**ROCKLAND, MA**

**APRIL 2021**

# Comprehensive Wastewater Treatment Plant Assessment and Evaluation

WRIGHT-PIERCE
Engineering a Better Environment

# COMPREHENSIVE WASTEWATER TREATMENT PLANT ASSESSMENT AND EVALUATION REPORT

**FOR THE**

**TOWN OF ROCKLAND, MASSACHUSETTS**

**APRIL 2021**

**PREPARED BY:**

**WRIGHT-PIERCE**

**600 Federal Street, Suite 2151**
**Andover, MA 01810**
**Phone: 978.416.8000 | Fax: 978.470.3558**

# ROCKLAND, MA
# COMPREHENSIVE WASTEWATER TREATMENT PLANT ASSESMENT AND EVALUATION

## TABLE OF CONTENTS

# TABLE OF CONTENTS (CONTINUED)

## TABLE OF CONTENTS (CONTINUED)



## LIST OF TABLES

# TABLE OF CONTENTS (CONTINUED)

## LIST OF FIGURES

## TABLE OF CONTENTS (CONTINUED)



## Appendix:

## SECTION 1

## EXECUTIVE SUMMARY

### 1.1 INTRODUCTION

The Town of Rockland owns a Wastewater Treatment Plant (WWTP) which serves the Town of Rockland and parts of the Town of Abington. The WWTP is located at 587 Summer Street. The WWTP is operated by Suez. The WWTP was originally constructed in the mid-1960s (drawings are dated 1964) and the plant was upgraded in the late 1970's to a two-stage nitrification activated-sludge plant (drawings are dated 1977). The Town has not completed a comprehensive plant assessment of the WWTP since the 1977 secondary system upgrade. In the interim, several assets, such as sludge and chemical pump replacements, have been upgraded through equipment replacement/upgrades. The Administration Building was expanded in 2000.

The Rockland WWTP is authorized to discharge treated effluent through its outfall to the French Stream. Effluent discharges from the wastewater treatment plant must meet standards set forth in state and federal water quality legislation. These standards establish minimum effluent discharge requirements which must be satisfied at all times. In accordance with Section 402 of the Clean Water Act, the plant's effluent quality requirements are contained in a National Pollutant Discharge Elimination System (NPDES) permit which was issued to the Town jointly by the Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MassDEP) in January 2006 (MA0101923) and modified and reissued in April 2007. The permit (and modifications) expired on July 1, 2011. A new NPDES permit has not yet been issued by EPA/DEP. A copy of the Final 2007 NPDES permit is contained in **Appendix A.**

### 1.2 PURPOSE AND ORGANIZATION OF REPORT

In 2019, the Town of Rockland elected to commission this WWTP Evaluation and Assessment to identify and plan for needed improvements at the WWTP. The comprehensive assessment included conducting a condition assessment of existing process and building systems; and developing a capital improvement plan (CIP) to address the condition, age, useful life and efficiency of each unit process and associated equipment currently installed at the wastewater treatment plant.

## 1.3 CONCLUSIONS AND RECOMMENDATIONS

Based on the work completed as a part of this project, the following conclusions and recommendations are provided:

1. The WWTP has provided reliable service since the early 1980s; however, many of the equipment and building systems are well beyond the end of their expected useful life and will require comprehensive upgrades in order to provide continued reliable service for the planning period. Typical service life for most WWTP equipment and building systems are between 25 to 30 years. The equipment and building systems at the Rockland WWTP have been in operation for over 40 years.
2. Furthermore, the existing WWTP infrastructure (tanks, buildings, electrical systems) have not been addressed since the 1977 upgrade and are also in desperate need of repair/improvements. This includes significant corrosion and concrete damage, inoperable mechanical HVAC systems, leaking roofs, water intrusion in the underground electrical duct banks, and various building and life safety code compliance issues. The consequence of failure varies from unit process to unit process. However, there are numerous very high priority items that could have severe ramifications if failure occurred prior to an upgrade.
3. A comprehensive upgrade of the WWTP should begin immediately. Based on the significant needs at the WWTP, a comprehensive upgrade will be a multi-year process.
4. The annual average flow currently treated at the WWTP is slightly below the facilities permitted flow capacity. An increase in the permitted flow capacity is not expected given the French Stream’s water quality, flow volume and impoundment locations. Therefore, aggressive removal of infiltration and inflow (I/I) should continue independent of the timing and/or scope of the WWTP improvements.
5. It is recommended that the Town immediately proceed with the development of a Comprehensive Wastewater Management Plan (CWMP). The CWMP is one of several requirements that would help position the Town for zero percent financing for the nutrient related portions of the WWTP upgrades. The CWMP can include evaluation of remote treatment and/or effluent disposal options in addition to I/I reduction to manage WWTP permitted flows to achieve long term compliance with the WWTP’s effluent permit.

6. The Town of Rockland's WWTP currently utilizes an anaerobic digestion process to reduce the volume and mass of the solid material (i.e., sludge) that must be removed from the facility each week. Reducing the amount of material that must be trucked offsite will reduce the WWTP's annual operating costs.
   a) The estimated capital costs to upgrade this treatment component outweighs the annual cost savings achieved through reduced sludge disposal costs, at the current market sludge disposal rate (i.e., $/wet ton of material hauled offsite).
   b) There is significant volatility in the local sludge disposal market. This is due to the changing landscape regarding PFAS chemicals and limited final sludge disposal locations. This volatility is likely to continue for the next few years. It is expected that sludge disposal cost will steadily increase from year to year.
   c) As sludge disposal costs increase over the coming years there may come a point in which the anaerobic digestion process would have a positive return on investment. It is unknown at which point over the next 20 years (typical project cycle) a positive net return would occur. It could be as short as three to five years or closer to 10 years.
   d) Eliminating the anaerobic digestion process in favor of a simplified solids handling scheme will have a lower initial capital cost.
   e) In January of 2018 a feasibility report entitled "Evaluation of the Feasibility of Combined Heat and Power at the Rockland Wastewater Treatment Plant" was submitted to the Town and the Massachusetts Clean Energy Center. The feasibility study evaluated expansion of the anaerobic digestion complex to include the acceptance of merchant sludge. The hauled-in merchant sludge could potentially provide a revenue source for the Town through sludge tipping fees and power generation. That report concluded that the existing general state of repairs required for the anaerobic digestion complex was cost prohibitive. As such, expansion of the anaerobic digestion complex to include the acceptance of merchant sludge was not recommended.
   f) The anaerobic digestion process also provides additional non-economic benefits including reduce odor generation and use of a green technology.
   g) The current project cost estimate includes abandoning the anaerobic digestion process and upgrading the WWTP to a simplified solid handling scheme. Retaining and upgrading the

anaerobic digestion process would add \$3.0M to \$5.0M in capital project costs, depending on options chosen.

h) The current schedule includes initiating design related services in mid-2022. A review of the anaerobic digestion cost-benefit analysis should be conducted at that time based on an updated understanding of the current sludge disposal market. This analysis should also reevaluate the financial implication of incorporating power generation independent of receiving merchant sludge.

7. The Town of Rockland is facing the prospect of a lower total phosphorus limit and a total nitrogen limit. Section 4 summarizes recommendations to achieve compliance with both parameters (nutrients). It is recommended that the Town move forward with a biological process that assists in the removal of these two nutrient parameters regardless of the timing of a future change to the current permit limit. It is almost certain that these parameters will be included in the facility permit within the 20-year planning window.
8. A tertiary treatment process was identified as being a required wastewater component if the Town receives a 0.1 mg/l seasonal total phosphorus limit. A tertiary treatment process is not required to achieve compliance with the current NPDES permit. As such, this unit process could be installed later commensurate with the issuance of a 0.1 mg/l TP limit.
   a) The presented tertiary project costs are based on the inclusion of a ballasted flocculation process to achieve permit compliance. This technology represents a conservative approach with respect to the estimated project costs.
   b) It is recommended that during the initial stages of the design phase of the WWTP upgrade, pilot testing be conducted to ascertain the actual site-specific phosphorus removal performance of cloth filtration technology. At this time, without actual site-specific pilot testing, it is unknown if cloth filtration can achieve consistent compliance with a 0.1 mg/l effluent total phosphorus limit.
   c) If proven successful, cloth filtration would represent a lower cost tertiary treatment solution.

## 1.4 PROJECT COSTS AND FINANCING

Planning level project costs have been estimated for the recommended facilities upgrades/improvements. A summary of the recommended improvements is provided in Section 5.

Total project costs by major unit processes are presented in **Table ES-1**. The total project cost estimate for the comprehensive upgrade is presented in **Table ES-2**.

It is recommended that the Town take advantage of low interest financing through the Massachusetts Department of Environmental Protection (DEP) Clean Water State Revolving Fund (CWSRF) program. CWSRF loans have a standard term of twenty years and an interest rate of approximately 2 percent. A CWSRF project can become eligible for a zero percent rate (for nutrient related portions of the upgrade, including Total Phosphorous reduction) if the community meets five specific criteria. One key criterion is the development of a CWMP. As such, it is recommended that the Town proceed with the development of a CWMP to position themselves for a loan through the CWSRF program (2 percent standard, 0 percent for the nutrient related portions of the project).

**TABLE ES-1**

**PROJECT COST ESTIMATE BY UNIT PROCESS**

| PROJECT COMPONENT | COST |
|---|---|
| Screening and Grit Facility (New) | $4,900,000 |
| Influent Pump Station Modifications | $2,200,000 |
| Primary Clarifier Modifications | $2,300,000 |
| Secondary System Modifications | $13,400,000 |
| Secondary Clarifier Modifications | $2,700,000 |
| Tertiary Building (New) | $6,300,000 |
| Chemical Building (New) | $1,900,000 |
| Chlorine Contact Tanks and Effluent P.S. | $300,000 |
| Sludge Storage Tanks | $2,300,000 |
| Administration Building Modifications | $5,200,000 |
| Garage and Electrical Building (New) | $3,200,000 |
| General | $4,400,000 |

**TABLE ES-2**

**TOTAL COST ESTIMATE – COMPREHENSIVE UPGRADE**

| PROJECT COMPONENT | | COST |
|---|---|---|
| CONSTRUCTION | | $38,240,000 |
| CONSTRUCTION CONTINGENCY | 5.0% | $1,910,000 |
| | | |
| ENGINEERING SERVICES | 20.0% | $7,648,000 |
| MATERIALS TESTING | 0.5% | $191,000 |
| ASBESTOS & LEAD PAINT ABATEMENT | | $0 |
| DIRECT EQUIPMENT PURCHASE | | $0 |
| LAND ACQUISITION/ EASEMENTS | | $0 |
| LEGAL/ ADMINISTRATIVE | 1.0% | $382,000 |
| | | |
| **SUBTOTAL** | | **$48,371,000** |
| | | |
| FINANCING | 1.5% | $726,000 |
| | | |
| **ENGINEER'S ESTIMATE OF PROJECT COST[2]** | | $49,100,000 |

Notes:

1. Cost estimate is based on ENR INDEX 11,625 (12/2020)
2. Cost estimate is based on eliminating the anaerobic digestion process in favor of an alternative solids handing scheme. Refurbishing the existing anaerobic digestion process would add an additional $3.0M to $5.0M to the total project cost.

## 1.5 PROJECT IMPLEMENTATION

The estimated project schedule for WWTP upgrades/improvements is shown in **Table ES-3**. The schedule is subject to change based on the Town's review and final selection of WWTP upgrades. The proposed schedule assumes the development of a CWMP in 2021, design phase engineering services in 2022, and construction beginning in early 2024. A two-year construction schedule has been assumed as part of this implementation schedule and completion of the upgrades in a single project (vs. multiple project phases).

**TABLE ES-3**

**PROPOSED SCHEDULE**

| MILESTONE | DATE |
|---|---|
| Completion of the WWTP Evaluation | Winter 2021 |
| Town Appropriates CWMP Funding at Annual Town Meeting | May 2021 |
| CWMP Development and Completion | July 2021 – June 2022 |
| Town Appropriates Design Phase Funding at Annual Town Meeting | May 2022 |
| Preliminary Design Phase Engineering Begins | July 2022 |
| DEP SRF Loan Project Evaluation Form (PEF) Submitted | August 2022 |
| Preliminary Design Report (30% design completion) | December 2022 |
| Draft DEP SRF Loan Intended Use Plan (IUP) Notification | December, 2022 |
| Final DEP SRF Loan IUP | January 2023 |
| Final Design and Permitting Begins | January 2023 |
| SRF Application Submission (90% Design completion) | By October 15, 2023 |
| 100% Design and Permitting Complete | December, 2023 |
| DEP Issues Project Approval Certificate (PAC) | By December 31, 2023 |
| Bidding | January 2024 - March 2024 |
| Start Construction | April 2024 |
| Substantial Completion of Construction | February - March 2026 |
| Final Completion of Construction | April 2026 |
| One-year Warranty Period | April 2027 |

WRIGHT-PIERCE
Engineering a Better Environment

# 1

# SECTION 1
# INTRODUCTION

## 1.1 INTRODUCTION

The Town of Rockland owns a Wastewater Treatment Plant (WWTP) which serves the Town of Rockland and parts of the Town of Abington. The WWTP is located at 587 Summer Street. The WWTP is operated by Suez. The WWTP was originally constructed in the mid-1960s (drawings are dated 1964) and the plant was upgraded in the late 1970's to a two-stage nitrification activated-sludge plant (drawings are dated 1977). The WWTP was designed for an annual average flow of 2.5 MGD and a peak hourly flow of 6.0 MGD.

The Town has not completed a comprehensive plant assessment of the WWTP since the 1977 secondary system upgrade. In the interim, several assets, such as sludge and chemical pump replacements, have been upgraded through equipment replacement upgrades. The following upgrades have also been completed:

- the expansion of the Administration Building in 2000
- an upgrade to the anaerobic digestion mixing system in 2013.

The key goals of the current plant evaluation include:

- Calculating the current flows and loads received by the facility and assess the expected growth in flows and loads over the next 20-year planning period.
- Assessing key permit issues facing the WWTP and conduct an alternatives evaluation of the improvements needed to meet current and potential future permitting/regulations (discharge limits, etc.). This includes a pending effluent total phosphorus limit and likely a future total nitrogen (TN) limit.
- A comprehensive assessment of all existing equipment and unit processes at the WWTP; conducting a condition assessment of existing process and building systems; and developing a capital improvement plan (CIP) to address the condition, age, useful life and

efficiency of each unit process and associated equipment currently installed at the wastewater treatment plant.

- Conducting a screenings analysis of potential alternatives to provide influent pumping, flow measurement, screening, and grit removal at the WWTP to accommodate planned future growth, ease of operation and maintenance activities versus cost implications.

- Conducting a screenings analysis of potential alternatives to provide biological phosphorus and nitrogen removal.

- Conducting a screenings analysis of alternative tertiary treatment processes for low level phosphorus removal.

- Conducting a screenings analysis of the existing anaerobic digestion process. This will include an evaluation of the economics associated with rehabilitating the existing digestion system and/or enhancements to the digestion process.

- Conducting a screenings analysis of potential sludge dewatering alternatives.

- Compilation of overall recommended improvements into a capital improvements plan based on current and anticipated future needs over the 20-year planning period.

## 1.2 PROJECT/UPGRADE HISTORY

The original Rockland WWTP, as it was constructed in 1964, consisted of an influent pumping facility, two primary clarifiers, two aeration tanks, two secondary clarifiers, and an anaerobic digestion system. The WWTP was upgraded in 1977 to a two-stage nitrification activated-sludge process for ammonia removal. The two-stage process was abandoned shortly after this upgrade to a single sludge nitrification activated sludge process and, in 2000, the Administration Building was expanded.

In general, most of the wastewater equipment currently in use at the facility consists of items that were installed as part of the 1977 upgrade. The existing infrastructure (i.e., structures, tanks, buildings, etc.) currently being used date from the original 1964 construction and the 1977 upgrade. A brief description of plant improvements since its original construction in 1964 is provided below.

Improvements constructed in **1964** (Sewage Treatment Facilities, Contract 64-1, Metcalf and Eddy) include:

- Influent screening and pump station with process equipment, electrical, and HVAC equipment
- Two primary clarifier tanks (currently not used)
- Two aeration tanks (currently used for wet weather flow diversion)
- Two secondary clarifiers (have since been demolished)
- Administration Building
- Two-stage anaerobic digestion process
- Chlorine contact tanks
- Site piping to accommodate the new structures and tanks constructed
- Site electrical distribution system

Improvements constructed in **1977** (Water Pollution Control Facilities, Contract 77-1, Metcalf and Eddy) include:

- Two new Primary Settling Tanks
- Two new Secondary Settling Tanks
- Two Nitrification Reactors
- Two Nitrification Settling Tanks
- New Chlorine Contact Tank, Effluent Pumping, and post Aeration Structure
- Expansion of the Administration Building
- Two additional anaerobic digestion tanks
- New Electrical Building
- Replacement of existing pumping systems and equipment throughout the facility
- New site piping to accommodate the new buildings and structures constructed.
- New site electrical distribution and stand-by generator
- Other improvements to electrical, HVAC, and Instrumentation.

Improvements constructed in **2000** (2000 Expansion Program of the Administration Building R.A.D. Jones Architects, Inc.) include:

- Expansion of the Administration Building including new:
  - Laboratory Facilities
  - Conference and reception area
  - Break Room
  - Shower and locker area

Improvements constructed in **2013** (WWTP Digester Mixing System Replacement, HTA) include:

- New mixing system for Primary Digester No.2

## 1.3 EFFLUENT STANDARDS

### 1.3.1 NPDES Permit

The Rockland WWTP is authorized to discharge treated effluent through its outfall to the French Stream. Effluent discharges from the wastewater treatment plant must meet standards set forth in state and federal water quality legislation. These standards establish minimum effluent discharge requirements which must be satisfied at all times. In accordance with Section 402 of the Clean Water Act, the plant's effluent quality requirements are contained in a National Pollutant Discharge Elimination System (NPDES) permit which was issued to the Town jointly by the Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MassDEP) in January 2006 (MA0101923) and modified and reissued in April 2007. The permit (and modifications) expired on July 1, 2011. A new NPDES permit has not yet been issued by the EPA/DEP. A copy of the Final 2007 NPDES permit is included in **Appendix A.**

### 1.3.2 Current NPDES Effluent Limitations

As the EPA and MassDEP have not issued an updated permit to the Town of Rockland, the Town continues to operate under the 2007 permit. The permit limits for the WWTP effluent (Outfall #001 to the French Stream) are summarized in **Table 1-1**.

**TABLE 1-1**

**NPDES EFFLUENT LIMITS FOR WWTP**

| Parameter | Monthly Average | Weekly Average | Daily Maximum |
|---|---|---|---|
| Flow, mgd | 2.5 | - | Report |
| $BOD_5$, mg/l | 20 | 20 | 30 |
| $BOD_5$, lbs./day | 417 | 417 | 626 |
| TSS, mg/l | 20 | 20 | 30 |
| TSS, lbs./day | 417 | 417 | 626 |
| pH, Std. Units | 6.5-8.3 | 6.5-8.3 | 6.5-8.3 |
| Fecal Coliform, #/100 mL | 200 | - | 400 |
| Total Residual Chorine, mg/L | 0.011 | - | 0.019 |
| Ammonia – Nitrogen, mg/l<br>Oct 1 – March 31<br>April 1 - May 31<br>June 1 – Sept 30 | 3.3<br>2.5<br>1.0 | 3.3<br>2.5<br>1.0 | 5.7<br>5.7<br>1.5 |
| Phosphorus, Total, mg/l<br>April 1- Oct 31<br>Nov 1 – March 31 | 0.2<br>1.0 | - | Report |
| Copper, Total, ug/l | 12 | - | 19 |
| Aluminum, Total, ug/l | 88 | - | Report |

### 1.3.3 Anticipated Phosphorus Limit

As noted above, the 2007 NPDES permit includes a phosphorus limit of 0.2 mg/l (April-October). The WWTP currently achieves this limit through a multi-point chemical addition process. Direct discussions with the MassDEP regarding a potential future more stringent phosphorus limit have not occurred as part of this WWTP assessment. However, through previous discussions between the Town and MassDEP, it has been identified that a reduction of the WWTP's total phosphorus limit could be included in the next permit. Potentially, the phosphorus limit could be:

1. Reduced to 0.1 mg/l for the period of April through October. This limit would be in-line with other low-level phosphorus limits applied within the Commonwealth and would represent the practical limit of technology for removal of this parameter.

2. Reduced to 0.2 mg/l for the period of November through March. The MassDEP has recently issued new permits to existing WWTP's with current phosphorus limits in which the wintertime effluent limits were reduced to be more in-line with current summertime effluent limits.

As part of this assessment, improvements required to achieve an effluent total phosphorus limit of 0.1 mg/l will be evaluated and alternative solutions identified. Almost uniformly, compliance with a total phosphorus limit of 0.1 mg/l will require the installation of a tertiary treatment process (a new process installed between the nitrification settling tanks and the chlorine contact tanks). The assessment of the WWTP did not account for a change to the November through March total phosphorous limit. A reduction in the wintertime total phosphorus limit would increase the WWTP's operating costs as chemical addition, and subsequently increased sludge production levels, would need to be continued throughout the year versus the summer period only. However, a reduction in the November through March limit should not require additional capital improvements at the WWTP.

### 1.3.4 Potential Future Nitrogen Limit

The current permit does not include any limits or monitoring requirements for nitrite, nitrate, total Kjeldahl nitrogen, and total nitrogen. It does include an ammonia-nitrogen limit. MassDEP has been issuing monitoring requirements and total nitrogen limits to various WWTP's throughout the Commonwealth. Given the location and characteristics of the French Stream it is prudent to consider what the impacts to the WWTP would be if it is required to achieve total nitrogen removal. On this basis, potential approaches for nitrogen removal are evaluated in Section 4.

It appears reasonable to assume a moderate total nitrogen limit of 8 mg/l rather than more severe limits of technology total nitrogen limits.

## 1.4 CLIENT WORKSHOP

A virtual workshop was conducted on December 11, 2020. Attendees included representatives from the Town of Rockland, Wright-Pierce, and Suez. The focus of that workshop was to review the material that is presented in Sections 2, 3, and 4 of this report. A copy of the workshop presentation has been included in **Appendix B**. The goals of that workshop were to present initial findings and recommendations to solicit feedback. After that workshop, several items were re-evaluated and adjusted. As such, the presentation included is not a reflection of the final recommendations, but it has been included in this report for documentation purposes.

2

# SECTION 2
# CURRENT AND FUTURE WASTEWATER FLOWS AND LOADS

## 2.1 INTRODUCTION

The Rockland WWTP receives flows from the Town of Rockland and a small portion of the Town of Abington. The Town of Rockland has a contractual intermunicipal agreement with the Town of Abington to treat up to 110,000 gallons per day (gpd) of wastewater. The WWTP services 95% of the Town of Rockland with about 5,700 homes and businesses connected into the sewer system as summarized in **Table 2-1**.

**TABLE 2-1**
**SEWERED POPULATION ESTIMATES**

| Parameter | Rockland | Abington |
|---|---|---|
| Total Population[1] | 17,986 | 16,026 |
| Persons per Household[1] | 2.56 | 2.53 |
| Population served by WWTP | 17,000 | 1,000 |
| Percent of Residents served by WWTP | 95% | 5% |

Source:
1. 2010 Census

Influent wastewater characteristics, specifically biological oxygen demand ($BOD_5$), total suspended solids (TSS), ammonia, total phosphorus, and wastewater temperature were statistically analyzed for the period of January 2016 through June 2020. The flows and loadings data were based on monthly and daily maximum sampling and analysis values reported by the Rockland WWTP. In general, influent TSS and $BOD_5$ were measured twice per week while ammonia and total phosphorus were measured once per month. Influent TKN and ortho-phosphorus were not measured. Flow, wastewater temperature, and precipitation levels were measured daily. All samples are assumed to be composite flow-based samples.

Influent wastewater characteristics were summarized and evaluated to determine the annual average, minimum month (30-Day), maximum month (30-Day), and maximum (peak) day values. A brief description of each calculated parameter is listed below:

- **Annual Average**: The average of daily values for the period.

- **Maximum Day**: The maximum single day that occurs for each parameter during the study period. The single maximum day values are reported 100th percentile along with 98th percentile for the data set.
- **Minimum Monthly**: The minimum 30-day running average for the study period.
- **Maximum Monthly**: The maximum 30-day running average for the study period.
- **Peak Hourly**: Peak hourly flow (i.e., the maximum instantaneous flow that reached the WWTP) is unknown. Influent flows above approximately 6.0 MGD are diverted via a portable, trailer-mounted pump to an offline holding tank. This flow is directed back to the influent pump station following the high flow event. The total flow diverted to this tank has never exceeded the tank's volume (110,000 gal).

## 2.2 CURRENT FLOWS AND LOADS

The flows and loads data from January 2016 to June 2020 is summarized in **Table 2-2**.

**TABLE 2-2**
**CURRENT INFLUENT FLOWS AND LOADS**

| Parameter | Flow | | BOD5 | | | TSS | | |
|---|---|---|---|---|---|---|---|---|
| | MGD | P.F. | mg/L | lbs/day | P.F. | mg/L | lbs/day | P.F. |
| Minimum Day | 1.13 | 0.46 | 98 | 926 | 0.25 | 129 | 1,216 | 0.24 |
| Minimum Month | 1.34 | 0.54 | 156 | 1,739 | 0.47 | 251 | 2,803 | 0.56 |
| Annual Average | 2.46 | - | 179 | 3,676 | - | 244 | 5,008 | - |
| Maximum Month[1] | 4.28 | 1.74 | 153 | 5,460 | 1.49 | 255 | 9,085 | 1.81 |
| Maximum Month Loading[2] | 3.39 | 1.38 | 193 | 5,460 | 1.49 | 321 | 9,064 | 1.81 |
| Maximum Day3 (98th %) | 4.69 | 1.91 | 172 | 6,713 | 1.83 | 265 | 10,381 | 8.54 |
| Maximum Day4 (100th %) | 6.09 | 2.47 | 260 | 13,211 | 3.59 | 504 | 25,560 | 5.10 |
| | **Temperature** | | **NH3-N** | | | **Total Phosphorus** | | |
| **Parameter** | **C** | **P.F.** | **mg/L** | **lbs/day** | **P.F.** | **mg/L** | **lbs/day** | **P.F.** |
| Minimum Day | 8.89 | 0.56 | 30.08 | 283 | 0.60 | 1.63 | 15 | 0.21 |
| Minimum Month | 9.80 | 0.62 | | | - | | | - |
| Annual Average | 15.76 | - | 22.92 | 470 | - | 3.61 | 74 | - |
| Maximum Month[1] | 9.80 | 0.62 | 17.65 | 629 | 1.34 | 3.04 | 109 | 1.47 |
| Maximum Month Loading[2] | 9.80 | 0.62 | | | | | | |
| Maximum Day3 (98th %) | 22.22 | 1.41 | | | | | | |
| Maximum Day4 (100th %) | 23.33 | 1.48 | | | | | | |

NOTES
1. Maximum Month Flows and Loading values are based on a maximum 30-day moving average.

2. Maximum Month Loading condition represents the actual influent conditions during the maximum BOD loading condition
3. Maximum Day is based on 98th percentile data.
4. Maximum Day is based on the maximum value of the total recorded flow for the data period.

The WWTP is designed to treat an average daily flow of 2.5 MGD. Based on the review of daily operational data between January 2016 to June 2020, the WWTP's current annual average daily flow is 2.46 MGD and the plant is currently operating at about 98% of its design capacity on an annual average basis. However, the average flow treated at the WWTP varies significantly throughout the year as shown in **Figure 2-1**.

Overall, Rockland's WWTP influent loading concentrations fall within the expected range of typical design values. **Table 2-3** shows the standard values for low, medium, and high strength wastewater as well as the WWTP's average loadings. The WWTP's average loading concentrations are typical of a medium strength wastewater.

**TABLE 2-3**

**STANDARD VALUES FOR LOW TO HIGH STRENGTH WASTEWATER LOADS(1) COMPARED TO ROCKLAND WWTP LOADS**

| | Concentration (mg/L) | | | |
|---|---|---|---|---|
| | Low Strength | Medium Strength | High Strength | Rockland WWTP Average |
| $BOD_5$ | 110 | 190 | 350 | 179 |
| TSS | 120 | 210 | 400 | 243 |

Notes: 1. Metcalf & Eddy, Wastewater Engineering Treatment and Reuse, 2004.

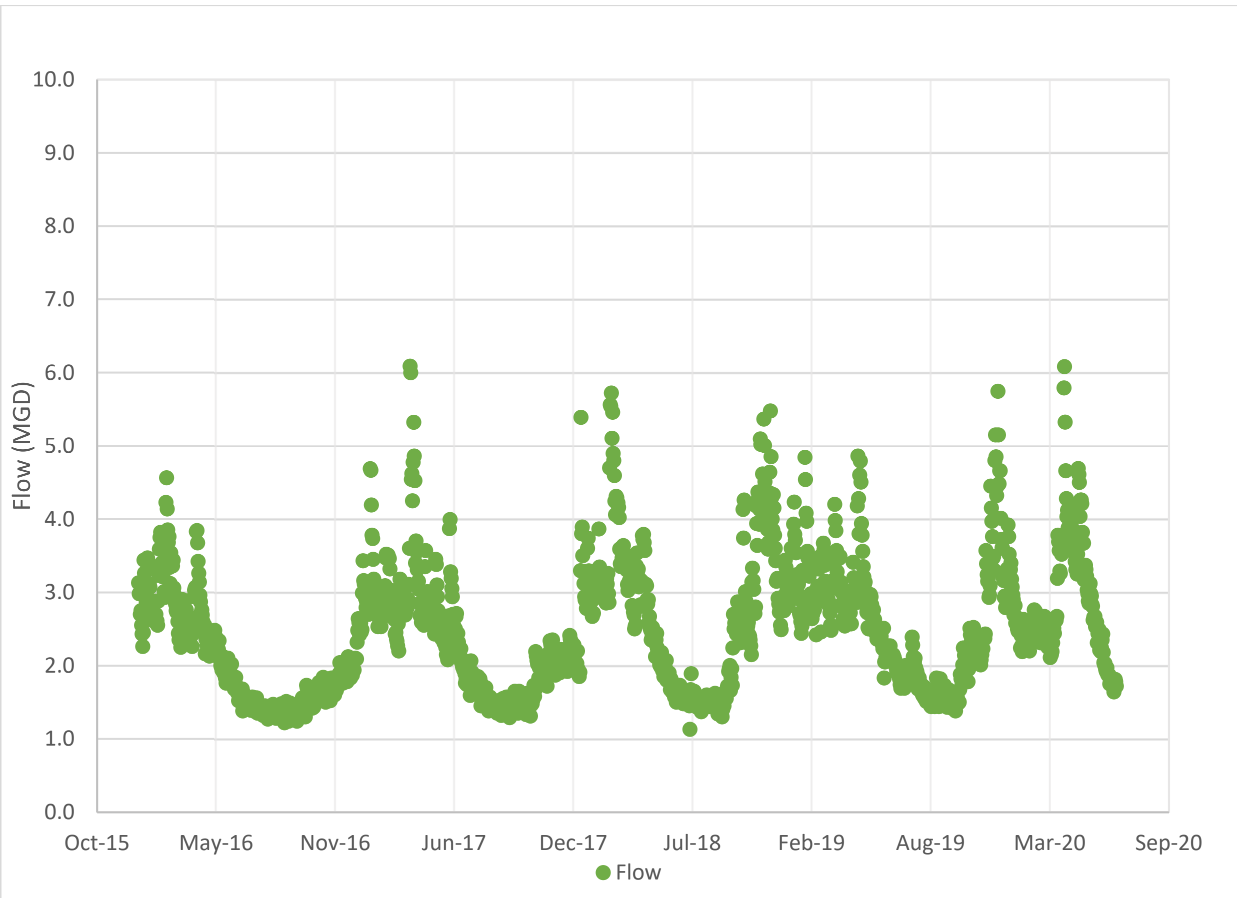
The characteristics of the influent wastewater at the Rockland WWTP are as expected for a 2.5 MGD wastewater treatment plant serving a Town with mostly residential and commercial sources. One item of note is the discrepancy between influent TSS and $BOD_5$ levels. TSS levels are about 36% greater than $BOD_5$ levels which indicates that the wastewater may contain a higher than normal level of inert material. The source of this material is unknown, but one explanation is that the material could be entering the sewer system as part of inflow and infiltration.

Several figures were developed to visually evaluate the influent wastewater characteristics, trends, and daily or monthly variations. Key observations for each figure are provided after all the figures. The following figures were developed:



**FIGURE 2-1**

**WWTP DAILY INFLUENT FLOW (MEASURED AS INFLUENT)**



## FIGURE 2-2

## WWTP FLOW AND PRECIPITATION (MEASURED AS INFLUENT)

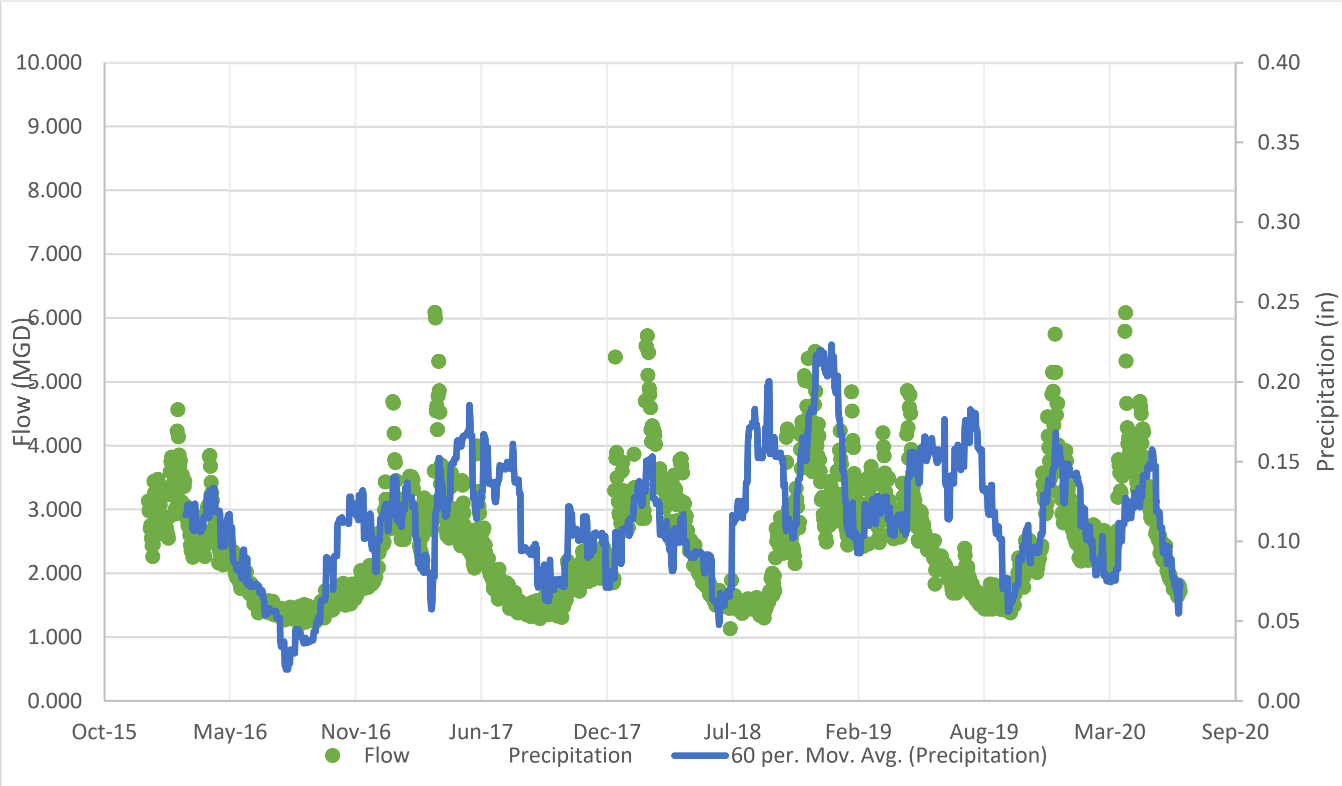


**FIGURE 2-3**

**PERCENTILE FREQUENCY DISTRIBUTION– DAILY FLOW**

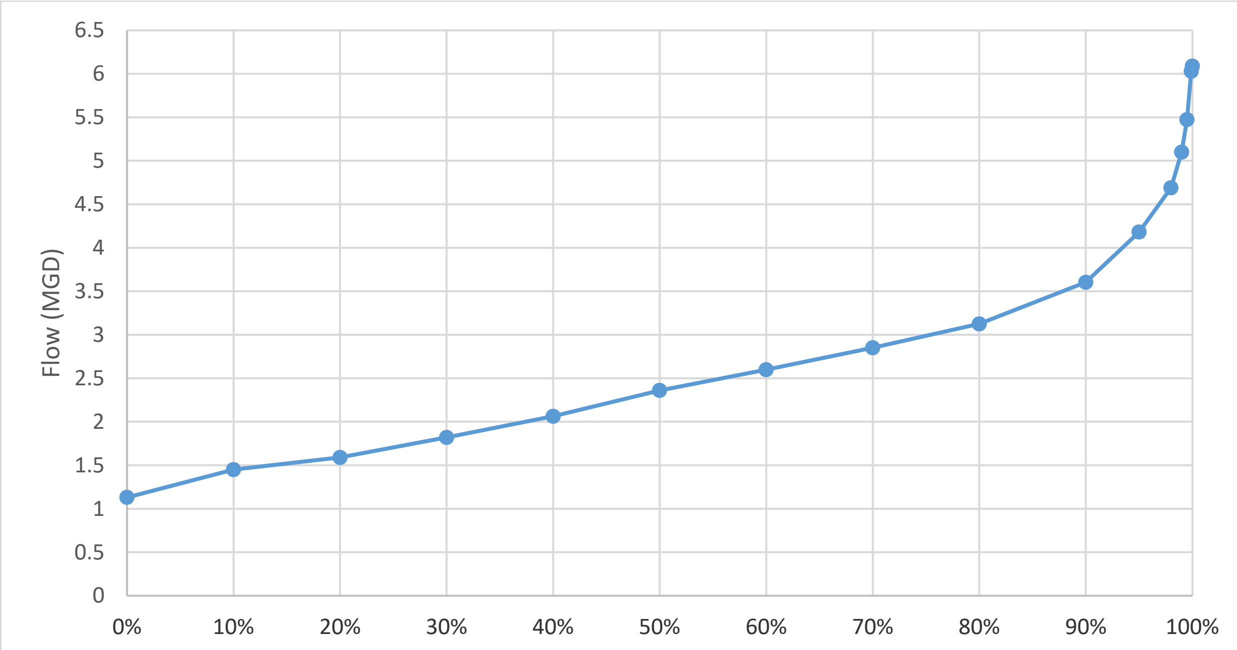



**FIGURE 2-4**

**INFLUENT WASTEWATER TEMPERATURE ℃**

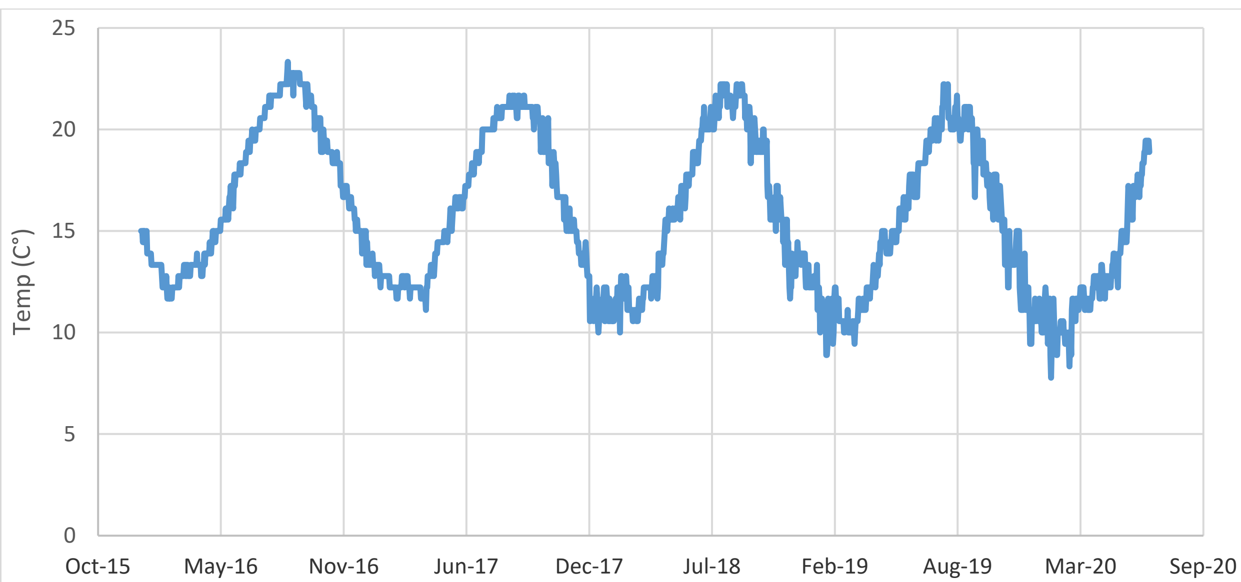


**FIGURE 2-5**

**INFLUENT $BOD_5$ AND TSS LOAD – MONTHLY AVERAGE**

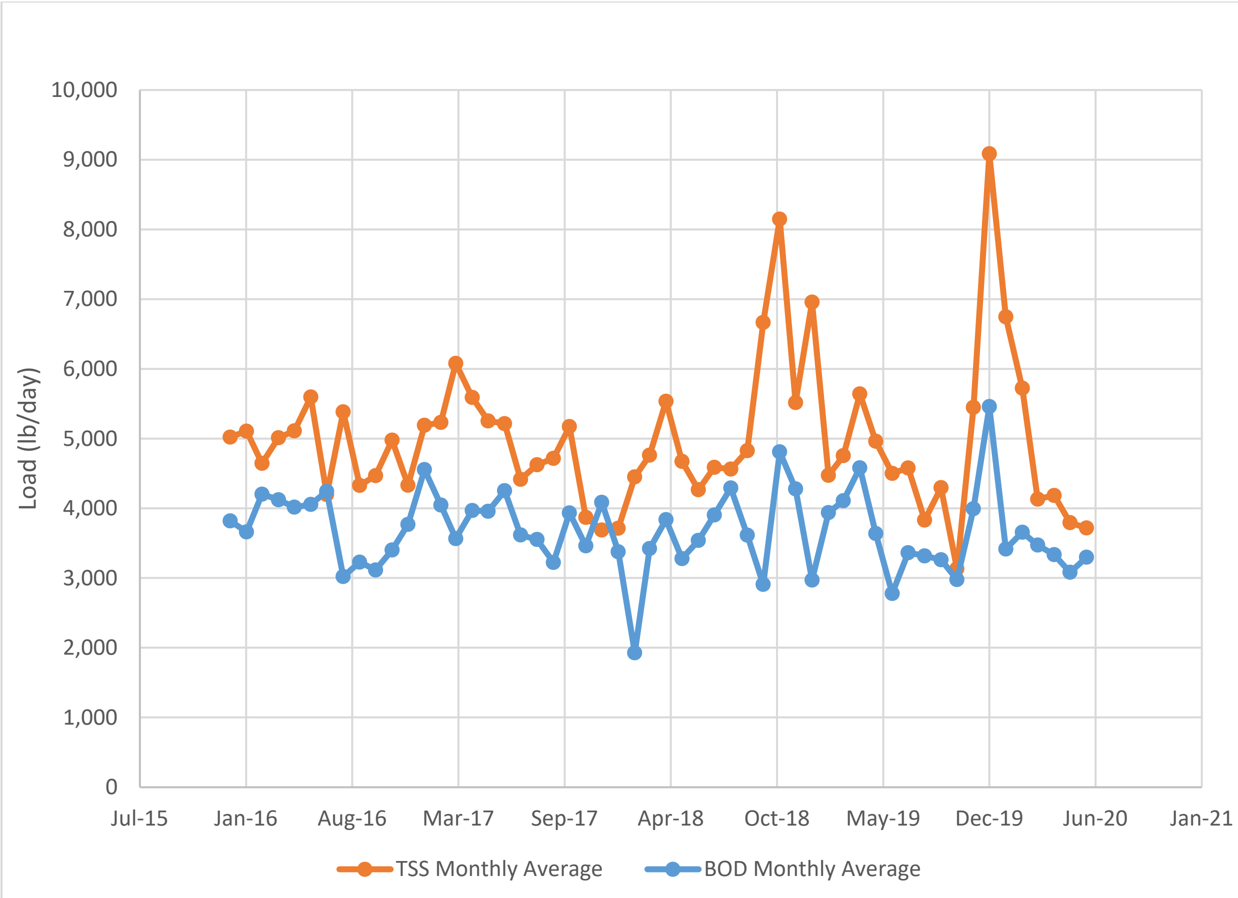


**FIGURE 2-6**

**PERCENTILE FREQUENCY DISTRIBUTION– DAILY INFLUENT $BOD_5$ AND TSS LOADS**

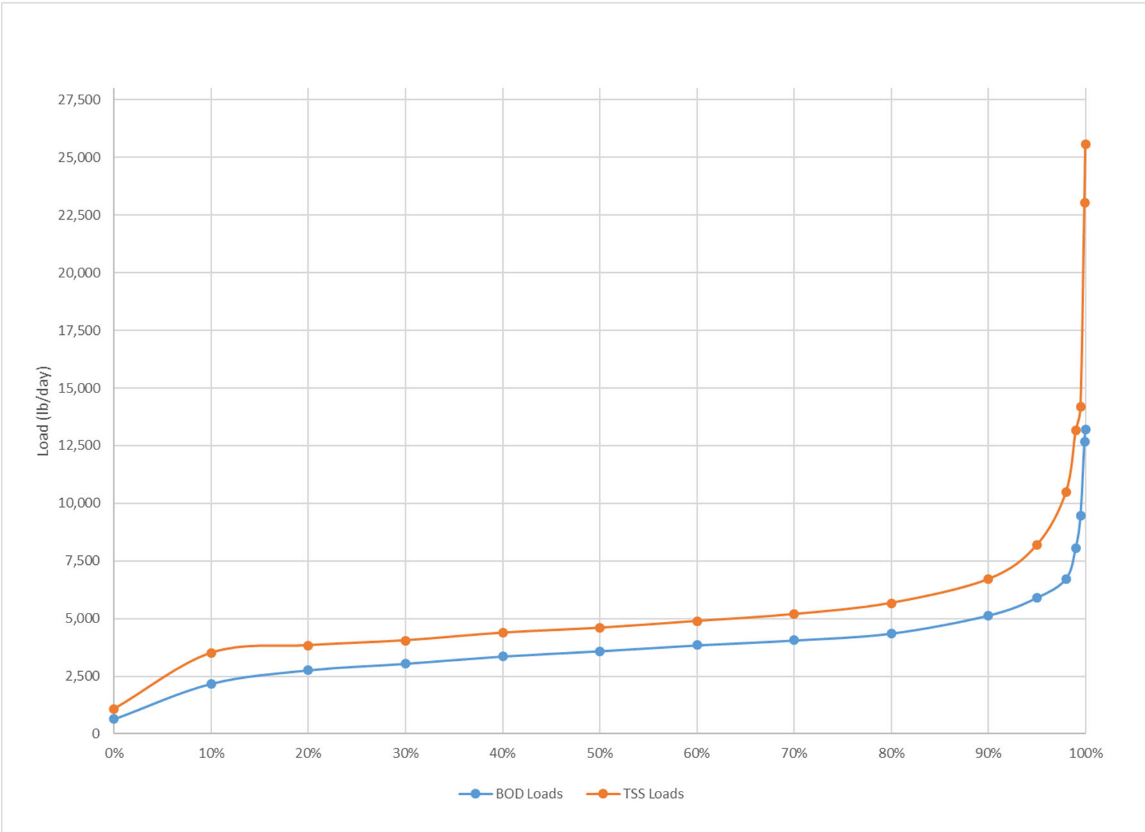
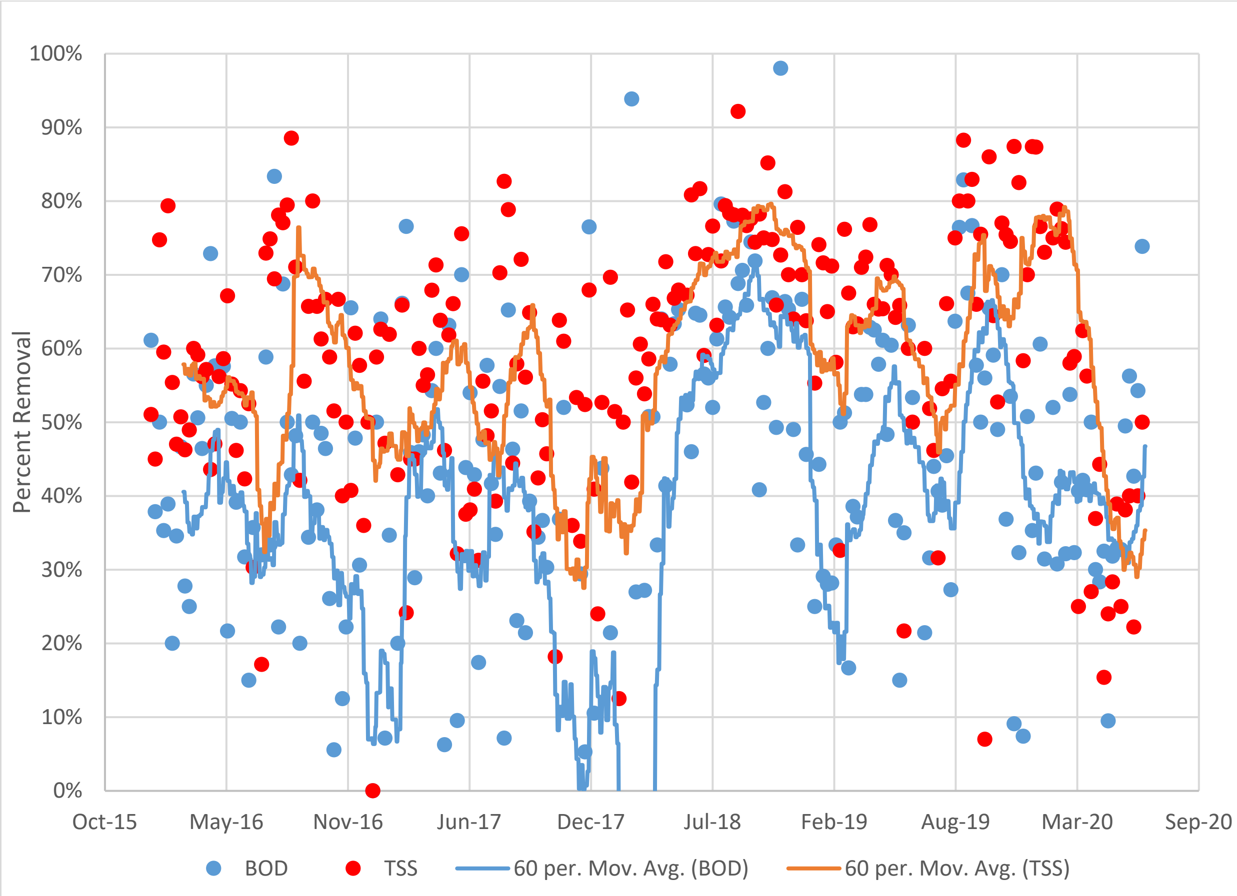


**FIGURE 2-7**

**PRIMARY CLARIFIER REMOVAL RATES**




Key Observations:

- Flow rates have varied significantly throughout the year with a strong seasonal correlation. Low summertime flows and higher winter/spring flows.
- A review of the flow rate and average precipitaiton levels confirms the strong trend of higher preciptation months commensurate with higher than average wastewater flow rates.
- Influent flow frequency followed a standard distribution with the exception of the 95$^{th}$ through 100$^{th}$ percentile events. The magnitude of change between the 95$^{th}$ and 100$^{th}$ percentile is not uncommon for WWTP's. It should be noted that during peak flow events, a portion of the flow is bypassed around the parshall flume via operation of the trailer mounted pump.
- Influent $BOD_5$ and TSS frequency showed a similar pattern as the flow rate. However, the magnitude of change was even greater at the 98$^{th}$ through 100$^{th}$ percentile range.

- Influent TSS and $BOD_5$ loadings have remained fairly consistent over the years, with a compound annual growth rate of -0.7% and -2.4%, respectively. The wastewater facility did experience several significant monthly TSS loading events in the winter of 2018 and 2019.
- Primary clarifier TSS and $BOD_5$ removal rates varied widely over the data set analyzed. The average TSS removal rate was 57%. The average $BOD_5$ removal rate was 38%. The average removal rates are right in-line with expected primary clarifier removal perfomance. However, the high variation is not typical. This may be due to the co-settling operation and lack of independent sludge storage prior to the anaerobic digestion process.
- Greater than expected primary clarifier TSS removal rates corresponded to high levels of influent TSS typically during wet weather flow events. Potentially these high flow events are readily settleable suspended solids that are easily removed in the primary clarifiers.

## 2.3 ANNUAL RATE OF INCREASE

As previously identified, the influent TSS and $BOD_5$ loads (lbs/day) have not increased over the last 5 years. Conversely, each parameter has seen a small decrease over the analysis period. Influent loading is an accurate way of estimating the amount of wastewater processed at the plant. Wastewater flows rates have been increasing over the last five years at an average annual rate of approximately 8.0%. Thus, additional water has entered the collection system without a measurable increase in the amount of material in the wastewater. This could be due to several factors but is most often attributable to increased infiltration and inflow entering the collection system. A review of the precipitation data over the last five years up to, but not including 2020, indicates that the annual rate of precipitation has increased by 14.2% percent, far greater than the rate of flow increase. However, the first half of 2020 has seen a drop in the total precipitation levels. This may change following the typical wetter fall period. Total precipitation levels vary from year to year and as such, drawing a definitive conclusion from these macro trends is difficult.

The data analysis does indicate that the influent loadings have been steady for the last several years, while the flow rate to the WWTP has varied significantly in response to seasonal precipitation levels. It is unknown if the gradual increase in total wastewater received at the facility will continue due to either precipitation impacts and/or the condition of the collection system piping.

## 2.4 PROJECTED DESIGN FLOWS AND LOADS

Design year flows and loads have been developed to account for projected increases in wastewater for the 20-year planning period. These projections have been developed utilizing historical growth metrics as well as estimated future increases in population and housing development in Rockland and the greater south shore municipalities. Design year flows and loads are estimates of the influent flows and loads that the WWTP will eventually receive in the year 2040.

### 2.4.1 Approved, Pending, and Future Sewer Build Out

The Town of Rockland identified several known projects that would impact the wastewater generated within the collection system. These projects were classified as either currently approved, pending, or near-term future projects (i.e., Southfield/Union Point). Massachusetts DEP Title 5 unit flows were applied to each project to estimate the total average and maximum wastewater flows and loads allocation for each connection. A summary of the total flow and load allocation from these projects is summarized in **Table 2-4**. These anticipated near term projects represent an approximate flow and load increase of 6% above current levels.

**TABLE 2-4**

**APPROVED, PENDING AND FUTURE SEWER BUILD OUT FLOWS AND LOADS**

| Parameter | Flow | | $BOD_5$ | | | TSS | | |
|---|---|---|---|---|---|---|---|---|
| | MGD | P.F. | mg/L | lbs./day | P.F. | mg/L | lbs./day | P.F. |
| Minimum Day | | 0.00 | | 0 | 0.00 | | 0 | 0.00 |
| Title 5 Unit Flows | 0.23 | 1.67 | 200 | 392 | 1.67 | 200 | 392 | 1.67 |
| Annual Average | 0.14 | - | 200 | 235 | - | 200 | 235 | - |
| Maximum Month | 0.19 | 1.35 | 200 | 317 | 1.35 | 200 | 317 | 1.35 |
| Maximum Month Loading | 0.19 | 1.35 | 200 | 317 | 1.35 | 200 | 317 | 1.35 |
| Maximum Day (98th %) | 0.28 | 2.00 | 200 | 470 | 2.00 | 200 | 470 | 1.20 |
| Maximum Day (100th %) | 0.28 | 2.00 | | | | | | |

| Parameter | Temperature | | NH3-N | | | Total Phosphorus | | |
|---|---|---|---|---|---|---|---|---|
| | C | P.F. | mg/L | lbs./day | P.F. | mg/L | lbs./day | P.F. |
| Minimum Day | | | 0 | 0 | 0.00 | | 0 | 0.00 |
| Title 5 Unit Flows | | | 26 | 52 | 1.67 | 7.00 | 14 | 1.67 |
| Annual Average | | | 26 | 31 | - | 7.00 | 8 | - |
| Maximum Month | | | 26 | 42 | 1.35 | 7.00 | 11 | 1.35 |
| Maximum Month Loading | | | | | | | | |
| Maximum Day (98th %) | | | | | | | | |
| Maximum Day (100th %) | | | | | | | | |

### 2.4.2 Design Year Flows and Loads Projections

Design year wastewater flows and loads projection for a 20-year planning period were developed for the Rockland WWTP as shown in Table 2-5. These future influent wastewater conditions were estimated through a review of the historical wastewater trends, future population projections, and currently identified projects by the Town.

It is recommended that the Town on Rockland plan for an annual wastewater load increase of 1.0%, or slightly over a 22% increase in the total wastewater loads received versus current levels. This value represents a conversative estimate given the available information. However, influent wastewater flow rates would be held relatively constant over the planning period and set at a maximum annual average of 2.5 MGD (the current permited annual flow rate is 2.5 MGD). This will require long term flow reduction strategies (i.e., infiltration and inflow reduction) be implemented by the Town. It is recommended that the WWTP's peak hourly flow design conditon be increased to 7.0 MGD. Indivdiual unit treatment processes would be evaluated and improved upon in order to hydraulically pass a maximum flow of 7.0 MGD. This value is recommended based on current peak flow concerns, a margin of peak flow safety factor and the expectation that, in the future, the Town will experience higher intensity wet weather events. A summary of the design year influent loading conditions is summarized in **Table 2-5**.

**TABLE 2-5**

**DESIGN YEAR FLOWS AND LOADS**

| | **Flow** | | **$BOD_5$** | | | **TSS** | | |
|---|---|---|---|---|---|---|---|---|
| **Parameter** | **MGD** | **P.F.** | **mg/L** | **lbs./day** | **P.F.** | **mg/L** | **lbs./day** | **P.F.** |
| Minimum Day | 1.15 | 0.46 | 121 | 1,159 | 0.25 | 159 | 1,521 | 0.24 |
| Minimum Month | 1.36 | 0.54 | 192 | 2,176 | 0.47 | 310 | 3,507 | 0.56 |
| Annual Average | 2.50 | - | 221 | 4,600 | - | 301 | 6,266 | - |
| Maximum Month[1] | 4.35 | 1.74 | 188 | 6,832 | 1.49 | 314 | 11,368 | 1.81 |
| Maximum Month Loading[2] | 3.44 | 1.38 | 238 | 6,832 | 1.49 | 395 | 11,342 | 1.81 |
| Maximum Day[3] (98th %) | 4.76 | 1.91 | 211 | 8,400 | 1.83 | 1347 | 53,511 | 8.54 |
| Maximum Day[4] (100th %) | 7.00 | 2.80 | 283 | 16,530 | 3.59 | 548 | 31,982 | 5.10 |
| | **Temperature** | | **NH3-N** | | | **Total Phosphorus** | | |
| **Parameter** | **C** | **P.F.** | **mg/L** | **lbs./day** | **P.F.** | **mg/L** | **lbs./day** | **P.F.** |
| Minimum Day | 8.89 | 0.56 | 37.04 | 355 | 0.60 | 2.01 | 19 | 0.21 |
| Minimum Month | 9.80 | 0.62 | | | - | | | - |
| Annual Average | 15.76 | - | 28.23 | 589 | - | 4.44 | 93 | - |
| Maximum Month[1] | 9.80 | 0.62 | 21.73 | 788 | 1.34 | 3.75 | 136 | 1.47 |
| Maximum Month Loading[2] | 9.80 | 0.62 | | | | | | |
| Maximum Day[3] (98th %) | 22.22 | 1.41 | | | | | | |
| Maximum Day[4] (100th %) | 23.33 | 1.48 | | | | | | |

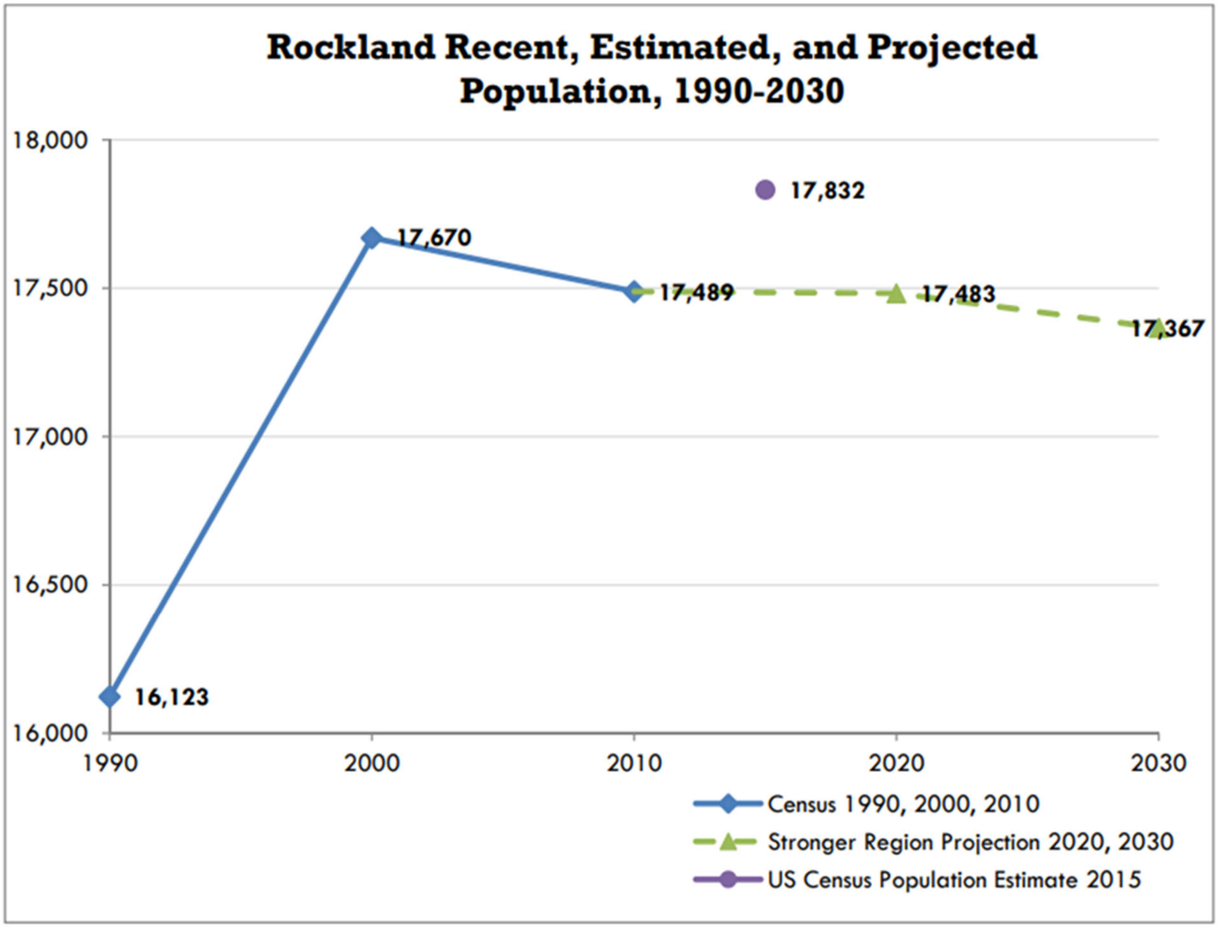
A summary of the information utilized to derive the annual load increase estimate is as follows.

1. Historical wastewater trends:
   a. As previously stated, the Rockland WWTP's influent BOD and TSS load have not increased over the past several years. Given the current sewer moratorium, this trend may be self-imposed and thus not an accurate reflection of growth demands if growth was left unchecked.

   b. Influent wastewater flow rates have increased over the analysis period, at an annual rate of approximately 8.0%. It is suspected that this increase is due to precipitation levels and associated infiltration and inflow impacts.

2. Population projections:
   a. The Town of Rockland had a large population growth between 1990 and 2000, but then slightly declined by 2010. The Metropolitan Area Planning Council (MAPC) projected stable population levels through 2030. However, The U.S. Census Bureau's Population Estimates Program estimated Rockland's population in 2015 as 17,832 residents, which indicates that the population may be growing rather than declining (Figure 2-8).
   b. The US Census Bureau population estimates indicate a 0.39% annual population growth rate for the Town of Rockland.
   c. The MAPC estimated that the net population for the entire metro Boston region could increase anywhere from 6.6% to 12.6% from year 2010 to 2040.
3. Housing projections:
   a. The Metropolitan Area Planning Council projected an 8% increase in the number of households in the Town of Rockland (from 2010 to 2030). The increase in household demand, but not increased population, was attributed to the aging Town population and thus a result in the change in the type of housing desired.

**FIGURE 2-8**



Rockland Recent, Estimated, and Projected Population, 1990-2030
18,000
17,500
17,000
16,500
16,000
1990
2000
2010
2020
2030
16,123
17,670
17,489
17,832
17,483
17,367
Census 1990, 2000, 2010
Stronger Region Projection 2020, 2030
US Census Population Estimate 2015

WRIGHT-PIERCE
Engineering a Better Environment

3

# SECTION 3

# EVALUATION OF EXISTING EQUIPMENT AND UNIT PROCESSES

## 3.1 INTRODUCTION

The purpose of this section is to describe the existing Wastewater Treatment Plant (WWTP), assess the current condition of the WWTP, and identify items that should be addressed as part of a facility upgrade. The identification and screening of potential alternatives to meet the long-term wastewater needs of the WWTP are provided in Section 4.

A multi-discipline engineering team conducted several site visits at the WWTP between the months of August 2020 and December 2020. This included members of the wastewater process group as well as members of the architectural, structural, electrical, and mechanical/HVAC disciplines. This section summarizes the assessment of the existing wastewater unit processes and equipment with some commentary on the condition of the structures and buildings. Detailed assessments of the conditions and recommended improvements of the electrical, structural, architectural, and mechanical/HVAC systems are in separate technical memorandums located in Appendix C.

## 3.2 BACKGROUND

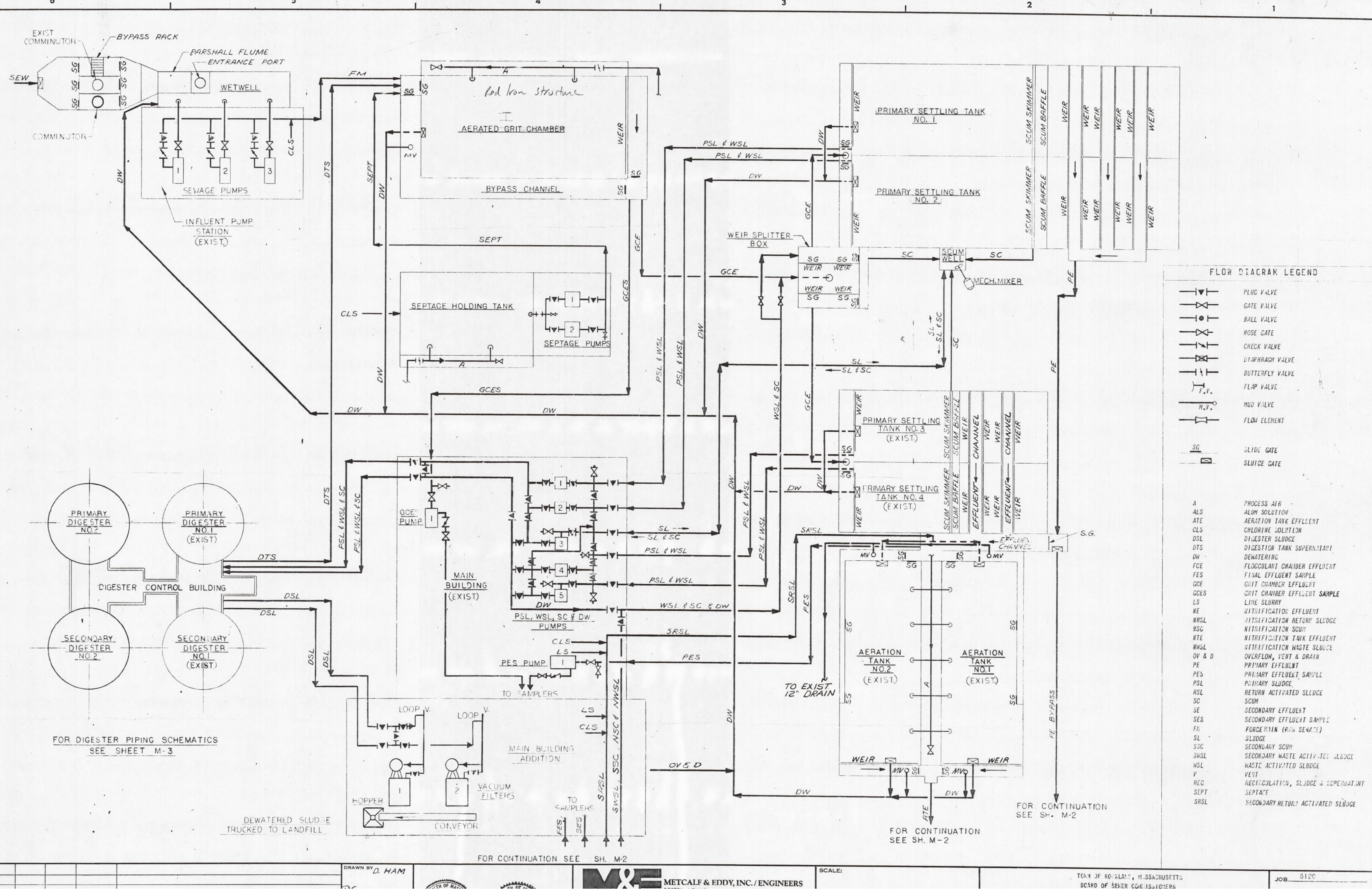
The WWTP was originally built in 1964 with a capacity to treat 1 MGD. The facility was upgraded in 1977 to a two-stage nitrification activated sludge plant with a capacity to treat 2.5 MGD to ammonia from the wastewater. The WWTP treatment process consisted of preliminary treatment, primary treatment, the two-stage activated sludge secondary treatment process, and disinfection. Sludge treatment consisted of anaerobic digestion and dewatering prior to final disposal. The facility changed the operation from two-stage to a single-stage nitrification activated-sludge process circa 1984. This was done as the same effluent quality was achieved with only the second stage online. The first stage of the activated-sludge process (aeration tanks and secondary settling

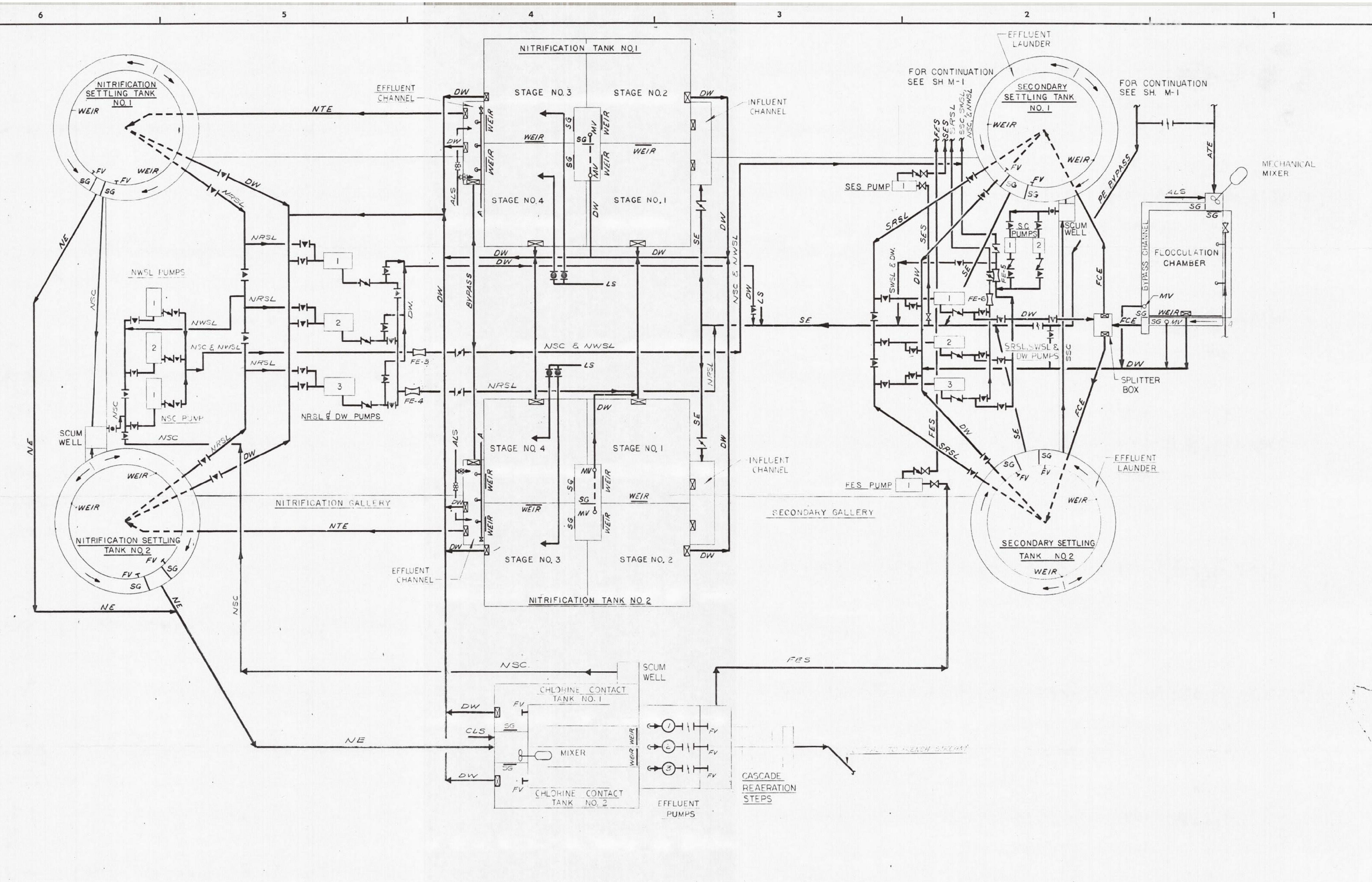
tanks) were taken offline and have remained offline since that time. The aeration tanks are occasionally used as wastewater storage tanks during peak flow events.

The current WWTP treatment process consists of preliminary treatment including screening and grit removal, followed by primary clarification, secondary treatment consisting of nitrification tanks with surface aerators and nitrification settling tanks, and disinfection. Sludge treatment consists of anaerobic digestion with storage and dewatering prior to disposal at the Synagro facility in Woonsocket, RI. As stated, the existing secondary treatment process is a single stage activated sludge process utilizing the original nitrification tanks and nitrification settling tanks (tank names as identified in the 1977 plant upgrade). For purposes of this report, that naming convention has been used throughout to refer to these tanks. The unit processes at the Rockland WWTP is shown in **Figure 3-1**.

**FIGURE 3-1**
**ROCKLAND WWTP UNIT PROCESSES**


1. Influent Pump Station
2. Grit Removal
3. Septage Tank
4. Primary Clarifiers
5. Aeration Tanks
6. Secondary Settling Tanks
7. Nitrification Tanks
8. Nitrification Settling Tanks
9. Chlorine Contact Chamber
10. Sludge Digesters


EXIST COMMINUTOR
BYPASS RACK
PARSHALL FLUME
ENTRANCE PORT
WETWELL
COMMINUTOR
SEW
SEWAGE PUMPS
INFLUENT PUMP STATION (EXIST.)
Red Iron Structure
AERATED GRIT CHAMBER
BYPASS CHANNEL
SEPTAGE HOLDING TANK
SEPTAGE PUMPS
PRIMARY SETTLING TANK NO. 1
PRIMARY SETTLING TANK NO. 2
PRIMARY SETTLING TANK NO. 3 (EXIST.)
PRIMARY SETTLING TANK NO. 4 (EXIST.)
SCUM SKIMMER
SCUM BAFFLE
WEIR
EFFLUENT CHANNEL
WEIR SPLITTER BOX
SCUM WELL
MECH. MIXER
AERATION TANK NO. 1 (EXIST.)
AERATION TANK NO. 2 (EXIST.)
TO EXIST 12" DRAIN
PE BYPASS
S.G.
FOR CONTINUATION SEE SH. M-2
PRIMARY DIGESTER NO. 1 (EXIST)
PRIMARY DIGESTER NO. 2
SECONDARY DIGESTER NO. 1 (EXIST.)
SECONDARY DIGESTER NO. 2
DIGESTER CONTROL BUILDING
FOR DIGESTER PIPING SCHEMATICS SEE SHEET M-3
GCES PUMP
MAIN BUILDING (EXIST)
PSL, WSL, SC & DW PUMPS
PES PUMP
TO SAMPLERS
MAIN BUILDING ADDITION
LOOP V.
VACUUM FILTERS
HOPPER
CONVEYOR
DEWATERED SLUDGE TRUCKED TO LANDFILL
FOR CONTINUATION SEE SH. M-2
FLOW DIAGRAM LEGEND
PLUG VALVE
GATE VALVE
BALL VALVE
HOSE GATE
CHECK VALVE
DIAPHRAGM VALVE
BUTTERFLY VALVE
FLAP VALVE
MUD VALVE
FLOW ELEMENT
SLIDE GATE
SLUICE GATE
A PROCESS AIR
ALS ALUM SOLUTION
ATE AERATION TANK EFFLUENT
CLS CHLORINE SOLUTION
DSL DIGESTER SLUDGE
DTS DIGESTION TANK SUPERNATANT
DW DEWATERING
FCE FLOCCULANT CHAMBER EFFLUENT
FES FINAL EFFLUENT SAMPLE
GCE GRIT CHAMBER EFFLUENT
GCES GRIT CHAMBER EFFLUENT SAMPLE
LS LIME SLURRY
NE NITRIFICATION EFFLUENT
NRSL NITRIFICATION RETURN SLUDGE
NSC NITRIFICATION SCUM
NTE NITRIFICATION TANK EFFLUENT
NWSL NITRIFICATION WASTE SLUDGE
OV & D OVERFLOW, VENT & DRAIN
PE PRIMARY EFFLUENT
PES PRIMARY EFFLUENT SAMPLE
PSL PRIMARY SLUDGE
RSL RETURN ACTIVATED SLUDGE
SC SCUM
SE SECONDARY EFFLUENT
SES SECONDARY EFFLUENT SAMPLE
FM FORCEMAIN (RAW SEWAGE)
SL SLUDGE
SSC SECONDARY SCUM
SWSL SECONDARY WASTE ACTIVATED SLUDGE
WSL WASTE ACTIVATED SLUDGE
V VENT
REC RECIRCULATION, SLUDGE & SUPERNATANT
SEPT SEPTAGE
SRSL SECONDARY RETURN ACTIVATED SLUDGE
DRAWN BY D. HAM
METCALF & EDDY, INC. / ENGINEERS
SCALE:
TOWN OF ROCKLAND, MASSACHUSETTS
BOARD OF SEWER COMMISSIONERS
JOB 5120




DRAWN BY

METCALF & EDDY, INC. / ENGINEERS

SCALE:

TOWN OF ROCKLAND, MASSACHUSETTS
BOARD OF SEWER COMMISSIONERS

JOB 5120

## 3.3 EQUIPMENT LIFE EXPECTANCY

An assessment of each wastewater unit process was conducted to ascertain its condition and it's expected future life (i.e., "how much longer can that item continue to reliably operate without failure To determine the age at which a specific item has reached the end of its life, Wright-Pierce has developed typical equipment service life predictions as presented in **Table 3-1**. These values were developed based on industry guidelines and experience at other WWTPs. If a piece of equipment is in particularly good or bad condition following inspection, the typical service life for that equipment is adjusted up or down accordingly.

As previously stated, the last major upgrade at this facility was completed in the early 1980s. As such, the majority of the equipment encountered during our site inspections date to that upgrade, making it close to 40 years old. While equipment life can be extended past the presented "typical" values, the age of most of the equipment at this facility is 10 to 20 years past its "typical" life expectancy. This adds considerable risk to the ongoing successful operation of the WWTP. The consequences of failure vary considerably from one item to the next. For example, failure of a chemical pump while disruptive, can be readily replaced with limited downtime. However, some of the larger more complicated items could have severe implications should they fail. This includes the existing mechanical aerators, primary and secondary clarifier mechanisms, electrical systems, and several items within the anaerobic digestion complex.

**TABLE 3-1**

**TYPICAL EQUIPMENT SERVICE LIFE SUMMARY**

| Equipment Description | Service Life (Years) |
|---|---|
| Air Relief Valve | 10 |
| Blower | 25 |
| Clarifier Bridge | 30 |
| Chemical Feed System | 10 |
| Concrete Structure, Building, Basin, Drywell/Wetwell | 60 |
| Drive Mechanism | 20 |
| Electrical Equipment | 30 |
| Electric Panel | 25 |
| Electrical System | 25 |
| Generator | 35 |
| Grounds | 300 |
| Heating, Ventilating, and Air Conditioning | 15 |
| Instrumentation and Controls | 10 |
| Lab and Kitchen Equipment | 20 |
| Maintenance/Tools | 10 |
| Motor | 20 |
| Office Equipment | 20 |
| Odor Control System | 15 |
| Process Equipment | 20 |
| Piping | 50 |
| Pumps | 20 |
| Safety Equipment/Gear | 10 |
| Slide Gate | 30 |
| Tank | 25 |
| Transformer, Transfer Switch | 25 |
| Valve - All | 25 |
| VFD, Motor Starter | 20 |
| Vehicle | 10 |

## 3.4 PRELIMINARY TREATMENT

### 3.4.1 Influent Pump Station

Wastewater flows through a 30-inch diameter influent gravity sewer into the influent manhole (IMH) where an internal weir wall directs flows less than 6.0 MGD through the influent channels to a wetwell in the influent pump station building where the flow is pumped by three vertical mixed flow pumps to the aerated grit chamber. The IMH was originally constructed in 1964. The concrete in the internal structure is slightly worn down and needs to be repaired. The influent manhole internal structure is shown in **Figure 3-4**.

Influent flows greater than 6.0 MGD overflow the internal weir wall in the IMH and flows through a 24-inch diameter gravity sewer line to the bypass influent manhole (BIMH). In this manhole, excess influent and recycle flows from the facility sludge processing units combine and gravity flow directly to the wetwell of the Influent Pump Station, bypassing screening and the influent Parshall flume. The BIMH was originally constructed in 1964. The concrete in this internal structure is slightly worn down and shows moderate degradation. The bypass influent manhole internal structure is shown in **Figure 3-5**.

**FIGURE 3-4**

**INFLUENT MANHOLE**

**FIGURE 3-5**

**INFLUENT BYPASS MANHOLE**

The Influent Pump Station is a multi-level structure consisting of an upper level motor room (also includes the motor control center (MCC) and associated instrumentation/controls), intermediate level influent channels and screenings and a lower level pump room and a lower level wetwell. The Influent Pump Station was constructed in 1964 and is showing significant corrosion issues, which is to be expected given its age and its location as the first unit process at the WWTP.

The three influent channels consist of a main channel with a JWC chain and rake screen, a second channel with grinder/auger unit, and a third bypass channel with manually-cleaned bar rack. The influent channel system was not designed to include a mechanical screen. As such, the inclusion of the mechanical screen results in very limited space for operators to conduct maintenance or other operational activities in this area. The concrete in the channels show significant surface degradation with exposed aggregate. The metal structures (isolation gates, channel covers, channel frames, etc.) show extensive corrosion degradation with significant steel loss. If this structure were to remain, the concrete and metal structures would need to be repaired and replaced, respectively. The influent channels and equipment are shown in **Figure 3-6**.

The JWC screen in the main channel is a continuous chain and rake screen suitable to handling up to 4.0 MGD in a channel 1.9-feet wide and 4.0-feet deep. This screen was installed in 2012 and is in decent condition. As the influent flow exceeds 4.0 MGD the channel grinder/auger unit in the second channel is opened to allow higher flow through and into the Parshall flume and wetwell. The grinder/auger unit can handle flow exceeding 4.0 MGD up to 6.0 MGD. The grinder/auger unit was installed in 2015 and is in good condition.

**FIGURE 3-6**

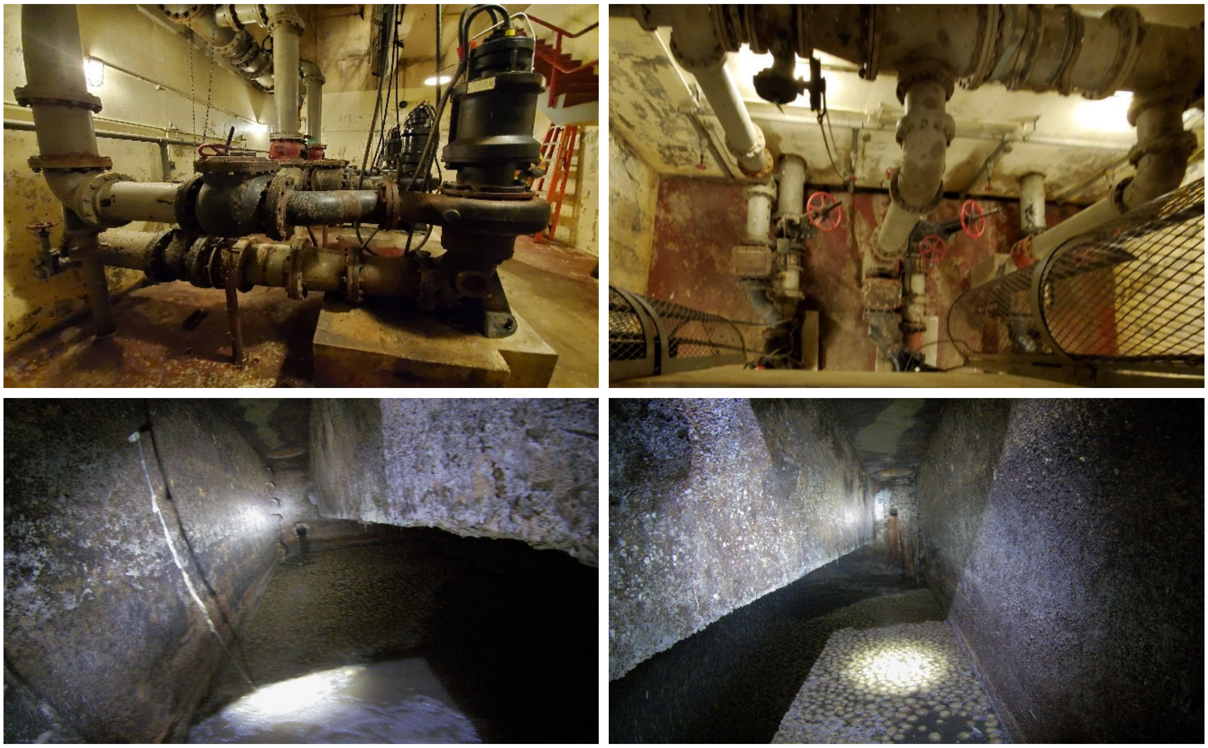
**INFLUENT CHANNELS**

The influent wetwell and pump room are shown in **Figure 3-7**. The pump room has three centrifugal pumps which were installed on 2009 and are in the middle of their life expectancy (typically 20 years in this application). The influent pump station piping and valves were replaced as part of the 1977 upgrade. Forty years of continual service is well beyond the life expectancy of the valving and closing in on the service of life of ductile iron pipe. Furthermore, the lack of grit removal prior to the influent pump station is an additional concern given the age of the valves and piping. It is expected that the piping and valves in this location would wear faster than other areas of the plant, potentially leading to failure due to erosion of the piping and valve material from the inside out. The level of internal material loss cannot be determined from an external inspection. Any leakage of wastewater in this area due to failure of the piping would be very problematic. This area should be considered a high priority issue.

Each pump is capable of pumping 3 MGD of influent from the wetwell to the grit removal chamber; however, the influent force main to the grit chamber can only handle approximately 6.0 MGD. When influent flow increases above 6.0 MGD, Godwin pumps are setup with suction hoses and strainers directly in the influent manhole and discharge directly to either off-line primary clarifiers or aeration tanks.

**FIGURE 3 7**

**INFLUENT WETWELL AND PUMP ROOM**



### 3.4.2 Grit Removal and Septage Receiving Chambers

Grit is removed in an aerated grit chamber, originally constructed in 1977, which has a maximum capacity of 6.0 MGD. The aeration system uses coarse bubble diffusers at the middle of the chamber and blowers in the main building. The chamber has a volume of 1,482 cubic feet and is 27-feet long, 9.0-feet wide, and 9.0-feet high. The concrete surfaces of the aerated grit removal chamber are showing moderate degradation, exposing the aggregate. The blowers were replaced in 2005 and are at the third quarter of their life expectancy. The grit removal clamshell hoist has been out of service since 2015 due to the conditions of the metal structure. The aerated grit removal chamber is shown in **Figure 3-8**. The grit collected at the bottom of the chamber is removed via vactor trucks. This removal is a manual operation that requires the influent to bypass the grit chamber.

Grit removal is an essential unit process that protects downstream equipment and ensures processes are protected from excessive wear resulting in increased longevity and reduced maintenance activities. However, if this unit were to fail prior to a planned WWTP upgrade, the WWTP would still be able to operate. There is currently no redundancy if this unit were to be taken out of service.

The current aerated grit unit follows traditional sizing criteria (i.e., detention time and tank geometry) up to wastewater flow rates of 6 MGD. Plant operations staff have identified grit accumulation in the primary clarifier tanks and anaerobic digestion tanks. Typically, high flow events bring a disproportionate amount of grit to a WWTP compared to average daily conditions. The grit accumulation identified by the plant staff could be a result of grit not being captured in the current aerated grit facility or grit that entered the facility during wet weather bypass pumping events.

**FIGURE 3-8**
**AERATED GRIT REMOVAL CHAMBER**

Ferric chloride is added in the gravity main from the aerated grit chamber to the primary clarifier splitter box and from the nitrification tanks to the nitrification settling tanks. Ferric Chloride addition is critical for the removal of phosphorus. Ferric chloride is pumped by new peristaltic pumps and stored in two fiberglass reinforced plastic (FRP) tanks located in the basement of the Main Building Addition as shown in **Figure 3-9.** The tanks were originally installed in 1977. The tanks are showing signs of leaking at penetrations and have exceeded their typical service life. Ferric chloride is added using four peristaltic chemical pumps installed in 2020 (two large pumps with a capacity of 33.3 GPH and two smaller pumps with a capacity of 30.1 GPD).

**FIGURE 3-9**

**FERRIC CHLORIDE TANKS**

Septage is not currently being treated in the facility as it was discontinued in the early 1980s. The septage holding chamber and pump station were originally constructed in 1964. The chamber has a volume of 3,331 cubic feet and is 27-feet long, 12.5-feet wide and 8.75-feet high. The concrete of the structures is in good condition; however, the septage grit blowers and pumps are seized and out of service. The septage holding tanks and pump station are shown in **Figure 3-10**.

**FIGURE 3-10**

**SEPTAGE HOLDING TANK AND PUMP STATION**

### 3.4.3 Preliminary Treatment Operation

The following operational issues were identified with respect to the preliminary treatment system:

- The facility has a maximum hydraulic capacity of 6.0 MGD. When the influent flow increases above 6.0 MGD, the staff in the facility use portable Godwin pumps to pump influent from the influent manhole to either off-line primary clarifiers or aeration tanks. This is a not an ideal situation and should be addressed in the next facility upgrade.
- The influent that exceed the influent manhole capacity overflows to the bypass manhole into the wetwell, bypassing the influent flume. This additional influent flow is measured by the facility once it is returned to the head of the facility following the peak flow event. Thus, the total flow is measured. However, the maximum instantaneous flow is not measured. This issue should be addressed in the next facility upgrade.
- The grit removal chamber can handle a maximum flow of 6.0 MGD. Influent flows above 6.0 MGD overflow the chamber running down the driveway causing washout near the septage chamber. This issue should be addressed in the next facility upgrade.
- Grit settles out at the bottom of the grit removal chamber and is removed via vactor trucks. This removal is a manual operation that requires the influent to bypass the grit chamber. The removal of grit in the facility should be updated to an automatic operation and addressed in the next facility upgrade.

## 3.5 PRIMARY SETTLING TANKS AND PRIMARY AND WASTE SLUDGE PUMPS

### 3.5.1 Primary Settling Tanks

From the grit chamber, wastewater flows to the primary splitter box where it is diverted to one of the two large primary settling tanks for primary treatment which includes removal of settleable solids, floating materials and scum. The facility has four primary settling tanks, two larger units constructed in 1977 and two smaller units constructed in 1964. Currently, the two large primary settling tanks are in service, the two small settling tanks are off-line and are used to store influent during peak flow events. Each large primary settling tank is rectangular with chain and flight mechanisms and has a volume of 17,088 cubic feet and is 89-feet long, 16-feet wide with a side water depth of 12-feet. The Facility has had many issues with the mechanisms over the years and staff have performed periodic maintenance on the units to increase their longevity. The mechanisms in each settling tank are original to their construction. The mechanisms consist of a conveyor chain assembly connected to flights that push the sludge toward the sludge hopper as the chains move. The chains of the mechanisms were replaced for plastic chains in 1998, other components are original to the plant and have not been replaced since 1977. The rotating scum trough that collects the scum pushed by the flights is seized preventing scum removal from the settling tanks. The mechanisms are beyond their useful life and need to be addressed in the next facility upgrade. The concrete of the large settling tanks has some visible cracks along the sidewalls above the water level. The concrete surface of the walls under the water level show significant degradation and loss of aggregate. The large primary settling tanks are shown in **Figure 3-11.**

The large primary settling tanks are used to co-settle waste-activated sludge (WAS) from the secondary settling tanks. This operation has the benefit of thickening the WAS as well as creating a blended sludge prior to the anaerobic digestion process. The co-settling of waste-activated sludge can negatively affect the solids removal performance of the primary settling tanks, as was noted in Section 2, potentially exceeding their design capacity. This is mitigated by the addition of ferric chloride which can condition the sludge and enhance settling.

**FIGURE 3-11**

**LARGE PRIMARY SETTLING TANKS**

The primary settling tanks are sized such that one settling tank can handle average daily flows. However, during wet-weather two settling tanks are needed to treat incoming wastewater flow. The primary clarifiers are sized appropriately to handle peak flow events based on current engineering standards. However, they are not adequately sized to handle the current peak flow events when used to co-settle waste activated sludge. While some reduced solids capture performance is expected during high flow events, it is not recommended that the current practice be eliminated prior to an upgrade. The current practice of adding coagulation chemistry upstream of the clarifiers should continue as it should provide a solids removal performance benefit to the clarifiers, helping offset high flow event impacts.

The primary splitter box can handle a maximum flow of 6.0 MGD which can be directed to the primary settling tanks. Higher flows will flood out the scum trough causing grease to washout and get into downstream units.

**FIGURE 3-12**

**SMALL PRIMARY SETTLING TANKS**

### 3.5.2 Primary Sludge Pumps

The primary sludge pumps transport co-settled thickened sludge and scum from the large primary settling tanks to the anaerobic digesters. There are five pumps, three new pumps were installed in 2018, connected to the large primary settling tanks and two old originally installed in 1964, connected to the small primary settling tanks. The pumps are simplex plunger type with a capacity of 75 gpm at total dynamic head of 230 feet. The pumps are located in the basement at the main building. The new pumps are in good condition, but the old pumps are beyond their useful life and should be replaced. The primary sludge piping and valves were installed in 1977. These items are beyond their typical service life and should be replaced. The primary sludge pumps are shown in **Figure 3-13**.

**FIGURE 3-13**
**PRIMARY SLUDGE PUMPS**

## 3.6 AERATION AND NITRIFICATION TANKS

After initial settling in the primary settling tanks, wastewater flows to the influent channel at the nitrification tanks where it mixes with the return activated sludge from the nitrification settling tanks. The nitrification tanks consist of two tanks in parallel with four zones in series in each tank. The first zone is operated as an anoxic zone (no residual dissolved oxygen) followed by three aerobic zones in series. The sludge-wastewater mixture, also known as mixed liquor, enters the anoxic zone of each nitrification tank where bacteria use the carbonaceous organic matter to remove nitrogen, then flows into the three aerobic zones in series where oxygen transferred through the agitation from the surface aerators is used by bacteria for the oxidation of carbonaceous organic matter and nitrogen.

After treatment in the nitrification tanks, the mixed liquor flows into the nitrification settling tanks for separation of biological sludge from the clear treated effluent. Each nitrification tank has a volume of 68,625 cubic feet and is 75-feet long, 75-feet wide with a side water depth (SWD) of 12.2-feet. The first three zones have surface mixer-aerators with 25 Hp motors, the last zone has 30 Hp motors. The speed of each mixer-aerator is automatically adjusted using VFDs based on the level of oxygen measured by the dissolved oxygen probes located in the aerobic zones.

The nitrification tanks were constructed in 1977. These tanks are showing significant levels of corrosion and structural cracks. In addition, the majority of the isolation gates and valves in the tanks are seized and inoperable. The surface aerators in the first three zones were installed as part of the 1977 upgrade and are beyond their useful life and need to be replaced or removed. The surface aerator in the last zones were installed in 2000 and are close to the end of their useful life.

Successful treatment of the wastewater at the Rockland WWTP is dependent on all surface aerators operating continuously, 24/7/365. Failure of any one of these units will result in significant challenges to achieve compliance with the effluent permit. The life of these units can be extended through replacement of the internal components (i.e., gear boxes), assuming compatible parts can be located. If complete failure of the surface aerator occurs, replacement of one of these devices would be a significant undertaking involving significant lead time on acquiring a replacement unit, draining a tank and use of a crane. This issue is further exacerbated due to the condition of the gates in the nitrification tanks which limit the plant operator's ability to isolate and drain a single tank. It is recommended that Rockland develop a contingency plan that could be executed if one of these units failed before a plant upgrade is completed.

It is recommended to replace the surface aerators for a more efficient and flexible aeration system able to meet the expected total nitrogen and total phosphorus effluent limits. The nitrification tanks are shown in **Figure 3-14**.

The facility has two old aeration tanks connected to the small primary settling tanks and secondary settling tanks. These aeration tanks were originally constructed in 1964 and were used to treat primary effluent from the small primary settling tanks as part of the first stage of the two-stage aeration system configuration. These tanks were taken offline in 1984 after determining that treatment could be achieved by operating only the second stage of the facility. The aeration tanks are offline and currently used for bypass storage during peak flow events. Each aeration tank has a volume of 20,864 cubic feet and is 81.5-feet long, 20-feet wide with a side water depth of 12.8-feet. The tanks have some significant cracks along their structures. The aeration piping at the bottom of the tanks is not functional. The old aeration tanks are not currently suitable for treatment but could be repurposed in the next facility upgrade. The aeration tanks are shown in **Figure 3-15**.

**FIGURE 3-14**

**NITRIFICATION TANKS**

**FIGURE 3-15**

**AERATION TANKS**

## 3.7 SECONDARY AND NITRIFCATION SETTLING TANKS

Treated mixed liquor from the nitrification tanks flows through the effluent channel into its corresponding nitrification settling tanks. In the nitrification settling tanks, incoming mixed liquor is separated into clarified effluent and settled sludge. The settled sludge at the bottom of the tanks is pumped back to the nitrification tanks to maintain a desired mixed liquor suspended solids (MLSS) concentration. The recycle stream is known as return activated sludge (RAS) and the fraction of the stream that is wasted is known as waste-activated sludge (WAS). The nitrification settling tanks consist of two circular tanks, each one has a volume of 34,207 cubic feet and is 60-feet in diameter with a side water depth of 12.1-feet. The nitrification settling tanks were constructed in 1977 and show some concrete degradation. The concrete above the liquid level shows moderate surface degradation and at the tank floor has some deep cracks. In addition, the catwalk, center well structure and collector arms are showing moderate corrosion. The drive units of the clarifier mechanism were replaced in 2018 and are in good condition. The other steel components are original to the tanks and are beyond their useful life. The replacement of the drive units should allow for acceptable treatment performance in the short-term until repairs of the concrete and steel can be performed. However, if failure of any of the metal structure occurs prior to a facility upgrade, effluent quality, and the facilities ability to process high flow events will be severely compromised. The nitrification settling tanks are shown in **Figure 3-16**.

**FIGURE 3-16**
**NITRIFICATION SETTLING TANKS**

The facility has two secondary settling tanks. The secondary settling tanks were originally constructed in 1977 as part of the first stage of the two-stage aeration system configuration. These tanks were taken offline in 1984 and are currently not used. The secondary settling tanks consist of two circular tanks, each one has a volume of 35,338 cubic feet and is 60-feet in diameter with a side water depth of 12.5-feet. The tanks have a considerable amount of vegetation growing in their troughs with significant concrete degradation along their walls and floor. One of the tanks has significant vegetation and cracks in the floor. The steel components show advanced corrosion and are not functional. The old secondary settling tanks are not currently suitable for treatment but could be repurposed in the next facility upgrade. The secondary settling tanks are shown in **Figure 3-17**.

**FIGURE 3-17**
**SECONDARY SETTLING TANKS**

### 3.7.1 Return Activated Sludge Pumps

The activated sludge system includes two below grade sludge pumping galleries, the secondary gallery and nitrification gallery. The return activated sludge (RAS) pumps are located in their corresponding nitrification and secondary galleries. All pumps are horizontal non-clog centrifugal type.

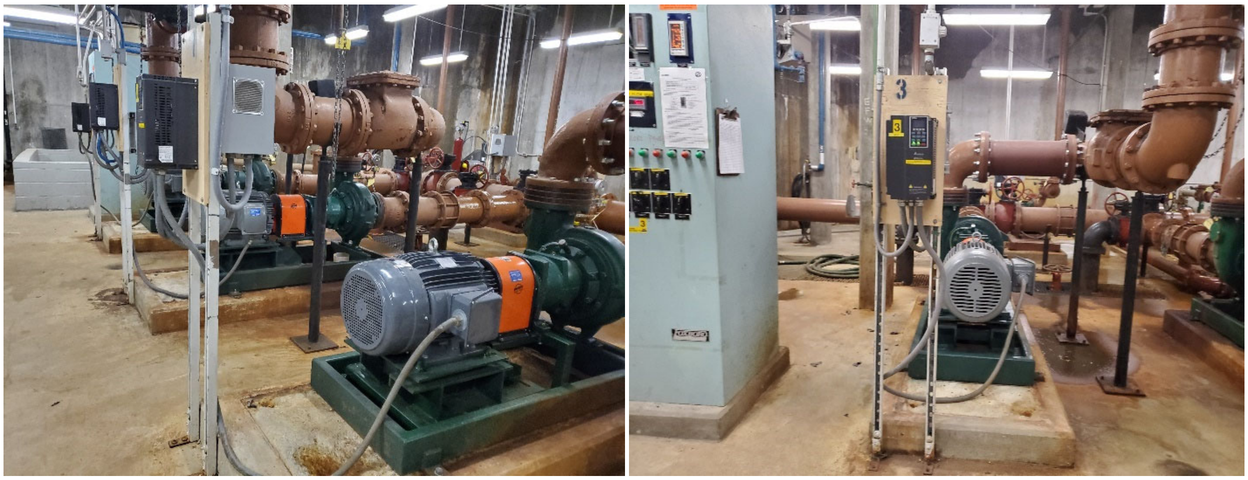
The secondary return activated sludge pumps (3 total) transport settled sludge from the secondary settling tanks to the aeration tanks. The RAS pumps at the secondary gallery were installed in 1977. These pumps are seized and out of service.

The nitrification-return activated sludge pumps (3 total) transport settled thickened sludge from the nitrification settling tanks to the influent channel of the nitrification tanks. The RAS pumps in the nitrification gallery were replaced in 2015 and have a capacity of 1,300 gpm at total dynamic head of 25 feet. Draining of the nitrification tanks and nitrification settling tanks is achieved through the use of these pumps. The piping and valves in this pump station are original to the 1977 plant upgrade and should be considered beyond their life expectancy.

The nitrification RAS pumps are shown in **Figure 3-18**.

**FIGURE 3-18**

**NITRIFICATION-RETURN ACTIVATED SLUDGE PUMPS**



## 3.8 WASTE-ACTIVATED SLUDGE AND SCUM PUMPS

The nitrification waste-activated sludge and scum pumps transport settled sludge and scum, respectively from the nitrification settling tanks to the primary clarifier influent splitter box. In the primary clarifiers, the WAS is co-settled with the primary solids prior to transfer to the anaerobic digestors. The two nitrification-WAS pumps were replaced in 2015. Two new nitrification scum pumps were installed in 2019. The WAS and scum pumps are horizontal non-clog centrifugal and positive displacement types, respectively. The WAS pumps have a capacity of 175 gpm at a total dynamic head of 47 feet. The scum pumps have a capacity of 100 gpm at a total dynamic head of approximately 50 feet. There are two old scum pumps originally installed in 1977 that used to take the scum from the secondary settling tanks to the primary clarifiers. These scum pumps are seized and out of service. The \nitrification WAS pumps are shown in **Figure 3-19**.

**FIGURE 3-19**

**NITRIFICATION-WASTE ACTIVATED SLUDGE PUMPS**

## 3.9 DISINFECTION AND EFFLUENT PUMPING STATION

### 3.9.1 Chlorine Contact Tank

The chlorine contact tank consists two parallel tanks used to disinfect wastewater. Influent wastewater flows to a common headbox and is then directed via gates to one of two tanks, as shown in **Figure 3-20**. Chlorine is injected at the headbox in the form of sodium hypochlorite. Wastewater travels around concrete baffle walls through the contact tank to achieve maximum contact time. The chlorine contact tank was constructed in 1977 and is showing structural deficiencies such as concrete spalling above the water surface. Each train should be taken offline so a full inspection may be completed to assess the condition of the concrete below the high-water elevation.

Scum collectors are located at the back end of the chlorine contact tanks and can be manually actuated to remove scum from the surface of the wastewater. Scum is collected in the troughs and recycled back into the treatment facility for processing. The scum collectors are original to the tanks. The scum collectors are beyond their useful life and need to be replaced.

**FIGURE 3-20**

**CHLORINE CONTACT TANKS**

### 3.9.2 Effluent Pumping Station

After treatment through the chlorine contact tank, final wastewater effluent flows by gravity to a wetwell in the Effluent Pumping Station, as shown in **Figure 3-21**. The Effluent Pumping Station consists of three submersible vertical propeller type pumps manufactured by Ebara that pump final effluent from the effluent wetwell to the cascade reaeration steps. The effluent pumps were installed in 2015, each pump has a capacity of 2,100 gpm at total dynamic head of 20 feet. The pumps, and associated valves and piping are in good condition and near-term replacement is not required.

In the cascade reaeration steps, the final effluent is reaerated to increase its oxygen content before being discharged through a 30-inch diameter outfall pipe to the French Stream. Effluent samples are taken from the effluent channels after the final step of cascade reaeration using a 24-hour composite sampler. The effluent sampler was installed in early 2000s and is in fair condition. The Cascade Reaeration Steps are shown in **Figure 3-22**

**FIGURE 3-21**

**EFFLUENT PUMP STATION**

**FIGURE 3-22**

**CASCADE REAERATION STEPS**

### 3.9.3 Chemical Disinfection Systems

Secondary effluent in the chlorine contact tank is treated with sodium hypochlorite to help kill pathogens and then with sodium bisulfite to reduce the level of residual chlorine before final discharge. Sodium hypochlorite is added into the chlorine contact tanks influent box. The chemical disinfection system consisting of two high density polyethylene (HDPE) storage tanks and two sodium hypochlorite pumps, as shown in **Figure 3-23** and **Figure 3-24**. The sodium hypochlorite storage tanks and chemical pumps are located in the first floor of the Main Building Addition. This location is a fair distance to the chemical application point which can lead to non-ideal chemical dosage response times to due changing conditions in the chlorine contact tank (i.e., variation in residual chlorine levels or flow variations). The sodium hypochlorite tanks were installed sometime prior to 2010 and are in good condition. The sodium hypochlorite pumps were installed in the last five years and are peristaltic pumps with a capacity of 33.3 GPH.

**FIGURE 3-23**

**SODIUM HYPOCHLORITE TANK**


**FIGURE 3-24**

**SODIUM HYPOCHLORITE PUMPS**

Sodium bisulfite is added to the chlorinated effluent from the chlorine contact tanks to remove residual chlorine prior to final effluent discharge into the French Stream. Sodium bisulfate is added using two peristaltic pumps with a capacity of 13.8 GPH each, as shown in **Figure 3-25**. The sodium bisulfite is stored in 55-gallon plastic drums. The bisulfite is added to the downstream end of the chlorine contact tanks. The pumps were installed in the last five years and are in the shed next to the cascade reaeration steps. The 55-gallon drums of bisulfite are stored outside without secondary containment. This system should be replaced with a bulk storage system with secondary containment within an industrial grade building.

**FIGURE 3-25**

**SODIUM BISULFITE DRUMS**


**FIGURE 3 26**

**SODIUM BISULFITE PUMPS**

## 3.10 ANAEROBIC DIGESTERS AND SLUDGE PUMP SYSTEMS

Co-settled sludge from the primary clarifiers is pumped to the anaerobic digestion complex for solids reduction prior to dewatering treatment. The facility has four anaerobic digesters, two small digesters constructed in 1964 and two large units constructed in 1977. The four digesters are located at the four corners of the digester complex. There are two buildings that make up the interior of the complex. These were constructed in 1964 and 1977. Currently, one large anaerobic digester is in service, one small anaerobic digester is used to store digested sludge prior to dewatering and other two digesters are off-line.

The Rockland WWTP produces approximately 4,200 lbs./day of sludge (combination of primary and secondary) that is fed to the anaerobic digestors at an average feed concentration of 2.5% for a daily average volume of 20,000 gallons. The percent volatile solids reduction through the digestion process averages approximately 47% (2016 through 2020).

The large digesters are cylinder shaped tanks of 45-feet diameter that were originally designed as primary and secondary digesters. The large primary digester is currently in service and has a volume capacity of 457,000 gallons with a water depth of 38-feet. This digester has a fixed steel cover that is showing significant corrosion and delamination. The steel cover needs to be repaired in the next facility upgrade. The digester has a mixing system that was replaced in 2013 and is in good condition. The large secondary digester is out of service with a damaged floating cover. This digester has a volume capacity of approximately 412,000 gallons with a water depth of 34.6-feet. The internal mechanisms and external connections to this digester are damaged and need to be replaced. The covers of the large anaerobic digesters are shown in **Figure 3-27**.

**FIGURE 3-27**

**LARGE ANAEROBIC DIGESTERS**

The small digesters are cylinder shaped tanks of 35-feet diameter that were also designed as primary and secondary digesters. The small primary digester is currently used to store digested sludge from the large primary digester. This digester has a volume capacity of approximately 145,000 gallons with a water depth of 20-feet. This small digester has a fixed steel cover that is in fair condition. The internal mixing system and other internal mechanisms are original and are likely beyond their useful life. The small secondary digester is out of service with a damaged floating cover. This digester has a volume capacity of approximately 130,000 gallons with a water depth of 18.2-feet. The small secondary digester plumbing connections are out of the digester flow loop and need to be replaced. The cover of the small anaerobic digesters and interior of the small primary digester are shown in **Figure 3-28**.

**FIGURE 3-28**

**SMALL ANAEROBIC DIGESTERS**

Sludge in the anaerobic digesters is recirculated through heat exchangers to adjust the sludge temperature to the desired target value. The facility has two sludge heat exchanger systems, one small installed in 1964 used to treat the sludge within the small digester; and one large originally installed in 1977 used to treat the sludge within the large digesters. The sludge heat exchangers are located in the basement of the digester building. Currently, the large sludge heat exchanger system is in service. This heat exchanger system was replaced in 2016 and is in good condition. The small heat exchanger system is out of service and plumbed out of the digester flow loop. The entire small heat exchanger system and its plumbing needs to be replaced. The large sludge heat exchanger is shown in **Figure 3-29**.

**FIGURE 3-29**

**LARGE SLUDGE HEAT EXCHANGER**

The facility has four sludge recirculation pumps, two small units installed in 1964 used to recirculate the sludge within the small digesters; and two large units installed in 1977 used to recirculate the sludge within the large digesters. The sludge recirculation pumps are in the basement of the digester building. The sludge recirculation pumps are torque-flow type pumps with a capacity of 125 gpm at total water head of 36 feet. Currently, the large sludge recirculation pumps are in service. These pumps are beyond their useful life expectation and need to be replaced in the next facility upgrade. The large sludge recirculation pumps are shown in **Figure 3-30**. The small sludge recirculation pumps are out of service and disconnected from the digester flow loop. These pumps need to be replaced in the next facility upgrade.

**FIGURE 3-30**

**LARGE SLUDGE RECIRCULATION PUMPS**

The sludge in the large digesters is treated for approximately 25 days. After this period, the final digested sludge experiences an average volatile solids reduction of approximately 47%. The volatile solids reduction has improved over the last several years (presumably due to the heat exchanger replacement), achieving between 50% and 60% reduction.

The facility has four digested sludge transfer pumps. Two small units installed in 1964 used to transfer sludge from the small digesters and two large units installed in 1977 used to transfer sludge from the large digesters. The digested sludge transfer pumps are shown in **Figure 3-31**. The sludge transfer pumps are simplex plunger type pumps with a capacity of 83 gpm at total dynamic head of 231 feet. Currently, the large sludge transfer pumps are used to transfer sludge from the large primary anaerobic digester to the small primary digester where the digested sludge is stored before is transferred to the dewatering units. The large sludge transfer pumps are beyond their useful life and need to be replaced.

The facility has two inline grinding units, installed in 2014, that macerate solids prior to pumping to the dewatering units. The sludge chopping pumps are shown in Figure 3-32. The pumps are in the basement of the Digester Building. The chopper pumps are centrifugal non-clogging type pump with a capacity of approximately 1,000 gpm at total dynamic head of 50 feet. The sludge chopper pumps were replaced in 2014 and are in good condition. The digested sludge transfer chopper pumps were replaced in 2018 and are also in good condition.

**FIGURE 3-31**

**DIGESTED SLUDGE TRANSFER PUMPS**

**FIGURE 3-32**

**SLUDGE CHOPPER PUMPS**

## 3.11 SLUDGE DEWATERING

Digested sludge stored in the small primary digester is pumped to the Belt Filter Presses (BFPs) in the Main Building where the sludge is dewatered to "cake". The sludge is sent to one of two flocculation tanks, where polymer is added to the sludge to promote flocculation prior to the BFPs. The presses dewater by applying pressure to the sludge between two belts to squeeze out the water. Sludge sandwiched between two tensioned porous belts are passed over and under rollers at greater pressure to remove the water. Water is recycled back to the influent wetwell, while the resulting dewatered cake is collected and transferred via a belt conveyance system. The facility has two Belt Filter Presses (Ashbrook Klampress) which were installed in 1994. The facility has had many issues with the BFPs over the years and has performed periodic maintenance on the units to increase their longevity. The filter presses are 26 years old and thus are beyond their typical service life and need to be replaced. The Belt Filter Presses are shown in **Figure 3-33**.

The BFP's achieve a 20% dry cake, which is excellent for a belt filter press dewatering anaerobically digested sludge. Dewatering activities typically occur two to three days per week. The Rockland WWTP disposes of approximately 1,850 wet tons of sludge per year or slightly greater than 5 tons/day.

Dewatered sludge is transferred from the BFPs via a belt conveyor system to a roll-off container in the Sludge Removal Room. Once the containers are full, the dewatered sludge is hauled to the

Synagro facility in Woonsocket, RI for final disposal. There is one conveyor system for both filter presses. The conveyor was installed in last facility upgrade in 1977. The conveyor system is beyond its typical service life and needs to be replaced in the next facility upgrade. The belt conveyor is shown in **Figure 3-34**.

**FIGURE 3-33**

**BELT FILTER PRESSES**

**FIGURE 3-34**

**BELT CONVEYOR**

Polymer is added to the sludge prior to dewatering to promote sludge flocculation and produce a dryer cake. The Town uses approximately 100 gal./month of liquid emulsion polymer. This polymer is cleaner than dry polymer to work with (no dust and dehumidification issues) and produces good cake solids at the dewatering presses. Polymer is pumped into a batch tank where is mixed and diluted with water for easier distribution.

Progressive cavity pumps transfer diluted polymer to the flocculation tanks upstream of the BFPs. The progressive cavity pumps are a low-shear pump that pump the polymer solution without breaking the long polymer chains that form and are used to coagulate sludge. The polymer mixing system, polymer feed and transfer pumps were installed in 2017 and are located next to the Filter Press Room.

## 3.12 ADMINSTRATION BUILDING

Ancillary equipment in the Administration Building includes the following:

### 3.12.1 Air Compressor

An air compressor system is located in the basement of the Equipment Room of the Administration Building and is used to supply compressed air to various needs throughout the facility. The air compressor system was installed in 1977 and is beyond its useful life. The air compressor system is shown in **Figure 3-35**.

**FIGURE 3-35**
**AIR COMPRESSOR**

### 3.12.2 Plant Water

Two plant water pumps are located in the basement of the Nitrification Gallery. A manual twin basket strainer is located upstream of the pump skid to remove particulate material and protect the pumps from foreign objects that may be drawn in from the uncovered chlorine contact tank. The plant water pumps were installed in 1977 and are beyond their typical life expectancy. They are intended to supply plant water to various components of the treatment facility including the BFPs, polymer make-down system, grit washer, and hydrants throughout the site. The plant water pumps are shown in **Figure 3-36**.

**FIGURE 3-36**
**PLANT WATER PUMPS**

A new plant water skid system is recommended to provide plant water to various unit processes in the facility.

### 3.12.3 Lime Addition System

Lime is primarily used in the facility to increase the alkalinity in the nitrification tanks and to help phosphorus precipitation in the secondary clarifiers. Lime in the aeration tanks increases the wastewater pH and alkalinity facilitating the biological activity for nitrification. When ferric chloride is added to precipitate phosphorus, lime counteracts the low pH induced by ferric increasing its effectiveness in removing phosphorus. In addition, lime can complex with phosphorus increasing the phosphorus precipitation in the secondary clarifiers. Lime in the facility is added as calcium hydroxide in a lime slurry. The lime slurry is produced from the mixing of dry hydrated lime with water. The facility has a lime storage silo outside the Administration Building. The silo was installed in 1977 and has a storage capacity of approximately 2,500 cubic feet. Lime from the silo is transported through an auger system to the lime slurry tanks. In the tanks, lime is mixed with water to produce the lime slurry. The lime slurry solution is then pumped to the nitrification tanks using progressive cavity pumps. The facility has two lime slurry tanks with mixing systems that were installed in 1977 and are in fair condition. The lime slurry storage tanks are shown in **Figure 3-37**. There are four lime slurry feed pumps which were installed in 2018 and are in good conditions. The lime equipment and silo are beyond their typical life expectancy (except for the recently installed feed pumps) and should be replaced. The lime slurry feed pumps are shown in **Figure 3-38**.

Lime addition for pH/alkalinity control at WWTP has been reduced over that last few decades given its related issues including significantly increasing sludge quantities, propensity to clog pipes and pumps, potential to overdose and the difficult and messy operation to create the lime slurry from dry lime. It is recommended the Town consider an alternative chemical such as magnesium hydroxide for pH/alkalinity adjustment.

**FIGURE 3-37**

**LIME SLURRY STORAGE TANKS**

**FIGURE 3-38**

**LIME SLURRY FEED PUMPS**

### 3.12.4 Polymer Addition System

Polymer is added to the treated effluent before the nitrification settling tanks to enhance the phosphorus precipitation in the clarifiers. The facility adds approximately 1 gal./day of polymer using peristaltic pumps. A polymer fill pump is used to transfer polymer from the delivery trucks up to the polymer storage tank as shown in **Figure 3-39**. The polymer pumps and storage tank are in the equipment room of the Administration Building. The polymer fill and feed pumps were installed in 2015 and are in good condition. The polymer pumps are shown in **Figure 3-40**.

**FIGURE 3-39**

**POLYMER STORAGE TANKS**

**FIGURE 3-40**

**POLYMER PUMPS**

### 3.12.5 Aeration System

The facility has three aeration blowers, two old units installed in 1977 and one new unit installed in 2010. The two older blowers are seized and out of service. The new blower is used to supply air to the aerated grit chamber. The blowers are in the equipment room of the Administration Building, as shown in **Figure 3-41**.

**FIGURE 3-41**

**BLOWERS**

### 3.13 ELECTRICAL SYSTEMS AND STANDBY GENERATOR

The electrical systems at the Rockland WWTP were installed as part of the 1977 plant upgrade. This includes the main switchgear, underground electrical duct banks and the motor control centers located in various buildings throughout the facility. The Administration Building addition in 2000 included modifications to that building's electrical components. In general, all the electrical systems are beyond their life expectancy. A detailed discussion of the existing electrical system, life expectancy, consequence of failure and recommended improvements are provided in the electrical assessment memorandum, Appendix C.

The facility has one standby engine generator that provides power to the entire facility when the main power supply is suspended. The standby generator was installed in 1979 and is in the generator room of the Electrical Building as shown in **Figure 3-42**. A detailed discussion regarding the assessment of the generator is in the electrical assessment memorandum, Appendix C. The generator is beyond its useful life and should be replaced.

**FIGURE 3-42**

**STANDBY GENERATOR**

4

# SECTION 4

# IDENTIFICATION AND SCREENING OF POTENTIAL TREATMENT ALTERNATIVES

This section of the report summarizes the evaluation of the existing major liquid stream and solids processes at the Rockland Wastewater Treatment Plant (WWTP). The major liquid and solids stream processes of the WWTP are described in this section, in the general order of flows through the facilities.

Workshops were held with the Town to gather information on existing conditions and to evaluate each process in order to make recommendations for improvement. An alternatives analysis was conducted on several unit processes. The recommendations provided in this section assume that replacement of these items would not occur until year 2025. As such, items that are not currently at the end of their useful life as of the date of this report, may be at or close to the end of their useful life once an upgrade commences. Improvements related to the architectural, structural, electrical and mechanical/HVAC systems can be found in Appendix C.

## 4.1 PRELIMINARY TREATMENT

Preliminary treatment at the Rockland WWTP consists of an influent pump station and a single aerated grit tank. The influent pump station, constructed in 1964, includes an initial mechanical screening system followed by a wetwell/drywell pump station configuration. Wastewater is pumped to an exterior downstream aerated grit removal tank.

### 4.1.1 Influent Pump Station

The lower portions of the pump station, specifically the wet well and dry well, are viable structures that should last several more decades without major upgrades. Thus, replacement of the influent pump station is not recommended. It is recommended that the lower wetwell be drained, cleaned and the concrete resurfaced to eliminate any exposed aggregate and address corrosion concerns. Replacing this structure would be extremely costly given the depth and size of the wetwell/drywell. Replacement of the influent pumps and associated piping is not immediately required as these pumps are only 10 years old. However, replacement of these pumps and associated piping will be required within the 20-year planning window based on asset management planning standards.

The building above the wetwell/drywell needs an immediate upgrade. There are several code related items that need to be addressed including the need for an isolated electrical room and an HVAC system upgrade to address ventilation and fire protection codes. Furthermore, several architectural components need replacement as outlined in the discipline specific memorandum (Appendix C). This includes replacement of the roof, windows, and doors.

### 4.1.2 Influent Screening Facility

The influent pump station includes an intermediate level (directly above the wetwell) which provides for influent flow measurement and mechanical screening. This area is extremely congested, showing signs of severe corrosion and provides very poor access for maintenance or operational activities. In addition, the floor of this level is directly above the influent wetwell and if retained would probably require additional reinforcing (would require the wetwell to be drained and directly inspected to verify floor condition).

It is recommended that influent screening system and flow measurement be removed from this location and a new screening facility constructed upstream of the influent pump station. It is not recommended to reuse the equipment in the existing screening area for the new screening facility.

### 4.1.3 Grit Removal

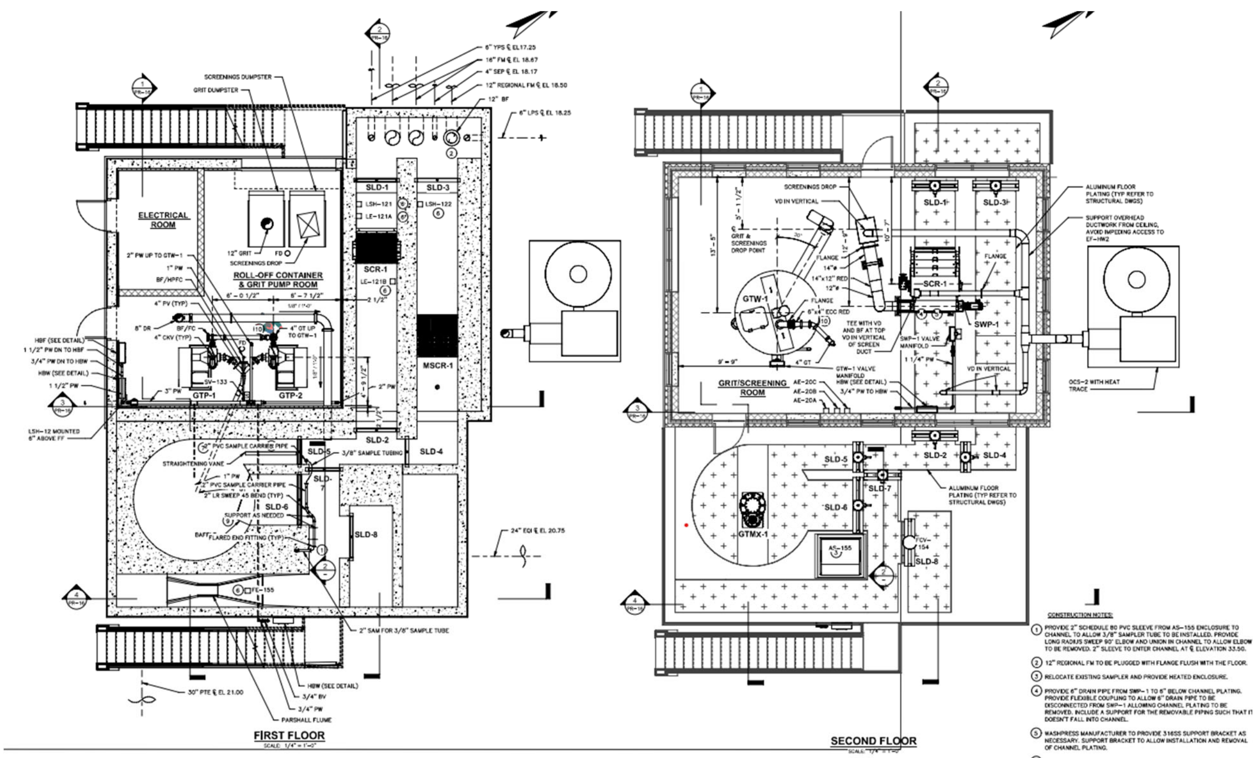
The existing aerated grit tank is located downstream of the influent pump station in an exterior concrete structure. Originally, accumulated grit was removed via a clamshell device, but that device has since been removed due to safety concerns with the structural framing.

It is recommended that a new grit removal system be installed within a proposed new screening facility upstream of the existing influent pump station. Grit systems are ideally located prior to influent pumping to eliminate grit accumulation in the influent wetwell and excessive wear and tear on the influent pumps. Influent pumps are considered a high priority item given the consequence of their failure. Locating the grit system upstream of the influent pumps will necessitate a reduction in the usable wetwell volume due to a lowering of the incoming hydraulic grade. Initial estimates indicate that the reduced wetwell volume is sufficient for a three-pump setup at a peak flow capacity of 7.0 MGD.

A single vortex type grit removal system is recommended to improve removal efficiency of incoming grit. The accumulated grit in the bottom of the vortex would be pumped to a grit washer. This device "cleans" the grit of organic material reducing potential odors. Following washing, grit would be transported to a small roll-off container for periodic offsite removal. An example of an influent screening and grit removal setup is depicted in **Figure 4-1**.

**FIGURE 4-1**

**EXAMPLE OF AN INFLUENT SCREEN AND GRIT BUILDING**




## 4.2 PRIMARY SETTLING TANKS AND PRIMARY WASTE SLUDGE PUMPS

### 4.2.1 Primary Settling Tanks

If a new screen and grit facility was constructed upstream of the existing influent pump station, influent wastewater would be pumped directly from the influent pump station to the primary settling tanks for primary treatment. This includes removal of settleable solids, floating materials, and scum. The following modifications and upgrades are recommended for the primary settling tanks:

- Eliminate co-settling of waste activated sludge
- Replace the existing mechanical equipment in settling tank No. 1 and No. 2
- Address structural issues including concrete and crack repair, handrailing, etc.

Demolish existing settling tank No. 3 and No.4. These tanks could be abandoned in place. However, due to potential future liability and related safety issues, it is recommended that these tanks be demolished. If these liability issues are properly addressed, retainage of this structure is possible.

Sludge from the settling tanks is removed via sludge pumps located in the basement of the Administration Building. These pumps were recently replaced. However, their associated piping and valves are more than 40 years old and are due for replacement. It is assumed that the underground piping is still in satisfactory condition.

## 4.3 SECONDARY TREATMENT

The existing secondary treatment system at the Rockland WWTP consists of the nitrification tanks, the nitrification settling tanks, the mechanical aerators and the return and waste-activated sludge pumps. The two nitrification tanks are operated in parallel with four zones in series in each tank. The first zone is anoxic followed by three aerobic zones in series. The nitrification settling tanks are two circular 60-feet diameter tanks with a 12-feet side water depth. The existing aeration system, secondary clarifier equipment and associated gates, valves, and pumps need immediate replacement.

The secondary treatment system provides biological removal of organic matter and the conversion of ammonia to nitrate (i.e., nitrification). Nitrification is required to achieve compliance with the current effluent ammonia limits. Plant staff have indicated that at times it has been difficult to maintain satisfactory nitrification levels.

A computerized biological process model (BioWIN® Version 6.0) was used to model the existing WWTP treatment processes. The process model was developed to simulate the performance of the

WWTP using its recent operational data. The model was calibrated to match the facility observed data. The calibrated model provided predictions for effluent quality, primary effluent quality, return stream quality, in-process solids concentrations and sludge production. The calibrated model was used to determine the facility capacity with the existing infrastructure to treat future flows and loads. The model was used to develop preliminary design criteria for treatment processes that meet the potential nutrient discharge concentrations for future flows and loads.

Observations from model development include:

- The existing activated sludge process, while historically providing satisfactory treatment, is close to its maximum organic loading capacity.
- The secondary treatment process does have sufficient capacity to absorb the "approved, pending and future wastewater buildout flows and loads", as summarized in Table 2-4. This is due to the relatively modest loads from these sources.
- The existing activated sludge process, while not originally designed for, is currently operated to achieve some level of total nitrogen removal. This operation reduces the amount of supplemental alkalinity (i.e., lime addition) required to maintain compliance with the effluent pH limit.
- The secondary clarifiers side water depth is considered shallow for a total nitrogen removal process.
- The anaerobic digestion process recycles a significant amount of ammonia increasing the WWTP's oxygen demand and reducing its safety factor with respect to achieving compliance with its effluent ammonia-nitrogen permit limit.

Secondary treatment processes are designed to include a "safety factor". A safety factor is required to allow for periodic "removal from service" of equipment and tanks to allow for routine maintenance and inspection. This is currently not possible at the Rockland facility due to both the inability to operate the isolation gates as well as the increased organic loading that would be applied to the remaining in-service systems. As such, an increase in the organic loading capacity of the secondary treatment system is recommended regardless of whether influent flows and loads increased beyond current levels.

The existing activated sludge process is operated to achieve total nitrogen (TN) removal. The existing effluent permit does require the Rockland facility to remove ammonia-nitrogen, but it does not require the removal of total nitrogen. However, incorporating total nitrogen removal does provide several significant benefits including a reduction in alkalinity consumption and oxygen requirements, ultimately resulting in a lower total operational cost. As discussed in Section 1, there is a high probability that the Town of Rockland will receive a total nitrogen effluent limit within the 20-year planning period. As such, it is recommended that any improvement or modification to the secondary process provide total nitrogen removal.

The existing activated sludge process does not provide for enhanced biological phosphorus removal. Currently, compliance with the facilities effluent total phosphorus limit is achieved through multi-point chemical addition. Expanding the biological process to incorporate enhanced biological phosphorus removal will reduce the amount of chemistry required for phosphorus removal and sludge produced due to chemical addition. Ultimately, reducing the operating costs associated with the secondary treatment system. Furthermore, incorporating biological phosphorus removal will enhance the settling of the mixed liquor resulting in increased solids removal performance during high flow events.

#### 4.3.1 Expected Effluent Quality

The existing secondary treatment process achieves compliance with the current effluent permit limits for TSS, BOD5, total phosphorus and ammonia. Total phosphorus is removed in the primary treatment and secondary treatment processes through chemical addition. The secondary treatment process also removes a modest amount of total nitrogen. However, that parameter is currently not a permit limit.

The secondary treatment processes presented herein will achieve compliance with the current and expected effluent limits for TSS, BOD5 and ammonia. Incorporating enhanced biological phosphorus removal, as described in the forthcoming alternatives analysis will not achieve compliance with the current or potential lower future total phosphorus limits. However, it will reduce the amount of chemistry required to achieve a total phosphorus limit. If the final effluent total phosphorus limit remains at 0.2 mg/l, supplemental chemistry can be added to either of the two nutrient removal processes to achieve compliance with the current total phosphorus limit. If the total phosphorus limit is reduced to 0.1 mg/l (as expected), it is recommended that chemical addition be reduced in the primary and secondary treatment processes. Each of the alternative secondary treatment processes will achieve an effluent total phosphorus concentration between 0.5 mg/l and 1.0 mg/l, depending on the wastewater temperature and flow conditions.

An effluent total phosphorus limit of 0.1 mg/l will necessitate the inclusion of a tertiary treatment process. The chemistry added to the secondary process would be redirected to the tertiary treatment process to achieve a 0.1 mg/l total phosphorus limit. It is more effective to add chemistry to a tertiary process to achieve permit compliance versus trying to achieve as low as possible total phosphorous concentration in the secondary treatment process.

Process modeling was conducted to determine the capacity and performance of alternative secondary treatment processes. Process modeling was completed both with and without the inclusion of the anaerobic digestion process. The anaerobic digestion process recycles a significant amount of phosphorus and nitrogen due to the digestion of biological solids. The amount of recycled ammonia-nitrogen elevated the effluent total nitrogen levels. Compliance with a future 10 mg/l total nitrogen limit or lower would require the installation of either a sidestream nutrient removal process or the inclusion of a 4-stage activated sludge process with supplemental carbon addition. A cost-benefit analysis of the anaerobic digestion process was conducted (details are provided later in this section). The cost analysis identified that retaining the anaerobic digestion process was cost prohibitive. Therefore, the secondary treatment alternatives analysis assumes that anaerobic digestion will not be provided at the Rockland WWTP in the future. The secondary treatment processes evaluated below will achieve an effluent total nitrogen concentration of 8 mg/l.

### 4.3.2 Secondary Treatment Alternatives

Two treatment alternatives were identified for potential implementation at the WWTP to address total nitrogen and phosphorus removal. The selection of the alternatives was based on a review of proven technologies that have been implemented in facilities with similar characteristics to that of the Town of Rockland WWTP. The two treatment alternatives selected for this evaluation are as follows:

- Alternative No.1 (Conventional Approach) – Modify the existing secondary treatment process into an anaerobic/anoxic/aerobic configuration by repurposing the existing secondary clarifiers as activated sludge tanks, thereby increasing the total aeration tank volume.
- Alternative No.2 (Innovative Technology Approach) – Modify the existing aeration tanks into an Integrated Fixed-Film Activated Sludge (IFAS) process in an anaerobic/anoxic/aerobic configuration. Additional capacity would be achieved through the inclusion of an IFAS biocarrier. Upgrading to an IFAS process will require implementation of the influent screening and grit removal recommendations presented herein.

### 4.3.3 Alternative No.1 (Conventional Approach)

The anaerobic/anoxic/aerobic (A2O) process is a biological process consisting of anaerobic, anoxic, and aerobic zones which promote the removal of nitrogen and phosphorus from wastewater. In this alternative, the A2O process configuration will be incorporated by retrofitting the existing secondary settling tanks into anaerobic and anoxic zones as illustrated in Figure 4-2. The anaerobic zone would be a three-stage “selector” style configuration. By providing a high F/M zone at the entrance to the anaerobic zone, floc forming microorganisms can outcompete filamentous bacteria leading to the production of flocs with high compaction characteristics and low sludge volume index (SVI) values. This will enhance the solids separation performance of the downstream settling tanks, thereby improving the WWTP’s effluent water quality, especially during high flow events.

The operational performance of the relatively shallow nitrification settling tanks could be further enhanced through a modification to their effluent weir structure. This modification would increase the side water depth in both the nitrification settling tanks and aeration tanks by approximately three feet. This change would provide several benefits, including:

- An increase in the sludge storage volume within the clarifier resulting in an increase in waste and return sludge concentration.
- Improved performance during high flow events by reducing the potential for influent wastewater to “scour” the sludge blanket.

- A new tertiary treatment process will require a new intermediate pump station to overcome current hydraulic grade line restrictions. If the hydraulic grade line is increased within the settling tanks, gravity flow through a future tertiary process would be achievable.

The anaerobic selectors will favor the growth of phosphate accumulating organisms (PAOs), also known as bio-P organisms. In the anaerobic selectors, these organisms grow and use energy produced by the fermentation of stored glycogen to break the high-energy bonds in internally accumulated polyphosphate, resulting in the release of phosphate (PO43-) and the consumption of short-chain volatile fatty acids (VFAs). When these organisms are then exposed to aerobic conditions, they take up phosphate, forming internal polyphosphate molecules. This luxury uptake results in more phosphate being included in the cells than was released in the anaerobic zone, so the net phosphate concentration in the liquid phase is reduced. When the microorganisms are wasted, the extra phosphate contained in the cell is also removed.

Return activated sludge (RAS) from the nitrification settling tanks is directed to the influent junction box where it mixes with primary effluent prior to entering the anaerobic selectors. In the anaerobic selectors, PAOs uptake soluble substrate and release phosphorus. Mixed liquor from the anaerobic zone flows into the anoxic zone where it mixes with a nitrate rich internal recycle (IR) stream from the aerobic zone. In the anoxic zone, denitrifying organisms reduce nitrate to nitrogen gas using substrate remaining from the anaerobic zone or from an external source, if needed. Denitrified mixed liquor from the anoxic zone flows into the aerobic zone where oxygen is supplied for use by nitrifying organisms to oxidize ammonia to nitrate.

Process modeling was conducted to determine the performance, operating characteristics and volume required to incorporate the A2O process configuration, at both the current and design year influent loading conditions. The existing aeration tanks do not have enough capacity to operate in their current configuration or an A2O configuration at the WWTP design year influent conditions. The existing aeration tanks, after the side water depth is raised by three feet, have enough capacity to nitrify (removal of ammonia). However, they would still be undersized for conversion to the A2O configuration. To properly incorporate the A2O configuration, it is recommended that, the unused settling tanks be retrofitted into anaerobic and anoxic zones to provide the additional volume needed for nitrogen and phosphorus removal. In addition, the inclusion of the anoxic zone will increase the WWTP alkalinity levels to help minimize negative impacts to the facilities pH levels.

The process configuration for this alternative is shown in **Figure 4-2**. The basis of design at annual average conditions for this alternative is presented in **Table 4-1**.

**FIGURE 4-2**

**BIOLOGICAL NUTRIENT REMOVAL ALTERNATIVE MODEL CONFIGURATION**

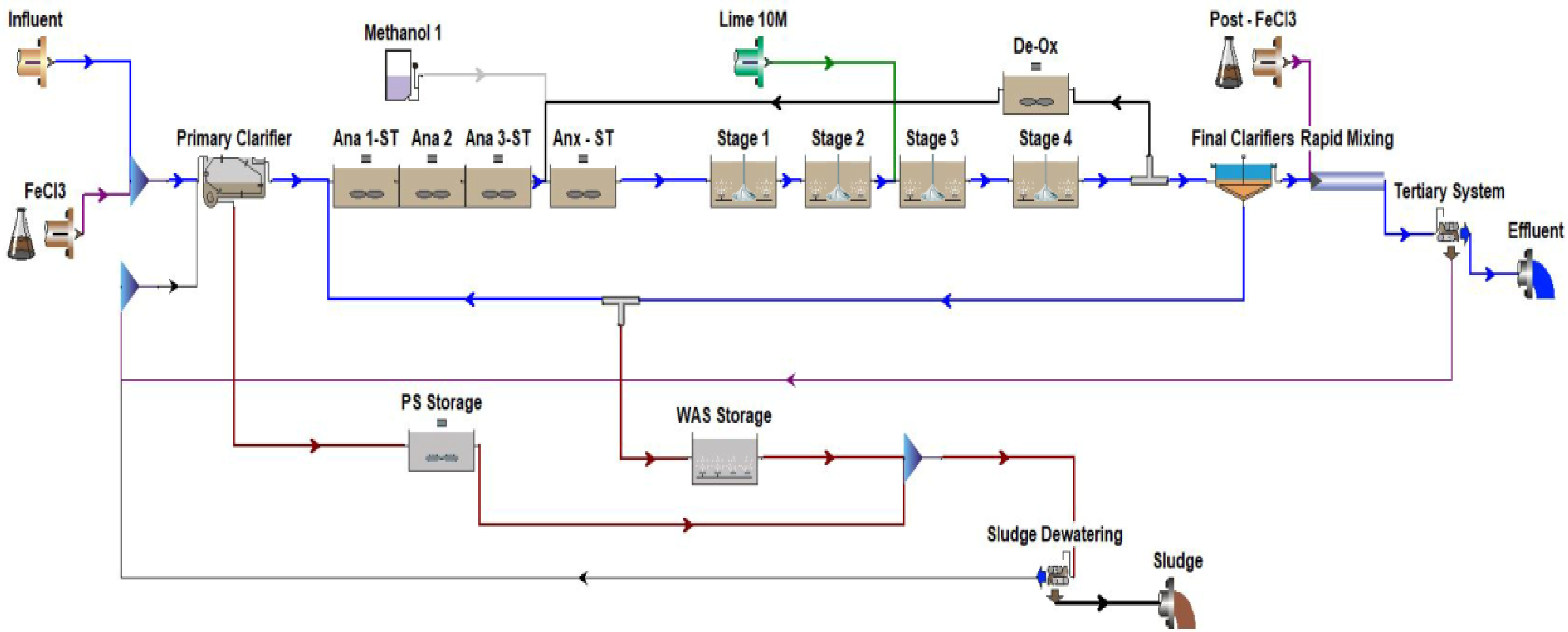


**TABLE 4-1**

**BASIS OF DESIGN**

**BIOLOGICAL NUTRIENTS REMOVAL ALTERNATIVE**

**DESIGN ANNUAL AVERAGE CONDITION**

| Parameter | Value |
|---|---|
| Aeration Tanks | 2 |
| Total Tanks Volume, Mgal | 1.94 |
| Typical RAS Flow, MGD | 1.0 – 2.0 |
| Typical IR Flow, MGD | 7.5 |
| Design MLSS, mg/L | 1,830 |
| Aerobic SRT, day | 8 |
| WAS, lbs./day | 2,900 |
| OTR, lbs./day | 5,100 |
| Air Required, scfm | 2,250 |

A proposed site layout plan for this alternative is shown in **Figure 4-3**. The major components and improvements needed to implement this alternative at the WWTP include the following:

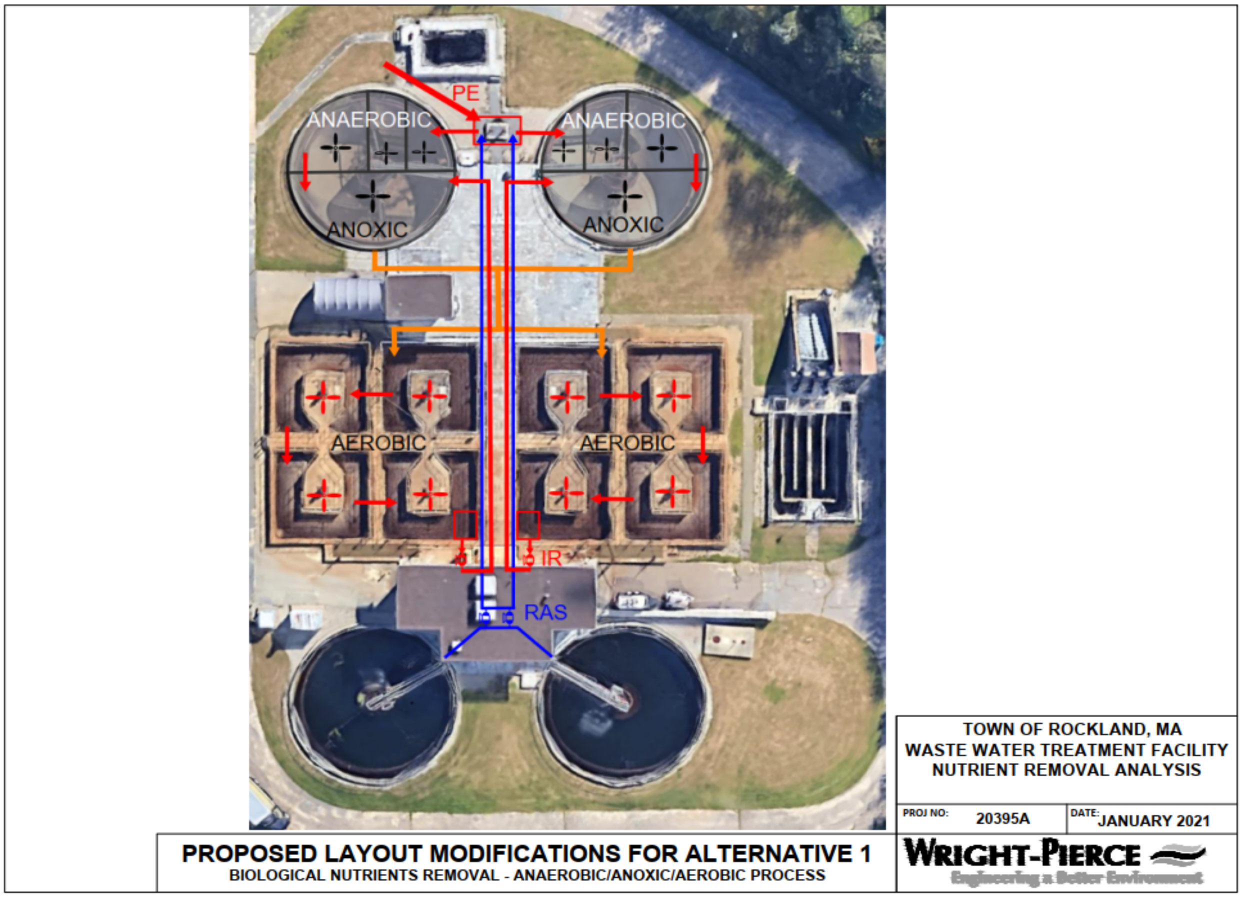
- Influent junction box upgrade including piping connections
- Retrofit the unused settling tanks into anaerobic and anoxic zones
    - Provide new submersible mixers
    - New interconnecting piping
    - Misc. structural repairs
- Aeration tank modifications
    - Replacement of the surface aerators with submerged mixer-aerators
    - New RAS system including pumps and piping
    - Two new Internal Recycle (IR) systems including new IR pumps and piping (located in the nitrification gallery)
    - New aeration system including three aeration blowers and piping
    - Misc. structural repairs
- Nitrification settling tank modifications

- Replacement of internal mechanisms and drives
- Replacement of effluent launder and weir

- Instrumentation, and electrical upgrades necessary to provide a functioning biological nutrient removal system

**FIGURE 4-3**

**PROPOSED LAYOUT MODIFICATIONS FOR ALTERNATIVE NO.1**




### 4.3.4 Alternative No.2 (Innovative Technology Approach)

The process configuration for this alternative is the same as Alternative No.1, an A2O process for the biological removal of nitrogen and phosphorus. However, additional biomass to achieve nitrification will be accomplished by adding integrated fixed film activated sludge (IFAS) media into the two existing aeration tanks. The media provides support to the organisms to develop a biofilm on their surface, increasing the biomass inventory without an increase in tank volume. The media are retained in designated treatment zones by wedge wire screens while flows pass through.

In the aerobic zones, the aeration system is comprised of an engineered grid of coarse bubble diffusers. The IFAS media is shown in **Figure 4-4**.

**FIGURE 4-4**

**IFAS MEDIA**

In this alternative, the existing aeration tanks will be modified into an A2O configuration with the inclusion of IFAS biocarrier. One of the existing aeration tanks (one per treatment train) would be modified for location of a three-stage anaerobic zone. The second aeration tank would be modified to the anoxic zone. Aerobic conditions would be provided in the two downstream aeration tanks as illustrated in Figure 4-5. Modification of the side water depth within the settling or aeration tanks is not required with this alternative.

The basis of design at annual average conditions for the biological nutrient removal alternative is presented in **Table 4-2**.

**FIGURE 4-5**

**BIOLOGICAL NUTRIENTS REMOVAL WITH IFAS ALTERNATIVE MODEL CONFIGURATION**

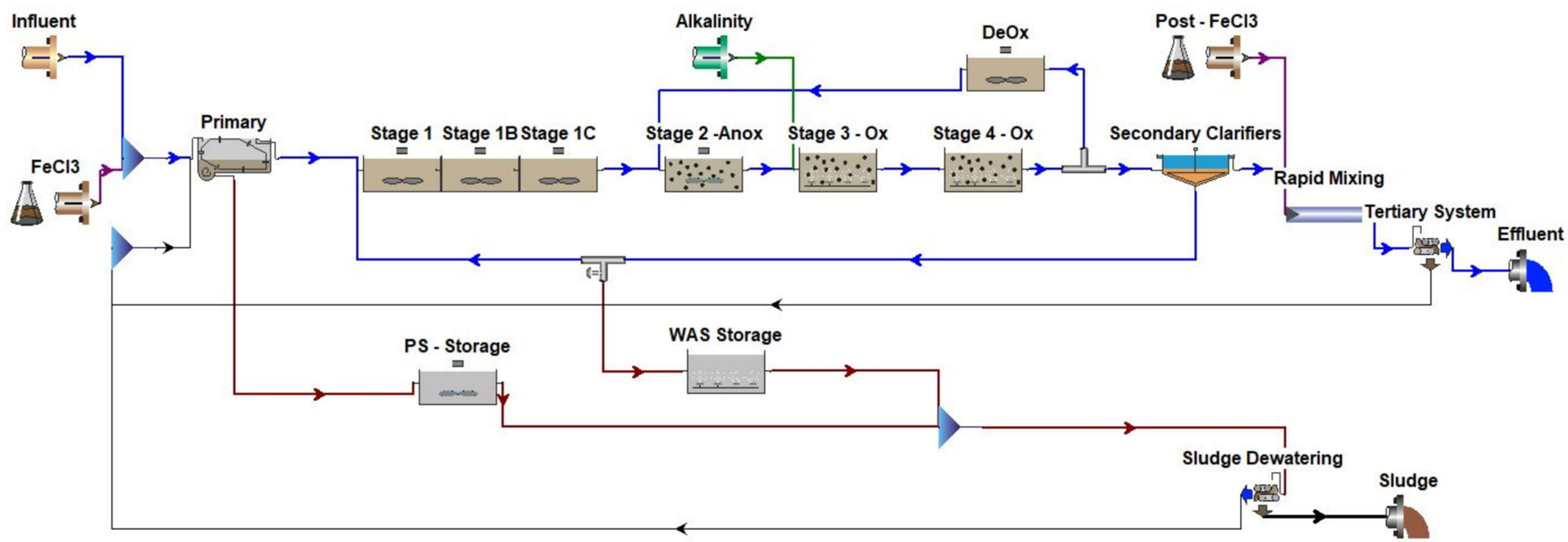


**TABLE 4-2**

**BASIS OF DESIGN**

**BIOLOGICAL NUTRIENTS REMOVAL WITH IFAS ALTERNATIVE**

**DESIGN ANNUAL AVERAGE CONDITION**

| Parameter | Value |
|---|---|
| Aeration Tanks | 2 |
| Total Tanks Volume, Mgal | 1.03 |
| Typical RAS Flow, MGD | 1.0 – 2.0 |
| Typical IR Flow, MGD | 7.5 |
| Design MLSS, mg/L | 2,000 |
| Aerobic SRT, day | 8 |
| WAS, lbs./day | 2,800 |
| OTR, lbs./day | 5,200 |
| Air Required, scfm | 3,540 |

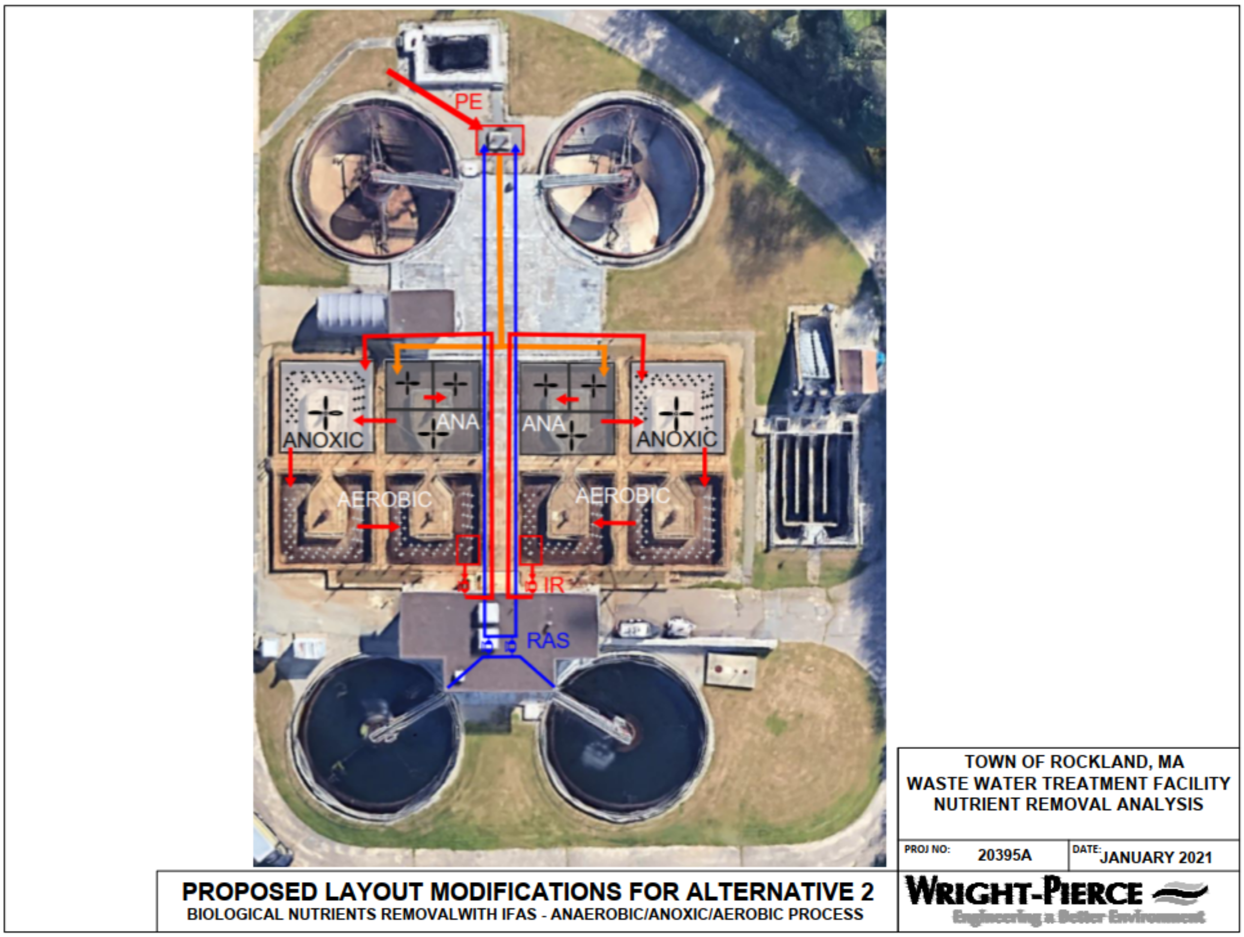
A proposed site layout plan for this alternative is shown in **Figure 4-6**. The major components and improvements needed to implement this alternative at the WWTP include the following:

- Influent junction box upgrade including piping connections
- Aeration Tank Modifications
  - Divide first stage of each existing aeration tank into a three-zone anaerobic tank with supplemental mixing
  - Second stage would be the anoxic zone filled with media (50% fill fraction) with supplemental mixing
  - Use third and fourth stages as aerobic zones filled with media (50% fill fraction) and replace surface aerators by submerged mixer-aerators
  - New RAS system including pumps and piping
  - Two new Internal Recycle (IR) systems including new IR pumps and piping (located in the nitrification gallery)
  - New aeration system
- Nitrification Settling Tank modifications

- Replacement of internal mechanisms and drives
  - Replacement of effluent launder and weir
- Instrumentation, and electrical upgrades necessary to provide a functioning biological nutrient removal with IFAS system

**FIGURE 4-6**

**PROPOSED LAYOUT MODIFICATION FOR ALTERNATIVE NO.2**




### 4.3.5 Aeration System

The existing mechanical surface aerators are well beyond their typical service life. Given the age of the units, it is difficult to find spare parts and other mechanical components to address ongoing maintenance needs. This equipment represents one of the most critical pieces of equipment within the WWTP. Failure of one of these items would have significant consequences. Specifically, failure of an aerator would immediately decrease the capacity and performance of the secondary treatment process. The most likely result would be an increase in the WWTP's effluent ammonia concentration potentially resulting in a permit violation. Replacement of a failed mechanical surface aerator would be on the order of several weeks if not months. Mechanical surface aerators, while still in use today, are very seldomly replaced in-kind. This is due to their significant energy use and limited ability to adjust their output capacity as a function of influent loadings.

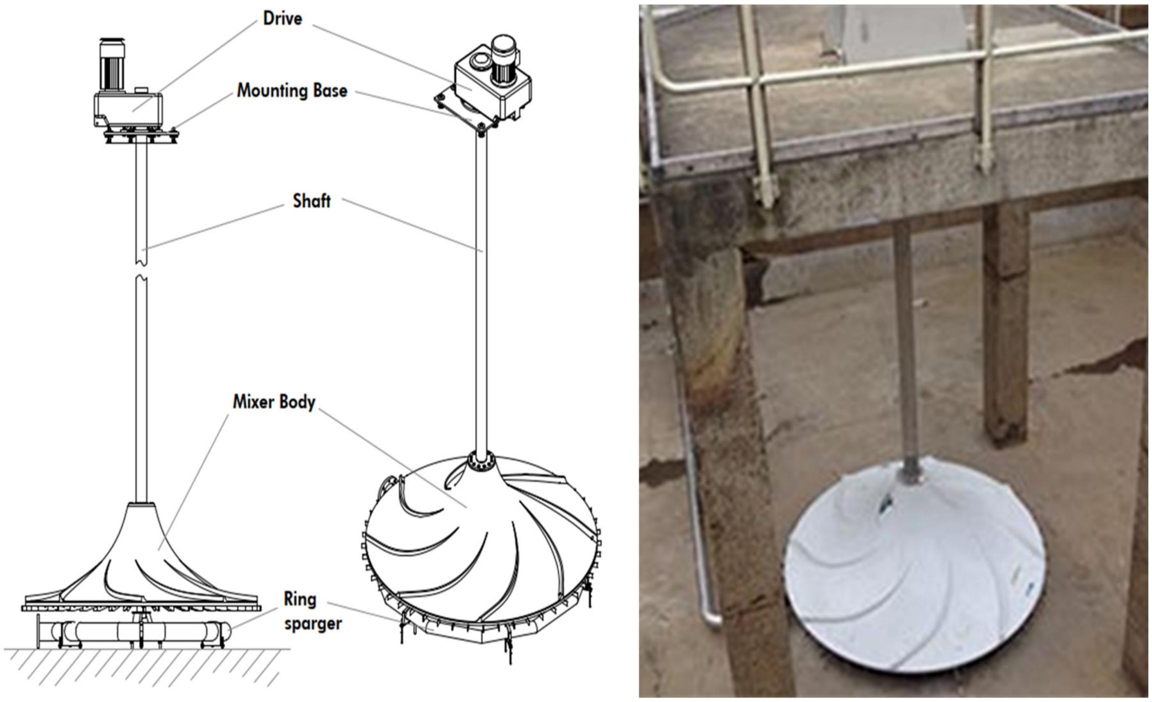
Diffused aeration and submerged hyperboloid mixer/aerators are two technologies that offer superior process performance at a significantly lower energy consumption levels than the existing mechanical aerators. Unfortunately, the energy efficiency of a diffused aeration system is directly proportional to the aeration tanks side water depth (the shallower the tank the more energy is required). As such, diffused aeration is not a viable alternative at the current aeration tank side water depth of 12feet. If the water depth was raised to 15 feet, then diffused aeration could be considered.

The submerged hyperboloid mixer/aerators have significant benefits for nutrient removal processes at an intermediate tank water depth (12 to 16feet). The submerged hyperboloid mixer/aerators can both mix and aerate or just mix the contents of the tank. This allows the plant operators to adjust the mixing and aeration levels independently of each other. This flexibly will greatly enhance the WWTP's ability to remove phosphorus and nitrogen and result in a reduced air flow and energy requirement.

These mixer/aerators can be easily installed on the existing surface aerator platforms. The fins positioned on the top of the hyperboloid mixers at the bottom of the tanks produce a bottom flow that is directed radially outwards to the sides of the tank. During aeration, air is pumped (via a new blower and stainless-steel piping system) under the hyperboloid mixers into the sparging system, and the mixers contain several fins to shear the air into fine bubbles. To provide a flexible and reliable biological nutrient removal process, it is recommended to replace the existing surface mechanical aerators with submerged hyperboloid mixer/aerators together with blowers and stainless-steel piping system. **Figure 4-7** shows the recommended submerged hyperboloid mixer/aerator technology.

**FIGURE 4-7**

**HYPERBOLOID SUBMERGED MIXER/AERATORS**




Several new blowers would be provided as part of the aeration package. There are several potential locations for these blowers including potentially in the below grade piping gallery or in the electrical room (once the generator is removed). However, each of these locations would not be considered ideal. As such, for purposes of this evaluation it has been assumed that a new blower building would be installed adjacent to the nitrification tanks.

### 4.3.6 Return Activated Sludge Pumps

The nitrification return activated sludge pumps (3 total) transport settled, thickened sludge from the nitrification settling tanks to the influent channel of the nitrification tanks. The RAS pumps in the nitrification gallery were installed in 2015 and have a capacity of 1,300 gpm at total dynamic head of 25 feet. Alternative 1 will require relocating the discharge of the RAS upstream of its current location, thus increasing the total dynamic head of the pumping system. New RAS pumps have been assumed due to the increased TDH. However, during detailed design, the possibility of reusing the existing pumps will be investigated further.

### 4.3.7 Internal Recycle Activated Sludge Pumps

The A2O process configuration for both secondary treatment alternatives will require the installation of an internal recycle system (IR). Nitrate rich mixed liquor is recycled from the end of the aeration tanks to the anoxic zone. A recycle ratio between 2 to 3 times influent flow is needed to produce a total nitrogen effluent concentration less than 8.0 mg/l.

The IR pumps can be installed in the nitrification gallery. New piping and valves within the gallery will transport MLSS back to the anoxic zone. The IR system will consist of three pumps (two duty and one standby).

### 4.3.8 Waste Activated Sludge and Scum Pumps

There are two nitrification WAS pumps, installed in 2015. And two new nitrification scum pumps, installed in 2019. The WAS and scum pumps are horizontal non-clog centrifugal and positive displacement types, respectively. The WAS pumps have a capacity of 175 gpm at total dynamic head of 47 feet. The scum pumps have a capacity of 100 gpm at total dynamic head of approximately 50 feet. These pumps have enough capacity to handle waste sludge flows generated at current and future loading conditions. However, a new piping system will be required to pump waste-activated sludge from the nitrification settling tanks to the sludge holding tanks.

### 4.3.9 Present Worth Cost Analysis

A present worth analysis was developed for each alternative approach for comparison purposes. Typically, the lowest net present worth is considered the most cost-effective alternative approach over a specific period. A detailed discussion of the cost estimating procedure, contingency levels, and assumptions is included in Section 5. The total construction cost for the secondary treatment facilities were estimated assuming a construction start date of 2023. The total project cost estimate includes construction contingency, engineering, and inspection services. An interest rate of 0.5% was applied to the estimated operation and maintenance (O&M) cost to determine each alternative's present worth.

The conceptual design construction cost estimate for the two secondary treatment alternatives are presented in **Table 4-3**. The costs include inflation to the expected mid-point of construction.

**TABLE 4-3**

**CAPITAL COST ESTIMATES – SECONDARY TREATMENT**

| Alternative | Total Construction Cost |
|---|---|
| No. 1 | Conventional Approach |
| No. 2 | Innovative Technology Approach |

Annual O&M costs were estimated for each alternative. O&M costs include items such as labor, electrical demand, chemicals, and products needed in the secondary treatment system. Actual costs to operate the WWTP may vary from these values, but they are sufficient for comparing the different secondary treatment alternatives. A summary of the O&M cost for each secondary treatment is presented in **Table 4-4.**

**TABLE 4-4**

**ESTIMATED MAINTENANCE COSTS FOR SECONDARY TREATMENT**

| Parameter | Alternatives | |
|---|---|---|
| | No. 1 | No. 2 |
| **Labor**[1] | \$40,000 | \$60,000 |
| **Electric Demand**[2] | \$236,000[3] | \$216,000[3] |
| **Chemical and Products Use** | - | - |
| **Total Annual O&M Cost** | \$276,000 | \$276,000 |

Notes:
1. An operator labor cost of \$55/hr. was used in the estimates.
2. Electrical demand was estimated for all process equipment associated with the secondary treatment processes based on expected online motor horsepower and expected run times. An average electrical cost of \$0.12 per k Wh was used for the comparative analysis.
3. Electrical demand cost for both alternatives include blowers, mixers, and internal recirculation pumps.

Present worth costs were developed for each alternative as shown in **Table 4-5** and include the summation of total capital costs and twenty years of annual O&M costs. Process equipment generally has a 20-year life cycle, so no salvage value has been carried for equipment.

**TABLE 4-5**

**ESTIMATED TOTAL PRESENT WORTH COST – SECONDARY TREATMENT**

| Alternative | Total Construction Cost | Net Present Value | Total Present Worth |
|---|---|---|---|
| No 1 – Conventional Approach | $12,440,000 | $5,200,000 | $17,640,000 |
| No. 2 – Innovative Technology Approach | $16,490,000 | $5,200,000 | $21,690,000 |

### 4.3.10 Secondary Treatment Alternative Recommendation

It is recommended that the Town of Rockland upgrade the existing secondary treatment process to an A2O process while expanding into the existing unused secondary settling tanks. This upgrade will achieve biological nitrogen and phosphorus removal thereby addressing future total nitrogen and phosphorus limits. Furthermore, the proposed process configuration will reduce the WWTP power consumption by eliminating the facilities mechanical aerators (far and away the largest energy consumption at the WWTP and replacing it with significantly more efficient aeration system. The A2O process will provide additional treatment capacity and improve the wastewater's settling characteristics which will greatly improve the system's ability to perform under peak influent flows.

### 4.3.11 Nitrification Settling Tanks

The existing nitrification settling tanks provide mixed liquor separation. Mixed liquor suspended solids from the activated sludge tanks is settled under quiescent conditions within the clarifier to separate the solids from the water, resulting in a largely clear final effluent. Solids separation performance is dictated in part by the "settleability" of the mixed liquor and the total flow going through the clarifiers. Transport of the settled sludge to the RAS pumps is in part a function of the clarifier mechanism.

The existing clarifier mechanisms are beyond their useful life and should be replaced. This includes the clarifier drive, turntable, scrapers, and walkway. New energy dissipating inlets and stamford baffles should be provided in both clarifiers. It is highly recommended that the clarifiers be reconfigured to increase their side water depth to 15 feet. This would require some structural modifications to the effluent weir channel. Increasing the side water depth will greatly improve the clarifier performance during high flow events (reduced potential to scour the sludge blanket) and allow for additional thickening of the mixed liquor.

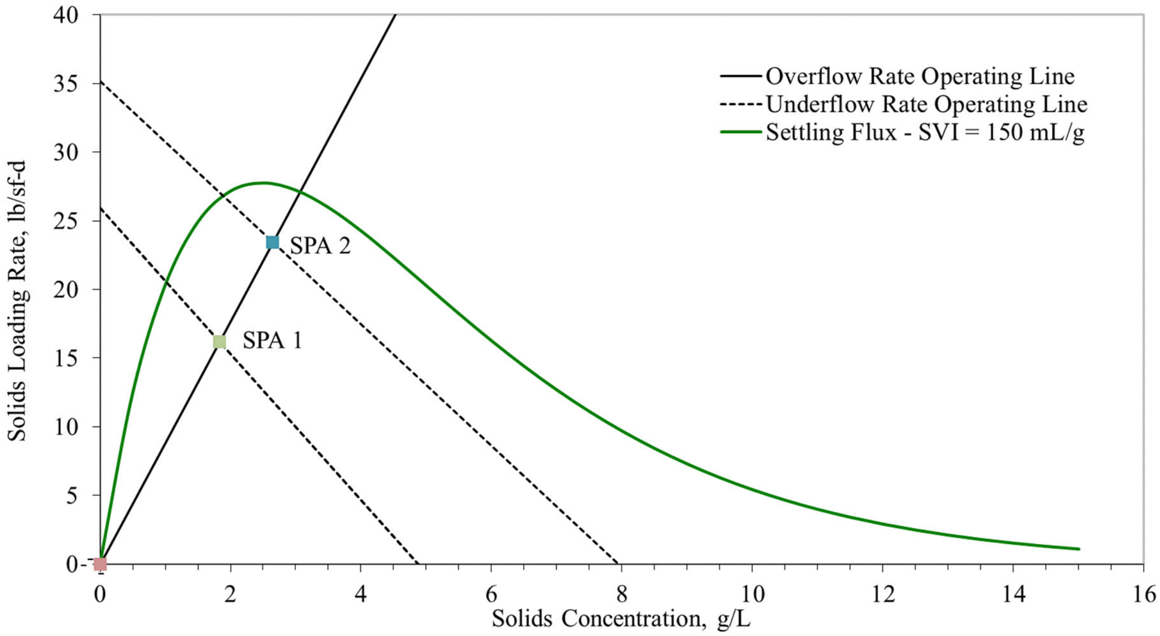
The performance of the secondary clarifiers was analyzed under steady-state conditions to establish their limit capacity. Clarifier capacity was determined via a State Point Analysis (SPA - the graphical technique used for evaluating the performance of secondary clarifiers under peak flow conditions), MLSS concentrations, sludge settling velocity, return sludge rate and SVI. The results of the SPA are graphically illustrated in **Figure 4-8**.

The point of intersection of the overflow rate (effluent over the weirs) and underflow rate (sludge withdrawn from clarifier) is the State Point. The location of the State Point in relation to the settling flux curve predict the performance of the secondary clarifier. The State Point of a well operated clarifier should be located below the settling flux curve and the underflow rate line operating below the descending limb of the settling flux curve. If the State Point is located above the settling flux curve in any condition, theoretically the material will not settle in the clarifier, but will flow out of the clarifier via the effluent weir. Similarly, if the underflow rate operating line is shown above the settling flux curve in any condition, the sludge blanket is projected to rise and exit the clarifier via the effluent weir.

The state point analysis was done for the two existing secondary clarifiers (60-foot diameter) assuming an average wastewater temperature of 16°C and a maximum MLSS value of 2,650 mg/l (design year max month condition). Alternative No. 1 will produce mixed liquor with good settleability properties with SVIs values from 75 to 150 mL/g. The clarifier capacity analysis was developed using an SVI value of 150 mL/g (worst case). The results of the SPA are shown in **Figure 4-8**. Two SPA points are highlighted indicative of the average and maximum month MLSS concentration at a peak day flow rate of 6.0 MGD. Numerically, the peak day capacity of the secondary treatment at an SVI of 150 is 6.0 MGD. The clarifiers, at an increased side water depth can handle instantaneous flows greater than 6.0 MGD, so long as the average for the day does not exceed 6.0 MGD.

**FIGURE 4-8**

**SECONDARY CLARIFIER STATE POINT ANALYSIS**




## 4.4 TERTIARY TREATMENT PROCESS ALTERNATIVES

Two treatment alternatives were identified for potential implementation at the WWTP to achieve an effluent total phosphorous limit of 0.1 mg/l. The selection of the alternatives was based on a review of proven technologies that have been implemented in facilities with similar characteristics to that of the Rockland WWTP. The two treatment alternatives selected for this evaluation are as follows:

- Alternative No.1 (Ballasted Clarification)
- Alternative No.2 (Cloth Media Filtration)

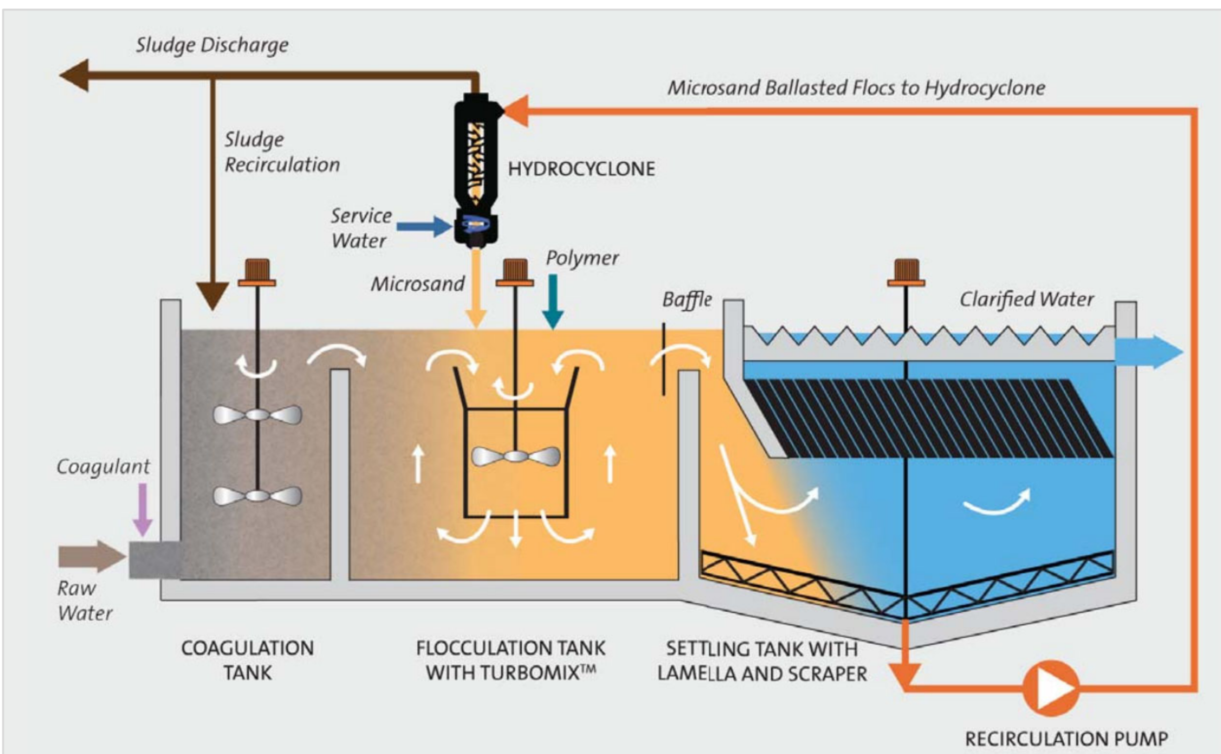
A third tertiary treatment alternative (deep bed sand filtration) was considered. This technology is a proven technology to achieve an effluent total phosphorus limit of 0.1 mg/l. However, the hydraulic grade required by this technology would require the installation of a new intermediate pump station. Increasing the hydraulic grade line through modifications to the secondary clarifiers would not provide enough hydraulic capacity to achieve gravity flow through this process. Therefore, this process was not considered as part of this evaluation.

### 4.4.1 Alternative 1 (Ballasted Clarification)

Ballasted Clarification is a high rate, physical-chemical clarification process for high rate removal of phosphorus. With ballasted clarification, secondary effluent is combined with a coagulant (metal salt) in a flash mix tank where micro-sand and polymer are added to promote particle destabilization and aggregation. The micro-sand binds with the particles via polymer bridging forming larger particle agglomerates that grow into higher density flocs in the maturation tanks. The resulting heavier flocs settle faster at the bottom of the lamella settlers. The sludge-micro-sand mixture collected at the bottom is pumped to hydrocyclones, where the sludge is centrifuge-separated from the micro-sand. The residual solids are pumped to the sludge storage tanks and the recovered micro-sand is recycled to the injection tank. **Figure 4-9** shows the ballasted clarification technology schematically.

**FIGURE 4-9**

**BALLASTED CLARIFICATION**




The ballasted flocculation process is a proven technology to achieve a total phosphorus limit of 0.1 mg/l, with numerous installations in New England. A two-train configuration is recommended, each capable of treating 4.4 MGD (allows for one unit to be out of service during maximum month flow conditions). The current hydraulic grade is not sufficient to achieve gravity flow through the process. Therefore, either a new intermediate pump station or an increase in the hydraulic grade would be required. For purposes of this evaluation, it has been assumed that the side water depth of the secondary clarifiers would be increased to 15-feet allowing for gravity flow under all future conditions.

The ballasted flocculation process provides several unique advantages. This process is robust enough that if solids did escape the nitrification settling tanks during high flow events, this process would not be impacted (from a solids separation perspective) thus reducing the potential for final effluent TSS violations. The ballasted flocculation process could also be used to remove other constituents if ever deemed required in the future (i.e., copper, aluminum, etc.). Of all the potential tertiary processes, this process will have the smallest footprint. Sludge from this process would be recycled back to the primary clarifiers, aiding in primary clarifier solids removal performance. This sludge would include a minor amount of sand. The major disadvantage with this process is that it does include a fair amount of associated equipment (pumps, mixers, polymer system) and thus is usually more costly to construct and maintain versus other processes.

The basis of design for the ballasted clarification is presented in **Table 4-6**.

**TABLE 4-6**

**BASIS OF DESIGN**

**BALLASTED CLARIFICATION ALTERNATIVE**

| Parameter | Value |
|---|---|
| System Trains | 2 |
| Total Flow per Train, MGD | 4.4 |
| Total Flow per System, MGD | 8.8 |
| **Single Train Design Parameters** | |
| Coagulation Tank Volume, gal | 6,100 |
| Maturation Tank Volume, gal | 10,700 |
| Settling Tank Surface Area, sf | 92 |
| Sand Recirculation Flow, gpm | 85 |
| Estimated Total Sludge Waste Flow, gpm | 68 |
| **Consumables at Average Design Flow (2.5 MGD)** | |
| Polymer, lbs./day | 9.0 |
| Ferric Chloride, lbs./day | 1,280 |
| Sand Loss, lbs./day | 65 |

A proposed site layout plan for this alternative is shown in Figure 4-10.

**FIGURE 4-10**

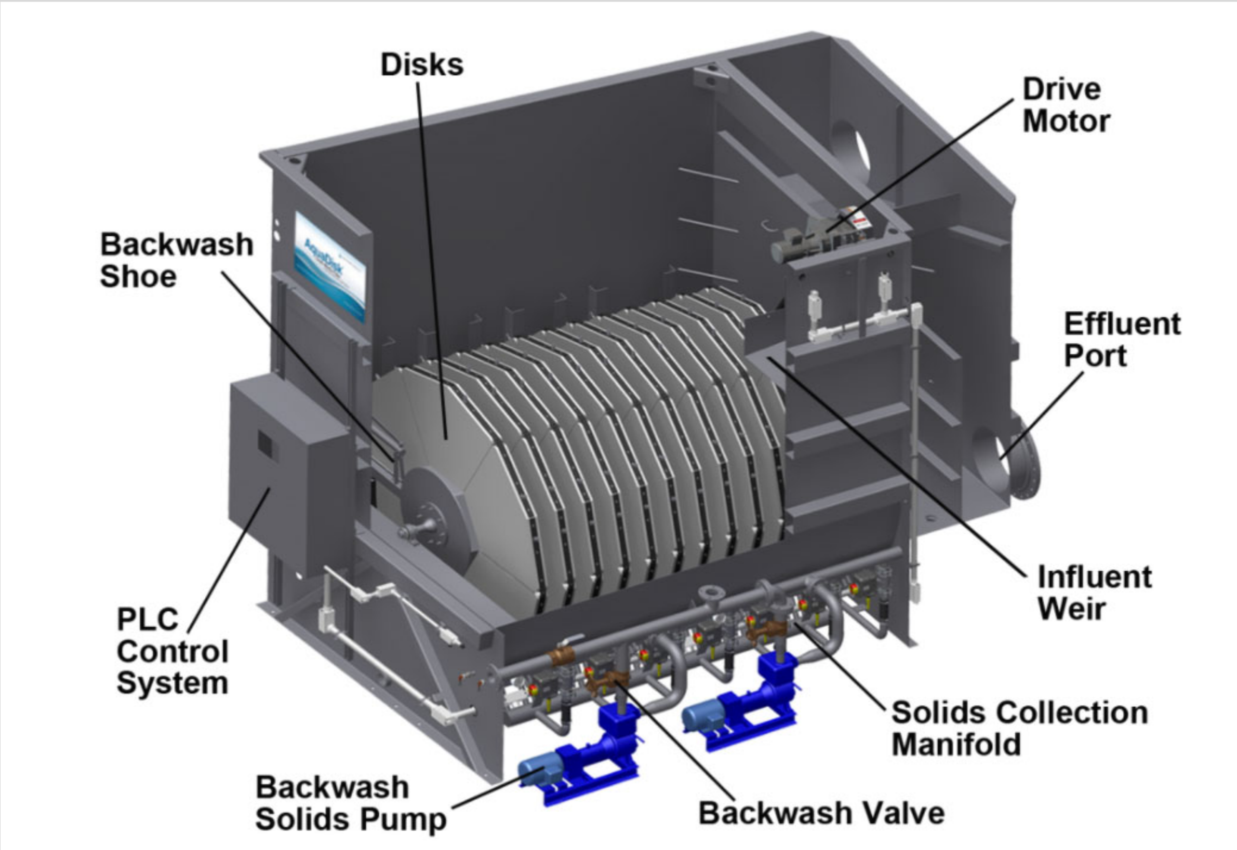
**BALLASTED CLARIFICATION SITE PLAN**

### 4.4.2 Alternative 2 (Cloth Media Filtration)

Cloth Media Filtration is a solid separation process that uses microfiber cloth disks to remove fine particles with nominal size of 2 microns or more. With cloth media filtration, secondary effluent is combined with a coagulant (metal salt) in a flash mix tank to promote colloidal particle destabilization and aggregation. The particles in the water bind with the coagulant forming larger particle agglomerates. As the mixture flows through the filter cloth, particle agglomerates are retained by the filter cloth while filtered water flows out of the unit through the central shaft, effluent chamber, and final overflow weir. Cleaning of the disks is periodically initiated to removed solids accumulated on their surface. The sludge on the disk surface is removed by suction and pumped to the primary settling tanks. Similarly, solids accumulated at the bottom of the filter tank would also be pumped to the primary settling tanks. **Figure 4-11** shows a schematic of the cloth media filtration technology.

**FIGURE 4-11**

**CLOTH MEDIA FILTRATION**




Cloth media filtration has been used extensively to achieve an effluent total phosphorus concentration of 0.15 mg/l. It has limited, but successful, use at WWTP's to achieve a 0.1 mg/l limit. In comparison to the ballasted flocculation, this process has significantly less experience at treating to limits of 0.1 mg/l. It's major advantage in comparison to the ballasted flocculation process is its reduced capital cost and lower operational costs. The cloth filtration process doesn't require polymer, sand addition and relies on less pumping system to achieve solids removal. However, if this technology is selected for implementation at the Rockland WWTP facility, it is recommended that Rockland determine its site-specific phosphorus removal performance based on pilot testing prior to implementation.

The basis of design for the cloth media filtration is presented in **Table 4-7**.

**TABLE 4-7**

**BASIS OF DESIGN**

**CLOTH MEDIA FILTRATION ALTERNATIVE**

| Parameter | Value |
|---|---|
| System Trains | 2 |
| Maximum Flow per Train, MGD | 4.4 |
| Maximum Flow per System, MGD | 8.8 |
| **Single Train Design Parameters** | |
| Rapid Mixing Tank Volume, gal | 1,650 |
| Flocculation Tank Volume, gal | 12,700 |
| Number of Disks per Train | 12 |
| Filter Area Provided, sf | 650 |
| Maximum Hydraulic Loading per Train, gpm/sf | 6.4 |
| **Consumables at Average Design Flow (2.5 MGD)** | |
| Ferric Chloride, lbs./day | 960 |

A proposed site layout plan for this alternative is shown in **Figure 4-12**.

**FIGURE 4-12**

**CLOTH MEDIA FILTRATION SITE PLAN**


### 4.4.3 Present Worth Cost Analysis

A present worth analysis was developed for each alternative approach for comparison purposes. Typically, the lowest net present worth is considered the most cost-effective alternative approach over a specific period. A detailed discussion of the cost estimating procedure, contingency levels, and assumptions is included in Section 5. The total construction cost for the tertiary treatment facilities were estimated assuming a construction start date of 2023. The total project cost estimate includes construction contingency, engineering, and inspection services. An interest rate of 0.5% was applied to the estimated operation and maintenance (O&M) cost to determine each alternative's present worth.

The conceptual design construction cost estimate of the two tertiary treatment alternatives are presented in Table 4 8. The costs include inflation to the expected midpoint of construction. It should be noted, if implementation of the tertiary treatment process is not selected at this time, the presented total construction costs cannot be subtracted from the total project construction costs presented in Section 5. The cost presented below include several items that would be required regardless of whether a tertiary system was included in the comprehensive upgrade project.

**TABLE 4-8**

**ESTIMATED CAPITAL COSTS – TERTIARY TREATMENT**

| Alternative | Total Construction Cost |
|---|---|
| 1 Ballasted Clarification | $7,000,000 |
| 2 Cloth Media Filtration | $5,910,000 |

Annual O&M costs were estimated for each alternative. O&M costs include items such as labor, electrical demand, chemicals, and products needed in the secondary treatment system. Actual costs to operate the WWTP may vary from these values, but they are sufficient for comparing the different tertiary treatment alternatives. Summary of the O&M cost for each secondary treatment is presented in **Table 4 9.**

**TABLE 4-9**

**ESTIMATED OPERATION AND MAINTENANCE COSTS**

**FOR TERTIARY TREATMENT**

| Parameter | Alternatives | |
|---|---|---|
| | 1. Ballasted Clarification | 2. Cloth Media Filtration |
| **Labor**[1] | $40,000 | $40,000 |
| **Electric Demand**[2] | $10,000[3] | $7,000[4] |
| **Chemical and Products Use** | $138,000[5] | $102,000[5] |
| **Total Annual O&M Cost** | $188,000 | $149,000 |

Notes:

1. An operator labor cost of $55/hr. was used in the estimates.
2. Electrical demand was estimated for all process equipment associated with the secondary treatment processes based on expected online motor horsepower and expected run times. An average electrical cost of $0.12 per kWh was used for the comparative analysis.
3. Electrical demand cost for Alternative 1 include rapid mixing, clarification, sludge pumps and chemical

pumps.

4. Electrical demand cost for Alternative 2 include rapid mixing, filtration, sludge pumps and chemical pumps
5. Chemical costs include: Ferric chloride $0.34/lb., Polymer $2.5/lb., Sodium hydroxide $2.1/gal and sand media $0.125/lb.

Present worth costs were developed for each alternative, as shown in Table 4-10, and include the summation of total capital costs and twenty years of annual O&M costs. Process equipment generally has a 20-year life cycle, so no salvage value has been carried for equipment.

**TABLE 4-10**

**ESTIMATED TOTAL PRESENT WORTH – TERTIARY TREATMENT**

| Alternative | Total Construction Cost | Net Present Value | Total Present Worth |
|---|---|---|---|
| 1 Ballasted Clarification | Ballasted Clarification | $7,000,000 | $3,600,000 |
| 2 Cloth Media Filtration | Cloth Media Filtration | $5,910,000 | $2,800,000 |

### 4.4.4 Tertiary Treatment Alternative Recommendation

Although more expensive on a capital O&M, and present worth basis, it is recommended that the Town of Rockland budget for the installation of a Ballasted Clarification process to achieve an effluent total phosphorus (TP) limit of 0.1 mg/l. Budgeting for this process represents a conservative and technology appropriate solution to achieve a 0.1 mg/l TP limit. A limit of 0.1 mg/l TP is a strict limit and there are very few applicable technologies that could be considered. Ballasted clarification while expensive, does have extensive experience achieving this limit. That said, the Town of Rockland should consider conducting a pilot test of the cloth media filter system. If pilot testing proves successful, the Town could move ahead with this option that offers both capital and O&M cost savings.

## 4.5 DISINFECTION AND EFFLUENT PUMPING STATION

The existing chlorine contact tanks need structural rehabilitation, but otherwise they are in adequate working order. Thus, it is recommended to retain them for future treatment. To address the current disinfection issues; specifically failure of existing underground chemical piping, chemical travel time, inadequate existing sodium bisulfite storage area, it is recommended that a new chemical storage building be constructed to the east of the existing disinfection and effluent pumping structure.

The chemical storage building would be a slab on grade structure containing new chemical storage tanks and associated pumping systems for both sodium hypochlorite and sodium bisulfite. Each of these systems would be in a separate area with secondary containment within the building. Final effluent sampling and disinfection monitoring equipment could be located within this space.

As discussed in Section 3; the lime silo, slurry tanks and associated pumping equipment is beyond its useful life. In lieu of replacing this system in kind, it is recommended that a new liquid magnesium hydroxide chemical system be installed at the Rockland plant. This system would consist of two bulk storage tanks and associated pumping equipment. This equipment would be located in the new chemical storage building. Supplemental alkalinity would be pumped to the adjacent secondary treatment structure for injection into the RAS piping system.

The effluent pumping system was upgraded in 2015 and thus no improvements are recommended at this time.

## 4.6 SOLIDS HANDLING PROCESS

### 4.6.1 Anaerobic Digesters

The facility has four anaerobic digesters, two small digesters constructed in 1964 and two large digesters installed in 1977. The four digesters are located at the four corners of the digester complex. There has been minor rehabilitation work conducted on the digester with a single mixing system replaced in 2013 and a new heat exchanger in 2016. However, there are significant upgrade needs related to the tank covers and the biogas handling system. Currently, only one digester is in operation with a second smaller unit used for sludge storage prior to dewatering.

Anaerobic digestion reduces the volatile solids content of the sludge generated at the WWTP thereby reducing the total mass of sludge that subsequently needs to be removed offsite for final disposal. On average, the digesters reduce the total mass for disposal by approximately 40%, or approximately 3.25 wet tons per day. Currently, the Town of Rockland pays $120 per wet ton of dewatered cake that is hauled offsite for disposal. Thus, the anaerobic digestion process eliminates approximately $142,000 per year in sludge disposal costs.

In January of 2018 a feasibility report entitled "Evaluation of the Feasibility of Combined Heat and Power at the Rockland Wastewater Treatment Plant" was submitted to the Town and the Massachusetts Clean Energy Center. The feasibility study evaluated the anaerobic digesters and specifically the cost-benefit of bringing in merchant sludge. The hauled-in merchant sludge could potentially provide a revenue source for the Town through sludge tipping fees and power generation. That report concluded that the existing general state of repairs required for the anaerobic digestion complex was cost prohibitive. As such, expansion of the anaerobic digestion complex to include the acceptance of merchant sludge was not recommended. This report did not evaluate the financial impacts of the rehabilitation requirements in comparison to a non-anaerobic digested sludge disposal option. It also did not evaluate the impact of return flows.

The majority of equipment and systems associated with the existing anaerobic digestion process are well beyond their useful life and need repair and replacement. Prior to evaluating alternative approaches to upgrading the anaerobic digestion process, a cost-benefit analysis was conducted as part of the WWTP assessment. The cost-benefit analysis focused on the capital and operational costs of upgrading and operating the anaerobic digestion process in comparison to the reduction in sludge disposal costs and the potential revenue from electricity generation. The following assumptions were included in the cost-benefit analysis:

- Annual sludge quantities were as defined by the BioWIN® process model
- 55% reduction in volatile suspended solids through the AD's
- Annual anaerobic digestion maintenance costs of $50,000
- 0.5 dedicated full-time employee for anaerobic digestion operation
- Sludge Dewaterability
    - 24% dry solids with an anerobic digestion process
    - 28% dry cake without an anaerobic digestion process
- Revenue potential with a CHP system
    - Assumed $220,000 in power generation potential (as defined in the 2018 report)
    - $10,000 in natural gas offset

It is very difficult to predict what the future disposal costs could be given the current sludge disposal climate (i.e., limited disposal outlet options, ongoing regulatory changes, etc.) As such, the annual estimated cost savings associated with the anaerobic digestion process was estimated across a range of potential disposal costs ($100/wet ton to $260/wet ton). Cumulative annual cost savings with anaerobic digestion (with and without an internal combustion engine for power generation) are presented in **Figures 4-13** and **4-14**. A negative value indicates that operation of the anaerobic digestion process would be more expensive than abandoning the anerobic digestion facility and dewatering the pre-digestion sludge and disposing of that material. Positive cumulative cost savings indicate that the anaerobic digestion process would reduce the annual WWTPWWTP operational costs. However, those values cannot be achieved without rehabilitation of the anaerobic digestion process and thus incurring the significant capital upgrade costs and subsequent annual debt retirement costs.

**FIGURE 4-13**

**CUMULATIVE COST SAVINGS WITH ANAEROBIC DIGESTION**

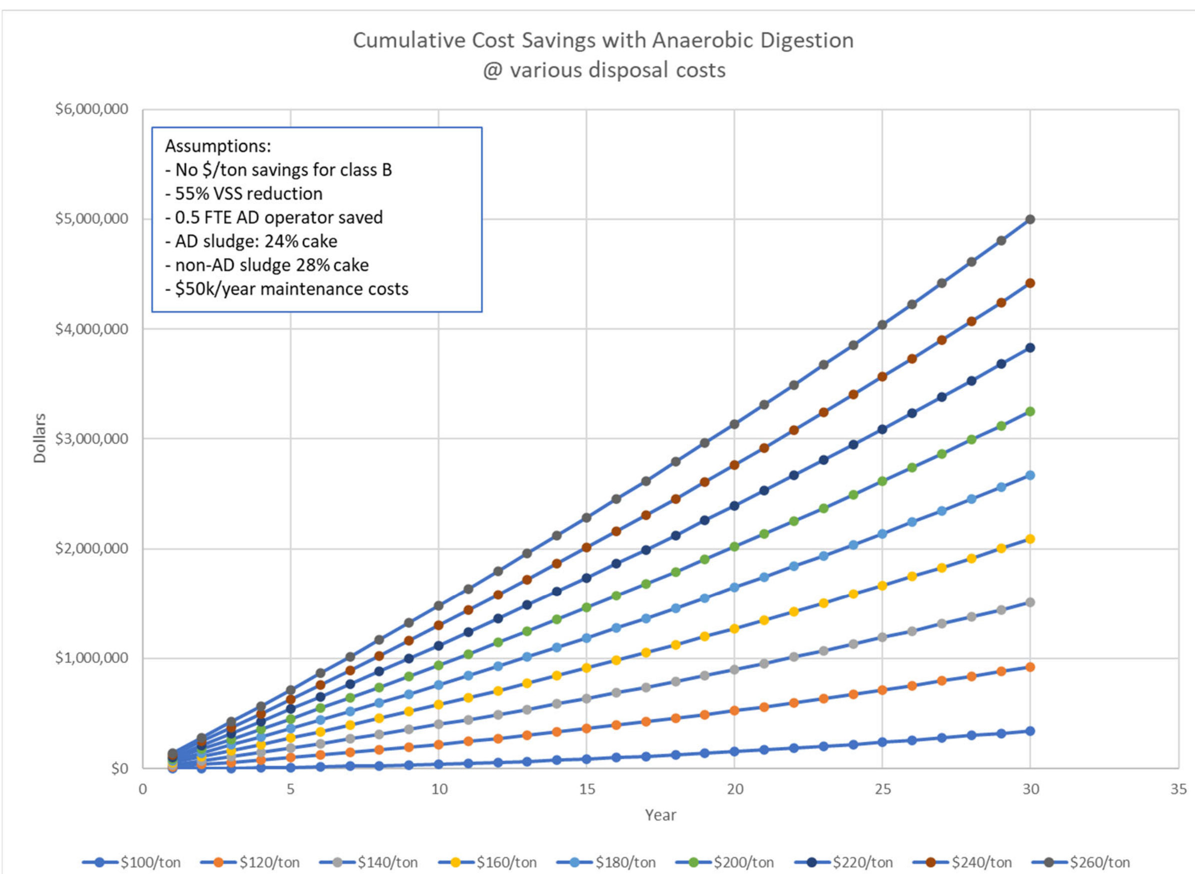
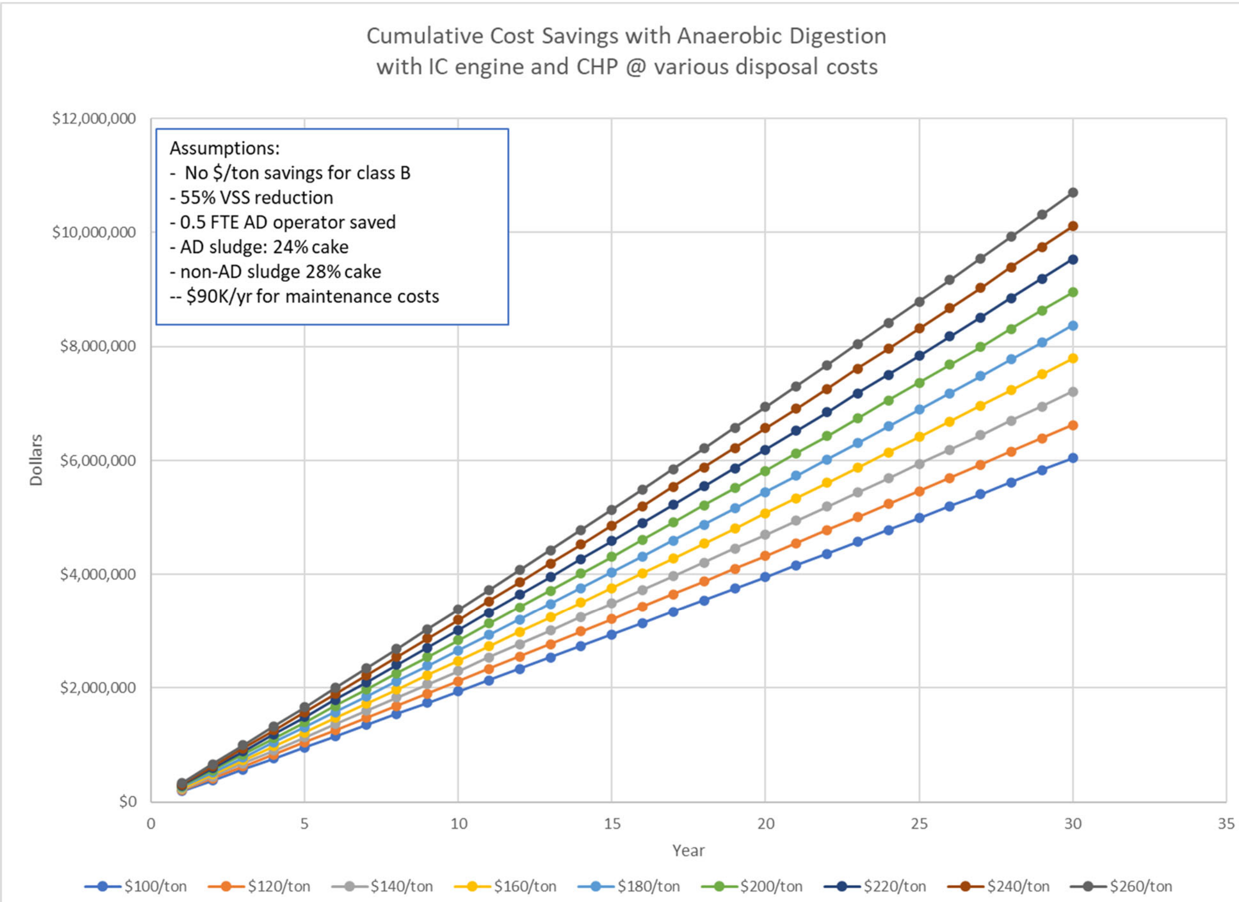


**FIGURE 4-14**

**CUMULATIVE COST SAVINGS WITH**

**ANAEROBIC DIGESTION WITH IC ENGINE AND CHP**




A detailed capital cost estimate to rehabilitate the anaerobic digestion complex was not conducted as part of the plant assessment. The 2018 feasibility study concluded that the capital cost to address the anaerobic digestion facility infrastructure was $6.7 M. The capital costs increase to $8.5 M if an internal combustion engine and combined heat and power system was included as part of the upgrade. Wright-Pierce concurs that these estimated capital costs are in the correct range of the required expenditure to address the condition of the existing anaerobic digestion complex.

Present worth costs were developed and include the summation of total capital costs and twenty years of annual O&M costs (net present value). The total project cost represents the difference in net capital cost of the anaerobic digestion process and a simplified solids handling scheme. A net present value for operation and maintenance costs was determined based on a federal discount rate of 0.5% over 20 years. The present worth costs are as presented in **Table 4-11**.

**TABLE 4-11**

**TOTAL PRESENT WORTH – ANAEROBIC DIGESTION**

| Alternative | Total Project Cost | Net Present Value | Total Present Worth |
|---|---|---|---|
| **Anaerobic Digestion Process** | | | |
| At a disposal cost of $120/cy | $4.4M | $0.9 M | -$3.5M |
| At a disposal cost of $260/cy | $4.4M | $5.0M | $0.6M |
| **Anaerobic Digestion Process with a CHP system** | | | |
| At a disposal cost of $120/cy | $6.2M | $6.6M | $0.4M |
| At a disposal cost of $260/cy | $6.2M | $10.7M | $4.5M |

The anaerobic digestion process does reduce the total sludge required for offsite disposal and thus the annual sludge disposal fees incurred. However, the magnitude of those savings does not offset the cost to operate the anaerobic digestion process. If the sludge disposal costs increase in the future, as expected, the annual sludge disposal cost savings does offset annual operating costs. However, the existing anaerobic digestion system needs extensive rehabilitation to maintain satisfactory operation over the next 20 years. Ultimately, the annual debt retirement costs to address these issues results in a negative total present worth for each scenario analyzed, until costs for disposal reaches approximately $230/wet ton.

The anaerobic digestion process is an excellent process for the reduction of sludge and as a method to reduce operational costs. However, this process is rarely included at wastewater treatment plant the size of Rockland. Ultimately, the total amount of sludge produced at a 2.5MGD facility is not sufficient to warrant its inclusion. Given the magnitude of the capital costs to rehabilitate the anaerobic digestion costs and the negative total present worth of this alternative, rehabilitation of the anaerobic digestion complex is not recommended at this time.

It should be noted that due to ongoing regional market volatility regarding the location and availability of sludge outlets, it is possible that a rapid increase in the sludge disposal costs to materialize in the very near future. It is recommended that further investigation be conducted at the onset of the preliminary design phase (mid 2022) regarding the anaerobic digestion process. A final decision can be made at that time regarding future use and potential upgrades to the digestion process.

### 4.6.2 Alternative Solids Handling Configurations

Two alternative solids handling approaches were identified in lieu of retaining the anaerobic digestion process. The two alternatives are as follows:

- Alternative No.1: The existing Aeration Tank would be converted into two sludge storage tanks. A new wall would be constructed perpendicularly to create two independent sludge storage tanks. One for primary sludge and one for waste sludge. In this alternative tertiary sludge would be sent to the primary clarifiers for co-settling prior to being transferred to the primary sludge storage tank. Waste-activated sludge would be sent directly from the secondary treatment process to the waste sludge storage tank. Sludges from both tanks would be removed independently, mixed in a flocculation tank, and processed through a sludge dewatering device.

The primary sludge storage tank would include a supplemental mixing device, a cover, and an independent odor control device. The waste-activated sludge tank would remain uncovered. Sludge mixing would be accomplished via diffused aeration. The sludge pumps and blowers would be in the basement of the Administration Building.

- Alternative No. 2: This alternative would be almost identical to Alternative No.1, except waste activated sludge would be sent to a thickening device prior to being sent to the waste-activated sludge storage tank. Pre-thickening the waste-activated sludge has several benefits including reducing the size of the waste-activated sludge storage tanks and expanding the types of dewatering devices that could be considered as an alternative to the current belt filter press dewatering device. However, thickening the waste-activated sludge does increase the potential for odor generation in the sludge storage tank (due to dissolved oxygen transfer concerns) and requires the installation of a mechanical thickening system, a thickened pumping system and an associated polymer system.

- Alternative No. 3: Convert small digester to gravity thickener for primary sludge thickening and storage. Convert the other small digester to waste activated sludge storage. Reuse the sludge dewatering feed pumps.

The existing activated sludge tanks are currently used to address periodic high flow events (they are used as peak flow equalization tanks). It is anticipated that through improvements to the plant hydraulics and secondary treatment process use of these tanks won't be necessary in the future for high flow management. However, the existing tanks are of sufficient size that only one of the existing tanks would be required for conversion for either Alternative No.1 or No.2. Thus, one tank would remain for high flow management, if desired. Alternative No. 3 would not impact the operation of the existing high flow management plant.

Alternative No.1 is recommended for implementation. Alternative No.1 will have a lower capital and lower annual operation and maintenance costs given the elimination of the waste-activated sludge thickening step. Alternative No. 3 is viable alternative, with similar cost implications, that should be considered during preliminary design.

### 4.6.3 Sludge Dewatering

The facility has two Belt Filter Presses (Ashbrook Klampress) that are used for sludge dewatering. Dewatered sludge is transferred from the Belt Filter Presses (BFP) via a belt conveyor system to disposal bins in the Sludge Removal Room. Once the bins are full, the dewatered sludge is hauled to the Synagro facility in Woonsocket, RI for final disposal. The BFPs were installed in 1994. The conveyor was installed in the last plant upgrade in 1977. The BFPs and sludge conveyor system are beyond their typical service life and need to be replaced.

The condition of the sludge impacts the performance and capabilities of the dewatering device. If anaerobic digestion is eliminated, there will be a few notable changes in the sludge characteristics including:

- An increase in the final dry solids content of the dewatered sludge

- An increase in the odor generation potential. This will be most evident in the disposal bins in the sludge removal room.

New Belt Filter Presses could be provided for sludge dewatering. The WWTP staff is very familiar with the belt filter press technology and the pros/cons of these types of systems. A new press can be designed as a two-belt or three-belt system to maximize dewatering performance. To address odor issues, belt filter press manufacturers have recently developed enclosures to minimize odors. However, there are many moving parts associated with belt filter presses and enclosures limit operator access, which makes equipment operation and maintenance difficult.

As the costs of sludge disposal have increased, the sludge dewatering market has moved toward equipment that can produce higher dewatered cake solids, thereby reducing transportation and tipping fee costs, as well as toward systems that do not require as much operator attention, thereby allowing for longer runtime hours. Dewatering operations at municipal wastewater treatment plants have increasingly upgraded to "enclosed-type" equipment due to the improved performance, health and safety, and odor control compared to the traditional belt filter press. Examples of “enclosed-type” dewatering options include centrifuges and rotary screw presses. Each of these types of dewatering technologies is described in the paragraphs below.

### 4.6.4 Rotary Screw Press

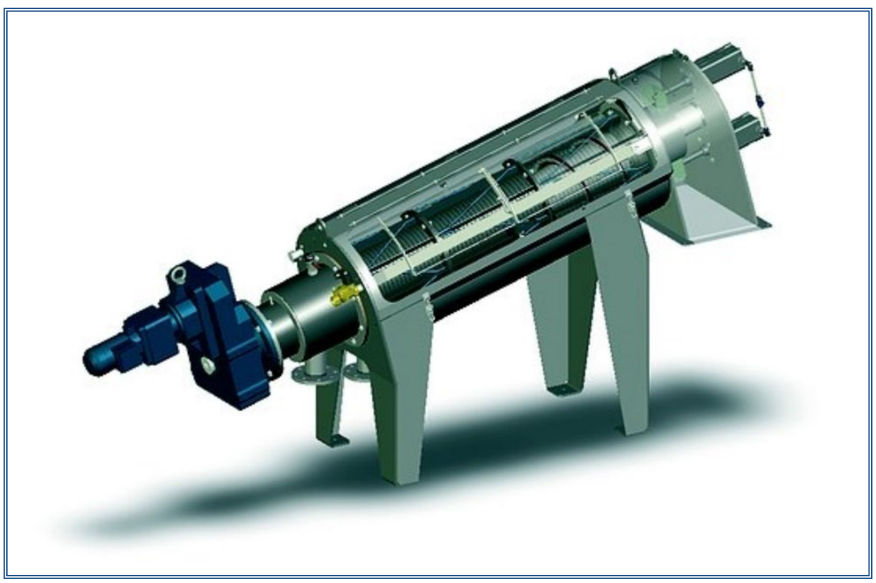
The rotary screw press (RSP) has been used extensively for dewatering municipal wastewater sludge. There are a number of manufacturers of the screw presses technology with considerable differences in their dewatering capabilities. As shown in Figure 4-15, this technology consists of feeding flocculated sludge into a horizontal or inclined screw (~20□) rotating inside a stainless steel, wedge wire or perforated screen. As the sludge is advanced up the screw, filtrate flows out through the screen. The frictional force at the sludge/screen interface coupled with increased pressure caused by an outlet restriction produces the dewatered sludge cake. The RSP technology was introduced into the European market approximately 20 years ago. Historically, this type of press has not been cost competitive in the municipal market due to the large sizes required to achieve the typical solids throughput. However, these units become more cost competitive when the dewatering is done over a longer period of time (10 to 16hr) or over a 24-hour per day continuous basis.

Screw presses typically achieve better sludge cake solids than belt filter presses and slightly lower than centrifuges. They typically have a larger footprint than centrifuges but smaller than BFPs.

The advantages of the screw press include fully enclosed, ease of operation with ability to fully automate, high solids content, low rotational speed, low energy requirements, moderate polymer requirements and low maintenance requirements. For high grit loadings, the low rotational speed is a significant advantage over centrifuges. The press is also completely enclosed minimizing odor control requirements. The unit is self-regulating to some extent and requires very little oversight during operation. The polymer feed rate is set proportional to the speed of the sludge feed to maintain the proper polymer ratio. The dewatering screw is designed to rotate very slowly gradually placing pressure on the sludge by decreasing the volume in the screw flight with water draining from the outside perforated cylinder.

**FIGURE 4-15**

**HUBER INCLINED SCREW PRESS**



### 4.6.5 Centrifuge

Centrifuges have had a long and strong presence in the municipal sludge dewatering market. In recent years, they have been the preferred dewatering technology for large facilities and have also been used at a significant number of smaller facilities, particularly for secondary only applications without primary sludge.

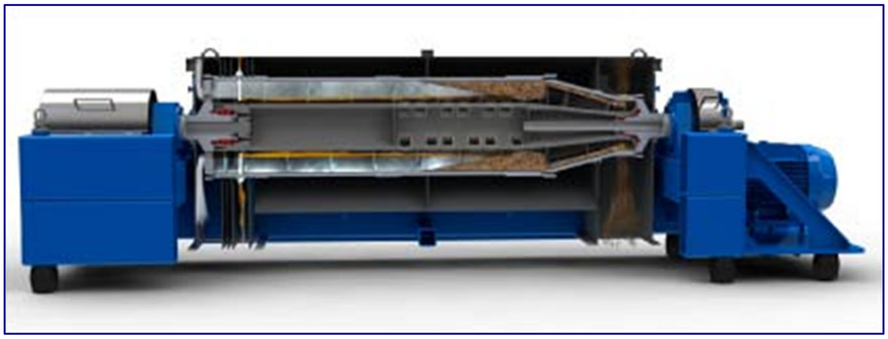
Centrifuge technology consists of feeding polymer flocculated sludge into a cylindrical bowl assembly rotating between 2,200 and 3,300 revolutions per minute (RPM). The solids are driven by centrifugal force to the bowl wall and then transported to the solids discharge chute via a screw feeder (scroll). Clarified liquid (centrate) flows backwards to the liquid discharge chute. Washdown can be automated and odor control is relatively easy on a centrifuge since it is enclosed. **Figure 4-16** shows a cutaway image of a typical dewatering centrifuge.

Modern centrifuges are self-regulating to some extent and thereby require less oversight during operation than previous equipment generations. Centrifuges are able to self-compensate for changes in feed solids by monitoring the torque and speed requirements of the inner scroll drive relative to the outer main bowl drive. In constant torque differential mode, the speed can be adjusted to remove or retain more solids as the weight of solids in the bowl changes. This reduces the need for oversight during operation of the centrifuge resulting in lower operating labor requirements. The constant torque mode provides more consistent cake solids.

A centrifuge is a highly sophisticated piece of equipment periodically requiring the replacement of the wear items and rebalancing. Factory servicing of the rotating assemblies (bowl, scroll and main bearings) is recommended. Thus, periodic extended down time needs to be planned for with one unit offline so that unexpected down time periods are minimized. Due to the high speed operation, centrifuge equipment problems are more likely to be severe enough to make the equipment unusable, whereas the other technologies being considered are prone to less acute problems that may diminish performance, but likely will still allow the equipment to be operated. For these reasons, equipment redundancy is a very important aspect to be considered in the design of a centrifuge system.

**FIGURE 4-16**

**CENTRIFUGE CUTAWAY**



### 4.6.6 Recommendation

It is recommended that the Town of Rockland replace the existing belt filter presses with an enclosed dewatering technology. Rotary screw presses and centrifuges are both applicable for use at the Rockland facility. However, Rotary Screw Presses do provide several advantages as noted below. Final selection of the dewatering technology can be delayed until the beginning of the preliminary design phase of the WWTP upgrades.

- The screw presses will have a lower energy cost per year. Furthermore, the motor size of the screw press will be significantly smaller than the centrifuge.
- The screw presses will have a lower polymer usage than the centrifuges.
- The screw presses will have lower annual maintenance costs
- The screw presses operate at a low rotational speed reducing internal wear and tear.
- Screw presses will perform better at the lower sludge feed concentration associated with solids handling Alternative No.1
- While screw presses will produce a significantly higher percent solids cake than belt filter presses, it will be slightly lower than the centrifuge technology.

It is recommended that the existing belt conveyor be replaced with a shaftless screw conveyor. The shaftless screw conveyor would be enclosed, minimizing odor release. A new odor control system is recommended. This system would pull odorous air directly from the screw press enclosure, screw conveyor enclosure and sludge garage.

## 4.7 ADMINISTRATION BUILDING

The Administration Building has been added to and modified several times since the original structure was constructed in 1966. This building provides space for administrative functions (i.e., conference room, office space, lunchroom, lockers, etc.) as well as process needs including a plant laboratory, dewatering area, chemical storage, and pumping systems. Space is also provided for maintenance and storage of equipment and spare parts in a first-floor garage space.

Recommended improvements to the building are in the building design memorandums which are in Appendix C. Improvements to the wastewater treatment processes located in this building have been summarized separately in the preceding sections of this report.

A new supervisory control and data acquisition (SCADA) is recommended. A SCADA system is a computerized system for gathering and analyzing real time data collected at various locations throughout the facility. A new fiber optic network (underground) would connect all the building and unit processes together. New local control panels with program logic controllers (PLC) would be provided at various locations to collect local data and control the various unit processes. A main control station would be provided in the Administration Building for real-time monitoring of the wastewater treatment plant.

## 4.8 ELECTRICAL BUILDING AND GARAGE

As summarized in the electrical assessment and recommendation memo (Appendix C), the Rockland WWTP should replace the entire existing electrical system. This includes replacement of all of the underground duct banks, individual building motor control centers, main switchgear, and generator.

The replacement of the plant-wide electrical systems is often one of the most difficult construction activities due to the need to construct the entire new electrical infrastructure prior to demolishing the existing one. To facilitate its replacement, a new electrical building is recommended. The new main switchgear and generator would be in this building. Given, the limited maintenance and garage space afforded in the Administration Building, it is also recommended that this building include new garage and maintenance space.

5

# SECTION 5

# RECOMMENDED PLAN AND PROJECT COSTS

## 5.1 INTRODUCTION

This section of the report presents the recommended facilities improvements/upgrades, estimated project costs, and proposed implementation schedule. As previously noted, the facility underwent its last major renovation in the early 1980s (construction drawings dated 1977). Therefore, virtually all of the recommended improvements not related to future nutrient limits, described herein, are necessary due to wear, age, and outdated/obsolete equipment systems.

## 5.2 RECOMMENDED IMPROVEMENTS

The Rockland WWTP needs an immediate upgrade to address aging infrastructure and provide capacity to meet growth needs and impending permit modifications. It is important to note that the majority of the equipment was installed as part of the 1977 upgrade and is now almost 40 years old and is well beyond the end of its useful life. As previously stated, most WWTPs undergo comprehensive upgrades every 25 years to address worn out equipment and systems. Furthermore, the existing WWTP infrastructure (tanks, buildings, electrical systems) have not been addressed since the 1977 upgrade and are also in desperate need of being addressed. This includes significant corrosion and concrete damage, inoperable mechanical HVAC systems, leaking roofs, water intrusion in the underground electrical duct banks, and various building and life safety code compliance issues. It should be noted that Suez has replaced various high priority pieces of equipment at the WWTP to maintain successful operation of the facility. While certainly beneficial and something that should be continued moving forward, these equipment replacements do not eliminate or delay the need for a comprehensive upgrade.

The consequence of failure varies from unit process to unit process. However, there are numerous very high priority items that could have severe ramifications if failure occurred prior to an upgrade. This includes the influent pump station electrical system, main electrical switchgear, mechanical aerators, RAS and sludge piping systems, nitrification settling tank sludge removal mechanisms, and various components within the anaerobic digestion complex.

It is recommended that the Town of Rockland undertake a comprehensive upgrade of the WWTP which should begin immediately. Based on the scope of needs at the WWTP, a comprehensive upgrade will be a multi-year process, resulting in further strain on the existing systems and equipment. Therefore, it is highly recommended that the Town immediately proceed with the development of a Comprehensive Wastewater Management Plan (CWMP) and the preliminary design of improvements. Typically, other communities have first proceeded with a CWMP followed by the design phase (as outlined herein). The completion of a CWMP and design phase services will take several years and require the existing WWTP equipment to continue to operate successfully for several more years. However, some communities have elected to proceed forward with a CWMP, and the design phase services concurrently as a method to reduce the total project schedule. A concurrent CWMP and design phase approach would reduce the overall schedule by approximately one year.

The recommended comprehensive upgrade would address the issues facing the WWTP and ensure successful treatment at the current and future estimated wastewater flows and loads. As previously identified, the annual average flow treated at the WWTP is just slightly below the facility's permitted flow capacity. An increase in the permitted flow capacity is not expected given the French Stream's water quality, flow volume, and impoundment locations. Therefore, aggressive removal of infiltration and inflow (I/I) should continue independent of the timing or scope of the WWTP improvements (enforce Town's 11:1 I/I removal program for new development municipal sewer connections). It is recommended that the Town of Rockland develop a Comprehensive Wastewater Management Plan (CWMP) prior to the WWTP upgrade design phase. The CWMP is one of several requirements that would position the Town for zero percent financing. The CWMP can include evaluation of remote treatment and/or effluent disposal options in addition to I/I reduction to manage WWTP permitted flows to achieve long term compliance with the WWTP's effluent permit.

The improvements summarized in Sections 3 and 4 of this report constitute a "comprehensive" upgrade. As identified in Section 4, it is recommended that the Town of Rockland abandon the existing anaerobic digestion process in favor of a simplified solids handling process. The estimated capital costs to upgrade this treatment component outweigh the annual cost savings achieved through reduced sludge disposal costs. There is significant volatility in the local sludge disposal market. This is due to the changing landscape regarding PFAS chemicals and limited final sludge disposal locations. This volatility is likely to continue for the next few years. It is expected that sludge disposal costs will steadily increase from year to year. The current schedule includes initiating design related services in mid-2022. A detailed review of the anaerobic digestion cost-benefit analysis should be conducted at that time based on an updated understanding of the current sludge disposal market. This analysis should also reevaluate the financial implication of incorporating power generation independent of receiving merchant sludge. The current project cost estimate includes abandoning the anaerobic digestion process and upgrading the WWTP to a simplified solid handling scheme. Retaining and upgrading the anaerobic digestion process would add approximately $3.0M to $5.0M in capital project costs, depending on options chosen.

The Town of Rockland is also facing the prospect of a lower total phosphorus limit and a total nitrogen limit. Section 4 summarizes recommendations to achieve compliance with both parameters. As previously stated, an upgrade to the secondary treatment process is required due to capacity and equipment related issues. It is recommended that the Town move forward with a biological process that assists in the removal of these two parameters regardless of the timing of a future change to the current permit limit. It is almost certain that these parameters will be included in the facility permit within the 20-year planning window. A tertiary treatment process was identified as being a required wastewater component if the Town receives a 0.1 mg/l seasonal total phosphorus limit. A tertiary treatment process is not required to achieve compliance with the current NPDES permit. As such, this unit process could be installed later commensurate with the issuance of a 0.1 mg/l TP limit.

The presented tertiary project costs are based on the inclusion of a ballasted flocculation process to achieve permit compliance. This technology represents a conservative approach with respect to the estimated project costs. It is recommended that during the initial stages of the design phase of the WWTP upgrade, pilot testing be conducted to ascertain the actual site-specific phosphorus removal performance of cloth filtration technology. At this time, without actual site-specific pilot testing, it is unknown if cloth filtration can achieve consistent compliance with a 0.1 mg/l effluent total phosphorus limit. If proven successful, cloth filtration would represent a lower cost tertiary treatment solution.

The following summarizes the recommended improvements associated with a comprehensive WWTP upgrade:

- Screening and Grit Facility
  - Provide a new facility located upstream of the influent pump station
  - One new mechanical screen and associated wash press
  - One new vortex style grit removal system and associated grit washer
  - One new grit and screenings receiving roll off
- Influent Pump Station Modifications
  - Replace existing pumps and piping
  - Address structural issues in lower wetwell
  - Address architectural, electrical and mechanical/HVAC associated with the existing building
- Primary Clarifier Modifications
  - Replace clarifier sludge removal mechanisms
  - Address tank structural issues
- Secondary System Modifications
  - Modify the secondary treatment process to an A2O process to achieve additional treatment capacity and biological nitrogen and phosphorus removal
  - Repurpose the existing secondary settling tanks to activated sludge tanks
  - Provide a new flow distribution structure
  - Provide new mixing system for anaerobic and anoxic zones
  - Provide new mechanical mixer/aerators for the oxic zones
  - Provide new blowers and associated blower building
  - Provide new internal recycle system
  - Provide new instrumentation and control system
  - Address secondary settling tank and nitrification tank structural issues
  - Provide new return and waste activated sludge pumps, piping and valves
  - Provide new mechanical/HVAC system for lower gallery
- Secondary Clarifier Modifications
  - Modify the effluent weirs to raise the tank water surface by three feet

- Provide new sludge removal mechanisms
  - Address tank structural issues
- Tertiary Building
  - Provide a new tertiary treatment process for phosphorus removal
  - Tertiary treatment process will include two ballasted flocculation units complete with associated pumps, mixers, hydrocylcones, chemical feed and polymer system
  - Provide a new ferric chloride storage and feed system
- Chemical Building
  - Provide a new chemical building
  - New magnesium hydroxide storage and feed system for supplemental alkalinity.
  - New sodium hypochlorite storage and feed system
  - New sodium bisulfite storage and feed system
- Chlorine Contact Tanks and Effluent Pump Station
  - Address tank structural issues
  - Sludge Storage tanks
  - Repurpose the ex. aeration tank to two new sludge storage tanks
  - Provide aeration and mixing devices
  - Provide a tank cover and associated odor control unit
  - Address tank structural issues
- Administration Building
  - Provide new primary sludge piping and valves
  - Provide new dewatering and sludge transfer pumps
  - Provide new blower for sludge tank mixing
  - Demolish existing lime system
  - Demolish existing lower level chemical systems
  - Provide two new screw presses for sludge dewatering
  - Provide new polymer system
  - Provide new sludge transfer conveyor, truck loading system and odor control unit
  - Address architectural, electrical and mechanical/HVAC associated with the existing building
- Garage and Electrical Building

- Provide a new electrical building with additional garage space
- Provide a new generator
- Provide a new main switch gear

- General
  - Provide a new electrical distribution system
  - Provide new site piping as required
  - Replace all existing motor control centers throughout the facility
  - Provide a new fiberoptic network and plant SCADA system
  - Address existing site lighting

## 5.3 ESTIMATED PROJECT COSTS

Planning level project costs have been estimated for the recommended facilities upgrades/improvements. Total project costs by major unit processes are presented in **Table 5-1**. The total project cost estimate for the comprehensive upgrade is presented in **Table 5-2**. The project cost estimate includes project costs related to the installation of a tertiary process. These planning-level costs were developed using standard cost estimating procedures consistent with industry standards utilizing concept layouts, unit cost information, and planning-level cost curves, as necessary. Total project capital costs include estimated construction costs to account for construction contingency, design, and construction engineering, permitting, as well as financing, administrative and legal expenses. The project cost information presented herein is in current dollars and is based on ENR Construction Cost Index 11625 (December 2020). The detailed construction cost estimate is provided in Appendix D.

Many factors arise during preliminary and final design phases (e.g., foundation conditions, owner selected features and amenities, code issues, etc.) that cannot be definitively identified and estimated at this time. These factors are typically covered by the allowances described above; however, this allowance may not be adequate for all circumstances.

For planning level cost estimate, the following assumptions and values were made:

- **Administrative and Legal Costs** – The administrative and legal costs are estimated to be approximately 1% of the total construction cost. This includes Town costs such as bond council and accounting services that are associated with the project.
- **Financing** – The Town will likely incur interim financing costs until the final loan is closed. 1.5% of the total project cost has been carried for interim financing costs.
- **Engineering Services** – The engineering services cost is estimated to be approximately 20% of the construction cost and is for all phases of engineering services associated with the project. The services include design, permitting, bidding, construction administration, onsite field observation (resident project representative), development of record drawings, development of the operation and maintenance manual, and commissioning phase services.
- **Contingency Costs** – There are two contingency costs – construction contingency (5%) to account for unexpected conditions in the field identified once construction starts, and design contingency (20%) to account for potential design changes necessary to address unforeseen or unaccounted for items. The contingency costs are a percentage of the total construction cost associated with the project.
- **Materials Testing Costs** – The materials testing costs are estimated to be approximately 0.5% of the total construction cost. This cost is for miscellaneous materials testing such as soils and concrete testing associated with the project.

## TABLE 5-1

## PROJECT COST ESTIMATE BY UNIT PROCESS

| PROJECT COMPONENT | COST |
|---|---|
| Screening and Grit Facility (New) | $4,900,000 |
| Influent Pump Station Modifications | $2,200,000 |
| Primary Clarifier Modifications | $2,300,000 |
| Secondary System Modifications | $13,400,000 |
| Secondary Clarifier Modifications | $2,700,000 |
| Tertiary Building (New) | $6,300,000 |
| Chemical Building (New) | $1,900,000 |
| Chlorine Contact Tanks and Effluent P.S. | $300,000 |
| Sludge Storage Tanks | $2,300,000 |
| Administration Building Modifications | $5,200,000 |
| Garage and Electrical Building (New) | $3,200,000 |
| General | $4,400,000 |

## TABLE 5-2

## TOTAL COST ESTIMATE – COMPREHENSIVE UPGRADE

| PROJECT COMPONENT | | COST |
|---|---|---|
| CONSTRUCTION | | $38,240,000 |
| CONSTRUCTION CONTINGENCY | 5.0% | $1,910,000 |
| | | |
| ENGINEERING SERVICES | 20.0% | $7,648,000 |
| MATERIALS TESTING | 0.5% | $191,000 |
| ASBESTOS & LEAD PAINT ABATEMENT | | $0 |
| DIRECT EQUIPMENT PURCHASE | | $0 |
| LAND ACQUISITION/ EASEMENTS | | $0 |
| LEGAL/ ADMINISTRATIVE | 1.0% | $382,000 |
| | | |
| **SUBTOTAL** | | **$48,371,000** |
| | | |
| FINANCING | 1.5% | $726,000 |
| | | |
| | | |
| **ENGINEER'S ESTIMATE OF PROJECT COST[2]** | | $49,100,000 |

Notes:

1. Cost estimate is based on ENR INDEX 11625 12/2020
2. Cost estimate is based on eliminating the anaerobic digestion process in favor of an alternative solids handing scheme. Refurbishing the existing anaerobic digestion process would add an additional $3.0M to $5.0M to the total project cost.

## 5.4 IMPLEMENTATION SCHEDULE

The estimated project schedule for WWTP upgrades/improvements is shown in **Table 5-3**. The schedule is subject to change based on the Town's review and final selection of WWTP upgrades. It is assumed that the Town will take advantage of low interest financing through the Massachusetts Department of Environmental Protection (DEP) Clean Water State Revolving Fund (CWSRF) program. CWSRF loans have a standard term of twenty years and an interest rate of 2 percent. A CWSRF project can become eligible for a zero percent rate (for nutrient related portions of the upgrade, including Total Phosphorous reduction) if the community meets specific criteria. The five criteria are:

1) The project is primarily intended to remediate or prevent nutrient enrichment of a surface water body or a source of water supply.

2) The applicant is not currently subject, due a violation of a nutrient-related total maximum daily load standard or other nutrient based standard, to a department of environmental protection enforcement order, administrative consent order or unilateral administrative order, enforcement action by the United States Environmental Protection Agency or subject to a state or federal court order relative to the proposed project.

3) The applicant has a Comprehensive Wastewater Management Plan (CWMP) approved pursuant to regulations adopted by the Department of Environmental Protection.

4) The project has been deemed consistent with the regional water resources management plans if one exists.

5) The applicant has adopted land use controls, subject to the review and approval of the department of environmental protection in consultation with the department of housing and economic development and, where applicable any regional land use regulatory entity, intended to limit wastewater flows to the amount authorized under zoning and wastewater regulations as of the date of the approval of the CWMP.

It is recommended that the Town proceed with the development of a CWMP to position themselves for a loan through the CWSRF program (2 percent standard, 0 percent for the nutrient related portions of the project). The proposed schedule assumes the development of a CWMP in 2021, design phase engineering services in 2022, and construction beginning in early 2024. A two-year construction schedule has been assumed as part of this implementation schedule and completion of the upgrades in a single phase (vs. multiple project phases).

**TABLE 5-3**

**PROPOSED SCHEDULE**

| MILESTONE | DATE |
|---|---|
| Completion of the WWTP Evaluation | Winter 2021 |
| Town Appropriates CWMP Funding at Annual Town Meeting | May 2021 |
| CWMP Development and Completion | July 2021 – June 2022 |
| Town Appropriates Design Phase Funding at Annual Town Meeting | May 2022 |
| Preliminary Design Phase Engineering Begins | July 2022 |
| DEP SRF Loan Project Evaluation Form (PEF) Submitted | August 2022 |
| Preliminary Design Report (30% design completion) | December 2022 |
| Draft DEP SRF Loan Intended Use Plan (IUP) Notification | December, 2022 |
| Final DEP SRF Loan IUP | January 2023 |
| Final Design and Permitting Begins | January 2023 |
| SRF Application Submission (90% Design completion) | By October 15, 2023 |
| 100% Design and Permitting Complete | December, 2023 |
| DEP Issues Project Approval Certificate (PAC) | By December 31, 2023 |
| Bidding | January 2024 - March 2024 |
| Start Construction | April 2024 |
| Substantial Completion of Construction | February - March 2026 |
| Final Completion of Construction | April 2026 |
| One-year Warranty Period | April 2027 |

WRIGHT-PIERCE
Engineering a Better Environment

# A

**MODIFICATION OF AUTHORIZATION TO DISCHARGE UNDER THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM**

In compliance with the provisions of the Federal Clean Water Act as amended, (33 U.S.C. §§1251 et seq.; the "CWA"), and the Massachusetts Clean Waters Act, as amended, (M.G.L. Chap. 21, §§26-53),

**Town of Rockland**
**Board of Sewer Commissioners**

is authorized to discharge from the facility located at

**Rockland Wastewater Treatment Plant**
South End of Concord Street
Rockland, MA 02370

to receiving water named

**French Stream**

in accordance with effluent limitations monitoring requirements and other conditions set forth in the permit issued on January 26, 2006, as modified by the conditions set forth herein in italics and summarized as follows:

**Page 2, Flow Limit, and Page 4, Footnote Number 3., Flow Reporting Requirements**

**Pages 14, 15 and 16, Section F., COMPLIANCE SCHEDULES**

This modification shall become effective April 1, 2007.

This permit modification and the authorization to discharge expires five years from the effective date of the permit, which was July 1, 2006.

Signed this 15th day of February, 2007

/S/ SIGNATURE ON FILE

Director
Office of Ecosystem Protection
Environmental Protection Agency
Boston, MA

Director
Division of Watershed Management
Department of Environmental Protection
Commonwealth of Massachusetts
Boston, MA

PART I

A.1. During the period beginning the effective date and lasting through expiration, the permittee is authorized to discharge from outfall serial number **001,** treated effluent to the French Stream. Such discharges shall be limited and monitored as specified below.

| EFFLUENT CHARACTERISTIC | EFFLUENT LIMITS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| **PARAMETER** | **AVERAGE MONTHLY** | **AVERAGE WEEKLY** | **MAXIMUM DAILY** | **MEASUREMENT FREQUENCY** | **SAMPLE[2] TYPE** |
| FLOW LIMIT [3] | *2.5 MGD* | *********** | ************* | CONTINUOUS | RECORDER |
| FLOW REPORTING[3] | Report MGD | *********** | Report MGD | CONTINUOUS | RECORDER |
| $BOD_5$[4] (October 1 - April 30) | 20 mg/l<br>417 lbs/Day | 20 mg/l<br>417 lbs/Day | 30 mg/l[1]<br>626 lbs/Day | 2/WEEK | 24-HOUR COMPOSITE[5] |
| TSS[4] (October 1 - April 30) | 20 mg/l<br>417 lbs/Day | 20 mg/l<br>417 lbs/Day | 30 mg/l[1]<br>626 lbs/Day | 2/WEEK | 24-HOUR COMPOSITE[5] |
| $BOD_5$[4] (May 1 - September 30) | 6 mg/l<br>125 lbs/Day | 6 mg/l<br>125 lbs/Day | 10 mg/l[1]<br>209 lbs/Day | 2/WEEK | 24-HOUR COMPOSITE[5] |
| TSS[4] (May 1 - September 30) | 10 mg/l<br>209 lbs/Day | 10 mg/l<br>209 lbs/Day | 15 mg/l[1]<br>313 lbs/Day | 2/WEEK | 24-HOUR COMPOSITE[5] |
| pH RANGE[1] | 6.5 - 8.3 SU SEE PERMIT PAGE 7 OF 16, PARAGRAPH I.A.1.b. | | | 1/DAY | GRAB |
| TOTAL CHLORINE RESIDUAL[6,7] | 0.011 mg/l | ************ | 0.019 mg/l | 1/DAY | GRAB |
| TOTAL CHLORINE RESIDUAL[6,7] | REPORT mg/l | ************ | REPORT mg/l | CONTINUOUS | CONTINUOUS |
| FECAL COLIFORM[1,6] | 200 CFU/100 ml | ************ | 400 CFU/100 ml | 3/WEEK | GRAB |
| SETTLEABLE SOLIDS | ************** | REPORT ml/l | REPORT ml/l | 1/DAY | GRAB |

CONTINUED FROM PREVIOUS PAGE

A.1. During the period beginning the effective date and lasting through expiration, the permittee is authorized to discharge from outfall serial number **001,** treated effluent to the French Stream. Such discharges shall be limited and monitored as specified below.

| EFFLUENT CHARACTERISTIC | EFFLUENT LIMITS | | | MONITORING REQUIREMENTS | |
|---|---|---|---|---|---|
| **PARAMETER** | **AVERAGE MONTHLY** | **AVERAGE WEEKLY** | **MAXIMUM DAILY** | **MEASUREMENT FREQUENCY** | **SAMPLE[2] TYPE** |
| AMMONIA NITROGEN<br>October 1 - March 31[8]<br>April 1 - May 31[8]<br>June 1 - September 30 | <br>3.3 mg/l<br>2.5 mg/l<br>1.0 mg/l | <br>3.3 mg/l<br>2.5 mg/l<br>1.0 mg/l | <br>5.7 mg/l<br>5.7 mg/l<br>1.5 mg/l | <br>2/WEEK | <br>24-HOUR COMPOSITE[5] |
| PHOSPHORUS, TOTAL[8]<br>April 1 - October 31<br><br>November 1-March 31[8] | <br>0.2 mg/l<br>Report lbs/day<br>1.0 mg/l<br>Report lbs/day | <br>********<br>********<br>********<br>******** | <br>Report mg/l<br>Report lbs/day<br>Report mg/l<br>Report lbs/day | <br>2/WEEK<br><br>1/WEEK | <br>24-HOUR COMPOSITE[5]<br><br>24-HOUR COMPOSITE[5] |
| ORTHOPHOSPHORUS<br>November 1-March 31 | <br>Report mg/l | <br>******** | <br>Report mg/l | <br>1/WEEK | <br>24-HOUR COMPOSITE[5] |
| COPPER, TOTAL | 12 ug/l | ********* | 19 ug/l | 1/MONTH | 24-HOUR COMPOSITE[5] |
| ALUMINUM, TOTAL | 88 ug/l | ********* | REPORT ug/l | 1/MONTH | 24-HOUR COMPOSITE[5] |
| DISSOLVED OXYGEN<br>(May 1 - September 30) | $\geq$7.4 mg/l SEE PERMIT PAGE 7 OF 16, PARAGRAPH I.A.1.h | | | 1/DAY | GRAB |
| WHOLE EFFLUENT TOXICITY<br>SEE FOOTNOTES 9, 10, 11, and 12 | Acute $LC_{50} \geq 100\%$<br>Chronic C-NOEC $\geq 99\%$ | | | 4/YEAR | 24-HOUR COMPOSITE[5] |

**The permittee shall follow the notification requirements found 40 CFR§ 122.41(m), see Permit Part II General Conditions, Section B.4.c., if a bypass of treatment occurs.**

Footnotes:

1. Required for State Certification.

2. All required effluent samples shall be collected from the following locations:

| **Parameter** | **Sampling Location** |
|---|---|
| Flow | (Influent) headworks building (ultrasonic probe) at Parshall flume |
| BOD, TSS | (Influent) headworks building just prior to Parshall flume.<br>(Effluent) wetwell immediately following contact chamber |
| Ammonia, Total Copper, Total Phosphorus | (Effluent) wetwell immediately following contact chamber |
| TRC, pH, Dissolved Oxygen | (Effluent) cascade steps |
| Fecal Coliform | (Effluent) end of chlorine contact basin |
| Whole Effluent Toxicity (WET) | (Diluent) Summer Street bridge upstream from the receiving water. (Effluent) cascade steps |

Any change in sampling location must be reviewed and approved in writing by EPA and MassDEP. All samples shall be tested using the analytical methods found in 40 CFR §136, or alternative methods approved by EPA in accordance with the procedures in 40 CFR §136. All samples shall be 24 hour composites unless specified as a grab sample in 40 CFR §136.

All sampling shall be representative of the effluent that is discharged through outfall 001. A routine sampling program shall be developed in which samples are taken at the same location, same time and same days of every month. Any deviations from the routine sampling program shall be documented in correspondence appended to the applicable discharge monitoring report that is submitted to EPA.

*3.* ***The flow limit is expressed as a monthly average.***

*The permittee shall also report (**without limit**) the annual average flow, which shall be reported as a rolling average. The first annual average flow value will be calculated using the monthly average flow for the first full month ending after the effective date of the permit modification and the eleven previous monthly average flows. Each subsequent month's discharge monitoring report ("DMR") will report the annual average flow that is calculated from that month and the previous 11 months. The maximum daily flows for each month shall also be reported (**without limit**).*

4. Sampling required for influent and effluent.

5. A 24-hour composite sample will consist of at least twenty four (24) grab samples during a 24-hour consecutive period [e.g. 0700 MON- 0700 TUES].

6. Fecal coliform discharges shall not exceed a monthly geometric mean of 200 colony forming units per (cfu) 100 ml, nor shall they exceed 400 cfu per 100 ml as a daily maximum. This monitoring shall be conducted concurrently with the TRC sampling described below. Fecal coliform samples shall be taken 3 times per week and conducted concurrently with the TRC sampling described below.

   The permittee shall collect and analyze a minimum of one TRC grab sample per day for calibration purposes. The same daily grab sample can be used for both compliance and calibration. A comparison of the grab sample results to the continuous analyzer reading, including the time of the grab samples, shall be attached to the DMRs.

   The permittee shall also report the average monthly and maximum daily discharge of TRC using data collected by the continuous TRC analyzer. Four continuous recording graphs (1/week) showing weekly data or an equivalent alternative record that provides the same data, shall be submitted with the monthly DMRs.

   The permittee shall substitute three TRC grab sample per day, for any day that they are unable to comply with the continuous recording requirement.

7. The minimum level (ML) for total residual chlorine is defined as 20 ug/l. This value is the minimum level for chlorine using EPA approved methods found in the most currently approved version of Standard Methods for the Examination of Water and Wastewater, Method 4500 CL-E and G, or USEPA Manual of Methods of Analysis of Water and Wastes, Method 330.5. The permittee shall use one of these two methods or another approved method that has an equivalent or lower ML (see 40 CFR, part 136). For effluent limitations less than 20 ug/l, compliance/non-compliance will be determined based on the ML. Sample results of 20 ug/l or less shall be reported as zero on the discharge monitoring report.

8. **See Section F of this permit for a schedule of compliance.**

9. The permittee shall conduct chronic (and modified acute) toxicity tests four times per year. The chronic test may be used to calculate the acute $LC_{50}$ at the 48 hour exposure interval. The permittee shall test the daphnid, Ceriodaphnia dubia, only. Toxicity test samples shall be collected during the second week of the months of January, April, July and October. The test results shall be submitted by the last day of the month following the completion of the test. The results are due February 28th, May 31st, August 31st, and November 30th, respectively. The tests must be performed in accordance with test procedures and protocols specified in **Attachment A** of this permit.

| **Test Dates** Second week in | **Submit Results By:** | **Test Species** | **Acute Limit $LC_{50}$** | **Chronic Limit C-NOEC** |
|---|---|---|---|---|
| January<br>April<br>July<br>October | February 28th<br>May 31st<br>August 31st<br>November 30th | Ceriodaphnia dubia (daphnid)<br><br>See Attachment A | ≥ 100% | ≥ 99% |

After submitting **one year** and a **minimum** of **four** consecutive sets of WET test results in one year, all of which demonstrate compliance with the WET permit limits, the permittee may request a reduction in the WET testing requirements. The permittee is required to continue testing at the frequency specified in the permit until notice is received by certified mail from the EPA that the WET testing requirement has been changed.

10. The $LC_{50}$ is the concentration of effluent which causes mortality to 50% of the test organisms. Therefore, a 100% limit means that a sample of 100% effluent (no dilution) shall cause no more than a 50% mortality rate.

11. C-NOEC (chronic-no observed effect concentration) is defined as the highest concentration of toxicant or effluent to which organisms are exposed in a life cycle or partial life cycle test which causes no adverse effect on growth, survival, or reproduction at a specific time of observation as determined from hypothesis testing where the test results exhibit a linear dose-response relationship. However, where the test results do not exhibit a linear dose-response relationship, the permittee must report the lowest concentration where there is no observable effect. The "99% or greater" limit is defined as a sample which is composed of 99% (or greater) effluent, the remainder being dilution water. This is a maximum daily limit derived as a percentage of the inverse of the dilution factor of 1.01.

12. If toxicity test(s) using receiving water as diluent show the receiving water to be toxic or unreliable, the permittee shall follow procedures outlined in **Attachment A Section IV., DILUTION WATER** in order to obtain permission to use an alternate dilution water. In lieu of individual approvals for alternate dilution water required **in Attachment A**, EPA-New England has developed a Self-Implementing Alternative Dilution Water Guidance document (called "Guidance Document") which may be used to obtain automatic approval of an alternate dilution water, including the appropriate species for use with that water. If this Guidance document is revoked, the permittee shall revert to obtaining approval as outlined in **Attachment A**.

The “Guidance Document” has been sent to all permittees with their annual set of DMRs and Revised Updated Instructions for Completing EPA’s Pre-Printed NPDES Discharge Monitoring Report (DMR) Form 3320-1 and is not intended as a direct attachment to this permit. Any modification or revocation to this “Guidance Document” will be transmitted to the permittees as part of the annual DMR instruction package. However, at any time, the permittee may choose to contact EPA-New England directly using the approach outlined in **Attachment A**.

Part I.A.1. (Continued)

a. The discharge shall not cause a violation of the water quality standards of the receiving waters.

b. The pH of the effluent shall not be less than 6.5 nor greater than 8.3 at any time.

c. The discharge shall not cause objectionable discoloration of the receiving waters.

d. The effluent shall contain neither a visible oil sheen, foam, nor floating solids at any time.

e. The permittee's treatment facility shall maintain a minimum of 85 percent removal of both total suspended solids and biochemical oxygen demand. The percent removal shall be based on monthly average values.

f. The permittee shall minimize the use of chlorine while maintaining adequate bacterial control.

g. The permittee shall submit the results to EPA of any additional testing done to that required herein if it is conducted in accordance with EPA approved methods, consistent with the provisions of 40 CFR §122.41(l)(4)(ii).

h. The dissolved oxygen level at the point of discharge must maintain a minimum of 7.4 mg/l.

2. All POTWs must provide adequate notice to the Director of the following:

a. Any new introduction of pollutants into that POTW from an indirect discharger in a primary industry category discharging process water; and

b. Any substantial change in the volume or character of pollutants being introduced into that POTW by a source introducing pollutants into the POTW at the time of issuance of the permit.

c. For purposes of this paragraph, adequate notice shall include information on:

(1) the quantity and quality of effluent introduced into the POTW; and

(2) any anticipated impact of the change on the quantity or quality of effluent to be discharged from the POTW.

**B.1. Limitations for Industrial Users:**

a. Pollutants introduced into POTW's by a non-domestic source (user) shall not pass through the POTW or interfere with the operation or performance of the works.

b. The permittee shall develop and enforce specific effluent limits (local limits) for Industrial User(s), and all other users, as appropriate, which together with appropriate changes in the POTW Treatment Plant's Facilities or operation, are necessary to ensure continued compliance with the POTW's NPDES permit or sludge use or disposal practices. Specific local limits shall not be developed and enforced without individual notice to persons or groups who have requested such notice and an opportunity to respond.

Within (90 days of the effective date of this permit), the permittee shall prepare and submit a written technical evaluation to the EPA analyzing the need to revise local limits. As part of this evaluation, the permittee shall assess how the POTW performs with respect to influent and effluent of pollutants, water quality concerns, sludge quality, sludge processing concerns/inhibition, biomonitoring results, activated sludge inhibition, worker health and safety and collection system concerns. In preparing this evaluation, the permittee shall complete and submit the attached form (Attachment B) with the technical evaluation to assist in determining whether existing local limits need to be revised. Justifications and conclusions should be based on actual plant data if available and should be included in the report. Should the evaluation reveal the need to revise local limits, the permittee shall complete the revisions within 120 days of notification by EPA and submit the revisions to EPA for approval.

The Permittee shall carry out the local limits revisions in accordance with EPA's Local Limit Development Guidance (July 2004).

B.2. Industrial Pretreatment Program

a. The permittee shall implement the Industrial Pretreatment Program in accordance with the legal authorities, policies, procedures, and financial provisions described in the permittee's approved Pretreatment Program, and the General Pretreatment Regulations, 40 CFR 403. At a minimum, the permittee must perform the following duties to properly implement the Industrial Pretreatment Program (IPP):

1. Carry out inspection, surveillance, and monitoring procedures which will determine, independent of information supplied by the industrial user, whether the industrial user is in compliance with the Pretreatment Standards. At a minimum, all significant industrial users shall be sampled and inspected at the frequency established in the approved IPP but in no case less than once per year and maintain adequate records.

2. Issue or renew all necessary industrial user control mechanisms within 90 days of their expiration date or within 180 days after the industry has been determined to be a significant industrial user.

3. Obtain appropriate remedies for noncompliance by any industrial user with any pretreatment standard and/or requirement.

4. Maintain an adequate revenue structure for continued implementation of the Pretreatment Program.

b. The permittee shall provide the EPA (and the MassDEP) with an annual report describing the permittee's pretreatment program activities for the twelve month period ending 60 days prior to the due date in accordance with 403.12(i). The annual report shall be consistent with the format described in Attachment C of this permit and shall be submitted no later than October 1 of each year.

c. The permittee must obtain approval from EPA prior to making any significant changes to the industrial pretreatment program in accordance with 40 CFR 403.18(c).

d. The permittee must assure that applicable National Categorical Pretreatment Standards are met by all categorical industrial users of the POTW. These standards are published in the Federal Regulations at 40 CFR 405 et. seq.

e. The permittee must modify its pretreatment program to conform to all changes in the Federal Regulations that pertain to the implementation and enforcement of the industrial pretreatment program.
The permittee must provide EPA, in writing, within <u>180 days of this permit's effective date</u> proposed changes, **if applicable,** to the permittee's pretreatment program deemed necessary to assure conformity with current Federal Regulations.
At a minimum, the permittee must address in its written submission the following areas: (1) Enforcement response plan; (2) revised sewer use ordinances; and (3) slug control evaluations. The permittee will implement these proposed changes pending EPA Region I's approval under 40 CFR 403.18. This submission is separate and distinct from any local limits analysis submission described in the permit.

B.3. Toxics Control

a. The permittee shall not discharge any pollutant or combination of pollutants in toxic amounts.

b. Any toxic components of the effluent shall not result in any demonstrable harm to aquatic life or violate any state or federal water quality standard which has been or may be promulgated. Upon promulgation of any such standard, this permit may be revised or amended in accordance with such standards.

B.4. Numerical Effluent Limitations for Toxicants

EPA or MassDEP may use the results of the toxicity tests and chemical analyses conducted pursuant to this permit, as well as national water quality criteria developed pursuant to Section 304(a)(1) of the Clean Water Act (CWA), state water quality criteria, and any other appropriate information or data, to develop numerical effluent limitations for any pollutants, including but not limited to those pollutants listed in Appendix D of 40 CFR Part 122.

## C. UNAUTHORIZED DISCHARGES

The permittee is authorized to discharge only in accordance with the terms and conditions of this permit and only from outfall 001. Discharges of wastewater from any other point sources, including sanitary sewer overflows (SSOs) are not authorized by this permit and shall be reported in accordance with Section D.1.e. (1) of the General Requirements of this permit (Twenty-four hour reporting).

## D. OPERATION AND MAINTENANCE OF THE SEWER SYSTEM

Operation and maintenance of the sewer system shall be in compliance with the General Requirements of Part II and the following terms and conditions:

1. Maintenance Staff

   The permittee shall provide an adequate staff to carry out the operation, maintenance, repair, and testing functions required to ensure compliance with the terms and conditions of this permit.

2. Preventative Maintenance Program

   The permittee shall maintain an ongoing preventative maintenance program to prevent overflows and bypasses caused by malfunctions or failures of the sewer system infrastructure. The program shall include an inspection program designed to identify all potential and actual unauthorized discharges.

3. Infiltration/Inflow Control Plan:

   The permittee shall develop and implement a plan to control infiltration and inflow (I/I) to the separate sewer system. The plan shall be submitted to EPA and MassDEP within six months of the effective date of this permit (see page 1 of this permit for the effective date) and shall describe the permittee’s program for preventing infiltration/inflow related effluent limit violations, and all unauthorized discharges of wastewater, including overflows and by-passes due to excessive infiltration/inflow.

   The plan shall include:

   - An ongoing program to identify and remove sources of infiltration and inflow. The program shall include the necessary funding level and the source(s) of funding.

   - An inflow identification and control program that focuses on the disconnection and redirection of illegal sump pumps and roof down spouts. Priority should be given to removal of public and private inflow sources that are upstream from, and potentially contribute to, known areas of sewer system backups and/or overflows.

   - Identification and prioritization of areas that will provide increased aquifer recharge as the result of reduction/elimination of infiltration and inflow to the system.

- An educational public outreach program for all aspects of I/I control, particularly private inflow.

- The permittee shall require, through appropriate agreements, that all member communities develop and implement infiltration and inflow control plans sufficient to ensure that high flows do not cause or contribute to a violation of the permittee's effluent limitations, or cause overflows from the permittee's collection system.

Reporting Requirements:

A summary report of all actions taken to minimize I/I during the previous calendar year shall be submitted to EPA and the MassDEP annually, by the anniversary date of the effective date of this permit. The summary report shall, at a minimum, include:

- A map and a description of inspection and maintenance activities conducted and corrective actions taken during the previous year.

- Expenditures for any infiltration/inflow related maintenance activities and corrective actions taken during the previous year.

- A map with areas identified for I/I-related investigation/action in the coming year.

- A calculation of the annual average I/I, the maximum month I/I for the reporting year.

- A report of any infiltration/inflow related corrective actions taken as a result of unauthorized discharges reported pursuant to 314 CMR 3.19(20) and reported pursuant to the Unauthorized Discharges section of this permit.

4. Alternate Power Source

In order to maintain compliance with the terms and conditions of this permit, the permittee shall continue to provide an alternative power source with which to sufficiently operate its treatment works (as defined at 40 CFR §122.2).

**E. SLUDGE CONDITIONS**

1. The permittee shall comply with all existing federal and state laws and regulations that apply to sewage sludge use and disposal practices and with the CWA Section 405(d) technical standards.

2. The permittee shall comply with the more stringent of either the state or federal (40 CFR part 503), requirements.

3. The requirements and technical standards of 40 CFR part 503 apply to facilities which perform one or more of the following use or disposal practices:

   a. Land application - the use of sewage sludge to condition or fertilize the soil

   b. Surface disposal - the placement of sewage sludge in a sludge only landfill

   c. Sewage sludge incineration in a sludge only incinerator

4. The 40 CFR part 503 conditions do not apply to facilities which place sludge within a municipal solid waste landfill. These conditions also do not apply to facilities which do not dispose of sewage sludge during the life of the permit but rather treat the sludge (e.g. lagoons- reed beds), or are otherwise excluded under 40 CFR 503.6.

5. The permittee shall comply with the 40 CFR, Part 503 regulations. A compliance guidance document is attached to help determine appropriate conditions. Appropriate conditions contain the following elements:

   - General requirements
   - Pollutant limitations
   - Operational Standards (pathogen reduction requirements and vector attraction reduction requirements)
   - Management practices
   - Record keeping
   - Monitoring
   - Reporting

   Depending upon the quality of material produced by a facility, all conditions may not apply to the facility.

6. The permittee shall monitor the pollutant concentrations, pathogen reduction and vector attraction reduction at the following frequency. This frequency is based upon the volume of sewage sludge generated at the facility in dry metric tons per year:

| | |
|---|---|
| less than 290 | 1/ year |
| 290 to less than1500 | 1 /quarter |
| 1500 to less than 15000 | 6 /year |
| 15000 + | 1 /month |

7. The permittee shall sample the sewage sludge using the procedures detailed in 40 CFR 503.8.

8. The permittee shall **submit an annual report containing the information specified in the regulations by February 19**. Reports shall be submitted to the address contained in the reporting section of the permit. Sludge monitoring is not required by the permittee when the permittee is not responsible for the ultimate sludge disposal.

   In such cases, the permittee is required only to **submit an annual report by February 19** containing the following information:

   - Name and address of contractor responsible for sludge disposal
   - Quantity of sludge in dry metric tons removed from the facility by the sludge contractor

## *F. COMPLIANCE SCHEDULES*

***No later than April 1, 2010,*** *the permittee shall achieve compliance with the final cold weather limits for ammonia as nitrogen (October 1 through May 31) and the summer total phosphorus limit (April 1 -October 31). During the interim period, monitoring and reporting of total phosphorous and ammonia as nitrogen shall be performed in accordance with the requirements in Part A.1.*

*During the interim period, the permittee shall achieve an average monthly total phosphorus limit of 1 mg/l during April 1-October 31, shall further optimize the removal of total phosphorus using existing equipment pursuant to requirements in item 1 below, and will be subject to earlier compliance dates for achieving the summer total phosphorous limit and the winter ammonia nitrogen limits if it is determined to be feasible pursuant to items 1 and 2 below.*

*During the interim period there is no cold weather interim limit for ammonia as nitrogen.*

*1.* ***Phosphorus Removal Optimization Requirement***

*Upon the effective date of the permit, the permittee shall begin to develop a plan for determining the lowest effluent phosphorus concentration achievable by the existing facility. The plan shall include, at a minimum, the use of multiple dosing points for chemical addition, various dosage rates, increased monitoring of influent and effluent phosphorus concentrations, and a plan for minimizing influent phosphorus loading to the treatment facility. The permittee shall submit the plan within three (3) months of the effective date of the permit* ***(note: the plan was submitted on September 28, 2006)*** *and implement the plan within three (3) months of its submittal, or upon approval by the agencies, whichever is sooner.*

*The plan shall provide for a phosphorous removal study to be performed during one full phosphorus removal season (i.e. the study shall be performed during the months of April, May, June, July, August, September, and October)* ***(note: the study must be completed by October 31, 2007)***.

*A final report documenting the results of the study shall be submitted by January 31, 2008. This final report shall include, at a minimum, the chemical dosage rates used, a summary of the influent and effluent phosphorus concentrations achieved, and an evaluation of whether the optimization of phosphorus removal at the existing facility is sufficient to consistently achieve the final monthly average phosphorus limit of 0.2 mg/l.*

*If the final report concludes that the final limit of 0.2 mg/l can be achieved by optimizing removal at the existing plant and minimizing influent loading, the final permit limit of 0.2 mg/l or less shall become effective on April 1, 2008.*

*If the final report concludes that the final limit cannot be achieved by the existing facilities, upgrades to the facility shall be completed according to the schedule in item 3 below.*

***2. Ammonia Removal Optimization Requirement***

*During the months of October 1, 2006 through May 31, 2007, the permittee shall operate the existing treatment plant in a manner consistent with optimizing removal of ammonia nitrogen. The permittee shall collect operational and effluent data during this period necessary to determine the treatment plant's ability to achieve the final winter permit limits for ammonia (i.e the final permit limits for the months of October through May). The permittee shall submit a report by August 31, 2007 which summarizes operational and effluent data collected during this period and concludes whether the existing facility is capable of achieving the final limits. If the permittee concludes that the facility can achieve the final limits , the limits must be achieved beginning on October 1, 2007.*

*If the final report concludes that the final limits cannot be achieved by the existing facilities, upgrades to the facility shall be completed according to the schedule in item 3 below.*

***3. Construction Schedule***

*a. By April 30, 2008, submit a plan for achieving the final limit(s) . The plan shall describe the treatment options evaluated, include preliminary cost estimates, and describe the selected treatment plant upgrades necessary to achieve the final effluent limits.*

*b. By March 31, 2009, complete plans and specifications for the necessary facility upgrades*

*c. By April 1, 2010 complete construction of necessary upgrades and attain* *compliance with the final effluent limit(s).*

***4. Technology Scaling***

*Design of any facility improvements during the effective dates of this permit shall not preclude installation of technology compatible with achieving more stringent total phosphorus limits that may be set in the future.*

**G. MONITORING AND REPORTING**

1. Reporting

Monitoring results obtained during each calendar month shall be summarized and reported on Discharge Monitoring Report Form(s) postmarked no later than the 15th day of the following month.

Signed and dated originals of these, and all other reports required herein, shall be submitted to the Director and the State at the following addresses:

Environmental Protection Agency
Water Technical Unit (SEW)
P.O. Box 8127
Boston, Massachusetts 02114

The State Agency is:

Massachusetts Department of Environmental Protection
Southeast Regional Office
Bureau of Resource Protection
20 Riverside Drive
Lakville, MA 02347

Signed and dated Discharge Monitoring Report Forms and toxicity test reports required by this permit shall also be submitted to the State at:

Massachusetts Department of Environmental Protection
Division of Watershed Management
Surface Water Discharge Permit Program
627 Main Street, 2nd Floor
Worcester, Massachusetts 01608

Copies of all reports required to be submitted in Section B, "Limitations for Industrial Users and Industrial Pretreatment Program" shall be sent to:

Massachusetts Department of Environmental Protection
Bureau of Waste Prevention - Industrial Wastewater Section
1 Winter Street
Boston, MA 02108

## H. STATE PERMIT CONDITIONS

This discharge permit is issued jointly by the U. S. Environmental Protection Agency (EPA) and the Massachusetts Department of Environmental Protection (MassDEP) under federal and state law, respectively. As such, all the terms and conditions of this permit are hereby incorporated into and constitute a discharge permit issued by the Commissioner of the MassDEP pursuant to M.G.L. Chap. 21, §43.

Each agency shall have the independent right to enforce the terms and conditions of this permit. Any modification, suspension or revocation of this permit shall be effective only with respect to the agency taking such action, and shall not affect the validity or status of this permit as issued by the other agency, unless and until each agency has concurred in writing with such modification, suspension or revocation. In the event this permit or any portion of this permit is declared, invalid, illegal or otherwise issued in violation of state law such permit shall remain in full force and effect under federal law as an NPDES permit issued by the U.S. Environmental Protection Agency. In the event this permit or any portion of this permit is declared invalid, illegal or otherwise issued in violation of federal law, this permit shall remain in full force and effect under state law as a permit issued by the Commonwealth of Massachusetts.

WRIGHT-PIERCE
Engineering a Better Environment

# B

# Comprehensive WWTP Assessment and Evaluation

## Workshop of the WWTP Preliminary Assessment and Solution Alternatives

December 11, 2020

W. Doug Hankins, PE
Edwin Castilla, PhD, PE

ROCKLAND, MA

WRIGHT-PIERCE
Engineering a Better Environment

1

KO1

## Agenda

- Evaluation of Existing Infrastructure
- Current and Design Flows and Loads
- Alternatives Analysis
  - Plant Hydraulics
  - Electrical Distribution
  - Solids Handling Process
  - Influent Pumping and Grit Removal
  - Clarification
  - Secondary Treatment System
  - Tertiary Treatment System
  - Chlorine Contact Tanks

WRIGHT-PIERCE
Engineering a Better Environment

2

2

KO1 should we move electrical distribution and Solids Handling Process to the end of the Alternatives Analysis section?
Kevin Olson, 12/9/2020

## Evaluation of Existing Infrastructure

- Key Findings:
  - Other than some new rotating equipment (i.e., pumps), about 95% all of equipment at the plant should be considered past their life expectancy. This includes process, electrical, plumbing and mechanical HVAC systems.
    - Recommend equipment replacement
    - Recommend replacement of most above-grade piping and valves
    - Architectural review not completed yet
  - Mechanical Aerators – critical component, difficult to repair/replace – equipment failure would likely result in permit compliance issues
    - Develop plan for supplemental oxygen delivery to aeration tanks (AT) in event mechanical aerator fails prior to upgrade

WRIGHT-PIERCE Engineering a Better Environment

3

3

## Evaluation of Existing Infrastructure

- Key Findings:
  - Influent Pump Station is a viable structure, no overt structural concerns
  - Significant structural cracking throughout the facility, in particular the nitrification tanks, secondary settling tanks and pumping galleries.
    - Cracks are all repairable – epoxy resin injection
    - Missing or not installed water stops – Elastomeric membrane applied to concrete
    - Some heightened structural concern with a location in nitrification pump gallery
  - National Electrical Code Issues
    - Lack of single disconnect for each Building
    - MCC locations within Buildings
  - National Fire Protection Assoc. Issues
    - Inadequate ventilation rates in critical areas

WRIGHT-PIERCE Engineering a Better Environment

4

4

## Current Flows and Loads

- 2016 -2020 analyzed
- Current compound annual growth rates
  - Flow: 8.0% (significant seasonal variation)
  - TSS Load: - 0.7%
  - BOD Load: - 2.4%
- Annual Rate of Precipitation Increase: 14.2%
- Begin influent TKN sampling

**TABLE 1-1**
**CURRENT INFLUENT FLOWS AND LOADS**

| | Flow | | $BOD_5$ | | | TSS | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | MGD | P.F. | mg/L | lbs/day | P.F. | mg/L | lbs/day | P.F. |
| Minimum Day | 1.13 | 0.46 | 98 | 926 | 0.25 | 129 | 1,216 | 0.24 |
| Minimum Month | 1.34 | 0.54 | 156 | 1,739 | 0.47 | 251 | 2,803 | 0.56 |
| Annual Average | 2.46 | - | 179 | 3,676 | - | 244 | 5,008 | - |
| Maximum Month[1] | 4.28 | 1.74 | 153 | 5,460 | 1.49 | 255 | 9,085 | 1.81 |
| Maximum Month Loading[2] | 3.39 | 1.38 | 193 | 5,460 | 1.49 | 321 | 9,064 | 1.81 |
| Maximum Day[3] (98th %) | 4.69 | 1.91 | 172 | 6,713 | 1.83 | 265 | 10,381 | 8.54 |
| Maximum Day[4] (100th %) | 6.09 | 2.47 | 260 | 13,211 | 3.59 | 504 | 25,560 | 5.10 |
| | **Temperature** | | **NH3-N** | | | **Total Phosphorus** | | |
| **Parameter** | **C** | **P.F.** | **mg/L** | **lbs/day** | **P.F.** | **mg/L** | **lbs/day** | **P.F.** |
| Minimum Day | 8.89 | 0.56 | 30.08 | 283 | 0.60 | 1.63 | 15 | 0.21 |
| Minimum Month | 9.80 | 0.62 | | | - | | | - |
| Annual Average | 15.76 | - | 22.92 | 470 | - | 3.61 | 74 | - |
| Maximum Month[1] | 9.80 | 0.62 | 17.65 | 629 | 1.34 | 3.04 | 109 | 1.47 |
| Maximum Month Loading[2] | 9.80 | 0.62 | | | | | | |
| Maximum Day[3] (98th %) | 22.22 | 1.41 | | | | | | |
| Maximum Day[4] (100th %) | 23.33 | 1.48 | | | | | | |

WRIGHT-PIERCE
Engineering a Better Environment

5

5

## Near Term Flows and Loads

- Can the WWTF handle the current approved and pending sewer connections?
- Yes
  - The existing WWTF can handle the additional load
  - Assumes no failure of critical equipment or systems (remember a lot of systems are beyond their current life expectancy)
  - Flow Compliance Issue

**APPROVED, PENDING AND FUTURE SEWER BUILDOUT**
**FLOWS AND LOADS**

| | Flow | | $BOD_5$ | | | TSS | | |
|---|---|---|---|---|---|---|---|---|
| Parameter | MGD | P.F. | mg/L | lbs/day | P.F. | mg/L | lbs/day | P.F. |
| Minimum Day | | 0.00 | | 0 | 0.00 | | 0 | 0.00 |
| Title 5 Unit Flows | 0.23 | 1.67 | 200 | 392 | 1.67 | 200 | 392 | 1.67 |
| Annual Average | 0.14 | - | 200 | 235 | - | 200 | 235 | - |
| Maximum Month | 0.19 | 1.35 | 200 | 317 | 1.35 | 200 | 317 | 1.35 |
| Maximum Month Loading | 0.19 | 1.35 | 200 | 317 | 1.35 | 200 | 317 | 1.35 |
| Maximum Day (98th %) | 0.28 | 2.00 | 200 | 470 | 2.00 | 200 | 470 | 1.20 |
| Maximum Day (100th %) | 0.28 | 2.00 | | | | | | |
| | **Temperature** | | **NH3-N** | | | **Total Phosphorus** | | |
| **Parameter** | **C** | **P.F.** | **mg/L** | **lbs/day** | **P.F.** | **mg/L** | **lbs/day** | **P.F.** |
| Minimum Day | | | 0 | 0 | 0.00 | | 0 | 0.00 |
| Title 5 Unit Flows | | | 26 | 52 | 1.67 | 7.00 | 14 | 1.67 |
| Annual Average | | | 26 | 31 | - | 7.00 | 8 | - |
| Maximum Month | | | 26 | 42 | 1.35 | 7.00 | 11 | 1.35 |
| Maximum Month Loading | | | | | | | | |
| Maximum Day (98th %) | | | | | | | | |
| Maximum Day (100th %) | | | | | | | | |

WRIGHT-PIERCE
Engineering a Better Environment

6

6

## Design Flows and Loads

- The US Census Bureau population estimates would indicate a 0.39% annual population growth rate for the Town of Rockland.
- The Metropolitan Area Planning Council projected an 8% increase in the number of households in the Town of Rockland (from 2010 to 2030).
- Design Assumption:
  - 0.75% Annual Growth for a 30 year window
  - Increase of max hydraulic capacity from 6 mgd to 7 mgd
  - 25% Increase in total wastewater received

**Rockland Wastewater Treatment Plant (Rockland, MA)**
**Design Year Flows and Loads**

| Parameter | Flow | | $BOD_5$ | | | TSS | | |
|---|---|---|---|---|---|---|---|---|
| | MGD | P.F. | mg/L | lbs/day | P.F. | mg/L | lbs/day | P.F. |
| Minimum Day | 1.15 | 0.46 | 121 | 1,159 | 0.25 | 159 | 1,521 | 0.24 |
| Minimum Month | 1.36 | 0.54 | 192 | 2,176 | 0.47 | 310 | 3,507 | 0.56 |
| Annual Average | 2.50 | - | 221 | 4,600 | - | 301 | 6,266 | - |
| Maximum Month[1] | 4.35 | 1.74 | 188 | 6,832 | 1.49 | 314 | 11,368 | 1.81 |
| Maximum Month Loading[2] | 3.44 | 1.38 | 238 | 6,832 | 1.49 | 395 | 11,342 | 1.81 |
| Maximum Day[3] (98th %) | 4.76 | 1.91 | 211 | 8,400 | 1.83 | 1347 | 53,511 | 8.54 |
| Maximum Day[4] (100th %) | 7.00 | 2.80 | 283 | 16,530 | 3.59 | 548 | 31,982 | 5.10 |
| **Parameter** | **Temperature** | | **NH3-N** | | | **Total Phosphorus** | | |
| | C | P.F. | mg/L | lbs/day | P.F. | mg/L | lbs/day | P.F. |
| Minimum Day | 8.89 | 0.56 | 37.04 | 355 | 0.60 | 2.01 | 19 | 0.21 |
| Minimum Month | 9.80 | 0.62 | | | - | | | - |
| Annual Average | 15.76 | - | 28.23 | 589 | - | 4.44 | 93 | - |
| Maximum Month[1] | 9.80 | 0.62 | 21.73 | 788 | 1.34 | 3.75 | 136 | 1.47 |
| Maximum Month Loading[2] | 9.80 | 0.62 | | | | | | |
| Maximum Day[3] (98th %) | 22.22 | 1.41 | | | | | | |
| Maximum Day[4] (100th %) | 23.33 | 1.48 | | | | | | |

WRIGHT-PIERCE
Engineering a Better Environment

7

7

## Expected Secondary and Tertiary Effluent Data

| PARAMETER | Expected Secondary Effluent | | | | Expected Tertiary Effluent | |
|---|---|---|---|---|---|---|
| | Annual Average | Max Month Winter | Max Month Summer | Peak Day | Nov 1–Mar 31 | Apr 1–Oct 31 |
| Flow, MGD | 2.5 | 4.38 | 4.38 | 6.0 | - | - |
| $BOD_5$, mg/L | < 15 | < 20 | < 10 | - | < 10 | < 5 |
| TSS, mg/L | < 15 | < 20 | < 10 | - | < 10 | < 5 |
| TN, mg/L | < 8.0 | < 8.0 | < 8.0 | - | < 8.0 | < 8.0 |
| Ammonia, mg/L | < 1.0 | < 1.0 | < 1.0 | - | < 1.0 | < 1.0 |
| TP, mg/L | < 1.0 | < 1.0 | < 1.0 | - | < 1.0 | < 0.1 |
| pH | 6.0-7.5 | 6.0-7.5 | 6.0-7.5 | - | 6.0-7.5 | 6.0-7.5 |
| Temp, °C | 16 | 9.8 | 17 | - | 9.8 | 17 |

WRIGHT-PIERCE
Engineering a Better Environment

8

8

## Big Picture

- Upgrade liquid process for biological phosphorus and nitrogen removal
  - Analyzed with and without anerobic digestion
- Tertiary phosphorus removal process required
  - Modify plant hydraulics or new effluent pump station required
- Electrical distribution
  - Recommend completely new infrastructure
- Anaerobic digestion cost-benefit analysis

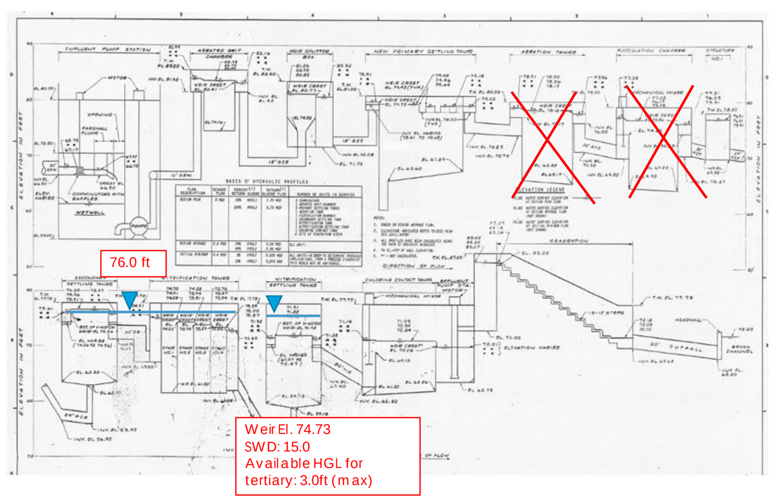
WRIGHT-PIERCE
Engineering a Better Environment





## Plant Hydraulics – desired approach

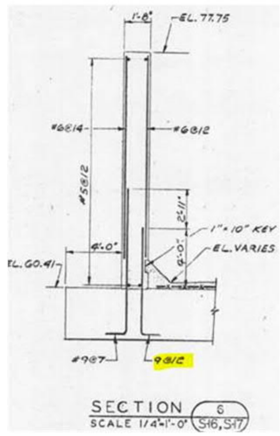
- Keep primary clarifier at same elevation
- Raise water level in aeration tanks and secondary clarifiers
  - Increase from 12 ft. SWD to 15 ft. (A.T. and S.C.)
- 3.0 ft. available for Tertiary Process
- Eliminate piping bottlenecks
- Eliminate need for offline storage

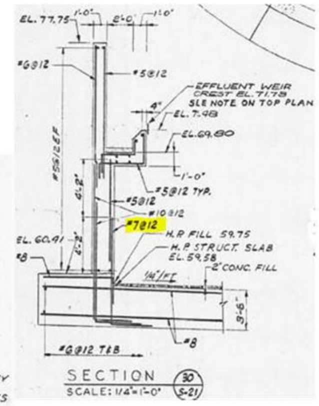



WRIGHT-PIERCE
Engineering a Better Environment

## Plant Hydraulics – desired approach

- Aeration Tanks and Clarifiers
  - Still evaluating structural impacts of higher side water depth (SWD)
  - Fairly confident structures (with some minor improvements can handle higher SWD)
- If water level can't be raised, will need new effluent pump station
- For today's discussions, assume water level can be raised



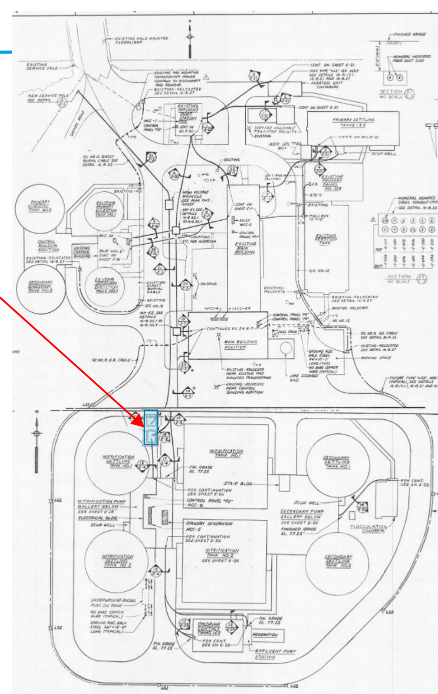

WRIGHT-PIERCE
Engineering a Better Environment

11

11

## Electrical Distribution

- Main electrical feed to outdoor switchboard
  - Individual MCC's fed from this location
  - Needs to remain online while new electrical system is constructed
  - 1977 Vintage
- Need location for new switchboard
  - Indoor recommended
  - Close to new generator
  - Then install new conduits to existing electrical rooms and replace all MCC's
    - Addresses buildings with multi-feeds
    - Single disconnect

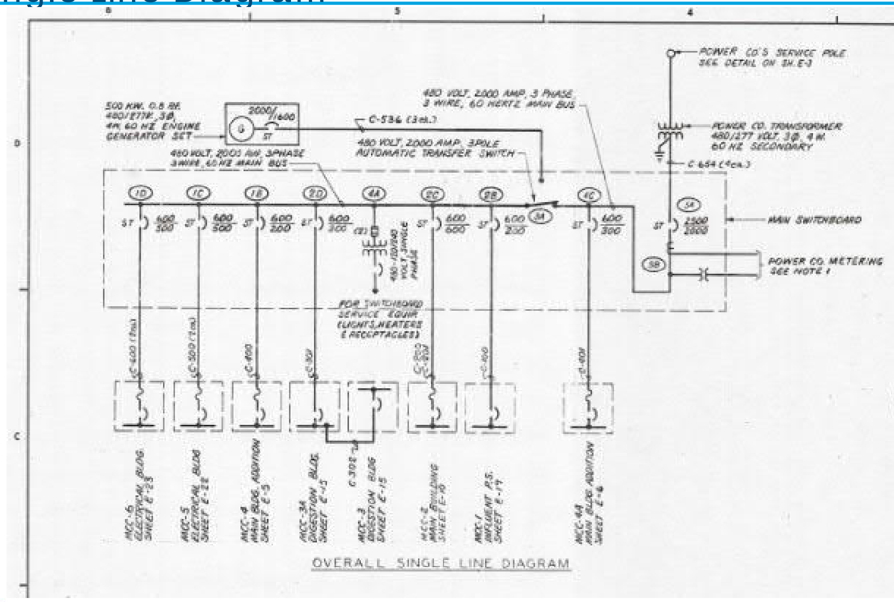


WRIGHT-PIERCE
Engineering a Better Environment

12

12

## Overall Single Line Diagram



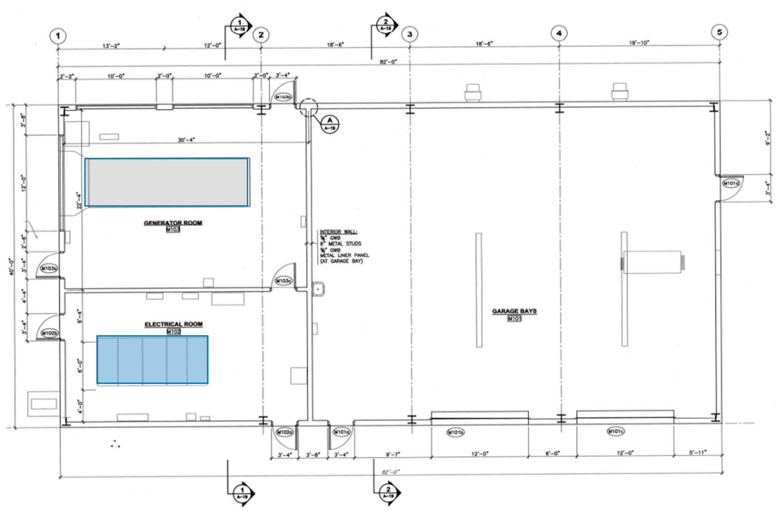

WRIGHT-PIERCE
Engineering a Better Environment

13

13

## New Electrical/Garage Building

- Recommend new indoor location for switchboard
- Example from similar sized WWTP
  - New Indoor Generator
    - Exterior Fuel Tank
  - New Main Switchboard
  - Installed in metal pre-engineered building
  - Also include new garage space
- Generator can be located outside

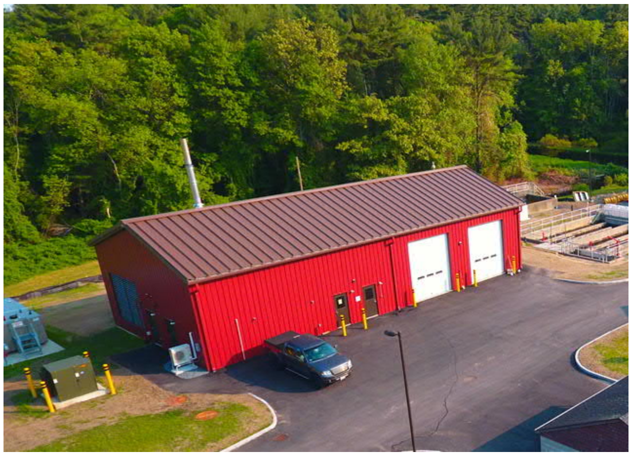



WRIGHT-PIERCE
Engineering a Better Environment

14

14

## Electrical/Garage Building Example




WRIGHT-PIERCE
Engineering a Better Environment

15

15

## Electrical/Garage Building Example

WRIGHT-PIERCE
Engineering a Better Environment

16

16

## Electrical/Garage Building Location

WRIGHT-PIERCE
Engineering a Better Environment

17

17

## Anaerobic Digestion (AD) Facility

- Brown and Caldwell 2018 Report
  - Generally, agree with the improvements required
    - New covers, gas storage, pre-thickening step, piping, etc.
  - Cost estimates are in the right ballpark

- Issues
  - High capital cost to make viable for long term
  - High return of nitrogen loading
    - extra $ to reduce this TN loading
    - Post-AD treatment or expanded activated sludge process
  - High return of phosphorus loading (extra chemistry required)

WRIGHT-PIERCE
Engineering a Better Environment

18

18

## Anaerobic Digestion Facility

- Cost Implications
  - 2 Full-Time Employees
  - Natural Gas Use
  - Annual maintenance costs
  - Sludge Disposal Costs
    - Current: $100/ton
    - Future? $180 to $200/ton?
- Dewaterability
  - Current: 20% cake (excellent with digested sludge)
  - Without A.D's: 25% cake, or greater

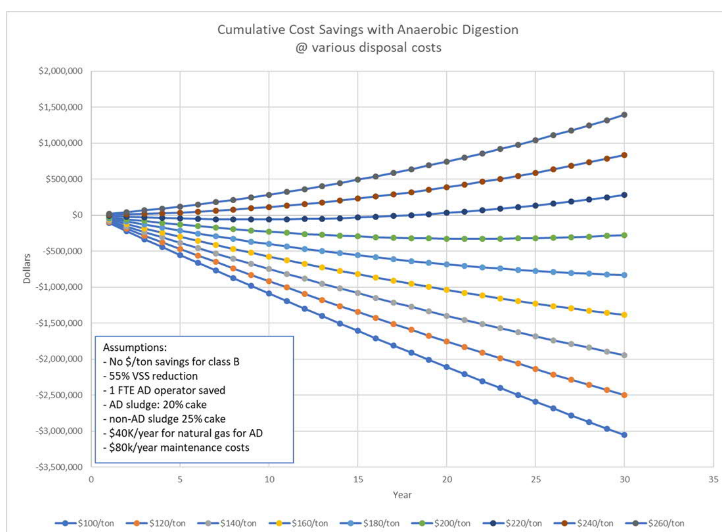
WRIGHT-PIERCE
Engineering a Better Environment

19

19

## Anaerobic Digestion Cost Analysis

- Capital cost: $8.7M
- Net Present Value (NPV)
  - How much money Rockland would save with anaerobic digestion process
  - $100/ton: -$3 M
  - $260/ton: $1.4 M
- Present Value (Capital cost + NPV)
  - $100/ton: -$11.8 M
  - $260/ton: -$7.3 M



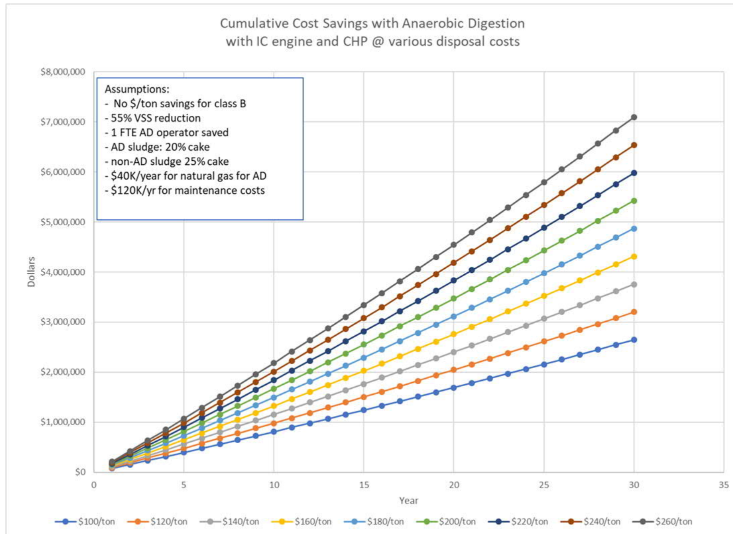

WRIGHT-PIERCE
Engineering a Better Environment

20

20

## Anaerobic Digestion with Power Generation - Cost Analysis

- Capital cost: $9.8M
- Net Present Value (NPV)
  - How much money Rockland would save with anaerobic digestion process
  - $100/ton: $2.6 M
  - $260/ton: $7.1 M
- Present Value (Capital cost + NPV)
  - $100/ton: -$7.1 M
  - $260/ton: -$2.7 M



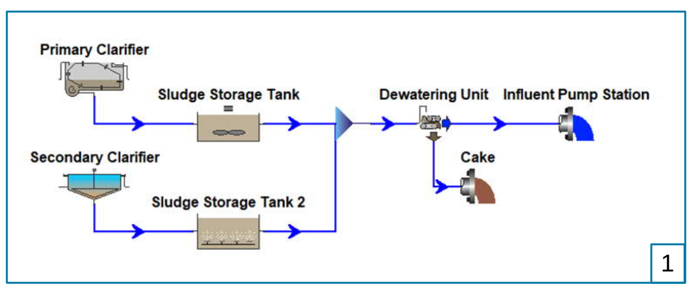

WRIGHT-PIERCE
Engineering a Better Environment

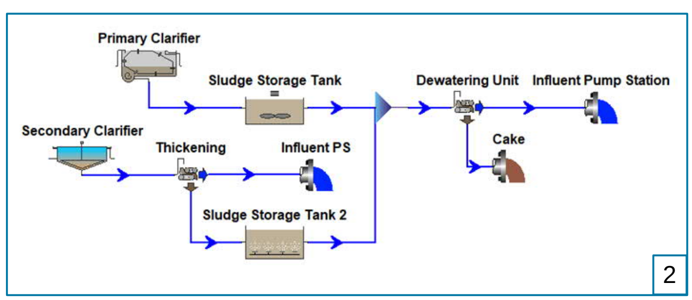
21

21

## Alternative Solids Handling Configurations

- Option 1
  - Simplistic
  - Potentially large volume of waste activated sludge
  - Dewatering unit considerations
    - 1.5% feed sludge
    - Reduces types of units that can be used
- Option 2
  - Additional thickening and pumping step
  - Lower storage volume requirements
  - Thicker feed sludge to dewatering unit
- Tertiary sludge sent to primary clarifier
- Odor Considerations



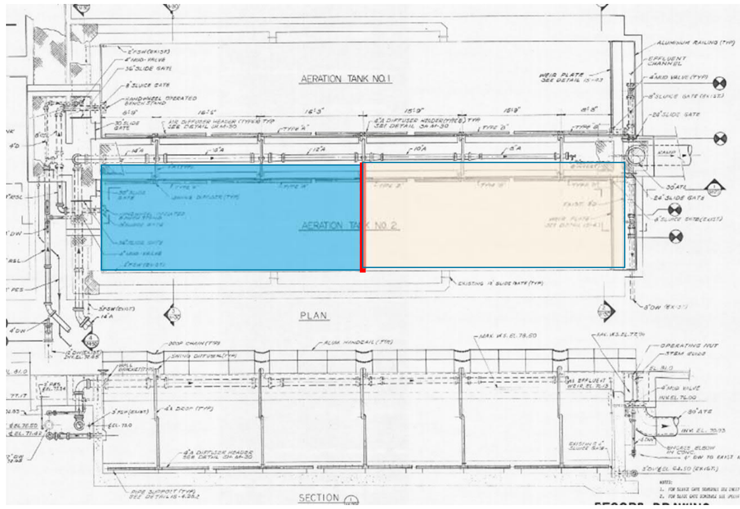

WRIGHT-PIERCE
Engineering a Better Environment

22

22

## Sludge Storage Option 1

- 110,000 gal each
  - 14 ft. wide x 13 ft. deep x 81.5 ft.
- WAS - Design Max month:
  - 2,730 lbs./day at 0.9% = 30,000 gpd
- Primary Sludge - Design Max Month:
  - 5,000 lbs./day at 2.5% = 23,000 gpd
- 3 to 4 days of storage capacity recommended
  - Pumps located in basement of Admin. Building




WRIGHT-PIERCE
Engineering a Better Environment

23



## Sludge Storage Option 2

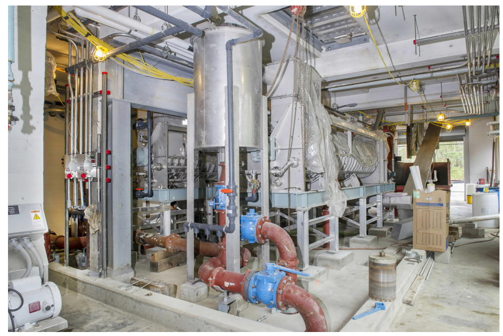
- Anerobic Digestion Building
  - Sludge Mixing and Storage Equipment
  - Sludge Thickening Device
- Sludge Digesters
  - Very Large for Sludge Storage

WRIGHT-PIERCE
Engineering a Better Environment

24

## Dewatering Options

- Screw Press
  - Slow speed
  - Enclosed vessel (covers removed in pics)
  - Typically operated unattended for 12-20 hrs./day
  - Can handle “dilute” sludge
  - Low connected horsepower
- Discussion Points
  - Desired run time, days/week and hours per day
  - Level of Redundancy
- Alternative Technologies
  - Centrifuge and Belt Filter Press



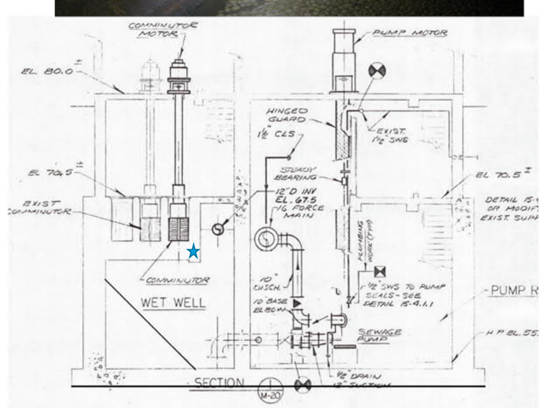
WRIGHT-PIERCE Engineering a Better Environment

25

25

## Influent Pump Station

- Wet Well Condition
  - Concrete fill protecting the exterior wall
  - No visible exposed rebar
  - Interior wall “doesn’t look that bad”
  - Concern with the Beam (blue star)
- Recommendations
  - Bypass wet well, resurface concrete, place pump station back into service
  - New pump station would be very expensive due to structure depth
  - Provide mechanical screening in new upstream structure
  - Improved ventilation and isolated electrical area




WRIGHT-PIERCE Engineering a Better Environment

26

26

## Influent Grit Removal

- Only 1 Existing unit (redundancy)
- Designed appropriately (tank geometry)
- Typically, decent at capturing large heavy grit, but less so lighter/fine grit
- Grit removal options
  - Replace clamshell grit bucket
  - Chain and flight
  - Screw conveyor

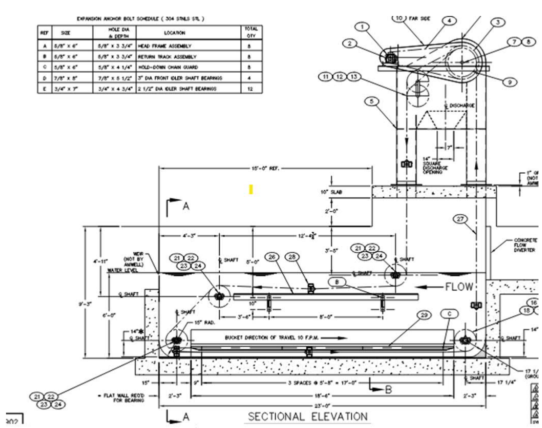
WRIGHT-PIERCE
Engineering a Better Environment

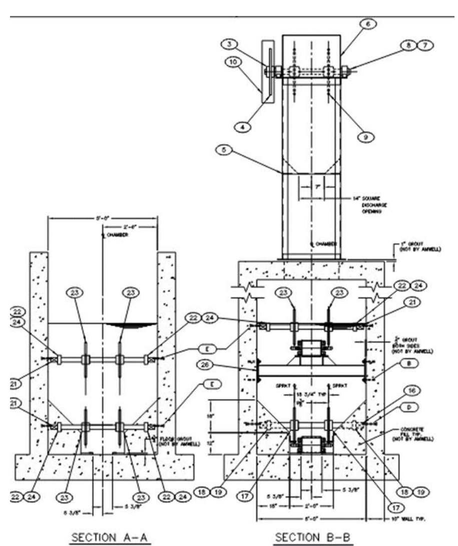
27

27

## Influent Grit Removal

- Chain and Flight Option



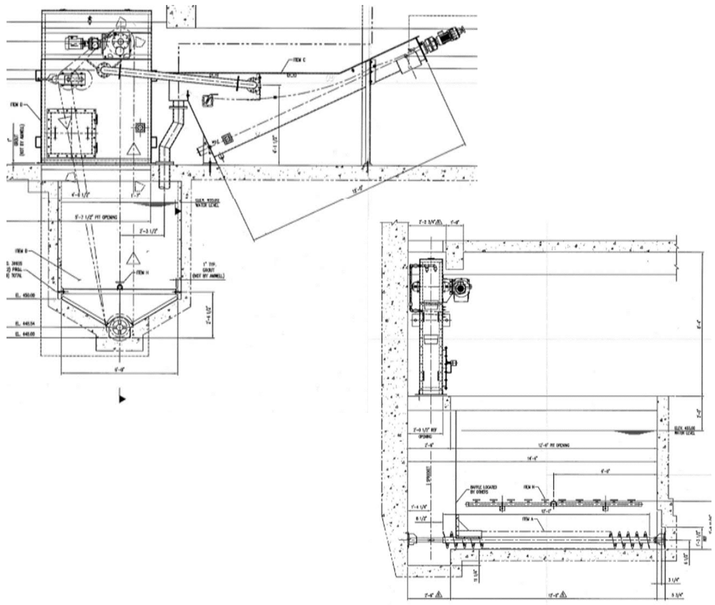

WRIGHT-PIERCE
Engineering a Better Environment

28

28

## Influent Grit Removal

- Screw Conveyor Option
  - We have not had good luck with grit bucket elevators
  - Could provide submersible pump in lieu of elevator



WRIGHT-PIERCE
Engineering a Better Environment

29

29

## Influent Grit Removal

- Grit material transported to a grit classifier for washing and compaction
  - Reduces odors
  - Reduces volume
- Can be used with either the chain and flight or screw conveyor option
- Indoor installation required for New England

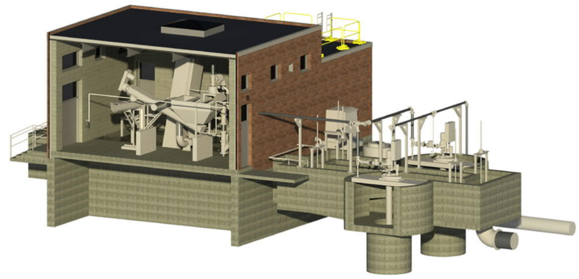
WRIGHT-PIERCE
Engineering a Better Environment

30

30

## Influent Grit Removal

- Vortex Grit Removal Option
  - 1 or 2 units
  - Can be located indoor or outside
  - Better at capturing fine grit particles
  - Grit washer and compactor unit
- Located after the influent pump station
- Requires upstream screening
- More expensive than retrofitting existing aerated grit



WRIGHT-PIERCE Engineering a Better Environment

31

31

## Primary Clarifiers

- Complete replacement of all internal equipment
  - Lower sludge hopper screw
- Concrete in decent shape
- Eliminate co-settling of waste sludge
  - Retain chemical addition prior to clarifiers
  - Tertiary sludge addition
  - Chemical in tertiary sludge will enhance phosphorus and TSS removal
- Adequately sized for current and future flows

WRIGHT-PIERCE Engineering a Better Environment

32

32

## Secondary Clarifiers

- Complete replacement of all internal equipment
  - Drive mechanism, sludge scrapers, walkway
  - Increase size of EDI well
  - Increase side water depth by raising effluent weir
- Total Capacity (at 15ft SWD)
  - 6 mgd continuously for one day
  - 6 to 7 mgd (short duration only)
- Replace with rapid sludge withdrawal type mechanism
- Enhanced MLSS Settleability with BNR Process
  - Eliminate effluent polymer use

WRIGHT-PIERCE
Engineering a Better Environment

33

33

## Secondary Treatment – Big Picture

- Existing Activated Sludge Process
  - Tanks are too small for conventional BNR process
  - Clarifiers are shallow
  - Mechanical aerators are critical component
- Alternatives Considered
  - Expansion into unused settling tanks
  - Installing technology in existing tanks to increase biomass population
- Anaerobic Digestion Impacts
  - Nitrogen loading very high
- High Flow Considerations
  - Keep operating MLSS down
  - Enhance MLSS settleability

WRIGHT-PIERCE
Engineering a Better Environment

34

34

## Secondary Treatment Alternatives

- Conventional Process
  - Alternative 1 : Activated Sludge
    Anaerobic/Anoxic/Aerobic Configuration
- Technology Assisted Process
  - Alternative 2 : Integrated Fixed-film Activated Sludge (IFAS)
    Anaerobic/Anoxic/Aerobic Configuration
  - Alternative 3 : Membrane Aerated Biofilm Reactor (MABR)
    Anaerobic/Anoxic/Aerobic Configuration
  - Alternative 4 : Membrane Bio-Reactor (MBR)
    Anaerobic/Anoxic/Aerobic Configuration

WRIGHT-PIERCE Engineering a Better Environment

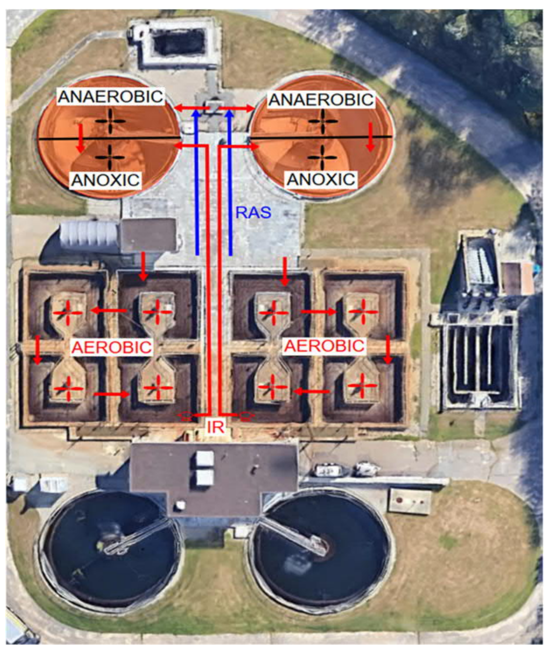
35

35

## Secondary Treatment Alternative 1

Activated Sludge

- Anaerobic/Anoxic/Aerobic Configuration
- Secondary settling tanks converted into Anaerobic and Anoxic zones
  - Bio-P and TN removal
- Surface Aerators replaced by new aeration device
  - All zones aerated
- Internal recirculation for denitrification

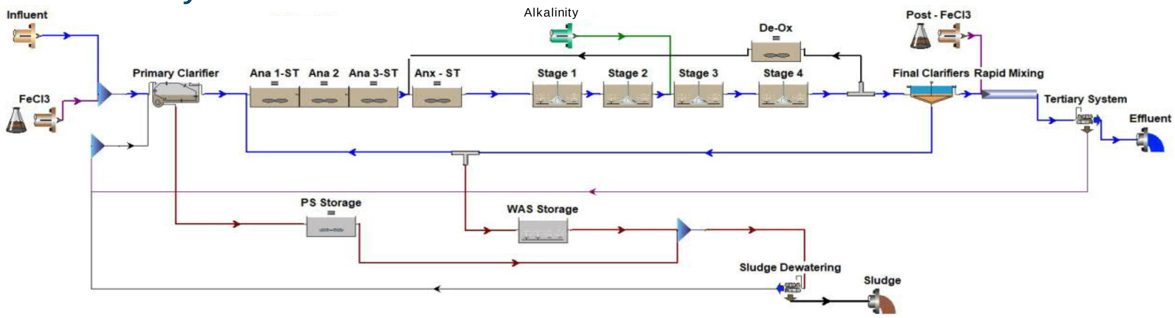



WRIGHT-PIERCE Engineering a Better Environment

36

36

## Secondary Treatment Alternative 1




### Activated Sludge – Anaerobic/Anoxic/Aerobic Configuration

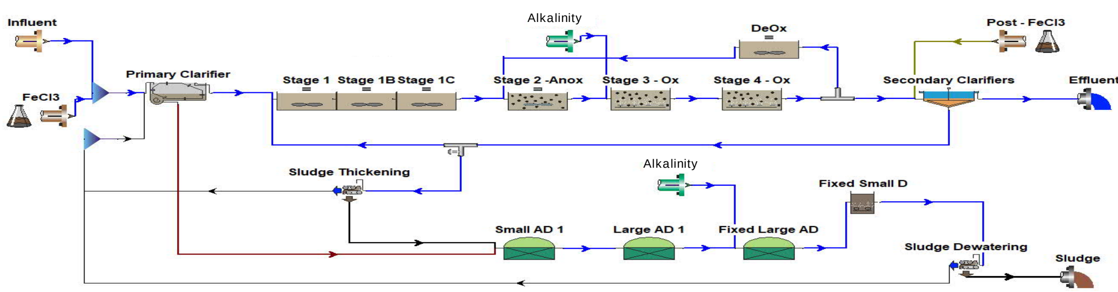
- Improved biological phosphorus and nitrogen removal
- Anaerobic zone that maximizes Bio-P
- Reduced ferric chloride addition
- Nitrification/Denitrification
- Additional carbon source for denitrification
- Better DO control to reduce aeration cost

WRIGHT-PIERCE
Engineering a Better Environment

37

37

## Secondary Treatment Alternative 2




### Integrated Fixed-film Activated Sludge (IFAS) Anaerobic/Anoxic/Aerobic Configuration

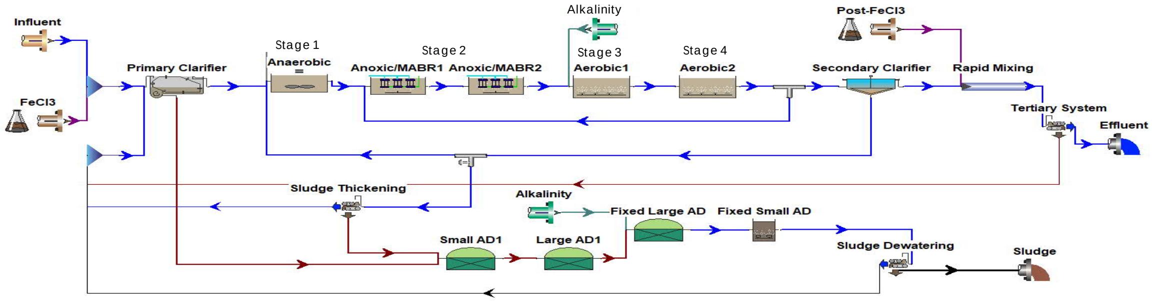
- Can be implemented in the nitrification tanks
- Requires more ferric chloride addition than Alternative 1
- Requires more aeration capacity
- Operates at similar MLSS concentration as Alternative 1
- Requires internal screening
- Proven technology used in industrial/municipal WWTP

WRIGHT-PIERCE
Engineering a Better Environment

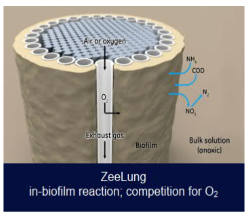
38

38

## Secondary Treatment Alternative 3




Membrane Aerated Biofilm (MABR) Anaerobic/Anoxic/Aerobic Configuration



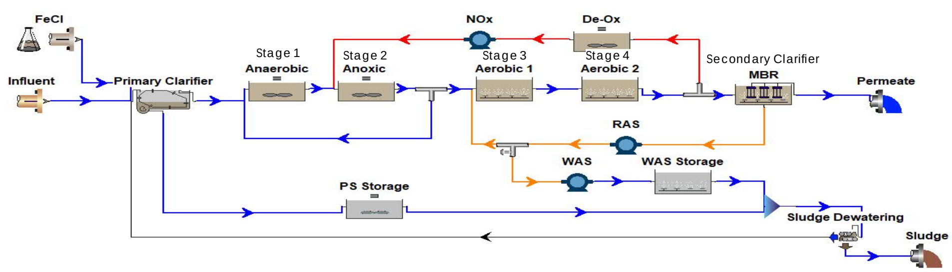

- Can be implemented in the nitrification tanks
- Requires more aeration capacity
- Efficient oxygen transfer
- Operates at much higher MLSS concentration than Alternative 1
- it requires additional secondary clarifier
- New technology with limited experience

WRIGHT-PIERCE
Engineering a Better Environment

39

39

## Secondary Treatment Alternative 4




Membrane Bio-Reactors (MBR) Anaerobic/Anoxic/Aerobic Configuration

- Can be implemented in the nitrification tanks
- Membranes can be installed in the secondary clarifiers
- Requires bigger aeration capacity
- Requires more mixed liquor recirculation
- Highest operational cost
- Proven technology used in industrial/municipal WWTP (FL, CA, GA, etc.)
- Mostly used in wastewater reuse applications

WRIGHT-PIERCE
Engineering a Better Environment

40

40

## Secondary Treatment Alterantives Summary

- Existing Unused Settling Tanks
  - Viable structures, minor rehab work req'd
  - Extra volume for conventional BNR
  - Sufficient capacity for future flows and loads
- Technology Assisted Processes
  - All can be retrofitted into existing Aeration Tanks
  - "Tight squeeze" – not a lot of extra capacity achieved
  - MBR – not recommended due to operational costs
  - MABR – viable but still in initial development stage
  - IFAS – viable, well developed process
- Future Considerations
  - IFAS could be implemented in combination with unused settling tanks to achieve additional capacity of nutrient removal beyond current project requirements.

WRIGHT-PIERCE Engineering a Better Environment

41

41

## Secondary Treatment Alternative Comparison

### Alternative 1: Activated Sludge

- Can achieve nutrient goals and capacity requirements
- Will develop a better settling MLSS than current process
- Requires additional volume (settling tanks) for anaerobic and anoxic zones
- Can be retrofitted with IFAS in the future for additional capacity of lower TN levels (if needed)

### Alternative 2 : Integrated Fixed-film Activated Sludge (IFAS)

- Can achieve nutrient goals and capacity requirements
- Can be implemented in the nitrification tanks,
- More complicated process to operate
- Slightly higher operating costs than the conventional activated sludge process
- Higher capital cost – approx. $2.5 to $3.5M higher than conventional

WRIGHT-PIERCE Engineering a Better Environment

42

42

## Aeration System Comparison

### Mechanical Surface Aerators

- Less energy efficient
- Lower DO control for Bio-P process

### Fine Bubble Diffusers

- Mixing and aeration cannot be separated
- Difficult low DO control for Bio-P process
- Reduced oxygen transfer in shallow tanks – not recommended if SWD less than 15 feet

### Hyperboloid Aerators/Mixers

- Decouples mixing from aeration
- Provides an excellent DO control – Variable Frequency Drive (VFD)
- Similar oxygen transfer to fine bubble (at 15 ft. SWD)
- Easy to implement in existing platforms

WRIGHT-PIERCE
Engineering a Better Environment

43

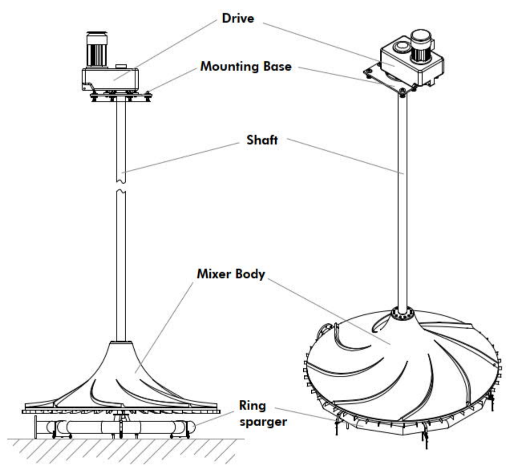
43

## Aeration Upgrade

- Mixer/Aerators
- Blowers
- Aeration Piping

### Mixer/Aerators – Technology Overview

- Non clogging Hyperboloid body
  - Integrated transport fins
  - Stainless steel shear ribs
- Vertical shaft with motor and mounting base
- Air sparge ring connected to air supply



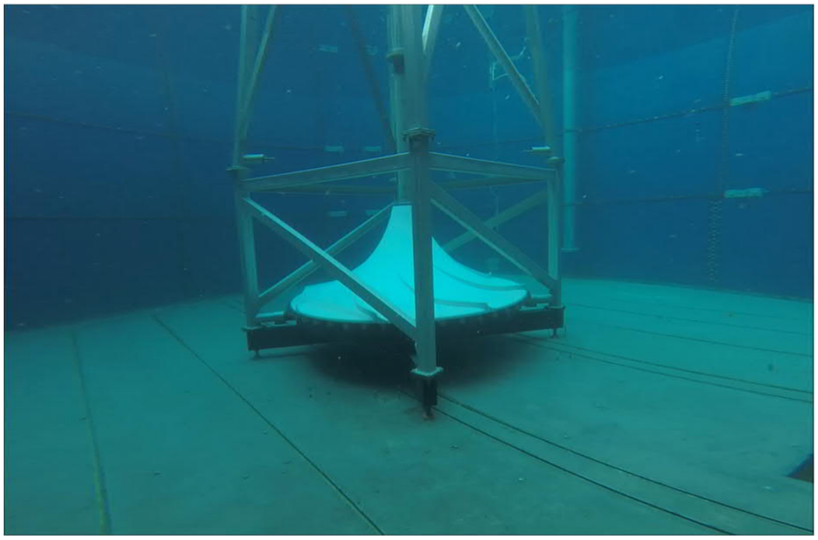

WRIGHT-PIERCE
Engineering a Better Environment

44

44

## Aeration Upgrade

Mixer/Aerators – Technology Overview



Wright-Pierce Engineering a Better Environment

45

45

## Tertiary Treatment Alternatives

Alternative 1 : Ballasted Flocculation/Clarification

Alternative 2 : Cloth Filtration

Alternative 3 : Reactive Media Filtration

Wright-Pierce Engineering a Better Environment

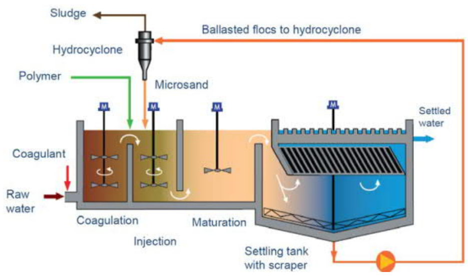
46

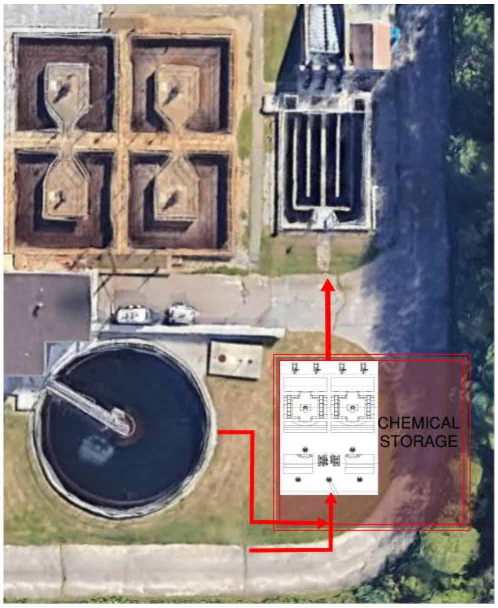
46

## Tertiary Treatment Alternative 1

### Ballasted Flocculation/Clarification

- High-rate clarification that uses micro-sand
- Requires coagulant (ferric chloride), polymer and micro-sand
- Low hydraulic losses – can fit within 3 ft. HGL
- Continuous discharge of chemical sludge




WRIGHT-PIERCE
Engineering a Better Environment

47

47

## Large Ballasted Flocculation Installation

WRIGHT-PIERCE
Engineering a Better Environment

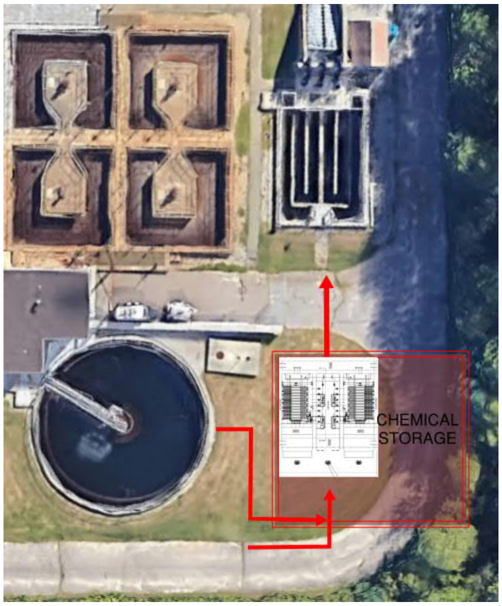
48

48

## Tertiary Treatment Alternative 2

### Cloth Filtration

- Requires rapid mixing and flocculation tank
- Requires coagulant (ferric chloride), but no polymer
- Moderate hydraulic losses – probably can fit within 3 ft. HGL
- Periodic backwashing of chemical sludge




WRIGHT-PIERCE
Engineering a Better Environment

49

49

## Disk Filter Installation

WRIGHT-PIERCE
Engineering a Better Environment

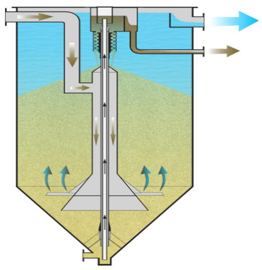
50

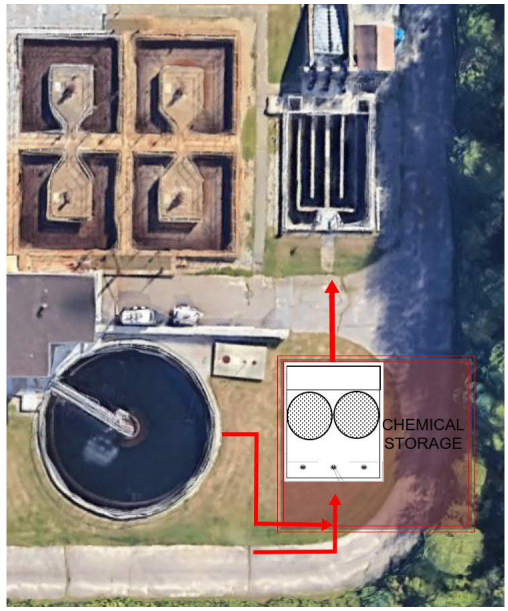
50

# Tertiary Treatment Alternative 3

## Reactive Media Filtration

- Requires rapid mixing and flocculation tank
- Requires coagulant (ferric chloride)
- High hydraulic losses – new pump station required
- Continuous backwashing of chemical sludge



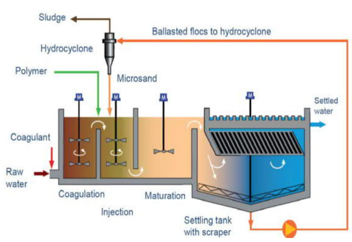


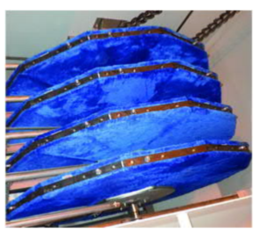

WRIGHT-PIERCE
Engineering a Better Environment

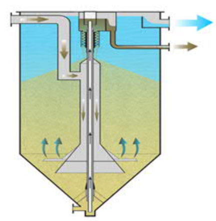
51

51

# Tertiary System Comparison





### Ballasted Flocculation
- Can achieve 0.1 mg/l TP effluent
- Lowest head loss alternative
- Highest chemical demand
- Most complicated process
- Smallest footprint
- Doesn't mind solids carryover from activated sludge process

### Cloth Filtration
- Has been shown to achieve 0.1 mg/l TP effluent
- Gravity flow-through possible without new pump station
- Minimum solids carryover desired
- Medium chemical demand
- Larger Footprint
- Simple process

### Reactive Media Filter
- Can achieve 0.1 mg/l TP effluent
- Simple Process
- Doesn't like solids carryover
- High hydraulic requirements – will require new pump station
- Low chemical demand

WRIGHT-PIERCE
Engineering a Better Environment

52

52

## Chlorine Contact Tanks (CCT)

- Two Units, each approximately 32,000 gallons
  - HRT: 36 min @ 2.5 MGD
  - HRT: 30 min @ 3.1 mgd
  - HRT: 18 min @ 5.0 mgd
- State will require 30-minute Hydraulic Retention Time (HRT)

> When evaluating whether an expansion of contact tank volume is required, it is permissible to "grandfather" an existing chlorine contact chamber, providing less than 30 minutes of contact time at peak flow, if historical plant data justifies sufficient, reliable disinfection at lower contact times. If increased flow is anticipated, field testing should be performed to demonstrate how the existing chlorine contact tank will permit reliable disinfection at the expected peak flow.

- Structure is in decent shape

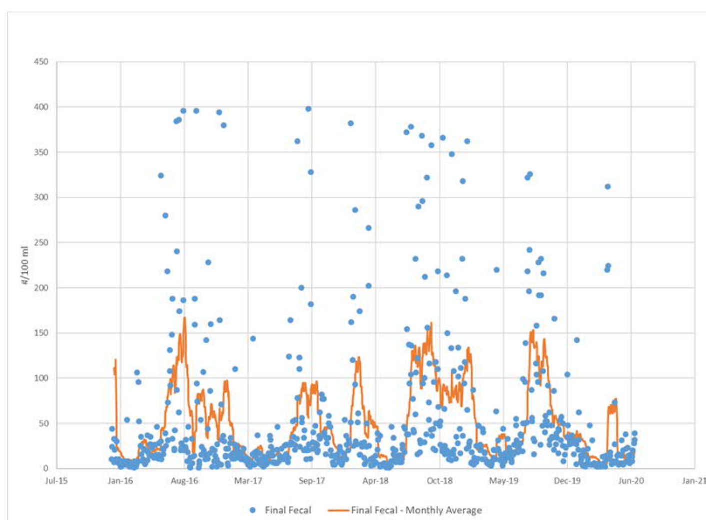
WRIGHT-PIERCE
Engineering a Better Environment

53

53

## Current CCT Performance

- Chlorine Dose
  - Ave: 2.11 mg/l
  - Max: 5.7 mg/l
- Good Performance
- Low effluent TSS helps
- Effluent TSS will be lower in future with Tertiary system




WRIGHT-PIERCE
Engineering a Better Environment

54

54

# THANK YOU

WRIGHT-PIERCE
Engineering a Better Environment



55

# C

WRIGHT-PIERCE
Engineering a Better Environment

**MEMORANDUM**

| | | | |
|---|---|---|---|
| **TO:** | Doug Hankins, Project Manager | **DATE:** | 11/30/2020 |
| **FROM:** | Cathy Michaud, LEED AP, AIA | **PROJECT NO.:** | 20395A |
| **SUBJECT:** | Rockland Wastewater Treatment Facility, Rockland, MA<br>Architectural Assessment<br>Recommended Upgrade Improvements | | |

## General Description

The Rockland Wastewater Treatment Facility site consists of multiple buildings and structures required to treat wastewater for the community of Rockland, MA. The plant was originally constructed in the 1960's then added to in 1977. The administrative building was then again upgraded in 2000.

Potential new structures include Influent Pump Station, Screening and Grit Removal, Tertiary Treatment, Chemical Storage and Maintenance Garage. Additional upgrades and equipment replacement are also planned within the existing structures. Architectural upgrades will include replacement of failed architectural items such as roofs, windows, doors and finishes along with modifications and repairs necessary to complete the process upgrades.

The construction types of the buildings vary and are described in detail below.

## General Comments

Maintenance at the site has mainly been limited to the major upgrade projects and because of that, condition of the buildings declines greatly with age. Generally, the buildings constructed in the 1964, 1977 projects are in fair condition. The 2000 addition to the administrative building is good condition with the exception of leaks in the roof and a few minor issues.

All of the caulking in the exterior walls has become brittle and failed. All caulking should be removed and reapplied. The roofs on the buildings around the administrative building are in fair condition. The windows, doors and hardware on the all buildings aside from the addition to the administrative building have reached their life expectancy and are in poor condition and should be removed and replaced.

## Governing Codes

Currently the governing building code in Massachusetts is the 8$^{th}$ Edition Base Code. This code includes:

- 2015 International Building Code as Amended
- 2015 International Existing Building Code as Amended
- 2015 International Energy Conservation Code as Amended

Many of the buildings/spaces at the Rockland Wastewater Treatment Facility are normally unoccupied spaces and designed solely for housing equipment necessary for the treatment of wastewater. As unoccupied spaces, the principals of the Uniform State Plumbing Code as listed in 248 CMR 10.02 do not apply and plumbing fixtures are not required in these spaces. 521 CMR – MA accessibility regulations also do not apply. Daily workplace activities take place in the Operations Area of the Administrative Building. Any revisions to this area will meet the plumbing and accessibility regulations.

**Existing Building Code Implications**

Work in existing buildings is governed by the Existing Building Code. The existing building code classifies work in existing buildings in 6 categories; Repairs, Alteration – Level 1, Alteration – Level 2, Alteration – Level 3, Change of Occupancy and Additions. Following is a summary of how these classifications are defined and basic implications of each classification to the project:

Repairs: Fixing or replacing damaged materials. Replacement materials must comply with the building code.

Alteration – Level 1: Replacement of existing materials and equipment with new that serves the same purpose. New materials and equipment must comply with the building and energy codes.

Alteration – Level 2: Reconfiguration of space (where the Work Area is under 50%), addition/elimination of doors and windows, extension of existing systems or installing additional equipment. Modifications must comply with the building, energy and accessibility codes and cannot worsen means of egress. Other items required include:

- Providing automatic sprinkler systems where required by the building code for new buildings, including in windowless stories greater than 1500 sf.
- Providing guards at openings in work areas.

Alteration – Level 3: Where the Work Area is greater than 50%. Work Area is defined as the portion of the building where space is reconfigured. If other sections of the Existing Building Code requires reconfiguration of space, this reconfiguration does not count towards the Work Area. Modifications must comply with requirements for Level 2 Alterations plus additional items including:

- Enclosing stairs.
- Enclosing shafts and floor openings.
- Providing the number of exits required per current code.
- Providing doors that swing in the direction of travel for areas with an occupant load over 50.

Change of Use: Where the use or occupancy classification of a building is changed modifications must comply with requirements for Level 2 and 3 Alterations. If the new use is required to be accessible, the building must also be made accessible.

Generally, the energy code does not require updating existing buildings to current energy codes. New work and items must meet current energy codes if possible. If a building currently has a vestibule, the vestibule must remain or a new one provided. If any space changes from an unconditioned space to a conditioned space, the envelope of the space must be updated to meet the envelop requirements of the energy code.

## ADMINISTRATIVE BUILDING

### General Description

The original 1964 building was roughly 116” x 32” designed by Metcalf and Eddy Inc. Metcalf and Eddy added an 80” x 48” wing in 1977 on the south end of the existing building. R.AD. Jones Architect designed the 2000 addition which added a new lab, conference, room, archives room and men’s toilet/ locker space. Little was done to the existing building during this upgrade. The boiler room and the storage room were both locked and not inspected.

### Existing Materials/Conditions/Modifications/Repairs

Exterior:

Foundation The foundation consists of concrete frost walls and a slab on grade.

Structure The structural system consists of load bearing CMU walls steel roof joists and metal roof deck.

| | |
|---|---|
| Walls | The exterior walls are precast concrete with concrete panels on the 1964, 1977 portion of the building. The 2000’s addition is Exterior insulation finish system and is in good shape |
| Doors | Doors on the 2000 addition are in good shape. Doors on the 1967, 1977 portion of the building are in fair condition. Some have staining and could be cleaned. |
| Hardware | The door hardware mostly is in fair condition. The lock should be replaced on the door that enters the shop area. |
| Windows | The windows on the addition are still in good condition. All windows from the existing 1964, 1977 building should be replaced. |
| Roofing | Parts on the existing EPDM have been patched as well as the new roof. Leaks continue despite patching. The ballasted roof should be removed and replaced. The EPDM roof is still under warranty and should continue to be maintaining to address leaks. Skylights should be removed and replaced. |
| Edge Trim | The edge trim is a metal fascia gravel stop. Trim on addition and existing are in fair shape. |

Interior:

| | |
|---|---|
| Floors | Vinyl tile in fair condition. Cracks where addition and existing meet. There is also cracking along the windows in the new break room. The vinyl base is hovering along floor in the corner of the new corridor near the men’s bathroom. Office areas have carpeting that appears to be original and has reached its life expectancy and should be replaced. |
| Walls | The interior walls are a mixture of painted CMU, glazed face CMU, tile and painted GWB. Most is in fair condition with scuff marks along new corridor near reception. There is a crack in the CMU in the electrical room. Some areas of infill are unfinished and should be painted. Several offices/conference rooms have wood paneling. The wood paneling is in fair condition and could be replaced for aesthetic reasons. |
| Ceilings | Acoustical tile which is in fair condition. There is evidence of staining in new corridor near the archives room. There is a missing tile in the link to the lab next to the electrical room as well as the |

| | |
|---|---|
| | women's bathroom, storage space between the office and shop area and open space across from the electrical room. |
| Doors | The doors are hollow metal doors in hollow metal frames and are in fair condition. Doors in the lower level are corroded and should be replaced. |
| OH door | The rollup door to the shop area has corrosion on the tracks and should be replaced. |
| Hardware | The door hardware from 1964, 1977 is in mostly fair condition. The door closer to the shop area is corroded and should be replaced. |
| Lab | The lab is part of the 2000 upgrade and is good condition. |
| Bathrooms | Men's bathroom was upgraded in 2000 and is in good condition. Women's bathroom is part of the 1977 upgrade and is missing tile. |
| Kitchenette | The kitchenette has wood cabinets and plastic laminate countertops. Cabinets are noticeably dirty and worn in areas. All surfaces should be cleaned. The backsplash of the laminate counter has delaminated and should be replaced. The wood shelf nearest the door is overloaded and sags in the middle, additional supports should be added to adequately support the shelf. |

## EXISTING 1964 & 1977 BUILDINGS

### General Description

Surrounding the administrative building are 4 structures built in 1964 and 1977. The structures are built from concrete with precast concrete tee beams. The exterior has precast concrete panels adhered to the concrete wall for an added decorative element. The following buildings are:

#### 1964 Construction

- Digester Building
- Headworks/Influent Building

#### 1977 Construction

- Electrical Building

- Stair Building

**1977 Upgrades/ Additions**

- Digester Building

**Existing Materials/Conditions/Modifications/Repairs**

Exterior:

| | |
|---|---|
| Foundation | The foundation consists of concrete frost walls and a slab on grade. Painted coatings are failing and should be removed, cleaned or refinished as required. Refer to the structural memo for specifics on the condition of the concrete foundations. |
| Structure | The structural system consists of concrete columns and tees to support the roof with CMU walls. |
| Walls | The exterior walls *are built of* precast concrete with concrete panels. Concrete is fair but stucco panels are falling apart on parts of the buildings. Consider removing failed stucco. Sealant is failing and should be cleaned and reapplied. These buildings lack Insulation. |
| Windows | All windows are in fair/poor condition and should be replaced. |
| Louvers | All louvers should be replaced. |
| Roofing | All roofs are EPDM with ballasted gravel finish. Roofs are in fair condition. Roofs have exceeded their life expectancy and should be replaced. |
| Edge Trim | The edge trim is a metal fascia gravel stop. Trim is in fair shape. |

Interior:

| | |
|---|---|
| Floors | The floors are unfinished concrete and in fair condition. Areas have a lot of staining. All of the concrete floors should be pressure washed to provide a good clean surface as part of the upgrade. |
| Walls | The interior walls are painted CMU. Due to the moist atmosphere in the space and the apparent roof leak mentioned above, much of the paint finish has failed. The walls should be prepped and repainted. |

| | |
|---|---|
| Ceilings | The ceilings are concrete and are in fair condition. Surfaces cleaned and repainted. |
| Doors | Doors are in fair/poor condition and have reached their life expectancy. All doors should be replaced. |
| Hardware | The door hardware on all doors should be replaced. |
| Stairs | Stairs are made of steel and are in fair condition. Concrete stairs have missing stair nosing and degraded concrete and should be repaired. |

**Space Modifications/Additions**

Note that the existing building is assumed to have been designed in accordance with the current codes at the time of the original construction. Any significant renovations or changes to the use or the spaces will trigger the need to meet the new code. The level of compliance and work required to meet the current code will need to be evaluated pending the level of proposed modifications to this building.

**Code Concerns**

- The basement chemical room was likely designed to be code complaint at the time of construction. Modifications to this area could trigger additional modification to comply with current codes.
- Additional life safety codes such as fire detection and alarm should be evaluated.

## DECHLORINATION SHED

### General Description

This small wooden shed houses chemicals on the south end of the WWTF. This shed was meant to be a temporary solution but ended up being long term. This shed is in rough shape and should be replaced with a permeant structure.

## NEW STRUCTIRES

### General Description

Potential new structures include Influent Pump Station, Screening and Grit Removal, Tertiary Treatment, Chemical Storage and Maintenance Garage. Proposed structures will

Rockland Wastewater Treatment Facility, Rockland, MA
Architectural Assessment
Recommended Upgrade Improvements

be located within the constraints of the existing site. Building separations shall meet code required separation distances proposed materials are as follow:

Exterior:

| | |
|---|---|
| Walls | Insulated masonry bearing walls with masonry veneer |
| Roofing | Concrete roof deck with EPDM roofing |
| Windows | Fixed aluminum storefront windows |
| Louvers | Kynar finished aluminum louvers |
| Doors | Painted hollow metal insulated doors |
| | Prefinished Roll-up doors |
| Access | Aluminum grated stairs |

Interior:

| | |
|---|---|
| Walls | Painted masonry walls |
| Stairs | Aluminum grated stairs |
| Floors | Exposed concrete floors |

**WRIGHT-PIERCE**
Engineering a Better Environment

# MEMORANDUM

| | | | |
|---|---|---|---|
| **TO:** | Doug Hankins, Project Manager | **DATE:** | 12/17/2020 |
| **FROM:** | Steve LaPrise P.E. | **PROJECT NO.:** | 20365A |
| **SUBJECT:** | Rockland Wastewater Treatment Facility, Rockland, MA<br>Electrical Assessment of the Existing Electrical Systems and Areas<br>Recommended Upgrade Improvements | | |

This memo represents assessments of the existing Electrical Switchgear, Motor Control Centers, Automatic Transfer Switch, existing conditions, and the existing Generator at the Rockland WWTF. A site visit took place on November 10th, 2020 with other design disciplines.

**EXISTING CONDITIONS:**

1. **Service:**
   The existing service is provided by National Grid. The medium voltage primary service is located to the right side of the plant entrance and feeds power to a pad mounted transformer located in the front of the Electrical Building. Transformer size was not identified on the unit. The Transformer Secondary Service is rated 2000 amps at 480/277 VAC, 3 phase, 4 wire, and connects to the Main switchgear located in a NEMA 3R enclosure located not far from the transformer.

2. **Switchgear**
   The Main Switchgear is rated for 2000 amps with Main breaker set to trip at 2000 amps. The Main Switchgear is manufactured by General Electric and was installed at the plant during a 1980 upgrade. The Switchgear and internal components are nearing the end of its useful operational life and should be replaced as part of the upgrade. Replacement parts older than 30 years are hard to find. The Switchgear includes the main breaker, Automatic Transfer switch (ATS) and seven circuit breakers, which power MCC's serving the various areas of the plant. Six breakers are on the load side of the ATS. One breaker is dedicated to MCC-4A and connects on the normal bus ahead of the ATS. The switchgear internally and externally is showing signs of rust.

The distribution breakers feed power to the following MCC's and locations listed below.

- MCC-1 – Influent Pump Station
- MCC-2 – Administration Building
- MCC-3A/3 –Digester Building
- MCC-4 Administration Building Addition
- MCC-4A Adminstration Building Addition (Belt filter Press Electrical Room)
- MCC-5 Electrical Building
- MCC-6 Electrical Building

3. **Generator System**

The existing generator consists of a diesel driven 480/277VAC, 500KW unit that provides back-up power to most of the plant. The unit was installed as part of the 1980 upgrade and is located within the Electrical Building. The Automatic transfer switch (ATS) monitors the incoming 480Volt 3 phase power on a transformer and calls for the generator to start upon loss of power. Once the generator reaches operating voltage, the transfer switch transfers to the generator source providing back-up power to the plant. Upon reinstatement of the normal 480VAC power, the transfer switch cycles back to the normal source, and the generator cools down and stops. Presently, the existing generator does not provide power to MCC-4A as part of the building addition. Per operator personnel the generator is adequately sized to provide backup power to the plant. The generator is serviced by Highland Power Company (508)-941-6500.

4. **Influent Pump Station:**

Based on the site visit walk through, the following items were noted.

- The screening area conduit, lighting and associated local control stations is in poor condition and replacement is required.
- Gas detection was present as required per NFPA 820.
- The dry pit submersible pumps located on the lower level and are fed from the MCC-1 above. This area is considered Class 1 Division 2 per NFPA 820. As there are holes in the floor of the top level for the pump feeders, the lower level hazardous area makes the top floor area hazardous as well per NFPA 820. The existing electrical equipment located in on all levels are not rated for the hazardous classification. If the space is ventilated six air changes per hour or more, the space would be rated general purpose. Ventilation or isolation from the lower level should be considered for this space as part of the upgrade especially if VFDs, MCCs, and control panels, and other electrical equipment are planned for this space.
- The Existing MCC-1 is manufactured by Unitrol and is original to the plant and has been upgraded over the years with starters, and feeder breakers. Most items in these sections is locked out and out of service. Additional sections were added in the 1980s manufactured by Sylvania that have starters on each side in a condensed footprint. Due to its age parts for the MCC are hard to come by, replacement is recommended.
- Existing VFDs and Nema 4X control panels look to be in fair condition but should be relocated or replaced as part of the upgrade
- There is an existing control panel with a chart recorder that does not appear to be in use and should be removed with any upgrades.
- Pager system is not in operation, operator would like it replaced with any upgrades.

5. **<u>Adminstration Building and Administration Building Addition:</u>**

Based on the site visit walk through, the following items were noted.

- The Admin building addition looked in good condition with new lighting and devices throughout.
- The original portion of the Admin building looked to be in fair condition, however new lighting and wiring devices should be considered due to the age of the facility.
- The Fire Alarm system is fairly new and installed as part of the building addition upgrade and serves only the Admin Building and addition, with a local annunciator and Master Control pull station locate outside near the entrance.
- The main electrical room is fairly congested, with VFDs and other control panels mounted throughout.
- The control panel in flush mounted in the hallway with many chart recorders has a closet cabinet for termination wiring and console located within the electrical room. Consideration should be given to a dedicated space for this equipment as part of the upgrade.
- MCC-2 is the Main MCC in the building and is a Unitrol MCC with two section added by Sylvania. It is powered by the Main Switchgear.
- The lower level electrical room that houses MCC-2 is very crowded and is not air conditioned.
- There is a VFD located atop MCC-2 and is not accessible without a ladder. This installation is a code violation of article 110 and 430 of the NEC.
- There are also MCC-4A and 4 located in an electrical room on the dewatering level. These MCCs are a back to back installation and manufacturer by Sylvania. MCC-4A and 4 are also powered from the Main Switchgear. MCC-4A however is not connected to the standby

power source. Thus, there are 3 feeders to this building. As each building should have one Main disconnect and feeder by code, this installation is a code violation unless it is considered an exception and approved by the authority having jurisdiction per article 225 of the National Electrical Code.

- The control panels located on the upper dewatering level were in poor condition, corroded, and covered with sludge and dirt. These panels should be replaced and located into a clean environment.
- The electrical room that houses MCC-4 and 4A was in good condition. No air conditioning was present within the space.
- The Lime chemical system conduits and devices were covered with Lime and appeared in poor condition with signs of corrosion on motorized equipment and Unistrut. Two large control panels on this level appear to be unused and could be removed with any upgrades.
- The compressor located in the Lime chemical area was also severely corroded and should be replaced.
- Compressors and other motor operated equipment located throughout the facility appeared to be in fair condition, though it was not clear if these pumps handled dewatering systems. If so, these areas could be rated Class 1 Division 2 per NFPA 820. Consideration should be given to ventilation in these spaces.
- Lighting in the lower levels were spotty in areas, and lighting should be replaced with any upgrades.
- The Sodium Hypo-chloride Chemical area conduits and equipment appeared in fair condition.

6. **Electrical Building:**

Based on the site visit walk through, the following items were noted.

- The lower pump gallery level of the Electrical Building is considered a hazardous area. This level and extending gallery contains return and waster sludge piping and should be rated as a Class 1, Division 2, classified space per NFPA 820. The VFDs and other existing electrical equipment located in the basement level are not rated for the hazardous classification. If the space is ventilated six air changes per hour or more, the space would be rated general purpose. Ventilation should be considered for this space as part of the upgrade especially if VFD's, pumps, control panels, and other electrical equipment are planned for this space. VFDs are recommended to be installed in a clean environment with air conditioning and or exhaust fans to maintain operational temperature.
- There is a Foxboro control panel that appears to be in use on the lower level.
- MCC-5 and MCC-6 are back to back type MCCs. These MCCs have reduced footprint due to Manufacture Sylvania design. Other MCCs would not fit within the same footprint. Many buckets were identified as being out of service.
- MCC-5 and 6 are fed from two separate feeders. This installation is a code violation unless it is considered an exception and approved by the authority having jurisdiction per article 225 of the National Electrical Code.
- The existing electrical room was overcrowded and all wall space was taken up with control panels and VFDs. Presently the room is not air conditioned.
- There is an old Foxboro panel located in the electrical room that does not appear to be in use.
- The existing lighting on lower levels was inadequate and some lights did not operate within the pipe gallery on lower level. Replacement is recommended.
- Conduits appear to be in fair condition; however, water stains were present on exterior walls, likely caused from water in existing conduits.
- Presently there is no fire alarm devices within the facility.

- Generator room lighting and conduits were in fair condition. Generator is over 30 years old and replacement is recommended.

7. **<u>Digester Building:</u>**

Based on the site visit walk through, the following items were noted.

- Conduit and lighting were in fair condition.
- The equipment located on the roof near the flare appear in poor condition and should be replaced.
- Sump pump control panel and pumps were very corroded and should be replaced.
- Gas detection was not readily apparent in process gas areas and required per NFPA 820.
- The lower level electrical/boiler area near the back entrance was very congested with the MCC-3 back against a wall and MCC-3A located on the stairway. MCC-3A manufactured by Sylvania and MCC-3 by Unitrol. A disconnect mounted on the side of MCC-3A does not appear to have working clearance per NEC article 110.
- The boilers burn off the digester produced gas and are used to as a heat source for digestion, Excess Gas is burnt off at the flare.
- Fire alarms devices were not present in any areas.

8. **<u>Aeration tank and other field conditions:</u>**

Based on the site visit walk through, the following items were noted.

- Conduit and lighting were in fair to poor condition in the Aeration tank.
- Site lighting operation in spotty and not all site lights operate. Some poles are crooked in the clarifier tank areas.
- PVC conduit along the sides of tank walls and within other field areas do not have any expansion fittings and will buckle and crack over time.
- Several junction boxes were corroded and taped shut with black electrical tape.

- Control stations near clarifiers were in fair to poor condition and should be replaced with future upgrades.
- Conduits run along the pavement in the Effluent Pump Area pose a hazard and should be relocated.
- Primary Clarifier covers over chain pulleys were in fair condition, conduits for theses pulleys were corroded and should be replaced with any upgrades.
- Nema 3R enclosure housing the switchgear is showing signs of rust on outside.
- The Grit handling tank, and septage receiving tank have not been used or operational for some time. Existing conduit and wire and any unused equipment should be removed, and below grade conduits capped in place.

## 9. Existing Code Violation

As mentioned, we observed code violations in the following buildings:

- Influent Pump Station
- Electrical Building
- Digester Building
- Main Building and addition.

The plant currently has a fire alarm system at the Main Building but does not have a fire alarm system at the other remote buildings. A facility wide fire alarm system should be installed as part of this upgrade, with an alarm beacon at each building, plus an annunciator and alarm beacon installed at the Admin Building.

Location of the Effluent pump disconnects were not apparent near the effluent structure. This could be a code violation, unless an exception is allowed per the local authority having jurisdiction.

Corroded conduit and exposed wire pose hazards to operator staff. These corroded conduits should be repaired and or replaced in the near term.

## 10. Single point of Failure

It is recommended in TR-16, that Wastewater Treatment Facilities avoid having a single point of electrical failure. Currently as the existing switchgear is older, one failure of this equipment could cause issues with electrical power for the plant. For instance, if the distribution buss or the automatic transfer switch were to fail, the WWTF would be offline, and part replacements may be difficult. Other issues such as older aerator starters at MCC-5 and 6, could cause issues with maintaining aeration in the near term if a starter were to fail.

The age of the Influent Pump Station MCC is concerning, as a failure of this MCC could cause issues with powering the influent pumps. Though the VFDs are newer, an upgrade should make replacement of this MCC a priority for power distribution at the pump station.

There were also a lot of duct banks and conduits that may be compromised due to water in the conduits, over time these ducts will short circuit as the wire installation breaks down, thus causing issues with the feeders from the switchgear to the remote building MCC's.

For the upgrade we recommend replacement of the main switchgear and the respective MCCs so that all new installations are backed by a warranty, and replacement parts are readily available. We also recommend that the new Automatic Transfer switch (ATS) has a manual bypass option, so that the ATS can be replaced or repaired while still maintaining plant electrical operation. It is also recommended that separate MCC sections power separate aeration tank trains and respective blowers so that there is some built in diversity for maintenance and operation. Any new upgrades should include new duct banks and new feeders to the MCC's with manholes with drainage so that water does not collect over time.

**IMPROVEMENT OPTIONS**

**New Service and Transformer:**

A new service 480/277 VAC 3 phase, 4 wire service and switchgear should be installed in a new building or structure on the facility campus. Getting the new switchgear out of the elements and into a clean environment would be ideal. The existing service could be rerouted with a new service transformer located just outside the new building. A new Emergency Standby generator could also be located near the new building. Possible locations for the new electrical gear could be the Blower Building, or an auxiliary garage.

Having the new equipment in a new location would allow the old equipment to remain operational until new systems are in place. We are expecting the new loads to be approximately 10% more that the existing loads. Thus a 2000 amp secondary service with a 1500KVA transformer would likely be required.

**Switchgear/MCC's**

The New Switchgear would consist of 5 sections, that would house a new 2000 main breaker, automatic transfer switch, generator breaker, and up to 7 distribution breakers for plant power distribution. The Switchboard would be installed at grade level within a new building nearest the point of the incoming below grade service conduits. The new switchgear would have 5 dedicated distribution breakers plus 2 spares, to feed the following new Motor Control Centers and Power Panels as part of the Upgrade.

- MCC-1 – Influent Pump Station
- MBDP-2 (MCC-2,4,4A) – Admin Building Distribution Panel
- MCC-3A/3 –Digester Building
- MCC-5/6 Electrical Building

- Blower Building, Garage or Auxiliary Structure MDP

Each new MCC or distribution panel would contain surge arresters, power metering, and the respective motor starters as well as VFD's needed for the plant processes and HVAC equipment in the area. Each MCC shall also have a feeder breaker to power a step down transformer and lighting panels for any low voltage power circuits needed as part of the upgrade.

**Generator Options:**

As the existing standby generator is rated 500 KW and provides adequate back-up, a new generator shall be close in size and voltage rating. An accurate analysis would have to be conducted during preliminary design based on the proposed new process equipment. The generator could be a diesel driven unit and will be located just outside a new building in a level 2 sound attenuated enclosure with a diesel belly tank or day tank.

**Influent Pump Station Improvements**

New conduit and wire, lighting, and MCC should be installed in the space to accommodate the upgrade in the existing building or a proposed building. Necessary OEM panels, and VFDs would also be installed to power the new equipment.

**Admin Building improvements**

New conduit and wire, lighting, and MCC should be installed in the in areas deemed necessary per code as part of the upgrade. A new distribution panel and location shall be determined during the preliminary engineering phase so there is one designated feeder and main disconnect. New Gallery pumps and respective VFDs should be installed in environmentally friendly areas rather than in the lower gallery areas.

**Electrical Building Improvements**

New conduit and wire, lighting, and MCCs should be installed in the in areas where the former generator resided for construction sequencing. An MCC5/6 location shall be determined during the preliminary engineering phase. New pumps, aeration OEM equipment, and respective VFDs should be installed in environmentally friendly areas or in the existing or new electrical room.

**Digester Building Improvements**

New conduit and wire, lighting, should be installed in the in areas deemed necessary per code or per client request as part of the upgrade. Roof top electrical devices should be replaced due to corrosion as part of this upgrade. For areas that are Class 1 Division 1 or 2, any installation shall adhere to the NEC requirements.

**Site Electrical Improvements**

As part of the upgrade, new site lighting should be installed throughout the facility on the roadways and main entrance. New site lighting conduits can be installed in the new duct bank planned for distribution. New site lighting should also be installed in the aeration tanks and the Primary Clarifiers. New technologies such as LED shall be examined to minimize maintenance and energy costs.

**Power and lighting -General**

Each existing building can be retrofitted with new energy efficient lighting for each space. New technologies such as LED shall be examined to minimize maintenance and energy costs. Available power company energy rebates could also be reviewed during design. New process area maintenance receptacles shall also be installed for each building and near process equipment. Each device shall meet the area classifications as required per the NFPA 820.

## New Fire Alarm System

A new Fire Alarm system should be installed throughout the entire plant. The new system shall be an addressable system with main control panel located within the Main Building with a main annunciator at the building front entrance. Other buildings shall be connected to the main panel with use of a fiber optic network as approved by the local authority having jurisdiction. All fire alarm system designs and installations must meet NFPA72 and all local code requirements. New devices shall also be rated for the area classification as established by the latest NFPA-820.

## Routing of new Duct Banks

New Duct Banks shall be installed with the respective feeder circuits for each of the remote buildings from a new designated building that houses the new switchgear. These new duct banks will be routed on the outside roadway around the plant to avoid conflicts with existing duct banks for construction sequencing. Site lighting conduits shall also be installed as necessary. Once the old service and feeder systems are no longer powered, the existing wire will be pulled out of the existing ducts and they shall be abandoned in place or listed as spare. New manholes and hand holes will be installed as needed for the new duct banks for power, signal or control wiring.

**WRIGHT-PIERCE**
Engineering a Better Environment

**MEMORANDUM**

| | | | |
|---|---|---|---|
| **TO:** | Doug Hankins, Project Manager | **DATE:** | 12/18/2020 |
| **FROM:** | Ted Carlman | **PROJECT NO.:** | 20395A |
| **SUBJECT:** | Rockland Wastewater Treatment Facility, Rockland, MA<br>Mechanical Assessment<br>Recommended Upgrade Improvements | | |

## EXECUTIVE SUMMARY

A site visits was conducted at the Rockland, MA Wastewater Treatment Facility on November 10, 2020 in order to perform a facility walk-through and an evaluation of the facility's existing conditions. This report addresses current issues, deficiencies and recommendations regarding HVAC and Plumbing systems.

Documentation:

HVAC, Plumbing, and Fire Protection plans for the WWTP are available.

Governing Codes

- NFPA 820
- 2018 International Mechanical Code
- 2018 International Plumbing Code
- ASHRAE 62.1, Ventilation for Acceptable Indoor Air Quality

## EXISTING CONDITIONS

### General

The majority of the existing HVAC, Plumbing, and Fire Protection systems in WWTP are original to the facility expansion constructed in 1977 except for a portion of the Administrative building that was renovated in 2000. The original 1977 construction documents and 2000 Administrative building construction documents appeared to accurately reflect the building systems. A majority of the systems connected to the main heating system were not operational at the time of the visit. The cause of this may have been due to the shutdown of hot water boiler plant.

### ADMINISTRATION BUILDING

HVAC

**Laboratory:** The laboratory was part of the 2000 renovation of the administrative building. The current HVAC system serving the laboratory consists of a packaged roof top air handling unit

(HVAC-1) providing space conditioning with a gas furnace and direct expansion (DX) cooling coil which uses refrigerant R-22. Two (2) gas fired makeup air handling units (MUA-1&2) and three (3) exhaust air fans (EF-1,2,3) serve the lab hoods. **The equipment is approximately twenty years old, in relatively good condition, but they are relatively inefficient, use refrigerant which is no longer available and at the end of its typical operating life.**

**Administrative Areas:** The administrative area was part of the 2000 renovation of the administrative building. The current HVAC system serving the administrative offices, conference rooms, and corridors consists of two (2) packaged roof top air handling units (HVAC-2&3) providing space conditioning with a gas furnace and direct expansion (DX) cooling coil which uses refrigerant R-22. There is additional fin tube perimeter heating in each of the spaces with an exterior wall. **The units are approximately twenty years old, in relatively good condition, but they are relatively inefficient, use refrigerant which is no longer available and at the end of its typical operating life. The fin tube appeared to be original to the 1977 building, in poor condition and well beyond the end of its useful operating life.**

**Shower/Locker/Toilet Room:** The Shower/Locker/Toilet Rooms were part of the 2000 renovation of the administrative building. The current HVAC system serving the Shower/Locker/Toilet Room also serves the western part of the administrative area, HVAC-2. In addition to the rooftop unit, there is a dedicated exhaust fan serving the Men's Toilet room. The exhaust for the shower/locker room is tied directly to HVAC-2. **The exhaust fan is approximately twenty years old, in fair condition, and is at the end of its typical operating life.**

**Chlorinator/Chlorine Storage Room:** The Chlorinator/Chlorine Storage Room is part of the original 1977 construction of the administrative building. The current HVAC system serving the space consists of two (2) roof mounted exhaust air fans (REF-13&16), two (2) intake air louvers, and two (2) hot water unit heaters (UH-8&9) connected to the central hot water heating system. **The equipment is approximately 43 years old, in poor/not operational condition and well beyond the end of its useful operating life.**

**Truckway Room:** The Truckway is part of the original 1977 construction of the administrative building. The current HVAC system serving the space consists of one (1) hot water unit heaters (UH-10) connected to the central hot water heating system. **The unit is approximately 43 years old, in poor/not operational condition and well beyond the end of its useful operating life.**

**Maintenance Shop:** The current HVAC system serving the space consists of two (2) hot water unit heaters (UH-11&12) connected to the central hot water heating system. **The units are approximately 43 years old, in poor/not operational condition and well beyond the end of their useful operating life. In addition to the unit heaters there are two (2) abandoned air handling units hung from the ceiling.**

**Boiler Room:** The boiler room for the most part is part of the original 1977 construction of the administrative building; however the original boiler was replaced in 2017 as part of an energy upgrade. The boilers and distribution system provide the means of heating for a majority of the WWTP. The two (2) boilers are gas fired Lochinvar FTX500N that inject heat into the primary heating loop via new Bell & Gossett EcoCirc boiler pumps. Each boiler has a 500,000 BTU per hour (BTUh) gross heating capacity and has a 10/1 turndown capability. The boilers, boiler pumps and accessories are in like new condition, but were not operable at the time of the visit due to a leak. The main distribution system is original to the 1977 building that consists of 4 heating zones, each with its own distribution pump and redundant pump. The pumps, piping and accessories are all in poor condition and are well beyond the end of their useful operating life.

**Basement Equipment/Chemical Storage Room:** The Equipment/Chemical Storage Room is part of the original 1977 construction of the administrative building. The current HVAC system serving the space consists of one (1) hot water air handling unit (AHU-8). **The unit is approximately 43 years old, in poor condition and well beyond the end of its useful operating life. The AHU was not operational at the time of the visit, and the system appeared to be covered in the chemical dust being stored in the area.**

**Dewatering Room:** The Dewatering Room is part of the original 1977 construction of the administrative building. The current HVAC system serving the space consists of one (1) hot water air handling unit (AHU-7), two (2) roof mounted exhaust air fans (REF-19&20), and five (5) hot water unit heaters (UH-1,2,3,4&5) connected to the central hot water heating system. **The equipment is approximately 43 years old, in poor condition and well beyond the end of its useful operating life. During the visit the AHU did not appear to be operational.**

**Basement Machine Shop and Blower Rooms:** The Basement Machine Shop and Blower Rooms are part of the original 1977 construction of the administrative building. The current HVAC system serving the space consists of one (1) hot water air handling unit (AHU-6), and one (1) supply air fan (SAF-1). **The equipment is approximately 43 years old, in poor condition and well beyond the end of its useful operating life. During the visit the equipment did not appear to be operational.**

<u>Plumbing</u>

**Laboratory:** Overall the laboratory is in good condition. Laboratory plumbing is old but in good condition. The eyewash stations are cold water only with no flow switch. The fume hoods operate as intended.

**Shower/Locker/Toilet Room:** The lavatory, water closets, and showers are in acceptable condition. The floor drains appeared to be in fair condition. The hot water heater serving the toilet room, locker room, break room, and laboratory is located the janitors closet adjacent to the toilet room. The hot water heater is gas fired with a 75 gallon capacity, 76 MBH heating input and was recently installed in 2019.

**1977 Southern Main Building:** The southern portion of the administrative building is part of the original 1977 construction. The domestic cold and hot water piping, service water piping, sanitary waste piping, and rain leaders are in fair to poor condition. The hot water heater is electric with a 50 gallon capacity, 7875W heating input and is in fair condition. The emergency shower/eyewash stations are cold water only with no flow switch. The toilet room lavatory, water closet, and shower are in fair/poor condition. Two 3" diameter double check valve backflow preventors are located in the basement at the north end of the building; both backflow preventers appear to be in poor/fair condition.

<u>Fire Protection</u>

**General:** Fire protection system appeared to be in fair/good condition depending on the location. The entire system appeared to be installed during the 2000 renovation. **The system is approximately twenty years old, in relatively good condition, but is at the end of its typical operating life.**

## DIGESTION TANKS BUILDING

**General:** The Digestion Tanks Building is part of the 1977 upgrade of the wastewater treatment plant. The current HVAC system consists of two (2) air handling units with steam heating coils (AHU-1&10), and one (1) roof mounted exhaust fan (REF-27) serving each of the building towers. The steam heating for the air handling units is provided by the original Weil-McLain 40 series cast iron steam boiler with 1200 MBH capacity and distribution system. The boiler has duel fuel system with the primary fuel being fuel oil and the secondary fuel being methane. **The air handling units, boiler and distribution system are 43+ years old, in poor/not operational condition and well beyond the end of their operational life.** The building is provided service water via a 2" pipe from the operations building that supply service water hose bibbs. The service water piping, sanitary waste piping, floor drains, sump pumps and rain leaders are in poor condition. The service water hose bibbs do not have integral vacuum breakers.

## NITRIFICATION AND SECONDARY GALLERIES

**General:** The Nitrification and secondary galleries were part of the 1977 upgrade of the wastewater treatment plant. The current HVAC system consists of one (1) air handling unit with a hot water heating coil (AHU-11), one (1) roof/grade mounted exhaust fan (REF-25), two (2) wall hung dehumidifiers, four (5) hot water unit heaters (UH-13,14,15,16,&17), and two (2) hot water cabinet unit heaters (C-17&18). The hot water heating equipment is connected into the main building hot water heating plant. **The air handling equipment and space heating equipment are approximately 43 years old, in poor/not operational condition and well beyond the end of their operational life.** The building is provided service water via a 2" pipe from the operations building that supply service water hose bibbs. The service water piping, sanitary waste piping, floor drains, sump pumps and rain leaders are in poor condition. The service water hose bibbs do not have integral vacuum breakers.

## ELECTRICAL BUILDING

**General:** The electrical building was part of the 1977 upgrade of the wastewater treatment plant. It serves as the plants electrical service and generator backup. The current HVAC system serving the electrical room consists of one (1) roof mounted exhaust fan (REF-25), one (1) inlet air louver & damper, one (1) hot water unit heater (UH-19), and one hot water cabinet unit heater (C-16). The current HVAC system serving the generator room consists of two (2) roof mounted exhaust fans (REF-22&23), two (2) inlet air louvers & dampers, and one (1) hot water unit heater (UH-18). The hot water heating equipment is connected into the main building hot water heating plant. **The equipment is approximately 43 years old, in poor/not operational condition and well beyond the end of their operational life.** The sanitary waste piping, floor drains and rain leaders are in fair condition.

## INFLUENT PUMP STATION

**General:** The Influent Pump Station was part of the 1977 upgrade of the wastewater treatment plant. The current HVAC system serving the building consists of one (1) utility supply fan serving the lower screenings room, one (1) roof mounted exhaust fan (REF-28), and one (1) inlet air louver & damper. **The equipment is approximately 43 years old, in poor/not operational condition and well beyond the end of their operational life.** The building is provided service water via a 1" pipe from the operations building that supply service water hose bibbs. The service water piping, sanitary waste piping, floor drains, and sump pump and in poor/not operable condition. The service water hose bibbs do not have integral vacuum breakers.

## RECOMMENDATIONS

Rockland Wastewater Treatment Facility, Rockland, MA
Mechanical Assessment


**General:** Wright-Pierce recommends updating a majority of the HVAC, Plumbing and Fire Protection systems serving the Rockland WWTP. A majority of systems are over 20 years old and at the end of the operating life. It is acceptable to reuse existing systems that were described as being in new or like new condition, including the hot water heating boilers, boiler pumps, and the gas fired hot water heater.

The HVAC updates would include providing code-compliant ventilation systems as required by NFPA 820, IMC, and ASHRAE 62.1, providing a new heating hot water distribution system, and replacing all heating and cooling equipment, ductwork, and piping.

The Plumbing updates would include replacing all of the major systems including: Domestic cold water, domestic hot water, and service water piping systems, sanitary waste drain systems, and rain leaders systems. The major pieces of plumbing equipment shall be replace as required including water heaters, sump pumps, emergency showers and eye wash stations. In to replacing existing systems, a new tepid water system with mixing valves would be required for the new emergency shower/eyewash stations.

## CODE DISCUSSION

**General:** The mechanical work scope for this project focuses on providing code-compliant ventilation systems in each of the areas listed above, as follows:

| Room | Ventilation | Code Reference (NFPA 820 unless noted otherwise) |
|---|---|---|
| Truckway | 6 ACH/3 ACH | Table 6.2.2(a), Row 13, Line a (Unclassified rating) |
| | 1 cfm/sf, continuous | International Mechanical Code, Section 502.8 |
| Dewatering | 6 ACH | Table 6.2.2(a), Row 12, Line a (Unclassified rating) |
| Chemical Rooms | 6 ACH/3 ACH | Table 6.2.2(a), Row 12, Line a (Unclassified rating) |
| | 1 cfm/sf, continuous | International Mechanical Code, Section 502.8 |
| Office/Administrative | 5-10 cfm/person, 0.06-0.18 cfm/sf | International Mechanical Code, Table 403.3 |

| | | |
|---|---|---|
| Laboratory | 10 cfm/person, 0.18 cfm/sf | International Mechanical Code, Table 403.3 |
| Lavatory/Locker Rooms | .75 cfm/sf exhaust | International Mechanical Code, Table 403.3 |
| Blower Room | 0.3 cfm/sf (occupied) | International Mechanical Code, Table 403.3 |
| Digestion Tank Building | 6 ACH | Table 6.2.2(a), Row 18, Line c (Unclassified rating) |
| Nitrification/ Secondary Galleries | <6 ACH, intermittent | Table 6.2.2(a), Row 22, Line b (Class 1/Division 2) |
| | 1 cfm/sf, continuous | International Mechanical Code, Section 502.8 |
| Influent Pump Station | <6 ACH, intermittent | Table 6.2.2(a), (Class 1/Division 2) |
| | 1 cfm/sf, continuous | International Mechanical Code, Section 502.8 |

**Building-by-Building Recommendations**

**ADMINISTRATION BUILDING**

- The existing HVAC systems shall be removed and new systems shall be installed to accommodate general office renovations and renovation of the basement area. This work will include replacing the existing air handling unit and air-cooled condensing unit with new equipment, reconfiguring the air distribution system to accommodate the proposed spaces, and revising the automatic temperature controls system. Systems shall conform with the requirements noted in NFPA 820 and IMC.
- HVAC and plumbing systems serving the laboratory will be reconfigured and/or replaced to accommodate the space.
- Existing plumbing systems in the building will be reconfigured and/or replaced to accommodate the architectural renovations, and new plumbing will be provided in the new toilet rooms in accordance with the American With Disabilities Act.
- The existing hot water boilers shall remain, but the plant distribution system and piping shall be removed and replaced in its entirety.
- Chemical rooms shall be upgraded to Unclassified Rating per NFPA 820 and Conform to IMC- The chemical rooms need to conform with requirements needed to establish an Unclassified rating in accordance with NFPA 820 and it also must conform to exhaust

requirements listed in the International Mechanical Code (IMC), section. Modify/replace the existing makeup air system serving chemical rooms to provide 6 ACH when the chemical rooms are occupied or the outside air temperature is greater than 50°F, and /3ACH or 1 cfm/sf (whichever is greater) when the chemical room is unoccupied and when the outside air temperature is 50°F or less. Provide a proof-of-flow sensor. Provide an exhaust air system which draws exhaust directly from the Chemical Room; fan speed shall be adjustable using variable speed motors. Provide a proof-of-flow sensor. Consider providing a heat recovery runaround loop to preheat outside air using heat reclaimed from exhaust air.

- Heating and ventilation in the Dewatering area and truckway will be replaced to provide airflows in accordance with NFPA 820 (continuous ventilation at 6 air changes per hour when occupied, 3 ACH when unoccupied and outside air temperatures are 50º F or lower). Equipment in this area will be NEMA 4X rated. This will be coordinated with odor control air exchange flow rates.
- Ductless split air conditioning will be provided in electrical rooms.
- Energy efficiency measures will be implemented, such as installing and/or restoring pipe insulation, sealing existing ductwork and adjusting controls.
- Provide an emergency shower/eyewash unit in the sludge garage, supplied with tepid water.
- Existing fire protection equipment will be replaced, and new equipment provided as appropriate.

**DIGESTION TANKS BUILDING**

- Heating and ventilation in the will be replaced to provide airflows in accordance with NFPA 820 (continuous ventilation at 6 air changes per hour when occupied, 3 ACH when unoccupied and outside air temperatures are 50º F or lower). Equipment in this area will be NEMA 4X rated.
- Provide an emergency shower/eyewash unit in the sludge garage, supplied with tepid water.
- Existing plumbing systems in the building will be replaced to meet the current plumbing code.
- Energy efficiency measures will be implemented, such as installing and/or restoring pipe insulation, sealing existing ductwork and adjusting controls.
- New fire protection shall be provided as appropriate.

**NITRIFICATION AND SECONDARY GALLERIES**

- Heating and ventilation in the will be replaced to provide airflows in accordance with NFPA 820 and IMC (continuous ventilation at 6 air changes per hour when occupied, 3 ACH when unoccupied and outside air temperatures are 50º F or lower). Equipment in this area will be NEMA 4X rated.
- Existing plumbing systems in the building will be replaced to meet the current plumbing code.
- Provide an emergency shower/eyewash unit in the sludge garage, supplied with tepid water.
- Energy efficiency measures will be implemented, such as installing and/or restoring pipe insulation, sealing existing ductwork and adjusting controls.
- New fire protection shall be provided as appropriate.

**ELECTRICAL BUILDING**

- The electrical building will contain electrical equipment, which will include numerous variable frequency drives. These will reject heat to the space. Provide a ductless split air conditioning system to keep the room from overheating.
- The generator room heating and ventilation in the will be replaced to provide adequate supply and exhaust airflows for the new generator.

**INFLUENT PUMP STATION**

- Heating and ventilation in the will be replaced to provide airflows in accordance with NFPA 820 and IMC (continuous ventilation at 6 air changes per hour when occupied, 3 ACH when unoccupied and outside air temperatures are 50o F or lower). Equipment in this area will be NEMA 4X rated.
- Existing plumbing systems in the building will be replaced to meet the current plumbing code.
- Provide an emergency shower/eyewash unit in the sludge garage, supplied with tepid water.
- Energy efficiency measures will be implemented, such as installing and/or restoring pipe insulation, sealing existing ductwork and adjusting controls.
- New fire protection shall be provided as appropriate.

WRIGHT-PIERCE
Engineering a Better Environment

# MEMORANDUM

| | | | |
|---|---|---|---|
| **TO:** | Doug Hankins, Project Manager | **DATE:** | 12/18/2020 |
| **FROM:** | Christine Sexton, PE | **PROJECT NO.:** | 20395A |
| **SUBJECT:** | Rockland Wastewater Treatment Facility, Rockland, MA<br>Structural Assessment<br>Recommended Upgrade Improvements | | |

## INTRODUCTION

A site visit was conducted at the Rockland, MA Wastewater Treatment Facility on November 10, 2020 in order to perform a facility walk-through and an evaluation of the facility's existing structures (buildings and tankage). Wright-Pierce was also on site on July 22, 2020 to observe and take photos of one of the Primary Settling Tanks drained and one of the Nitrification Settling Tanks drained. This memorandum summarizes observations made during the site visits and made through review of existing documentation provided by the facility. Based on these observations, findings and recommendations regarding the existing buildings and tankage have been made including recommendations for upgrades, maintenance, and other restorative measures.

## DESCRIPTION OF EXISTING FACILITIES AND RECOMMENDATIONS

### GENERAL

It appears the guard height varies at the Facility. Need to confirm the guard height is OSHA compliant.

### INFLUENT PUMP STATION

The influent pump station was originally constructed in 1964.

**Observations**

- Painted steel monorail beam has peeling paint and signs of corrosion.
- The monorail capacity is not labeled. The hoist may or not be okay depending on capacity.
- There is failing paint on the slabs, walls, stairs and handrail.

- An existing floor slab opening was cut to account for newer equipment extending between levels. The cut was rough and the concrete exhibits minor exposed aggregate and exposes the ends of a couple reinforcing bars.
- There are concrete cracks and spalls.
- There are lifting eyes with no labeled capacities, which also appear to be corroded.
- The floor plating is warped and embedments have detached.
- Pipe supports are showing signs of corrosion.

**Recommendations**

- Powerwash the entire pump station to remove paint and loose and degraded concrete.
- Remove all failed paint and corrosion from steel monorail beam and steel guard surfaces by sand blasting and recoat with epoxy. Label monorail with capacity.
- Repair all cracks in the concrete by pressure injection of an epoxy resin as required.
- Remove degraded concrete and resurface with cementitious repair material, including areas where rebar is exposed.
- Remove lifting eyes. Cut lifting eyes flush with concrete and coat with epoxy.
- Replace warped floor plates. Drill holes and use concrete screws to hold down detached embedments.
- Remove all failed paint and corrosion from steel pipe support surfaces and recoat with epoxy. Consider replacing painted steel with aluminum or stainless. Add a stanchion pipe support to replace the wood support.

AERATED GRIT CHAMBERS

The aerated chamber was originally constructed in 1977. The grit removal clam hoist has been out of service since 2015. The grit collected at the bottom of the chamber is currently removed via vactor trucks. This removal is a manual operation that requires bypassing the grit chamber.

**Observations**

- The tank was filled with liquid so the concrete below the waterline could not be observed.
- The concrete above the waterline appeared to be in fair condition.
- Several cracks exhibiting efflorescence were observed in the portion of the exterior North wall visible above grade.
- At two valve locations, chains are being used instead of Aluminum guard.
- The painted monorail steel frame above the chambers has peeling paint and is showing signs of corrosion. The monorail beams are severely corroded.

**Recommendations**

- Clean and fully inspect the concrete grit chambers.
- Repair all cracks in the concrete by pressure injection of an epoxy resin as required.
- Replace the chains on guard with new guard.
- Remove all failed paint and corrosion from the monorail steel frame by sand blasting and recoat with epoxy.
- Replace the monorail beams.

SEPTAGE HOLDING AND TRANSFER TANK

The septage holding chamber and pump station were originally constructed in 1964. Treating septage at the WWTF was stopped in the early 1980s.

**Observations**

- The concrete appeared to be in good condition with mild exposed aggregate on the lower portion of the walls.
- Chains are being used instead of Aluminum guard in a few locations.

**Recommendations**

- Resurface approximately the lower 4’-0” +/- of the tank walls.
- Replace the chains on guard with new guard.

WEIR SPLITTER BOX

Wastewater flows from the Aerated Grit Chamber to the primary splitter box, where it is diverted to either Primary Settling Tank No. 1 or No. 2.

**Observations**

- Cracks and pin holes exhibiting efflorescence were observed in the concrete walls.
- Toe plates are missing from guard.

**Recommendations**

- Repair all cracks in the concrete by pressure injection of an epoxy adhesive as required. Cracks that are damp will require a polyurethane expanding foam resin that will react with the water.
- Install toeplate on the guard.

PRIMARY SETTLING TANKS NO. 1 AND 2

The facility has four primary settling tanks. The two large primary settling tanks were constructed in 1977 and are in service.

**Observations**

- Primary Settling Tank No. 1 was filled with liquid so the concrete surfaces below the waterline could not be observed. Primary Settling Tank No. 2 had been drained and inspected in July of 2020.
- The concrete walls especially at the waterline in the effluent drop channel area exhibited exposed aggregate.
- Concrete cracks and spalls were observed.

- Guard is missing around the scum well.
- Toe plates are missing from guard.

**Recommendations**

- Resurface the concrete walls and launders.
- Repair all cracks in the concrete by pressure injection of an epoxy resin as required. Cracks that are damp will require a polyurethane expanding foam resin that will react with the water.
- Remove degraded concrete and resurface with cementitious repair material.
- Install guard around the concrete scum well.
- Install toeplate on the guard around the tanks.

PRIMARY SETTLING TANKS NO. 3 AND 4

The two small primary settling tanks were constructed in 1964. Currently, they are offline and are used to store influent during peak flow events.

**Observations**

- Some major cracks and significant concrete spalling were observed.

**Recommendations**

- If this tank is not demolished, then some concrete repairs will be required for safety.

AERATION TANKS

The aeration tanks were originally constructed in 1964. The aeration tanks were taken offline in 1984 after determining that treatment could be achieved by operating only the second stage of the facility and are currently only used for bypass storage during peak flow events.

**Observations**

- Some of the vertical expansion joints sealant are failing.

- Spalls and vertical/diagonal cracks are observed in the concrete wall surfaces.
- Toe plates are missing from guard.
- Chains are being used instead of Aluminum guard in a few locations.
- A 30” diameter effluent opening in the concrete may be a safety concern.

**Recommendations**

- Remove and replace expansion joint backer rod and sealant.
- Repair all cracks in the concrete by pressure injection of an epoxy adhesive as required. Cracks that are damp will require a polyurethane expanding foam resin that will react with the water.
- Remove the degraded concrete and resurface the exposed aggregate with a cementitious overlay.
- Install toeplate on the guard around the tanks.
- Replace the chains on guard with new guard.
- Install a safety grate over the large effluent opening in the slab.

NITRIFICATION TANKS NO. 1 AND 2

The nitrification tanks were constructed in 1977.

**Observations**

- Nitrification Tanks No. 1 and 2 were filled with liquid so the concrete surfaces below the waterline could not be observed.
- Many cracks were observed on the slab between Tank No. 1 and No. 2, which it the top slab of the hallway between the Secondary Pump Gallery and Nitrification Pump Gallery.
- Toe plates are missing from guard.
- Chains are being used instead of Aluminum guard in a few locations.
- Many of the hanging threaded rod pipe supports and U-bolt pipe support straps have failed.

Rockland Wastewater Treatment Facility, Rockland, MA
Structural Assessment


**Recommendations**

- Drain and clean the tanks for structural inspection and evaluation.
- Repair all cracks in the concrete by pressure injection of an epoxy resin as required. Cracks that are damp will require a polyurethane expanding foam resin that will react with the water.
- Install toeplate on the guard around the tanks.
- Replace the chains on guard with new guard.
- Replace existing or install new pipe supports.

NITRIFICATION SETTLING TANKS NO. 1 AND 2

The circular nitrification settling tanks were constructed in 1977 and show some concrete degradation. The tank collector drive units were replaced in 2018. The other steel components are original to the tanks and are severely corroded and beyond their useful life.

**Observations**

- Nitrification Settling Tank No. 2 was filled with liquid so the concrete surfaces below the waterline could not be observed. Nitrification Settling Tank No. 1 had been drained and inspected on July 22, 2020.
- The launders have a slight accumulation of algae. The concrete surfaces exhibit mild exposed aggregate.
- Vertical cracks are observed in the tank walls.
- Spalls and cracks are observed in the concrete slab.
- Toe plates are missing from tank guard and a portion of the walkway bridge.
- The top slab of the Nitrification Pump Gallery had an elastomeric waterproofing that has failed.
- The expansion joint between the Nitrification Settling Tanks and the top slab of the Nitrification Pump Gallery appears to have failed in places. The elastomeric waterstop has been completely removed.

**Recommendations**

- Resurface concrete launders.
- Repair all cracks in the concrete by pressure injection of an epoxy adhesive as required. Cracks that are damp will require a polyurethane expanding foam resin that will react with the water.
- Remove the degraded concrete and resurface with a cementitious overlay.
- Install toeplate on the guard around the tanks and the missing piece on the bridge.
- Replace the expansion joint sealant.

NITRIFICATION PUMP GALLERY

**Observations**

- There is a horizontal joint along the Nitrification Settling Tanks that is exhibiting efflorescence. From the record drawings, this is the joint at the launder slab (approx. 9'-4" high). At this height the tank wall changes thickness and the wall reinforcing transitions from #10 @ 12" to #5 @ 12". It appears that the waterstop in this joint has failed or was never installed. Dwgs do not show a waterstop at this location. A general note on the drawings states to provide waterstops at all horizontal and vertical joints below water surface in tanks.
- There is concrete crazing and spalling in a narrow section of wall between the Nitrification Settling Tank and an expansion joint. It appears the crazing may be an alkali-silica reaction (ASR). This is a concern because in ASR, aggregates with certain forms of silica react with alkali hydroxide in concrete to form a gel that can produce destructive swelling.
- The expansion joints are failing in many places.
- Cracks exhibiting efflorescence were observed in the corners of the top slab edges.
- Cracks and pin holes exhibiting efflorescence were observed in the concrete walls.
- The walls have many locations where there is liquid brown staining from expansion joints, cracks and pipe openings. There is an active leak in the concrete at the corner of the hallway between the Nitrification Tanks, which is leaking directly on an electrical junction box.

- The concrete slab is spalling in several locations and one has an exposed reinforcing bar.
- A pump equipment pad has a significant crack in it and the skid is corroded.
- Pipe supports are showing signs of corrosion. One pipe is being supported by wood.
- The concrete walls and slabs have peeling paint.

**Recommendations**

- Coat a 1-foot strip of wall along the inside face of the tanks along the launder slab joint to seal the joint with an elastomeric membrane.
- Spray the crazed concrete wall with a lithium compound that reduces ASR. Reevaluate the existing wall. If the damage to the existing wall is extensive, use the existing wall as a form to cast-in place a new wall designed to support the loading.
- Remove and replace the expansion joints backer rods and sealants.
- Repair all cracks in the concrete by pressure injection of an epoxy adhesive as required. Cracks that are damp will require a polyurethane expanding foam resin that will react with the water.
- Seal the leaks at the concrete pipe openings.
- Remove degraded concrete by sandblasting and resurface with cementitious repair material. Epoxy paint exposed rebar.
- Demolish and install a new concrete pump equipment pad.
- Remove all failed paint and corrosion from steel pipe support surfaces and recoat with epoxy. Consider replacing painted steel with aluminum or stainless. Replace stanchion supports that are severely corroded. Install a more permanent pipe support to replace the wood.
- Remove the failing coating from the wall and slab surfaces.

FLOCCULATION CHAMBER

The flocculation chamber connected to the two secondary settling tanks has been abandoned.

**Observations**

- The Flocculation chamber was filled with liquid so the concrete surfaces below the waterline could not be observed.
- Floor plate section is missing above one of the slide gate locations.
- The two concrete stairs have moved away from the tank.
- Chains are being used instead of Aluminum guard in a few locations.
- Toe plates are missing from tank guard.

**Recommendations**

- Drain and clean the tanks for structural inspection and evaluation.
- Install the missing plate section.
- Replace the two stairs.
- Replace the chains on guard with new guard.
- Install toeplate on the guard around the tanks.

SECONDARY SETTLING TANKS NO. 1 AND 2

The circular secondary settling tanks were originally constructed in 1977 as part of the first stage of the two-stage aeration plant configuration. These tanks were taken offline in 1984 and are currently not used. The steel components show advanced corrosion and are not functional.

**Observations**

- Secondary Settling Tanks No. 1 and 2 have a considerable amount of vegetation growing in the troughs and some on the base slab.
- There are many vertical cracks in the tank walls and cracks in the base slab.
- Toe plates are missing from the walkway bridge guard.
- The grating sections on the bridge do not appear to be lined up. Some sections may be loose.
- The top slab of the Secondary Pump Gallery had an elastomeric waterproofing that has failed.

- The expansion joint between the Secondary Settling Tanks and the top slab of the Secondary Pump Gallery appears to have failed in places. The elastomeric waterstop has been completely removed.

**Recommendations**

- Remove the vegetation and clean the tanks for structural inspection.
- Repair all cracks in the concrete by pressure injection of an epoxy adhesive as required. Cracks that are damp will require a polyurethane expanding foam resin that will react with the water.
- Install toeplate on the guard of the walkway bridge.
- Securely fasten any sections of grating on the bridge that may be loose.
- Replace the expansion joint sealant.

SECONDARY PUMP GALLERY

**Observations**

- There is a horizontal joint along the Secondary Settling Tanks that is exhibiting efflorescence. The concrete appears to have been previously injected with repair material. From the record drawings, this joint is at the height of the Secondary Settling Tank base slab (approx. 2'-11" high). It appears that the waterstop in this joint has failed or was never installed.
- The expansion joints are failing in many places.
- Cracks and pin holes exhibiting efflorescence were observed in the concrete walls.
- The walls have many locations where there is liquid brown staining from expansion joints, cracks and pipe openings. There is an active leak in the concrete at a pipe opening, which is leaking directly on an electrical junction box.
- The concrete is spalling in several wall and slab locations and one area on the Secondary Settling Tank wall has an exposed reinforcing bar.
- Pipe supports are showing signs of corrosion.

**Recommendations**

- Coat a 1-foot strip of wall along the inside face of the tanks along the launder slab joint to seal the joint with an elastomeric membrane.
- Remove and replace the expansion joints backer rods and sealants.
- Repair all cracks in the concrete by pressure injection of an epoxy adhesive as required. Cracks that are damp will require a polyurethane expanding foam resin that will react with the water.
- Replace pipe sealants.
- Remove degraded concrete and resurface with cementitious repair material, including areas where rebar is exposed.
- Demolish and install a new concrete pump equipment pad.
- Remove all failed paint and corrosion from steel pipe support surfaces and recoat with epoxy. Consider replacing painted steel with aluminum or stainless. Replace stanchion supports that are severely corroded.

ADMIN BUILDING, PRIMARY DIGESTER NO. 1 AND SECONDARY DIGESTER NO. 1

These structures were originally constructed in 1964.

**Observations**

- Painted steel guard, stair handrail, stair clip angles, and stair stringers are exhibiting signs of corrosion.
- Cracks and spalls were observed in the concrete surfaces.
- Pipe supports are showing signs of corrosion.
- The concrete and CMU walls and concrete slabs have peeling paint.

**Recommendations**

- Remove all failed paint and corrosion from steel surfaces by sandblasting and recoat with epoxy. Consider replacing painted steel pipe supports with aluminum or stainless. Replace stanchion pipe supports and stair clip angles that are severely corroded.
- Repair all cracks in the concrete by pressure injection of an epoxy adhesive as required.
- Remove degraded concrete and resurface with cementitious repair material.
- Remove the failing paint from the wall and slab surfaces.

ADMIN BUILDING ADDITION, PRIMARY DIGESTER NO. 2 AND SECONDARY DIGESTER NO. 2

These tanks were constructed in 1977.

**Observations**

- The concrete and CMU walls, concrete beams and concrete slabs have peeling paint.
- The expansion joint filler between the slabs and Digesters have failed in many places.
- The Digester covers are exhibiting signs of corrosion.
- The methane gas support base on the roof is showing signs of corrosion.
- There is a broken steel drain cover on the lower level.
- In one location the exterior metal siding of the Digester has been damaged. It appears to have been impacted by equipment.

**Recommendations**

- Remove the failing paint from the wall, beam and slab surfaces.
- Remove and replace the failed expansion joint filler.
- Remove all failed paint and corrosion from steel surfaces by sandblasting and recoat with epoxy.
- Replace the broken steel drain cover.
- Repair the damaged exterior metal siding.

CHLORINE CONTACT CHAMBERS AND EFFLUENT PUMP STATION

**Observations**

- Tanks were filled with liquid so the concrete below the waterline could not be observed.
- There are several vertical cracks on the walls exhibiting efflorescence.
- The concrete at the waterline exhibited exposed aggregate.
- Chains are being used instead of Aluminum guard in a few locations.
- Toe plates are missing from guard.

**Recommendations**

- Drain and clean the tank for structural inspection and evaluation.
- Repair all cracks in the concrete by pressure injection of an epoxy adhesive as required. Cracks that are damp will require a polyurethane expanding foam resin that will react with the water.
- Resurface the exposed aggregate on the tank walls with a cementitious overlay.
- Replace the chains on guard with new guard.
- Install toeplate on the guard.

ELECTRICAL BUILDING

**Observations**

- The exterior painted steel monorail support frame and beam has peeling paint and signs of corrosion.
- The monorail capacity is not labeled.
- The exterior concrete pedestal supporting the monorail support frame column is severely cracked.
- There are concrete spalls in the slab in several locations.

**Recommendations**

- Remove all failed paint and corrosion from steel monorail support frame and beam surfaces by sand blasting and recoat with epoxy. Label monorail with capacity.
- Replace the exterior concrete support pedestal.
- Remove degraded concrete and resurface with cementitious repair material, including areas where rebar is exposed.

ADMIN BUILDING

**Observations**

*Exterior*

- The exterior concrete east stairs have significant cracks and spalls with some exposed rebar on the underside of the concrete landing.
- There is minor concrete spalling on the south concrete loading platform.

*Filter Press Room*

- In the stairways, paint on the concrete beams was peeling and concrete spalling was observed.
- The monorail load capacity was not visibly indicated.
- The floor around the filter presses has standing liquid.
- There are some rough concrete areas on the slab where equipment pads had been removed.
- There is a broken floor drain cover near the hopper slab opening.
- The ladder up to the roof has smooth rungs, which are more vulnerable to slippage than non-slip surfaced rungs.

*Lime and Ferric Chloride Room*

- One of the Ferric Chloride FRP tanks is not sitting completely on the concrete equipment pad. The concrete anchors to restrain the tank are missing.
- There are a few significant cracks on the underside of the ceiling slab with brown staining.
- Concrete coating is failing on some of the containment area, wall, slab and column surfaces.

- The aluminum stair column base plate in the Lime area is corroded.
- Several steel unistrut and pipe supports are showing signs of corrosion.
- There is a crack at the double doors all around in the expansion joint.

*Maintenance Garage*

- The monorail load capacity was not visibly indicated.

*Sludge Truck Container Area*

- There is a lifting hook with no labeled capacity, which appears in good condition.
- There are no roll-off plates beneath the sludge truck container wheels.

*Sodium Hypochlorite Room*

- The chemical containment area wall has a concrete crack and spall.
- The concrete containment area coating is failing in areas, especially near the sump.

## **Recommendations**

*Exterior*

- Remove degraded concrete and resurface with cementitious repair material, including areas where rebar is exposed.

*Filter Press Room*

- Remove peeling paint from concrete surfaces by high pressure water or abrasive blast.
- Remove degraded concrete and resurface the exposed aggregate with a cementitious overlay.
- Label monorail with capacity.
- Replace the broken floor drain cover.
- Consider replacing ladder with a ladder with non-slip surfaced rungs, if slippage is a concern.

*Lime and Ferric Chloride Room*

- Shift the Ferric Chloride tank to be fully supported on the concrete equipment pad. Install the concrete anchors to restrain the chemical FRP tanks.

Rockland Wastewater Treatment Facility, Rockland, MA
Structural Assessment
Recommended Upgrade Improvements12/18/2020


- Repair all cracks in the concrete by pressure injection of an epoxy adhesive as required. Cracks that are damp will require a polyurethane expanding foam resin that will react with the water.
- Remove the peeling paint from the concrete walls, slabs and columns. Remove the failing coating from the concrete containment surfaces and recoat.
- Replace the corroded aluminum stair column base plate in the Lime area.
- Remove all failed paint and corrosion from steel Unistrut and pipe support surfaces and recoat with epoxy. Consider replacing painted steel with aluminum or stainless.
- Replace the cracked joint sealant.

*Maintenance Garage*

- Label monorail with capacity.

*Sludge Truck Container Area*

- Label the lifting hook capacity.
- Install roll-off plates for the sludge truck container.

*Sodium Hypochlorite Room*

- Repair all cracks in the concrete by pressure injection of an epoxy resin as required.
- Remove the degraded concrete. Resurface exposed aggregate with concrete repair material.
- Remove failing coating from concrete surfaces and recoat the containment area.

Please note depending on the scope of work, there may be modifications (i.e. roof and/or insulation replacement) included that may trigger an assessment as to whether the structural capacity of the existing buildings or components of buildings and structures must conform to the current Building Code.

**STRUCTURAL DESIGN**

The following standards and criteria will be used in the structural design of the WWTF:

**Governing Codes and Standards**

- Commonwealth of Massachusetts State Building Code - 9th Edition
- International Building Code 2015
- ASCE 7-10 Minimum Design Loads for Buildings and Other Structures
- ACI 318-14 - Building Code Requirements for Reinforced Concrete
- ACI 350-06 - Code Requirements for Environmental Engineering Concrete Structures
- ACI 350.3/350.3R-06 - Seismic Design of Liquid-Containing Concrete Structures and Commentary
- AISC Manual of Steel Construction - 13th Edition
- Aluminum Association - Specifications for Aluminum Structures
- ACI 530/530.1-13 - Building Code Requirements and Specification for Masonry Structures and Related Commentaries
- Occupational Safety and Health Administration

**Design Criteria**

***Material Properties***

- Concrete
  - $f'_c$ - 4,500 psi
  - $f_y$ - 60,000 psi (Reinforcing steel)
  - Max W/C ratio - 0.42
  - Air Content - 6 +/- 1.5%
- Structural Steel
  - Structural Shapes and Lintels
    - ASTM A992 Grade 50 (wide flange and “S” type beams)
    - ASTM A36 Grade 36 (channels and angles)
    - ASTM A572 Grade 50 (plates)
  - Anchor Rods - ASTM F1554
  - Bolts - ASTM A325
  - Finish - Hot-dipped galvanized or painted
  - Welding - E70XX electrodes
- Structural Aluminum
  - Shapes/Plates - ASTM B308 Alloy 6061-T6
  - Bolts - Stainless Steel Type 316
  - Finish - Mill or clear anodized
- Masonry
  - $f'_m$ - 1,500 psi

- CMU Block - ASTM C90 Type N-1 - 2,000 psi
- Mortar - ASTM C270 Type S - 1,800 psi
- Grout - ASTM C476 - 2,000 psi

***Live Loads***

In accordance with Massachusetts Building Code, ACSE 7 and the Risk Category III/IV:

*Building:*

- Floor Live Load - Uniformly distributed load based on equipment weights and expected usage
- Ground Snow Load - 35 psf
- Wind Speed - Ultimate: 143 mph, Nominal: 111 mph
- Seismic Design Factors:
  - $S_s$ (0.2 second Spectral Response Acceleration coefficient) = 0.198
  - $S_1$ (1.0 second Spectral Response Acceleration coefficient) = 0.065

*Tanks and Foundations:*

- Freezing Index = 750 +/-
- Frost Depth = 43” +/-, Use 4’-0”
- Lateral earth pressures:
  - Above groundwater table - 65 psf / ft
  - Below groundwater table - 95 psf / ft
- Lateral surcharge pressures:
  - Lateral surcharge resulting from a 300 psf surcharge loading
- Hydrostatic pressures: leak test and uplift - 65 psf / ft
- Flotation resistance - Dead weight of concrete structure and soil over slab extension

# D

**ROCKLAND, MA**
**WWTF ASSESSMENT**
**W-P PROJECT NO. 20395A**

**ENR INDEX 11580, 11/2020**
**CONSTRUCTION COST ESTIMATE**

| DESCRIPTION | ESTIMATED COST |
|---|---|
| **CIVIL** | |
| WWTF SITE WORK | $200,000 |
| WWTF SITE DRAINAGE | $50,000 |
| WWTF ELECTRICAL DUCTBANKS AND PADS | $150,000 |
| WWTF SITE PIPING (INCL. IN PROCESS) | |
| WWTF SITE RESTORATION AND REPAVING | $400,000 |
| SCREENING AND GRIT FACILITY (NEW) | $117,600 |
| INFLUENT PUMP STATION MODIFICATIONS | $57,750 |
| PRIMARY CLARIFIER MODIFICATIONS | $68,250 |
| SECONDARY SYSTEM MODIFICATIONS | $77,725 |
| SECONDARY CLARIFIER MODIFICATIONS | $10,878 |
| TERTIARY BUILDING (NEW) | $90,739 |
| CHEMICAL BUILDING (NEW) | $44,617 |
| CHLORINE CONTACT TANKS AND EFFLUENT P.S. | $0 |
| SLUDGE STORAGE TANKS | $47,250 |
| ADMINSTRATION BUILDING MODIFICATIONS | $5,250 |
| GARAGE AND ELECTRICAL BUILDING (NEW) | $58,800 |
| **ARCHITECTURAL** | |
| SCREENING AND GRIT FACILITY (NEW) | $315,000 |
| INFLUENT PUMP STATION MODIFICATIONS | $241,500 |
| PRIMARY CLARIFIER MODIFICATIONS | $0 |
| SECONDARY SYSTEM MODIFICATIONS | $609,000 |
| SECONDARY CLARIFIER MODIFICATIONS | $0 |
| TERTIARY BUILDING (NEW) | $275,625 |
| CHEMICAL BUILDING (NEW) | $496,125 |
| CHLORINE CONTACT TANKS AND EFFLUENT P.S. | $0 |
| SLUDGE STORAGE TANKS | $0 |
| ADMINSTRATION BUILDING MODIFICATIONS | $693,000 |
| GARAGE AND ELECTRICAL BUILDING (NEW) | $213,150 |
| PROCESS EQUIPMENT AND PIPING FINISHES | $150,000 |
| **STRUCTURAL** | |
| SCREENING AND GRIT FACILITY (NEW) | $787,500 |
| INFLUENT PUMP STATION MODIFICATIONS | $116,550 |
| PRIMARY CLARIFIER MODIFICATIONS | $68,250 |
| SECONDARY SYSTEM MODIFICATIONS | $756,000 |
| SECONDARY CLARIFIER MODIFICATIONS | $147,000 |
| TERTIARY BUILDING (NEW) | $414,078 |
| CHEMICAL BUILDING (NEW) | $99,671 |
| CHLORINE CONTACT TANKS AND EFFLUENT P.S. | $36,750 |
| SLUDGE STORAGE TANKS | $131,250 |
| ADMINSTRATION BUILDING MODIFICATIONS | $105,000 |

**ROCKLAND, MA**
**WWTF ASSESSMENT**
**W-P PROJECT NO. 20395A**

**ENR INDEX 11580, 11/2020**
**CONSTRUCTION COST ESTIMATE**

| DESCRIPTION | ESTIMATED COST |
|---|---|
| GARAGE AND ELECTRICAL BUILDING (NEW) | $105,000 |
| **PROCESS** | |
| SCREENING AND GRIT FACILITY (NEW) | $922,845 |
| INFLUENT PUMP STATION MODIFICATIONS | $405,090 |
| PRIMARY CLARIFIER MODIFICATIONS | $743,400 |
| SECONDARY SYSTEM MODIFICATIONS | $3,614,804 |
| SECONDARY CLARIFIER MODIFICATIONS | $950,661 |
| TERTIARY BUILDING (NEW) | $2,223,805 |
| CHEMICAL BUILDING (NEW) | $228,900 |
| CHLORINE CONTACT TANKS AND EFFLUENT P.S. | $65,100 |
| SLUDGE STORAGE TANKS | $739,200 |
| ADMINSTRATION BUILDING MODIFICATIONS | $1,164,240 |
| GARAGE AND ELECTRICAL BUILDING (NEW) | $5,250 |
| **HVAC/ PLUMBING** | |
| SCREENING AND GRIT FACILITY (NEW) | $0 |
| INFLUENT PUMP STATION MODIFICATIONS | $100,800 |
| PRIMARY CLARIFIER MODIFICATIONS | $0 |
| SECONDARY SYSTEM MODIFICATIONS | $367,500 |
| SECONDARY CLARIFIER MODIFICATIONS | $0 |
| TERTIARY BUILDING (NEW) | - |
| CHEMICAL BUILDING (NEW) | - |
| CHLORINE CONTACT TANKS AND EFFLUENT P.S. | - |
| SLUDGE STORAGE TANKS | - |
| ADMINSTRATION BUILDING MODIFICATIONS | $369,600 |
| GARAGE AND ELECTRICAL BUILDING (NEW) | $122,850 |
| **INSTRUMENTATION** | |
| NETWORK/FIBER OPTIC | $150,000 |
| SCREENING AND GRIT FACILITY (NEW) | $97,335 |
| INFLUENT PUMP STATION MODIFICATIONS | $30,500 |
| PRIMARY CLARIFIER MODIFICATIONS | $58,477 |
| SECONDARY SYSTEM MODIFICATIONS | $333,900 |
| SECONDARY CLARIFIER MODIFICATIONS | $76,328 |
| TERTIARY BUILDING (NEW) | $28,875 |
| CHEMICAL BUILDING (NEW) | $81,375 |
| CHLORINE CONTACT TANKS AND EFFLUENT P.S. | $21,000 |
| SLUDGE STORAGE TANKS | $92,270 |
| ADMINSTRATION BUILDING MODIFICATIONS | $94,709 |
| GARAGE AND ELECTRICAL BUILDING (NEW) | $20,475 |
| **ELECTRICAL** | |

**ROCKLAND, MA**
**WWTF ASSESSMENT**
**W-P PROJECT NO. 20395A**

**ENR INDEX 11580, 11/2020**
**CONSTRUCTION COST ESTIMATE**

| DESCRIPTION | | ESTIMATED COST |
|---|---|---|
| WWTF ELECTRICAL DISTRIBUTION | | $750,000 |
| WWTF ELECTRICAL SITE LIGHTING/MANHOLES | | $50,000 |
| WWTF FIRE SYSTEM | | $25,000 |
| WWTF ELECTRICAL DEMOLITION | | $150,000 |
| SCREENING AND GRIT FACILITY (NEW) | | $292,182 |
| INFLUENT PUMP STATION MODIFICATIONS | | $181,249 |
| PRIMARY CLARIFIER MODIFICATIONS | | $251,192 |
| SECONDARY SYSTEM MODIFICATIONS | | $1,204,046 |
| SECONDARY CLARIFIER MODIFICATIONS | | $190,819 |
| TERTIARY BUILDING (NEW) | | $157,500 |
| CHEMICAL BUILDING (NEW) | | $45,864 |
| CHLORINE CONTACT TANKS AND EFFLUENT P.S. | | $21,000 |
| SLUDGE STORAGE TANKS | | $151,925 |
| ADMINSTRATION BUILDING MODIFICATIONS | | $236,773 |
| GARAGE AND ELECTRICAL BUILDING (NEW) | | $1,216,215 |
| **SPECIALS** | | |
| MOBILIZATION | | $200,000 |
| DEMOBILIZATION | | $150,000 |
| PILES | | $0 |
| GROUNDWATER DEWATERING (OPEN) | | $20,000 |
| SUBTOTAL, CONSTRUCTION | | $17,193,744 |
| GENERAL CONTRACTOR OH&P AND GENERAL CONDITIONS | 17.5% | $3,009,000 |
| SUBTOTAL, SUBCONTRACTORS (C/M/P/I/E) | | $8,348,616 |
| GENERAL CONTRACTOR MARKUP | 5.0% | $417,000 |
| ELECTRICAL/ TELEPHONE ALLOWANCE | | $10,000 |
| BONDS & INSURANCES | 1.5% | $435,000 |
| UNIT PRICE ITEMS | 1.0% | $172,000 |
| SUBTOTAL, CONSTRUCTION COSTS | | $29,585,360 |
| PROJECT MULTIPLIER, DESIGN CONTINGENCY | 1.20 | |
| PROJECT MULTIPLIER, INFLATION TO MIDPT CONST. | 1.08 | |
| **ENGINEERS ESTIMATE OF CONSTRUCTION COST** | | **$38,236,000** |

Engineering a Better Environment

600 Federal Street, Suite 2151
Andover, MA 01810
978.416.8000 | www.wright-pierce.com

Kevin.olson@wright-pierce.com