SECTION 1

INTRODUCTION

1.1. GENERAL

This study is intended to fulfill the evaluation phase of the first two CSO abatement goals described in Section 4 of the City of Gardiner's Combined Sewer Overflow Master Plan Update, which was approved by the Maine DEP on November 2, 2009. Those goals are to optimize the influent screw pump operating level and maximize the pumping capacity, and to maximize storage in the influent interceptor prior to the automatic switchover to CSO operating mode at the wastewater treatment facility. The primary intent of these two abatement goals is to ensure that the full capacity of the secondary treatment system is being used at all times during CSO events, thereby increasing the amount of flow receiving secondary treatment and reducing the amount of flow receiving primary treatment during any CSO event, and to prevent overflows at Emergency Overflow 002 at Rolling Dam Brook and two low-lying manholes on Route 24.

1.2 SUMMARY OF CSO ISSUES

Trying to optimize the operation of the CSO system has presented operational challenges and burdens to the City's operations staff since the CSO abatement project was completed in 2006. When precipitation or high snowmelt is expected or predicted, the staff must devote time to monitoring and controlling the various facilities, which places unwelcome demands on the City's resources and budgets. In preparation of a CSO event, the City will undertake any or all of the following steps:

- Ensure that the Maine Avenue Pump Station (MAPS) and terminus manhole telemetry is functioning properly
- Monitor the flowrate at MAPS

- Clean the bar racks at MAPS
- Check the generators at MAPS and the WWTF
- Monitor influent wetwell level at the Wastewater Treatment Facility (WWTF)
- Monitor the water level of the Kennebec Interceptor (KI) at Rolling Dam Brook Emergency Overflow Structure
- Start preparing the City's Form for High Flow Event

As flows increase at the WWTF, the operators are often presented with a decision whether to activate the CSO system by anticipating or projecting the time and volume of flow expected in the KI. Part of the reason for needing to make this critical decision is due to a characteristic of the influent screw pumps in which their capacity decreases as the suction head increases past a specific level. This is discussed in more detail in Section 2.5.

1.3 SUMMARY OF FLOWS

CSO flows for the years 2000 through 2007 are provided in Table 1-1. Table 1-1 was compiled from records from WWTF staff as required for DEP monitoring requirements, and was also included in the recently approved CSO Master Plan Update. There does not appear to be any discernible trend of CSO incidence or magnitude for the period.

1.4 DESCRIPTION OF EXISTING FACILITIES

The Gardiner CSO system consists of a combination of pump stations, overflow structures, conveyance piping, and associated instrumentation and programming for monitoring and control of flows to the wastewater treatment facility. A schematic of the CSO system is provided in Figure 1-1. A summary of the facilities is provided below, with the associated capacities where applicable.

Maine Ave Pump Station - With a design pumping capacity of 7.0 mgd, MAPS receives influent flow from the City's sewerage system, from both gravity and pumped sources, as well as from the Town of Farmingdale. The estimated maximum instantaneous flowrate to MAPS is approximately 7.7 mgd. There is also a licensed combined sewer overflow (CSO 003) located at the pump station. Whenever CSO flows exceed the station's pumping capacity, including those times when the pumping capacity may be reduced by the instrumentation in the terminus manhole (described below), the excess flow is discharged untreated to the Kennebec River and is recorded as a CSO event. MAPS was originally constructed in the mid 1980's and was upgraded as a part of the CSO abatement project in 2006.

Force Mains - Two 14-inch force mains, each approximately 1600 feet long, convey sewage from the MAPS to the Terminus Manhole. The combined capacity of the force mains is estimated at 7.0 mgd.

Terminus Manhole - The Terminus Manhole is a 4-foot square manhole that receives a maximum instantaneous flow of 7.0 mgd from MAPS, approximately 1.2 mgd from the Randolph pump station, and approximately 1.1. mgd from local gravity sewers. The Terminus Manhole was constructed to replace the existing force main receiving manhole during the CSO Abatement project in 2006. All flow received in the Terminus Manhole is discharged to the Kennebec Interceptor. The submersible level transducer and telemetry system in the Terminus Manhole monitor the liquid level in the manhole and, when necessary to prevent surcharging of the Kennebec Interceptor and possible flooding of homes connected to the interceptor, automatically reduces the pumping rate at MAPS.

Table 1-1

Figure 1-1

Kennebec Interceptor - The KI consists of a combination of the original 30-inch reinforced concrete pipe (RCP) and a relief interceptor consisting of 36-inch RCP pipe from Terminus Manhole to the WWTF. Flows combine and separate at several locations along the approximate 12,700-foot length via doghouse manholes. The combined capacity of the dual barrel interceptor is estimated to be 9.2 mgd.

Rolling Dam Brook Overflow Structure - Overflow Structure at Rolling Dam Brook, measures approximately 18 feet long, 9 feet wide, and 14 feet deep, and contains two chambers and a flow control regulator device. A level sensor detects overflows only at the structure on the downstream side of the control gate. This structure was previously Licensed CSO No. 002; however, after completion of the CSO Abatement project in 2006, the designation was changed to Emergency Overflow 002.

Metering Chamber - The metering chamber is located approximately 85 feet upstream of the Influent Sewer Manhole. The metering chamber is approximately 17 feet x 10 feet, and contains a 9-inch Parshall flume. Based on discussions with the operations staff, the level element to record the depth (which correlates to flowrate) at the flume is not in service, and has not been used or monitored in recent collective memory. Details of the influent metering chamber from the original 1980's construction project are provided in Appendix A.

Influent Sewer Manhole - The influent Sewer Manhole was installed with the original plant construction, and was modified as part of the 2006 WWTF upgrade project. A diversion weir was installed in 2006, at elevation 8.00. When the water level in the influent sewer rise above this elevation, a portion of the flow is diverted to the CSO pump station. Details of the Influent Sewer manhole as modified for the 2006 upgrade project are provided in Appendix B.

CSO Pump Station - The CSO Pump Station receives CSO bypass overflow from the Influent Sewer Manhole, and pumps the diverted flow to the primary clarifier for solids removal, which then flows to the chlorine contact tank for disinfection (during disinfection season) prior to discharge to the Kennebec River. The CSO Pump Station capacity is 5.0 mgd, provided by two

60-horsepower (hp) submersible pumps, each rated for 3,500 gpm. The CSO Pump Station was installed in 2006 as part of the WWTF upgrade.

Influent Pumps - Influent wastewater is lifted to the WWTF for treatment by one of two 48" diameter screw pumps. Each pump has a maximum rated capacity of 3,300 gpm. The drives for the pumps are provided by two-speed 50 hp motors, sheaved to provide 3,300 gpm at 45 rpm, and 1,700 gpm at 23 rpm. The lift provided by the pumps is approximately 38.5 feet. Dimensions of the pumps are provided in Appendix C obtained from the O&M Manual from the original construction project.

1.5 HYDRAULIC CAPACITY MODELING

A steady-state, sub-critical, one-dimensional model of the influent interceptor was conducted as part of this evaluation. The data used in the model were obtained from the construction drawings, as well as standard coefficients for hydraulic friction and fitting losses from standard references. One of the key aspects of any modeling effort is to calibrate the model. Ideally, for an hydraulic model, this step would involve measuring the flow and noting the upstream water surface elevation while the flow is perceived as being relatively constant for a period of time. This procedure would then be repeated for varying flows. After the field data had been collected and verified, model calibration could be achieved by varying the friction coefficients for each reach of the conveyance system.

The only flow measuring facilities available for the conveyance system are provided in the flow measuring station, consisting of the vault, 9-inch Parshall flume and level measuring device. However, based on discussions with the City's operations staff, this equipment is not in service and has not been used to record flow in collective memory. Therefore, the results of the model are an unverified estimate of the system capacity at sustained flow conditions. The exact capacity of the system is unknown, as well as the ability to predict when peak surges will occur in the pipeline as conditions vary.

The major limitation of a steady-state, one-dimensional model is that it is inadequate to provide realistic predictions of the transient variations of a CSO event. In summary, steady-state model calculations are based on the condition of a constant volume of flow being present along the entire length of the pipe; no variations are accounted for over time. This specific condition rarely occurs during a CSO event, as the flow varies due to external contributions, pressure variations, etc., along the length of the pipe in study. Modeling for these events would require a much more detailed multi-dimensional, dynamic model, which was beyond the scope of this study.

A steady state, sub-critical hydraulic model is performed using a "backwater" procedure, in which the downstream starting elevations are either known or calculated, from which the upstream water surfaces are calculated. As part of the modeling for this study, the downstream hydraulic conditions were investigated by review of the existing construction drawings from the original plant construction. This review revealed the presence of the existing 9-inch Parshall flume in the flow metering vault. Consultation of standard references for a 9-inch flume indicated that its rated capacity is approximately 5 mgd, after which it is considered to be submerged and inaccurate. The actual flows during CSO events typically exceed 5 mgd, with a maximum flowrate of 9.5 mgd. Thus, the capacity of the Parshall flume is greatly exceeded during most CSO events, which is expected to cause an undesirable restriction in the capacity of the conveyance system. Therefore, it is recommended that the Parshall flume be removed.