

**COMBINED SEWER OVERFLOW  
MASTER PLAN UPDATE**

**for**

**CITY OF GARDINER, MAINE**

**OCTOBER 2009**

**WRIGHT-PIERCE**   
Engineering a Better Environment

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**APPENDICES**

- A 2002 FACILITIES PLAN UPDATE (EARTH TECH, INC.)
- B JANUARY 2008 INTERIM REPORT
- C MAY 2008 SUMMARY OF STATUS REVIEW MEETING
- D ANNUAL CSO PROGRESS REPORT FOR 2007



## SECTION 1

### INTRODUCTION

#### 1.1 Background

The City of Gardiner originally completed a Combined Sewer Overflow (CSO) Facilities Plan in March 1995. The original Plan recommended that the City incorporate Best Management Practices (BMPs); construct capital improvements at the wastewater treatment facility (WWTF), CSO 002 at Rolling Dam Brook, the Maine Avenue Pump Station, and in several locations within the wastewater collection system; and plan for future long-term measures including a flow control structure on the Kennebec Interceptor; variable frequency drives at the Maine Avenue Pump Station, a private inflow removal program, and on-going CSO planning.

The 1995 Plan was updated in December 2000 and a revised update was issued in July 2002. According to the 2002 update, the recommendations contained in the 1995 Plan were implemented between 1995 and 2000.

#### 1.2 Overview of 2002 Facilities Plan Update

The 2002 Facilities Plan Update recommended the following long-term CSO control program:

- Continued implementation of the on-going BMP program.
- Correction of wastewater collection system deficiencies in drainage areas 3 and 5.
- Relocation and consolidation of CSO 003 with CSO 002 and treatment of the combined flows at the WWTF site using settling/storage and high-rate disinfection.
- Upgrading the Maine Avenue Pump Station by replacing one of the existing pumps with a substantially larger wet weather pump and adding a new standby generator to power the new pump.
- If warranted after implementation of the recommendations, a program of Phase 2 collection system investigations aimed at additional I/I detection and removal.

In late 2002 the City retained Wright-Pierce to provide the engineering services necessary to implement the recommendations in the updated Plan, which was prepared by Earth Tech, Inc. Wright-Pierce's Preliminary Design Report for the CSO abatement project, which was completed in February 2003 and approved by Maine DEP on June 10, 2003, recommended that the facilities proposed at the Maine Avenue Pump Station and the WWTF be modified from those proposed in the 2002 Facilities Plan Update, and that the correction of collection system deficiencies in drainage areas 3 and 5 be delayed until after completion of the recommended facilities, when the need for these corrections could be re-assessed to determine whether they were advisable.

The recommended CSO abatement facilities, which were constructed between mid-2004 and mid-2006, are described below in Section 2.1.



### **1.3 2008 CSO Master Plan Update**

The 2008 CSO Master Plan Update, which is required by DEP to be completed by January 1, 2009, is intended to assess the results of the City's 2006 CSO abatement project and, based on those results to date, present updated CSO abatement goals and an updated schedule. The 2002 Facilities Plan Update, which is contained in Appendix A, is intended to be an integral part of the 2008 update, and general descriptive information and drawings contained in the 2002 update will not be repeated here but may be found in the attached 2002 update.



## SECTION 2

### 2006 CSO ABATEMENT PROJECT

#### 2.1 Project Description and Cost

The facilities recommended in the 2002 update, as modified by Wright-Pierce in 2003, were completed in 2006. The project included constructing new pumps to increase the capacity of the Maine Avenue Pump Station from 4.2 to 7 million gallons per day (mgd), a relief interceptor to increase the capacity of the Kennebec Interceptor from 6.5 to 9 mgd, and a primary clarifier and disinfection facilities to increase the capacity of the WWTF from 4.5 to 9.5 mgd (4.5 mgd secondary treatment full-time and an additional 5 mgd primary treatment during CSO events). The 2006 project is described in more detail in the January 2008 Interim Report contained in Appendix B.

The total cost of the 2006 project, which also included a WWTF upgrade constructed concurrently with the CSO abatement project, was \$7.2 million. The cost of the CSO abatement facilities alone was approximately \$4.3 million.

#### 2.2 Reduction in Untreated CSO Flows

Following completion of the abatement project in June 2006, untreated CSO flows were reduced from an annual average of 15.5 million gallons during the previous six years to an annual average of 2.2 million gallons between July 2006 and the end of 2007.

The reduction in untreated CSO flows is discussed in more detail in Section 3.



## SECTION 3

### RESULTS OF CSO ABATEMENT PROGRAM TO DATE

#### 3.1 Evaluation Criteria

In order to assess the results of the CSO abatement project, flow data were obtained from the City for both the WWTF and CSOs for the years 2000 through 2007. Specifically, the annual CSO Progress Reports, including the Summary of CSO Activity and Volumes, and WWTF Monthly Reports for each year were reviewed in order to determine the annual volumes of flow receiving full secondary treatment, primary treatment (from mid-2006 to end of 2007), and no treatment (i.e. CSO flows).

The following categories of flows were then totaled and tabulated on an annual basis for the seven-year period, along with the annual precipitation amounts:

- Total Secondary Flow Treated
- Total Primary Flow Treated
- Total Flow Treated
- Total CSO Flow Untreated
- Total System Flow

#### 3.2 Evaluation of Flow Data

Based on the total annual flows in each of the five evaluation categories listed above, the overall effectiveness of the recently-completed CSO abatement project was then assessed. In order to quantify the CSO abatement results, the following three evaluation criteria were developed for the periods prior to the completion of the CSO project (January 2000 through June 2006) and after the project (July 2006 through December 2007):

- Average Annual CSO Flow
- Total CSO Flow as a Percentage of Total System Flow
- Total CSO Flow in 1,000 Gallons per Inch of Precipitation

Using any one of the three evaluation criteria as a sole means of assessing the success of the CSO abatement efforts to date would likely include some amount of inconsistency due to the fact that untreated CSO flows result from some factors that cannot be accounted for in an analysis based on flow quantities (rainfall intensities, variations in sanitary wastewater flows, etc.). However, it is believed that using three different, albeit similar, criteria will the impact of such unaccounted factors and result in a calculation of the overall success of the CSO abatement program to date that is reasonably accurate based on the available data.

Table 3-1 at the end of this section presents the results of the flow totalization and tabulation, as well as the calculations for the three evaluation criteria shown above. It should be noted that 2006 is separated



into the periods January through June and July through December in the table, since the new CSO treatment facilities were placed on line in July 2006. The information contained in the table is summarized below.

#### Average Annual CSO Flow

The average annual untreated CSO flow between January 2000 and June 2006 was 15.5 million gallons, while for the period between July 2006 and December 2007 this was reduced to 2.2 million gallons, a reduction of 85.8 percent. Based on this evaluation factor, the City's CSO abatement program has resulted in an 85.8 percent reduction in untreated CSOs.

#### Total CSO Flow as a Percentage of Total System Flow

Between January 2000 and June 2006, the total untreated CSO flow was 3.3 percent of the total flow in the system for the same period. From July 2006 until December 2007 this was reduced by 84.8 percent to 0.5 percent. Therefore, based on this factor, the CSO abatement program has resulted in an 84.8 percent reduction in untreated CSOs.

#### Total CSO Flow in 1,000 Gallons per Inch of Precipitation

Untreated CSO flow between January 2000 and June 2006 totaled 326,000 gallons per inch of total precipitation. For the period between July 2006 and December 2007, this was reduced to 48,000 gallons per inch, a reduction of 85.3 percent. On this basis, the City's CSO program has resulted in an 85.3 percent reduction in untreated CSOs.

### **3.3 Summary of Results of CSO Abatement Results to Date**

Based on the three evaluation criteria calculated and discussed above, the City of Gardiner's CSO abatement program can be said to have achieved an overall reduction in untreated CSO flows of just over 85 percent since completion of the CSO abatement project 18 months ago. The calculations of the effectiveness of the program for each of the criteria were very similar, ranging from 84.8 percent to 85.8 percent, and the average result was 85.3 percent.

It should be noted that, of the total untreated CSO flows since the completion of the abatement project (3.3 million gallons), just less than 2.5 million gallons occurred during the Patriot's Day storm on April 15 and 16, 2007, which resulted in heavy flooding in Gardiner. There is little doubt that the flood conditions contributed to much of the CSO flow on those two days. It is also worthy of note that, even with the impacts of the Patriot's Day storm and flooding, the City has been able to treat 99.5 percent of all flows in the wastewater system since the completion of the abatement project.

As noted earlier in this report, while the calculations cannot be claimed to represent an exact quantification of the reduction in untreated CSO flows, it can be stated with some confidence that the City's CSO abatement program has been about 85 percent effective to date in that CSO flows have been reduced by this amount. Overall, since completion of the CSO abatement project in 2006, the total untreated CSO flow has been reduced from 3.3 percent to 0.5 percent of total system flow.

TABLE 3-1  
 WWTF AND CSO FLOW SUMMARY 2000-2007

	2007	2006 July-Dec	2006 Jan-June	2005	2004	2003	2002	2001	2000
<b>Total Precipitation, inches</b>	43.0	25.8	23.1	68.4	37.8	50.5	42.8	35.7	50.3
<b>Total Secondary Flow Treated, MG</b>	403.2	218.1	260.1	529.2	389.3	453.2	441.0	368.0	471.4
<b>Total Primary Flow Treated, MG</b>	7.7	6.5	N/A	N/A	N/A	N/A	N/A	N/A	N/A
<b>Total Flow Treated, MG</b>	410.9	224.6	260.1	529.2	389.3	453.2	441.0	368.0	471.4
<b>Total CSO Flow Untreated, MG</b>	2.5	0.8	9.5	46.6	5.1	13.1	11.5	6.5	8.3
<b>Total Annual System Flow, MG</b>	413.4	225.4	269.6	575.8	394.4	466.3	452.5	374.5	479.7
<b>CSO Flow as % of Total Annual System Flow</b>	0.6	0.4	3.5	8.1	1.3	2.8	2.5	1.7	1.7
<b>CSO Flow as 1,000 Gal per Inch Precipitation</b>	58.1	31.0	411.3	681.3	134.9	259.4	268.7	182.1	165.0
Average annual CSO flow from Jan 2000 to June 2006 in MG = 15.5									
Average annual CSO flow from July 2006 to Dec 2007 in MG = 2.2									
Reduction in CSO flows on this basis = 85.8%									
Total CSO flow as % of total annual system flow from Jan 2000 to June 2006 = 3.3									
Total CSO flow as % of total annual system flow from July 2006 to Dec 2007 = 0.5									
Reduction in CSO flows on this basis = 84.8%									
Total CSO flow in 1,000 gal per inch precipitation from Jan 2000 to June 2006 = 326.0									
Total CSO flow in 1,000 gal per inch precipitation from July 2006 to Dec 2007 = 48.0									
Reduction in CSO flows on this basis = 85.3%									
Notes: 1. CSO treatment facilities placed on line in July 2006									
2. Patriot's Day rain and flood conditions accounted for all but 19,000 gallons of CSO flow in 2007									



## SECTION 4

### UPDATED CSO ABATEMENT GOALS AND SCHEDULE

#### 4.1 Abatement Goals

Gardiner's overall long-term CSO abatement goal is to eliminate all untreated CSO flows from the system. Although this may or may not be achievable, the City and Wright-Pierce have developed several updated goals, based on the measured success of the 2006 CSO abatement project, that should go a long way towards achieving this result. The plan is to complete three projects over the next two to three years that will further reduce CSO flows to some degree and then, based on the results of the additional interim abatement work, construct a major project that will be intended to fully eliminate all CSO flows within the schedule and budget constraints shown in Table 4-1 at the end of this section.

In the previous section, it was noted that the 2006 project has resulted in CSOs being reduced by approximately 85 percent based on three different evaluation criteria. It was also noted that, of the 2.5 million gallons of total CSO flow in 2007, all but 19,000 gallons occurred during the Patriot's Day storm on April 15 and 16, during which heavy flooding occurred in downtown Gardiner. Most of the CSO flow during this overflow event was a direct result of the flooding conditions. Controlling the floodwaters entering the wastewater system during events such as this storm is the key factor for eliminating CSOs in Gardiner.

Specifically, the City's updated CSO abatement goals consist of the following, each of which is discussed in more detail below and is also shown on Table 4-1 at the end of this section, along with estimated costs and completion dates:

- Optimize the influent screw pump operating level and maximizing the influent pumping capacity.
- Maximize the storage in the influent interceptor sewer prior to the automatic switchover to CSO mode at the WWTF.
- Construct an infrastructure improvement project, including sewer main replacement intended to reduce infiltration/inflow.
- Construct an off-line underground storage tank at the Maine Avenue Pump Station to hold the floodwaters for gradual introduction to the wastewater system.

#### Optimize Influent Screw Pump Operating Level and Maximize Pumping Capacity

This project will consist of modifying the operating levels in the screw pump wet well to ensure that the WWTF influent pumps are operating at their maximum capacity prior to the automatic switchover to CSO mode. At the present time, the wet well reaches a level slightly higher than the optimum level that produces maximum capacity from the pumps before the switchover to CSO mode and remains at that level during the time the WWTF is operating in this mode. This results in slightly less than the full capacity of the secondary treatment system being used during the time that the WWTF is operating in the CSO mode, and slightly higher flows receiving primary treatment.



In order to increase the flow to the secondary treatment system during CSO flow events, the level at which the WWTF automatically switches over to CSO mode will be lowered to the level that results in the plant's full 4.5 mgd capacity receiving secondary treatment. The modification will likely be made in the influent manhole just upstream of the screw pump wet well. In this manhole, part of the flow is diverted to the CSO treatment facilities by means of an overflow weir during CSO events.

The best method to accomplish this will be determined during an evaluation phase planned to be completed by November 2009, the design of the modification will be completed by March 2010, and construction is scheduled to be completed by December 2010 at an estimated total project cost of \$100,000.

#### Maximize Influent Interceptor Storage Prior to Switchover to CSO Mode

The storage capacity within the influent interceptor is not used to its fullest extent during CSO events at the present time. The intent of this project will be to cause the flow in the interceptor to back up prior to triggering the CSO switchover at the WWTF during CSO events. This will probably be accomplished by adding an automated valve within the interceptor just upstream up its entry into the influent manhole at the WWTF. During CSO flows, as indicated by the flow level within the interceptor sewer, the valve will partially close until the level in the interceptor rises an acceptable maximum level. Should increasing flows in the interceptor cause the level to continue rising, the valve will begin re-opening until the flow level is maintained at that which maximizes storage within the interceptor.

The details of this project will be developed during an evaluation phase scheduled to be completed by November 2009, the design will be completed by March 2010, and construction of the project will be completed by December 2010. The total estimated cost of the proposed project is \$100,000.

#### Infrastructure Improvement Project Including Sewer Main Replacement

The City is planning to construct an infrastructure improvement project in an area to be determined. The intent of the project is to replace sidewalks, storm sewers, water distribution pipes, and sanitary sewer as necessary in order to improve the overall City infrastructure system in the area. The project area will be selected based on need, with part of the evaluation centering on the need for removal of infiltration and/or inflow.

The planning for the project is scheduled for completion by September 2008, design by December 2009, and construction by April 2011. The total cost of the infrastructure improvement project is estimated to be \$1,000,000, with the CSO-related portion of the project estimated at \$500,000.

#### Off-Line Underground Storage Tank at Maine Avenue Pump Station

The final goal in Gardiner's long-term CSO abatement plan is to construct an off-line underground storage tank in the vicinity of the Maine Avenue Pump Station. The main intent of the storage tank will be to provide storage during times of flooding in the area, so that the floodwaters, which now cause or increase CSOs at the pump station, can be re-introduced to the sewer system when flows subside and the system is capable of transporting and treating the flows.



A secondary benefit of constructing the storage tank will be to increase the detention time in the wet well of the pump station when necessary. Some SSOs, typically small volumes, now occur when a mechanical or electrical problem occurs at the pump station and cannot be remedied sufficiently quickly to prevent an overflow. With additional wet well storage, these types of overflows can be eliminated.

It is the intent of the City of Gardiner to design and construct an underground storage tank of sufficient size to be able to contain the worst CSO event to date. By doing so, the City will be able to eliminate all known CSOs.

At the suggestion of Maine DEP, the City and Wright-Pierce will also consider the feasibility of constructing an interceptor sewer and pump station to collect flood water from basements in the downtown area and pump it directly to the Kennebec River. If this should prove to be feasible, the size of the storage tank will be reduced.

The details of the underground storage tank and/or the interceptor sewer and pump station project will be developed during an evaluation phase scheduled to be completed by December 2013, the design by June 2015, and the construction by December 2016. This project has been scheduled so that the evaluation phase will occur approximately two years after completion of the other projects comprising the updated CSO abatement goals so the impacts of the CSO reduction from the other projects will be known by the time the evaluation for the final project is underway. Any additional work that may be deemed necessary to achieve the CSO goal of elimination will also be determined and described in the evaluation phase.

The total estimated cost of the storage tank is \$1,000,000; however, this is a very preliminary estimate, as the size of the tank will obviously depend on the success of the other abatement projects to be completed before the storage tank project begins.

#### CSO Master Plan Update

Following construction of the underground storage tank in December 2016, it is the intent of the City's CSO abatement program that all CSOs be eliminated. In order to ascertain this, the CSO Master Plan will again be updated in December 2018. The updated plan will include an evaluation of the success of the CSO abatement projects to date and, if necessary, an abatement schedule that will contain any new projects that may be necessary to eliminate any remaining CSO discharges.

## **4.2 Proposed Abatement Schedule**

The proposed schedule for the updated CSO abatement goals is shown in Table 4-1 at the end of this section. The schedule for each of the updated goals was included in the discussion of the respective projects in the previous section.

## **4.3 Impact on Sewer Rates**

The present average annual residential user charge in Gardiner is \$432, which is 1.23 percent of the City's annual median household income of \$35,103, according to the 2000 census. The City's current total annual wastewater budget is \$1.4 million, including debt service requirements. Assuming 20-year



SRF loans at 3 percent interest for each of the four projects shown in Table 4-1, a rate increase of approximately 1 percent will be required to repay the cost of the first two projects, which are planned to be constructed concurrently in 2010 at an estimated cost of \$200,000.

The infrastructure construction project scheduled for completion in April 2011 at an estimated CSO-related cost of \$500,000, will necessitate an additional rate increase of 2.5 percent to an average of \$447 per year.

The final CSO abatement project, currently planned for completion in 2016 at an estimated cost of \$1,000,000, will necessitate a sewer rate increase of an additional 4.8 percent to \$468 per year.

In all, the proposed updated CSO abatement goals will require that sewer rates be increased from the present \$432 per year to approximately \$468 per year, an increase of 8.3 percent.

Finally, it should be noted that these sewer rate impacts are simplified in that they do not account for any other increases in the City's annual wastewater revenue needs and/or any interim rate increases that are unrelated to the CSO abatement program. The estimated costs and the impact on sewer rates also do not account for any inflationary increases in capital and operating costs. The projected impacts are intended only to present an approximate idea of the rate increases necessary for the implementation of the updated CSO goals without consideration of other factors affecting the City of Gardiner's sewer rates.

TABLE 4-1  
 PROPOSED UPDATED CSO ABATEMENT  
 GOALS AND SCHEDULE

<u>CSO Abatement Goal</u>	<u>Estimated Project Cost</u>	<u>Completion Date</u>
• Optimize Influent Screw Pump Operating Level and Maximize Pumping Capacity	\$100,000	Eval 11/09, Des 3/10, Constr 12/10
• Maximize Influent Interceptor Storage Prior to Switchover to CSO Mode	\$100,000	Eval 11/09, Des 3/10, Constr 12/10
• Infrastructure Construction Project, Including Sewer Main Replacement	\$1,000,000 (~\$500,000 CSO)	Eval 9/08, Des 12/09, Constr 4/11
• Construct Underground Storage Tank (Off-line) at Maine Avenue Pump Station	\$1,000,000	Eval 12/13, Des 6/15, Constr 12/16
• Submit CSO Master Plan Update, Including an Evaluation of the Success of Abatement Projects to Date and, if Necessary, an Abatement Schedule Containing Projects to Eliminate any Remaining CSO Discharges	\$40,000	Submittal 12/18

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