# SECTION 2

# EVALUATION OF ALTERNATIVES

## 2.1 MAINE AVENUE PUMP STATION

The Maine Avenue Pump Station (MAPS) is the most upstream feature of the CSO system, and therefore is the primary point of control during CSO events. When high flow periods are expected, the operations staff undertakes a standard operating procedure in anticipation of the event. One of the steps in the SOP is to manually clean the influent bar rack to reduce or mitigate the backup from the first flush from the sewer system. The operators must then make periodic return trips to the station for repeated cleanings during the first critical phases of a CSO event. An automatic bar rack or screening system would eliminate this burden on the operators' time, and would also result in more efficient removal of the screenings which could, in turn, mitigate any backups of the flow at MAPS and reduce the likelihood of such backups contributing to a CSO event.

Several types of automatic influent screening devices are available, ranging from automatic bar racks with a traveling rake to more compact drum screens. The advantage of the latter option is that the drum type include screenings washing and pressing in an integral unit. The automatic bar rack type requires a separate screenings wash press. All screenings presses require a source of wash water.

Wright-Pierce contacted manufacturers of the rotating type equipment for proposals for their units for MAPS. Unfortunately, due to the existing channel configuration and access, none of the manufacturers recommended their units for this application. However, options for using the self-cleaning bar-rack type equipment may appear feasible. The primary concern for using any automatic mechanical unit at MAPS is the possibility that the existing emergency bypass channel may not be usable, depending on the size of the screening unit, in the event the unit must be taken out of service. In this scenario, it would be necessary to clean the racks manually with a rake. One of the types of equipment uses an hydraulic articulating rake drive in which the rake parks at the

top of the unit which would facilitate manual cleaning. The other types with a chain and rake would prove more difficult to rake manually, as the manual raking could only be performed between the flights of rakes on the chain. Examples of the types of equipment proposed are provided in Appendix D. The budgetary cost of the equipment is approximately $180,000, not including installation. Similarly, the screenings wash press budget price is approximately $70,000.

If the installation of an automatic self-cleaning screen is considered for the MAPS, the need to install another bypass channel should be evaluated. The bypass channel would mitigate the burden of cleaning the automatic rake by hand, which is not generally recommended. However, providing a bypass channel would involve structural work in the MAPS, which must be performed while the station is active. The complexity and nature of this work would be beyond the budget of the immediate improvements that has been budgeted for the first round of CSO upgrades.

An alternative consideration to the installation of an automatic self-cleaning screen is the installation of centrifugal chopper pumps in place of the standard centrifugal pumps at MAPS. Chopper pumps, which were not commonly in use in the municipal sector at the time of the MAPS upgrade, are gaining favor due to the increasing incidences of pump clogging due to the use of "flushable" towels and other such items. It is estimated that one of the existing pumps could be replaced with a chopper pump for approximately $60,000. This alternative should also be investigated further for possible implementation during a future upgrade. Information on chopper pumps from three typical manufacturers is contained in Appendix E.

## 2.2 KENNEBEC INTERCEPTOR

The Kennebec Interceptor conveys wastewater and CSO flows from the Terminus Manhole to the WWTF. The interceptor is approximately 12,700 feet long, and has sections with dual barrel mains, the original 30-inch interceptor along with the parallel 36-inch interceptor installed in 2006. Flow is normally conveyed in the original 30-inch sections. As the water level in the main rises, such as during a CSO event, it spills over into the 36-inch section at several doghouse manholes along its length. This system allows single barrel flow and reasonable velocities and residence

times during normal periods, while also providing the extra capacity and some storage required for CSO events.

Since the interceptor is a passive system, with no active monitoring or control systems, there are no options or alternatives that will optimize its use or performance. Instead, the other alternatives presented herein may mitigate the occurrences of CSO discharges.

During high flow periods, the operations staff monitors the level in the influent and CSO wetwells. If the level in the influent wetwell reaches approximately elevation 13.5, the CSO pumps are started to prevent submergence of the influent pump bearings. One of the other locations that is monitored is the water elevation at the Rolling Dam Brook Overflow Structure (RDB). If the level appears to be encroaching on the top of the control gate, the operators will also initiate the CSO pumps. An ultrasonic level transducer is provided at RDB, and is positioned on the downstream side of the control gate. The level sensor therefore is configured to only record level in the structure if there is an overflow event. The signal from the level transmitter is sent to the WWTF via phone line, set to send a pulse at 10,000 gpm increments. Consequently, a momentary actual overflow of a few gallons is recorded as 10,000 gallons. However, the level control system does not currently have the ability to monitor the depth upstream of the control gate. If the water level in the KI were monitored continuously by an additional level sensing device, the CSO pumps could be activated automatically. In so doing, several objectives could be achieved: 1) eliminate the operational burden for the operators in manually monitoring RDB; 2) Maximize the capacity of the KI; and 3) further mitigate the occurrence of emergency overflows at RDB. The estimated construction cost for an additional level control system with automatic starting of the CSO pumps is $25,000

Additionally, locking covers should be provided at two manholes in low areas along the interceptor in order to prevent overflows at the manholes caused by surcharging of the interceptor during high flow events. The estimated cost of the locking covers is $2,500.

## 2.3 TERMINUS MANHOLE

The force main terminus manhole receives flow from the Maine Avenue and Randolph Pump Stations and a local gravity sewer contribution. The Terminus Manhole is equipped with a submersible pressure transducer and telemetry system that currently reduces the MAPS pumping rate when necessary to prevent flooding of the Kennebec Interceptor and possible flooding of homes connected to the interceptor. The pumps at the Randolph Pump Station will be upgraded in the near future with variable frequency drives to vary the pump speed in order to pace the discharge from the station in response to water levels in the Terminus Manhole. Based on discussions with the City's operations staff, the function of the Terminus Manhole appears to be operating satisfactorily, and no further modifications are warranted at this time.

## 2.4 INFLUENT SEWER CONTROL

The Influent Sewer Manhole was originally installed as a typical 6-foot diameter precast concrete structure with a brick/grout invert to accommodate the 30-inch influent sewer. As part of the 2006 upgrade, a weir wall at elevation 8.0 was installed, which would bypass a portion of the flow to the CSO pump station at water surface elevations within the manhole above this elevation, approximately ¾ of the pipe depth. Discussions with the City's operations staff have indicated that the flowrate to the influent screw pumps often exceeds their capacity, exacerbated by the phenomenon whereby the pump capacity decreases at water levels above the crown of the intake point, elevation 8.8; this effect is the reverse of that for centrifugal pumps in which capacity increases at higher suction head. Furthermore, if the water level in the wetwell rises above the pump bearing, approximately elevation 14.0, will result in failure of the pump bearing. Thus, the presence of an unregulated flow to the wetwell presents an operational challenge for the operations staff as well as the potential for a catastrophic failure of the influent screw pump.

One of the most feasible remedies is to regulate the flow to the influent wetwell. The influent wetwell is equipped with two 30-inch wide by 36-inch deep sluice gates, one dedicated to each screw pump. A flow regulating scheme could be provided by installing an automatic gate operator with a level measuring device for each sluice gate. The gate operator has an integral programmable logic controller (PLC) and connected level transducer that would be programmed to adjust the gate opening as necessary to limit the water level in the wetwell to the pump's optimal

depth, approximately 28 inches above the tube invert. The gate opening would thereby be continuously adjusted to maximize the flow to the secondary process and prevent the decrease in pumped capacity. According to the manufacturers contacted to obtain information and pricing for this equipment, this type of flow control is relatively common and cost effective. There are several installations of this type within a few hours drive to Gardiner. The installed cost for each gate is estimated to be approximately $12,500, yielding a total system cost of $25,000. A brochure of the type of actuator proposed is provided in Appendix F.

## 2.5 INFLUENT PUMP MODIFICATIONS

Raw wastewater is lifted from the influent wetwell to the preliminary and secondary treatment unit processes by one of two 48-inch screw pumps. The pumps are driven by 50-hp, two-speed motors, to provide a capacity of 1,700 gpm at low speed of 23 rpm, and a design capacity of 3,300 gpm at maximum speed of 45 rpm. Speed reduction from the motors to the pumps is provided by a sheave/belt-gearbox drive system. The pumps are now represented by Siemens Water Technologies Corp., Thomasville Georgia. The dimensions of the pumps are provided in the shop drawings from the original construction project in Appendix C.

One of the unique characteristics of a screw pump is that the hydraulic capacity decreases if the tailwater elevation rises above the crown of the inlet tube, which is approximately elevation 8.8. The pump will experience failure if the lower bearing is submerged, at approximately elevation 14.0. The operations staff has observed the decrease in capacity of the pumps during CSO events, which has resulted in operational difficulties in maximizing the flow through the secondary process during these events. Furthermore, the operators have also observed that the capacity of the pumps is not identical; however the difference in capacities has not been quantified.

Wright-Pierce contacted Siemens to discuss options for upgrading or improving the capacity of the pumps. Siemens confirmed that the maximum rated capacity of the pumps is 3,700 gpm (5.3 mgd) at 52 rpm. This modification could be made relatively inexpensively by changing the sheaves and belts, which Siemens estimated to cost less than $1,000 per pump. However, the resulting brake power draw would be in the service factor of the existing 50 hp motors, which is considered to be

an unsafe condition for continuous, long-term use, especially for a critical unit process. Therefore, if the pumps' capacity were upgraded, Wright-Pierce would recommend that the motors be replaced. New two speed motors are estimated to cost approximately $10,000, with an estimated installation cost of about $5,000 per pump. Or, new motors with variable frequency drives (VFDs) could be provided for more control and flexibility in pumping rates. Accordingly, the total project cost to upgrade the pump capacity is estimated to be approximately $30,000, or approximately $50,000 if VFDs are provided. The Siemens service technician and Wright-Pierce verified that the capacity of the gearbox is 100 hp, and would not need further modification to accommodate the larger motor size.

Siemens initially suspected that the cause of the unequal capacity of the pumps was due to slip in the sheave/belt drive of the lower capacity pump, which could possibly be corrected with new belts or maintenance/replacement of the sheave. However, the operations staff verified the rpm of the screws in August 2010, and the service technician could not identify other causes for the apparent flow discrepancy between the pumps.

## 2.6 SECONDARY TREATMENT MODIFICATIONS

Secondary wastewater treatment at the WWTF is provided by a conventional rotating biological contactor (RBC) process followed by secondary clarification. The RBC modules are arranged in two trains of four RBCs each. Trains are run in parallel, and the available hydraulic hardware does not allow extensive alteration of the flow path. All RBCs are provided with supplemental aeration. The ability to provide return sludge was added as part of the 2006 WWTF Upgrade.

After biological treatment, secondary clarification is provided by two 45-foot diameter, center feed clarifiers. The clarifiers were modified in 2006 to provide spiral blade scraper mechanism and variable speed drives, energy dissipating inlets and Stamford baffles. Based on conventional overflow rate criteria, the capacity of the secondary clarifiers is approximately 4.5 mgd, primarily for hydraulic considerations.

One of the commonly used process modifications employed by treatment plant operators to accommodate peak hydraulic or biological loadings is to switch the flow path from series or parallel trains to contact stabilization. In summary, the contact stabilization process is achieved by dividing the aeration tanks in to 1/3-2/3 or 1/2-1/2 basin compartments, and then bypassing the influent to the downstream basin called the "contact" tank. A high return sludge rate is used to achieve a relatively high underflow rate to minimize solids in the clarifier and to return and hold them in the upstream "stabilization" basin. The drawings for the WWTF were reviewed to assess the feasibility of making this process modification during CSO events. Unfortunately, the channel configuration and flow control hardware available are not conducive to implementation of the CS flow train, and this option was eliminated from further consideration.

One of the options for consideration presented above is to increase the capacity of the influent pumps to pass more flow through the secondary process, to as high as 5.3 mgd. The operation of the secondary clarifiers at this elevated overflow rate may be possible for short-term durations such as a CSO event by adopting operational changes of the clarifiers using a State Point Analysis as a guide. State Point Analyses are computational tools based on the characteristics of the clarifiers and the results of settling tests of the floc. A sample of a resulting graph from a state point analysis is presented in Figure 2-1. One of the advantages of the state point analysis is that it quickly provides real time and predictive operational recommendations for changing conditions. This operational technique could provide additional flexibility for operating the secondary clarifiers at their maximum optimal capacity, thereby minimizing the frequency and duration of the volume of flow bypassed to the CSO treatment system. The estimated cost to perform the State Point Analysis is $2,500.

## 2.7 FLOW MONITORING

During periods of extremely high flows, flooding sometimes occurs upstream of the MAPS in the interceptor sewer in Maine Avenue. In order to gain an understanding of the origin of these flows, the City desires to perform a flow monitoring program to determine the flows at three locations in Gardiner and Farmingdale. The estimated cost of a six-week flow monitoring program is $15,000.