

**SEWER SYSTEM MASTER PLAN UPDATE
FOR
CSO ABATEMENT**

TOWN OF SKOWHEGAN, MAINE

MAY, 2012



Prepared by:
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OLVER ASSOCIATES INC.

ENVIRONMENTAL ENGINEERS

April 27, 2012

Mr. Brent Dickey, Superintendent
Skowhegan Pollution Control Facility
225 Water Street
Skowhegan, Maine 04976

Dear Brent:

Enclosed for your review, comments and further discussion is a final version of the CSO Master Plan Update report which incorporates the review comments that were provided by the Town. Over the past year, we have evaluated the current response of the Town's sewer system and CSO locations to wet weather and high groundwater events. This has included system wide flow monitoring and an evaluation of the origins of the excess flows that lead to CSO activities. The Town has made great progress over the last decade in reducing CSO activity to their current levels. Additional work will be needed in the coming years to fully abate CSO activity to at least the one-year frequency storm threshold that has served as the past target. As we have discussed, other communities have had to meet a higher frequency storm event including several that were under consent agreement.

We have considered storage, treatment and upstream excess flow removal options at each CSO location that we feel will allow Skowhegan to meet its CSO abatement requirements. We believe that additional storage or sewer separation should be built to mitigate peak flows from Madison Avenue into CSO No. 003. An upgrade of the obsolete and undersized ejector station on Island Avenue and a possible diversion or storage of any remaining connected catchbasins from Water Street should eliminate CSO No. 009. The Elm Street pump station CSO No. 005 should be eliminated by addressing excess flows that originate in old or defective lines in three upstream areas, namely Mary Street, Summer Street, and Bennett Street. Excess flows on Main Street and a few side streets off Main Street in old combined clay lines are major contributors to CSO No. 008 activity. These flows should be stored or removed. We do not believe that upgrading the South side interceptor capacity is the best use of the Town's funds at this time. Old clay sewers in the Joyce Street area including Joyce Street, Joyce Valley, the cross-country line to Waterville Road, and Mount Pleasant Street all contribute much of the excess flow in the CSO No. 004 area.

We believe that the Town can eliminate CSO activity at two more locations, No. 005 and 009, fairly quickly and should then focus on CSO. No. 004 and 008 with more extended projects. While storage and treatment of excess flows has been the past focus, the Town will eventually

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Mr. Brent Dickey, Superintendent
April 27, 2012
Page 2

need to address the condition of some of its 100 year old clay and combined sewers which represent over sixty percent of the total sewer length. There may be a better return on investment by repairing clay lines that will need to be upgraded anyway and will last another 100 years with everyday use than on building storage or treatment at all locations that will be used only a few days each year and still be left with miles of old sewers. We have tried to present a balanced approach to future projects that will address multiple infrastructure needs for the Town.

While we expect that DEP will want the Town to accelerate its CSO program over the shortest possible schedule, it is our opinion that another twenty years is the minimum amount of time needed. The fact that general taxation is used to fund your program, and also the fact that you have a large industrial base over which to spread costs, may be used as an argument for an accelerated schedule. We suggest that the Town argue that its past and future CSO expenditures be viewed on the basis of how they would impact an equivalent user fee if one existed. If you divide your CSO costs over the sewer user base, your debt obligation is significant even though your effective costs may seem low. Other communities in Maine have encountered financial difficulties after a large industry curtailed its production forcing the full debt service to be borne by the sewer users and taxpayers. While we are not suggesting that the curtailment of an industry is a consideration in Skowhegan, we believe that long term debt service obligations should be viewed in that light as a justification to proceed over an extended schedule.

We look forward to meeting with you at your convenience, to reviewing the final report in detail, and to incorporating any additional comments and revisions that the Town may have. In the meantime, please call if you have any questions or need additional information as you review the final report. As always, we appreciate this opportunity to be of continued professional engineering service to the Town of Skowhegan.



Very truly yours,

OLVER ASSOCIATES INC.

A handwritten signature in black ink, appearing to read "W. M. Olver", written over a horizontal line.

William M. Olver P. E., President

WMO/sb

CC: Mr. Greg Dore, Public Works Director

EXECUTIVE SUMMARY

Since 1972, the Town of Skowhegan has operated a secondary wastewater treatment plant on Joyce Street. The facility has a peak hydraulic capacity of 7.5 MGD. The Town's sewer system contains over thirty miles of pipe, sixty percent of which is constructed of old clay or asbestos cement materials and prone to leakage from groundwater infiltration. Over sixty percent of the sewer system is combined and subject to stormwater inflow during wet weather events. The sewer system also includes several pump stations, a siphon below the Kennebec River, and interceptor sewers on both sides of the river. Peak sewer system flows periodically exceed the hydraulic capacity of these wastewater infrastructure components. When this occurs, overflows of untreated sewage into the river occur at six remaining combined sewer overflow (CSO) points.

As a CSO community, Skowhegan is required by both Federal and State environmental laws to take measures to abate its CSO discharges. This includes the development, implementation and periodic update of a Master Plan for CSO Abatement. The Town's wastewater discharge license requires that the present CSO Master Plan be updated by April 30, 2012. Olver Associates Inc. was retained to assist with this update. The purpose of a CSO Master Plan Update is to review the status of the Town's CSO problems, to evaluate the progress that has made to-date, and to modify the plan as needed to allow CSO abatement objectives to be met. In order to reduce CSO activity, the Town must either remove, store or treat the excess flows that are overloading the sewer system.

The Town has made significant progress in addressing and reducing CSO discharges since the first CSO Master Plan was developed in 1990. Since then, the Town has reduced its CSO discharge points from ten locations down to the six points that now remain active. CSO activity has been reduced from 363 events per year a decade ago to only 54 events last year. Annual discharges of untreated sewage out the CSO points have been reduced from as much as 62 MG/year down to only 4.75 MG last year. The Town has accomplished this by investing over \$9.5 million dollars in treatment plant and pump station expansions, construction of a 1.0 MG offline storage tank, and selective repairs to several upstream sewer areas. These steps have moved the Town's CSO abatement program forward and in the right direction.

The Town is required to eliminate CSO activity during all wet weather events below a threshold design storm. In past CSO Master Plans, the target has been to have no CSO activity below a one-year frequency storm of 2.40 inches/day. Other Maine communities have had to reduce their CSO discharges below a greater storm. Skowhegan has not yet met this target. At the present time, ninety percent of Skowhegan's CSO activity is occurring during wet weather events of less than a one-year storm, and sixty-three percent of activity occurs in rainfall events of less than a three-month storm. As a result, the Town will be required to take additional steps to further abate its CSO discharges.

The peak flow rate in the sewer system currently reaches 10.16 MGD during a one-year storm and 19.91 MGD during a twenty-five year storm. CSO discharges become active at various points in the sewer system when peak flows exceed the downstream infrastructure capacity. The origins of these excess flows were evaluated in the current Master Plan Update and the following conclusions reached:

- The majority of excess flows into the Heselton Street pump station CSO No. 002 originate from the old sewer on Heselton Street. The Town has plans to upgrade this line in the near future. While CSO No. 002 is no longer active, the removal of excess flows from this area will help to unload downstream CSO locations.
- High flows from old clay and combined sewers on Madison Avenue and Winter Street, as well as upstream areas on the North side of the sewer system, are the primary cause of activity at the North Footbridge CSO No. 003. This CSO is active an average of five times per year at events less than a six-month storm.
- The Joyce Street CSO No. 004 is active an average of twenty times per year of which ninety-three percent are associated with less than a one-year storm. This activity is caused primarily by excess flows from old leaking clay sewers, some with combined catchbasins on Joyce Street, Joyce Valley, Mount Pleasant Street, the cross-country line from Joyce Street to Waterville Road and from the adjacent residential subdivision around Dickey Street. CSO No. 004 is also impacted by peak flows from the South side interceptor.
- CSO No. 005 at the Elm Street pump station is active about nine times per year due to high excess flows that originate on Mary Street, Summer Street and Bennett Street. Eighty percent of this activity occurs at less than a one-year storm.
- CSO No. 006 at the Dinsmore pump station is no longer active and has been eliminated.
- The Town's recent CSO abatement work has stopped activity at the Bush Street CSO No. 007. High excess flows still remain on Bush Street and in the Bush Valley sewer. The Town plans to remove these flows in the near future which will help to unload downstream CSO locations.

- CSO No. 008 at the South Footbridge is active about eleven times per year. This activity is associated with storms of less than a one-year frequency eighty-seven percent of the time and of less than a three-month frequency sixty-seven percent of the time. Excess flows that originate on Main Street, Willow Street, Bailey Street, Bloomfield Street and Alder Street are the major causes of this activity.
- The Island Avenue CSO No. 009 is active about twelve times per year with seventy-five percent of this activity occurring at less than a three-month storm. These overflows are caused by an undersized and obsolete ejector station that may still have connected catchbasins from across the bridge on Water Street under surcharged conditions.
- CSO No. 010 is located at the 1.0 MG storage tank on Water Street. The CSO is active an average of eight times per year with ninety-four percent of activity occurring below a one-year storm and seventy-two percent below a three-month storm. Once the 1.0 MG storage volume is full, CSO losses at this location have averaged 650,000 GPD/inch of rainfall. Excess flows from North Avenue and Chandler/Dane Streets are the major contributors to these discharges as well as peak flows from the entire North side of Town.

Over the past decade the Town has focused on the storage and treatment of excess flows to achieve the CSO activity reductions that have occurred. In order to fully address the CSO issue, additional storage or treatment capacity may need to be constructed. The Town should also consider rehabilitating or separating some of the leakiest upstream sewers in non-urban, non-downtown areas. The Town will eventually have to invest in the upgrade of some of its 100 year old clay sewers, regardless of the CSO program. It may be beneficial to address some of these old sewers in areas where they are also the cause of the high flows that lead to CSO activity. Over half of the total annual flow received at the wastewater treatment plant originates from groundwater infiltration and base inflow which does not need to receive treatment. Addressing upstream sewer problem areas will remove these excess flows from the treatment plant, provide additional treatment capacity for future growth, and improve the Town's upstream sewer infrastructure with an investment that has a 100 year useful life.

As part of this Master Plan update, additional treatment, storage and excess flow removal alternatives were examined in detail for each CSO location. The most cost-effective and practical alternative was selected for each location and the following criteria was used to establish priorities:

- 1) Complete sewer work that is already planned on Heselton Street and Bush Street.

- 2) Remove excess flows from deteriorated combined sewer on East Maple Street.
- 3) Remove excess flows from Winter Street to reduce CSO No. 003 loadings.
- 4) Eliminate CSO No. 009 by upgrading the obsolete Island Avenue ejector station and by diverting or storing excess flows from any remaining surcharged catchbasins on Water Street.
- 5) Eliminate CSO No. 005 at the Elm Street pump station by addressing peak flows that originate in leaking sewers on Mary Street, Summer Street and Bennett Street.
- 6) Eliminate CSO No. 008 at the South Footbridge by removing peak flows from Main Street as has been previously recommended in prior Master Plans. At the same time, also address peak flows on several sidestreets off Main Street, including Willow Street, Bailey Street and Bloomfield Street. Previous suggestions to increase the South side interceptor capacity are not recommended for implementation at this time.
- 7) Address old leaking sewers in wet areas off the Joyce Street region, most of which are constructed with clay pipe and include several combined sections. This should reduce excess flows to CSO No. 004 and eliminate its activity.
- 8) Separate or store remaining excess flows from Madison Avenue area to reduce CSO No. 003 loadings.
- 9) Completion of the above prioritized projects should consolidate the remaining CSO activity in Skowhegan at CSO No. 010 and also reduce activity at this location. When this occurs, further decisions can be made on how best to eliminate flows from this location. This may include removing excess flows on North Avenue and Chandler/Dane Streets or adding additional treatment or storage capacity on Water Street.

Detailed cost estimates for each of the above abatement projects were developed and are presented in Appendix A of this report. The estimated cost of all of the above projects is \$10.115 million dollars in 2012 dollars. Given the financial impact of these projects and the fact that the Town has already invested over \$9.5 million dollars to-date, we suggest that an additional twenty years be added to the compliance schedule for the Town's CSO abatement program as follows:

YEAR(S)	CSO ABATEMENT ACTIVITY	ESTIMATED PROJECT COST*	ESTIMATED BLOCK COSTS
2012	Submit CSO Master Plan	\$ 24,000	
	Heselton/Bush Street sewers	280,000	\$ 304,000
2013	Clean/video Dickey/Mary/High School area	20,000	
2013-2017	East Maple Street sanitary/storm sewers	420,000	
2013-2017	Winter Street sanitary/storm sewers	480,000	
2013-2017	Upgrade Island Avenue PS	510,000	
2013-2017	Mary Street sewer relining	100,000	
2013-2017	Summer Street sanitary sewer	400,000	
2013-2017	Bennett Street sanitary sewer	415,000	
2018	Update CSO Master Plan	25,000	\$ 2,370,000
2018-2022	Main Street sanitary sewer	945,000	
2018-2022	Alder Street storm sewer	365,000	
2018-2022	Willow Street sanitary/storm sewer	430,000	
2018-2022	Bailey Street sanitary/storm sewer	235,000	
2018-2022	Bloomfield Street sanitary/storm sewer	495,000	
2022	Update CSO Master Plan	30,000	\$ 2,500,000
2023-2027	Joyce Street sanitary ewer	360,000	
2023-2027	Joyce Street cross-country to Waterville Road sanitary sewer	295,000	
2023-2027	Joyce Valley sanitary sewer	345,000	
2023-2027	Mount Pleasant Street sanitary/storm sewer	480,000	
2023-2027	Madison Avenue sanitary sewer	1,280,000	
2027	Update CSO Master Plan	35,000	\$ 2,795,000
2028-2032	North Avenue sanitary sewer	1,465,000	
2028-2032	Chandler/Dane Street sanitary/storm sewer	795,000	
2032	Update CSO Master Plan	40,000	\$ 2,300,000

*All costs presented in 2012 dollars and should be updated each year.

TABLE OF CONTENTS

	Page
<u>Executive Summary</u>	i
<u>Table of Contents</u>	vi
<u>List of Tables</u>	ix
<u>List of Figures</u>	x
1. <u>Skowhegan’s Sewer System CSO Issues</u>	1
1.1 Skowhegan’s Municipal Sewerage System	1
1.2 Impact of Excess Sewer Flows on Sewerage System	6
1.3 Skowhegan’s Combined Sewer Overflow Points	18
1.4 Skowhegan’s CSO Abatement Obligations	20
1.5 Objectives of CSO Master Plan Update	22
2. <u>Skowhegan’s CSO Abatement Program</u>	24
3. <u>Assessment of Skowhegan’s CSO Activity</u>	32
3.1 CSO Assessment Procedures	32
3.2 CSO Drainage Area Characterization	33
3.3 Receiving Water Characterization	38
3.4 CSO Activation Frequency	39
3.5 CSO Activation Conditions	43
3.6 Typical CSO Discharge Volumes	53
3.7 Estimated CSO Pollutant Loadings	56
3.8 Summary of Skowhegan’s CSO Assessment	57
4. <u>Sewer System Infiltration/Inflow Analysis</u>	59
4.1 Excess Infiltration/Inflow Considerations	59
4.2 Extent of Excess Flow Problem	60
4.3 Infiltration/Inflow (I/I) Evaluation	63

5.	<u>Best Management Practices for CSO Minimization</u>	75
5.1	Objectives of Best Management Practices.....	75
5.2	Sewer Maintenance Best Management Practices	77
5.2.1	General Considerations	77
5.2.2	Sewer Flushing and Cleaning.....	77
5.2.3	Pump Station Maintenance.....	78
5.2.4	CSO Activation Surveys	79
5.2.5	Dry Weather Overflow Elimination	79
5.3	Sewer Regulation Best Management Practices	79
5.3.1	General Considerations	79
5.3.2	Control of Unpolluted Discharges.....	79
5.3.3	Industrial Strength Waste Discharge Control.....	80
5.3.4	Future Industrial Sewer User Siting.....	81
5.3.5	CSO Outfall Identification Signs	81
5.3.6	Urban Storm Water Management	81
5.4	Treatment Plant Best Management Practices	81
5.4.1	General Considerations	81
5.4.2	High Flow Management Considerations.....	81
5.5	Additional BMP Considerations	82
6.	<u>Alternatives for Further CSO Abatement</u>	83
6.1	General Considerations for CSO Reduction.....	83
6.2	Alternatives for Further CSO Abatement	85
6.2.1	No-Action Alternatives	85
6.2.2	Excess Flow Removal At Its Source	86
6.2.3	In-Line Storage.....	88
6.2.4	Offline Storage	91
6.2.5	Excess Flow Treatment	92
6.3	Selected Principal Alternatives for Each CSO	93
6.3.1	Heselton Street Pump Station CSO No. 002	93
6.3.2	North Footbridge Siphon Inlet CSO No. 003.....	94
6.3.3	Joyce Street CSO No. 004.....	95
6.3.4	Elm Street Pump Station CSO No. 005.....	96
6.3.5	Dinsmore Street Pump Station CSO No. 006	97
6.3.6	Bush Street/Cross-Country CSO No. 007.....	97
6.3.7	South Footbridge CSO No. 008	98
6.3.8	Island Avenue Pump Station CSO No. 009	100
6.3.9	CSO Storage Tank No. 010.....	101

6.4	Estimated Costs of Potential CSO Abatement Alternatives	103
6.4.1	Heselton Street Pump Station CSO No. 002 Abatement Costs	104
6.4.2	North Footbridge/Siphon Inlet CSO No. 003 Abatement Costs	104
6.4.3	Joyce Street Area CSO No. 004 Abatement Costs	104
6.4.4	Elm Street Pump Station CSO No. 005 Abatement Costs	105
6.4.5	Dinsmore Street Pump Station CSO No. 006 Abatement Costs	106
6.4.6	Bush Street Area CSO No. 007 Abatement Costs	106
6.4.7	South Footbridge Area CSO No. 008 Abatement Costs	106
6.4.8	Island Avenue Pump Station CSO No. 009 Abatement Costs	107
6.4.9	Water Street Storage Tank CSO No. 010 Abatement Costs ..	107
7.	<u>Skowhegan's Updated Sewer System Master Plan for CSO Abatement</u>	109
7.1	CSO Master Plan Objectives	109
7.2	Impacts of Proposed Abatement Projects on CSO Activity	111
7.3	Estimated CSO Abatement Project Costs	115
7.4	Financial Capacity Analysis	116
7.5	Tentative Implementation Schedule	118
7.6	Interim Monitoring Plan	120
7.7	Periodic Master Plan Review	121
7.8	Public Notification	121

APPENDICES

- A. Detailed Preliminary Cost Estimates for Sewer System CSO Abatement Projects
- B. Annual DEP CSO Monitoring Reports

LIST OF TABLES

TABLE	TITLE	PAGE
1	Composition of Skowhegan Sewer System	3
2	Skowhegan’s Wastewater Pumping Stations.....	4
3	Storm Magnitude Frequency for Skowhegan	16
4	Flow Basis at One Year Storm (MGD)	16
5	Flow Basis at 25 Year Storm (MGD)	17
6	Skowhegan’s CSO Discharge Locations	18
7	Observed CSO Activation Events Per Year	39
8	Current CSO Activation Frequency By Month	41
9	Distribution of Recent Skowhegan Rainfall Events	43
10	Storm Frequency Activation Percentiles for Each CSO.....	45
11	Annual CSO Discharge Volumes Per Year	53
12	Average Unitized CSO Discharge At Each CSO	55
13	Typical CSO Discharge Volumes at Various Storm Sizes.....	56
14	Typical CSO Discharge Quality	57
15	Estimated Total CSO Pollutant Losses	57
16	Relative Magnitude of Various Peak Flow Sources	61
17	Typical Annual Total Wastewater Gallons Treated (MG)	62
18	Unitized Groundwater Infiltration By Sewer Subsystem	65
19	Unitized Peak Stormwater Inflow Rates.....	68
20	Peak Inflow Generation Rates By Subsystem (MGD)	70
21	EPA’s Nine Minimum CSO Controls.....	75
22	High Priority Sewer Flushing Areas	78
23	High Priority Pump Station Maintenance Locations	78
24	Estimated Sewer System Peak Flow Rate Reduction from Proposed CSO Abatement Projects	112
25	Estimated Reduction in Active CSO Locations.....	114
26	Summary of CSO Abatement Capital Costs.....	115
27	Tentative CSO Project Implementation Schedule	120

LIST OF FIGURES

<u>FIGURE</u>	<u>TITLE</u>	<u>PAGE</u>
1	Sewer System Configuration	2
2	Pollution Control Facility Treatment Process Schematic	5
3	Typical Sanitary Flow Origins	8
4	Typical Groundwater Infiltration Sources	11
5	Typical Stormwater Inflow Sources	12
6	CSO Location Map	25
7	CSO Interconnection Map	34
8	Skowhegan's CSO Activity	42
9	Skowhegan's Typical Rainfall Distribution	44
10	North Footbridge/Siphon Inlet CSO 003 Activation Threshold Storm.....	47
11	Joyce Street CSO No. 004 Activation Threshold Storm	48
12	Elm Street Pump Station CSO No. 005 Activation Threshold Storm.....	49
13	South Footbridge CSO No. 008 Activation Threshold Storm	50
14	Island Avenue Pump Station CSO No. 009 Activation Threshold Storm.....	51
15	Water Street Storage Tank CSO No. 010 Activation Threshold Storm.....	52
16	Annual CSO Discharge Volumes	54
17	Sewer System Subsystems and Infiltration/Inflow	
	Monitoring Nodes	64
18	Identified Areas of Excess Flow Origins	74
19	Typical Precast In-line Storage Tank.....	90
20	CSO Abatement Project Priorities	113

POCKET

Skowhegan Sewer System Map

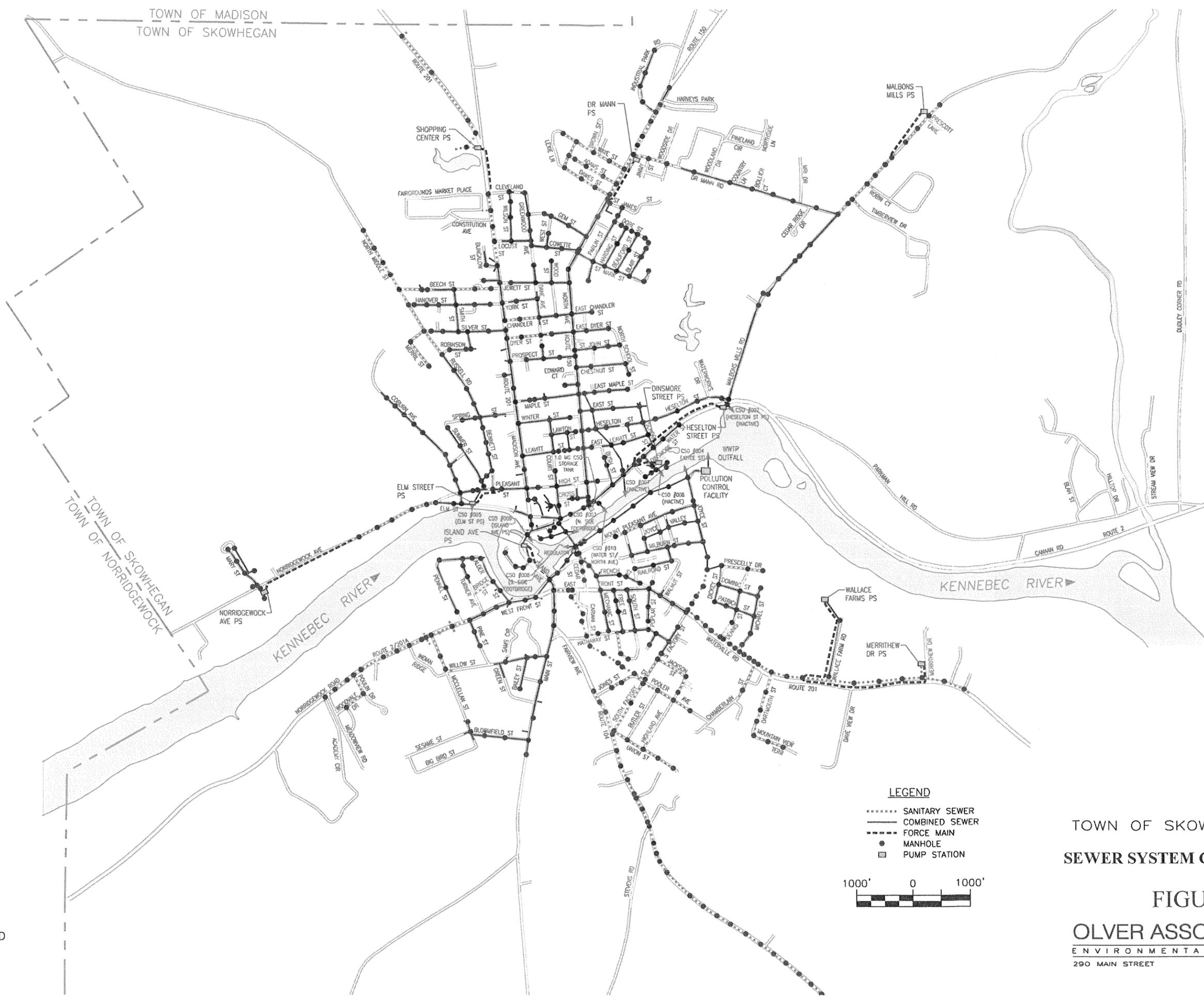
1. SKOWHEGAN'S SEWER SYSTEM CSO ISSUES

1.1 SKOWHEGAN'S MUNICIPAL SEWERAGE SYSTEM

The Town of Skowhegan operates a wastewater collection and treatment system that serves about 1500 connected sewer users (1800 equivalent residential and commercial users) representing a sewer population of just under 5,000 people. Wastewater is collected by a complex network of sewers and pump stations and conveyed to the central treatment plant site on Joyce Street. The plant has an average daily flow capacity of 1.65 MGD and a peak hourly capacity of 7.5 MGD. The sewer system consists of over 161,000 LF, or over thirty miles, of pipe and eleven pump stations and consists of two major districts, North and South, as separated by the Kennebec River. A siphon carries flows under the river from the North District to the South District in order to reach the treatment plant. The general configuration of the Town's municipal sewer system is shown on Figure 1. A larger scale map of the sewer system can be found in the pocket at the end of this report.

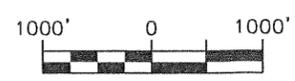
A large portion of the Town's sewer system is combined, meaning that both sanitary sewage and stormwater flows from street catchbasins are carried in the same pipes. Eighty percent of the sewer system was originally combined, but this number has decreased to about sixty-one percent as a result of previous sewer improvements. Prior to the construction of the wastewater treatment plant in 1973, all flows were discharged to the Kennebec River, so it made no difference if stormwater and sewage were mixed together in the sewer system. In fact, the presence of peak stormwater flows was considered beneficial since they provided periodic flushing of the sewer lines. With the construction of the downstream treatment plant, excess flows in the sewer system are problematic since they can overload the facility and hinder its ability to treat the sanitary sewage for which it was designed.

Typical sizes of the Town's gravity collector and interceptor sewers range from 8" Ø to 72" Ø. These sewers are constructed of a variety of different pipe materials including vitrified clay (VCP), asbestos cement (ACP), polyvinyl chloride (PVC), and reinforced concrete (RCP). As shown below in Table 1, almost sixty percent of the sewer system is constructed of vitrified clay and asbestos cement pipe, both of which are considered to be substandard by current design practices. Many of the Town's clay pipe sections are likely fifty to one-hundred years old. Clay pipes were often laid with open, leaking joints at three foot intervals. This pipe material is also brittle and prone to cracking which allows groundwater to enter the sewer. Asbestos cement pipe was likely used forty to fifty years ago, but has fallen out of favor due to safety issues related to the asbestos fibers. In addition, the cement that holds the fibers together is prone to deterioration in the presence of moisture and hydrogen sulfide sewer gas. This has led to the failure of ACP sewers and this material is no longer used. The remaining sewer lines, representing just over forty percent of the system, are constructed of sewer pipe materials such as PVC, HPDE, and RCP. These lines are newer and likely installed within the last forty years.



LEGEND

- SANITARY SEWER
- COMBINED SEWER
- FORCE MAIN
- MANHOLE
- PUMP STATION



TOWN OF SKOWHEGAN, MAINE
SEWER SYSTEM CONFIGURATION

FIGURE 1

OLVER ASSOCIATES INC.
ENVIRONMENTAL ENGINEERS
290 MAIN STREET WINTERPORT, MAINE

SOURCE:
TOWN OF SKOWHEGAN AND
MAINE OFFICE OF GIS

TABLE 1: COMPOSITION OF SKOWHEGAN SEWER SYSTEM

<u>PIPE MATERIAL</u>	<u>PERCENT</u>	<u>ACCUMULATIVE PERCENT</u>
Vitrified clay (VCP)	41.5%	41.5%
Asbestos cement (ACP)	16.2%	57.7%
Polyvinyl chlorine (PVC)	36.7%	94.4%
Reinforced concrete (RCP)	5.6%	100.0%

The presence of such a large percentage of clay and asbestos cement pipes, representing about eighteen miles of the total sewer system, makes the Skowhegan system prone to excess flows from groundwater infiltration. In addition, the fact that over sixty percent, or about eighteen miles, of the system is combined with connected catchbasins, makes the system prone to excess flows from peak stormwater events. During periods of heavy precipitation from rainfall and snowmelt events, the volume of peak stormwater inflow from street catchbasins, roof drains and cellar drains can exceed the capacity of both the sewer system and the downstream wastewater treatment plant. Peak flows can also overwhelm the pumping stations that are used to lift flows over elevation changes in the system. When the capacities of the sewer pipes, pump stations or treatment plant are exceeded, the excess flows backup and are discharged untreated to the Kennebec River through combined sewer overflow (CSO) points.

The natural topography of the Skowhegan area allows the majority of the sewer system's flows to reach the treatment plant site by gravity. With the exception of the siphon structure which uses differential elevation head to convey flows below the Kennebec River from the North District to the South District, all of the Town's major sewer lines and interceptors utilize gravity flow. Eleven pump stations are located at various points throughout the system to lift flows up over topographical elevation differences to the nearest gravity sewer. These pump stations are shown on Figure 1 and listed in Table 2. Nine of the pump stations are located on the North side of the river with the remaining two on the South side.

TABLE 2: SKOWHEGAN'S WASTEWATER PUMPING STATIONS

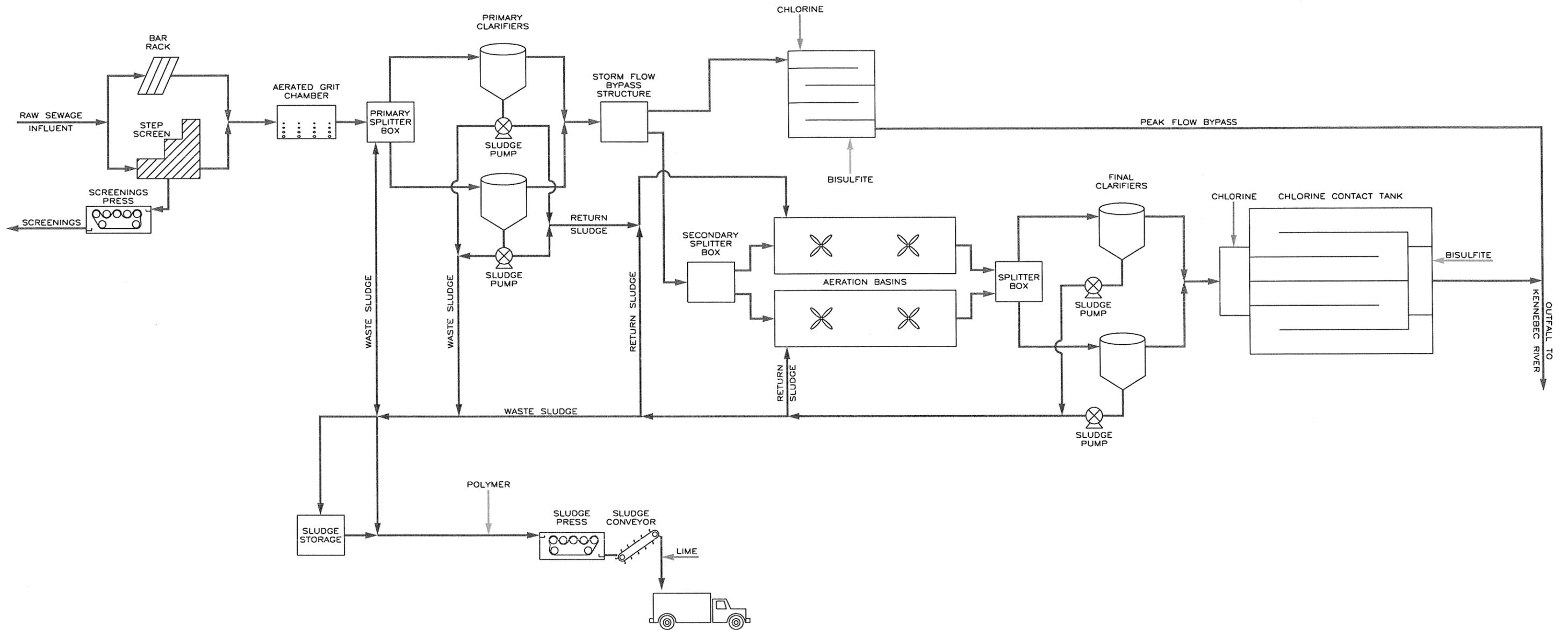
<u>PUMP STATION</u>	<u>GENERAL SERVICE AREA</u>
Dinsmore Street PS	Dinsmore Street area
Dr. Mann PS	Upper North Avenue area
Elm Street PS	Coburn/Summer/Bennett St./Norridgewock Ave. areas
Heselton Street PS	Heselton/Lower Malbons Mills/Dr. Mann areas
Island Avenue PS	Island Avenue area
Malbons Mills PS	Upper Malbons Mills area
Norridgewock Avenue PS	Mary Street area
Merrithew Drive PS	Merrithew Drive/Waterville Road areas
Shopping Center PS	Lakewood Road area
Wallace Farms PS	Wallace Farms Road area
CSO Storage Tank	Downtown Stormwater Storage

All flows from both the North and South sides of the sewer system eventually reach a 2600 LF long interceptor sewer along the south bank of the Kennebec River between the siphon outlet near Cedar Street and the treatment plant off Joyce Street. The majority of the interceptor sewer is constructed of 24" Ø RCP pipe, but some initial sections just after the siphon discharge were designed as 16" Ø and 20" Ø sections in order to regulate peak flow volumes to the plant.

The Town's wastewater treatment plant was constructed in 1972 to remove pollutants from sewage prior to its discharge into the Kennebec River as clean, treated effluent. The facility utilizes the activated sludge process to provide secondary level treatment to the incoming wastewater. This is accomplished by a series of unit processes that progressively treat the wastewater as it flows through the plant. The facility's original unit processes were augmented by a peak flow upgrade that was completed in 2004.

Figure 2 shows a schematic presentation of the treatment plant's unit processes. Influent flows first receive preliminary treatment in the plant's headworks. Debris is removed from the influent by screening and sand and gravel are removed in a grit chamber. The influent flow is also measured and sampled. Flows then receive primary treatment in two 40' Ø clarifiers which serve as settling basins to remove pollutants by gravity sedimentation. Raw sludge is pumped from these reactors for subsequent dewatering.

Two aeration basins, each holding about 185,000 gallons of water, are used to grow microbes that biodegrade the organic pollutants in the primary effluent. The incoming pollutants are converted to either microbial cells that can be settled from the water or carbon dioxide gas which is released to the atmosphere. Oxygen to support the microbial activity in the reactors is provided by four mechanical surface aerators, each rated at 15 HP.



TOWN OF SKOWHEGAN
 POLLUTION CONTROL FACILITY TREATMENT
 PROCESS SCHEMATIC

FIGURE 2

Microbes from the aeration basins are settled in two 50' Ø final clarifiers. The microbes settle to the bottom of the reactors as secondary sludge leaving clean water above the sludge blanket. The clarified effluent is sent to a chlorine contact tank for disinfection while the microbes are pumped back to the aeration basins to treat additional wastewater.

The plant has two effluent disinfection reactors. Normal flow levels are treated in a two cell chlorine contact tank with each cell containing about 25,000 gallons. This reactor provides about 40 minutes of detention time at average flow loadings and just under 15 minutes at peak hourly flows. A second chlorine contact tank was added in 2004 to treat peak flows during storm events. This reactor adds about 30,000 gallons of detention time that is used to disinfect peak stormwater loadings that enter the plant during rainfall and precipitation events.

Raw sludge from the primary clarifiers and excess microbial cells that are periodically wasted from the biological system are cosettled and then dewatered on a two meter belt filter press. The sludge is treated with polymer to enhance dewatering and with lime for odor and pathogen control prior to its final disposal.

Treated effluent from the chlorine contact tank is discharged to the Kennebec River via a 24" Ø RCP outfall pipe. The outfall contains both treated secondary effluent during normal flow periods as well as chlorinated primary effluent that is generated in the peak flow reactor during wet weather events.

The treatment plant is licensed to discharge a monthly average flow of 1.65 MGD through its normal secondary treatment system. When peak hourly flows into the plant exceed 5.0 MGD, excess flows are diverted to the peak flow disinfection reactor up to its maximum flow capacity of 7.5 MGD. The plant's normal effluent must meet typical secondary standards of 30 mg/l (milligrams per liter) for both monthly average biochemical oxygen demand (BOD) and total suspended solids (TSS). Between May 15 and September 30, the effluent must be disinfected to an E. coli bacteria level of no more than 64 col/100 ml (colonies per 100 milliliters) on a monthly average basis and 427 col/100 ml on a peak daily basis. E. coli levels during peak stormwater events must also meet the 427 col/100 ml standard through the peak flow disinfection reactor.

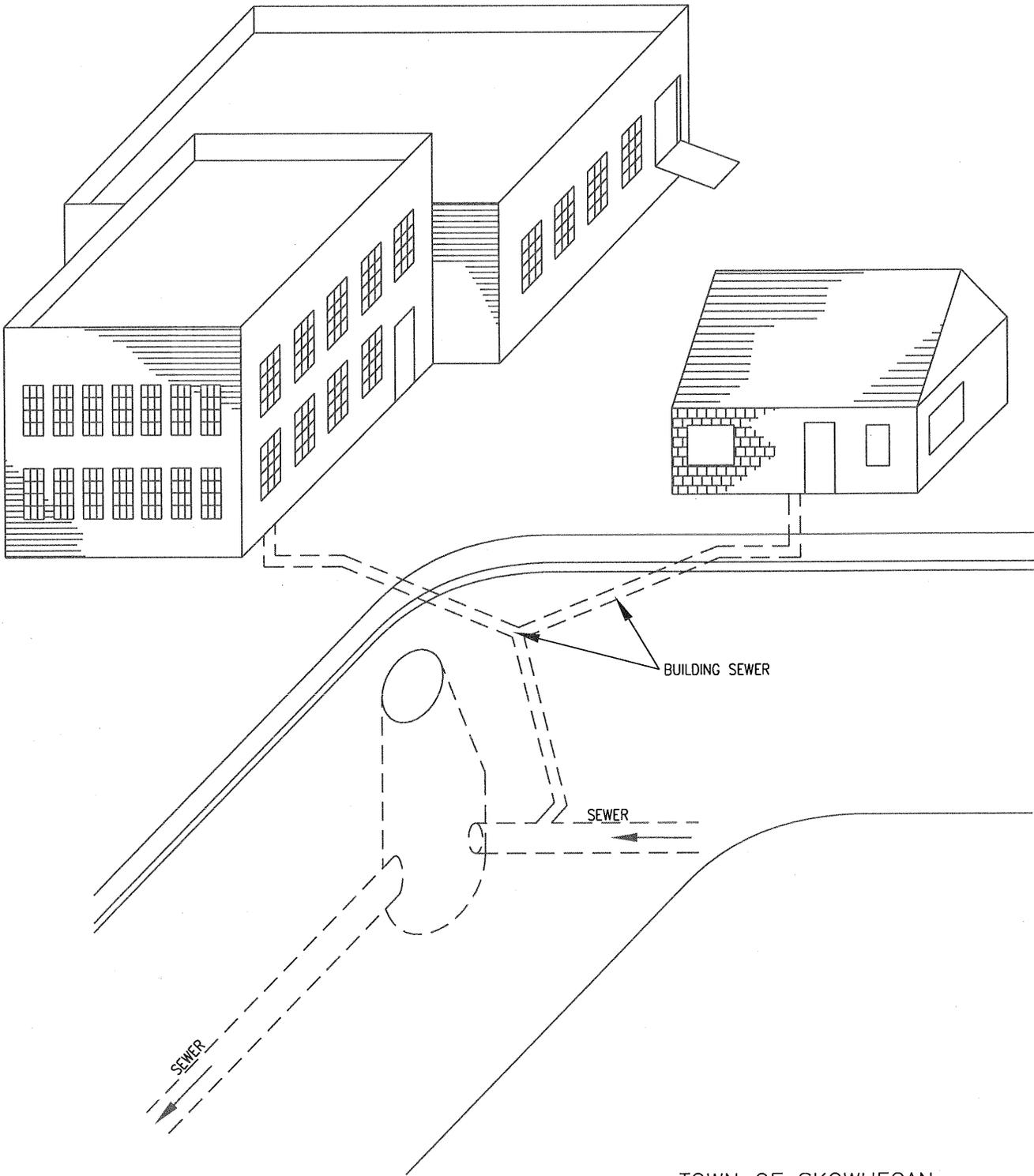
1.2 IMPACT OF EXCESS SEWER FLOWS ON SEWERAGE SYSTEM

Skowhegan's wastewater treatment plant was designed in 1972 with an average daily flow capacity of 1.44 MGD and a peak hourly flow capacity of 4.68 MGD. With the addition of the peak flow disinfection system in 2004, the plant's capacity was upgraded to an average daily flow of 1.65 MGD and a peak hourly capacity of 7.5 MGD. These capacities are often exceeded due to the presence of excess groundwater infiltration into old, leaking sewer lines and the entry of stormwater inflow into the system from combined sewers, catchbasins, roof drains and cellar sump pumps. The fact that about sixty percent of the sewer system is constructed with old clay and asbestos pipes makes it

prone to groundwater infiltration entry. In addition, the fact that sixty percent of the sewer system is combined makes it susceptible to wide flow variations from stormwater inflow.

The poor condition of large segments of the Skowhegan sewer system, as well as the fact that some areas of the sewer system remain combined with sanitary flow and storm flows that are present together in the same pipes, serves as the basis for the high peak flows that are observed. A review of sewer system flows suggests that far greater volumes of flow are present than would be caused by sanitary sewage flows alone. There are typically several major sources of flow generation into the municipal sewer system as follows:

- Base sanitary flow is a measure of the raw sewage generated by homes, businesses, industrial applications, and commercial users throughout the community. Sanitary flows are the flow component for which the construction of wastewater treatment facilities was generally intended. The amount of sanitary wastewater present in the sewer system can be estimated by a correlation with the Town's potable water records, by considering typical design values (such as Plumbing Code data) for various categories of sewer users, or by analyzing actual flow records for the existing treatment facilities. Figure 3 shows the typical route of sanitary flow entering into the sewer system through a series of building sewers, manholes, and sewer pipes.
- Peak hourly sanitary flow is generally estimated by applying a statistical peaking factor to the base sanitary flow. For a community of Skowhegan's size, it is typical to observe a peak sanitary flow rate that is about three to four times the base sanitary flow rate. These peak flow periods occur throughout the day in response to fluctuating water use patterns by the sewer users. It is not uncommon to experience a maximum peak flow in the system early in the morning as sewer users rise and shower and then throughout the day in relation to noon and evening meal periods.



TOWN OF SKOWHEGAN
TYPICAL SANITARY FLOW ORIGINS

FIGURE 3

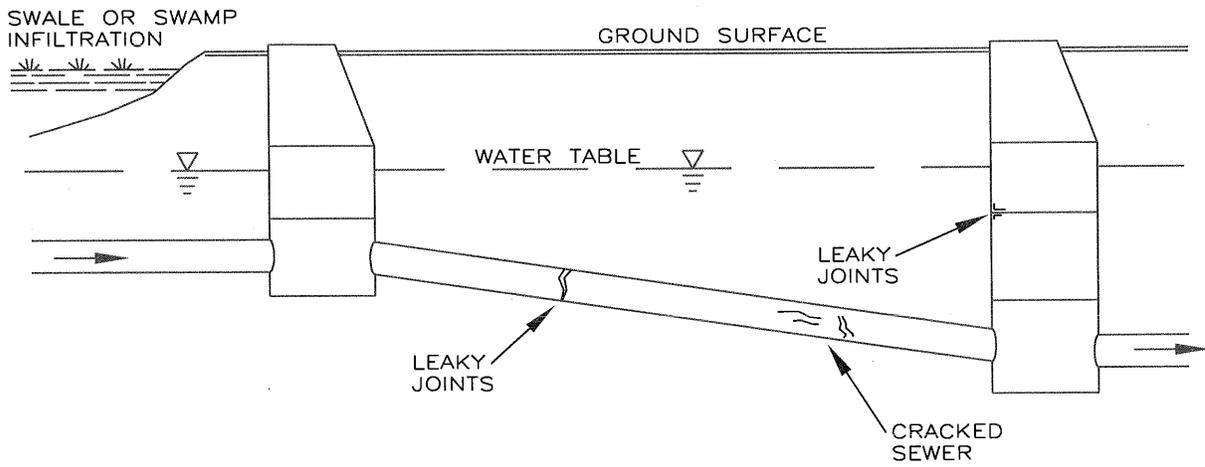
- Infiltration is the introduction of extraneous groundwater into sewer systems through defective pipes, pipe joints, service connections, and manhole walls. The rate of infiltration into the system is generally at its annual peak each Spring corresponding to the highest elevation of the groundwater table. The net infiltration flow rates at each monitoring location in a sewer system can be used to calculate the unitized infiltration rates per unit quantity of pipe in each CSO district, system, or subsystem. Where appropriate, upstream flow areas are subtracted from downstream measurements to determine the infiltration rate entering a specific reach of pipe. These flow quantities are then divided by the amount of pipe within their area of flow contribution in order to express the infiltration rates in terms of gallons per day per inch-mile (GPD/in-mi).

It is common and necessary to express infiltration rates this way for comparison because larger diameter pipes and longer sewer runs have larger surface areas and longer linear lengths, respectively, through which groundwater may enter the sewer lines. By using the GPD/inch-mile unit, direct comparisons can be made between portions of the sewer system and relative leakage rankings can be determined. For the purpose of comparison, new PVC sewers with tight gaskets typically have an infiltration rate less than 200 GPD/in-mi. Older PVC sewers in good condition may experience infiltration rates in the 500 GPD/in-mi range. EPA criteria for sewer system evaluations generally consider infiltration rates above 3,000 to 10,000 GPD/in-mi as excessive depending on the length of the sewer system. For the thirty-mile long Skowhegan sewer system, a value of 3,000 GPD/in-mi would be applicable. Figure 4 shows the typical origins of sewer system groundwater infiltration.

- Stormwater inflow is the largest single source of extraneous water entering the Skowhegan sewerage system. It consists of stormwater which enters through catchbasins in combined sewers, separated storm sewers that reconnect to the sewer system, and roof, cellar, and underdrains from buildings which are connected to the collection system. Inflow can also come from above ground drainage ditches or streams which intersect catchbasins or field inlets and then flow into the sewer system. The magnitude of stormwater inflow into a sewer system depends on the frequency, duration, and rainfall amount during various storm events. It also depends on ground cover conditions, soil conditions, groundwater saturation levels, and frozen ground conditions at the time of the storm. For example, a similar rain event falling on dry soil during Summer conditions may have less of an impact on the sewer system than the same event falling onto frozen Winter ground conditions or saturated Spring groundwater conditions. A two-inch rainfall that occurs gradually over twenty-four hours will have less of an impact on the sewer system than a Summer thunderstorm that causes two inches of rain to fall in a few hours. While the extent of peak inflow into a sewer system can be highly variable, the adverse impact of inflow on a sewer or treatment system can be severe. Inflow represents sudden, peak flow

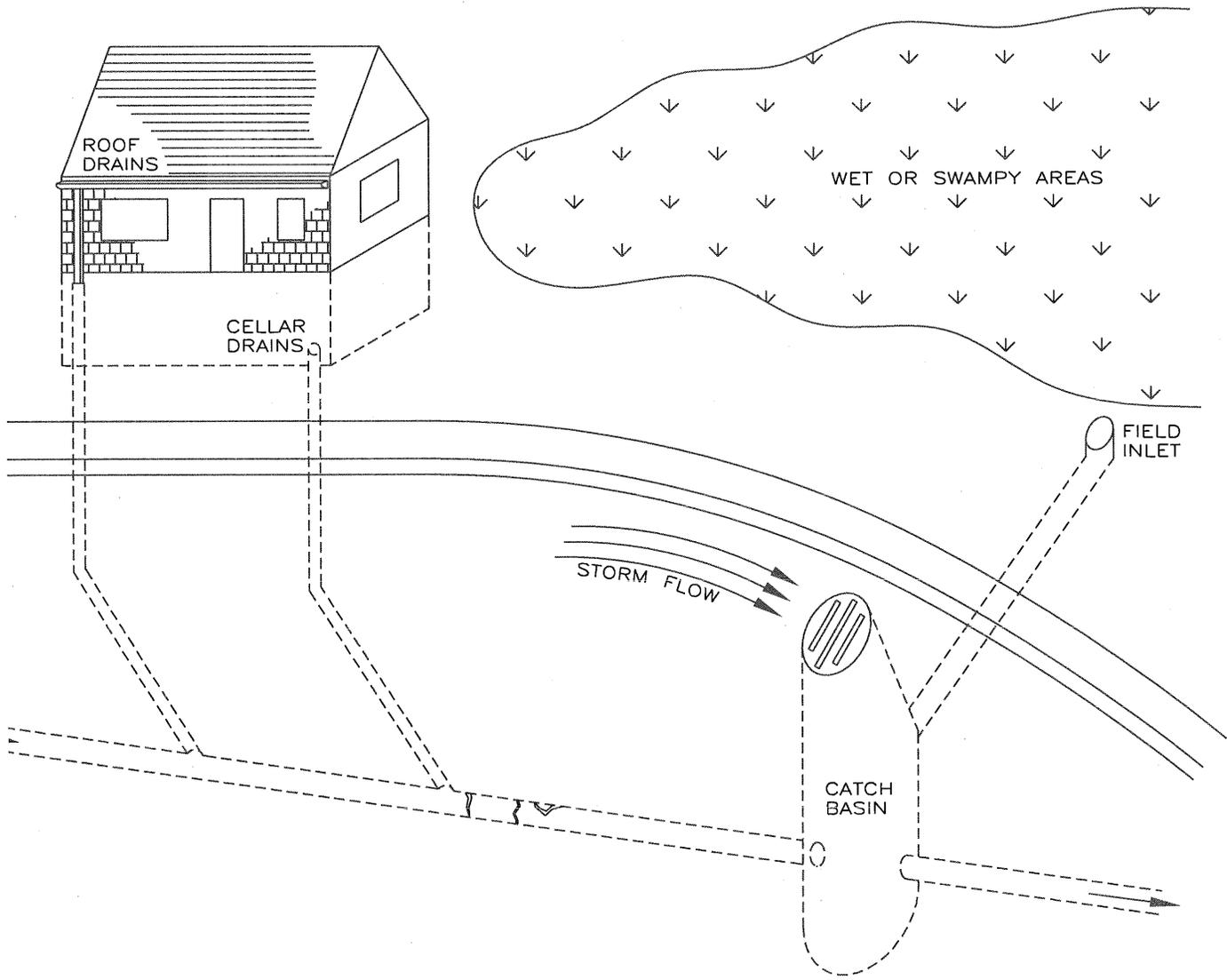
variations that can rapidly enter a sewer system and cause overflows or process washouts. This type of sudden flow impact is in contrast to that of groundwater infiltration which tends to occur more gradually and that represents a background level of flow that varies seasonally. Inflow events show up as peak spiked flows in the sewer system and treatment plant. Figure 5 shows typical sources of sewer system inflow.

- Inflow induced infiltration represents the net effect of inflow and infiltration in a sewer system. Rainfall from inflow events can cause temporary changes in the local groundwater table as precipitation soaks into the soil. This elevation of the groundwater table causes an increase in the static pressure of water over old and leaking sewer pipes and a subsequent increase in groundwater infiltration into the pipes. Inflow induced infiltration is manifested by a gradual rise in background infiltration levels that occurs after a rainfall event and that may take several days to subside after the storm event ends.
- Snowmelt represents additional wet weather flow that occurs each Spring as elevated ambient temperatures cause a gradual loss of the snowpack. Overland runoff of melting snow may find its way into catchbasins, field inlets, and streams that are the source of inflow into the sewer system. Snowmelt also results in the eventual elevation of the groundwater table under Spring saturation conditions which is often coincident with the onset of peak annual sewer system groundwater infiltration.



TOWN OF SKOWHEGAN
 TYPICAL GROUNDWATER INFILTRATION SOURCES

FIGURE 4



TOWN OF SKOWHEGAN
 TYPICAL STORMWATER INFLOW SOURCES

FIGURE 5

From the flow data presented in the Town's monthly DEP reporting forms for the two-year period between 2009 and 2010, the following observations were made with regard to the amount of each of the above sewer system loadings that reach the wastewater treatment plant:

- The average daily flow to the plant on all days, including wet weather events, was 1.150 MGD.
- If wet weather days are omitted, the average daily dry weather flow was 0.955 MGD.
- The maximum sustained, thirty-day monthly flow at the plant was 2.082 MGD. This occurred during April when groundwater infiltration, snowmelt, and Spring rain events were prevalent.
- The maximum recorded daily flow was 3.263 MGD. This occurred in March during a peak flow rainfall event in conjunction with snowmelt.
- The peak hourly dry weather flow received at the plant is typically about 1.85 MGD.
- The peak hourly wet weather flow recorded at the plant was 6.00 MGD due to limitations in the flow meter capacity, but a total of 7.5 MGD of combined secondary effluent and primary stormwater can be treated.

The plant's flow data record shows that peak excess flow levels exist in the sewer system beyond the reported design capacity of the treatment plant. This leaves the Town subject to upstream CSO activity until additional excess flows are removed, additional storage capacity is provided in the sewer system, or until additional treatment plant capacity is constructed.

The data record examined is only valid for the two-year period that it represents. Since peak flows are heavily influenced by the magnitude, intensity and duration of wet weather events, higher or lower plant flows may occur during storm events that vary from those observed during the examined data record. Because the treatment plant must provide sufficient capacity during all storm events, it is necessary to extrapolate the observed data to other wet weather conditions that were not observed during the subject two years, but which could occur in the future.

A statistical review and analysis of the plant's flow data provides a valuable approach to determine and model potential peak flow in the sewer system beyond that shown by the data record. This procedure consists of a detailed examination of plant flow records and an allocation of the total flow observed to the categories of their origin, namely sanitary flow, groundwater infiltration, and stormwater inflow. Once design

values are developed for each of these flow categories, the individual categories can be added back together to yield the theoretical total flows that might be expected to be present if the data record was extended and if the flow meter was large enough to record them. This approach is first calibrated to see how it compares to actual plant data and, if the calibration shows good reliability, it is extrapolated to look at flows that might occur during a potential design storm of either a one-year or a twenty-five year frequency event.

The treatment plant's flow records can be analyzed to yield useful information about the origins of the plant's flow as follows:

- The total influent flow for each day of the year can be obtained from the plant's flow records. The total plant flow reflects both wet weather and dry weather days.
- The daily dry weather flow reflects sanitary influent and groundwater infiltration, but it deletes wet weather flow impacts. The dry weather flow can be estimated by deleting from the average any day that had precipitation. It is often necessary to also ignore the flows that occur several days after a rain event due to the lasting effects of inflow induced infiltration which tends to bias flows.
- Groundwater infiltration flows into the treatment plant can be estimated by reviewing the minimum instantaneous volumes that the plant receives over a twenty-four hour period during dry weather. Often, these minimum flows occur between 2 AM and 6 AM when very few users are sending wastewater to the system. On dry weather days, the minimum nighttime flows to the plant will be essentially only the groundwater leakage that is occurring. This represents a base background flow that occurs at a constant rate over twenty-four hours, but which may vary seasonally as the groundwater table fluctuates.
- Base sanitary flows into the sewer system can be estimated as the difference between the daily dry weather flow and the nighttime groundwater infiltration rate. During dry weather periods, these are essentially the only two flows that are present in the sewer system.
- The total base wet weather impact on the treatment plant can be estimated by analyzing the amount of additional daily flow volume that occurs at the plant during various precipitation events. This data can be unitized to GPD per inch of rainfall to gain a perspective on how various storm events impact the system. As the number of storm events increase, the unitized data generally will be shown to converge to a very reliable and replicable range of values.

- The peak hourly flow rates received at the plant will vary during periods of both dry weather and wet weather. They can be found by a review of the peak instantaneous flow values recorded by the plant's flow meter with CSO flows added as applicable.

The Skowhegan flow data, as reviewed between 2009 and 2010, allows some general observations to be made regarding the origins of various sources of flow into the Town's sewer system as follows:

- Base daily sanitary flows into the system average 0.52 MGD over the year.
- Peak hourly sanitary flows can be estimated by applying a typical peaking factor of 3.5 to the base sanitary flow. On an annual average basis, this would yield an estimated peak hourly flow of about 1.85 MGD.
- Peak groundwater infiltration reaches a maximum level of about 0.80 MGD during spring high water table conditions. During the remainder of the year, base infiltration is typically 0.30 MGD and drops to near 0.10 MGD in the summer.
- The base inflow impact on the treatment plant is significant and varies over the year. The average base inflow impact causes an average daily flow rise of 0.90 MGD per inch of rainfall over the entire year.
- Peak hourly inflow impacts are the origin of most of the system's excess flow problems. The impact of inflow on the plant's peak hourly flow averages 4.25 MGD of peak flow per inch of rainfall.

During the two-year period of data observation, the highest recorded rainfall event was 2.67 inches of precipitation per day. In order to extrapolate the observed data to other storms beyond the period of record, it is useful to consider the extent of other rainfall events that are typical for the Skowhegan area. Table 3 defines the amount of rainfall that would be expected for various magnitude storm events. The storm return period listed in the table indicates the statistical probability of a storm of that size occurring at the specified interval. For example, a one-year storm event of 2.40 inches/day has a statistical probability of occurring once each year. Therefore, the greatest storm of 2.67 inches/day that occurred over the observed two-year period of record represents nearly a two-year storm event.

TABLE 3: STORM MAGNITUDE FREQUENCY FOR SKOWHEGAN

STORM RETURN FREQUENCY	STORM MAGNITUDE (INCHES/DAY)
3 Month	1.35
6 Month	1.75
9 Month	2.00
1 Year	2.40
2 Year	2.70
5 Year	3.50
10 Year	4.10
25 Year	4.70

Over the past seventeen years, Skowhegan has used a one-year frequency storm event of 2.40 inches/day of rainfall as the basis by which excess flows in the sewer system have been evaluated. If the statistical flow data for the sewer system is considered in terms of a one-year storm, the expected sewer system peak flows that might occur are summarized below in Table 4:

TABLE 4: FLOW BASIS AT ONE-YEAR STORM (MGD)

FLOW PARAMETER	AVG. DAILY DRY	MAX. DAILY DRY	PEAK HOURLY DRY	MAX. DAILY WET	PEAK HOURLY WET
Sanitary flow	0.52	0.52	1.85	0.52	1.85
Infiltration	0.30	0.80	0.80	0.80	0.80
Inflow	0.00	0.00	0.00	2.16	10.20
TOTALS	0.82	1.32	2.65	3.48	12.85

The data provided in Table 4 suggests that the Skowhegan sewer system can experience a sustained maximum daily flow of 3.48 MGD and a peak hourly flow of 12.85 MGD during a one-year frequency storm event. When the initial excess flow study was conducted in 1995, EPA and DEP were advocating a “presumptive” approach to CSO abatement which indicated that excess flow issues could be considered resolved if CSO discharges were reduced by at least eighty-five percent or down to no more than five to seven discharge events per year. In the two decades since then, CSO discharge regulations have evolved and become more stringent. The CSO abatement goal today is to eventually reach zero CSO discharges during a reasonable storm event. While we understand that DEP has accepted previous CSO Master Plans in Skowhegan that are based on a one-year storm event, it appears that this policy has not been formalized since other communities have been mandated to achieve CSO reductions at a higher twenty-five year storm event level. In order to

assess the impact of a twenty-five year storm on the Skowhegan sewer system, Table 5 estimates sewer systems flows at that level.

Since Skowhegan will be required to eventually eliminate its CSO discharges, it is typical to estimate peak flows in the sewer system based on a more significant inflow event than a one-year storm such as a twenty-five year frequency storm of 4.70 inches/day of rainfall. Table 5 extrapolates the expected sewer system peak flows that might occur using a design rain storm of 4.70 inches/day:

TABLE 5: FLOW BASIS AT TWENTY-FIVE YEAR STORM (MGD)

FLOW PARAMETER	AVG. DAILY DRY	MAX. DAILY DRY	PEAK HOURLY DRY	MAX. DAILY WET	PEAK HOURLY WET
Sanitary flow	0.52	0.52	1.85	0.52	1.85
Infiltration	0.30	0.80	0.80	0.80	0.80
Inflow	0.00	0.00	0.00	4.23	19.98
TOTALS	0.82	1.32	2.65	5.55	22.63

From the data presented in Tables 4 and 5, the following conclusions can be reached regarding the required basis of design for the Skowhegan sewer system at current loading levels:

- The treatment plant will typically need to treat a minimum dry weather flow of about 0.82 MGD at current loading levels.
- Maximum daily dry weather flows in the spring will typically be 1.32 MGD prior to the onset of snowmelt conditions.
- Peak hourly flows to the plant will normally be up to 2.65 MGD on dry weather days.
- The maximum daily sustained flow that might enter the sewer system on wet weather days is about 3.48 MGD during a one-year storm and 5.55 MGD during a twenty-five year storm at current loading conditions.
- The maximum instantaneous peak hourly flow rate that might be present in the sewer system during a design storm of one-year is 12.85 MGD and at a storm of twenty-five years is 22.63 MGD. These instantaneous peaks exceed the hydraulic capacity of the treatment plant and the presently available storage volumes. The excess flows above that which the plant can treat or that can be stored will be bypassed upstream in CSO points. These peak flows represent the rates at which flows pass through the sewer system, not the actual volumes.

The above analysis suggests that the treatment plant is generally very stable and loaded at below its design capacity during dry weather periods. The plant can also process sustained wet weather flows. Peak wet weather events, especially those that occur concurrent with periods of snowmelt or high groundwater, remain the primary cause of CSO activity in Skowhegan.

1.3 SKOWHEGAN'S COMBINED SEWER OVERFLOW POINTS

Because excess groundwater infiltration and stormwater inflow contribute to sewer system flows that are periodically greater than the capacity of the sewerage system and downstream wastewater treatment plant, ten combined sewer overflow (CSO) points were originally incorporated into the Skowhegan sewer system. One of these was removed over twenty years ago. The remaining nine CSO points have been the focus of recent CSO Master Plans. The locations of each of these overflow points is summarized below in Table 6:

TABLE 6: SKOWHEGAN'S CSO DISCHARGE LOCATIONS

<u>CSO NO.</u>	<u>CSO LOCATION</u>	<u>CURRENT STATUS</u>
002	Heselton Street Pump Station	Inactive
003	North Side Footbridge	Active
004	Joyce Street/Treatment Plant	Active
005	Elm Street Pump Station	Active
006	Dinsmore Street Pump Station	Eliminated
007	Bush Street	Inactive
008	South Side Footbridge	Active
009	Island Avenue Pump Station	Active
010	Water Street/North Avenue CSO PS	Active

Of the original nine CSO locations in the Skowhegan sewer system, only six remain active at the present time. As will be discussed, modifications to the sewer system, as well as upstream sewer changes, have deactivated CSO No. 002 at the Heselton Street pump station and eliminated CSO No. 006 at the Dinsmore Street pump station. A third CSO at the end of Bush Street (No. 007) has been sandbagged and is now effectively inactive. It has not been permanently blocked off because upstream sewer work has yet to be completed. The six CSO points that remain active at the present time are the North Side Footbridge (No. 003), Joyce Street/Treatment Plant (No. 004), Elm Street Pump Station (No. 005), South Side Footbridge (No. 008), Island Avenue pump station (No. 009) and the Water Street/North Street CSO storage tank and pump station (No. 010).

When the Town began its CSO abatement program back in 1990, it had a significant number of annual CSO overflow days which are defined as the total number of days in which any CSO point is active. In 1999, the Town recorded 458 CSO overflow events which resulted in the loss of 40 MG of sewage to the Kennebec River. By 2005, the Town had reduced its CSO activity to 341 discharge events with 48 MG of untreated sewage discharged. CSO activity has been further reduced to only 56 events on 21 active days in 2011 with a loss of only 4.8 MG of untreated sewage to the River.

The Town has accomplished this by focusing on the construction of excess flow storage and treatment infrastructure with a lesser amount of sewer system separation and remediation projects. In the earliest versions of the Town's CSO Abatement Facilities Plan, it was determined that the separation and removal of excess flows from the sewer system would not be as cost-effective as storing or treating these flows. This recommendation has been carried forward in subsequent Facilities Plan Updates. As a result, the Town has been implementing a phased CSO abatement program which has included the following:

- The treatment plant's flow capacity was increased from 1.44 MGD to 1.65 MGD for average daily flow and from 4.68 MGD to 7.5 MGD for peak hourly flow.
- Several pump stations have been upgraded to increase their peak flow capacities and to prevent the loss of excess flows from the CSO points that are located at these pump station sites.
- Modifications to the sewer system have been made by adding restrictions or weirs that have increased the system's in-line storage capacity.
- Off-line storage has been added that allows peak hourly flows to be stored and then gradually released back into the sewer system.
- Limited sewer separation projects have been constructed upstream in some of the leakiest areas of the sewer system.

To implement these CSO remediation efforts, the Town has expended about \$9.5 million dollars on projects that are directly related to CSO remediation as part of \$11.4 million dollars of total sewer system improvements. These expenditures have resulted in significant CSO activity reductions. The challenge that the Town faces going forward is to cost-effectively further reduce CSO discharges into the River. DEP has instituted a policy of placing CSO abatement schedules into the discharge licenses of the wastewater treatment plants that serve CSO communities. This means that the remediation schedule of future CSO projects will become part of the Town's discharge license. If the Town fails to meet the proposed schedule, this will constitute

a discharge license violation that will be subject to potential enforcement action and fines. In addition, much of the previous CSO abatement work in Skowhegan was based on addressing the excess flows that are generated in a one-year frequency storm event of 2.40 inches/day of rainfall. DEP has been advocating the elimination of CSO activity in other communities at storm events of greater frequencies. This suggests that Skowhegan will likely need to take additional steps in the future to reduce its CSO discharges beyond the storage and treatment volumes that have been provided to-date.

1.4 SKOWHEGAN'S CSO ABATEMENT OBLIGATIONS

Because Skowhegan is an active CSO community, it is required to meet several CSO related regulations that are defined under both Federal and State law. These laws allow CSO communities to retain their CSO discharges only if they have an approved Master Plan in place to eventually address their CSO discharges. Master Plans must be typically updated every five years.

Skowhegan must conform to Federal and State regulations and guidelines that govern CSO abatement. These guidelines can be found in three documents as follows:

- Wastewater treatment facility discharge permit
- DEP CSO abatement guidelines
- EPA CSO abatement guidelines

The provisions of each of these documents, as they pertain to CSO reduction and abatement, are summarized below. It is the intent of this Sewer System Master Plan Update to address the requirements of all three documents where applicable.

1. Wastewater Treatment Plant Discharge License Requirements

Skowhegan's wastewater treatment plant discharge license requires the Town to take the following measures regarding its CSO problems:

- a) The Town is required to notify DEP annually of the frequency and volume of CSO activity that occurred.
- b) The Town is required to periodically update its CSO Master Plan and to implement all scheduled CSO abatement projects.
- c) Since excess infiltration and inflow into the sewer system are the cause of the CSO discharges, the Town must follow a wet weather flow management plan to minimize the impacts of excess flows on the treatment plant.

2. DEP Guidelines for CSO Abatement & Master Plans

DEP's guidelines for CSO abatement and sewer system master plan development require the Town of Skowhegan to:

- Periodically assess the magnitude of its CSO problem.
- Monitor CSO activity, frequency, discharge volume and quality.
- Identify infiltration and inflow sources in the sewer system that cause CSO activity.
- Implement short term best management practices (BMP) for CSO abatement.
- Evaluate long term alternatives for CSO abatement.
- Prioritize and schedule long term CSO abatement measures based on financial capacity and water quality benefits.
- Develop and submit periodic sewer system master plan updates for CSO abatement.

3. EPA Guidelines for CSO Abatement & Master Plans

The Environmental Protection Agency (EPA) has issued a CSO policy which requires Skowhegan to comply with the following conditions:

- a) The Town must evaluate its sewer system and characterize its CSO discharge problem, including its extent, causes, and impacts on water quality.
- b) The Town must implement EPA's nine minimum CSO controls which consist of:
 - 1) Proper operation and maintenance of the sewer system and CSO (s) including routine sewer cleaning, CSO maintenance, and pump station maintenance.
 - 2) Maximize sewer system storage including removing any unnecessary excess water sources, such as roof drains, and optimizing CSO outlet weir levels to back up sewer flows prior to their discharge.

- 3) Implement and enforce pretreatment permits against high strength or industrial sewer users to minimize the loss of pollutants into the sewer system or out CSO discharges.
- 4) Maximize the amount of excess water that reaches the wastewater treatment plant including providing primary treatment and disinfection for flow volumes that reach the plant in excess of the secondary treatment system capacity.
- 5) Eliminate all sources of dry weather CSO activity. EPA can initiate enforcement action against dry weather CSO discharges.
- 6) At all remaining wet weather CSO discharges, consider equipment to reduce solids and floatable material losses to the receiving water.
- 7) Encourage pollution prevention programs that reduce the amount of pollutants entering the sewer system, particularly from industries and high strength waste dischargers.
- 8) Provide public participation in the CSO master planning process by utilizing public hearing forums, workshops, and local media sources.
- 9) Continue CSO monitoring as the master plan is implemented and updated to assess the actual field impacts of each remediation step as compared to the expected impact from the CSO master planning study.

1.5 OBJECTIVES OF CSO MASTER PLAN UPDATE

The Town's DEP wastewater discharge license requires Skowhegan's CSO Master Plan to be updated and submitted to the Department no later than April 30, 2012. Olver Associates Inc. was retained by the Town in 2011 to assist in the preparation of this CSO Master Plan Update. Over the last year, we have reviewed all previous CSO data and reports that the Town provided and have conducted site visits to observe the overall configuration of the sewer system. We have conducted a detailed analysis of the Town's present CSO activity in terms of current wet weather precipitation events and have evaluated how previous CSO abatement projects have altered the sewer system's CSO response to these events. The entire sewer system was flow gauged during a number of high groundwater infiltration and stormwater inflow events in 2011 in order to determine areas of the system that appear to represent the most significant origins of excess flow. Potential alternatives to minimize these excess flows to a level that will abate CSO activity were evaluated. These alternatives included removing these excess flow zones from the sewer system via separation and

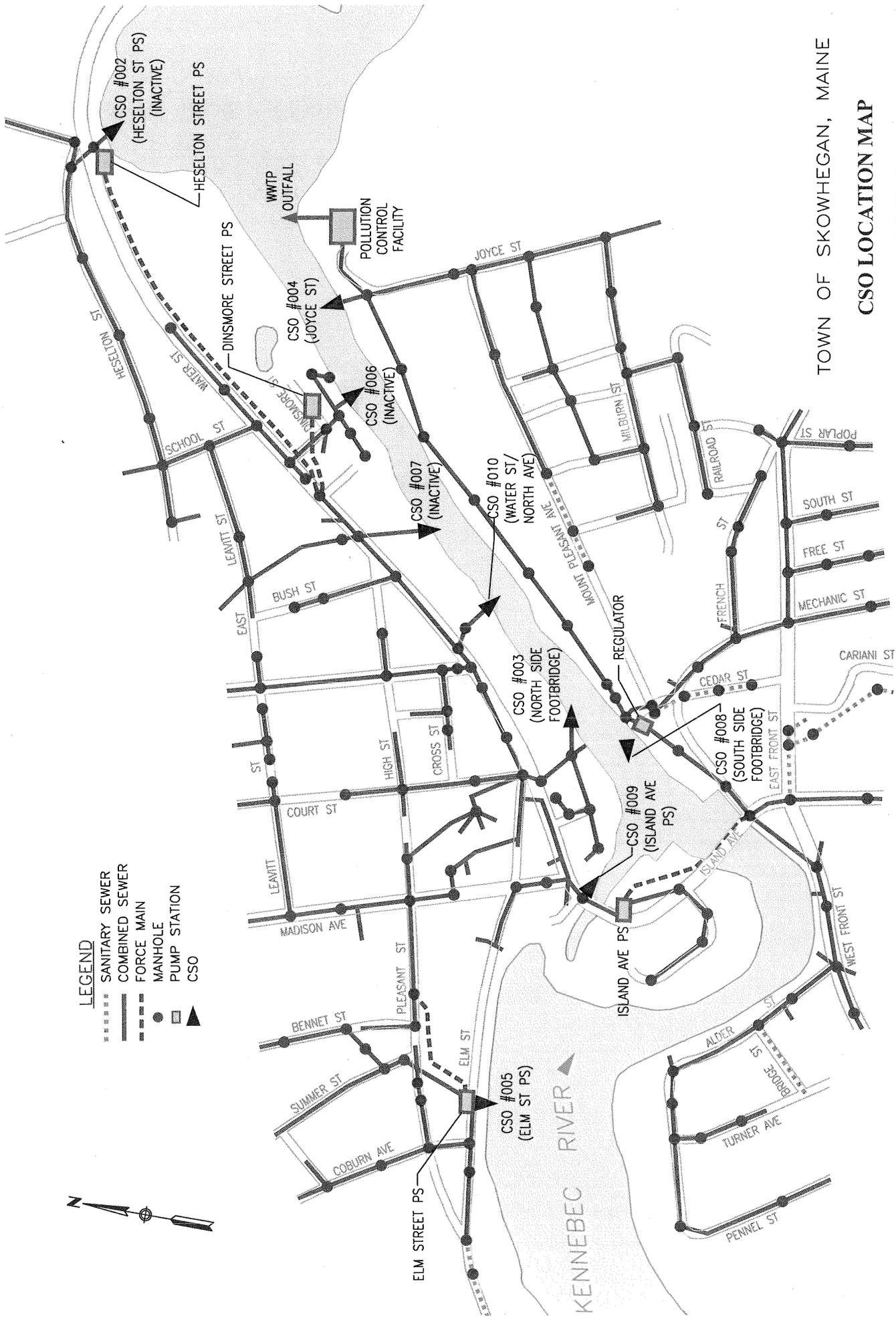
remediation projects, building additional storage capacity to hold excess flow surges, and treating these flows at either satellite or central locations. Costs for each of these potential approaches were estimated and alternatives were recommended for implementation after considering the financial capacity of the Town to undertake further CSO abatement projects. Once approved by the Maine DEP, this CSO Master Plan Update will become a part of Skowhegan's wastewater discharge license and the Town will be required to implement each project on the proposed schedule.

2. SKOWHEGAN'S CSO ABATEMENT PROGRAM

When the Town's Pollution Control Facility was constructed in 1972, it was connected to the end of an existing sewer system that was over eighty percent combined and over sixty percent that was between fifty and seventy-five year old pipe. Biological wastewater treatment plants are designed to remove organic pollutants from normal sanitary sewage and provide little treatment benefit, other than screening and disinfection, for the treatment of dilute stormwater flows. As a result, it was not uncommon for communities across the country to install treatment plants that were sized to process peak sanitary sewage flows, but not peak stormwater inflow or groundwater infiltration. It was common practice to install CSO relief points throughout the sewer system to allow peak flows to bypass the treatment plant whenever the plant or sewer system capacities were exceeded. The nine CSO points in the Skowhegan sewer system, as shown on Figure 6, were placed in service in accordance with the peak flow design philosophy that was prevalent in the Seventies. From a practical perspective, the goal of early wastewater treatment plant construction was to eliminate the discharge of raw sanitary sewage from receiving waters during normal flow days. It was considered unfeasible to fully separate sewer systems throughout the country, including the Skowhegan system, to eliminate all peak stormwater flows from old combined sewer systems. It was a substantial enough undertaking to fund the construction of the wastewater treatment plants and financial resources were not available to address sewer system capacity issues at the same time. As a result, CSO discharges were considered to be an acceptable tradeoff in order to facilitate wastewater treatment plant construction.

Over the last forty years since the construction of the Skowhegan treatment facility, Federal and State regulations regarding CSO discharges have become more stringent. Soon after the majority of the wastewater treatment plants had been constructed, the regulatory focus began to shift to CSO points in sewer systems. The immediate goals of the country's wastewater treatment plant construction efforts were to improve and protect water quality and public health. It was understood that the continued discharge of untreated sewage through CSO points, no matter how little, was contrary to these goals. Once stormwater inflow or groundwater infiltration has come into contact with sanitary wastewater in combined sewers, it has the potential to impact receiving water quality if discharged through the CSO points. CSO communities, like Skowhegan, are now required to implement measures that will abate and eventually eliminate all CSO activity during dry weather events and during wet weather events of a measurable storm frequency. In many cases, twenty-five year frequency storm events have been used as a reasonable threshold below which wet weather CSO events should not occur.

Addressing the excess flows in the Skowhegan sewer system and the abatement of CSO discharges has been an ongoing issue even before the treatment plant was constructed. In an early report published over fifty years ago, Metcalf & Eddy suggested that CSO discharges might one day require chlorination. When the treatment plant was designed by Metcalf & Eddy, the selected design basis at that time of 1.44 MGD average daily



LEGEND

- SANITARY SEWER
- COMBINED SEWER
- FORCE MAIN
- MANHOLE
- ▣ PUMP STATION
- ▲ CSO



TOWN OF SKOWHEGAN, MAINE
 CSO LOCATION MAP

FIGURE 6

OLVER ASSOCIATES INC.
 ENVIRONMENTAL ENGINEERS
 250 MAIN STREET
 WINTERPORT, MAINE

SOURCE:
 TOWN OF SKOWHEGAN AND
 MAINE OFFICE OF GIS

flow and 4.68 MGD peak hourly flow was considered to be reasonable for the volume of sanitary flow that was present in the system. It was understood that peak wet weather flows above these amounts would not reach the treatment plant, but would be discharged out the CSO structures as was common practice.

One of the first attempts to quantify the excess flow problem in Skowhegan was done in a 1980 Infiltration/Inflow (I/I) study prepared by Kleinschmidt & Dutting. The purpose of this early study was to estimate the amount of groundwater infiltration and stormwater inflow in the sewer system and to determine if it was cost-effective to remove it from the system. The study concluded that sixty to seventy percent of the annual flow volume in the Skowhegan sewer system was groundwater infiltration and stormwater inflow. However, the study concluded that this level of added flow was “not excessive” since the Town’s sewer system had been designed and installed with the specific intent to carry these flows. The study noted that it would be less costly to treat these flows up to the treatment plant’s capacity and to bypass the rest through CSO points as compared to fully separating the Town’s sewer system. Since the CSO regulations had not yet evolved to restrict these discharges, this would be a logical conclusion.

The early I/I study recommended that no major projects be conducted to remove excess flows. It did suggest, however, that smaller projects could be conducted to remove any large sources of excess flow that were found in the system. Three examples of potential excess flow remediation projects were given. These included addressing excess flow sources on East Street, in the Joyce Valley sewer between Mount Pleasant Street and Milburn Street, and north of the Waterville Road between Walnut Street and South Factory Street. These three areas were noted as having higher excess flow rates than the rest of the overall sewer system.

While early I/I studies often concluded that it was acceptable to continue CSO discharges since it was not cost effective to remove the excess flows, emerging CSO abatement regulations began to change this perspective. In 1990, Kleinschmidt Associates was retained to prepare an initial program of CSO abatement for Skowhegan.

The purpose of this study was to identify the locations and physical features of each CSO point, to determine the types of groundwater infiltration and stormwater inflow events that caused each CSO to discharge, and to determine the water quality impacts of these discharges. The study also developed short term and long term recommendations for the mitigation of water quality issues and for the abatement of the CSO discharges. At the time of the study, Skowhegan had ten CSO discharge points, one of which was later consolidated by the construction of a relief sewer near North Street.

The 1990 study concluded that the treatment plant generally would receive the average daily flows for which it was designed and that no CSO discharges were noted until sewer system flows reached 1.8 to 2.0 MGD. The report noted that CSO activity was observed to be imminent at low rainfall events of 0.20 to 0.46 inches/day which would represent

extremely low storm thresholds given that a three-month storm would be about three times higher at 1.35 inches/day. The report also indicated that CSO discharges were having an adverse impact on the river's water quality as measured by an increase in E. coli bacteria levels.

The report suggested several sewer system problem areas that were contributing to CSO activity including the following:

- CSO No. 002 at the Water Street (now Heselton Street) pump station was found to be overloaded by backflush flows from the Skowhegan Water Treatment Plant as well as by limitations in the pump station's equipment.
- CSO No. 003 at the siphon inlet near the North footbridge was found to be active at rainfall events of less than 0.20 inches/day. It was noted that this location would always be a central CSO point from the entire North side of the sewer system as all upstream peak flows had to pass through this location.
- CSO No. 004 at the treatment plant entrance on Joyce Street was noted to be active whenever the plant's peak flow exceeded 4.7 MGD.
- CSO No. 005 at Elm Street was noted to be an extremely active location even though no actual flow measurements were taken to quantify the amount of excess flow loss.
- CSO No. 006 at the Dinsmore Street pump station was suggested to be relatively inactive and susceptible to activity at rainfall events somewhat above 0.49 inches/day.
- CSO No. 008 at the South footbridge area was noted to be one of the most active discharge points in the entire system. The report suggested that it would become active even during dry weather if sewer system flows exceeded 0.90 MGD.
- CSO No. 009 at the Island Avenue pump station was noted to be active at rainfall events as low as 0.20 inches/day. It was reported that the capacity of the ejector station was a limiting factor that contributed to overflows as well as peak flows entering the island from the north side system.
- CSO No. 010 on Water Street was found to be active during dry weather events due to hydraulic restrictions at this location.

The report noted that the majority of the Skowhegan sewer system was constructed of old pipes that were designed as combined sewers. It concluded that it would not be cost-effective to consider the separation of the entire combined sewer system. Minor modifications to some of the CSO discharges were suggested to reduce the frequency of

CSO discharges, but these activities alone were not expected to eliminate excess flow losses. The report suggested that further evaluation would be needed to monitor excess flow volumes and to determine how much additional pump station and treatment capacity might be needed. It also suggested that in-line or off-line storage should be considered to reduce peak flows in the system. While full separation of the sewer system was found to be impractical, the report suggested that specific projects might be identified to remove peak flow sources in discrete problem areas. The report suggested that further studies would be needed to assess the best methods for peak flow treatment, but that the initial focus should be on the four largest CSO points at CSO No. 003, 004, 008 and 010.

The Town retained Whitman & Howard to prepare a CSO Master Plan in 1993. An EPA SWMM model was developed to predict peak flow volumes in the sewer system that would trigger CSO activity. A 1995 Whitman & Howard report concurred that complete separation of the combined sewer system would not be cost-effective and suggested that a combination of treatment and storage options be pursued. The report recommended that CSO discharges be abated on the North side using off-line storage and selected sewer separation projects. On the South side, the report recommended that the interceptor sewer capacity be increased, that in-line storage be provided and that the wastewater treatment plant's capacity be expanded to 15 MGD.

As can be the case when theoretical SWMM model data is compared to actual field data, the Town was concerned that some of the SWMM model based recommendations were overly conservative, especially for the South side of the system. The Town retained Wright-Pierce in 1996 to evaluate the Town's wastewater system in preparation for an eventual upgrade of those facilities. On the basis of this work, it was agreed that the proposed CSO abatement measures for the North side were appropriate, but that the South side measures were too conservative. CSO abatement improvements on the South side were designed to include an expanded treatment plant peak flow capacity of 7.5 MGD of which 5.0 MGD would pass through secondary treatment with the remaining 2.5 MGD receiving preliminary treatment, primary treatment and disinfection only. The prior suggestion to expand the South side interceptor sewer's capacity was put on hold until other improvements to the sewer system could be completed and evaluated.

The Town currently has been following a CSO abatement approach, as approved by DEP, that consisted of two phases. In Phase I, CSO deficiencies on the South side of the system were the focus. Phase II addressed CSO issues on the North side. The current and past program has focused on peak flow storage and treatment based upon the conclusion that it would not be cost-effective to fully separate the combined sewer system. Limited sewer separation projects in key, high-flow areas were recommended. The goal of these improvements was to abate CSO activity below storms of a one-year frequency (2.40 inch/day of rainfall).

Some of the major CSO reduction measures that have been completed, and some of the ongoing work that has been defined in recent CSO Master Plan Update, is summarized as follows:

A. SOUTH SIDE PHASE I STATUS

- The capacity of the Town's Pollution Control Facility was upgraded from its original peak flow capacity of 4.68 MGD to a new capacity of 7.50 MGD with the addition of a new peak flow secondary treatment bypass system.
- A step screen was added to the treatment plant to eliminate previous manual screen plugging problems that contributed to surcharged conditions in the interceptor sewer and CSO discharges at Joyce Street.
- Sewer system areas subject to excess flows were identified for separation. These areas included West Front Street, East Front Street, Hospital Valley, Free Street, South Street, Mechanic Street and Poplar Street where separation or remediation projects have been completed.
- Additional high flow sewer areas were identified on Main Street, Joyce Street, and the Joyce Valley sewer, but work has not been scheduled in these areas at this time.
- Previous Master Plans have considered a potential hydraulic bottleneck in the South side interceptor sewer where the pipe size is reduced to 16" and 20" Ø for a short section downstream of the 72" Ø interceptor and CSO No. 008. Depending on the CSO abatement results of other identified projects, the need to address this issue will be determined at a future date. This will be a difficult sewer to modify given the local topography.
- The need to provide additional storage or satellite treatment at CSO No. 008 remains a potential project for future discussion depending on the results of other abatement measures. This may be a difficult project to implement due to site constraints.

B. NORTH SIDE PHASE II STATUS

- The Town demolished the former Water Street pump station at CSO No. 002 and replaced it with a new submersible pump station across Route 2 on Heselton Street. This has increased both the pumping capacity and the wet well storage at this location. The Town has also had better communications with the Water Company regarding the rate at which they discharge their filter backwash. In addition, peak flows from an adjacent sewered area have been rerouted away from this subsystem. These efforts have eliminated activity at CSO No. 002.

- The Town rerouted the discharge from the Heselton Street pump station away from Dinsmore Street. This has eliminated the need to pump this water twice and has also relieved the peak flow loading on the Dinsmore Street pump station. This has eliminated activity at CSO No. 006.
- The Town has made improvements to sewers in the East Street and East Leavitt Street areas. This has reduced flows to the CSO No. 007 location near Bush Street which has allowed it to be sandbagged and eliminated from CSO activity. The Town is also planning to conduct further sewer improvements on Bush Street and Heselton Street which will reduce flows that pass through the CSO locations at CSO No. 002 and 007. These projects will also reduce flows at all downstream CSO points at CSO No. 003, 004, 008 and 010.
- The Town upgraded its pump station at Elm Street (CSO No. 005) and at Dinsmore Street (CSO No. 006) to include greater pumping and storage capacity. These efforts have reduced CSO activity at Elm Street and contributed to the elimination of the Dinsmore Street CSO as noted above.
- The Town has constructed a 1.0 MG off-line storage tank and pump station on Water Street at CSO No. 010. This allows peak flows from the downtown area, North Avenue and upstream CSO points, to be stored to the extent possible and then pumped back into the sewer system after peak wet weather flows subside.
- The Town has conducted sewer improvement projects in many areas of the North side including Elm Street, Wilson Street, Greenwood Avenue, Gem Street, Cowette Street, St. Mark Street, and Dyer Street.
- The need for storage or treatment upstream of CSO No. 003 at the siphon inlet was considered in past plans and inline storage in the interceptor sewers was included when the Town built the Water Street CSO offline storage tank.

To-date, the Town's CSO abatement efforts have been successful in reducing CSO activity as well as discharge volumes. As previously noted, annual CSO activation events of 458 back in 1999 were reduced to only 56 events in 2011, a reduction of 88 percent. In addition, annual CSO volume losses of 48 MG in 2005 were reduced to only 4.8 MG in 2011, a reduction of 90 percent. Days on which CSO activity occurred any place in the sewer system was decreased from 115 days/year in 2002 to only 21 days in 2011, a reduction of 82 percent. In order to achieve these results, the Town has expended over 11.4 million dollars in wastewater infrastructure improvements over the last decade, of which 9.5 million was directly related to CSO projects.

Despite the Town's previous CSO abatement efforts and the funds that it has expended to-date, it is likely that additional work will need to be completed at additional costs in order to further reduce CSO activity in Skowhegan. In previous CSO Master Plans, projections that the work completed to-date would nearly eliminate all CSO activity to

near zero for a one-year storm event have not yet materialized. It is important to note that predictions for CSO reduction do not represent an exact science due to the many variables and factors involved. Slight changes in rainfall magnitude, intensity and duration can have significant impacts on CSO activity. Variations in groundwater levels, soil saturation conditions, snow and ice cover, and the time of year of a storm can all impact the peak flows in the sewer system and the resultant CSO activity. Two identical storms occurring under slightly different ambient conditions may affect CSO activity differently. It is also important to note that weather patterns in Maine have shifted over the last few years with higher intensity storms from the south occurring at a much greater frequency than historical patterns. The Town's CSO efforts to-date have had a significant positive impact on CSO reduction in Skowhegan, but have not yet fully solved the CSO problem. This will occur when the Town has no more wet weather CSO discharges at less than a defined threshold storm. As noted, this has been defined as a one-year storm in previous studies with the approval of DEP. As also noted, DEP has not had a consistent policy in this regard and has suggested that other CSO communities must meet a higher threshold storm. This becomes more of an issue in Skowhegan where storage and treatment have been the focus of previous work instead of the separation and removal of peak flows. When flows are removed from the sewer system, they will be absent from all future rainfall events, regardless of the storm frequency. When they are stored or treated, it becomes more important to define the exact amount of residual excess flow that will remain at various storm frequencies since the storage or treatment reactors must be sized to hold these flows.

3. ASSESSMENT OF SKOWHEGAN'S CSO ACTIVITY

3.1 CSO ASSESSMENT PROCEDURES

Where CSO discharges are known to exist, DEP has established procedures which must be followed to assess the frequency, causes, and water quality impacts of the CSO activity. These procedures include the following measures as are applicable to the Town of Skowhegan:

- The location of each active CSO point must be determined and mapped.
- The general land use and wastewater user base of the service area upstream of the CSO must be evaluated.
- The potential impact of CSO activity on the receiving water's quality standards must be considered including the historical impairment of water quality uses.
- CSO activity and discharge volumes must be assessed over a minimum time period that includes multiple CSO events.
- The Town is required to estimate CSO discharge volumes, define the conditions that appear to trigger these CSO discharges, and review upstream flows in the sewer system to determine if they appear to be excessive.
- As required, sampling of the CSO discharge volume must be conducted in order to estimate the water quality of the discharged wastewater. An assessment of the water quality of the first flush volume, which is defined as the initial discharge wave that flows through the system after peak flows begin, is also required. The sampling period for the CSO discharge should include at least four events at each CSO location.
- As appropriate, water quality sampling of the receiving water during CSO discharges is suggested in order to determine if water quality issues are being created by the CSO.
- Observations of the sewer system are required to determine if any prohibited dry weather CSO events are occurring.

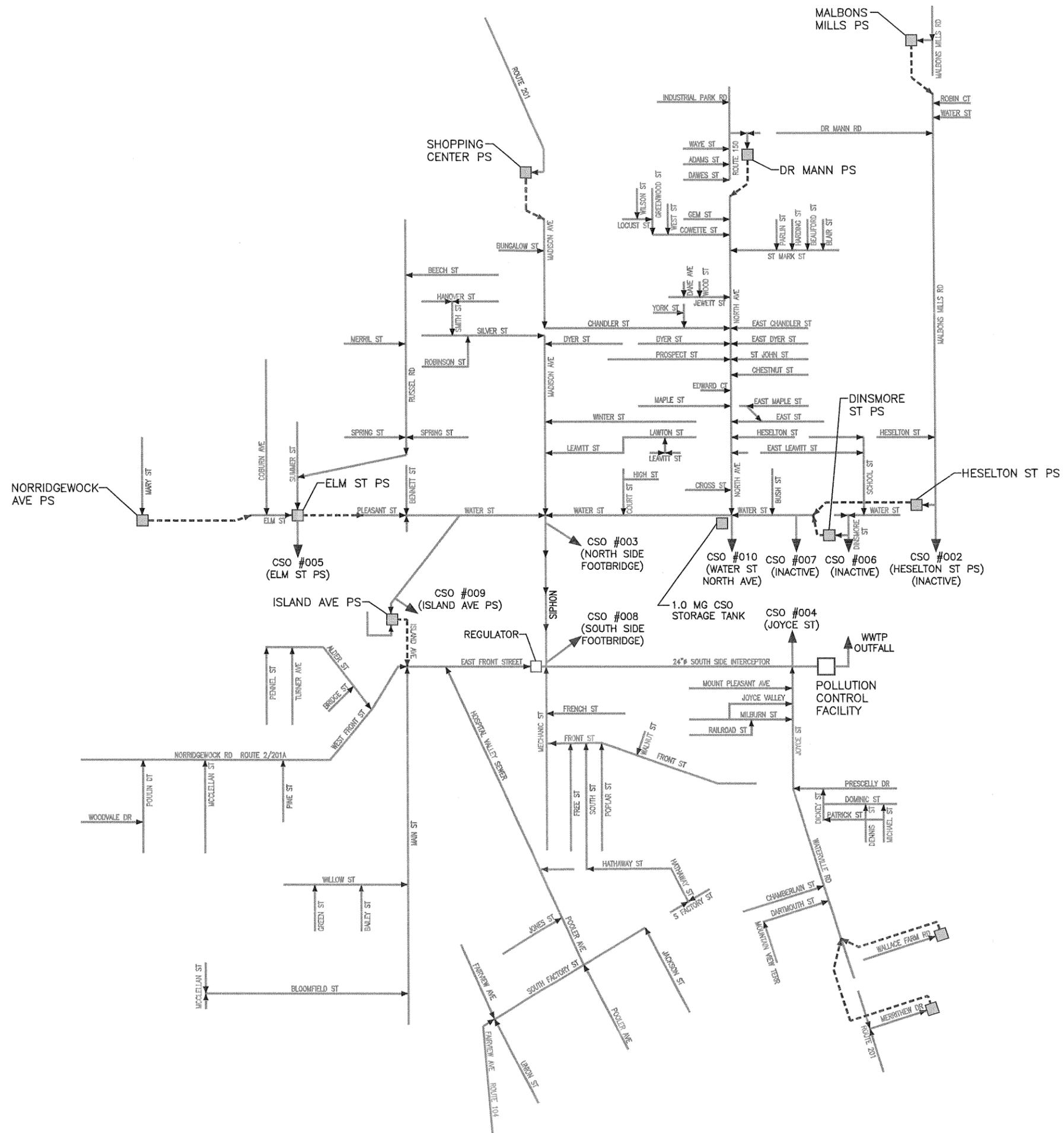
On the basis of this general criteria, the nine Skowhegan CSO points were evaluated over a four-year period from January 2008 to December, 2011. This timeframe corresponds to the current status of the Skowhegan sewer system since the completion of the Phase I and Phase II improvement projects in 2004 and 2007, respectively. This

allows the data record to be examined to determine the impact that the Phase I and II projects have had on reducing CSO activity in Skowhegan.

3.2 CSO DRAINAGE AREA CHARACTERIZATION

As shown in Figure 7, Skowhegan has nine CSO points and drainage areas in its sewer system, six of which are currently active at the completion of the Phase I and Phase II CSO abatement work. Five CSO points are associated with pump station locations which suggests that pump capacity and wet well storage volumes are factors in determining CSO activity. One CSO is located near the head of the treatment plant on Joyce Street. Activity at this location is dependent upon the expanded treatment plant's ability to accept peak flow rates from the sewer system. Two CSO points are located near the Kennebec River siphon, one at its inlet and another upstream of its outlet. The inlet CSO will be active whenever the capacity of the siphon is exceeded by peak flows from the North side of the sewer system. The outlet CSO will become active when the hydraulic capacity of the South side interceptor is exceeded. All of the CSO points are located along the pumped and gravity sections of the Town's interceptor sewer system. The drainage areas and characteristics of each CSO are discussed as follows in the order that they are located beginning at the farthest CSO from the treatment plant (No. 002) and ending with the CSO near the plant's headworks (No. 004).

- CSO No. 002 is located at the Heselton Street pump station just off Route 2 at the eastern boundary of the sewer system. It serves a drainage area of about 250 acres consisting of primarily residential sewer users along Heselton Street, Malbons Mills Road, and Dr. Mann Road. A section of combined sewer on East Street has historically been diverted to this area by a relief sewer. The Skowhegan Water Company's filter plant is located on Waterworks Drive, just off Heselton Street and contributes large volumes of flow to the system when it backwashes its filter beds. The major sources of peak flow into this subsystem appears to be groundwater infiltration and inflow induced infiltration from old clay sewer lines on Heselton Street. In addition, backflushing operations from the water filtration plant on Heselton Street has the ability to surcharge this system. The pump station at this location was formerly located on Water Street and was undersized for peak flows and in poor mechanical condition. Excess sewer system flows and inadequate pump station capacity appear to have been the primary cause of CSO activity at this location. The Town has recently made major modifications to this area as part of its Phase II CSO abatement program. The pump station was relocated from Water Street to Heselton Street and upgraded with duplex 410 GPM pumps in a ten foot wet well. The Town has worked closely with the Water Company to reduce the impact of its backwash discharges and has rerouted the relief sewer from East Street. These measures have reduced peak flows in the system such that CSO 002 is now inactive.



LEGEND

- SANITARY SEWER
- - - - - FORCE MAIN
- ▲ CSO LOCATION
- PUMP STATION

TOWN OF SKOWHEGAN, MAINE

CSO INTERCONNECTION MAP

FIGURE 7

OLVER ASSOCIATES INC.
 ENVIRONMENTAL ENGINEERS
 290 MAIN STREET WINTERPORT, MAINE

SOURCE:
 TOWN OF SKOWHEGAN AND
 MAINE OFFICE OF GIS

- CSO No. 006 at the Dinsmore Street pump station is the next discharge point along the interceptor. This drainage area is relatively small and receives flows from about three acres of residential and light commercial users along Shirley Street, Dinsmore Street and Kennebec Street. The force main from the upstream Water Street pump station historically discharged into this system so that its flows had to be pumped a second time through the Dinsmore Street pump station. CSO activity in the past was caused by a combination of peak groundwater infiltration and inflow induced infiltration from clay sewers and stormwater inflow from the connected catchbasins. When these conditions occurred, the pumped discharge from the Water Street pump station often overloaded the capacity of the Dinsmore Street pump station and led to CSO discharges. The Town has taken measures to reduce these peak flows as part of its Phase II CSO abatement work. The pump station has been upgraded with 300 GPM pumps. When the Heselton Street pump station was installed, the gravity sewer that it discharged into was extended past the Dinsmore Street pump station. Upstream relief sewers from the East Leavitt and East Street areas have been redirected back to North Avenue. These measures have greatly reduced the peak flows into this area and have allowed CSO No. 006 to be eliminated.
- CSO No. 007 is the next discharge point along the interceptor sewer system. It is located off Water Street across from Bush Street and receives flows from a drainage area that encompasses about ten acres of residential and light commercial properties in the Bush and Water Street areas. In addition, about fifteen acres of upland from East Leavitt Street, Heselton Street and East Street have historically been connected to this area from relief sewers that tie in from the North Avenue subsystem. About fourteen catchbasins are believed to be connected into this subsystem. CSO activity in the past has been caused by peak flows from groundwater infiltration and inflow induced infiltration into the old clay sewer lines as well as stormwater inflow into catchbasins, roof drains and cellar drains. The Town has completed sewer work on East Street and East Leavitt Street to redirect stormwater from this area. As a result of these measures, peak flows at this subsystem have been reduced and CSO No. 007 is no longer active.
- CSO No. 010 is located off Water Street near the North Avenue intersection. It receives flows from a large 300 acre discharge area consisting of medium to high density residential neighborhoods, commercial areas, a shopping center, the Town's fairgrounds, and the Industrial Park. The system contains numerous sidestreets off North Avenue, many of which have sewers constructed with old clay pipes as does North Avenue itself. There are 94 connected catchbasins in this subsystem. Excess flows in this area have historically been caused by peak groundwater infiltration and inflow induced infiltration into old clay sewers as

well as stormwater inflow into combined sewers. The Town installed a relief sewer on North Avenue in 1986 to address surcharging conditions in this line. The Town has completed upstream sewer improvement projects on several streets including East Street, East Leavitt Street, Gem Street, Cowette Street, Greenwood Avenue, Wilson Street and St. Mark Street. In addition, as part of the recent Phase II CSO abatement projects, a 1.0 MG peak flow storage tank was constructed under the municipal parking lot to mitigate flows into CSO No. 010. This has helped to capture the first flush from this large drainage area and allow it to be pumped back into the sewer system as peak wet weather flows dissipate.

- CSO No. 003 is located off Water Street near the North side of the footbridge and at the inlet to the siphon that flows below the Kennebec River. This system receives flows from about 150 acres of densely developed downtown commercial area as well as adjacent areas along Madison Avenue, Court Street, Water Street, Commercial Street and numerous residential sidestreets. This area consists of many old clay sewers that are heavily combined with at least 86 connected catchbasins. Peak flows into this area are caused by groundwater infiltration and inflow induced infiltration into old clay sewer lines as well as stormwater inflow into combined sewers. Because CSO No. 003 is located near the inlet of the siphon, it represents the central collection point for all North side flows with the exception of Island Avenue. The CSO will overflow whenever the 3.5 MGD capacity of the siphon is exceeded. Before this occurs, the interceptor sewer will become surcharged and some reduction in CSO discharge volume could occur if any capacity is available in the nearby 1.0 MG CSO storage tank.
- CSO No. 005 is located on Elm Street at the western side of the North side sewer district. It is affiliated with the Elm Street pump station which serves an upstream drainage area of about 80 acres of primarily residential development. Flows from Coburn Avenue, Pleasant Street, Summer Street, Spring Street, Russell Road, and Merrill Street flow into the pump station. In addition, the force main from the Norridgewock Avenue pump station near Mary Street discharges into this station. This area has a combination of old clay and new PVC sewers with areas of combined sewers. There are about 28 connected catchbasins upstream of the pump station. Peak flows are caused by groundwater infiltration and inflow induced infiltration into the old clay lines as well as inflow into the combined sewers. The Town has recently made sewer improvements on sections of Elm Street and Coburn Avenue. The Elm Street pump station was also upgraded as part of the Phase II CSO activity projects with duplex 275 GPM pumps and a ten foot diameter wet well. While these improvements likely reduced the potential for CSO activity at this location, the concurrent connection of the force main from the Norridgewock Avenue pump station may have offset this benefit. Even though the

Norridgewock Avenue pump station serves only a small drainage area on Mary Street of less than ten acres, it appears to be prone to peak wet weather flows based on station run time records.

- CSO No. 009 is located at the Island Avenue pump station. It receives sanitary flows from a very limited industrial and commercial drainage area on the island. The pump station is an old pneumatic ejector in poor condition with limited pumping and storage capacities. CSO discharges at this location are the result of peak stormwater flows that are connected as well as by the limited capacity of the ejector station.
- CSO No. 008 is located at the south end of the footbridge. It serves a 400 acre drainage area on the South side of the system that includes Main Street, West Front Street, Norridgewock Road, Fairview Avenue and numerous sidestreets. Sewer use in this area is both residential and commercial. Many of the sewers in this area are constructed of old clay and newer asbestos pipes, both of which are subject to groundwater infiltration and inflow induced infiltration. There are over sixty connected catchbasins in this area that add stormwater inflow to the system. The Town has completed some sewer improvement work upstream of CSO No. 008 including replacing the Hospital Valley interceptor between East Front Street and Jones Street. In addition, sewer separation work has been completed on parts of East and West Front Streets. CSO activity at this location is influenced by the upstream peak flow volumes as well as potential hydraulic limitations downstream. All flows from this area must reach the treatment plant via the south interceptor which can become surcharged whenever the downstream treatment plant reaches its peak capacity. The surcharged condition will cause flows to back up at the CSO. In addition, a hydraulic limitation was built into the interceptor between CSO No. 008 and the siphon outlet by installing a 16" Ø and 20" Ø sewer section instead of 24" Ø pipe along the entire interceptor length. Previous CSO Master Plans have suggested the elimination of this hydraulic bottleneck as a way to reduce CSO activity at CSO. No. 008. These studies have also noted that CSO No. 008 is active only when CSO No. 004 at the treatment plant is active which suggests that the interceptor is surcharged during these events.
- CSO No. 004 is located just upstream of the treatment plant at the end of Joyce Street. All flows from the entire North and South side of the Skowhegan sewer system must pass this structure on their way to the treatment plant. In addition, another 300 acres of residential and commercial drainage area is connected to the interceptor upstream of this location on Joyce Street, Mount Pleasant Street, Joyce Valley, Milburn Street, Waterville Road, East Front Street and along numerous side streets. Some of these sewer areas have been separated, while others are still combined with connected catchbasins. Areas of old clay pipe are still in use along some of the street areas. Peak flows at CSO No. 004