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REGIONAL WASTEWATER TREATMENT CONSOLIDATION STUDY

Technical Memorandum 2: Condition Assessment

B&V PROJECT NO. 198910

PREPARED FOR

Naugatuck Valley Council of Governments

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Appendices

1.0 PURPOSE AND BACKGROUND

The purpose of this technical memorandum is to provide a high-level summary of the condition of existing wastewater treatment and collection system facilities of the five communities participating in this wastewater regionalization study. Information used in this assessment will include review of existing facilities plans and other reports, interviews with knowledgeable wastewater operations and management professionals in the five communities, and site visits by Black & Veatch engineers.

This report will discuss planning-level capital costs to upgrade the five treatment plants and their associated collection systems to meet current regulations, remove excessive I/I, and extend the life of the systems for the 20-year planning study horizon. Where capital costs to upgrade the wastewater facilities are available from previous work performed by the communities, these will also be included. 'Placeholder' type estimates will be assigned where capital costs are not available, and where available capital cost projections do not cover the entire planning period, through 2040.

This technical memorandum is intended to establish baseline conditions for wastewater treatment infrastructure in each of the five wastewater treatment communities in the NVCOG Wastewater Regionalization Study. The baseline conditions should reflect the budgetary level capital costs of infrastructure improvements that would need to be made during the planning period (through 2040), with no further regionalization implemented. This includes capital expenditures that would be required to replace aging infrastructure, to meet regulatory requirements, and to accommodate flow increases due to anticipated population increases within the service areas of the five communities.

During Phase 2 of this Wastewater Regionalization Study, the infrastructure needs and related cost projections associated with this Base Case scenario (no regionalization) will be reviewed, analyzed and updated further with more detail and with additional input from the communities. The Base Case for each of the communities then will be compared to the various regionalization alternatives under consideration.

2.0 DERBY WASTEWATER FACILITIES ASSESSMENT

2.1 DESCRIPTION OF EXISTING FACILITIES – DERBY WATER POLLUTION CONTROL FACILITY

The City of Derby water pollution control facility (WPCF), which discharges to the Housatonic River, was built in 1964. The plant was upgraded to secondary treatment in 1973. Limited upgrades undertaken since the 1973 upgrade include: sludge handing facilities (1986); a mechanical upgrade of the influent pump station and replacement of screenings/grinder (1996); electrical upgrade of the influent pumping station (1996); and new aeration system fine bubble diffusers (1997).

The most recent significant construction project (1998) included: electrical upgrades, replacing the main influent pumps, repairs to the grit basins, repairs to the primary settling tanks, modifications to the aeration basins aeration system, mechanical upgrade of the secondary clarifiers, a new bulk storage facility for sodium hypochlorite, and a new sodium bisulfate feed facility.

The WPCF serves approximately 95% of the residents of the City of Derby, plus a small portion of Orange that includes approximately 144 units in Fieldstone Village. The plant is a conventional secondary treatment plant designed for nitrogen removal via a Modified Ludzack-Ettinger (MLE) process configuration. Seasonal disinfection is provided by hypochlorite addition. Since the plant discharges directly to the Housatonic River, there is currently no permit limit for phosphorus (unlike for WPCF's discharging to the Naugatuck River).

Primary sludge and thickened waste activated sludge (WAS) are dewatered onsite, with the sludge cake trucked offsite for further treatment by incineration and ash disposal.

Black & Veatch reviewed the available drawings of the treatment plant, and the most recent Wastewater Facilities Planning Study (Weston & Sampson, March 2014). That facilities plan included an evaluation of the existing wastewater treatment plant and collection system, and developed a capital expenditures plan to address major anticipated upgrades required over a 20-year planning period. That study also looked at regionalization opportunities with other local communities.

Black & Veatch also visited the Derby WPCF on July 12, 2018, accompanied by Derby plant supervisor Lindsay King. A follow-up discussion at the plant site also included Jack Walsh (WPCA chairman) and Carmen DiCenso (the City's economic development liaison).

Peak flow to the plant is limited to approximately 10.0 MGD, based on the capacity of the plant's influent pump station. However, Derby has noted in the past that actual peak flow from the collection system may be up to 13 MGD. (This is documented in minutes of meeting with CT DEP on August 10, 2010, in Appendix H of the Facilities Planning Study.)

Overall, the treatment plant is very old, and in need of a major overhaul, or possibly a near-complete replacement of almost all major systems. The plant is difficult to operate, creating extraordinarily challenging working conditions for plant operations staff and impacting effluent quality.

The existing WPCF process configuration is described in Section 9.4 of the 2014 Wastewater Facilities Planning Study. An evaluation of the condition of each major system of the plant follows, based on a review of existing reports, observation of the facilities and discussions with WPCA staff.

1. **<u>Influent Trash Racks</u>.** Flow enters the plant via two gravity sewer interceptors. Some screenings are captured with trash racks just upstream of the influent pumps on screens that are located several stories below-grade. The racks are cleaned manually and require manned entry into the inlet structure. The screenings are stored in bins within the inlet structure which are reportedly pulled up to grade when full. The inlet trash rack system is in poor condition in terms of process effectiveness, proper ventilation and safety, and should be corrected as a first priority. The lack of proper screens, grinders and grit removal upstream of the influent pumps results in additional wear and operating challenges for the pumps. A proper headworks should be provided upstream of influent pumping. However, lack of conceptual design makes it difficult to assess the footprint required for a properly functioning preliminary screenings facility. During follow-on study and design this should be investigated, along with the optimal (fine to medium) bar spacing that could be accommodated hydraulically.

Figure 2-1 Derby Trash Racks

2. **<u>Influent Pump Station</u>.** The influent pump station has two pumps with long, problematic shafts (motors on upper level); and one pump with a close-coupled motor. The newer close-coupled pump is the normal duty unit, because of issues with the other two extended shaft units. Due to age and problems at this facility, the influent pump station is in need of a major upgrade, and perhaps a complete replacement. All pumps, piping, valves and

controls need to be replaced at the influent pump station. This facility also needs to be able to handle peak flows from the collection system.

Figure 2-2 Derby Influent Pumps with Extended Shafts

3. **Aerated Grit Chamber.** Downstream of the pump station is a single aerated grit chamber, with no redundancy. Grit is removed from the tank using a clamshell bucket on an overhead monorail. The grit is discharged into an adjacent grit dumpster. The aerated grit tank is partially covered with a steel frame structure with a fiberglass canopy. Certain grating sections were compromised at the top of this structure. This arrangement is ineffective, difficult to operate and a safety concern as well. Overall, the grit system is in poor condition and needs to be completely replaced with an appropriate system that provides at a minimum, capability to bypass the grit removal system when extensive maintenance is required.

Figure 2-3 Derby Grit Facility Overhead Clamshell Hoist

4. **Channel-Mounted Comminutor.** Two channels direct flow from the grit chamber to the primary clarifiers. With a new headworks screening facility, as called for above,

the comminutors would no longer be required and therefore should be removed. This will allow for redundant channels to primary treatment.

Figure 2-4 Derby Comminutor Channel

5. **Primary Clarifiers.** The WPCF has two 90 ft. x 16 ft. x 10.5 ft. side water depth (SWD) rectangular primary settling tanks, which include chain-and-flight sludge collectors and tipping weir scum troughs. Due to the lack of proper headworks facilities, grit tends to collect in these clarifiers and cause operations challenges. It appears the plant has adequate primary clarifier capacity, at least under normal flows. One of the primary clarifiers was down for repair at the time of the site visit; the focus of the repair appeared to be the internal mechanism. Both clarifiers were constructed in 1964, and show some structural cracks due to their age and settlement. Complete replacement of the mechanisms at both clarifiers is recommended. These structures also need to be studied to determine the extent of repairs required.

   Two plunger pumps located in the operations building convey primary sludge to storage.

Figure 2-5 Derby Primary Clarifiers

6. **Aeration Basins.** The plant has three basins for activated sludge secondary treatment. Each basin is configured in two passes, each pass being 100 ft. x 20 ft. x 15 ft. SWD.

Basins No. 2 and 3 were modified in the 1998 upgrade to operate in an MLE process configuration for nitrogen removal (with the first two-thirds of the first pass in each train being converted to an anoxic zone). The third basin, Basin No. 1, was left unmodified. Operations staff report that the two modified basins have provided sufficient capacity for plant wastewater flows. Based on issues discussed in the Facilities Plan, the aeration basin diffuser and blower system should be upgraded to improve overall energy efficiency, and for better DO control to optimize nitrogen removal. Additional investigation is required to confirm whether the existing off-line aeration basin needs to be upgraded.

Figure 2-6 Derby MLE Basins

7. **<u>Aeration Blowers</u>.** Process air to the aeration basins is provided from one variable speed positive displacement blower installed during the 1998 upgrade, and by an ABS variable-speed turbo blower purchased by the City in 2010. The newer, high-speed turbo blower is located in the same room with sludge pumps, which raises concern since the sensitive electronic controls of turbo blowers can be impaired by the presence of hydrogen sulfide.

   Most of the blower system piping is outdated, and is leaking in several locations. The blower system should be updated at the same time that work in the aeration basins is being done in order to replace the aeration piping and to provide redundant blowers that are energy efficient. The blowers may need to be relocated to another building or in a new building if ventilation at the existing location cannot be positively corrected.

Figure 2-7 Derby Aeration Blowers

8. **Secondary Clarifiers.** Secondary settling is accomplished in two 60 ft. dia. x 10 ft. SWD secondary clarifiers with draft tube type sludge removal mechanisms. With only two clarifiers there is no redundancy if one unit is out of service. Also, the flow split between the two is uneven. New mechanisms and improved internal baffling are recommended for both secondary clarifiers, as well as hydraulic modifications upstream to improve flow splitting upstream of the clarifiers. The operations and performance should be reviewed after these modifications are implemented, to assess whether additional capital improvements will be required. The secondary clarifiers are served by three variable-speed centrifugal RAS pumps, all located in a dry pit.

Figure 2-8 Derby Secondary Clarifier

9. **Disinfection.** The Derby WPCF provides seasonal disinfection (May-September) with sodium hypochlorite, fed via peristaltic metering pumps. There are two parallel chlorine contact basins. The Facilities Planning Study noted that this system has been functioning properly overall, but recommended modifications to improve operational flexibility and to optimize the chemical dose. Dechlorination is accomplished by feeding sodium bisulfite. Since the chlorination system was installed over 20 years ago, plans for its renewal should be included as part of the overall plant upgrade.

Figure 2-9 Derby Chlorine Contact Basins

10. **Sludge Processing and Disposal**. Primary sludge is pumped manually to a sludge holding pit in front of the aerobic digesters. There are two rectangular aerobic digesters with coarse bubble diffusers, built in 1972 and located in a fiberglass enclosure with inadequate ventilation. Waste activated sludge (WAS) is thickened in a rotary drum thickener, located in the secondary control building. Thickened WAS is mixed with the primary sludge, and the mixed sludge is dewatered on a 1.5-meter gravity belt filter press, then trucked offsite by Synagro for further treatment and incineration.

    The two circular anaerobic digesters at the plant were built in 1964 and no longer function as digesters, but have been used for sludge storage. There are also two rectangular aerobic digesters at the plant with coarse bubble diffusers, built in 1972 and located in a fiberglass enclosure with inadequate ventilation.

    The Facilities Plan noted that the sludge processing equipment is over 30 years old, having served beyond the end of its useful life. That Plan recommended a complete upgrade of the sludge processing system, including rehabilitation of the old digesters and providing new sludge dewatering facilities, including a sludge cake storage area. However, Black & Veatch believes that the size of this plant is too small to justify this level of capital expenditure for solids processing. Average annual flow for 2015-2017 was only 1.3 MGD. For a plant of this size, we believe a more appropriate solution (one we expect will be lower in life cycle cost and easier to operate) would be to store thickened liquid sludge onsite without dewatering, and to haul it offsite in liquid form, in tanker trucks.

    The approach we recommend would eliminate the need for: anaerobic digesters, aerobic digesters, sludge dewatering systems, sludge cake conveyance, and sludge cake storage and handling. Instead, all that would be required is WAS thickening, primary sludge thickening, thickened liquid sludge pumping, thickened liquid sludge storage and tanker truck loading facilities. The liquid sludge storage facility would require mixing and the ability to decant.

Figure 2-10 Derby Former Anaerobic Digesters

11. **Electrical System.** Most of the electrical equipment at the plant is over 30 years old. The plant upgrade should consider replacing all major MCC's and power and lighting panels.

12. **Plant Controls and SCADA.** The plant is largely operated in manual mode and does not have a functioning Supervisory Control and Data Acquisition (SCADA) system to monitor and control plant operations. A new SCADA system should be included as part of the plant upgrade.

13. **Odor Control.** Odor control will be an increasingly important issue at the plant, especially in view the plant's proximity to the Downtown area, and anticipated development on a site adjacent to the plant. Odor control facilities must be included with the plant upgrade and be integrated with other systems, particularly the headworks, sludge processing areas and other areas that are sources of odorous air.

14. **General, Site-wide Observations.** In addition to the condition assessment observations made related to specific systems, as noted above, there were also general observations made, related to the overall condition of the Derby WPCF.

    Significant concrete spalling and rebar corrosion are noticeable at some of the structures, particularly in the headworks area. Also, there were a number of noticeable safety hazards at the plant. These included: open, unprotected areas above liquid surfaces; solids accumulated in walking areas; and poor ventilation in confined space type areas that had to be entered regularly by plant staff for maintenance (including manually raked bar screens in a lower level space at the headworks). The plant water system is at the end of its useful life and should be replaced with the next major plant upgrade.

    The plant site is largely hemmed in with relatively little room to expand, especially with plans for development on adjacent property.

2.2 DESCRIPTION OF EXISTING FACILITIES – DERBY WASTEWATER COLLECTION SYSTEM

The Derby wastewater collection system, which serves approximately 95% of the properties in the City, dates from the late 1800's. The town's collection system is served by two major interceptors: one serving the area on the west side of the Naugatuck River, and the other serving the area on the east side. The subareas are broken out and described further in Section 5 of the Facilities Plan.

According to Derby's Collection System Capacity, Management, Operation & Maintenance (CMOM) Manual (November 2017), the Derby collection system has approximately 218,172 LF of gravity sewer and 6,770 LF of force main. Overall, sewer pipe sizes in the collection system range from 6-inch to 24-inch. The system also includes four inverted siphons.

From the Wastewater Facilities Planning Study, approximately 70% of the gravity sewers in the collection system consists of vitrified clay (VC) pipe. Based on a review of 20 years of television inspection tapes of existing sanitary sewers in Derby done by Weston & Sampson in 2012, representing approximately 45,600 LF of pipe, by far the more serious defects found in the system per foot were in the VC pipes (see Facilities Plan, section 5.1.3).

The 2014 Facilities Plan identified significant infiltration and inflow (I/I) issues in the collection system. The Phase II Sewer System Evaluation Survey (SSES) (April 2016) investigated 11 sewersheds or subareas of the wastewater collection system, utilizing television inspection, smoke testing, dye water testing, flow monitoring and other standard SSES techniques. Significant inflow was found in five of the subareas, and significant infiltration was found in eight of the 11 subareas. Of more than 160,000 LF of pipeline evaluated, approximately 16,000 LF were identified as candidates for cost-effective repair. A total of $5.4 M in specific improvement projects (2015 dollars) was identified through the Survey, which also recommended additional investigations in the collection system and I/I removal on private property. Derby is committed to an ongoing I/I reduction program, in accordance with an ongoing Clean Water Act Consent Order with DEEP and USEPA (Docket No. CWA-AO-R01-FY16-02). As documented in a letter to CT DEEP on November 22, 2016 related to the Consent Order, the City plans to spend an average of $270,000/year on I/I reduction over the next 15 years, to comply with the Order.

In 2017, Derby replaced 2,000 LF of sewer mains on Emmet Avenue. Other recent work on the collection system included isolating catch basins with indirect connections to the sewer system and replacing manhole covers. However, much additional work remains to be performed to upgrade the collection system.

A major upgrade/ rehabilitation of the downtown area (Route 34) of Derby is a state-funded project, with construction scheduled to begin in 2019. As part of this program, the roof drains and sump pump systems at 37 buildings in the downtown area will be separated and re-connected to a new storm water drainage system that will be constructed as part of the roadway rehabilitation project.

2.3 DESCRIPTION OF EXISTING FACILITIES – DERBY WASTEWATER PUMPING STATIONS

The Derby wastewater collection system has four pumping stations. These are described in Section 6 of the 2014 Facilities Planning Study, and are:

1. South Division Street PS – The upgrade to this pump station has been completed.
2. Burtville Avenue PS – The upgrade to this pump station has been completed.
3. Roosevelt Drive PS – Replacement of this pump station is under construction, scheduled to be completed in May 2019, at a budgeted cost of $7.4M.
4. Patty Ann Terrace PS **–** This pump station, which was noted as deficient in the 2014 Facilities Planning Study, has been recently replaced by a new pump station.

The pumping stations are monitored through two inspections that occur each week. Each station has an alarm, which is transmitted by telemetry system to a pager. To date, these pump stations have not been on a SCADA system. The plan to add a new facility, the East Derby Pump Station, was recommended at the time of the 2014 Facilities Planning Study. However, Derby WPCA no longer considers this project, which was intended to eliminate a problematic siphon under the Naugatuck River, to be necessary. Therefore, following completion of the Roosevelt Drive Pump Station in 2019 there are no planned capital projects related to the wastewater pumping stations.

2.4 CAPITAL PROJECT NEEDS TO 2040 UNDER BASE CASE

This section summarizes the capital upgrades and improvements that would be needed for Derby to meet system needs throughout the planning period (to 2040), without regionalization.

The 2014 Facilities Planning Study developed a recommended plan for capital improvements over a 20-year planning period, summarized in Table 11-1 of that study. Derby WPCA officials updated items on that table related to projected collection system and WPCF capital improvements as part of the referendum passed in 2014.

2.4.1 Capital Projects to 2040 – Derby Water Pollution Control Facility

Based on Black & Veatch's review of the existing facilities at Derby, the following summarizes the improvements that we believe should be made at the WPCF. In view of the age and condition of the existing facilities, we believe that under the base case scenario (no regionalization for Derby), these improvements should be implemented in a single major plant upgrade. That upgrade should include the following components:

1. Replacement of the existing headworks, to provide a reliable medium- or fine-screening facility upstream of the influent pump station.
2. Replacement/ upgrade of the grit removal facility.
3. Complete mechanical and electrical upgrade of the influent pump station, replacing all pumps, motors, valves, piping, controls, etc. A major upgrade to the building housing the pump station also will be required.
4. Replacement of the existing primary clarifier mechanisms, which are beyond their useful life. The concrete tanks also need to be carefully reviewed in light of cracks in these structures, to assess the extent and cost of repairs required.
5. Complete mechanical upgrade of the sludge transfer pumping systems, including primary and secondary sludge pumping, thickened sludge pumping, and primary sludge grinders.

6. Simplify the sludge processing arrangement. Provide thickening for primary sludge and for waste activated sludge; and then store the thickened liquid sludges onsite, to be trucked offsite for dewatering and incineration. This approach would eliminate the need for anaerobic digestion, aerobic digestion, sludge dewatering and sludge cake transfer/ storage facilities onsite. This is a more cost-effective solution for a relatively small plant of this size, and would be simpler to operate and maintain.
7. Upgrade the site-wide electrical system, and provide a full plant SCADA upgrade. This would provide several operational advantages, such as allowing automatic or remote activation to switch to step-feed mode during wet weather events (as opposed to the current situation, which requires local manual switching).
8. An upgrade (as opposed to a total replacement) of the main operations building.
9. A full process upgrade of the secondary treatment system, to optimize performance of the BNR system and to improve energy efficiency. This would include adding additional high efficiency blowers and aeration distribution system, improving segregation and air supply to the blowers, replacing the RAS pumps, and hydraulic modifications to improve flow spit to the secondary clarifiers.
10. The secondary clarifier mechanisms and internal baffles need to be replaced. Surface loading rates are high at current and future peak day and peak hour hydraulic loading rates, and the relatively shallow depths of the clarifiers (10 ft SWD) do not provide a great deal of operating cushion to protect the sludge blanket from being scoured during peak flows. It may be possible to mitigate this without adding a third clarifier by implementing other modifications, for example by adding sludge blanket baffles within the clarifiers. This will need to be confirmed with additional study of the clarifiers.
11. The plant water system should be replaced.
12. Other plant systems including disinfection, dechlorination and odor control, should be upgraded.
13. We do not see a justification for implementing a membrane-based treatment system in the future, as was suggested for a future Phase 3 Upgrade package, in the Facilities Planning Study. For this size facility, with the effluent limitations anticipated for the future, we believe the best long-term plan will be to stay with an activated sludge BNR-type system with conventional clarifiers. This will also be easier to operate and will have lower O&M costs compared to a membrane-based treatment system.

2.4.2 Alternative Sludge Processing Approach

The strategy of eliminating sludge dewatering, as proposed above, could include modifying existing tankage or installing two new steel storage tanks: one for thickened primary sludge (TPS) and one for thickened waste activated sludge (TWAS). Plant personnel would pump the thickened sludges to the storage tanks daily; then the thickened sludges would be transferred to tanker trucks for hauling to the offsite merchant facility.

Based on rough estimates of sludge produced at the Derby plant, it appears that two 40,000-gallon steel tanks, one for TPS and TWAS storage, would suffice. The tanks should provide for several days' worth of thickened sludge storage in the event of an interruption in the hauling schedule.

If required, the temporary sludge storage tanks could be silo-type with conical bottoms to minimize concerns with sludge settling out. They should also be covered to minimize the release of any odors that are produced during storage. Any new tanks required would be anchored to new concrete pads, and could be located near the anaerobic digester tanks; however, other locations could be made to work as well.

Storage tanks for the thickened sludges (TPS and TWAS) could be fed through new connections to the existing buried sludge lines. Sludge loading pumps would be required to transfer one truck's worth of sludge (6,500 gallons). These truck loading pumps would withdraw sludge through a connection at the bottom of the storage tanks.

Due to the raw nature of the stored sludges, odors associated with hydrogen sulfide formation may be produced, particularly in the TPS storage tank. To minimize these odors, ferrous chloride could be metered into the two thickened sludge streams ahead of the storage tanks. Odorous off-gases in the air spaces above the sludge liquid in the storage tanks could be treated by an activated carbon odor control system. A similar activated carbon system would be used to treat off-gases that are produced as trucks are filled.

2.4.3 Capital Projects to 2040 – Derby Wastewater Collection System

The following projects are scheduled for construction in 2019:

1. Route 34 gravity sewer replacement;
2. Hawthorne Avenue sewer lining and replacement; and
3. Force main extension and replacement, associated with Roosevelt Drive Pumping Station improvements.

The following projects that were included in Table 11-1 of the Facilities Planning Study have been deleted from the capital improvements program:

1. McConney Grove sewer system extension; and
2. Various planned development projects, including: Commerce Street/ Business Park, Hitchcock/ Hines, Derby Business Revitalization, HALO Project, and Derby Sterling Opera House.

As noted in prior reports, collection system peak flows can reach up to 13 MGD. While some work has been undertaken in the collection system, additional work is required to provide a reliable system. Investigations and prioritization is needed to maximize reliability and benefit.

2.4.4 Capital Projects to 2040 – Derby Wastewater Pumping Stations

The following projects that were included in Table 11-1 of the Facilities Planning Study have been completed (as of October 1, 2018):

1. South Division Street Pumping Station improvements;
2. Burtville Avenue Pumping Station improvements; and

3. Patty Ann Terrace Pumping Station improvements.

The Roosevelt Drive Pumping Station improvements project, which was included in Table 11-1 of the Facilities Planning Study, is scheduled for construction in 2019. Therefore, the only pumping station project included in the Facilities Planning Study that is yet to be constructed is the proposed new Division Street Pump Station.

2.5 PROJECTED CAPITAL EXPENDITURES – 2040 BASE CASE

Projected expenditures for the WPCF, the wastewater collection system, and the wastewater pumping stations have been addressed as part of this early planning study. Budgetary capital and operating costs associated with the base case scenario for Derby outlined in this section are provided in Appendix A of this report. Since no engineering design has been undertaken for these proposed upgrades, the costs provided in that appendix are for higher-level budgeting purposes only, and have been based on typical parametric considerations, i.e. dollars-per-gallon, taking into consideration the size and age of the facility as well as the overall constraints of the site. Operations and maintenance costs have been based on current operating cost information provided by the City.

3.0 ANSONIA WASTEWATER FACILITIES ASSESSMENT

3.1 DESCRIPTION OF EXISTING FACILITIES – ANSONIA WATER POLLUTION CONTROL FACILITY

The Ansonia Water Pollution Control Facility (WPCF) was constructed as a primary treatment plant in 1968, and upgraded to secondary treatment in 1970. An extensive upgrade to the WPCF was completed in 2011. The WPCF serves approximately 98% of the residents of the City of Ansonia, a small portion of Derby, and minor sections of Seymour and Woodbridge. The plant is a secondary treatment plant in a four-stage Bardenpho process configuration for nitrogen removal, with oxidation ditch (carousel) aeration, and UV disinfection. The plant process also provides for seasonal phosphorus removal, to meet effluent requirements for discharge to the Naugatuck River.

As part of the condition assessment of existing facilities, Black & Veatch reviewed the Preliminary Design Report (October 2006) and the design plans for the plant upgrade. Black & Veatch also visited the WPCF on July 12, 2018 accompanied by plant superintendent Brian Capozzi. An assessment of each major system of the plant follows, based on a review of existing reports, observation of the facilities and discussions with WPCA staff.

1. **Mechanical screening.** The plant has only one mechanical bar screen, which was installed as part of the 2011 plant upgrade, along with the associated screenings process equipment. This is upstream of the influent pump station. There is also a second (manual) bar screen located at the lower level, which is more difficult to access.

Figure 3-1 Ansonia Mechanical Bar Screen

2. **Influent Pump Station.** The plant's influent pumping station has two smaller and two larger centrifugal pumps in a dry pit. All four pumps are new from the 2011 plant upgrade.

Figure 3-2 Ansonia Influent Pumps

3. **<u>Vortex Grit Separation</u>.** The plant has a new covered vortex grit chamber and grit system, also from the 2011 plant upgrade. There are provisions to bypass flow around the grit chamber when maintenance is required.
4. **<u>Primary Clarifiers</u>.** The chains and flights in the existing primary clarifiers were replaced during the 2011 upgrade. The clarifiers were full at the time of the visit, but appear to be in satisfactory condition based on staff input.

Figure 3-3 Ansonia Primary Clarifiers

5. **<u>Primary Sludge Pumps</u>.** The primary sludge pumps are air-driven diaphragm pumps, in a 4+1 arrangement. Pumps are FLSmidth slurry pumps, which are unusual in this type of application; those pumps are typically found in mineral slurry applications in the

mining and minerals industries, rather than for domestic wastewater sludge. It was reported that these are high-maintenance items, and that the ball checks need to be replaced relatively frequently. Without a high amount of maintenance for this system, these pumps would be unreliable. Ansonia is considering replacing these pumps with a pump more commonly used in primary sludge pumping applications.

Figure 3-4 Ansonia Sludge Pumps

6. **<u>BNR Secondary Treatment</u>.** The secondary treatment system features 2-stage anoxic zones, as well as first and second stage aeration. The old aeration basins were modified to become first stage anoxic zones. There appears to be some structural damage showing at these older tanks, including some cracks at the top of the walls.

   The first stage of aeration is accomplished by two oxidation ditch (carousel or racetrack type) aeration basins operated in parallel, which were installed during the 2011 upgrade. Orientation of one of the ditches appears to be backwards relative to what it should be, and as a result there may be some short-circuiting. Since the plant is operating below its design capacity, this does not appear to be a problem at this time. However, it could become an issue if plant flows increase to the point where they approach the plant's design capacity.

   Former rectangular secondary clarifiers were modified to become second stage aeration and second stage anoxic basins. New blowers and diffusers were installed for the second stage aeration system.

Figure 3-5 Ansonia Converted Anoxic Basins

Figure 3-6 Ansonia Oxidation Ditch Aeration Basin

7. **Secondary Clarifiers.** New circular secondary clarifiers were installed during the 2011 plant upgrade, along with new RAS and WAS pumping systems. Ansonia is adding alum ahead of the secondary clarifiers for phosphorus removal. Ansonia operations staff report that the phosphorus removal system is working well, and they have been meeting permit requirements for effluent phosphorus.

Figure 3-7 Ansonia Secondary Clarifier

Figure 3-8 Ansonia RAS and WAS Pumps

8. **<u>UV Disinfection</u>.** A new UV disinfection system was added to replace the chlorine contact tanks. Although the plant has only a single UV channel, some level of redundancy is provided since there is more than one bank of UV lamps in that channel.

9. **<u>Effluent Pump Station</u>.** The effluent pumping station, which is adjacent to the influent pump station, has two pumps in a duty/standby arrangement. The influent and effluent pumping stations are both designed for peak flows of up to approximately 12 MGD. However, according to plant staff the flow to the effluent pump station is limited to approximately 7 MGD. The cause of this limitation has not been fully investigated.

However, initial observations suggest there may be a hydraulic constriction in the conveyance system feeding into the effluent pump station wet well. As a result, the plant cannot handle peak flows greater than 7 MGD.

This is a problem that deserves immediate attention, and needs to be corrected as soon as possible, as historic peak flows to the plant as high as 10 MGD have been recorded. The current situation not only limits the plant's ability to handle peak flows from Ansonia, but also limits the facility's ability to receive wastewater flows from other communities as part of this regionalization study.

10. **Alkalinity Supplementation System.** The Merrick silo soda ash feed system was not being used at the time of the site visit, because the treatment process has not been requiring supplemental alkalinity. Plant operations staff noted that the layout of the pump system makes maintenance of this system very challenging.

11. **Thickened Sludge Storage.** WAS is thickened using rotary drum thickening. Thickened WAS is stored in one of two sludge holding tanks (two converted anaerobic digesters). Primary sludge from the primary clarifiers is pumped to the other storage tank. The sludge from these tanks is hauled away via tanker trucks to offsite incineration.

    The sludge storage tanks do not have decanting ports. The City reports that having the ability to decant from the storage tanks would reduce the amount of water hauled off by the tanker trucks, thereby extending storage capability and reducing hauling costs.

Figure 3-9 Ansonia Former Digesters Used for Sludge Storage

12. **Overall Observations.** In general, the plant infrastructure appeared to be in good condition, since most of the mechanical systems and some of the basins had been replaced or overhauled as part of the major upgrade to the plant in 2011. Also, MOR

effluent data indicate very good, consistent treatment plant performance. Record effluent BOD and TSS is consistently in single digits, and the WPCF is meeting nitrogen and seasonal phosphorus removal requirements.

3.2 DESCRIPTION OF EXISTING FACILITIES – ANSONIA WASTEWATER COLLECTION SYSTEM

This assessment of the condition and needs of the Ansonia wastewater collection system is based information contained in the 2004 Facilities Planning Study and discussion with WPCA staff.

The Ansonia collection system includes approximately 345,000 LF of sewers and includes three major interceptors: Two-Mile Brook interceptor, interceptors along the Naugatuck River, and an inverted siphon under the river. Much of the pipe is old, including vitrified clay (VC) pipe. Ansonia has undertaken several I/I reduction projects in recent years. However, while progress has been made, the collection system has I/I issues that contribute to high peak wet weather flows to the WPCF as noted in TM No. 1 – Flows and Loads.

As part of the 2004 Facilities Planning Study, televised inspections were performed for a significant number of pipes in the system. The videotapes of these inspections are still available, but summaries of the data were not developed, and some of the recommended improvements based on these videos were implemented. No further televised sewer inspections or other sewer system evaluation surveys (SSES) have been conducted since the 2004 study and associated construction activities.

Improvements recommended in the 2004 Facilities Planning Study were bundled into engineering and rehabilitation projects in May 2006. Two contracts were developed. The original design contract was $891,000 to cover identified improvements including inflow control, point repairs, manhole cover replacements, etc. Insituform was selected for the second contract, which focused on pipe lining and other rehabilitation efforts, with a contract cost of $2,934,000. The length of pipe and number of manholes rehabilitated in this project is not readily known. It was reported that because the pre-construction televised inspections required additional repairs, the lining project addressed approximately 60% of the recommended improvements identified in the 2004 Facilities Planning Study. No additional rehabilitation work has been performed on the collection system since the completion of these projects.

3.3 DESCRIPTION OF EXISTING FACILITIES – ANSONIA WASTEWATER PUMPING STATIONS

The City of Ansonia collection system has 14 wastewater pumping stations. Four of these are small "can" type stations that serve just a few homes; Ansonia hopes to eliminate up to three of these small stations by going with gravity systems instead. Of the remaining 10 larger stations:

- six have been upgraded within the past six years;
- the two largest two stations (Coe Pump Station, and Bartholomew or "Bart" Pump Station) were completely upgraded within the past ten years, including with new generators; and
- the other two stations were upgraded 6-10 years ago.

The WPCA staff is responsible for pumping station maintenance.

3.4 CAPITAL PROJECT NEEDS TO 2040 UNDER BASE CASE

This section summarizes the estimated capital improvements that would be needed for Ansonia to meet system needs throughout the planning period (to 2040), without regionalization

3.4.1 Capital Projects to 2040 – Ansonia Water Pollution Control Facility

Ansonia completed an extensive upgrade to the WPCF in 2011, and is consistently meeting permit requirements for all parameters, including nitrogen and seasonal phosphorus removal. The plant is overall in satisfactory operating condition. It is operating well under its design capacity, and is not projected to exceed that within the 20-year planning period. While the hydraulic restriction at the effluent pump station is a deficiency identified above that needs to be addressed immediately, at this point it has not yet been determined what the cause of that problem is, nor what capital expenditures would be necessary to correct it.

Otherwise, no additional major capital needs are foreseen in the near future as being required at the WPCF under the base case scenario (if no regionalization for Ansonia). Based on a 20 to 25-year average life for major mechanical systems that are well-maintained, and barring unforeseen changes in discharge requirements, the next major upgrade should be to replace recently-installed mechanical equipment when it comes to the end of its useful life. That would put the next significant mechanical upgrade cycle for the Ansonia WPCF in the 2031-2036 timeframe, near the end of the current planning period of this study.

3.4.2 Capital Projects to 2040 – Ansonia Wastewater Collection System

Increased investment in the collection system is needed to maintain appropriate service levels and meet regulatory requirements. A common industry approach in high-level analysis is to reference the estimated useful life of assets and estimate investment levels based on that useful life. For example, a 100-year useful life would require replacing an average of 1% of the system each year.

Initial activities would be focused on identified hot spots that have more frequent backups. The objective would be to focus on problematic areas and address them. The north end of downtown is believed to be the most problematic area at this time.

3.4.3 Capital Projects to 2040 – Ansonia Wastewater Pumping Stations

All ten of the larger pumping stations in the system have been upgraded within the past 10 years, and there are no plans to upgrade any of these stations in the near future nor to add new pumping stations. All of the pump stations in the system may be due for a major mechanical upgrade in 10-15 years. In the interim, it appears that the only capital expenditures foreseen related to the pumping stations would be for periodic upgrades and replacement of mechanical equipment and components that is typical for these types of facilities.

3.5 PROJECTED CAPITAL EXPENDITURES – 2040 BASE CASE

Projected expenditures for the WPCF, the wastewater collection system, and the wastewater pumping stations have been addressed as part of this early preliminary study. Budgetary high-level capital and O&M costs associated with the work described in this section are provided in Appendix B of this report. In the absence of engineering estimates for specific capital projects, the cost information in that appendix represents high-level budgetary costs based on typical parametric values such as dollars-per-gallon of treatment. Operations and maintenance costs have been developed from current operating cost information provided by the City.

4.0 SEYMOUR WASTEWATER FACILITIES ASSESSMENT

4.1 DESCRIPTION OF EXISTING FACILITIES – SEYMOUR WATER POLLUTION CONTROL FACILITY

The Seymour WPCF was built in the 1970s, with a significant upgrade implemented in the early 1990s. It serves a sewered population of approximately 7,500 that includes the Town of Seymour plus a small portion of Oxford. The Seymour WPCF is a secondary treatment plant in a Modified Ludzak Ettinger (MLE) process configuration, followed by chlorination/dechlorination disinfection and cascade reaeration prior to discharge to the Naugatuck River. Recently the plant has begun to provide enhanced seasonal phosphorus removal, via chemical addition.

The plant, which currently is operated by Veolia Water, is designed and permitted to treat 2.93 MGD on an average annual basis. However, in recent years (2015-2017) the average flow to the plant has been approximately 0.97 MGD.

As part of the condition assessment of existing facilities, Black & Veatch reviewed available documents, which included the May 2016 WPCF Phosphorus Planning draft engineering report, and some of the 1991 upgrade design drawings which were made available. Black & Veatch also visited the WPCF on August 22, 2018 accompanied by Veolia Water plant manager Walter Royals. An assessment of the major plant facilities follows based on a review of available documents, observation of the facilities and discussions with Veolia Water and WPCA staff.

1. **Influent Screening.** After Parshall flume flow measurement, the incoming wastewater flows through a coarse manual bar rake with 1.5-inch spacing. The flow then travels through a single mechanical bar screen located in a three feet wide channel. Bar spacing on the screen is 0.75 inches. A bypass channel allows for uninterrupted flow-through during times when the mechanical screen is down for maintenance. Captured screenings are lifted by a bucket elevator system to a dumpster at grade. The mechanical bar screen equipment and screenings handling system dates to the 1990s plant upgrade, and needs to be replaced with new equipment. This entire facility is located outdoors which makes operations and maintenance difficult, especially during the cold seasons.

Figure 4-1 Seymour Headworks Area

2. **Grit Removal.** A single rectangular aerated grit chamber receives the flow after screening. The tank is equipped with a submerged auger and bucket elevator for removal of grit. The grit is discharged into a classifier system prior to being conveyed into a dumpster. A bypass channel allows for flow to continue to pass through the plant during times when the grit chamber is down for service. The grit chamber facility and equipment was last upgraded in the early 1990s, and needs to be replaced with new equipment.

3. **Influent Pump Station.** The influent pump station is set up in a wetwell/drywell arrangement, and has three pumping units. The pumps are located at the lower level, with motors on the upper level connected by extended shafts. Each pump is rated at 2,700 gpm and the facility is reportedly rated at 5,000 gpm with two pumps operating and the third pump is a standby unit. All pumps are operated with variable frequency drives (VFDs). The pump station equipment was installed in the 1990s upgrade; however, some modifications have been made to the pumps since that time. Based on age of the equipment, this facility needs to undergo a major overhaul in the near future.

4. **Primary Settling Tanks**. The plant has four rectangular primary settling tanks. Two of the tanks date back to the original construction of the 1970s; the other two were constructed as part of the upgrade done in the early 1990s. The tanks include longitudinal sludge collectors with surface scum skimming. Effluent from the primary settling tanks flows to the secondary treatment influent box. Scum collected from the primary settling tanks is discharged to the primary scum reactor. The mechanisms on two of the four primary settling tanks require replacement. Metal within the tanks will require either replacement or sand blasting and recoating, depending on actual condition.

Figure 4-2 Seymour Primary Clarifiers

5. **Aeration Basins.** The biological treatment facilities include three rectangular extended aeration activated sludge basins. The basins are in an MLE configuration, to provide nitrification-denitrification. The middle basin, which serves as the anoxic zone, receives the primary effluent. Three submersible mixers keep this basin gently stirred. The outer basins are equipped with grid type fine bubble diffusers. The aerated basins are

equipped with effluent weirs which allow mixed liquor flow to the final clarifiers. Based on the age of the equipment, it is recommended that the aeration diffuser system in the aeration basins be programmed for replacement.

Figure 4-3 Seymour MLE Basin

6. **Aeration Blowers.** The aeration blowers include a newer magnetic bearing turbo blower unit which serves as the duty unit and two older style multistage centrifugal blowers. It is recommended that a new turbo blower be provided to match the operating conditions of the existing turbo blower. This will provide for more efficient operations and reliable back-up to the existing turbo blower. The older multi-stage blowers should be decommissioned. It is noted that the blowers are located within the same general space as sludge pumps. Turbo blowers have sensitive electronics that make them vulnerable to harsh environments, including sludge gasses that are prevalent at a wastewater treatment plant. The ventilation in the blower room space needs to be reviewed and modified accordingly such that the air supply to the blowers, including the space they occupy, is noncorrosive and conducive to their overall reliability. Relocating the blowers may be required if the ventilation system problem is not corrected.

Figure 4-4 Seymour Blower

7. **Final Clarifiers.** The two final clarifiers are 65-foot diameter, with 13-foot side water depth. The clarifiers are equipped with rotating suction type sludge collectors. The clarifiers were part of the early 1990s upgrade. Due to their age, the internal mechanisms in these tanks need to be replaced with new equipment. A detailed condition assessment of this equipment may show that sand blasting and recoating of all metal parts could be done as part of the upgrade.

Figure 4-5 Seymour Final Clarifier

8. **Phosphorous Removal System**. The Town recently installed and commissioned a chemical phosphorous removal system at the plant. The system utilizes alum, which is introduced into the process at the aeration basins effluent.

Figure 4-6 Seymour Alum Feed System for P Removal

9. **Disinfection**. Sodium hypochlorite is used for disinfection, with sodium bisulfite added post-disinfection, for dechlorination. From conversations with plant staff, it appears that the disinfection and dechlorination systems, including the chlorine contact tanks, are in satisfactory condition at this time.

10. **Sludge Processing and Treatment.** Sludge from the primary settling tanks is mixed with primary scum and pumped to a rotating drum thickener (RDT) for thickening. The waste activated sludge is co-thickened with the primary sludge at the RDT. The thickened combined sludge is discharged to a sludge holding tank located below grade. The thickened sludge is pumped to the belt filter press (BFP) for dewatering. The dewatered sludge cake discharges into a truck which hauls the material off-site to a merchant incineration facility for final treatment.

    The RDT has reached the end of it useful life and needs to be replaced. The BFP has also reached the end of its useful life. From experience gained from working at other small plants, we believe that sludge processing should end with thickening at Seymour. The thickened sludge would then be hauled off-site for additional treatment at the merchant incineration facility. The two sludges should also be handled separately, and not combined; this is to minimize release of odorous compounds and to minimize corrosion of steel and concrete. This should be investigated further in lieu of proceeding with new sludge dewatering equipment.

Figure 4-7 Seymour Rotary Drum Thickener

11. **Electrical System.** The majority of the electrical panels and motor control centers at the plant are approximately 25 years old, dating back to the early 1990s upgrade. Some units are even older, from the 1970s project. This equipment is either at its end of usefulness or fast approaching its life expectancy. We recommend that all MCCs and electrical panels from prior to the 1990s upgrade be replaced with new gear. The electrical power and lighting panels and MCCs from the 1990s upgrade should be carefully evaluated and replaced as needed. This gear can be expected to reach the end of its useful life by 25 or 30 years after being put in service; on that basis Seymour should program for its replacements soon.

12. **SCADA.** The WPCF is operated for the most part in manual mode. It is manned one shift per day, five days per week, with alarms during off-hours going to operator phones. The Town should implement a new SCADA system at the facility. A SCADA system will provide for effective monitoring and also for automatic control. The SCADA system can be programmed to operate the plant with various degrees of automation. A new SCADA system

would improve reliability in operations and maintenance, and also would enhance accountability in O&M and in overall treatment performance.

13. **Valves & Gates.** The WPCF has numerous slide gates, sluice gates and valves. The sludge processing systems in particular have numerous valves critical to the operation of these systems. A close inventory and condition assessment of all slide and sluice gates and valves throughout the plant should be undertaken and these critical components should be replaced as needed.

14. **Odor Control System.** The existing biofilter, which draws odorous air from the sludge thickening and dewatering areas, does not work and needs to be replaced.

4.2 DESCRIPTION OF EXISTING FACILITIES – SEYMOUR WASTEWATER COLLECTION SYSTEM

This assessment of the condition and needs of the Seymour wastewater collection system is based on limited information provided by Nafis & Young Engineers, including information contained in GIS files. According to the GIS, the collection system comprises approximately 63 miles of pipe, with the primary materials being PVC (39%), asbestos cement (34%), and vitrified clay (23%).

No prior plans, condition assessments, or I/I investigation data were available. Prior conversations with WPCA representatives and consultants indicate that the sewer collection system has received limited capital investment over the years. There are no known engineering reports nor investigations available on the condition of the collection system. No information about prior repair history or collection system investments were available.

However, earlier this year Seymour started an initial flow monitoring plan on a section of the collection system. The initial focus of the I/I monitoring program is taking place in an older area that has more problems. Clay pipe is a major problem in the older parts of the system, due to structural integrity and I/I issues. The outlying areas of the town that were developed more recently tend to have newer, PVC pipes.

The WPCA staff is responsible for maintaining the wastewater collection system. At this time, Seymour has no annual sewer replacement program.

As noted in TM No. 1 – Flows and Loads, the collection system has significant infiltration and inflow (I/I) issues that cause high peak wet weather flows to the WPCF. Seymour had the second highest peaking factor of the towns in the study, indicating that the wastewater collection system may be in poor and deteriorating condition, and may have direct inflow connections as well.

4.3 DESCRIPTION OF EXISTING FACILITIES – SEYMOUR WASTEWATER PUMPING STATIONS

The two largest pump stations in the collection system are both located on Derby Avenue: the South Derby Pump Station and the North Derby Pump Station. It appears these two pump stations received significant upgrades approximately 10 years ago. There are also eight smaller pump stations, at least six of which are new stations with submersible pumps. The Seymour WPCA staff is responsible for maintaining the pumping stations. No upgrade and maintenance records were provided on these smaller pump stations.

4.4 CAPITAL PROJECT NEEDS TO 2040 UNDER BASE CASE

This section summarizes the estimated capital facilities that would be required for Seymour to meet system needs throughout the planning period (to 2040), without regionalization. It addresses the WPCF, the wastewater collection system, and the wastewater pumping stations.

4.4.1 Capital Projects to 2040 – Seymour Water Pollution Control Facility

Based on Black & Veatch's review of the existing facilities at Seymour, the following summarizes the improvements that we believe should be made at the WPCF. In view of the age and condition of the existing facilities, we believe that under the base case scenario (no regionalization for Seymour), these improvements should be implemented in a single major plant upgrade. That upgrade should include the following components:

1. Replacement of the existing screenings facility at the headworks, to provide a reliable medium- or fine-screening facility. This would include new mechanical screening equipment as well as associated screenings processing and conveyance systems. These systems should be enclosed.
2. Replacement of the grit removal facility.
3. Complete mechanical and electrical upgrade of the influent pump station, which would include replacing all pumps, motors, valves, piping, drives, controls, etc.
4. Replacement of the mechanisms in two of the four primary clarifiers. The concrete tanks also need to be carefully reviewed in light of their age to assess the extent and cost of repairs required.
5. Replacement of the aeration diffusers in the aeration basins, and other related modifications as needed to optimize BNR system performance and to improve energy efficiency. This would include replacing the older multi-stage blowers with a new turbo blower suitable to operate in concert with the existing turbo blower. Either fix the HVAC issues in the blower area, or consider relocating the blowers into another existing or new building as necessary to maintain an appropriate operating environment.
6. Replacement of the mechanisms on both circular secondary clarifiers.
7. Replacement of the rotary drum thickener (RDT), with similar equipment or other appropriate waste active sludge thickening systems.
8. Decommission the belt filter press (BFP). Instead of dewatering sludge onsite, provide thickened liquid storage onsite, with decanting capability, for trucking liquid sludge offsite for further processing and incineration. For a plant this size, this will be more cost-effective in the long term than dewatering onsite.
9. Upgrade of the site-wide electrical system, which would include replacing all MCC's as well as all of the older electrical panels, including power and lighting panels. Power cables should also be considered for replacement.
10. Provide a full plant SCADA system upgrade.

11. Review the condition of gates and valves throughout the plant, and replace those that are not functioning or which are at the end of their useful life.

4.4.2 Capital Projects to 2040 – Seymour Wastewater Collection System

No capital planning information was provided relating to planned investment in the collection system. It is assumed that increased investment in the collection system is needed to maintain appropriate service levels and meet regulatory requirements. A common industry approach in high-level analysis is to reference the estimated useful life of assets and estimate investment levels based on that useful life.

Because of the high I/I rate and the lack of prior investigation, it is assumed that 1.5% of the system will require replacement or rehabilitation per year to maintain the system. This corresponds to approximately 5,000 ft of pipe per year. This level of investment may not have a significant impact on reducing I/I in the system. It also appears that capital improvements for an initial period of time is also necessary to increase overall system reliability.

Some initial activities would be focused on identified hot spots that have more frequent backups. The objective would be to focus on problematic areas and address them.

4.4.3 Capital Projects to 2040 – Seymour Pumping Stations

There are two larger and eight small pump stations in the collection system. Based on age and condition, we would anticipate a major mechanical upgrade for the larger stations in 10-15 years. The smaller pump stations need to be investigated to determine investment requirements and timing. Lacking this information, it is assumed that these smaller pump stations require upgrade in the next 5 to 10 years.

4.5 PROJECTED CAPITAL EXPENDITURES – 2040 BASE CASE

Projected expenditures for the WPCF, the wastewater collection system, and the wastewater pumping stations have been addressed as part of this early planning study. Budgetary capital and operating costs associated with the base case scenario for Seymour outlined in this section are provided in Appendix C of this report. Since no engineering design nor assessment work has been undertaken for the Town's wastewater treatment, collection and pump station infrastructure, the costs provided in that appendix are for higher-level budgeting purposes only, and have been based on typical parametric considerations such as dollars-per-gallon, taking into consideration the size and age of the facility as well as the other factors, such as plant site constraints.

5.0 BEACON FALLS WASTEWATER FACILITIES ASSESSMENT

5.1 DESCRIPTION OF EXISTING FACILITIES – BEACON FALLS WATER POLLUTION CONTROL FACILITY

The Beacon Falls WPCF is a small facility, with a permitted design flow of 0.71 MGD and recent annual average flow (2015-2017) of approximately 0.31 MGD. The 2015 Wastewater Facilities Plan estimated an average annual flow of 0.36 MGD and a peak day flow of 1.01 MGD. The plant solely serves residents of the Town of Beacon Falls, while other residents in town are served by septic systems and some wastewater flow is sent to the Naugatuck WPCF. The Beacon Falls WPCF was built in 1971 as a secondary treatment plant with primary clarifiers, activated sludge, secondary clarifiers and anaerobic sludge digestion (now used as a sludge holding tank).

The plant, which is subject to nitrogen limits, has been a net payer into the Long Island Sound nitrogen credits exchange program. The plant currently discharges approximately 50 pounds/day of nitrogen; the Town paid approximately $16,000 into the nitrogen credits exchange program in 2017.

The most recent major upgrade to the WPCF was done in 1994, and included: new aeration blowers and diffusers, septage receiving station, sludge pumps, a new (12-foot side water depth) final settling tank, and modifications to the existing (8-foot side water depth) final settling tank. A UV disinfection system was added at the WPCF in 2006. Since much of the mechanical equipment is approaching 25 years in service and clearly nearing the end of its useful life, the plant is due for a major mechanical upgrade.

Since the plant is not at the southernmost (downstream) end of the collection system service area, most of the wastewater flow must be pumped to the plant.

Following a study by an engineering consulting firm which recommended an extensive upgrade to the WPCF, Beacon Falls retained DPC Engineering to develop a more streamlined plan for upgrading the facility. The projected capital cost for upgrading the Beacon Falls WPCF, included in the appendix to this report, is based on information provided by DPC Engineering.

Black & Veatch met with Beacon Falls WPCA members and operations staff at the Beacon Falls WPCF on August 22, 2018, and were given a tour of the facility at that time. The following summarizes observations made regarding condition of the existing facilities.

1. **Influent Pump Station.** The plant influent pump station features three constant speed centrifugal pumps in a wet pit/dry pit configuration. Based on the age and condition of the equipment, it appears that this pump station is structurally sound overall, but is due for a mechanical upgrade.

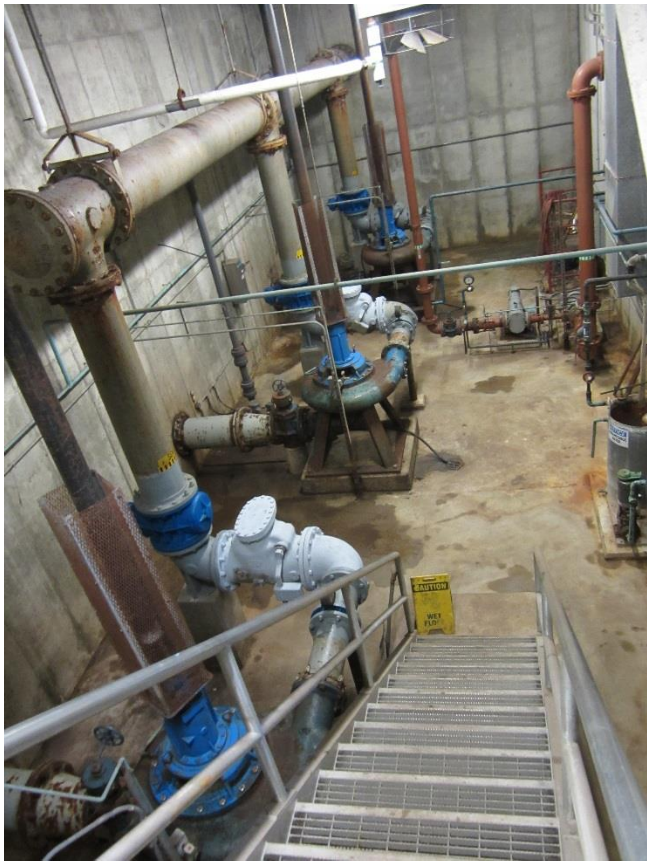

Figure 5-1 Beacon Falls Influent Pump Station

2. **Headworks.** The headworks, which is located downstream of the influent pump station, features a comminutor in parallel with a manually cleaned bar screen in the bypass channel. The equipment is at the end of its useful life and should be replaced.

Figure 5-2 Beacon Falls Comminutor and Bar Screen

3. **Primary Settling Tank.** There is only one primary settling tank at the plant, a rectangular basin mostly below grade, which dates back to the early 1970's. With the tank in service and most of it out of view, it was not possible to assess its condition. A condition assessment needs to be undertaken to determine whether structural repairs are needed. It was not clear whether this tank can be bypassed.

Figure 5-3 Beacon Falls Rectangular Primary Clarifier

4. **Aeration Basins and Blowers.** The secondary treatment system is activated sludge basins, with a grid of diffusers. These were installed during the 1994 upgrade, along with the three small conventional aeration blowers which are located in the basement of the Operations Building. Based on the age of these units, they should be replaced with more energy-efficient modern blowers. The aeration basins need to be modified as well, to improve nitrification and denitrification capability.

Figure 5-4 Beacon Falls Aeration Basin

Figure 5-5 Beacon Falls Aeration Blowers

5. **Secondary Clarifiers.** The Seymour plant has two rectangular concrete secondary settling tanks. The older, original clarifier is relatively shallow (8-foot depth); the second clarifier, added during the 1994 upgrade, is 12 feet deep. It was reported that a retrofit at the inlet to these tanks is required to optimize flow split and overall treatment performance.

Figure 5-6 Beacon Falls Secondary Clarifier Effluent Weirs

6. **<u>Ultraviolet Disinfection</u>.** A new two-bank outdoor ultraviolet disinfection system, installed in 2006, is reported to be in good working condition.

Figure 5-7 Beacon Falls UV Disinfection System

7. **<u>Alkalinity Addition</u>.** Soda ash is added at the headworks for alkalinity supplementation, to facilitate nitrogen removal.

8. **<u>Sludge Processing</u>.** The existing sludge pumps, which include plunger pumps for primary sludge and RAS/WAS pumps for secondary sludge, were installed in the 1994 upgrade and are due to be replaced. The solids processing system blends primary and secondary sludge, which is periodically decanted to a final concentration of approximately 2% solids. The sludge is trucked off-site to a regional sludge treatment merchant plant. The

existing anaerobic digester no longer functions as a digester, and is used for sludge storage. There is an abandoned sludge centrifuge onsite. Mechanical thickening should be provided to decrease sludge disposal costs.

Figure 5-8 Beacon Falls Plunger Pumps for Sludge

9. **Other Items.** The Beacon Falls WPCF Upgrade Summary memorandum provided by DPC Engineering, dated October 18, 2018 identified additional upgrades required at this facility. This includes: operations building roof replacement, site-wide electrical system upgrades, a new emergency standby generator, and miscellaneous safety-related improvements.

5.2 DESCRIPTION OF EXISTING FACILITIES – BEACON FALLS WASTEWATER COLLECTION SYSTEM

Most of the collection system (perhaps two-thirds) consists of pipe installed within the past 20 years, mostly PVC. The remaining one-third of the collection system is older than that. It is reported that the system has approximately 33 miles of sewer pipes overall. The Beacon Falls WPCA has recently taken over responsibility for maintaining the collection system. Most of the maintenance work is related to occasional blockages and root intrusion type problems. There is no annual program for pipe replacement in the system.

An I/I study was reported to have been conducted as part of the 2015 Wastewater Facilities Plan. It recommended further I/I investigation in the future, as well as limited I/I remediation work. At this time, I/I reduction is not a high priority for the Beacon Falls WPCF, and all future plans related to plant upgrades have assumed current levels of I/I wastewater flows.

5.3 DESCRIPTION OF EXISTING FACILITIES – BEACON FALLS WASTEWATER PUMPING STATIONS

All flow to the WPCF is pumped to the plant (none flows to the plant by gravity). There are three municipal pump stations in the collection system, plus one private pump station operated by a condominium developer. The three municipal pump stations typically require minimal maintenance work; it is anticipated that they will require their next major renewal/rehabilitation in approximately 10 years. The three pump stations are:

1. Railroad Avenue Pump Station – Located across from the WPCF, last upgraded 10 years ago; this station takes about 85% of the system flow. Consists of two pumps, each 1,000 gpm.
2. Pines Bridge Pump Station – Utilizes Tsurimi cutter pumps.
3. West Road Pump Station – A very small station, with a 3-inch force main.

5.4 CAPITAL PROJECT NEEDS TO 2040 UNDER BASE CASE

This section summarizes the estimated capital facilities that would be needed for Beacon Falls to meet system requirements throughout the planning period (to 2040), without regionalization. It addresses expenditures for the WPCF, the wastewater collection system, and the wastewater pumping stations.

5.4.1 Capital Projects to 2040 – Beacon Falls Water Pollution Control Facility

Proposed capital facility needs for the Beacon Falls WPCF are based on recommended upgrade items in a projected capital improvements program provided by DPC Engineering in the Beacon Falls WPCF Upgrades Summary memorandum dated October 17, 2018. The list of new or upgraded facilities programmed at the plant is identified below:

1. Influent Pumping System Upgrade
2. Headworks (Screen Building at Existing Pump Station)
3. Primary Clarifier (Convert to Anoxic)
4. Aeration System Upgrades and Instrumentation
5. Secondary Clarifier Upgrade/Expansion
6. Secondary Clarifier Anoxic Conversion
7. RAS/WAS Systems Upgrades
8. Gravity Thickener – Anoxic Recycle Conversion
9. Rotary Drum Thickener – Dewatering (In Existing Building/Finance)
10. Electric/Main Switchgear/Generator
11. Digester Cleaning, Replacement Roof and Mixer
12. Operations Building Replacement Roof
13. Safety Improvements

5.4.2 Capital Projects to 2040 – Beacon Falls Wastewater Collection System

There is no program for sewer replacement in Beacon Falls at this time. While no major new sewer projects have been identified, over time the system will need replacement of aging sewers on a long-term cycle. We have assumed the collection system improvements to be started and underway within the short-term (approximately 5 years).

5.4.3 Capital Projects to 2040 – Beacon Falls Pumping Stations

Beacon Falls has three relatively small municipal pumping stations in its collection system. The largest one, Railroad Avenue Pumping Station, will likely be due for a major upgrade in approximately 10 years. The other two stations will require periodic replacement of mechanical equipment and other repairs. With no additional information provided for these pump stations, it is assumed they will require upgrade in approximately 10 years.

5.5 PROJECTED CAPITAL EXPENDITURES – 2040 BASE CASE

Projected expenditures for the WPCF, the wastewater collection system, and the wastewater pumping stations have been addressed as part of this early planning study. Budgetary capital and operating costs associated with the base case scenario for Beacon Falls outlined in this section are provided in Appendix D of this report. Capital costs associated with upgrading the WPCF have been based on engineering cost information provided by DPC Engineering. Other costs provided in that appendix are for higher-level budgeting purposes only, and have been based on typical parametric considerations such as dollars-per-gallon, taking into consideration the size and age of the facilities as well as other factors.

6.0 NAUGATUCK WASTEWATER FACILITIES ASSESSMENT

6.1 DESCRIPTION OF EXISTING FACILITIES – NAUGATUCK WATER POLLUTION CONTROL FACILITY

The Naugatuck Water Pollution Control Facility (WPCF) serves the Borough of Naugatuck and portions of adjacent communities: Middlebury, Oxford, Beacon Falls and Prospect. Recent average flows to the plant (2015-2017) have been approximately 4.6 MGD, which is significantly below the permitted design average flow for the plant of 10.3 MGD.

The original plant was upgraded to secondary treatment in the 1970's. The treatment process lineup includes influent pumping followed by primary sedimentation, 4-stage Bardenpho BNR for nitrogen removal, secondary clarification, and disinfection prior to discharge to the Naugatuck River. Disinfection consists of sodium hypochlorite addition at the head of a chlorine contact tank, with bisulfite addition at the end for dechlorination.

The lack of a headworks at the plant to remove grit and screenings presents an operational challenge at the primary settling tanks and downstream facilities.

The Naugatuck WWTF is also the site of a regional solids processing facility that includes bulk sludge delivery, liquid sludge storage, dewatering via centrifuge or belt filter press, and incineration. High strength sidestream flows from the regional solids processing facility to the WWTP contribute significantly to plant loading.

The Naugatuck WWTF Facilities Plan (December 2017) included a recent, detailed condition assessment of the existing facilities, and developed a capital improvements plan for projects that should be undertaken within the next 10 years to address the needs of the plant over a 20-year planning period. The Facilities Plan addressed the aging infrastructure that needs to be repaired or replaced, and included process changes to meet the new phosphorus limitations. The regional sludge incinerator was not included in the scope of the Facilities Plan.

The condition of the existing facilities at the Naugatuck WWTF is discussed in detail in Section 4 and Appendix D of the 2017 Facilities Plan.

Black & Veatch visited the Naugatuck WWTF on July 27, 2018 to observe major plant systems. The facilities include the following:

1. **Influent Pump Station.** The plant influent pump station consists of four pumps in a dry pit/ wet pit arrangement. There is no headworks upstream of the influent pump station; consequently, the influent pumps are subject to maintenance challenges related to both grit and screenings. Three of the four influent pumps were recently replaced with new Sulzer centrifugal pumps.

Figure 6-1 Naugatuck New Sulzer Influent Pump

2. **Primary Settling Tanks**. The plant has two operable rectangular primary settling tanks, each 120 ft x 30 ft x 12 ft SWD. Each tank has two parallel sections, with chain and flight sludge collectors and cross-collectors. The tanks are covered with fabric covers, for odor control. The scum collection system has not worked for several years.

Figure 6-2 Naugatuck Primary Settling Tanks, Covered for Odor Control

3. **BNR Biological Treatment.** Biological treatment is accomplished in two parallel trains, by a 4-stage Bardenpho process for nitrogen removal. The basins have internal curtain walls to segregate the zones, along with internal mixed liquor recycle to enhance denitrification. Air for the diffuser grids is provided by two Piller turbo blowers installed in 2013, with backup provided by positive displacement blowers installed in 1986. A number of deficiencies in the biological treatment system, and opportunities to improve performance, were noted in Section 4.6 of the 2017 Facilities Plan.

   Naugatuck and Veolia are working to meet 0.4 mg/L effluent phosphorus while keeping chemical costs low. The high sidestream phosphorus loading from onsite sludge processing activities makes this more of a challenge than at more typical domestic wastewater treatment plants. To achieve phosphorus reduction in anticipation of more stringent permit limits scheduled to take effect late summer/early fall of 2019, Naugatuck has started to implement low capital cost measures and chemical addition (PAC). These initial measures have resulted in effluent phosphorus reduction; however, additional capital cost improvements are planned in the upcoming months to reduce phosphorus levels and to meet the permit requirements.

Figure 6-3 Naugatuck Anoxic Basins, in Modified 4-Stage Bardenpho Process

Figure 6-4 Naugatuck Activated Sludge Aeration Basin

Figure 6-5 Naugatuck Piller Turbo Blower, for Aeration System

4. **Secondary Clarifiers**. The Naugatuck WPCF has three rectangular secondary clarifiers, each 150 ft x 40 ft x 12 ft SWD. Much of the mechanical equipment, including the collector drives, RAS pumps and WAS pumps, is from the 1970's and needs to be replaced. Flow from these three clarifiers is sent to a fourth polishing clarifier downstream of the other three.

Figure 6-6 Naugatuck Secondary Clarifiers

5. **Disinfection System.** Disinfection, which is provided by hypochlorite addition, is followed by bisulfite dechlorination. Since a significant portion of the plant's secondary effluent is used by the sludge incinerators, only a portion of the secondary effluent is disinfected and discharged to the Naugatuck River. The condition of the chlorine contact tanks is considered fair.

Figure 6-7 Naugatuck Chlorine Contact Basins

6. **Sludge Thickening and Dewatering.** Primary sludge and WAS are co-thickened in a gravity thickener. There are four covered gravity thickeners at the WPCF. Thickened sludge is stored in multiple sludge storage tanks onsite. Sludge dewatering is accomplished with two centrifuges (installed 2002) and two belt filter presses (installed in the 1970's). Due to the large amount of sludge being processed from other plants at the incineration facility, sludge dewatering generally takes place on a 24/7 basis.

Figure 6-8 Naugatuck Belt Filter Press

6.2 DESCRIPTION OF EXISTING FACILITIES – NAUGATUCK WASTEWATER COLLECTION SYSTEM

The existing sewer system is comprised of 156 miles of gravity sewer ranging from 6 inches to 24 inches in diameter and 0.8 mile of force main and is divided into 20 subsystems. In October 2017 Naugatuck received a Consent Order (No. CWA-AO-R01-FY17-07) relating to the collection system. The Order contains specific requirements for reporting and operations and maintenance of the collection system, as well as an I/I Control Plan and a Capacity, Management, Operation and Maintenance (CMOM) program.

The Naugatuck WPCA has engaged in an active sewer system evaluation survey (SSES) and rehabilitation program, with recent engagements including the 2015 I/I analysis, which recommended two phases of SSES, the first of which was completed and documented in the SSES Plan Report in 2017. The 2017 SSES plan documented the investigation of priority I/I subbasins, and its recommendations included further SSES activities as well as cost-effective rehabilitation and I/I removal efforts. These recommendations were incorporated into the 2017 Facilities Plan. I/I reduction resulting from the proposed activities was estimated to be 0.3 MGD on average.

6.3 DESCRIPTION OF EXISTING FACILITIES – NAUGATUCK WASTEWATER PUMPING STATIONS

The Naugatuck collection system has five wastewater pumping stations. All were constructed in the 1970's or 1980's, and are relatively small facilities with submersible pumps. The condition of these facilities is discussed in Section 6 and Appendix J of the 2017 Facilities Plan. In all cases, it is reported that the pumps were recently replaced or rebuilt. All stations are generally reported to be in good condition, however the Inwood Pump Station has corrosion on some of the metal piping and valves, which may be due to hydrogen sulfide.

6.4 CAPITAL PROJECT NEEDS TO 2040 UNDER BASE CASE

This section summarizes the estimated capital facilities that would be required for Naugatuck to meet system needs throughout the planning period (to 2040), without regionalization. It addresses the WPCF, the wastewater collection system, and the wastewater pumping stations.

6.4.1 Capital Projects to 2040 – Naugatuck Water Pollution Control Facility

The recommended capital improvements for the Naugatuck WPCF are indicated on Table 8-2 of the 2017 Naugatuck Wastewater Treatment Facilities Plan, with the associated costs (in 2016 dollars) provided on Table 8-4 of that Plan. The capital costs for the WPCF presented in Appendix E have been developed based on that information.

The Facilities Plan accounted for capital costs that would need to be expended during the first ten years of the planning period, through FY 2026. During the later years of this regionalization planning period, which extends to 2040, replacement of mechanical equipment expected to wear out after 2026 also need to be included.

6.4.2 Capital Projects to 2040 – Naugatuck Wastewater Collection System

In the 2017 Facilities Plan, a program of collection system studies and improvements was identified, including a budget for emergency repairs, for the period of FY18 to FY26. This information has been used as a basis for the projected costs in Appendix E of this report.

6.4.3 Capital Projects to 2040 – Naugatuck Pumping Stations

Several relatively small recommended capital or repair type projects for the wastewater pumping stations are listed in Table 8-3 of the 2017 Facilities Plan. This includes generator replacement and miscellaneous repairs in the near term, and regular, scheduled equipment replacement in

11-20 years. Estimated costs for those projects are included in Table 8-4 of the 2017 Facilities Plan. Those costs have been used as the basis for the projected pumping station capital costs that are included in Appendix E of this report.

6.5 PROJECTED CAPITAL EXPENDITURES – 2040 BASE CASE

Projected expenditures for the WPCF, the wastewater collection system, and the wastewater pumping stations have been addressed as part of this early planning study. Budgetary capital and operating costs associated with the base case scenario for Naugatuck outlined in this section are provided in Appendix E of this report. Capital costs associated with upgrading the WPCF have been based on engineering cost information provided in the 2017 Facilities Plan. Other costs provided in that appendix are for higher-level budgeting purposes only, and have been based on typical parametric considerations such as dollars-per-gallon, taking into consideration the size and age of the facility and other factors as pertinent.