paired with the disinfection recommendation to move to an ultraviolet (UV) system. Changing the location of the effluent pumps would create space for the UV system and would also improve operability and ease of maintenance for those pumps.

4.8 DISINFECTION

The chlorine disinfection system is in good condition but has hydraulic limitations and treatment constraints. The chlorine contact tanks are incapable of hydraulically handling high flow events due to outfall capacity limitations and have overflowed on several past occasions. Per TR-16 guidelines, the tank geometry prevents efficient mixing and the tanks are undersized for efficient dosing of sodium hypochlorite. To overcome this, operations staff rely on higher than normal dosing rates followed by de-chlorination with sodium bisulfite at the end of the tanks. This increases operational costs of the system. Modifying the existing tank by increasing wall and baffle height is not recommended.

The long-term recommendation is to convert the disinfection system from chlorine-based to UV disinfection. This would require using the existing effluent pump room space, which would have a trickledown effect requiring relocation of the odor control and plant water systems. This option eliminates the hydraulic and treatment issues of the Disinfection

System and provides operational improvements to the Effluent Process System and ancillary systems. By placing disinfection ahead of the Effluent Pump Station, it allows the pump station to pump directly to the outfall instead of transitioning to a gravity flow system. This has energy savings associated with lower head, a scalable system to adjust to changes storm-driven and long-term sea level changes, and avoided sanitary sewer overflows from the chlorine contact tanks. It also reduces overall operational costs through avoided chemical costs. With proper planning for future needs, the open-channel UV disinfection system is also scalable for future regional flows by the addition of light banks.

If funding is not able to prioritize the transition to a new UV process, the Town may consider converting the existing sodium hypochlorite system to peracetic acid. This would first need to be piloted at the plant before full scale use, but peracetic acid has proven to be a relatively low-cost replacement for sodium hypochlorite at treatment plants in both Europe and the United States. Peracetic acid requires less contact time, which increases the treatment capacity if the existing chlorine contact tanks are used. Hydraulic issues would need to be addressed separately, which can be temporarily accomplished by adding a portable pump connection in the effluent channel of the chlorine contact tanks connected to the outfall to increase effluent capacity. Further raising of the tanks or replacement of the tanks at a higher elevation was not deemed feasible or cost effective.

4.9 SLUDGE TREATMENT

The sludge treatment system will require replacement of aging equipment and, as described elsewhere in this document, needs to be upgraded to allow repurposing of the Primary Clarifier tanks. The WPCF currently converts WAS to thickened sludge via a Rotating Sludge Thickener (RST). During colder periods, the active Gravity Thickener and Primary Clarifiers are needed to avoid frozen sludge and provide adequate sludge storage space and proper thickening. Alternate options were evaluated to potentially improve cost savings and replace deteriorating sludge treatment equipment.

One alternative is to re-invest in the RST-based approach to achieve thickened sludge. Operations staff are familiar with operation and maintenance requirements associated with the RST. Replacements to aging infrastructure such as the RST, sludge transfer pumps and associated piping and valves can be phased incrementally for replacement based on priority and availability of funding. To bring the sludge storage indoors the existing incinerator would be demolished to create room for the new tank as a first step of a phased implementation approach. Repurposing exterior septage tanks for storage was explored, but not deemed feasible due to the geometry of the tank not being conducive to thickened sludge pumping and removal from the tank.

The RST system could also be replaced with a centrifuge system to achieve thickened or dewatered sludge. This approach would eliminate the need for the above ground storage tank as well as the supplemental RST feed and tank recirculation pumps. Eliminating these assets would help to reduce equipment maintenance and operation costs at the plant. A dumpster for dewatered sludge could be located directly below the centrifuge in the garage in a new room segmented off from the rest of the building to control odors. This configuration would eliminate the need for thickened sludge pumping. Creation of dewatered sludge may reduce future sludge hauling costs as compared to thickened sludge. Demolition of the incinerator is not needed for the centrifuge. Modifications to the sludge holding tanks including increased aeration would be required to increase WAS storage capacity to allow larger but less frequent batch processing of WAS. This, in turn, reduce the on-site storage time for the dewatered sludge and the number of hauling trips. Odor control improvements would be required in both spaces to deal with the increased odors from dewatered cake.

The centrifuge system is recommended over the RST system. The centrifuge eliminates equipment (i.e. pumps) compared to the RST and avoids incinerator demolition which is a significant capital expense. Hauling and disposal of dewatered sludge cake is currently believed to be the more cost-effective, long-term solution over hauling and disposal of thickened sludge. Retrofit of the centrifuge system's dewatered cake equipment to handle thickened sludge is also a possibility should future economic conditions warrant it.

Given the current uncertainty in sludge markets, this alternative should be re-vetted prior to final design to ensure that the proposed technology is still best suited for the market. Future markets may have evolving preferences for the acceptance of various types of waste and may introduce an entirely different sludge handling approach such as sludge drying or dehumidification by the time Hull is looking to upgrade the process.

4.10 ODOR CONTROL

The existing odor control system is in the influent pump room and has leaking equipment and containment cracking. Should the Effluent Pump Station be converted to a dry pit submersible system, odor control equipment would need to be moved. For these reasons, it is recommended to retrofit the existing decommissioned Gravity Thickener with a seashell biofilter media odor control system. Seashell biofilter media has a capital cost higher than traditional media but has a similar lifespan and is cheaper to replace. Long term costs are similar but seashell biofilter media currently is slightly cheaper over a 20-year implementation period. Carbon media would require additional storage, negating the opportunity to repurpose existing infrastructure, and an additional blower.

4.11 EMERGENCY GENERATORS

The newer (2002) 750 kW emergency generator is currently in good working condition and the older 520kW generator is in fair condition but are located below the DFE on the first floor in the control building. Two options are recommended based on availability of future funds. The short-term approach is to install a portable generator connection plug on the second floor of the control building as part of the electrical upgrades to power critical equipment after a major storm event. This is a more feasible option under current budget constraints while still helping the plant to regain limited functionality of key equipment after an extreme storm. The long-term, higher capital cost recommendation is to relocate the emergency generator capability to the second floor of the control building to increase resiliency and allow critical equipment to be run during the storm event. Demolition of the incinerator and construction of a new floor space would provide potential space for the relocation, though an elevated exterior generator on a platform could also be considered. Both locations are located near the recently installed elevated diesel fuel tank for easy fuel routing. Sizing should be reevaluated to handle power requirements needed by future processes and peak loads during major storm events. A new generator or generators should be considered based on future needs and generator condition. Fuel alternatives should also be considered to increase operational runtime and efficiency.

4.12 CONTROL BUILDING

The control building currently does not yet allow for public/office use by the Sewer Department but continues to serve its original design for plant operator staff and lab operations, the conveyance of wastewater to exterior treatment processes, and sludge processing. Typical deterioration and deficiencies were noted consistent with what is expected of an approximately 40-year old building, especially due to the nature of the building's exposure to raw municipal wastewater, coastal location, and storage of chemicals. Recommendations for control building upgrades are tiered based on priority of repairs.

The most prominent and frequent observations were degradation of exposed concrete surfaces. These are the highest priority upgrades since sound surfaces are imperative for safety and continued operations. Defects that could be included in a concrete repair project include: Exterior and interior spalling, cracking, peeled paint coatings, efflorescence, water staining, biological staining, chemical staining, exposed concrete reinforcement, and degradation of associated joint caulking and mortar.

Second-tier upgrades to the control building are associated with windows, doors, and lighting. Exterior window glazing treatments require removal and replacement. Interior and exterior doors and frames are deteriorating and require either refurbishment or replacement. Interior and exterior lighting is recommended to be replaced with LED high-efficiency lighting to help reduce control building energy costs.

Third-tier upgrades to the control building are associated with overhead doors and creation of additional interior floor space. Overhead doors are considered operable in the near-term, but exhibit surface coating damages, peeling paint, and metal corrosion in some areas. All overhead doors are recommended to be replaced as funding allows. Flood barriers should be replaced to improve ease of maintenance during storm preparation. Space is constrained at the WPCF. Additional space could be created for storage or generator relocation through demolition of the incinerator and extension of the floors across the new space. Stand-alone structures could also be constructed on-site for additional storage of equipment or vehicles.

No specific defects were noted for general spaces in the control building, which includes the janitor's room, men's and women's bathrooms, staff locker room, lunchroom, laboratory, and other ancillary rooms. Refurbishment of these general spaces is recommended, primarily via rehabilitation of all CMU walls and concrete surfaces for paints and coatings where applicable.

4.13 HVAC SYSTEMS

HVAC systems throughout the plant have been substantially compromised over the years, particularly due to a plant containment failure in 2013 that took out the main system in the basement. The building has since been heated using electric heaters throughout the building and is a costly way to heat the building from an energy consumption standpoint and was always intended to be temporary until the system could be replaced. Air conditioning also exists only through localized mini-split units and window mounted AC units in particular rooms. At this time, a 90% design from Tighe & Bond has been created with plans of going into construction in the near future that will address many of these shortcomings. Future improvements should look to extend this system to improved process areas. Performance of the new HVAC system should be evaluated after construction to confirm performance, particularly in the headworks and effluent pump station areas where condensation should be reduced and corrosive atmospheric conditions improved. The new electrical room being constructed on the second floor as part of the HVAC will get new HVAC systems as part of that project.

4.14 PLANT ELECTRICAL SYSTEMS

Critical components of the plant electrical system are located below the DFE and are prone to failure during a flood event. Electrical upgrades are recommended based on current low resiliency and age of equipment. Recommended upgrades are phased to improve resiliency of critical equipment assuming a limited budget to do so. Electrical upgrades can be implemented as stand-alone projects or integrated into other process-related projects.

In either case, the first phase of upgrades would entail, at a minimum, a new motor control center (MCC) for critical electrical loads. This includes providing additional resilient power distribution systems above the design flood elevation for critical infrastructure. A smart MCC is recommended, which includes VFDs and a PLC for control. The new MCC would house electrical components for the main influent and effluent pumps, a plant water pump, aeration controls, and an additional power panel. Assuming electrical upgrades are implemented as part of a larger project, this phase may also include replacement of the main switchgear and an expanded MCC to house electrical gear associated with the remaining influent pumps, plant water pumps, and secondary treatment components. Electrical components described in the recent FEMA HMGP application should be included in the first phase of upgrades.

Future phases of electrical upgrades would replace the main service switchboard, if not replaced in the first phase, as well as relocate the remaining MCC loads that exist below the second floor. This would complete the migration of the MCC-4, MDP-5, and MDP-6 motor loads up from the basement elevation and existing MCC-1 loads up from the ground floor.

4.15 PLANT AND COLLECTION SYSTEM WASTE RECEIVING

The future closure of the Town landfill requires an alternate solution for vactor waste dumping. Scituate currently is in the design phase of building a new dump pit for this purpose, and it is recommended that an intermunicipal agreement to share resources for future plant and collection system waste receiving be pursued. If the Town of Hull needs to receive and treat their own collection system waste in the future, a coarse bar screen system with a grease baffle is recommended. This relatively low-cost approach can repurpose existing infrastructure, minimize additional WPCF footprint, take in both plant waste and collection system waste, and divert to either the headworks or solids handling streams for processing. A dewatering dumpster at the Town landfill site could also be considered.

The primary clarifier tanks, after decommissioning as a treatment step, may also be used for the temporary storage of material from other tanks. The gravity thickener could also be used for this purpose. Sludge pumps could be repurposed to feed either into the solids handling system or pump directly to a tanker truck for off-site disposal.

4.16 REMOTE PUMP STATIONS

All remote pump stations in Hull are recommended to be either rebuilt or modified to meet current design guidelines for resiliency as described in the WHG memorandum included as Appendix K, as well as addressing notable structural or equipment related defects at many of the stations. Recommended improvements are tiered based on recommended implementation timeline: immediate, near-term, and long-term.

Immediate improvements are recommended at Pump Station 5 and Pump Station 9 to improve station operation and operator safety. The Pump Station 5 pumps are in poor condition with no opportunity to do additional repairs. Replacement is a high priority due to condition, and installation of dry pit submersible pumps is the recommended approach. VFDs can be moved to a higher elevation, above the DFE to improve resiliency. Updates to pump controls are recommended to potentially extend pump life.

Pump Station 9 has severe structural degradation, unsafe and exposed electrical systems, failed ventilation piping, and failed suction piping between the wet well and dry pit. The severe structural degradation and resiliency risk of the pump station puts it as the top priority for replacement. Items potentially affecting operator safety should be on the immediate improvement list, but no other immediate improvements are recommended at the pump station as replacement should be fast-tracked.

Less critical immediate improvements include reducing operating bands on pumps at Lift Station A and Pump Station 6 to improve pump cycling and making sump pump floats operable in Lift Station A. These can be done as time allows, as they would only improve an already acceptable condition.

Near-term improvements are recommended for Pump Stations 9 and 4 to replace aging infrastructure and improve resiliency. Pump Station 9 currently has severely degraded pump equipment, failing structural conditions, electrical hazards, and a high resiliency risk due to the proximity to the ocean. Pump Station 9 is recommended to be replaced with a modern wet pit submersible station and valve vault with control building. Pump Station 4 also has degraded pump equipment, structural deficiencies, poor electrical equipment condition, and resiliency concerns. This station should also be replaced in the near-term in a similar fashion to Pump Station 9, and potentially include ground stabilization measures. If funding is not available for full replacement, a holdover plan for replacement of critical assets should be considered. This involves replacing pumped systems with retrofit dry pit submersible style pumps, replacement of failing valves, and relocation and potential upgrade of critical electrical components.

Mid-term recommended improvements include retrofitting Pump Stations 1, 3, and 6 with dry pit submersible motors that fit on existing volutes to provide a moderate amount of resiliency to stations without overhauling structures entirely. Pump Stations 1 and 3 were mechanically rebuilt with new pumps, valves, and piping in 2017 and 2018. These rebuild projects were done under emergency conditions and could not allow for complete resilient retrofits but have greatly extended the life of the stations until longer term flood resiliency measures can be incorporated. The communication hardware will also need to be replaced in the near-term as the existing modems are obsolete and unable to be repaired or replaced. Switching to a private radio or cellular network is recommended.

Long-term pump station improvements include improving resiliency and repairing aging equipment at, in order of priority, Pump Stations 3, 5, 1, 6, and Lift Station A. Pump Station 3 improvements include full replacement of the pump station with consideration for regional flows and a permanent Bioxide tank. The tank should be located inside to improve flood resiliency. The control structure should be elevated to address structural and resiliency concerns. This work can likely be done concurrent with regionalization, as the pump station plays a potentially key role in conveying flows from neighboring towns. Pump Station 5 recommendations include providing a resilient upper structure by raising it above the local design flood elevation, and structural repairs for the lower structure to rehabilitate aging infrastructure. Pump Station 1 recommendations include elevating the control structure for long-term resiliency, and replacement with a wet pit submersible wet well and valve vault. Pump Station 6 improvements include retrofitting dry pit submersible pumps and elevating the control structure and associated electrical equipment DFE to improve system resiliency. Pump Station 6 upgrades are a lower priority since it is one of the more recently constructed pump stations in Hull. Improvements at Lift Station A are considered the lowest priority in this tier since it has a newer upper structure and is already located at a higher elevation. Replacement of the pump station with a wet pit submersible station may eventually be required due to the poor structural condition of the lower level.

4.17 COLLECTION SYSTEM PIPELINES

The Town has made significant effort to decrease infiltration, inflow, and structural issues throughout the collection system. Major sewer projects on the main Interceptor and in the Atlantic/Gunrock areas are ongoing. There is some early evidence that infiltration may be reduced as a result of lining the Interceptor and manhole rehabilitation. Continued improvement throughout the system will be necessary to address the aging system and continue to bring down peak flows. The improvement will require a relatively steady investment to maintain sustainable collection system costs. A Sewer System Evaluation Study (SSES) is ongoing that will study and make recommendations for defect repairs as needed throughout much of the Town.

4.18 OUTFALL PIPELINE

The outfall pipeline currently limits flow from the WPCF, especially during high water events such as due to tides or storms. This effect is anticipated to be exacerbated with future sea level rise. Capacity is also restricted by blockage of diffuser ports. These blockages are assumed to be due to the sea floor rising in local areas as sediments are transported by currents and waves. Recent investigations were partially successful in inspecting the outfall pipeline. External inspections were not able to locate all diffusers due to them being buried. Internal inspection was cut short due to a sand blockage in the pipeline. Those portions of the outfall that were inspected were in good condition.

Major capital work on the outfall is not anticipated at this time but re-establishing the outfall diffuser ports above the sea floor is recommended to maximize capacity and avoid flow restrictions within the outfall. This work may be possible through additional bottom time by experienced divers where they complete a more thorough search for buried diffuser ports and place diffuser extensions on located ports. Conversion of the outfall system from a gravity system to a pumped system, as recommended for the Effluent Process, would also reduce capacity limitations. Periodic inspections are recommended to assess trends in shifting bottom conditions and diffuser conditions.

4.19 VACTOR/JETTER AND CCTV EQUIPMENT SOURCING

It is recommended at this time that the Town continue to use contractor vactor/jetter and closed-circuit television (CCTV) services in lieu of acquiring cleaning and inspection equipment and bringing on additional skilled staff to do the work. A high-level cost comparison of value of the two approaches strongly suggested that the costs associated with ownership of the equipment exceeded the contractor costs under all scenarios analyzed, including consideration of DPW-wide usage. The high capital acquisition cost, cost of maintenance, and cost of trained staff outweighed the benefits of ownership. Creating a regional resource through inter-municipal agreements with Scituate and Cohasset may make sense, especially given that Scituate has recently refurbished their vactor truck and is considering procurement of CCTV equipment.

4.20 RECOMMENDED IMPROVEMENTS PRIORITIZATION

Improvements are grouped based on criticality and benefit to Hull's wastewater facilities to better understand the prioritization needs for the upgrades. Highly critical and critical improvements address systems in need of improvement due to having poor equipment conditions in processes critical to conveying flow, meeting permit requirements, or otherwise keeping the facility running. All projects with these designations should be implemented as soon as funding allows to alleviate concerns over critical systems near the edge of failure.

The remaining projects are less critical for reducing risk, but do improve operating efficiency of the plant, whether through energy reduction, increased system reliability, or better working conditions for staff. Some of these projects will mainly benefit regional partners and can be implemented when regional contributions materialize. Other projects may qualify for external funding. These Facility and Regional Benefit projects should still be implemented as future funding allows to help bring operating costs to lower and more sustainable rates in the future.

Table 3: Improvements Prioritization

	Highly Critical Projects	Critical Projects	Facility Benefit / Ongoing Improvement Projects	Regional Benefit Projects
Water Pollution Control Facility	• Effluent Pump Station Valve Replacement and Isolation • Influent Pump Station Upgrade • Secondary Treatment System Equipment Replacement	• Grit System Replacement • Solids Handling Upgrade • Disinfection system replacement • Electrical Systems Resiliency Upgrade • Tier 1 Control building Improvements • Backup Generator Relocation to Second Floor	• Odor Control Upgrade • Fine Bubble Diffuser Replacements • Jockey Blower Addition • Storage Facilities Expansion • Tier 2 and 3 Control Building Improvements • Plant and Collection System Waste Receiving	• Aeration Tank Fine Bubble Diffuser Upgrades • Selective Sludge Wasting
Collection System	• Pump Station 5 Dry Pit Submersible Upgrade • Pump Station 9 Replacement	• Pump Station 4 Replacement	• Pump Station 1 and 6 Dry Pit Submersible Pump Retrofits • Continued I/I Reduction and Structural Improvements	• Pump Station 3 Replacement • Interceptor Extension or Improvements

Note 1: Recommended improvements not included in the table such as additional remote pump station replacements are considered future projects. No immediate critical action is required, though changing future conditions may cause these projects to become a higher priority.
Note 2: Projects previously planned and budgeted for implementation are not included in this table.

5. FUNDING

5.1 FUNDING OVERVIEW

The Town has established a five-year CIP fund through bonding that provides the identified funds available for implementation of the recommendations in this Facility and Resiliency Plan Update. Alternative funding sources such as grants and state revolving fund loans may be available to help increase funding for additional improvements. This section outlines existing budgetary conditions and an approach to work towards these long-term goals within available financial resources.

5.2 CURRENT TOWN FINANCES

The Town has established a Capital Improvement budget for the 2019-2023 time period. The capital budget will be authorized by residents of the Town on an annual basis based on a set schedule. A portion of that capital budget has already been expended on collection system pipeline improvements, replacement and upgrade of some critical equipment, and ongoing projects that improve conditions or prepare for future improvements. Table 4 summarizes planned authorizations, as well as budget already allocated and available. Much of the allocations from 2020 to 2023 cover projects that restructure the original Town planning budget in Section 6.

Table 4: Town Capital Budget Authorization Schedule

Funding Year	Authorization Amount*	Funds Allocated**	Funds Available***
2019	$12,303,283	$12,303,193	$100
2020	$11,300,000	$5,843,879	$5,456,121
2021	$9,500,000	$0	$9,500,000
2022	$9,950,000	$0	$9,950,000
2023	$2,794,578	$0	$2,794,578

* *Authorization Amount in Funding Years 2021, 2022, 2023 are as scheduled.*
** *Funds Allocated reflects authorized budget already spent, encumbered, or planned purpose.*
*** *Funds Available reflects budget that has not been allocated and is available for capital improvements*

The prior Town spending plan had assumed projects and project values for the funds described in Table 4 above. These initial projects were intended to replace many components of the plant and remote pump stations, as well as improving the collection system through I/I reduction studies, structural repairs, and sewer cleaning. Studies since this original CIP, including this Facility and Resiliency Plan Update, have helped solidify Town needs and priorities. The capital improvement planning process summarized in this document reallocates funds to schedule the highest priority projects within the pre-established budget by replacing, modifying, reducing, or eliminating scope of work previously budgeted for in the Town budget for 2019-2023.

Recommended improvements that cannot be budgeted within the Town authorizations should still be planned for implementation in future years to continue towards a higher standard of reliability and resiliency as well as lower, more sustainable yearly operating and maintenance costs. Alternate funding sources, some of which are described below, may be used in tandem with the Town authorizations to help accelerate project schedules that would otherwise be deferred to a future time. These future projects may ultimately be funded through the Town of Hull, potential regional partners, or future alternative funding source availability.

5.3 ALTERNATIVE FUNDING SOURCES

Funding and financing sources are available to help improve wastewater facilities in energy efficiency and resiliency. These programs were identified as part of the *Energy Efficiency & Renewable Energy Funding Sources* memorandum, included as Appendix J. Funding sources include the ability to receive grant funding or loans for various energy related projects, including a potential for future rounds of MassDEP GAP funding and SRF loans. GAP funding may help stretch limited budgets in Hull to be able to include improvements that affect energy efficiency while simultaneously affording upgrades related to improving the critical processes. SRF loans would allow the Town of Hull to borrow funds with low interest to fund upgrades and reduce the immediate cost associated with large projects. Unique energy opportunities for Hull may also include working in a combined effort with the local Hull Municipal Light Plant. There may be opportunities to introduce demand response, demand shaving, or renewable energy programs.

Viable funding and financing sources for resiliency projects include the Massachusetts Department of Energy Resources (DOER) Municipal Vulnerability Preparedness (MVP) Program, SRF loans, the Federal Emergency Management (FEMA) Hazard Mitigation Assistance (HMA) Program, and the Coastal Zone Management (CZM) Coastal Resilience Grant Program. The MVP program can help fund vulnerability assessments and develop action-oriented resiliency plans. The HMA Program is better suited for the funding of improving critical infrastructure resiliency and long-term solutions for reducing risks from natural hazards and climate change. The CZM program is specific to local efforts that address coastal flooding, erosion, and sea level rise.

Resources in Appendix J include additional description of many of the above programs as well as contact information and web links to locate additional information about these programs.

6. PROJECT IMPLEMENTATION

6.1 CAPITAL IMPROVEMENT PROJECT TIMELINE

Based on the recommended improvements described in Section 4 and the available budgets summarized in Section 5, a revised Capital Improvement Plan (CIP) was created to schedule projects within funding limits from 2019 to 2023 to address critical needs. The CIP prioritizes improvements that are critical to plant operations as well as improvements that reduce operation and maintenance costs through more efficient or reliable equipment. Recommended improvements have been bundled where there was related construction work and to fit within fiscal constraints. The most critical projects are scheduled for implementation in the coming years. Unscheduled projects will require funding beyond what has been budgeted for currently. As additional funding is identified, unscheduled projects should be evaluated for which have become the highest remaining priority that can be funded. Projects linked to regionalization are conditional based on needing additional treatment capacity or changed remote pumping capacity requirements.

The envisioned projects are explained in brief below as to how they were grouped and conceptualized. Each project is described in greater detail in subsequent subsections. The timing of each is outlined in the timeline presented in Figure 5.

The primary scheduled WPCF improvement projects are the Influent Process, Secondary Treatment, and Control Building Upgrades Project, Solids Handling Upgrade Project, and the Effluent Process Replacement Project. These projects improve nearly all major processes to ensure the WPCF can withstand high flow and flooding events and maintain treatment under current and future Hull conditions. The influent process upgrades are prioritized in earlier funding to address the non-resilient and under-capacity influent pump station, providing protection to the control building against severe flooding in the event of a storm or internal containment failure. Secondary treatment and grit removal systems are also upgraded to replace failed or near failed process equipment that have a significant effect on final effluent quality. This project also includes high priority control building upgrades.

The Solids Handling Upgrade Project addresses the lack of redundancy in the solids system and potential for drastically increased sludge hauling costs if the system were to permanently fail. The solids handling upgrade also allows the Town to eliminate other processes, such as the Primary Clarifiers, and equipment, such as some sludge pumps, that become unnecessary with the upgrade. The Effluent Process Replacement Project upgrades both the disinfection and Effluent Pump Station to address hydraulic limitations and disinfection inefficiencies while also improving maintenance conditions and reducing annual operating costs. Scheduled near-term improvements address the highest priority deficiencies in the Effluent Pump Station, allowing this larger project to be delayed for a short time. There may be some benefit to the Town to implement the Solids Handling Upgrade Project and the Effluent Process Replacement Project as a single project. This may require restructuring the funding schedule for 2022 and 2023 depending on bond timing. In case this approach is not possible, the timeline in Figure 5 assumes that they are implemented independently.

Remote pump station improvements are generally prioritized lower than most WPCF upgrades. Pump Station 9 is the only remote pump station anticipated to be replaced with current Town funding. Pump Stations 5 and 4 are scheduled to receive upgrades improving equipment reliability and resiliency. Limited funding prevents replacement of these stations from being scheduled in the near-term. Other remote pump station improvements will likely need to be future capital dollar allocation from the Town or an alternative funding source to be secured.

After implementation of the scheduled recommended projects, continued plant upgrades are anticipated to be reduced. With the larger critical pieces of the plant addressed during the 2020-2023 period, equipment failure related replacement and repairs should be lower, but continued investment in the WPCF and collection system will still be required to address problems and defects early to control capital repair costs and maintain lower operating costs.

6.2 COST BASIS

Project costs are presented in this section. They are based on pricing from work, activities, or unit costs from similar relevant projects as well as budgetary pricing quotes for some equipment. Projects assume a 15 percent design fee, bidding costs, 17 percent construction administration fee, and markups for contractor overhead and profit, mobilization, and electrical costs. A 30 percent contingency is also applied to most projects to cover uncertainties that may arise during final design development. Costs described in this memorandum are presented as 2020 figures unless specifically noted otherwise. These concept-level estimates are intended to provide initial budgeting assumptions to allocate funds within the Town budget. The estimates will need to be updated as the project-level basis of design is established and the project moves through final design. Project implementation decisions may need to be made in the future as priorities shift over time and as new project information is developed. For projects that are relatively unique to Hull, cost estimates developed for planning purposes can be found in Appendix M. Other projects that are less unique to Hull, such as remote pump station replacements, are based on recent previous work of similar scope and difficulty and do not have detailed cost breakdowns.

Figure 5 and Figure 6 below depict project scheduling. Costs shown in Figure 5 are in May 2020 dollars and reflects the planned CIP work being accomplished within the Town capital budgets through 2023. There are other Town projects with uncertain budgets and timelines that will be prioritized against the planned CIP work for implementation. The most recent published ENR Construction Cost Index is 11,392 (20-City Average). Figure 6 highlights those projects that are recommended for scheduled implementation by 2023 as part of this Facility and Resiliency Plan Update. In Figure 6, the dollar values shown in Figure 5 are escalated at 3% per year from May 2020 to the mid-point of design, bid, and construction. This 3% assumption is representative of recent escalation, but it is unclear how the construction market may adjust to the ongoing pandemic. It is highly recommended that project costs be updated early in the design for each project when project scope is more clearly defined and the market conditions are better known. This will allow the Town to adaptively manage its capital priorities and budget through value engineering, bid structuring, alternate funding, and scheduling.

As can be seen in Figure 6, shortfalls are predicted in 2021 and 2022 when comparing the escalated costs to the current Town appropriation plan. Some of the shortfall identified in 2021 reflects an overlap in costs between line items shown in Figure 6. If the current HMGP grant application is awarded, that will further reduce the 2021 shortfall. Other strategies to consider include use of bid alternates, project scope reduction, leveraging other available Town budgets, and pursuit of stimulus funding and other grant and loan opportunities. After exhausting these measures, the Town could consider modifying future appropriations requests to reflect the best available information at that time.

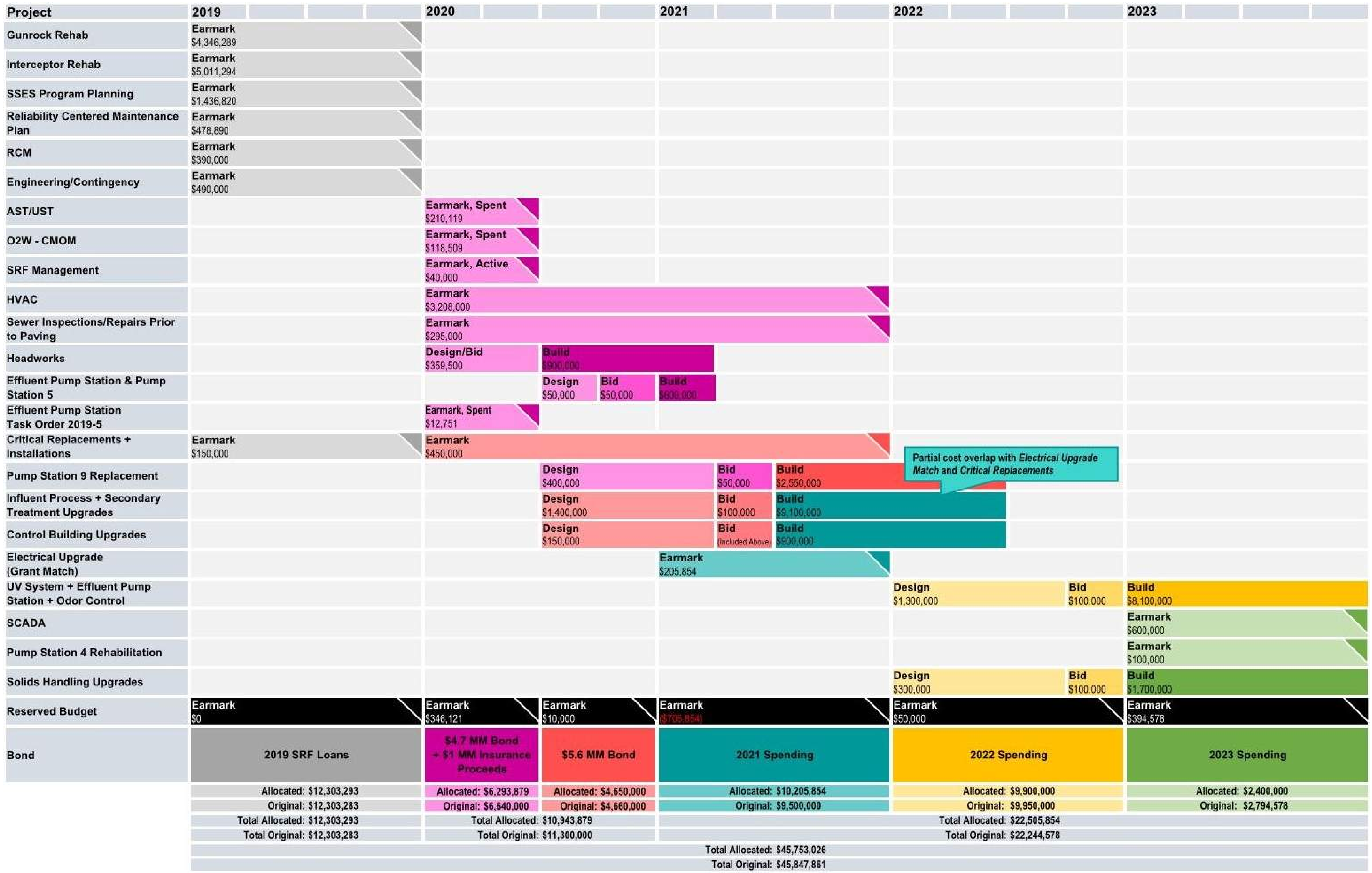


Figure 5: Scheduled Projects Timeline (2020 $)

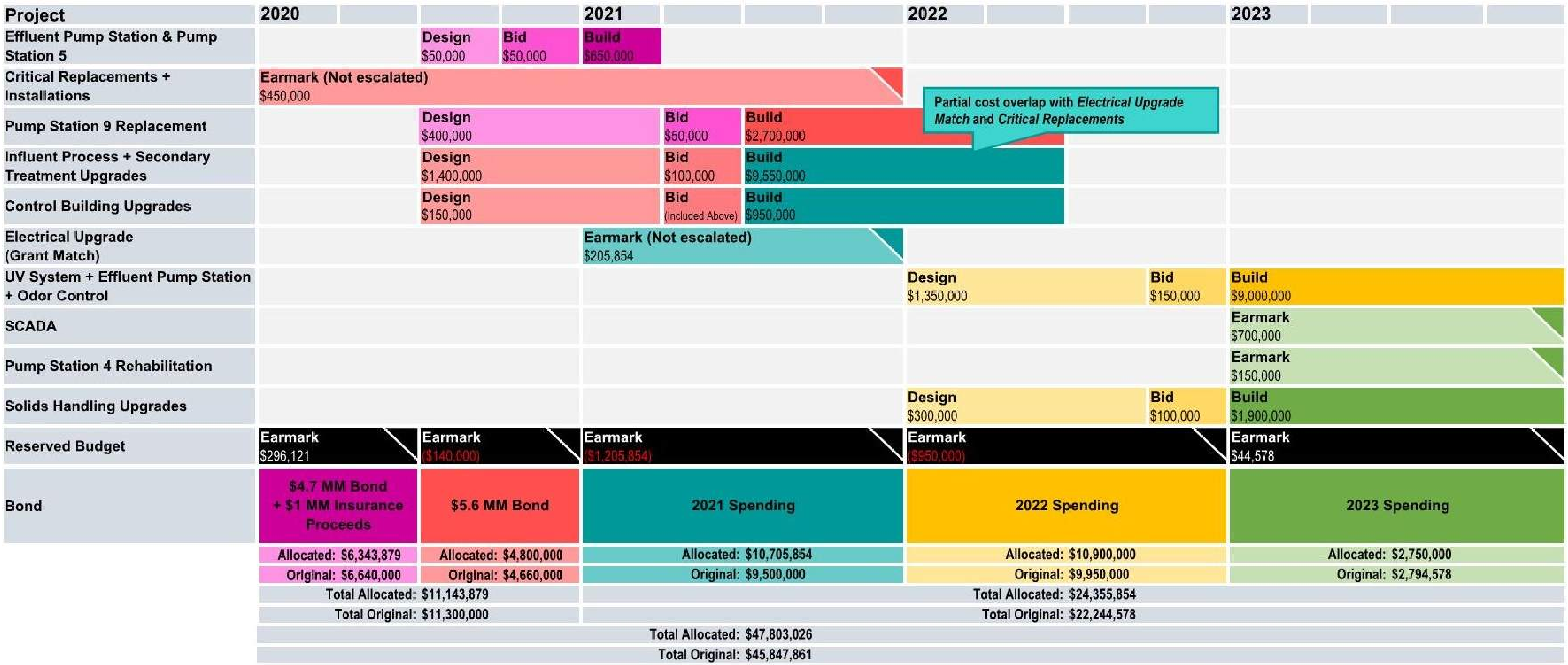


Figure 6: Future Scheduled Projects Timeline (Escalated 2020 $ at Mid-Point)

6.3 SCHEDULED PROJECTS

The projects described in this section address many of the priority recommendations identified in Section 4 of this document. Figure 7 and Figure 8 compare graphically the current and recommended processes at the WPCF.

6.3.1 Effluent Pump Station and Pump Station 5 Rehabilitations

The Effluent Pump Station and Pump Station 5 Rehabilitations project is intended to address corrosion related damages within the Effluent Pump Station and Pump Station 5. Current levels of corrosion in the Effluent Pump Station valves and Pump Station 5 pumps put both systems at high risk of failure. Both systems are beyond maintenance ability with the systems only being able to be run to failure without large equipment replacements. The project should be budgeted and constructed in the near-term to allow continued operation of both facilities. Combining work at both sites into a single bid package is expected to increase work efficiency due to the similar scope of work.

Effluent Pump Station work will replace corroded discharge check and isolation valves on each pump to ensure the pumps can be isolated and hold back water when shut off. The project will also replace the effluent flow meter and an effluent force main gate to regain permanent flow metering capabilities and the ability to isolate the pump station from the Chlorine Contact Tank if needed for maintenance. An isolation gate upstream of the pump station near or in the plant water manhole S-2 is also part of the project.

The work in the Effluent Pump Station addresses the highest priority issues to keep the station functioning under typical operating conditions. Additional future work will still be required to address electrical resiliency, additional corrosion issues, piping and pump replacement, and HVAC upgrades. This work is described in a separate project which largely reconstructs the space.

Pump Station 5's corroded pumps are recommended to be replaced with a modern dry pit submersible pump to allow continued operation and increased resiliency at the station. The new pumps will require piping modifications from the wet well wall up to the intermediate level including isolation and check valves as well as some concrete work in the lower level. VFDs on the intermediate level should be replaced and relocated to the upper level to increase resiliency.

The estimated cost for the work including design, bidding, and construction of the work is $700,000 including a 20 percent contingency. The project is assumed to be designed and constructed in approximately six months.

6.3.2 Pump Station 9 Replacement

Pump Station 9's severely degraded structure and corroded mechanical components are beyond economical repair and replacement of the station is recommended. The project includes a new submersible pump station, with a wet well, buried valve vault, and elevated control structure to meet Woods Hole Group recommendations for a 75-year design life protecting against resiliency concerns. The structure is envisioned to be built adjacent to the current structure to keep the existing pump station online during construction of the new pump station. This will minimize bypass costs and downtime while transitioning operation from the old to the new pump station. The elevated control structure will house new switchgear, VFDs, controls, and a backup generator for powering and controlling the pump system. The structure will need to be designed with visual impact in mind given the high-profile area near the ferry station and Hull High School.

The estimated cost for the work including design, bidding, and construction is $3,000,000 including a 30 percent contingency. The project is assumed to be designed within nine months and built within one year.

Other safety-related repairs described in Section 4.16 should be implemented immediately and ahead of completion of the replacement project. These include ventilation pipe repair, covering exposed electrical components, and some structural concrete repair.

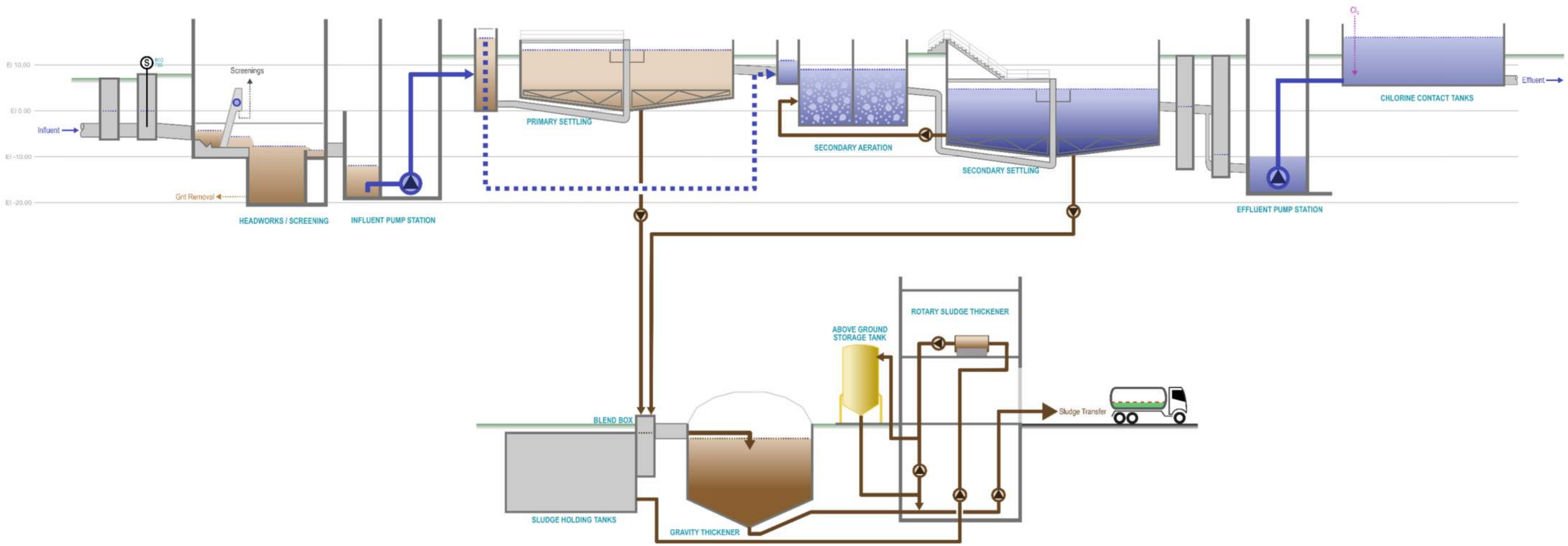


Figure 7: Current Process Flow Diagram

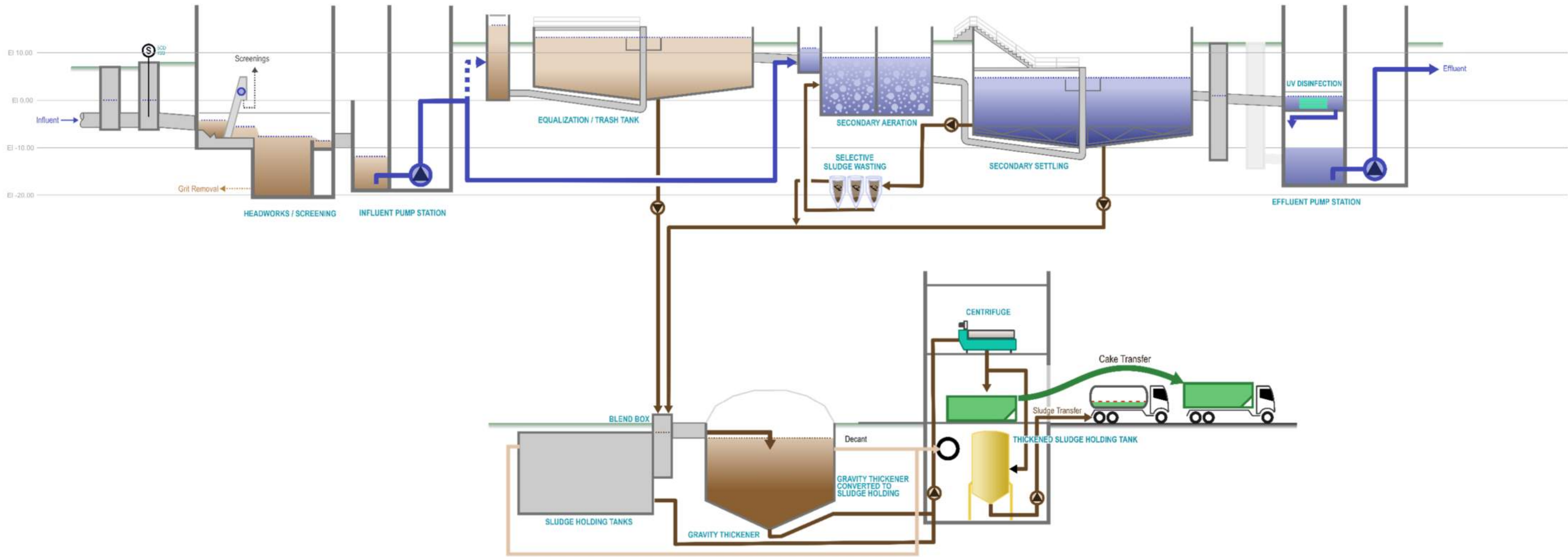


Figure 8: After Process Flow Modifications

6.3.3Influent Process, Secondary Treatment, and Control Building Upgrades

The Influent Process, Secondary Treatment, and Control Building Upgrades project is intended to upgrade or replace components of the plant that are critical to maintaining forward flow and meeting permit limits. Major processes covered include the replacement of the near-failed grit system, replacement of the influent pump station, replacement of the secondary clarifier systems, and control building upgrades.

The aerated grit system is recommended to be replaced with a stacked tray grit removal system. The current grit pumping chamber can be abandoned with the relocation of all mechanical equipment of the new system above the operating floor. This relocation will also decrease the possibility of flood damage from containment failure. The stacked tray grit system can fit inside the existing footprint with minimal alterations. The grit aeration system, including the basement level grit blowers and room, can be abandoned or demolished.

The Influent Pump Station is recommended to be upgraded with five new dry pit submersible pumps to increase reliability and resiliency. Piping modifications include the addition of a larger parallel influent force main directly to a new distribution box in front of the Aeration Tanks. This parallel force main will increase influent pump capacity and facilitate the eventual abandonment of the Primary Clarifiers. The existing 8-inch force main is assumed for cost purposes to be replaced in kind based on pipe age and comparable work in the same location. Whether the 8-inch force main will be replaced may be decided during pre-design based on updated information from an ongoing underground pipe study. The new system can be built with minimal bypassing by installing pumps sequentially.

Secondary Clarifier upgrades include the replacement of both secondary clarifier mechanisms to issues related to equipment age and condition. RAS, WAS, and scum pumps are recommended for replacement due to deteriorating or in failed condition. Failed RAS piping below the clarifier should be chipped out and replaced to allow the plant to regain full RAS capacity. RAS piping will also be replaced in Aeration Tanks 1 and 3. Provisions for a selective sludge wasting process should be included as part of the design to improve current treatment at high flows and prepare for higher loading rates in the future. The selective sludge wasting process is not included in the installed price due to insufficient Town funds, though the system should be considered as a bid additive alternate to be able to install the system proactively if project costs are less than anticipated. The system may otherwise be installed in a later regional project.

New electrical gear is proposed to be installed on the second floor of the control building, replacing both the pump motor control centers and main switchgear, increasing overall resiliency of the plant. The relocation of the main switchgear from the basement will allow for the addition of a floor hatch above Influent Pump No. 5 for safer equipment removal. New motor control centers would be provided for all the new influent pumps and, subject to external funding, two of the effluent pumps. MCCs will also be built in the same area for the new Secondary Clarifier mechanisms and related pumps in the secondary sludge gallery. A new duct bank from the gallery to the control building will route electrical feeds to the new electric room on the second floor. A new portable backup generator connection will be installed in the same area to provide the WPCF with the capability to power the critical electrical equipment after a storm event has subsided should the primary generators not be operational.

Control building upgrades are intended to address failing structural and architectural components, including a number of concrete and masonry repairs, surface painting and coating, door replacement, window replacement, drainage and plumbing upgrades, and lighting upgrades. The upgrades would not cover overhead door replacement or incinerator removal and repurposing of the space.

The estimated cost for the work including design, bidding, and construction of the work is $10,600,000 including a 30 percent contingency. The project is assumed to be designed within nine months and built within one year.

6.3.4 Solids Handling Upgrade

The Solids Handling Upgrade is intended to replace the aging infrastructure associated with the current sludge thickening processes. The improvements allow the plant to have a consistent sludge process year-round that allows for a reduction in process equipment both within the solids handling and primary clarification processes. While this process segment is not critical to maintaining forward flow or providing treatment to permit limits, the upgrade does offer significant improvements in yearly sludge hauling costs, reduced maintenance, and simplified operations for a relatively inexpensive capital cost. The current system additionally has little redundancy and prolonged failure would result in steep cost increases associated with unthickened sludge hauling.

Current market volatility in sludge pricing may drastically change the cost of sludge transport and disposal, as well as recommended disposal methods. It is recommended that the sludge handling solution be reevaluated in the future as the market may change or a new technology may emerge as viable. The ability of the preferred sludge handling solution to produce different types of sludge would be advantageous to the Town to respond to changing market conditions over time without replacing equipment and facilities.

Replacement of the RST with a centrifuge is recommended. The centrifuge would be in the same room and drop sludge cake through a hole cut in the floor to a dumpster in the garage. The garage bay with the dumpster would be sectioned off to control odors from the process. Transfer pumps from the sludge holding tanks to the centrifuge would be replaced with rotary lobe pumps to better control sludge feed rate to the centrifuge. Sludge holding tanks would have aeration extended into the currently unaerated tanks to keep the unthickened sludge mixed for periods up to one week before needing to be processed. The centrifuge would be sized to process approximately one week's worth of sludge in a twelve-hour period to minimize the amount of time that the cake is held in the facility to minimize odor concerns.

Obsolete equipment demolished as part of this project would include the existing RST, the above ground thickened sludge storage tank, sludge recirculation pumps, RST feed pumps, transfer pumps, and the outdoor gravity thickener.

Removing the above-ground sludge storage tank would eliminate the freezing issue and allow the primary clarifiers to be abandoned or repurposed. Conversion of the Primary Clarifier tanks to trash/equalization tanks is included in this project and would allow additional capture of solids from the first flush of a storm even or from tank cleaning. The conversion would include demolition of the primary clarifier mechanisms, upgrade of the sludge pumps to a higher flow rate and extending sludge pump piping to a quick disconnect fitting at the ground level to allow disposal to a tanker truck.

The estimated cost for the work involved with the centrifuge system providing dewatered cake including design, bidding, and construction of the work is $2,100,000 including a 30 percent contingency. The project is assumed to be designed within six months and built within one year.

In case the market shifts towards thickened sludge and away from dewatered sludge, the centrifuge system could be retrofitted to produce thickened sludge. To do so, some downstream processes would need to be added including installation of a new sludge holding tank, transfer pumps, recirculation pumps, and a discharge pump from the centrifuge to the tank. The incinerator would likely need to be demolished to provide a space for an indoor sludge holding tank. These elements are not included in the current recommendation as the current market trend is towards dewatered sludge but are mentioned here as a potential future reference.

6.3.5 Effluent Process Replacement

The Effluent Process Replacement Project resolves several of the WPCF's long-term process and resiliency issues. It removes the hydraulic concerns of the chlorine contact tanks overflowing during extreme storm events while eliminating the costs and concerns with the disinfection process by replacing chlorine with UV. The project improves ease of operability, maintenance, and resiliency of the effluent pump station by converting the submersible pump station to a dry pit submersible pump station. Odor control will be improved by repurposing existing infrastructure to provide odor control with seashell biofilter media. This conversion removes chemical safety issues by replacing aging infrastructure and equipment, improves pump energy efficiency, and increases available yard space.

Installation of an open-channel UV disinfection system in the existing effluent pump room space is recommended. Demolition of existing effluent pump submersible pumps, piping, and valves will be required. Structural concrete rehabilitation will be needed to improve long-term operator safety in the space and support the open-channel system that is located over the effluent wet wells. Additional influent and effluent piping will be required to reroute existing flows, and slide gates will be needed to provide isolation for any future maintenance needs. HVAC additions will be made to better condition this space against corrosion of equipment. Existing chlorine contact tanks are assumed to be demolished as part of this project to increase available yard space but might be able to be repurposed for storage with some additional investment.

Effluent pump station improvements involve converting the pumping system from a wet pit submersible style to a dry pit submersible style. Dry pit submersible pumps would be installed in the existing influent pump room space that is adjacent to the effluent wet wells. New piping and valves would be installed to replace aging and deteriorating infrastructure. The existing plant water pump skid and piping will be replaced and relocated to make space for the dry pit submersible pumps. The new location for the plant water pump skid is proposed to be the existing odor control equipment space. Slab hatch opening structural modifications are included to improve operator safety and access to the effluent wetwell from the proposed UV room for future inspection and cleaning purposes.

Odor control improvements consist of replacing the existing caustic soda system with seashell biofilter media. This project would relocate the odor control system from the influent pump room to the decommissioned Gravity Thickener No. 2. Existing gravity thickener mechanisms, dome cover, and existing odor control system would be demolished. Concrete repairs will be required to restore condition of the Gravity Thickener tank. New air piping will be installed to the tank, and necessary modification made to the existing gravity thickener blend box.

The estimated cost for the work including design, bidding, and construction of the work is $9,500,000 including a 30 percent contingency. The project is assumed to be designed within nine months and built within 18 months.

6.3.6 Pump Station 4 Improvements

Pump Station 4 Improvements Project will increase pumping reliability and resiliency. The current pumps will be replaced with retrofit dry pit submersible pumps. Pump station valves would also be replaced if not taken care of earlier. The project is intended to improve the station within a limited budget with the understanding that meeting more modern best practices will require a full replacement of the structure in the future. A separate project will also be required to stabilize the shore adjacent to the structure to prevent ongoing settling issues. Pump Station 4 may need to be relocated as part of the stabilization efforts.

The estimated cost for the pump reliability and resiliency work is $100,000 and is intended to be implemented as a replacement project by the Town or included as part of a larger project to reduce the associated cost of design, bidding, and construction administration for the project.

6.3.7 SCADA Improvements

It is recognized that SCADA improvements will be required in the relatively near future to replace aging infrastructure and modernize the system for current and planned applications. For planning purposes, this Facility and Resiliency Plan Update assumes that this work will be part of the 2023 work plan at $600,000.

6.4 UNSCHEDULED PROJECTS

As described above, the Town has a limited budget for capital improvements. The following projects are recommended as they improve or restore functionality, reduce operations and maintenance costs, and improve resiliency but they cannot be scheduled until additional funds are available.

6.4.1 Emergency Generator Relocation

The Emergency Generator Relocation Project will address long-term resiliency concerns at the plant. The emergency generators are located on the first floor of the control building which is below the design flood elevation. This makes them vulnerable to failure during an extreme storm event. An elevated portable generator connection will allow the plant to run critical flood proof electrical equipment immediately after an extreme storm event subsides, but moving the emergency generators above the flood elevation will allow the WPCF to keep this electrical equipment powered for the duration of the storm event as well.

The emergency generators are proposed to be replaced and relocated to the space currently occupied by the incinerator. This would provide for direct access to the elevated diesel fuel tank just outside the control building. To achieve this a new structural floor would need to be built after demolition of the incinerator, though alternative locations could be explored during design.

The estimated cost for the work including design, bidding, and construction of the work is $3,000,000 including a 30 percent contingency. The project is assumed to be designed within six months and built within one year.

6.4.2 Remote Pump Station Improvement

Most of the remote pump stations will need continued investment to improve baseline reliability and resiliency. Pump Station 9 is scheduled for replacement and Pump Stations 4 and 5 are scheduled to install dry pit submersible pumps and elevate below-grade VFDs. The changes have already largely taken place at Lift Station A. Similar pump retrofits and electrical equipment relocation should be implemented at Pump Stations 1 and 6 as well as Pump Station 3 should the regionalization replacement project not be implemented. Valves, piping, and equipment should be budgeted to be replaced as the components reach the end of their life. Other improvements include the replacement of the aging communications system, as parts are unavailable to fix the current telephone-based modems. Safety improvements should also be made to improve operator access to lower levels and ensure proper ventilation to the structure. Ongoing structural repairs should be anticipated in the older structures.

Dry pit submersible retrofit motors to fit the older pump volutes are anticipated to cost approximately $50,000 to $100,000 per station including installation costs assuming no required changes to the piping system as these pump motors are direct replacement for the existing motors. Modern dry pit submersible pump replacements are not anticipated to fit in any pump station except for Pump Station 6. The cost of the replacement dry pit submersible pumps is approximately the same cost as the dry pit retrofit motors. The modernization of the communications system is anticipated to cost approximately $100,000 across all stations. Both items can be staggered investments across the pump stations in need of improvement over time to fit within annual budgets. Other improvements will vary based on station complexity and level of future degradation.

6.4.3Pump Station 4 Replacement

Pump Station 4's aging structure needs replacement and is a particularly high resiliency risk due to the proximity to the bay. The structure is additionally affected by ground settlement caused by unstable surrounding soils. The combination of these factors makes replacement of Pump Station 4 a higher priority than replacement of Pump Stations 1 and 3.

Pump Station 4 is recommended to be replaced with a new submersible pump station, underground valve vault, and a new control building elevated to meet design flood elevation criteria to achieve a 75-year design life as outlined by the Woods Hole Group. The electrical equipment and backup generator would be housed in the new elevated control structure to ensure continued functionality of the station during flood events, with the structure being designed to meet wave analysis criteria. There is potential for this structure to be relocated to the lot across the street to build the project in parallel to keep the system running during construction to minimize downtime. This may also provide some mitigation for soil settling problems.

The estimated cost for the work including design, bidding, and construction of the work is $3,000,000 based on work of similar scope and difficulty. The project should be able to be designed within nine months and built within one year.

6.4.4Other Remote Pump Station Replacements

Resiliency concerns and structural condition will be drivers for the replacement of many of the 40+ year old pump stations. The Remote Pump Station Improvement projects will buy the Town some time, but replacement pump stations will eventually be needed. Similar to Pump Station 9, the replacement pump station would consist of a new submersible wet well, valve vault, and elevated control structure. The electrical equipment and backup generator would be housed in the new elevated control structure to ensure continued functionality of the station during flood events

Full replacements of Pump Stations 1, and 3 are needed to offset continued structural and equipment degradation within the planning period, approximately twenty years. Pump Station 3 will likely be addressed as a regional project and is discussed further in Section 6.5. Pump Station 5 control structure should be elevated higher than its current elevation to meet the Town's design standard. This resiliency improvement will supplement the work completed in the Effluent Pump Station and Pump Station 5 Rehabilitation Project. Additionally, lower level structural conditions will need to be assessed in the future to ensure the lower level can be reused. Pump Station 6 may only need upper level improvements to raise the controls and generator as the lower structure is newer. Lift Station A replacement can likely be deferred until after replacement of the other pump stations due to its overall better condition.

The anticipated cost of a full replacement costs per station as described above is approximately $3,000,000 based on equivalent projects. Projects should be able to be designed within nine months and built within one year. Differing scopes of work may adjust this cost and schedules on a site by site basis.

6.4.5Storage Facilities

Storage for portable equipment and spare parts at the plant is lacking and currently leaves equipment either unprotected outside or in storage containers in the yard. A number of options for expanding the facility storage exist, including the demolition of the incinerator and repurposing of the space for light storage, the repurposing of the chlorine contact tanks as a storage building, or constructing other permanent structures on the yard to provide adequate protection and storage. Anticipated costs can range from $100,000 to $700,000 depending on the storage approach taken.

6.4.6Plant and Collection System Waste Receiving

The recommended approach for waste receiving is for Hull and Scituate to share Scituate's dump pit. This avoids additional capital cost and takes advantage of regional facilities. Alternatively, a small coarse bar rack could be purchased and installed as a stand-alone project or incorporated into another scheduled project if funds allow. The estimated cost for the work including design, bidding, and construction of the work is $400,000.

For higher volumes of waste, use of the converted primary clarifier to a trash/equalization tank is the recommended approach. The work for this conversion and associated piping modifications are described as part of the Solids Handling Upgrade Project.

6.4.7 Collection System Improvements

The Town has significant inflow and infiltration contributions to flow, as demonstrated by the high wet weather peaking factors. Additionally, flow to the WPCF has a measurable response to tidal state. Recognizing the importance of collection system maintenance and improvement, the Town has already invested significant capital dollars into the ongoing Interceptor and Atlantic/Gunrock Projects. This investment appears to be showing returns already in reduced rainfall response. The Town's artificial intelligence pilot program, funded through the MA Clean Energy Center, may help to better understand inflow and infiltration within the Town. The current SSES project will identify priority improvement locations to continue to reduce flows to the WPCF and maintain a functioning collection system. Although no additional Town budget dollars are allocated for pipeline and manhole improvements, it is recommended that alternate forms of funding collection system improvements be identified. Future budgeting and rate setting should consider including regular funds for collection system capital projects based on the recommendations of the SSES.

6.4.8 Plant Berm

The Town has completed preliminary design for a berm around the perimeter of the WPCF to protect the plant against flooding and wave impacts. The berm would have the potential to protect equipment within the yard as well as flooding within the control building. However, many of the proposed plant upgrades will already address resiliency concerns through the installation of more resilient equipment, relocation of critical electrical equipment, and other best practice measures that protect both against storm flooding and flooding due to plant containment failures. As such, the berm may be less critical to the plant as originally intended, though still offers some potential benefits for the protection of the operator spaces on the first floor. If the berm is not constructed, the plant will likely need to consider improved floodproof doors, garage doors, and other barriers to protect the lower levels. The first floor and lower levels will still be likely be impacted by extreme storms; space usage should continue to take this aspect into account to ensure that only non-critical or rapid return functions are installed in these levels.

Ultimately, the cost of a berm addition should be weighed against the other improvements that potentially protect the plant facilities with less permitting and financial burdens. The berm still may offer protection that these other upgrades cannot, such as protection of yard facilities and biological processes.

6.5 PROJECTS TO BE ADDRESSED WITH REGIONALIZATION

6.5.1 Aeration Tank Upgrades

Bringing significant flows and loads from Scituate and Cohasset will likely drive the need to expand aeration capacity to meet BOD and TSS permit requirements. The mechanical aerators in Aeration Tanks 2 and 4 are recommended to be replaced with fine bubble diffusers. This will mirror the installation currently in Aeration Tanks 1 and 3 to increase aeration performance. Additional blower capacity will not be required as the current aeration blowers are adequately sized for fine bubble diffusers in all four aeration tanks. Piping expansions will be required to connect the new system to the current one, as well as additional dissolved oxygen monitoring, actuated valves, and SCADA modifications. For budgeting purposes, the selective sludge wasting process is included during this upgrade to increase secondary capacity, though this may be potentially added in an earlier project.

The estimated cost for the work including design, bidding, and construction of the work is $1,400,000 including a 30 percent contingency. The project is assumed to be designed within six months and built within three months.

6.5.2 Pump Station 3

Future capacity requirements for Pump Station 3 will be partially driven by conveyance decisions made in the regionalization process. Flow from Scituate and Cohasset could be routed through Pump Station 3 to be conveyed to the Hull interceptor sewer. This approach would require increased station capacity to meet new flow demands.

Alternatively, the interceptor could be extended to the border with Cohasset. This would allow flows from Lift Station A and Pump Station 1, which are currently in the Pump Station 3 sewer-shed, to be redirected to the Interceptor and bypass Pump Station 3. This would reduce the capacity requirement at Pump Station 3 as well as avoid pumping flows from Pump Station 1, Lift Station A, and regional partners unnecessarily. Either scenario will prompt Hull to reconsider the station's pump selection, wet well capacity, pipe sizing, and electrical system.

A new structure may be desirable to accommodate the new conditions and equipment and replace the aging and less resilient infrastructure. The station is recommended to be rebuilt using a submersible pump and wet well design with buried valve vault to improve pump resiliency. A new control building is recommended to be built to meet elevations described by the Woods Hole Group to meet the 75-year design life to withstand future flood scenarios. The elevated structure will house new electrical gear, a generator, and provide a permanent protected home for the Bioxide tank used to help control odors in the downstream collection system.

The estimated cost for the work including design, bidding, and construction is $3,500,000 based on recent projects of similar scope and difficulty. The project is assumed to be designed within nine months and built within one year.

7. CONCLUSIONS

The Facility and Resiliency Plan Update provides recommendations that improve Hull's wastewater facility reliability, resiliency, and ability to treat current and future anticipated loads within the existing capital improvement budget. Deferred upgrades are currently costing the Town significant dollars for emergency repairs and leave the plant vulnerable to process failures. Investing in the plant will simplify operations, reduce maintenance costs, and make the plant more resilient to external forces such as climate change, uncertain sludge disposal markets, and regionalization. This plan makes recommendations for most major systems of the plant including the influent pump station, secondary treatment system, disinfection, effluent pump station, and solids handling systems. Several collection systems improvements, particularly around improving the reliability and resiliency of remote pump stations, are also recommended.

After implementing the recommendations in this report, the influent and effluent pump stations at the plant will be able to convey a peak flow of 13.5 MGD for severe storm conditions, with capacity improvements throughout the WPCF to also accommodate this flowrate. The need for temporary operations for diverting flow throughout the plant will be eliminated, increasing plant efficiency and reliability. Continued I/I reduction in the collection system will be required to ensure systems at the plant do not become overwhelmed. Recommendations associated with treatment capacity account for both current loads and future loads associated with Hull buildout and other potential regional contributions while also increasing operability and efficiency. Sludge systems are upgraded to increase disposal flexibility to keep sludge disposal costs lower in an uncertain future sludge market.

At the remote pump stations, projects are recommended and scheduled for the highest priority issues where continued service is at risk. The Facility and Resiliency Plan Update provides recommended options for additional remote pump station improvements that are scalable based on available funding. Some of these recommendations extend the life of or improve the existing pump stations while other recommendations replace the pump stations with fully modernized, resilient pump stations.

Continued investment into the WPCF, remote pump stations, and collection system will still be required after completion of the recommended scheduled projects. The projects scheduled for the 2020 through 2023 time period do, however, make significant gains towards reducing excessive emergency repairs and costs associated with system inefficiency. With these improvements and continued investment, Hull has the ability to lower operational costs for the facilities to more sustainable levels.

APPENDIX A. FLOWS AND LOADS

APPENDIX B. EQUIPMENT CONDITIONS ASSESSMENT

APPENDIX C. PROCESS PERFORMANCE AND CAPACITY ASSESSMENT

APPENDIX D. PROCESS ALTERNATIVES EVALUATION

APPENDIX E. CONTROL BUILDING ASSESSMENT

APPENDIX F. REMOTE PUMP STATIONS EVALUATION

APPENDIX G. ELECTRICAL RESILIENCY

APPENDIX H. PLANT DIVERSION EVALUATION

APPENDIX I. VACTOR/JETTER AND CCTV EQUIPMENT ANALYSIS

APPENDIX J. ENERGY EFFICIENCY AND RENEWABLE ENERGY FUNDING SOURCES

APPENDIX K. DESIGN FLOOD ELEVATIONS (WOODS HOLE GROUP)

APPENDIX L. RCM/RCD FINAL REPORT EXCERPTS

APPENDIX M. PLANNING LEVEL PROJECT COST ESTIMATES

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