



**CITY OF MIDDLETOWN, NEW YORK
SEWER SYSTEM EVALUATION SURVEY**

JANUARY 2004



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TABLE OF CONTENTS

PAGE

ES	Executive Summary	ES-1
1	Introduction	1-1
1.1	Purpose of Study	1-1
1.2	Previous Studies.....	1-1
2	General Sewer System	2-1
2.1	Existing Collection System.....	2-1
2.2	Existing Treatment System.....	2-1
2.3	Inflow and Infiltration Problems.....	2-1
2.4	Sewer System Map	2-2
2.4.1	Development of Sub-drainage Area Boundaries.....	2-2
3	Wastewater Treatment Facility Flow Analysis	3-1
3.1	Water Use Evaluation	3-1
3.1.1	Water Consumption.....	3-1
3.1.2	Determination of Sewage Base Flow	3-1
3.1.3	Determination of Total Infiltration and Inflow	3-2
3.1.4	Determination of Infiltration	3-2
3.1.5	Determination of Inflow	3-3
3.2	BOD Evaluation.....	3-3
4	Physical Survey and Analysis	4-1
4.1	Flow Metering Description.....	4-1
4.1.1	Continuous Flow Metering.....	4-1
4.1.2	Instantaneous Flow Measurements	4-1
4.2	Flow Analysis	4-3
4.2.1	Theoretical Sewage Base Flows.....	4-3
4.2.2	Flow Metering Results	4-5
4.2.3	Dry Weather Analysis	4-5
4.2.4	Wet Weather Analysis.....	4-6
4.3	Groundwater Monitoring and Analysis	4-8
5	Conclusions and Recommendations	5-1
5.1	Inflow and Infiltration.....	5-1
5.1.1	Area TE1, East Side Trunk Sewer between Meter #3 (Bradner Ave. & Rodman St.) and Meter #32 (Beers Dr. & Houston Ave.).....	5-1
5.1.2	Area TM3, Area Tributary to Meter #37 (Wawayanda Avenue & West Conklin Avenue)	5-4
5.1.3	Area TM7-6, Areas Tributary to Meters #28 and #30 (Old State Hospital) ...	5-6
5.2	I/I Sources Identified by 1984 SSES	5-7
5.2.1	Miscellaneous I/I Sources	5-7
5.2.2	Stratton Avenue Sewer Line.....	5-9
5.2.3	Little Avenue Inflow Sources.....	5-9
5.3	Private Sewer Components	5-10
5.4	Other Observations	5-10
5.4.1	Hydraulic Restrictions	5-10
5.4.2	Sanitary Sewer Overflows (SSOs)	5-11

5.4.3	Manhole Overflows.....	5-12
6	Summary of Recommendations.....	6-1
6.1	Summary of Proposed Projects.....	6-1
6.2	Implementation Schedule.....	6-3

LIST OF TABLES

TABLE 3-1	SANITARY SEWER SYSTEM FLOWS – JANUARY 2000-JULY 2003	3-4
TABLE 3-2	SANITARY SEWER SYSTEM FLOWS – MAY-JUNE 2003.....	3-6
TABLE 4-1	FLOW METER LOCATIONS AND THEORETICAL SEWAGE BASE FLOWS	4-4
TABLE 4-2	DRY AND WET WEATHER FLOW METERING DATA.....	4-7
TABLE 4-3	GROUNDWATER GAUGES	4-9
TABLE 5-1	I/I REDUCTION COSTS - EAST SIDE TRUNK SEWER BETWEEN EAST MAIN STREET AND HOUSTON AVENUE	5-4
TABLE 5-2	INFLOW REDUCTION COSTS - OLD STATE HOSPITAL, AREAS TRIBUTARY TO METERS #28 AND #30.....	5-7
TABLE 5-3	MISCELLANEOUS INFLOW SOURCES FROM 1984 SSES PROPOSED FOR CORRECTION	5-8
TABLE 5-4	STRATTON AVENUE SEWER REPLACEMENT COSTS.....	5-9
TABLE 5-5	LITTLE AVENUE STORM SEWER COSTS	5-10
TABLE 6-1	SUMMARY OF PROPOSED PROJECTS.....	6-2
TABLE 6-2	IMPLEMENTATION SCHEDULE	6-3

LIST OF FIGURES

FIGURE 2-1	SEWER SYSTEM SCHEMATIC.....	2-3
FIGURE 2-2	SEWER SYSTEM SUB-AREAS.....	2-4
FIGURE 3-1	SANITARY SEWER SYSTEM FLOWS – JANUARY 2000-JULY 2003	3-5
FIGURE 3-2	SANITARY SEWER SYSTEM FLOWS – MAY-JUNE 2003.....	3-7

LIST OF APPENDICES

Appendix A	Wastewater Treatment Facility Flow Charts
Appendix B	Continuous Flow Meter Specifications
Appendix C	Continuous Flow Metering Graphs
Appendix D	Dye Testing Flow Data
Appendix E	Instantaneous Velocity Meter Specifications
Appendix F	Instantaneous Velocity Meter Flow and Calibration Data
Appendix G	Groundwater Gauge Locations
Appendix H	Inflow Sources from 1984 SSES

LIST OF EXHIBITS

Exhibit A	Sanitary Sewer System Map – Sewer System Sub-Areas
Exhibit B	Sanitary Sewer System Map – Flow Analysis Areas and Proposed Project Areas

ES Executive Summary

The City of Middletown's sanitary sewer system was subjected to a Sewer System Evaluation Survey (SSES), which is the subject of this report. The SSES was conducted after an Infiltration/Inflow (I/I) Analysis showed significant amounts of I/I in the City's sanitary sewer system. The magnitude of the I/I problem can be seen by inspection of Figures 3-1 and 3-2. The average daily flow at the Wastewater Treatment Facility (WWTF) over the entire period from January 2000 to December 2002 was 4.9 MGD, including I/I. The estimated average actual sewage flow is 2.7 MGD, exclusive of I/I, which results in an average I/I flow of approximately 2.2 MGD. The I/I contribution during wet weather can be much higher, however, as seen in Figure 3-2, occasionally exceeding 6 MGD under maximum wet weather day conditions.

Initial field activities during the course of the SSES included continuous flow metering at 37 different sites throughout the City and concurrent groundwater level monitoring at many of these sites in May and June of 2003. A comparison of the flow metering data with the theoretical sewage base flows for each site revealed that a majority of the metered areas exhibit significant I/I contributions (Table 4-2). Due to the widespread nature of the problem and the often elusive nature of I/I, it was determined to focus on a limited number of areas which exhibited the worst I/I conditions as determined based on flow per equivalent population and volume of I/I, and which appeared to possess the best probability of successful I/I reduction in a cost-effective manner, instead of attempting to locate and correct the more widespread I/I throughout the system. Additional field activities to confirm and further refine the areas of greatest concern included dye test flow measurements and instantaneous flow measurements with a portable velocity meter. Input regarding areas of concern was also obtained from City personnel familiar with the sewer system.

It was concluded that by targeting the areas with the worst I/I conditions for correction, including miscellaneous inflow sources identified by the 1984 SSES, an estimated 0.32 MGD of infiltration and 1.20 MGD of inflow per inch of rainfall could be eliminated from the sewer system (Table 6-1). The potential effect on maximum day flow rates, taking April 22, 2000 (the maximum flow day during the WWTF flow analysis period) as an example, is a reduction in total flows at the WWTF from 9.0 MGD to 6.9 MGD. While it was attempted to use conservative numbers in estimating the potential I/I reduction, it should be noted that I/I reduction efforts are often less successful than anticipated due to the impact of such factors as elevation of groundwater levels due to the elimination of infiltration sources, and migration of groundwater from rehabilitated sections to entry points in non-rehabilitated sections of the sewer.

The implementation schedule for the proposed I/I reduction projects is shown in Table 6-2. The remaining excess flows not addressed by the proposed I/I reduction projects will be addressed by the upcoming WWTF upgrade and expansion, as it is believed this will be a more cost-effective means of addressing these widespread flows.

1 Introduction

1.1 Purpose of Study

A Sewer System Evaluation Survey (SSES) for the City of Middletown, New York (City) was undertaken following direction from the New York State Department of Environmental Conservation (NYSDEC) to address infiltration and inflow in the City's sewer system. Previous studies demonstrated that there is significant infiltration and inflow (I/I) in the City's sewer system. The impacts of I/I are seen frequently in the flowrates at the City's Wastewater Treatment Facility (WWTF), resulting in periodic violations of the WWTF's SPDES permit. The objective of the SSES is to identify, to the extent possible, sources of infiltration and inflow (I/I), and to examine the feasibility of removing such sources. At a time when an upgrade is being planned at the WWTF, the feasibility of reducing the magnitude of peak wet weather flows is of great importance in order to assess the need for expansion of the WWTF.

1.2 Previous Studies

Chumard and McEvelly Consulting Engineers completed an infiltration/inflow analysis in 1978. The analysis included water consumption data, population breakdown estimates, rainfall records, metered sewage flows and field measurements. The 1978 Infiltration/Inflow analysis concluded that the City's sanitary sewer collection system was subject to excessive infiltration and inflow and recommended implementation of a Sewer System Evaluation Survey (SSES) to identify specific sources of infiltration and inflow.

Chumard and McEvelly Consulting Engineers conducted the SSES between 1980 and 1982, with the final report completed in May, 1984. The SSES included flow monitoring, groundwater monitoring, and manhole inspections to further quantify the extent of I/I, and to isolate problem areas. Based on these findings, portions of the system were then inspected by TV and/or smoke tested. The SSES reported that the 1982 average daily flow at the Wastewater Treatment Facility (WWTF) was 3.711 MGD, of which it was estimated that actual sewage was 2.42 MGD, resulting in the conclusion that the system experienced an average I/I flow of approximately 1.3 MGD on an annual basis. The SSES developed prioritized recommendations for cost-effective rehabilitation of the sewer system to reduce the annual average I/I by approximately 0.5 MGD. These recommendations have not been completely implemented.

Hazen and Sawyer completed an Infiltration Inflow Analysis Report in March 2002, which analyzed data for the period from December 1998 to December 2001. The analysis included water production data from the Water Filter Plant and water consumption records, metered sewage flows at the WWTF, rainfall records, and City-wide population data. The average flow at the WWTF during this period was 5.0 MGD, with a minimum average daily flow of 3.1 MGD and a maximum of 9.0 MGD. The report indicated that the average flow during the winter-spring months (January to May) is typically approximately 1.0 MGD higher than the average flows during the remainder of the year (June to December), and attributed this to higher groundwater level elevations and snow melting effects during the winter-spring period. From this it was concluded that City's sewer system is subject to substantial groundwater infiltration, which varies season-

ally. The report also concluded that the sewer system is subject to both inflow and rain induced infiltration, with storm events contributing as much as 3.5 MGD in increased flows depending on severity of the storm, and with WWTF flows remaining high for several days after major storm events before they return to pre-storm flows. The report concluded that for the analysis period, an average of 1.42 MGD of I/I enters the City's sewer system on a daily basis, or 28.5% of the total flow to the WWTF, and that during major storm event the WWTF flow increases by as much as 45% and requires between four to eight days to return to pre-storm flow conditions. The report noted, however, that the sewage base flow and therefore the I/I calculations were based upon records of water production from the meters at the Water Filter Plant, which were known to be inaccurate by as much as an estimated 1.0 MGD. This inaccuracy was not factored into the calculations. The report recommended that an SSES be undertaken to identify specific sources of infiltration and inflow, followed by rehabilitation of the identified I/I sources.