Final Report
Long Term Control Plan
Phase 1

City of Watertown

New York

Prepared by:

Staff, Department of Engineering

City of Watertown, New York

Executive Summary

In 2002 the City of Watertown was directed by the New York State Department of Environmental Conservation (NYSDEC) to prepare this report. Their order required the submission and approval of two reports prior to beginning the work on this Long Term Control Plan (LTCP) such that there would be an understanding and agreement between the NYSDEC and the City as to what would be studied and subsequently reported in the LTCP. The preliminary reports were submitted in 2004 and approved in 2006. This LTCP is due to the NYSDEC by December 1, 2008.

The LTCP is first a description of the combined sewer system (CSS) of the City of Watertown and also a description of the Black River, the receiving stream into which all storm waters and treated (as well as untreated) sanitary wastewaters discharge. The City's CSS contains fifteen active combined sewer overflow devices and one wastewater treatment Plant (WWTP) by-pass device totaling sixteen points where sanitary wastewater has potential to enter the Black River without treatment. This LTCP identified impairments that exist within the CSS that adversely impact the CSS ability to collect and successfully transmit wastewater (and storm water) to the City's WWTP. The LTCP then proceeds to evaluate the impact upon the Black River endured because of discharges occurring as a result of the identified impairments. This evaluation is made possible because of accurate and precise modeling of the CSS which has been completed that quantifies and qualifies the overflows and by-passes. Finally, a plan to rectify impairments is formulated and information presented such that implementation of upgrades to the CSS may proceed in an organized, sequential, effective and prudent fashion. A financial assessment is included with which decisions may be guided relative to the economic impact the CSS upgrade projects may have on the average household within the City.

An Advisory Committee was formed in 2002 and it has guided the City in the completion of this LTCP from its beginning to the present. At a meeting of the Advisory Committee on Thursday, October 23, 2008, the Committee approved three recommendations:

> The first recommended City Council acceptance of this report as a factual representation of the City's CSS;
>
> The second recommended City Council acceptance of the four summarized impairments to the CSS that were identified;
>
> The third recommended that the City Council focus its limited capital funds to combined sewer separation projects.

The three recommendations in their entirety are attached to this executive summary.

Advisory Committee
to
The City of Watertown, New York
For
The Preparation of and Recommendations concerning:

The Long Term Control Plan
Phase 1

At a meeting of the Advisory Committee on October 23, 2008, the following recommendations were acted upon with all members voting in favor of each of the three recommendations save one member abstaining from each vote (abstaining votes cast by member representing the New York State Department of Environmental Conservation):

Recommendation Number 1:

The Advisory Committee recommends the Draft Long Term Control Plan Phase 1 dated 2008 be accepted as a factual presentation of the actual conditions of the combined sewer system of the City of Watertown to include its modeled response to storm events. This recommendation is qualified by the fact that 84.3% of the area upstream of active combined sewer overflow devices was actually modeled and studied, and the remaining 15.7%, although not yet modeled or studied, is assumed to be appropriately represented by that which is known.

Recommendation Number 2:

The Advisory Committee recommends the acceptance of the summary of impairments to the combined sewer system of the City of Watertown as:

- Anomalous inflow in the Western Outfall trunk sewer downstream of Wealtha Avenue;
- Rapid infiltration in the North Side Trunk Sewer immediately upstream of Kelsey Creek Combined Sewer Overflow device (003);
- Impacts of storm overflow on the Black River from the Engine Street Basin (007);
- General Infiltration existing throughout the entire combined sewer system.

Recommendation Number 3:

The Advisory Committee believes that the ultimate correction to the overflows and by-pass of untreated wastewater to the Black River caused by the existence of the combined sewer overflow and by-pass devices in the City of Watertown's system is best accomplished by the separation of those sewers that are combined and the systematic elimination of infiltration discovered to exist in the sewer system. Interim measures, such as the installation of preliminary or primary separation devices at the combined sewer overflows or by-pass devices would divert limited capital dollars from combined sewer separation projects which are believed to be the better course of action. The Advisory Committee recommends that capital projects accepted by the City Council of the City of Watertown concentrate on combined sewer separation.

Table of Contents

List of Tables

List of Figures

Abbreviations and Acronyms used in this report:

BMP:	Best Management Practices
BOD_5:	Biochemical Oxygen Demand, 5 day incubation
CAC:	Citizen Advisory Committee
CMMP:	Characterization, Monitoring, and Modeling Plant
CSO:	Combined Sewer Overflow
CSS:	Combined Sewer System
CSTS:	Cooper Street Trunk Sewer
CY:	Calendar Year
LTCP:	Long Term Control Plan
FY:	Fiscal Year
MGD:	Million Gallons per Day
mg/l:	Milligrams per liter or parts per million
NPDES:	National Pollutant Discharge Elimination System
NSTS:	North Side Trunk Sewer
NYSDEC:	New York State Department of Environmental Conservation
POTW:	Publicly Owned Treatment Works
PPP:	Public Participation Plan
SPDES:	State Pollutant Discharge Elimination System
SS:	Suspended Solids
USEPA:	United States Environmental Protection Agency
USGS:	United States Geological Survey
WPCP:	Watertown Pollution Control Plant
WQS:	Water Quality Standards

Final Report

Long Term Control Plan

Phase 1

October 29, 2008

I. Introduction

On June 1, 2002 in an amendment to the City of Watertown's New York State Pollutant Discharge Elimination System (SPDES) Permit[1] the New York State Department of Environmental Conservation (NYSDEC) imposed upon the City the requirement to engage in the process of developing a Long Term Control Plan (LTCP) for the Combined Sewer Overflows (CSOs) existing in the City.[2] A Project Team was immediately formed to accomplish the tasks imposed, meeting for the first time on October 3, 2002.

Among other things, the SPDES amendment specified the submission and approval of two preliminary plans which would establish an agreed upon procedure the City would then follow in the preparation of the required LTCP. These preliminary plans are:

---

[1] New York State Pollutant Discharge Elimination System (SPDES) Permit Number NY 002 5984; Effective Date March 1, 2005; Expiration Date March 1, 2010

[2] Pages 19 and 20 of the permit amendment outlining the requirements for the Long Term Control Plan are attached as **Appendix A**

1. The Public Participation Plan (PPP) approved by the NYSDEC on May 23, 2006; and

2. The Combined Sewer Systems (CSS) Characterization, Monitoring, and Modeling Plan (CMMP) with its final revision submitted July 17, 2006 and subsequently approved by the NYSDEC on September 14, 2006.

A. Goals and Objectives:

The goal of the Long Term CSO Control Plan is to positively identify, in both qualitative and quantitative terms, the actual adverse impacts that the City's active CSOs have upon the water quality of the Black River, and once identified, then to identify and enact reasonable control measures in a prudent sequence, schedule, and cost effective manner that both make sense and will reduce the identified adverse impacts in some meaningful and measurable way.

An understanding of the current conditions of the City's CSS is, therefore, essential. Further, a basic understanding of the current conditions ("base line" conditions) of the Black River, the "receiving stream," is equally important. This is so the magnitude of discharges to the Black River from the CSOs may be properly assessed against the significance of their respective impacts upon the River.

This LTCP must, therefore, present sufficient information to accomplish the following:

1. Define the Black River Basin, placing the City's system in its correct context as it relates to the entirety of the watershed, identifying those watershed issues of concern and of which the City's sewer system either is, or is believed to be a contributing factor;

2. Identify and define those additional factors (historical rainfall, seasonal river flows, river uses, etc.) to complete the context within which the City shall be evaluated;

3. Define the City's combined sewer system and the local sub-basins within which it exists, properly identifying any and all sensitive areas and critical system users;

4. Define in a qualitative and as much as practical a quantitative sense the City's combined sewer system's response to rainfall events of varying intensities and durations;

5. Determine in a quantitative sense the thresholds at which CSOs become active, quantifying the volume of the overflow and the resultant loadings of targeted pollutants, relating volume and loadings of CSO discharges to storm events of varying intensities and durations; and

6. Determine the baseline conditions of the Black River in terms of volume and loadings of those same parameters identified and monitored in "5" above, placing CSO contributions in context with existing conditions not attributed to the CSOs.

The key that underpins the 6 points cited above is the recognized need to have up front among all the interested parties that will face the evaluation of this LTCP an agreement on what data, information and analysis will eventually be needed to support the development of the LTCP, the review of the applicable water quality standards (WQS), and the identification of meaningful recommendations with their appropriate implementation procedures. This was the purpose for the Public Participation Plan and the Characterization, Monitoring and Modeling Plan that were submitted and approved as preliminary documents. The LTCP that follows is consistent with both approved plans.

B. The Black River

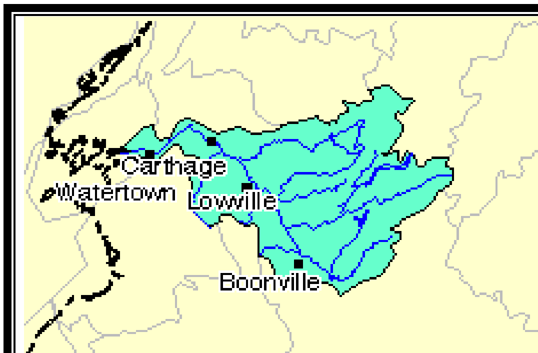

Figure 1: Black River Basin in Upstate New York

The Black River is the receiving stream of discharges from the Watertown's Pollution Control Plant (WPCP) and from the active City CSOs. It is an approximately 110 mile long river draining approximately

1,914 square miles of Adirondack Mountains, adjacent foothills, and lowlands. The westerly flowing Black River is tributary to Lake Ontario at the Lake's northeastern quadrant. The City of Watertown in Jefferson County, New York is located at "mile 11" of the river. A USGS river gauge is located at the Van Duzee Street Bridge at Watertown, with approximately 1,864 square miles or 97.4% of the drainage basin upstream of this point. For the 80 year period ending in CY 2000, the average River flow at the Watertown gauging station is approximately 4,156 cubic feet per second (2,686 million gallons per day, MGD). For perspective, the WPCP discharged an average 9.78 MGD during CY 2007. Thus, on an average day, the City's WPCP discharge accounts for something in the order of 0.36% of the water in the river at the point of discharge. Since something in the order of 16.5±%[3] of the sewers in the City of Watertown is combined, the discharges to the river during precipitation events from the WPCP can swell to as much as 30+ MGD. Add to this the fact that during such events any number of the combined sewer overflows (CSOs) may be active. Exactly how much would be discharged from the CSOs must likewise be taken into account.

Further, of great significance is the variation in flow exhibited by the river during the different months of the year. During the same 80 year period referenced above, the average monthly flows of the River at Watertown ranged from as low as 1,773 cubic feet per second (1,146 MGD) to as much as 10,000 cubic feet per second (6,463 MGD), as indicated in "Figure 2." The peak 24 hour flow rate on record at the Watertown gauging station occurred January 10, 1998 and is 55,500 cubic feet

[3] See Table 4 and the explanation that immediately follow it on page 30 of this report.

per second (35,868 MGD). It is readily apparent that the river responds dramatically to the seasons, and will exhibit significant spikes if heavy precipitation in conjunction with saturated or frozen ground is experienced together with a high degree of rapid snow melt. Conversely, the minimum 24 hour flows, at times, can drop below 1,000 cubic feet per second.[4] Summary data collected at the USGS gauging station at Watertown is presented in **Appendix B**.

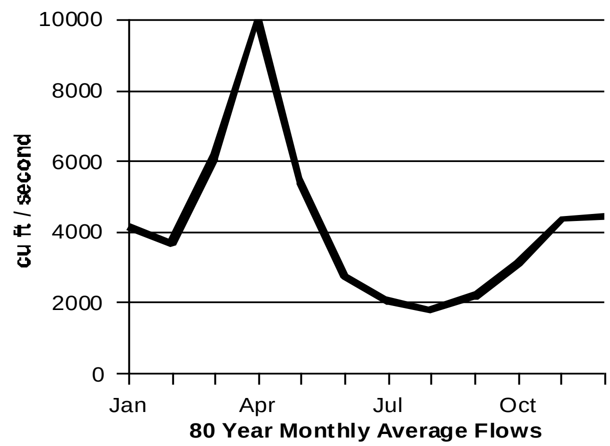

Figure 2: Average monthly flow rates on the Black River.

The higher the City discharge and the lower total river flow each would tend to render the discharges as “more impacting” upon the river. Thus, as a general rule of thumb, the river would be most sensitive to such discharges during a high intensity storm experienced during the June through September time frame - your typical “summer thunder storm.”

Much has been written in various studies commissioned by the City of Watertown in recent history relative to the existing and hoped for uses of the Black River as it

[4] The lowest monthly average flow rate for the Black River in the 80 year study period is 730 cubic feet per second (472 MGD) occurring August 1923. Even at this low river flow rate, the 2007 average daily flow rate for the City’s POTW would rise to only 2% of the total River’s flow rate.

Figure 3: View of Black River upstream of Delano Island.

makes its trek through the City. It is not the intent of this plan to "reinvent" such writings. For convenience, key elements of referenced studies are presented as **Appendix C** to this plan. Suffice it to say that the River is recognized as a valuable asset of vital importance to the City. It is in the interest of the City as well as all river users that all things practical be accomplished that can have a measurable positive impact upon the Black River.

To make a proper assessment of the impact CSO discharges have on the River, one would need to know certain things about the river and about the CSO discharges themselves in terms of both quality and quantity of specific elements characterizing these discharges. What these things would be and how they would be monitored and measured is the detailed purpose of the Characterization, Monitoring and Modeling Plan approved in 2006. Section III of this LTCP shall discuss these things in detail. Calendar years 2004 – 2008 saw the monitoring, measuring and collection of data upon which this LTCP Phase 1 report is based.

II. Public Participation:

In developing its long-term CSO control plan, the permittee will employ a public participation process that actively involves the affected public in the decision-making to select the long-term CSO controls…

Citizen Advisory Committees (CACs) can serve as liaisons among municipal officials, NPDES permitting agencies, and the general public. Public meetings and public hearings can provide an effective forum to present technical information and obtain input from interested individuals and organizations…[5]

The above two quotes from the USEPA Guidance Manual formed the basis of the Public Participation Plan for the City. The first act of the City was to form an Advisory Committee comprised of key City Departments, NY State and Jefferson County Agencies, Local Industry, Recreational Groups and Academia to guide the City in the preparation of the Preliminary Plans. The Advisory Committee had fourteen members with specific interests and expertise as indicated in Table 1.

A. Public Participation and Agency Interaction:

Each committee member's participation was considered important with each member being advised if from time to time their specific presence at committee meetings was not possible, then an individual specifically appointed by them was to attend in their absence. Thus the interests of each individual and therefore the

[5] Excerpts from Section 1.6.2 of EPA 832-B-95-002 **Combined Sewer Overflows Guidance for Long-Term Control Plan**

interests of the group that individual represented would be consistently and continuously voiced.

Table 1: Breakdown of membership on the Advisory Committee[6]

Interests Represented	Number of representatives on the Advisory Committee
City Administration	1
City Subordinate Departments (Planning, POTW, Industrial Pretreatment, Engineering, Public Works)	6
Jefferson County Planning	1
Industry	1
NYSDEC	1
Other State and County Agencies (Soil & Water Conservation; Tug Hill Commission)	2
Private Recreational Interests	1
Academia	1

B. Public meetings, hearings, and presentations

The committee met monthly through the fall of 2002 preparing and submitting the Public Participation Plan to the City Council of the City of Watertown in December 2002. The City Council approved and authorized its submission to the NYSDEC in January 2003.

The Committee immediately turned its attention to the Characterization, Monitoring and Modeling Plan, meeting monthly through 2003, submitting its recommendations to the City Council, obtaining Council approval and submitting the proposed plan to the NYSDEC in December 2003.

Each committee meeting, while open to the public and the news media, were sparsely attended by any individuals other than the committee members.

Two announced public meetings of the City Council of the City of Watertown with advanced published agendas featured current elements of the LTCP efforts. The first was for the formal presentation and recommendation for approval of the published Public Participation Plan and the second was the analogous meeting for the presentation and recommendation for approval of the published Characterization, Monitoring and Modeling Plan. In both instances, presentations were publicly made with ample opportunity for public comment then offered.

Both submitted plans were approved by the NYSDEC in 2006. Once approved, the 2 year cycle of data acquisition commenced. The Advisory Committee remained formed but adjourned regularly scheduled meetings during the regulatory review phase of the submitted plans and the data acquisition, monitoring and modeling phase (2004-08). With the completion of the Draft LTCP, it is appropriate to reconvene the Committee and host an organized public informational meeting to assist in exposing the efforts once again to the public and solicit input. This will be accomplished during the fall of 2008.

III. System Characterization:

A. Nine Minimum Controls

[6] The specific names of the members, titles and contact information is attached as **Appendix D**

The 2002 SPDES modification contained a section entitled BEST MANAGEMENT PRACTICES FOR COMBINED SEWER OVERFLOWS.[7] As indicated in the introductory paragraph of this section:

> ***The BMPs are equivalent to the "Nine Minimum Control Measures" required under the USEPA National Combined Sewer Overflow Policy.***

Paragraph 15 of the BMP section requires that an annual report be submitted summarizing current status of the implementation of this section.

B. Characterization, Monitoring and Modeling

During CY 2007 the POTW treated a total 3,570 MG, averaging 9.78 MGD. This total volume generated from the summation of Influents A and B is down from the previous year (as is indicated by the Table 2 below).

Table 2: Summary of Total Plant Flows.

Calendar Year	Total Gallons Treated	Average Daily Flow	% Total Gallons from Western Outfall
2005	**4,321 MG**	**11.84 MGD**	**28.6 %**
2006	**3,982 MG**	**10.91 MGD**	**30.0 %**
2007	**3,570 MG**	**9.78 MGD**	**28.9 %**

[7] See SPDES No. NY 002 5984 Part 1, Pages 16 through 18 attached as **Appendix E**

Figure 4: Aerial of the Watertown Pollution Control Plant

The Watertown Pollution Control Plant (WPCP) is a 16.0 million gallon per day hydraulically rated secondary wastewater treatment and sewage sludge disposal facility. It is comprised of preliminary treatment (mechanical bar screen and detritor grit removal); a single 16.0 MGD primary treatment system with both its Influents "A" and "B" comingling upstream of the primary clarifiers; an 8.0 MGD rated two stage high rate trickling filter secondary with its independent clarifiers and outfall; and in parallel with the trickling filter secondary, an 8.0 MGD standard rate conventional activated sludge secondary with its independent clarifiers and outfall. Sludge disposal is comprised of gravity thickening, two stage anaerobic digestion, chemical conditioning, filter press dewatering, and fluid bed incineration. The scrubber ash from the incineration process is disposed at the Rodman Regional Landfill.

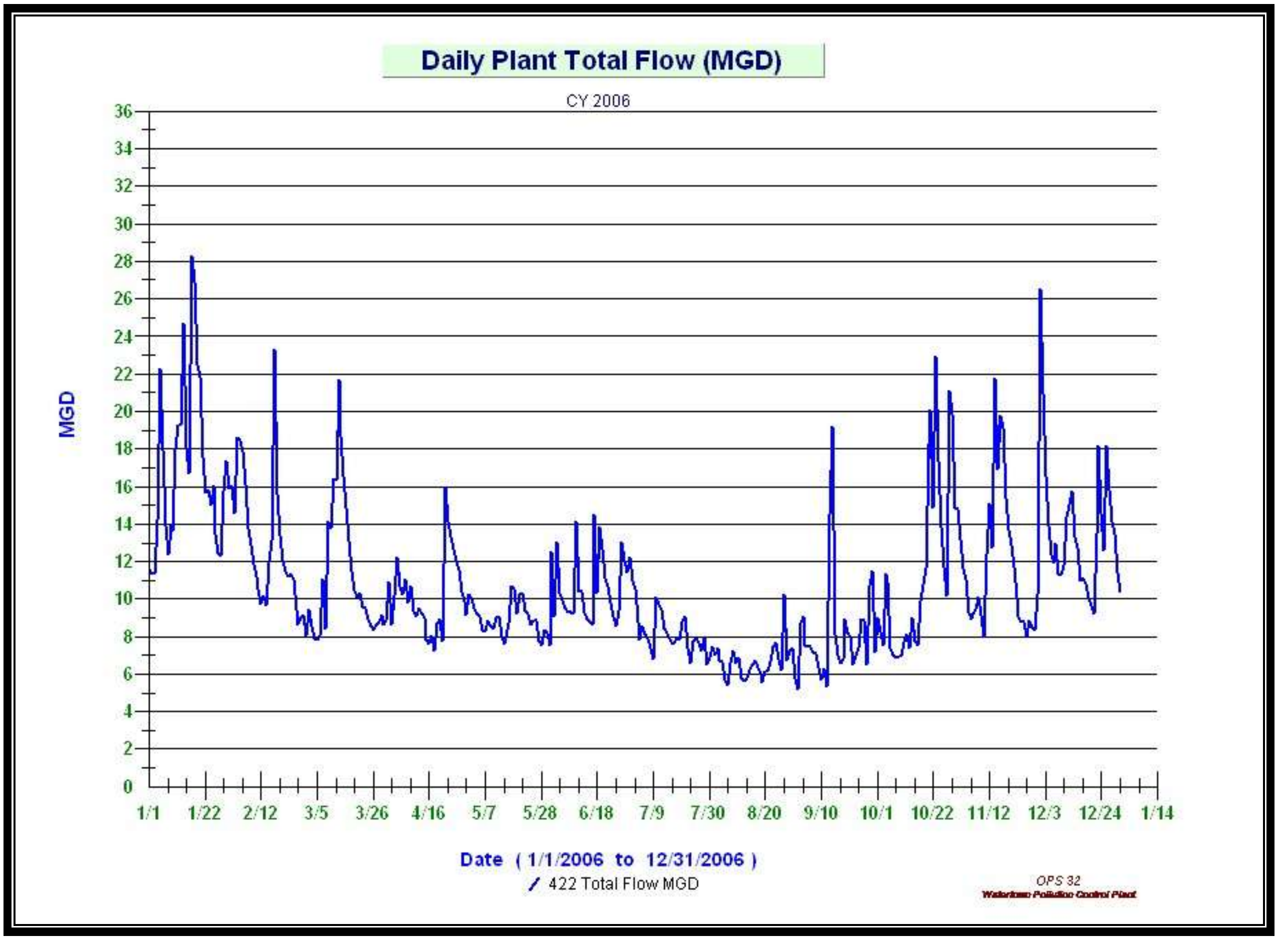

Figure 5: Average Daily Flows (total Plant) for CY 2006

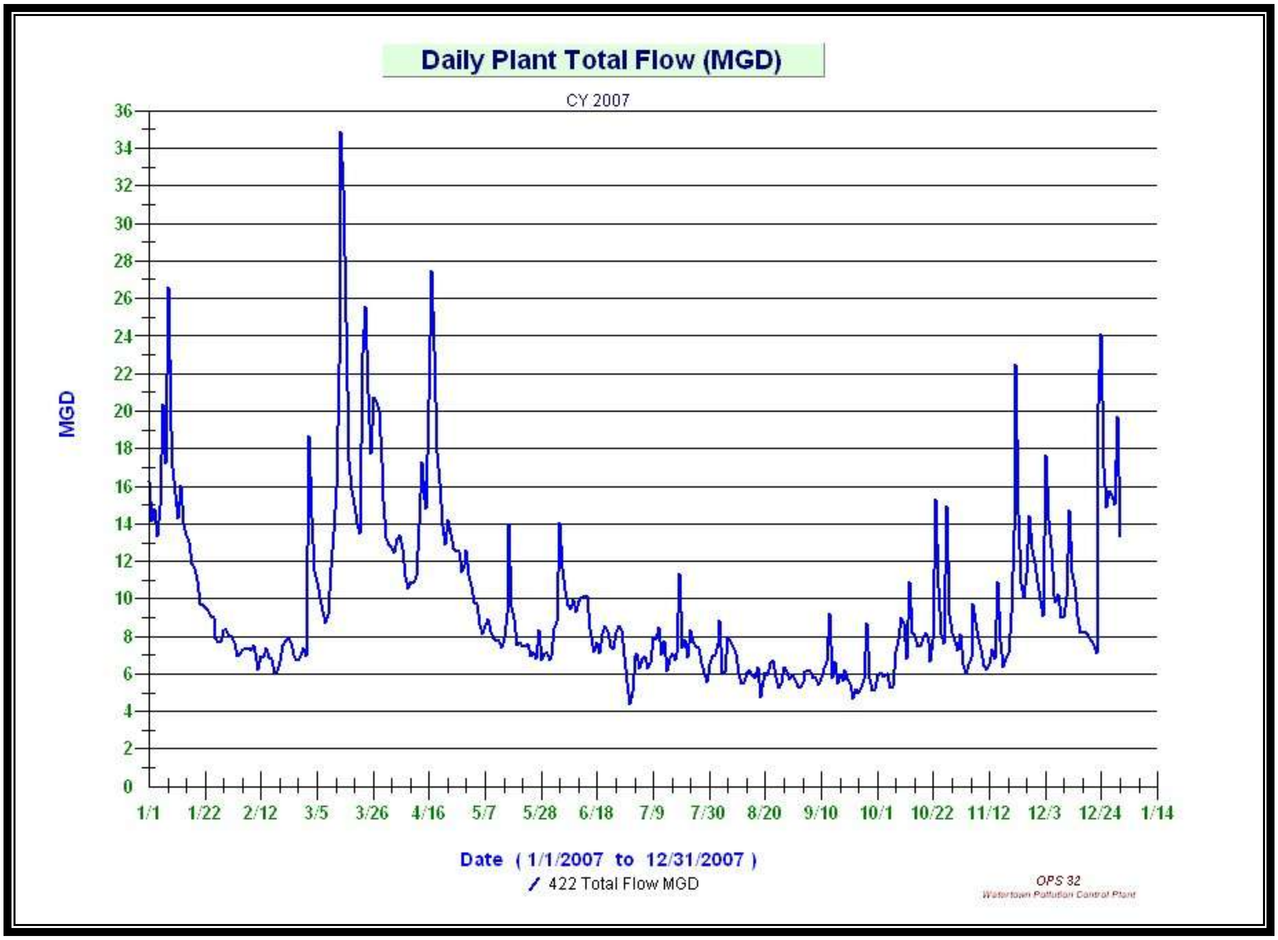

Figure 6: Average Daily Flows (total Plant) for CY 2007

The average daily flows for the WPCP for calendar years 2006 and 2007 as shown in Figures 5 and 6 above exhibit the same pattern – wet November through early April and dry late April to October.

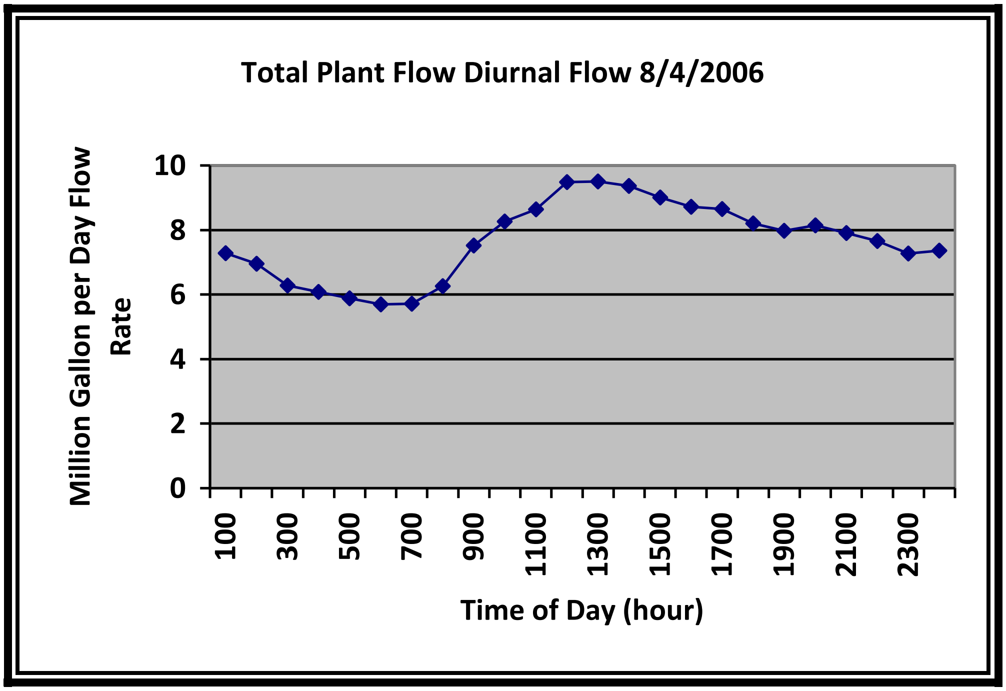

Figure 7: Typical diurnal dry weather flow pattern for total plant flow (Influents "A" + "B")

NOTE: Diurnal flow patterns[8] sufficiently spaced from storm events enable the isolation and quantifying of infiltration. Hence, the diurnal pattern of the Total Plant Flow is presented in Figure 7 above. Diurnal patterns will likewise be presented below for the studied basins in this LTCP (Basins 001, 003, 007, 019, and 020). Incorporating the correct values for population densities and gallons per capita per day of sanitary flows will properly shape the diurnal curve, with the proper selection of infiltration then enabling the placing of the curve at the proper vertical height in the graph (thus causing the modeled curve to superimpose upon the actual curve recorded at the respective monitored point during the calibration process of the model). Section III.E below will present modeled diurnal curves superimposed upon actual field recordings.

[8] Diurnal – Pertaining to or occurring in a day or each day; daily; a flow pattern that repeats (i.e. low flows during late evenings and early mornings with higher flows in the late mornings and afternoons.

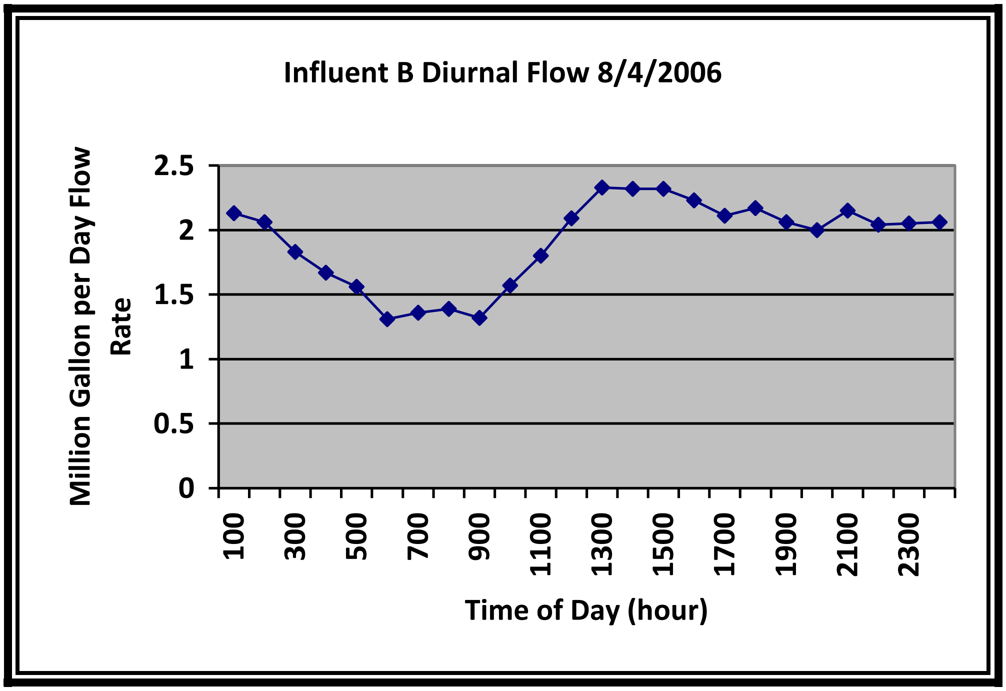

Figure 8: Typical diurnal dry weather flow pattern for Influent "B"

The combined sewer system within the City of Watertown is comprised of 3 sewer interceptor systems which collect wastewater from 25 distinct sewer basins (see Figure 9 below.) The Kelsey Creek System north of the Black River is comprised of the North Side Trunk Sewer and the Cooper Street Trunk Sewer. South of the River is the Main Trunk Sewer System and the Western Outfall Trunk Sewer System. Each individual sewer basin is a geographically unique collection system that discharges its contribution to one of the City's Trunk Sewers at one unique point. Of the 25 sewer basins, 15 remain with combined sewer overflow (CSO) devices collocated at its connection point with its respective interceptor. Each CSO device is numbered and named consistent with the basin that supplies its wastewater flows. Table 3 below presents the 15 active CSOs and the single POTW By-Pass device for a total of 16 points of potential discharge of untreated wastewater to the

Black River. Figure 10 below indicates pictorially the relative size and location of the 15 basins with active CSOs.

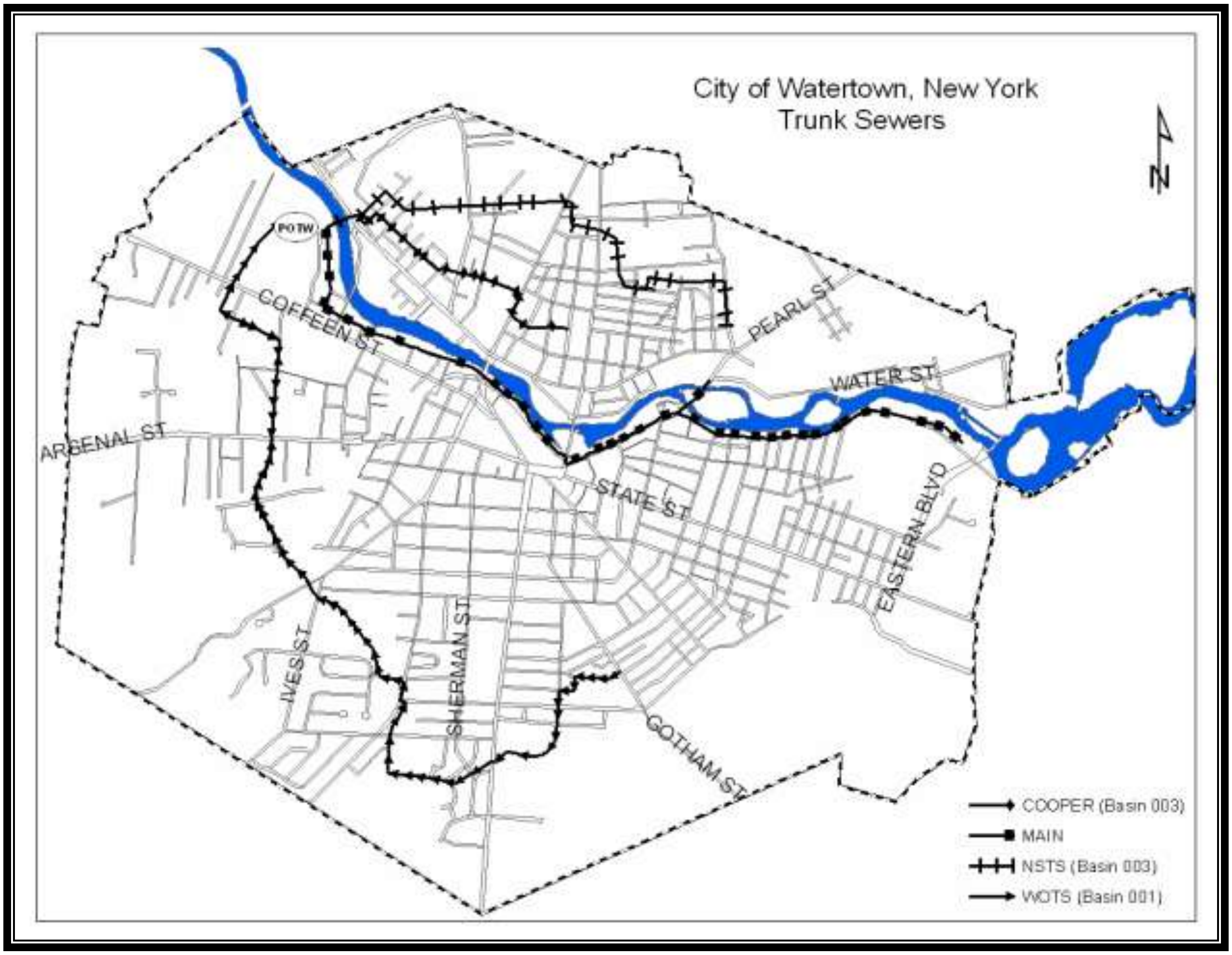

Figure 9: There are three Trunk Sewer Systems forming the spine of the combined sewer system of the City – the Kelsey Creek System north of the River comprised of the North Side Trunk Sewer (NSTS) and the Cooper Street Trunk Sewer; and on the River's south side are the Main Trunk Sewer (running adjacent to the River) and the Western Outfall Trunk Sewer (running further south).

Table 3: POTW By-Pass and Basins with active CSO devices[9]

Basin/CSO/By-Pass Number	Basin/CSO Name	Total Acres served by the Basin
001	**Western Outfall**	**2332**
003	**Kelsey Creek**	**766**
004	POTW Influent "A" By-Pass Device [10]	----
005	Van Duzee South	46
006	Cedar Street	115
007	**Engine Street**	**465**
010	West Main (opposite Curtis)	35
011	Newell Street at Arch Street	30
012	Newell & JB Wise Place	11
013	Main Avenue East	69
016	Factory at Mill Street	80
019	**Pearl at Water Street**	**379**
020	**Huntington at Rutland**	**100**
021	Huntington at Central	122
022	Huntington at Hamilton	45
024	Huntington at Indiana	202

[9] The five basins highlighted in Table 3 are those monitored and modeled for this Phase 1 LTCP. The City intends to complete the modeling and monitoring of the remaining basins in the months that follow the submission of this report.
[10] NOTE: all basins except for 001 and 003 are upstream of this By-Pass device; 001 and 003 are downstream.

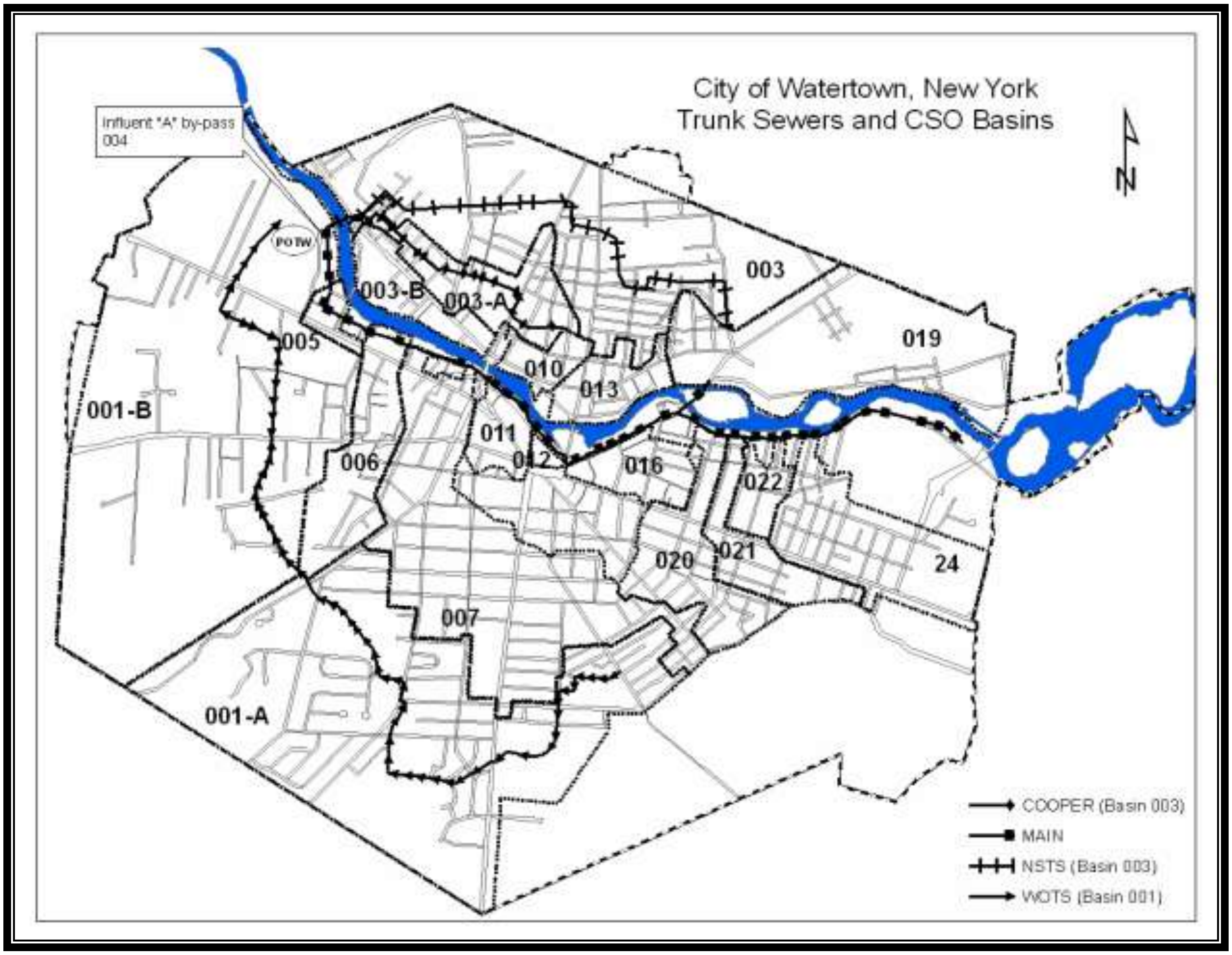

Figure 10: The 15 Sewer Basins with active CSOs

There are a total of 4,797 acres within the 15 basins with CSO devices. Because of equipment and time constraints, the City's characterization, monitoring and modeling plan outlined the intent to monitor and model 5 of the 15 basins (001, 003, 007, 019, and 020) for the 2008 LTCP Phase 1 submission. This is 4,042 of the 4,797 acres, or 84.3% of the total land surface area within the City upstream of an active CSO (see Figure 11 below). The City is already in the process of modeling the remaining 15.7% of the combined sewer system and shall have the modeling and calibration completed early in 2009. Table 4 below summarizes the pipes contained in the five basins studied herein.

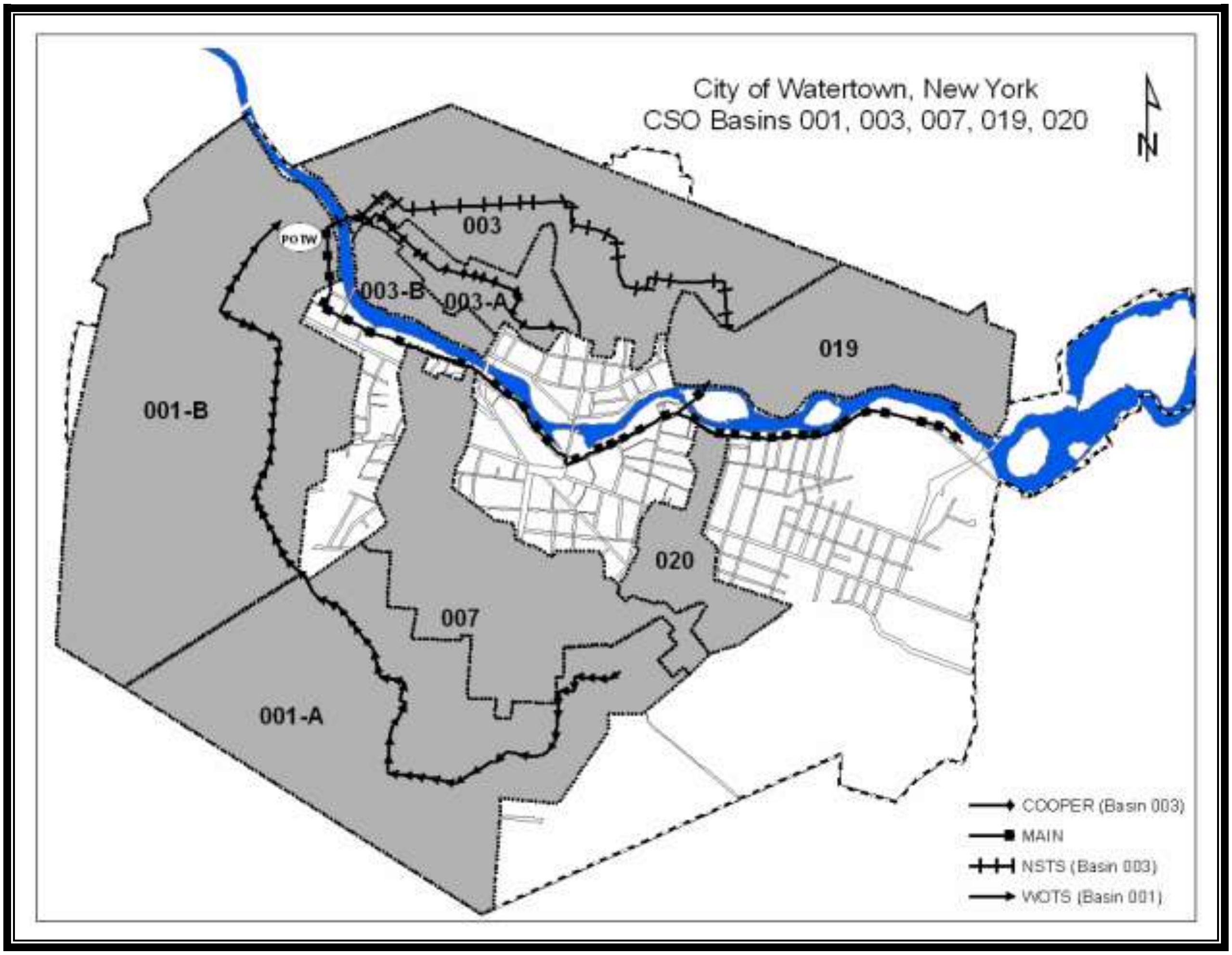

Figure 11: Five CSS Basins monitored for the LTCP Phase 1 Report

Table 4: Summary of pipes within the Basins studies in this LTCP Phase 1

Basin Summary	Total Length in Feet		
	Trunk Sewer	non-Trunk Sewer	Total
			-
Basin 001	22,287.1	92,728.7	115,015.8
Basin 003	60,018.6	13,313.8	73,332.4
Basin 007	8,278.0	50,676.4	58,954.4
Basin 019	4,189.9	15,224.6	19,414.5
Basin 020		14,701.9	14,701.9
Main Trunk Sewer	15,489.7		15,489.7
Misc		8,009.7	8,009.7
Total (Feet)	**110,263.3**	**194,655.1**	**304,918.4**
Total (Miles)	**20.9**	**36.9**	**57.7**

According to current City records, the percent separated sewers in the Basin Summary presented in Table 4 is as follows:

Basin 001	99.7% separated (348.0 total feet combined)
Basin 003	75.9% separated (17,637.5 total feet combined)
Basin 007	52.7% separated (28,333.1 total feet combined)
Basin 019	93.1% separated (1,334.8 total feet combined)
Basin 020	81.5% separated (2,721.0 total feet combined)
Main Trunk	100% separated

The composite for the pipes studied in this LTCP Phase 1 is 83.5% separated and 16.5% combined (50,372.4 feet combined of the total 304,918.4 feet studied). Since this study encompasses 84.3% of the total land area of the City wherein the CSS has active CSOs, it is not likely that this % separation value for the City's total system would change once the remaining basins are modeled.

35.0% of the combined sewers (17,637.5 feet of 50,374.4 feet) are in the Kelsey Creek Basin (003);

56.2% of the combined sewers (28,333.1 feet of 50,374.4 feet) are in the Engine Street Basin (007);

91.2% of the combined sewers are located in either Basin 003 or Basin 007.

Analyses for the following list of analytes were conducted on representative basin samples and the Black River. The Black River was sampled at five locations[11] as indicated in Figure 12 below.

Analytes monitored and/or analyzed

Flow; pH; oil and grease
biochemical oxygen demand
dissolved oxygen
solids (total, dissolved and suspended)
select metals (Mercury, Lead, Cadmium)
Coliform and fecal coliform
nutrients (nitrogen and phosphorus)

[11] **River sample point 1**: downstream of the tail race of the City Hydroelectric Plant on Marble Street, and upstream of the "most upstream" active City CSO;
River sample point 2: downstream of Sewall's Island. This represents the approximate midpoint of the River's trek through the City.
River sample point 3: immediately downstream of the Engine Street CSO (007)
River sample point 4: immediately downstream of the Kelsey Creek/Black River confluence, and upstream of the two City permitted POTW outfalls
River sample point 5: immediately upstream of the Interstate I-81 bridge crossing the Black River. This point is approximately 0.4 miles downstream of the POTW's most downstream outfall and the Western Outfall CSO (001)

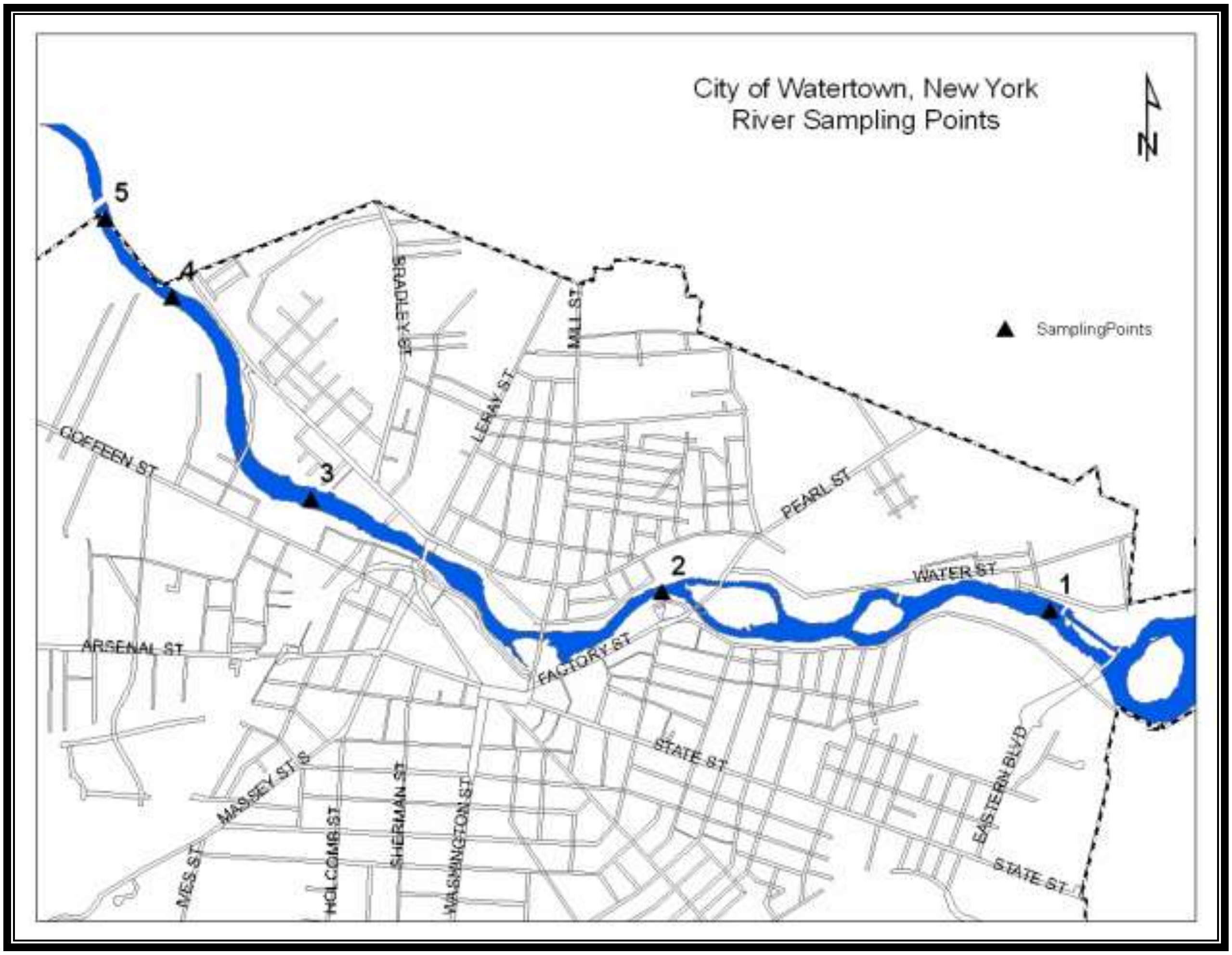

Figure 12: Five Black River Sampling Locations

C. Implementation of CMMP

While the CMMP was not approved by the NYSDEC until September 14, 2006, actual implementation of the work effort commenced prior to that point. The City's SPDES Permit required semi-annual reports to be filed with the Regional Water

Engineer describing the progress and status of the LTCP development.[12] By means of these reports, the NYSDEC was kept up to date on work efforts relative to the LTCP. Actually monitoring and sampling was limited to the spring, summer and fall months.

Table 5: Implementation progress relative to the CMMP

Calendar Year	Focus of monitoring and sampling efforts
2004	Basins 007, 020, 024; November 2004 City installed permanent flow recorder in the Western Outfall (001) immediately upstream of its CSO, and a second permanent flow recorder at its overflow weir.
2005	Entire POTW staff focused on headworks analyses consistent with the City's Industrial Pretreatment Program.
2006	Public Participation Plan approved in May 2006 and the CMMP approved in September 2006. City participated in a regional water and sewer capacity assessment with the Development Authority of the North Country. Detailed study of the Western Outfall (001) with multi portable flow meters attempted to isolate observed flow anomalies within the basin. The City contracted in December 2006 with a professional consultant to model and to calibrate the combined sewer system pipes in the selected 5 basins for the Phase 1 LTCP. The City installed a permanent "bi-directional" area/velocity flow meter in the by-pass pipe of the POTW Influent "A" By-Pass device. In addition to basin 001, flow monitoring was also conducted in basins 007, 019, 020, and 024.

[12] SPDES No. NY 002 5984, page 20 of 21, Paragraph II.A (see Appendix A). The first semi-annual report was December 17, 2002 for the period June 1 – December 1, 2002; and the 11th was filed July 9, 2008 for the period January 1 – June 30, 2008.

2007	City Consultant continues modeling, performs continuity tests and calibrations on the 5 selected basins. The Black River is sampled twice (once at dry weather flows and once under hydraulic stressed conditions (wet weather flows). Flow monitoring continues with focus shifting to supplement "gaps" now identified by the consultant for calibration requirements.
2008	Basin 003 sampling and flow monitoring was completed in the spring. All flow monitoring confirmed sufficient to complete calibration of the model for the five selected basins. The calibrated model was released to the City May 2008. Remaining wet weather River sampling was conducted and five additional dry weather flow sampling events on the River were conducted. Draft work on the Phase I LTCP commenced in August 2008.

What follows is a more detailed summary of each of the five basins modeled.

D. Summary of Basins

1. Western Outfall Basin (001):

The Western Outfall Basin (001) is by far the City's largest basin, totaling 2,332 acres of the 4,797 acres or 48.6% of the acreage upstream of active CSOs. It also contains 21.8 miles of the 57.7 miles of sewers (37.8%). It is the "most studied" basin. River Sample Point 5 is downstream of this basin. Table 6 below presents a more detailed summary of the pipes that comprise the Western Outfall Basin (001).

Table 6: More detailed summary of the pipes in the Western Outfall Basin (001)

Basin 001	Total Length in Feet		
Pipe Diameter	Trunk Sewer	non-Trunk Sewer	Total
6"		1,713.7	1,713.7
8"	382.0	61,327.1	61,709.1
10"	704.1	19,286.4	19,990.4
12"		7,191.6	7,191.6
15"	2,315.0	2,235.0	4,550.0
18"	3,942.8	654.0	4,596.8
21"	4,202.0		4,202.0
24"	1,119.0		1,119.0
27"	4,181.5		4,181.5
30"	754.7	321.0	1,075.7
33"	2,702.5		2,702.5
36"	1,983.5		1,983.5
Total (Feet)	**22,287.1**	**92,728.7**	**115,015.8**
Total (Miles)	**4.2**	**17.6**	**21.8**

Table 8 below details precipitation events resulting in "overflow events" at the Western Outfall overflow device (001) for calendar year 2007.

For the calendar year 2007, the Western Outfall Interceptor carried a total 1,047 million gallons, averaging 2.8685 MGD. The 14,961,400 gallons bypassed (see Table 8) during the calendar year account for 1.4 % of the total. Nearly 73% of this amount (10,860,000 gallons) bypassed during two long and sustained events lasting a continuous 89.5 hours (March 13-16 and December 23-24, 2007). Both events, in addition to precipitation, also were influenced by a significant thaw and snow melt. The Western outfall captured 98.6% of the total flow in the interceptor during CY 2007, and delivered it to the POTW for treatment. Table 7 below compares CY 2007 with the previous two years.

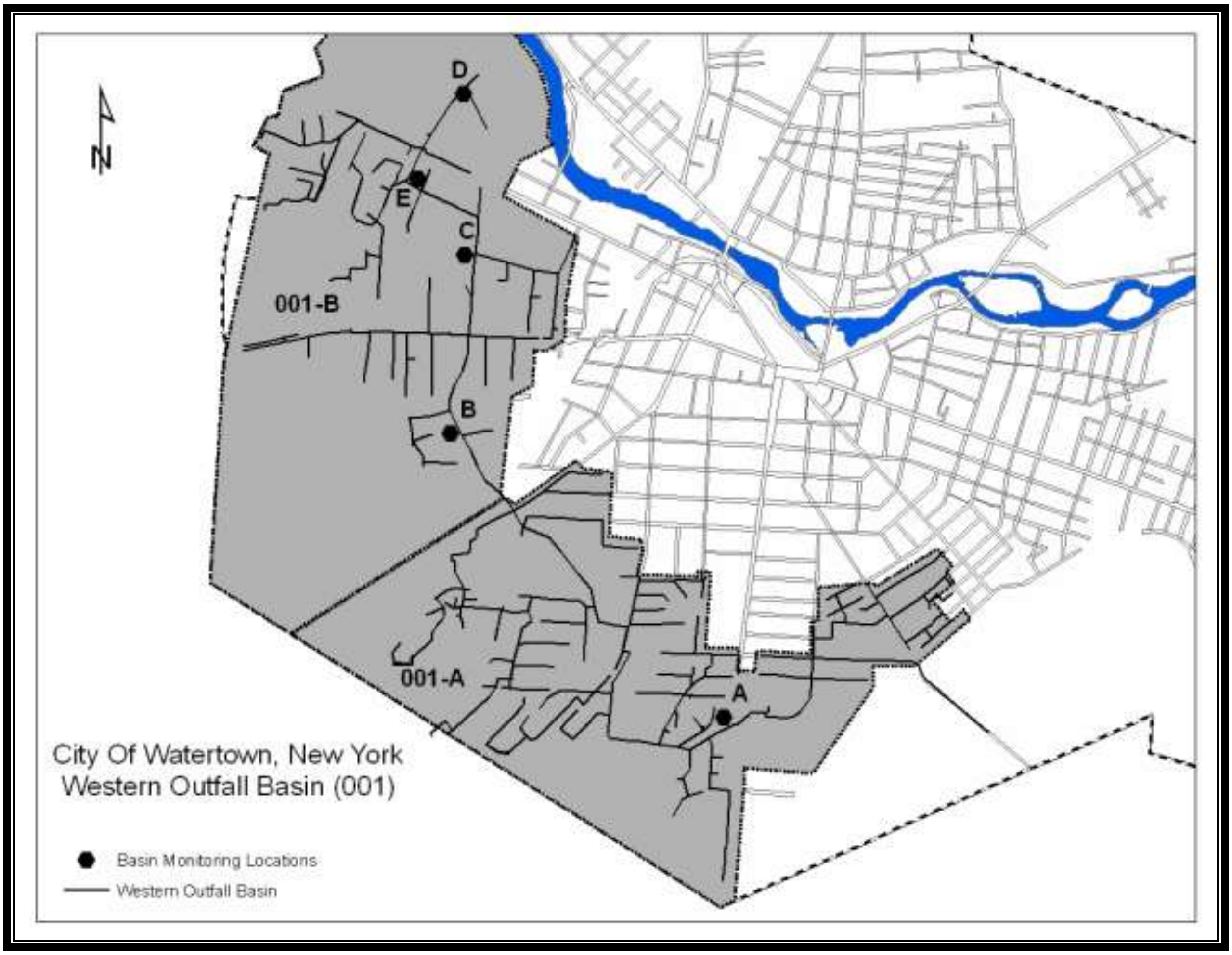

Figure 13: Western Outfall Basin (001). Indicated within the highlighted area of Basin 001 are the actual pipes that are modeled. All pipes 6" in diameter or greater are modeled. Outside Basin 001 in the un-highlighted remainder of the City, City streets are shown. This is the same pattern shown in Figures 17, 21, 23, and 25.

Table 7: Summary of efficiency of Western Outfall Interceptor flow capture.

Calendar Year	Total Gallons in the Interceptor	Total Gallons Bypassed	% Total flow captured and treated at POTW
2005	1,258 MG	21,900,000	98.3 %
2006	1,206 MG	9,701,700	99.2 %
2007	1,047 MG	14,961,400	98.6 %

As indicated in Figure 5, during the first week of August 2006 the Western Outfall basin (as did the realm of the entire facility) was at an approximate midpoint of dry weather conditions (which had prevailed from the beginning June of 2006 through the end of September 2006). During this period, precipitation events occurred resulting in sharp spikes in the interceptor flows. But following the precipitation flow, recovery was nearly instantaneous due to the low antecedent moisture content in the basin surface area. During the first week of August 2006 therefore, the diurnal flows of the interceptor exhibited conditions void of the impacts of rapid infiltration[13] and inflow. The maximum flow in the interceptor during the period August 1 through August 7 was 3.059 MGD, while the average daily flow was 2.0384 MGD and minimum flow was 1.302 MGD. The interceptor would flow at rates above the average from 0800 hours to midnight, and would flow below the average flow rate from midnight to 0800 hours. Peak flows would occur between noon and 1400 hours. Minimum flows would occur at the vicinity of 0600 hours. Figure 14 below presents a typical diurnal flow curve during this week particular week.

[13] Rapid infiltration is different from "simple" infiltration. Rapid infiltration is caused by a storm event that deposits large quantities of water into the ground that will significantly elevate normal or "simple" infiltration levels until the storm water "surge" has been relieved. Rapid infiltration normally lasts for one to three days following a storm event.

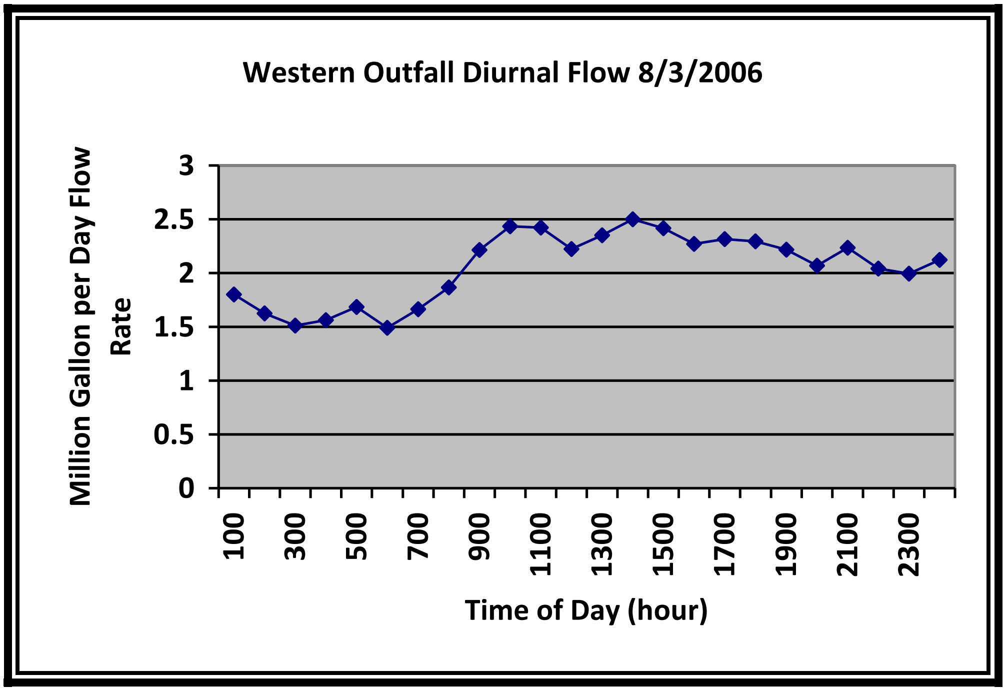

Figure 14: Western Outfall Basin (001) Diurnal Flow (Typical)

Comparing the dry weather diurnal flow pattern in CY 2006 with analogous periods in CY 2005 (Aug 3-10) and CY 2007 (Aug 25-31) offers an interesting observation as indicated in Table 10 below. Data remains insufficient to draw any particular conclusions as there are too many variables involved not yet fully understood. It may represent growth in the system or perhaps something as simple as people altering vacation practices as a response to economic trends (i.e. the cost of fuel, etc.). Regardless, the dry weather flow data grew at a uniform rate for the three years presented.

Table 8: Overflow events at the Western Outfall CSO 001 for CY 2007.

CY 2007 Dates of Events	Bypass Hours	Total Gallons in Interceptor During Event Period	Total Gallons Bypassed	% Gallons Bypassed
1/1	2.75	4,651,000	70,000	1.5%
Jan 05-07	25.00	15,531,900	886,800	5.7%
Jan 07-08	16.25	13,119,200	787,100	6.0%
Jan 09-11	42.00	13,314,900	140,000	1.1%
Mar 13-16	62.50	47,676,400	8,670,000	18.2%
Mar 22-23	30.50	15,712,000	980,000	6.2%
Apr 16-18	31.25	23,649,600	800,000	3.4%
6/4	1.00	2,785,700	30,000	1.1%
7/11	1.00	2,869,800	10,000	0.3%
7/16	0.50	2,636,500	30,000	1.1%
7/19	2.50	2,685,300	10,000	0.4%
7/28	0.75	2,931,700	20,000	0.7%
8/6	0.75	3,010,300	7,500	0.2%
9/27	0.50	3,417,100	10,000	0.3%
10/8	21.75	2,095,300	20,000	1.0%
10/13	0.50	3,081,600	10,000	0.3%
10/19	0.75	2,967,300	30,000	1.0%
10/23	2.50	3,970,900	70,000	1.8%
11/21	1.50	3,973,900	10,000	0.3%
12/3	3.50	5,595,500	180,000	3.2%
Dec 23-24	27.00	17,478,000	2,190,000	12.5%
Annual Total	274.75	193,153,900	14,961,400	7.7%

Table 9: Overflow events at the Western Outfall CSO for CY 2006.

CY 2006 Dates of Events	Bypass Hours	Total Gallons in Interceptor During Event Period	Total Gallons Bypassed	% Gallons Bypassed
1/14	14.00	10,090,000	749,200	7.4%
1/18	14.00	9,630,000	758,300	7.9%
2/3	4.00	5,970,000	50,000	0.8%
2/17	11.00	9,350,000	600,000	6.4%
3/10	4.50	7,800,000	103,800	1.3%
1/3	3.00	6,550,000	57,800	0.9%
Mar 16-17	--	8,310,000	72,200	0.9%
4/22	3.00	4,490,000	5,000	0.1%
6/1	1.00	3,340,000	12,300	0.4%
6/17	3.00	4,070,000	142,700	3.5%
6/19	1.00	3,410,000	21,700	0.6%
6/27	3.00	3,570,000	150,200	4.2%
7/10	1.25	3,290,000	93,200	2.8%
9/2	1.00	2,890,000	61,200	2.1%
9/13	3.75	4,440,000	113,100	2.5%
10/4	1.25	3,450,000	20,000	0.6%
10/14	1.25	3,350,000	50,000	1.5%
10/19	1.50	3,580,000	10,000	0.3%
10/20	8.50	5,540,000	60,000	1.1%
10/23	15.75	7,750,000	580,000	7.5%
10/28	15.25	14,240,000	390,000	2.7%
11/14	1.50	7,750,000	350,000	4.5%
11/16	6.50	6,520,000	190,000	2.9%
11/30	2.25	3,390,000	40,000	1.2%
12/1	24.00	13,200,000	3,210,000	24.3%
12/2	24.00	8,920,000	1,540,000	17.3%
12/3	13.25	5,710,000	57,300	1.0%
12/23	8.00	5,010,000	67,400	1.3%
12/26	13.25	5,270,000	146,300	2.8%
Annual Total	203.75	180,880,000	9,701,700	5.4%

Table 10: Comparison of Western Outfall dry weather conditions in consecutive calendar years.

Dry Weather Flow Conditions	August 3-10, 2005	August 3-10, 2006	August 25-31, 2007
Average Daily Flow (MGD)	1.58	2.038	2.408
Peak Daily Flow (MGD)	2.21	3.059	3.16

Comparing the dry weather average daily flow and peak flow for the Western Outfall (Basin 001) with the annual average daily flow and peak flow offers a perspective of the impact of infiltration and inflow upon the interceptor. For CY 2007, there is observed a very close relationship between the average daily flows in both the dry weather condition and the annual average. This seems to point to the extended dry weather conditions that prevailed during the late spring, summer and fall of 2007 and the resulting dry antecedent moisture content of the Western Outfall Basin, itself. For this reason, CY 2006 data was used to calibrate dry weather diurnal patterns rather than CY 2007. Peak numbers did not seem to change as that is more reflective of the consistency between the two years with respect to the intensity and duration of the more severe storms that did occur.

Table 11: Comparison of Western Outfall flows in consecutive calendar years.

Annual Averages	CY 2006	CY 2007
Average Daily Flow (MGD)	3.304	2.87
Peak Daily Flow (MGD)	19.98	19.84

The Western Outfall overflow device will activate when the interceptor reaches a 7.5 MGD flow rate. This occurred during 21 different events during calendar year 2007 (see Table 8) for about 274.75 total hours of activity. Given that there are

8,760 hours in 365 days, then the Basin 001 overflow device was active 3.14 % of the time. See Table 12 below for how this compares with previous years.

Table 12: Comparison of duration of bypass events in the Western Outfall for consecutive calendar years.

Comparison of Event Durations	CY 2005	CY 2006	CY 2007
Number of Active Events	36	29	21
Total Hours of Bypass	198.32	203.75	274.75
Total % Time the CSO was Active	2.26	2.33	3.14

Table 13: Contribution of Town Sewer Districts to the Western Outfall.

Total MG per Year	CY 2005	CY 2006	CY 2007
Sewer District 2	41.04	42.62	47.23
Sewer District 3	15.87	17.09	11.79
Sewer District 4/5	64.77	61.15	58.65
Annual Total	121.68	120.86	117.67
% Total Western Outfall Flow	9.6%	10.0%	11.2%
% Total POTW Flow	2.8%	3.0%	3.3%

The Town of Watertown Sewer Districts 2, 3, and 4/5 (which includes the Watertown Correctional Facility) all tie into the Western Outfall interceptor up stream of its overflow device. Sewer District 4/5 connects at the southern extremity of Washington Street as it crosses the City border. Sewer District 2 connects at the western extremity of Arsenal Street as it crosses the City border, and Sewer District

3 connects north of Coffeen Street and immediately upstream of the overflow device. These sewer districts are fully separated systems and their discharges into the City system are uniform. Table 13 above presents their respective contributions.

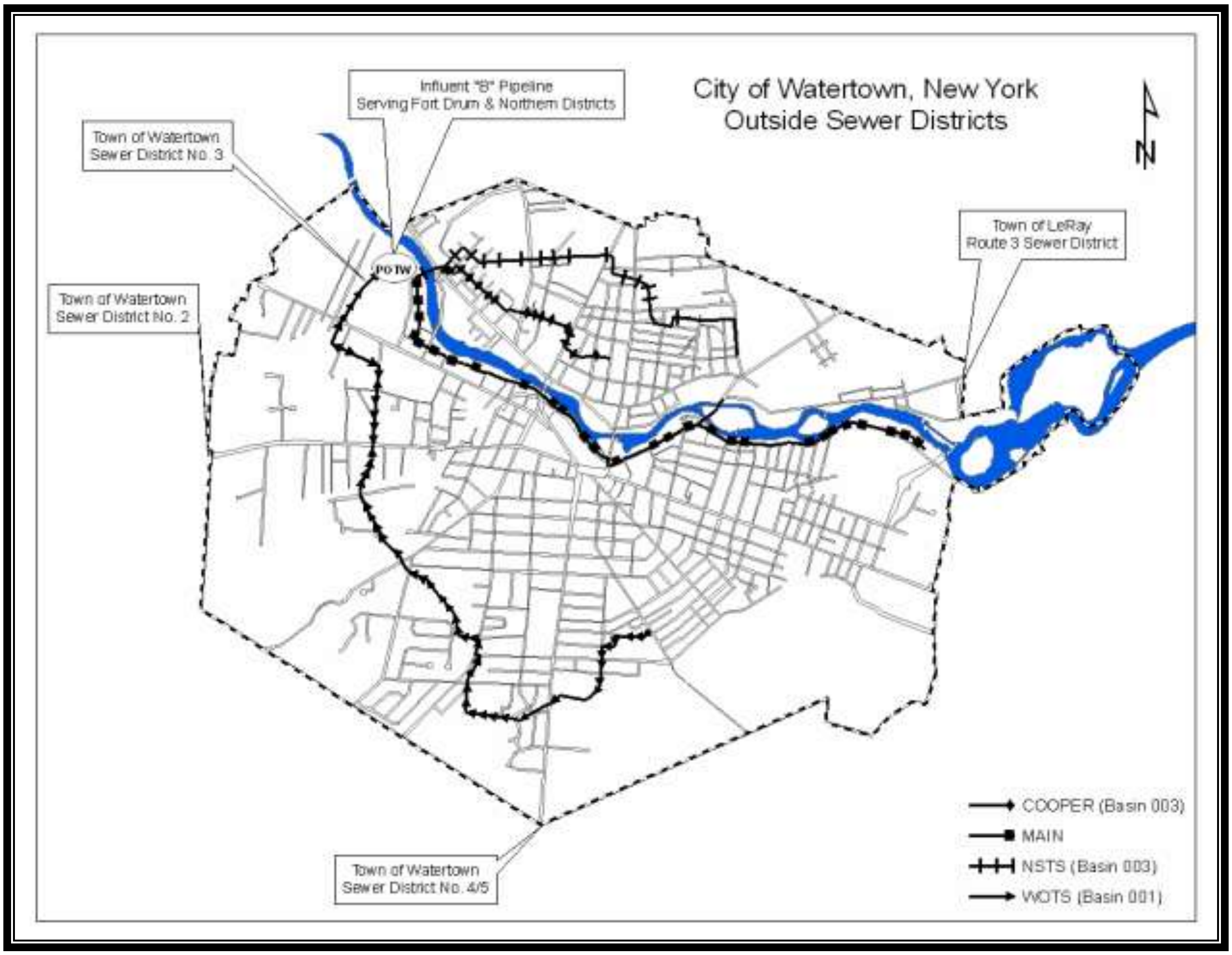

Figure 15: Outside Sewer Districts and the points of connection to the City's CSS

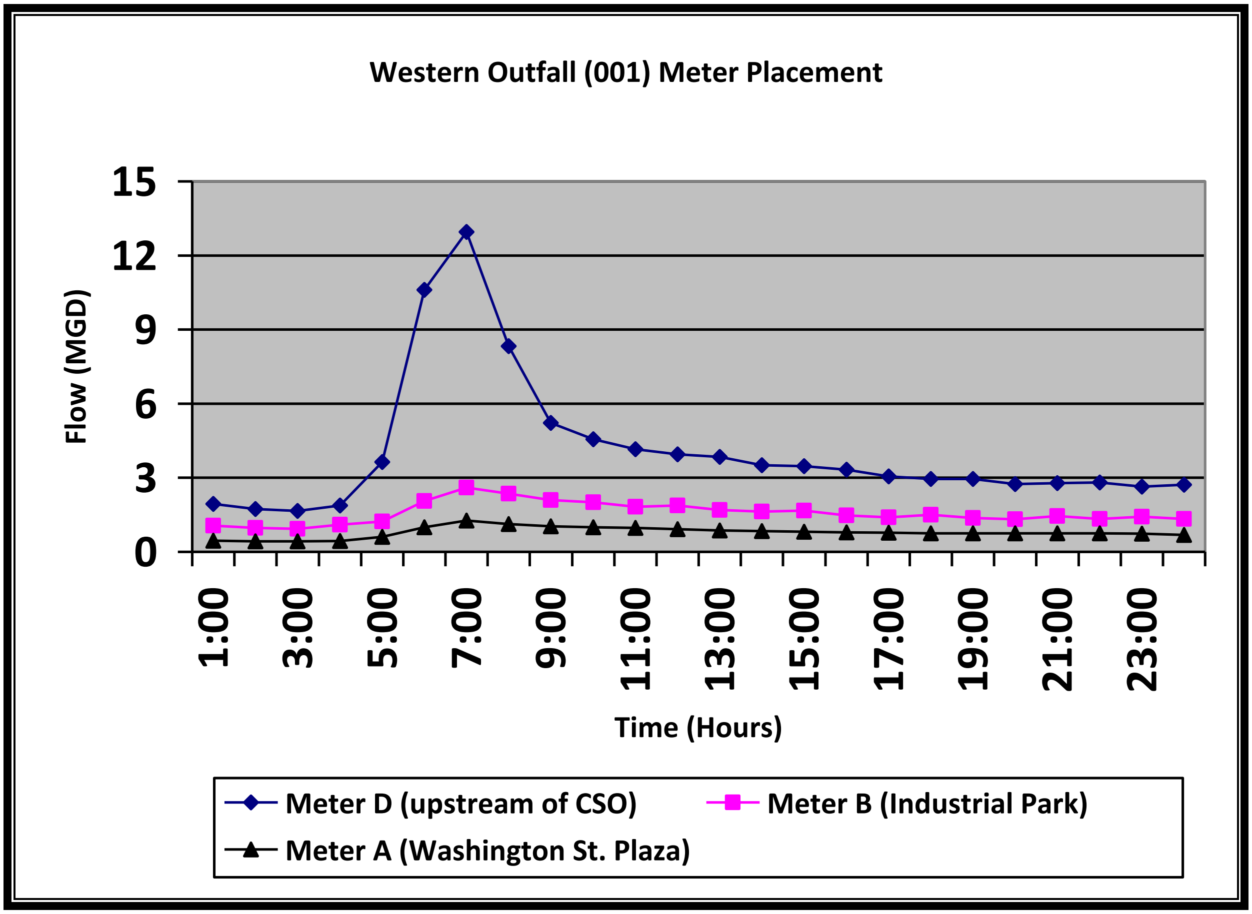

Figure 16: June 17, 2006 Storm – Specific metered flows in the Western Outfall Basin (001)

During the summer of 2006, significant attempts were made to pinpoint the exact location of a significant inflow anomaly exhibited in the Western Outfall (001). Reference is made to Figure 13 for specific lettered meter locations. As is indicated in Figure 16, meter D (upstream of CSO) is recording an inflow not present in meters B and A. Meters were located at A, B, and D for June 2006; B, C, and D for July and August of 2006; and C, E, and D for September 2006. Flow in the Western Outfall as shown in Figure 13 proceed from A to D. Investigations terminated the end of September not yet locating the specific inflow anomaly except that it appears to be downstream of E and upstream of D. This flow anomaly is a significant impairment and shall be further emphasized in Section IV of this report.

Impairments identified in the Western Outfall Basin (001):

- **Inflow anomaly existing downstream of Wealtha Ave and upstream of CSO 001 (see page 44); and**

- **"Normal" or "simple" infiltration (see Section III.E for definition) at a rate of 1.18 MGD or 58.4% of its dry weather flow (see Table 19 for more detail).**

2. Kelsey Creek Basin (003):

The Kelsey Creek Basin (003) is the City's second largest basin, encompassing 766 acres or 16.2% of the acreage upstream of an active CSO device. It contains 13.9 miles of sewers, or 24.1% of the total studied in this LTCP. It also contains 17,637.5 feet of combined sewers (35% of the total combined sewers studied in this LTCP). River Sample Point 4 is immediately downstream of this basin. Table 14 below presents a more detailed summary of the pipes that comprise the Kelsey Creek Basin (003).

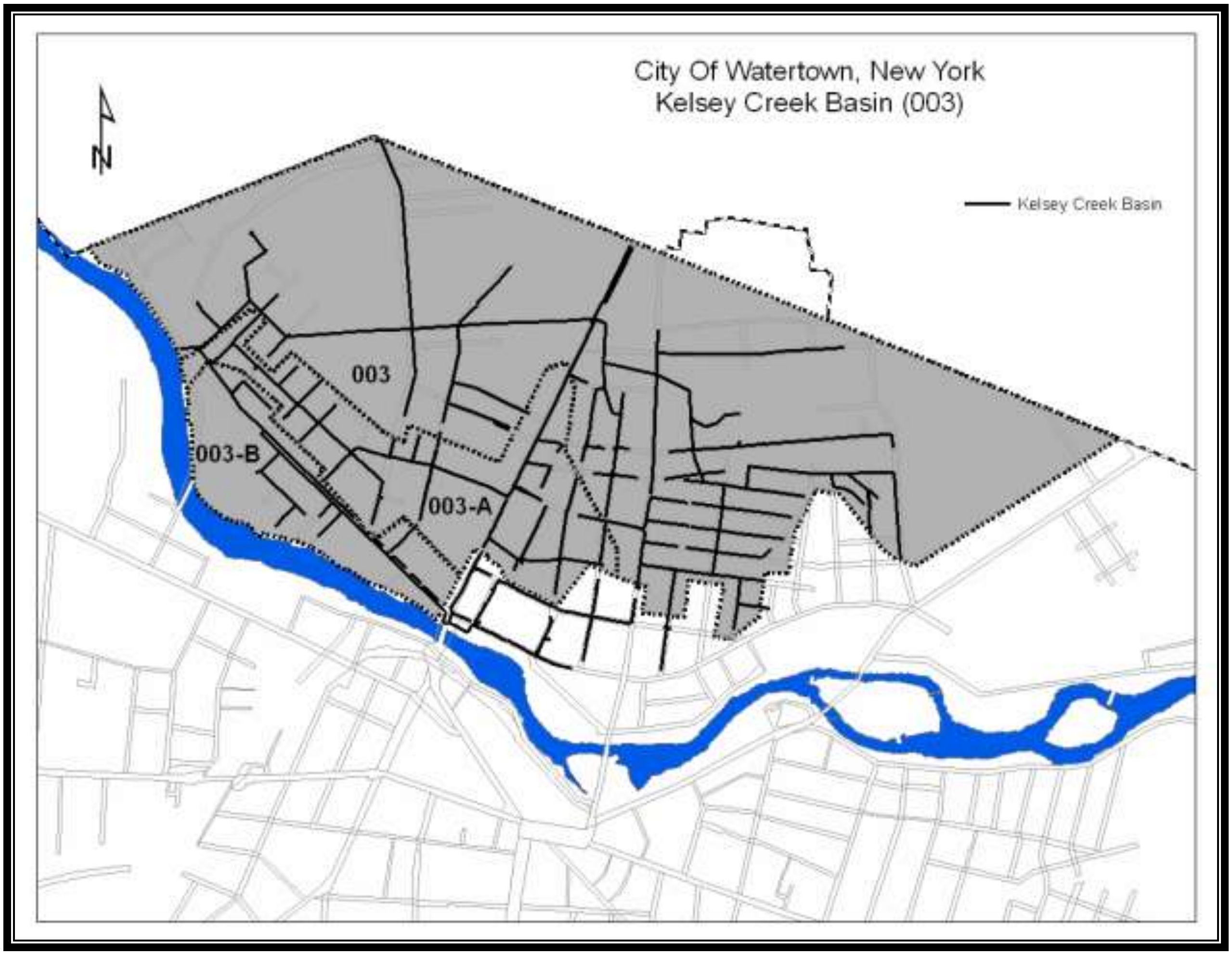

Figure 17: Kelsey Creek Basin (003)

Table 14: More detailed summary of the pipes that comprise the Kelsey Creek Basin (003)

Basin 003	Total Length in Feet			
Pipe Diameter	**CSTS**	**NSTS**	**non-Trunk Sewer**	**Total**
6"		416.3		416.3
8"	6,085.1	11,130.2	3,852.2	21,067.5
10"	7,587.1	10,093.0	2,333.0	20,013.1
12"	2,276.3	6,802.0	5,543.0	14,621.3
15"	449.0	1,850.0	333.0	2,632.0
18"	142.0	2,222.2	1,076.6	3,440.8
20"	411.0			411.0
24"	3,156.4	1,514.0		4,670.4
30"	2,607.0	1,077.0	176.0	3,860.0
33"				-
36"		2,200.0		2,200.0
Total (Feet)	**22,713.9**	**37,304.7**	**13,313.8**	**73,332.4**
Total (Miles)	**4.3**	**7.1**	**2.5**	**13.9**

Monitoring focused upon the Kelsey Creek Basin (003) in September and October 2007. During late September, meters were relocated from their original positions due to logistics difficulties encountered with the original locations. Ultimately, a meter was placed immediately upstream of the CSO and meters were placed in each the North Side Trunk Sewer (NSTS) and the Cooper Street Trunk Sewer (CSTS) immediately upstream of their respective confluence. Three rainfall events were captured in October 2007. The October 13-14, 2007 storm is shown in Figure 18 below. Note the relative insignificant impact the storm had on the NSTS and the very significant impact it had on the remaining two meters. The CSO for the Kelsey System is physically located in the stream bed of Kelsey Creek. A portion of the NSTS is also in the stream bed upstream of the CSO and downstream of the NSTS meter location. The pipe joints in this section of the NSTS are deteriorated and large quantities of water enters the pipe from the stream bed. Figure 19 below is a section of this pipe within the stream bed and clearly captures the adverse impact.

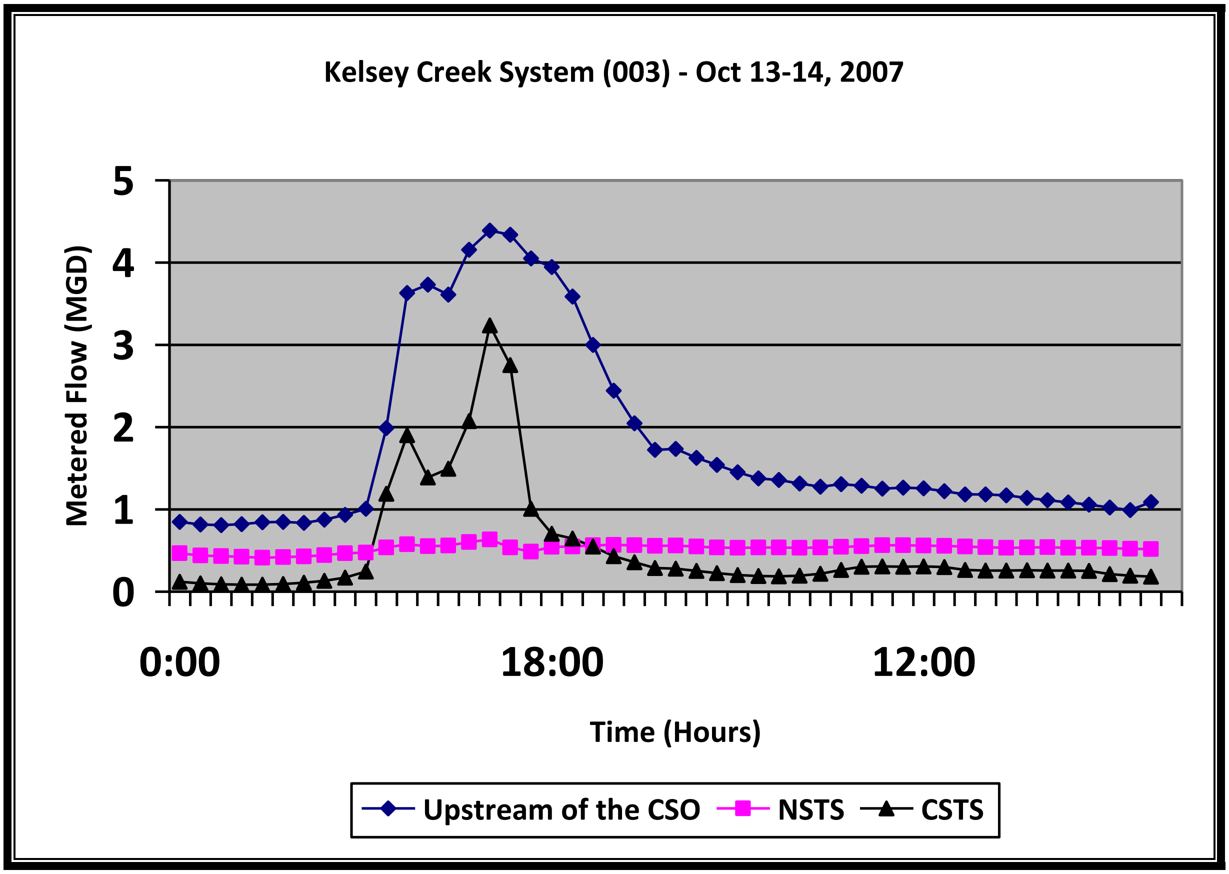

Figure 18: Metered flows (MGD) in the Kelsey System (003) October 13-14, 2007

Very large percentages of both infiltration and rapid infiltration in the NSTS pipes immediately upstream of the CSO and in the Cooper Street Trunk Sewer were needed to enable the model to approach actual conditions measured and recorded.

Figure 19: North Side Trunk Sewer immediately upstream of the Kelsey Creek Basin (003) CSO

Figure 20 below details a more expanded look at the storm featured in Figure 18. In Figure 20, the three storms that had occurred back to back culminating in the October 13-14, 2008 storm are presented. The CSTS and the NSTS are presented in "stacked area graph format" meaning that the NSTS contribution is physically lying on top of the CSTS contribution and the total height achieved in the stack represents the total contribution the two of them made together. Superimposed upon the two trunk sewer contributions is the measurements recorded just upstream of the Kelsey Creek CSO. Note that before the first storm had hit, the meter at the CSO was actually recording a flow equal to the summation of the two trunk sewers. But note also that following the first storm, the meter at the CSO was recording flows in the order of 0.5 MGD greater than the summation of the two trunk sewers. Before the first storm, the Kelsey Creek stream bed was dry and there was no rapid infiltration as shown in Figure 19. Following the first storm and continuing thereafter the streambed was flowing and the infiltration of that section of the NSTS downstream of the NSTS meter but upstream of the CSO meter (that section of the NSTS in the streambed) is this very differential now clearly shown in Figure 20. There is water in the stream bed at least 10 months of the year and the rapid infiltration is in the order of 0.5 MGD when it occurs. This would account for something in the order of 150 million gallons of unwanted rapid infiltration per year. Figure 20 also zeros in on the fact that inflow in the Kelsey Creek system has its source in the CSTS.

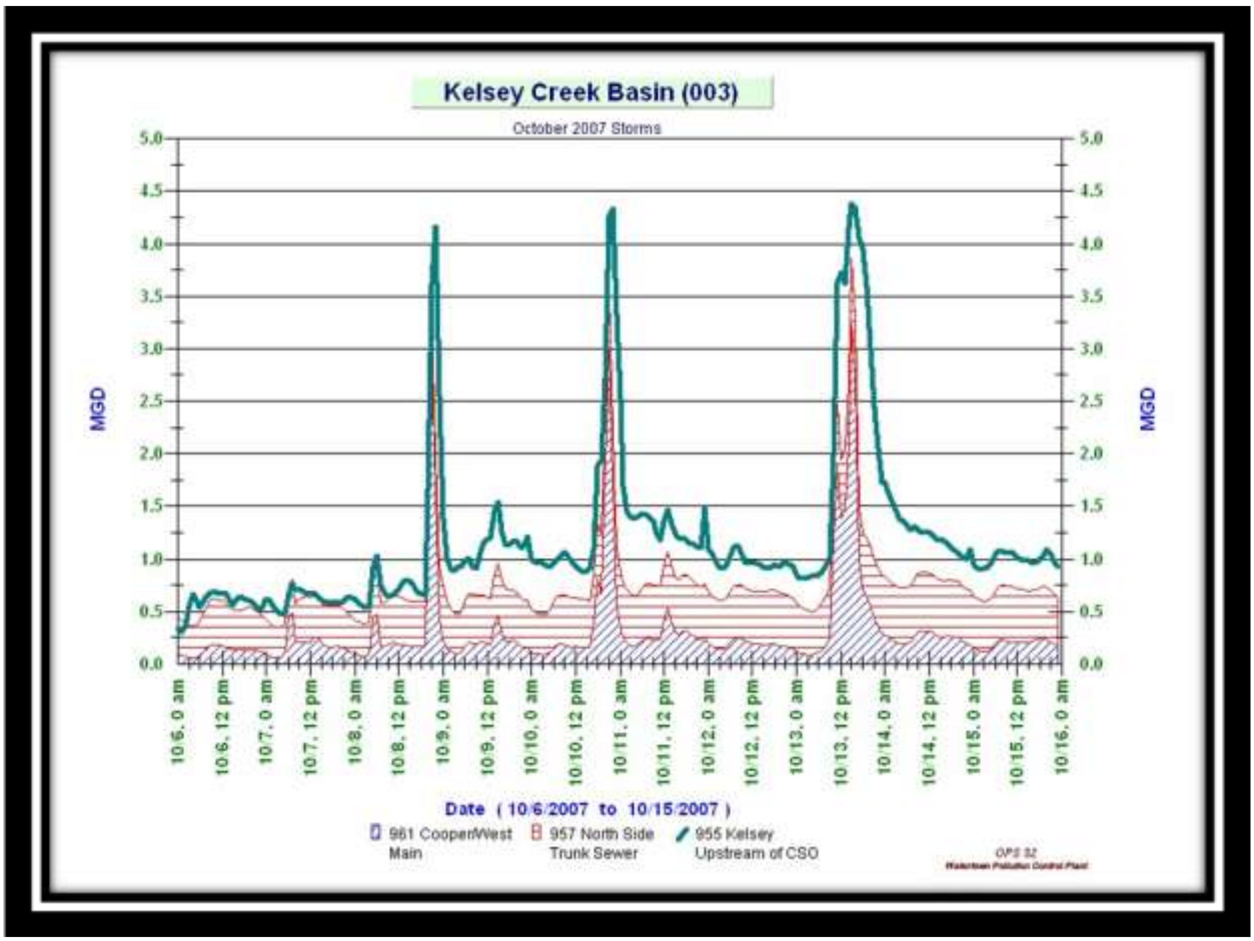

Figure 20: Kelsey Creek Basin's physical response to a series of storms.

<u>Impairments identified in the Kelsey Creek Basin (003):</u>

- **Inflow anomaly existing in the most downstream sections of the NSTS;**
- **Large degree of inflow comprehensively existing in the CSTS (35.0% of all combined sewers exist in Basin 003, predominately in the CSTS component of the Basin); and**
- **"Normal" or "simple" infiltration (see Section III.E for definition) at a rate of 0.85 MGD or 69.1% of its dry weather flow (see Table 19 for more detail).**

3. Engine Street Basin (007):

The Engine Street Basin (007) is the City's third largest basin encompassing 465 acres or 9.7% of the acreage upstream of an active CSO device. The basin contains 11.2 miles of sewers, or 19.4% of the pipes studied in this LTCP. This is the "most combined" basin of the City with 28,333.1 feet of combined sewers (56.2% of the total combined sewers studied in this LTCP). River Sample Point 3 is immediately downstream of this basin. It will be shown below that this is the basin most "detected" on the Black River when the CSOs are active. Table 15 below presents a more detailed summary of the pipes that comprise the Engine Street Basin (007).

Table 15: More detailed summary of the pipes that comprise the Engine Street Basin (007)

Basin 007	Total Length in Feet		
Pipe Diameter	**TRA Sewer**	**non-Trunk Sewer**	**Total**
6"		650.0	650.0
8"		21,927.6	21,927.6
10"		14,565.9	14,565.9
12"		5,313.9	5,313.9
15"		4,000.2	4,000.2
18"		404.0	404.0
20"		1,682.9	1,682.9
21"		1,363.0	1,363.0
24"		769.0	769.0
36"	398.0		398.0
51"	1,435.0		1,435.0
60"	6,445.0		6,445.0
			-
Total (Feet)	**8,278.0**	**50,676.4**	**58,954.4**
Total (Miles)	**1.6**	**9.6**	**11.2**

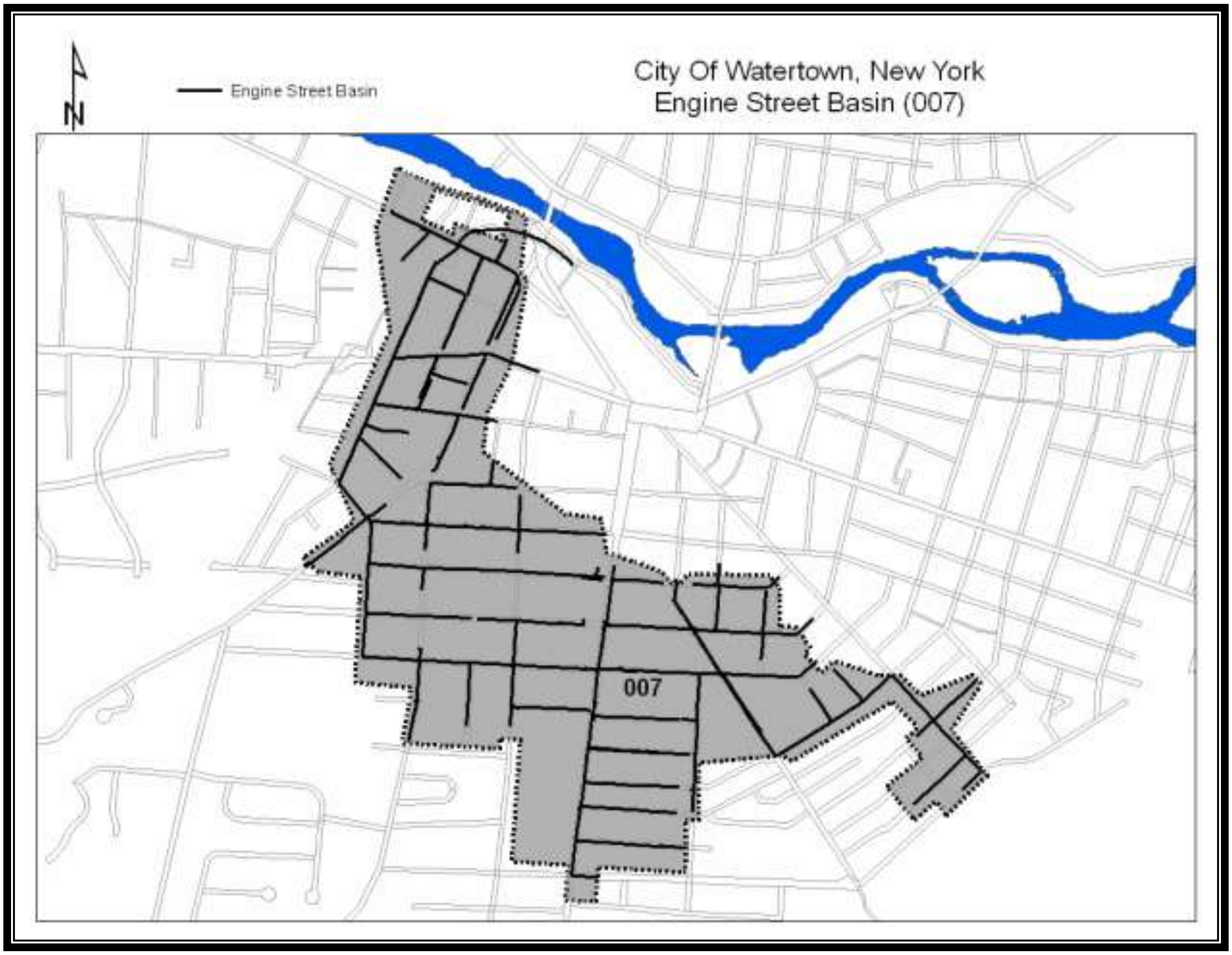

Figure 21: Engine Street Basin (007)

A portable area/velocity flow monitor was placed in Basin 007 CSO device channel May – August 2006, and repeated again in CY 2007. If flow within the channel reaches the elevation of an overflow weir, the portion that overflowed is directed to the Black River. The volume remaining in the channel is directed to the Main Trunk Sewer. Monitoring conducted during CY 2007 confirmed the consistency of the regulating device placed downstream of CSO 007 carrying captured flow to the Main Trunk Sewer thus validating the assumption that bypass flow would be that which exceeds the regulated volume. The regulating device is an 18" concrete pipe placed at a slope of 0.28%. The Manning Equation presented below proved to be consistently accurate and results in a maximum 3.425 MGD for the Engine

Street CSO flows to the Main Trunk Sewer. Any flow in the Basin 007 above this threshold will be diverted to the Black River.

$$\mathbf{Q = \frac{0.463}{n} D^{8/3} S^{1/3}}$$

Where: **S = slope in feet per 1,000 feet**
D = inside diameter of pipe in feet
n = the Manning roughness coefficient (0.013)

The weir plate within the CSO device was replaced in December 2006. During the dry weather period of August 1 through August 7, 2006 reliable flow data was obtained and diurnal data was plotted. Here the basin average daily flow was 0.696 MGD; its peak flow rate was 1.267 MGD and its minimum flow rate was 0.111 MGD. The dry weather diurnal flow pattern for the Engine Street Sewer is presented below in Figure 22.

<u>Impairments identified in the Engine Street Basin (007):</u>

- **Large degree of inflow comprehensively existing throughout Basin 007 (56.2% of all combined sewers exist in Basin 007);**
- **"Normal" or "simple" infiltration (see Section III.E for definition) at a rate of 0.24 MGD or 36.4% of its dry weather flow (see Table 19 for more detail); and**
- **River sampling indicated impact during storm events when CSO 007 is active (see Section III.G.1 and 2, and Appendix F for details).**

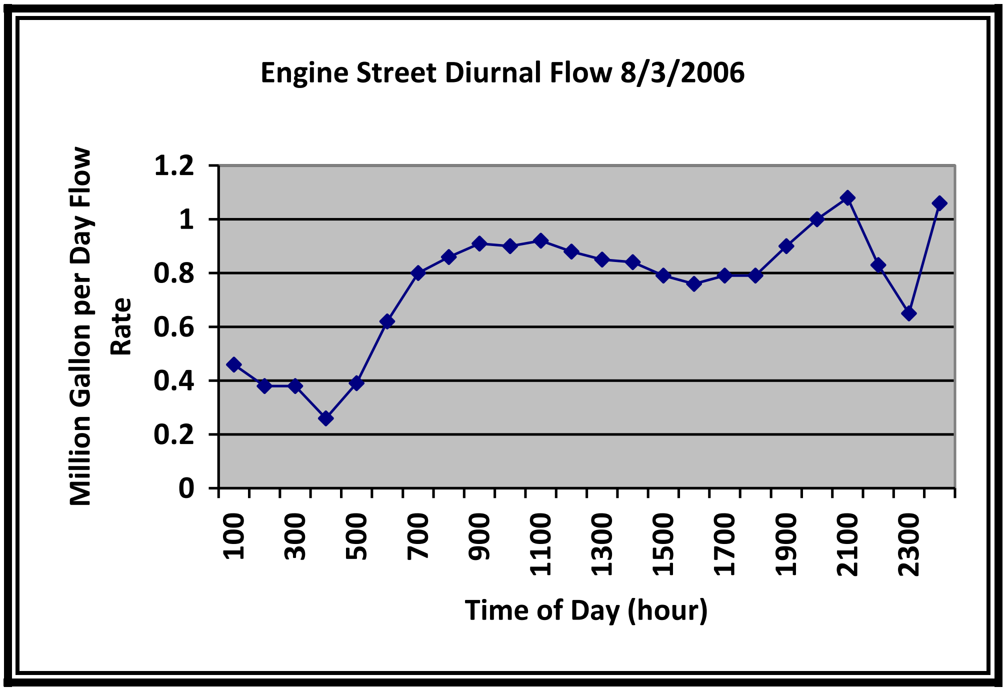

Figure 22: Engine Street Basin (007) Diurnal Flow (Typical)

4. **Pearl Street Basin (019):**

The Pearl Street Basin (019) is the City's fourth largest, encompassing 379 acres or 7.9% of the total acreage upstream of an active CSO device. The basin contains 3.7 miles of sewers (6.4% of the total studied in this LTCP). Table 16 below presents a more detailed summary of the pipes that comprise the Pearl Street Basin (019).

A portable area/velocity flow monitor was placed in the vicinity of the CSO in its upstream pipe during August 2006. Similar to Basin 007, an overflow weir exists within the CSO device. Water not overflowing would be directed to the Main Interceptor. Average dry weather flow was 0.0994 MGD, with its peak dry weather flow rate being 0.178 MGD, and its minimum being 0.032 MGD. Figure 24 below presents the diurnal pattern for the basin for the dry weather flow.

Table 16: A more detailed summary of the pipes that comprise the Pearl Street Basin (019)

Basin 019	Total Length in Feet		
Pipe Diameter	**Trunk Sewer**	**non-Trunk Sewer**	**Total**
6"			-
8"		4,193.3	4,193.3
10"		6,878.0	6,878.0
12"		867.3	867.3
15"	3,434.9	463.4	3,898.3
18"		400.0	400.0
20"		386.0	386.0
21"		2,004.6	2,004.6
24"	755.0		755.0
30"		32.0	32.0
			-
Total (Feet)	**4,189.9**	**15,224.6**	**19,414.5**
Total (Miles)	**0.8**	**2.9**	**3.7**

A component of the Pearl Street basin flows would be the contribution from the Town of LeRay Route 3 Sewer District (RT3) connecting downstream of its pumping station and at the extreme northeast point of the Water Street sewer (a tributary to the Pearl Street basin). This accounts for the sharp, pulse character of the Basin 019 diurnal pattern as presented in Figure 24.

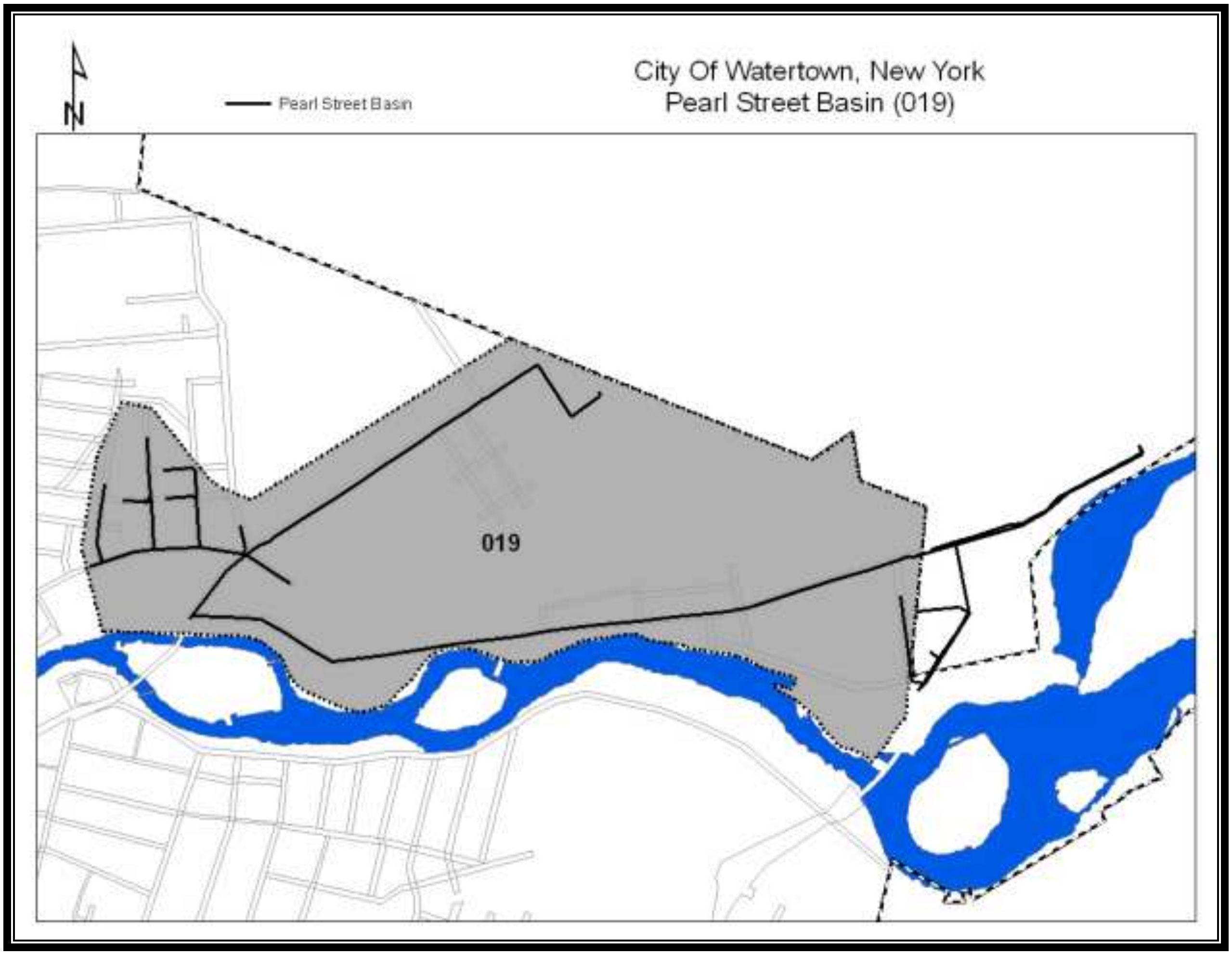

Figure 23: Pearl Street Basin (019)

A synopsis of the monthly contributions from RT3 since its "startup" December 2003 in total gallons per month is presented in Table 17.

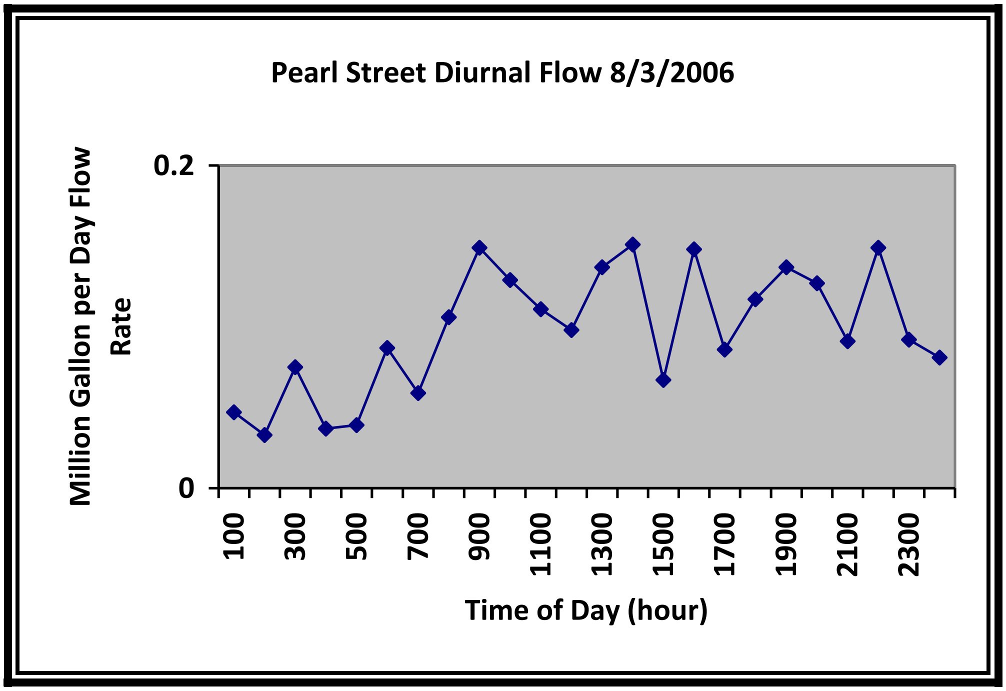

Figure 24: Pearl Street Basis (019) Diurnal Flow (Typical)

RT3 is a new, separated, commercial/residential developed sewer district. Its flows are uniform and not significantly impacted by either infiltration or inflow. Comparing the total volume of wastewater from Basin 019 for August 2006 (3,087,600 gallons – the only month Basin 019 flows were monitored and recorded) with the RT3 contribution for August 2006 (1,794,219 gallons), RT3 contributed 58.1 % of the basins total flow during the month. Comparing the RT3 flows for the total calendar year with the total POTW flows for the same year indicates that RT3 contributed 0.49 % in CY 2004, 0.58 % in CY 2005, 0.63 % in CY 2006, and 0.69 % in CY 2007. While the percentages may seem to indicate that the RT3 flows are increasing, this is in fact not the case. The lower than normal precipitation for CY 2007 resulted in a decrease in total POTW volume treated. This rendered the RT3 component a larger share of the total. As indicated in Table 17 the total flow from RT3 actually decreased in CY 2007 from that of 2006.

Table 17: Flow contributions from the RT3 Sewer District.

Gallons per Month	CY 2004	CY 2005	CY 2006	CY 2007
Jan	1,069,050	2,039,447	2,872,139	2,035,851
Feb	1,202,113	1,894,756	2,528,559	1,711,269
Mar	1,540,619	2,071,584	2,705,970	3,275,432
Apr	1,968,569	2,464,216	1,962,247	2,774,072
May	1,346,031	1,960,930	2,054,382	2,297,669
Jun	1,416,347	1,845,866	1,946,549	1,988,144
Jul	1,532,016	2,001,569	1,707,077	1,750,373
Aug	1,570,235	2,016,721	1,794,219	1,938,820
Sep	1,818,715	2,039,201	1,890,221	1,622,243
Oct	1,933,463	2,320,766	1,801,948	1,826,468
Nov	1,847,473	2,807,088	1,848,612	1,715,536
Dec	2,361,271	1,585,083	2,161,665	1,843,309
Total	19,605,902	25,047,227	25,273,588	24,779,186

Impairments identified in the Pearl Street Basin (019):

- **Nominal inflow existing with 2.7% of all combined sewers located in Basin 019; and**
- **"Normal" or "simple" infiltration (see Section III.E for definition) at a rate of 0.08 MGD or 44.4% of its dry weather flow (see Table 19 for more detail).**

5. **Rutland Street Basin (020):**

Table 18: A more detailed summary of the pipes that comprise the Rutland Street Basin (020)

Basin 020	Total Length in Feet		
Pipe Diameter	**Trunk Sewer**	**non-Trunk Sewer**	**Total**
			-
8"		5,093.9	5,093.9
10"		6,678.0	6,678.0
12"		2,930.0	2,930.0
			-
Total (Feet)	**-**	**14,701.9**	**14,701.9**
Total (Miles)	**-**	**2.8**	**2.8**

Impairments identified in the Rutland Street Basin (020):

- **Nominal inflow existing with 5.4% of all combined sewers located in Basin 020.**

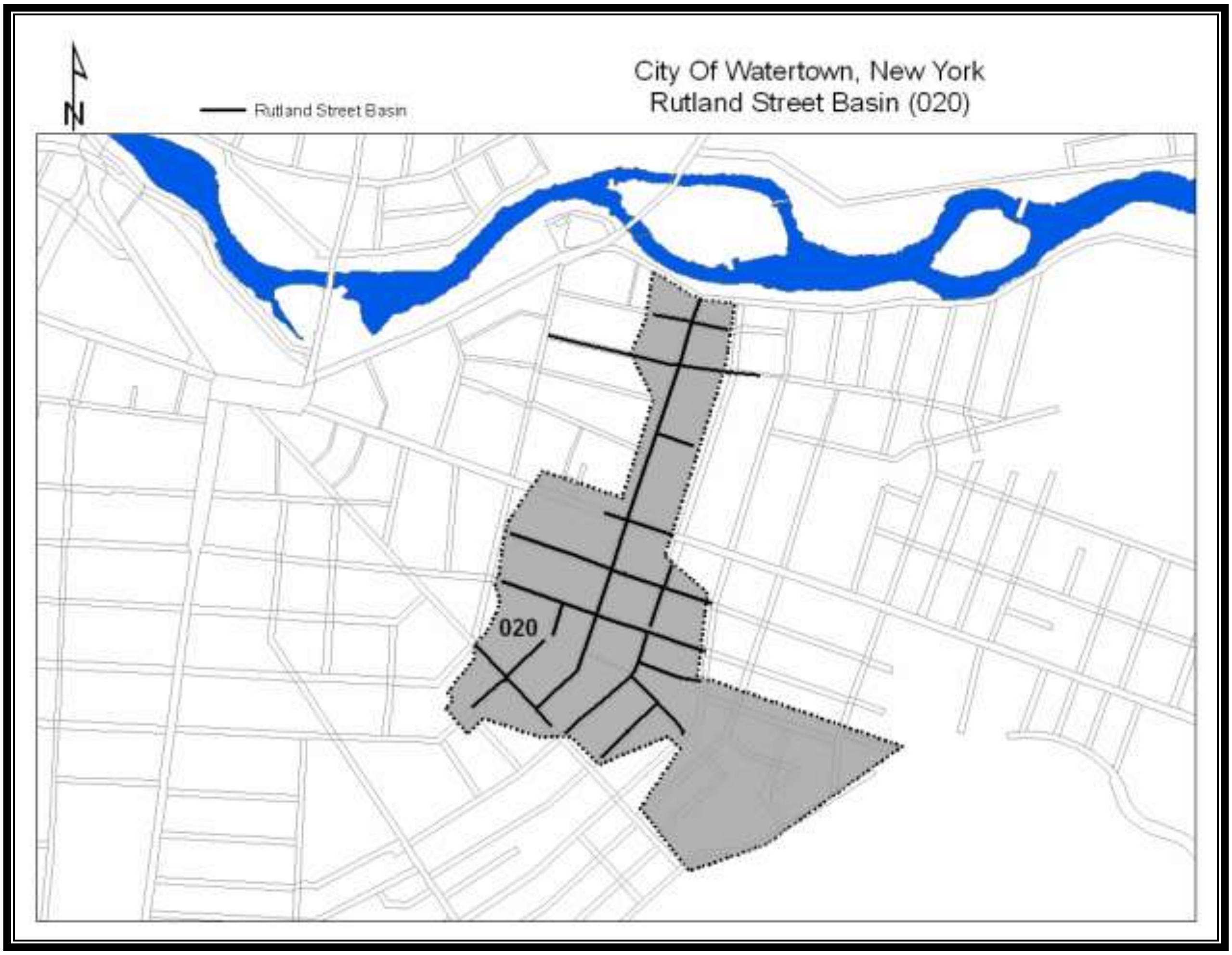

Figure 25: Rutland Street Basin (020)

A portable area/velocity flow monitor was placed in vicinity of the CSO in its upstream pipe May – August 2006. Similar to Basin 007, an overflow weir exists within the CSO device. Water not overflowing would be directed to the Main Interceptor via an 8 inch diameter concrete pipe with a 4.85% slope.[14] Average dry weather flow was 0.122 MGD, with its peak dry weather flow rate being 0.371

---

[14] Supplement 1 to the 7th Semi-Annual Report dated July 5, 2006 documented for CSO 020 the Manning calculation that indicates a maximum flow rate in the 8" concrete pipe of 1.680 MGD. Any flow rate higher than this value is presumed to overflow the weir in the CSO device. This presumption relies upon a Manning coefficient of n = 0.013 and unobstructed conditions within the pipe.

MGD, and its minimum being 0.020 MGD. Figure 26 below presents a typical diurnal pattern for the basin for the dry weather flow.

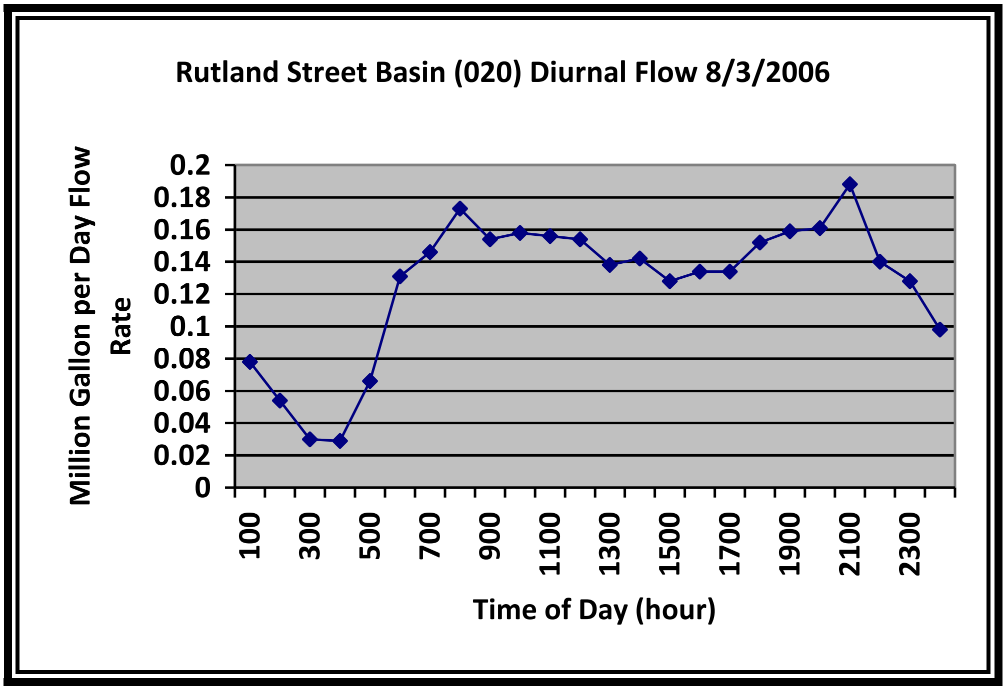

Figure 26: Rutland Street Basin (020) Diurnal Flow (Typical).

6. Remaining Basins to model:

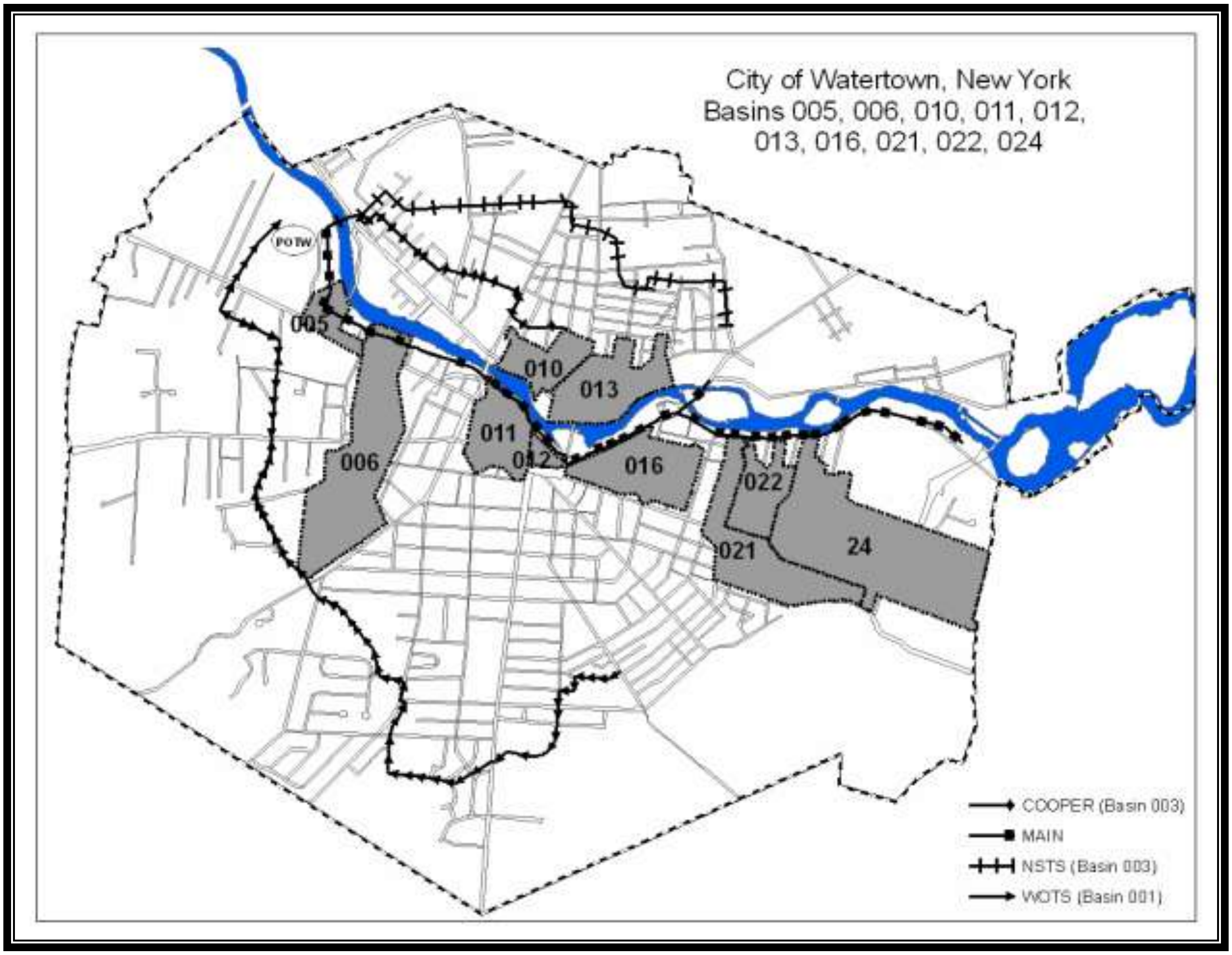

Figure 27: Remaining 10 basins to model

E. Calibration against monitored events

Calibrated first were the dry weather diurnal flows. This enabled the quantification of "simple" infiltration. A series of Figures follow that indicate the very close prediction of the calibrated model diurnal flows with what is actually observed in the field.

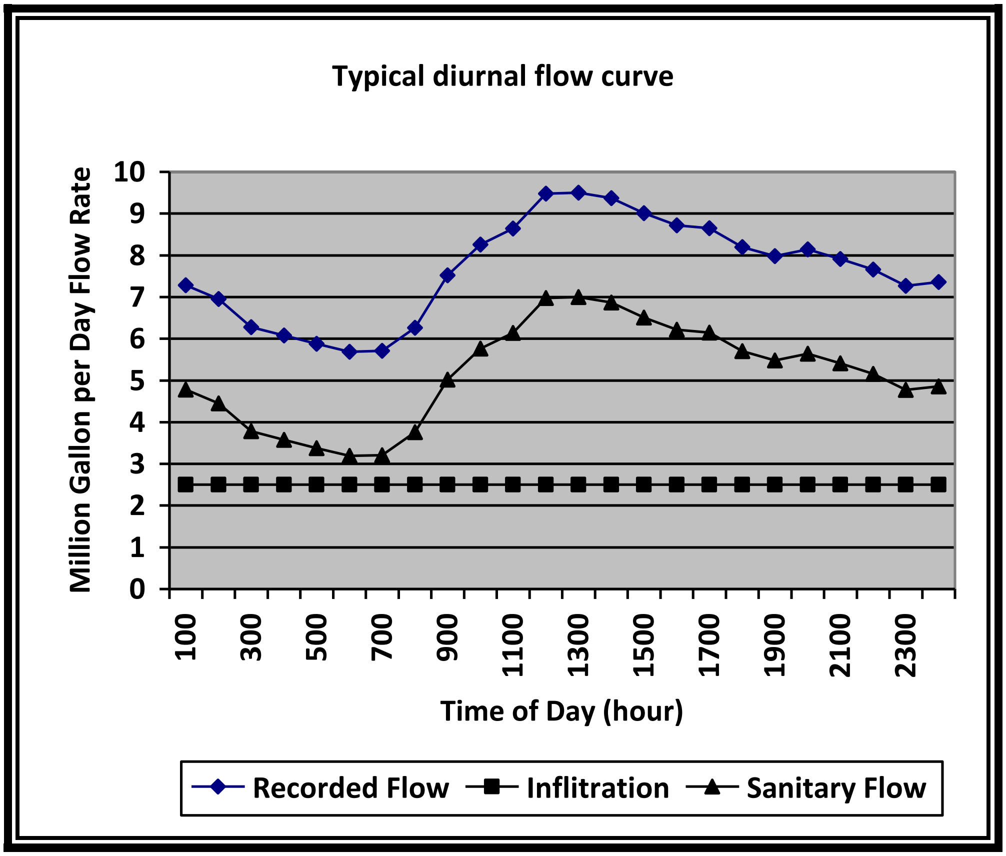

Figure 28: The relationship between infiltration and sanitary flow in a typical diurnal flow curve

As is indicated in Figure 28 above, the recorded flow of a diurnal curve is the summation of the sanitary flow and the infiltration flow. The sanitary flow is that which fluctuates from the low of early morning to the high of early to mid afternoon. It generally follows a sinusoidal wave shape. "Simple" or "normal" infiltration is caused by groundwater seeping into the pipe via cracks or separation of joints in the pipe. Infiltration is a relative constant. As indicated earlier in this report, population density times the sanitary flow per capita per day can result in the total sanitary contribution, with the actual field recording aiding in the development of the shape of the "sinusoidal" wave. By adjusting the wave vertically until the wave coincides with actual field recordings, one can determine the "typical" infiltration contribution. This is the value of the dry weather diurnal calibration.

All the Figures that follow were calibrated in this manner. Table 19 below summarizes the infiltration determined at the indicated meter location.

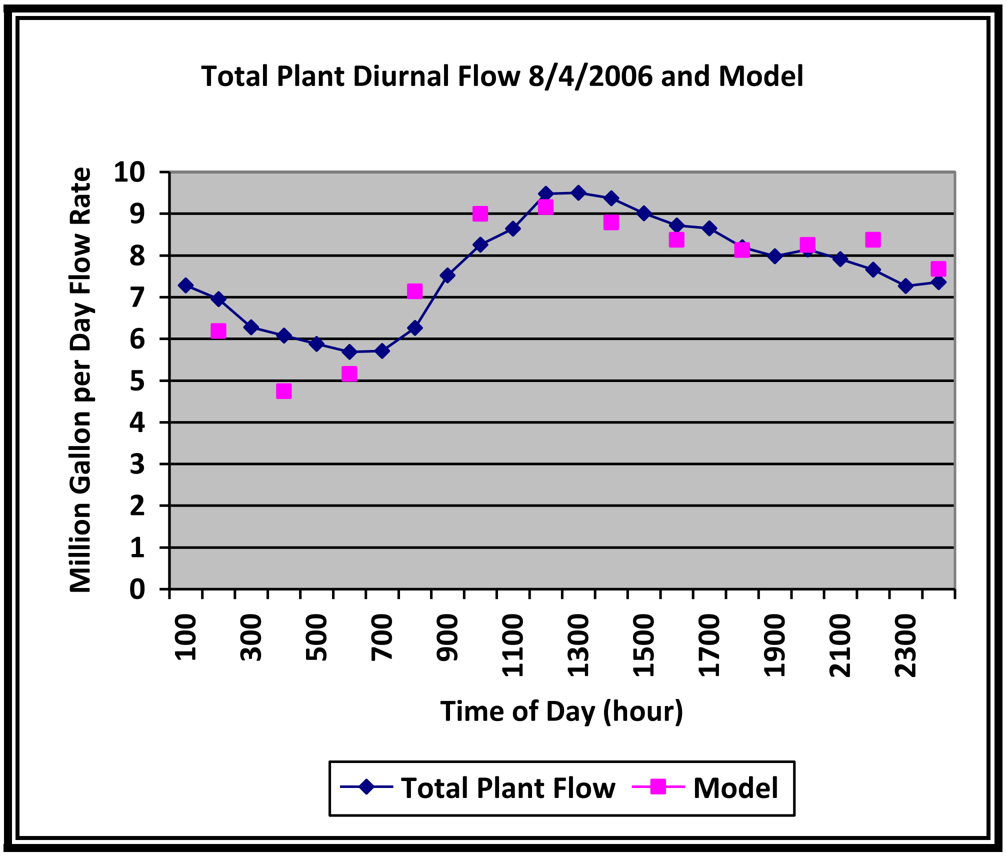

Figure 29: Total Plant Flow diurnal curve - modeled vs actual recording

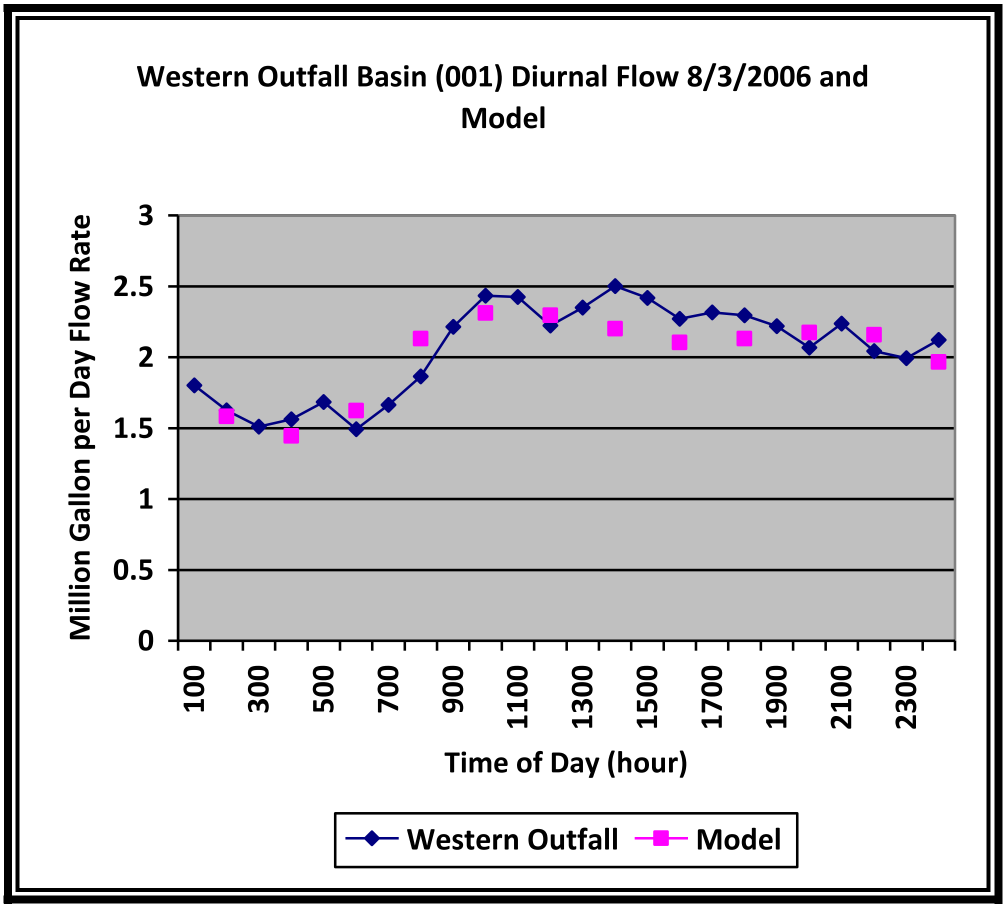

Figure 30: Western Outfall Basin (001) diurnal flow - modeled vs actual recording

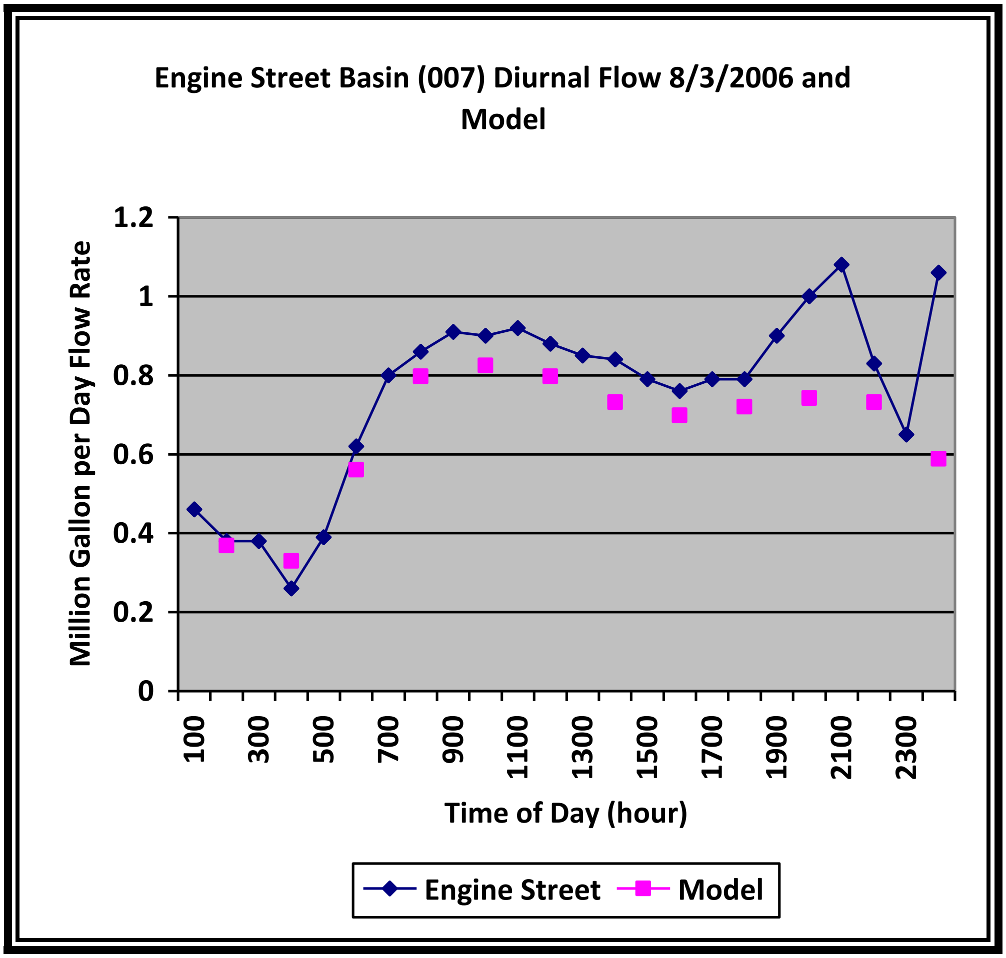

Figure 31: Engine Street Basin (007) diurnal flow - modeled vs actual recording

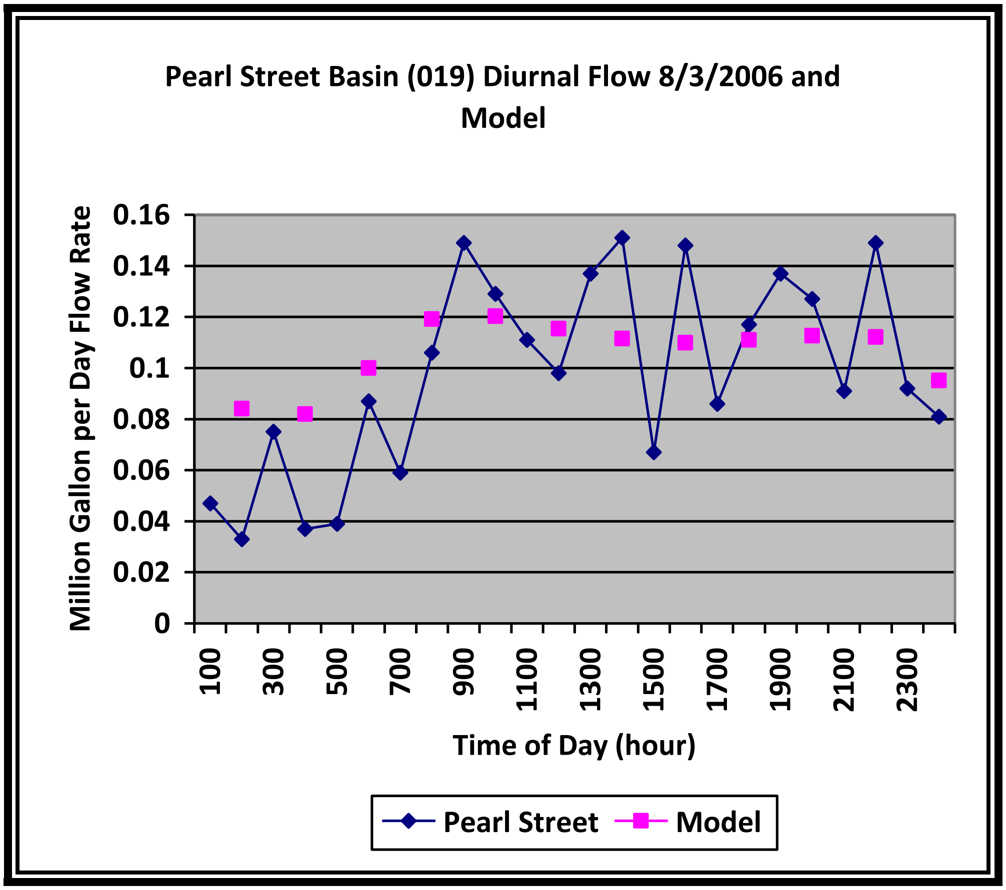

Figure 32: Pearl Street Basin (019) diurnal flow - modeled vs actual recording. The Route 3 Sewer District which enters the City's CSS in the upper reaches of Basin 019 feeds the City via a pump station, accounting for the pulsing pattern of the actual flow curve.

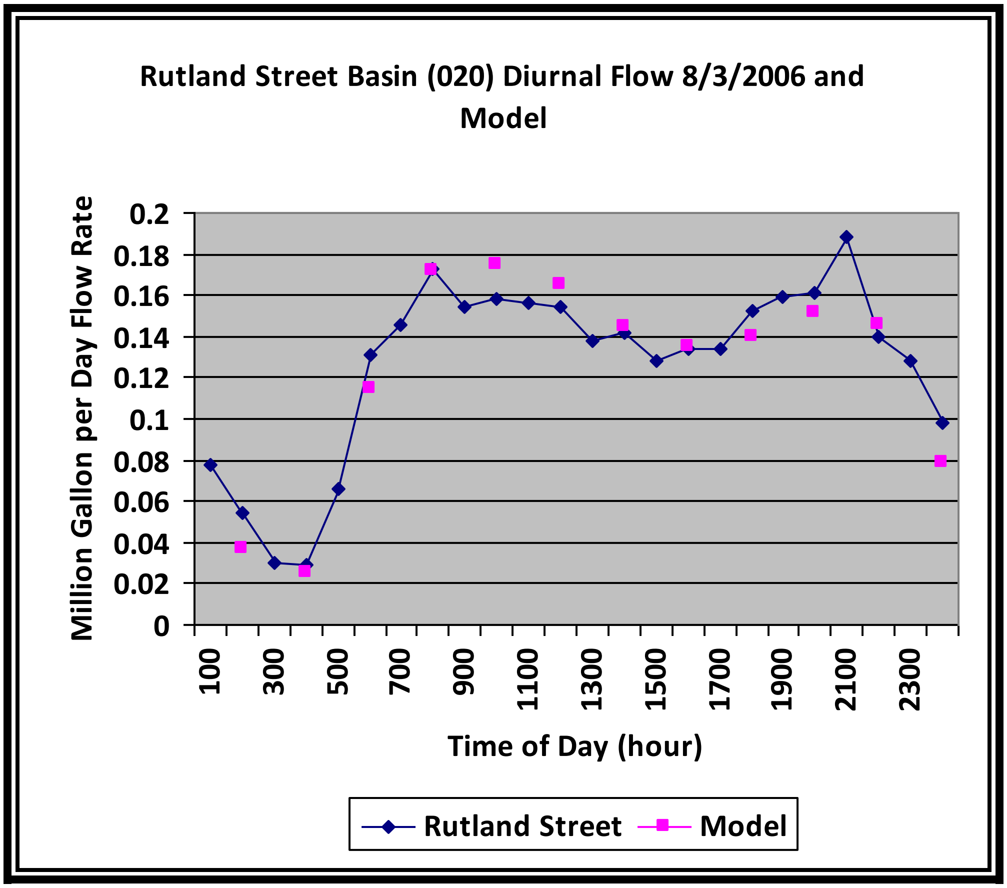

Figure 33: Rutland Street Basin (020) diurnal curve - modeled vs actual recording

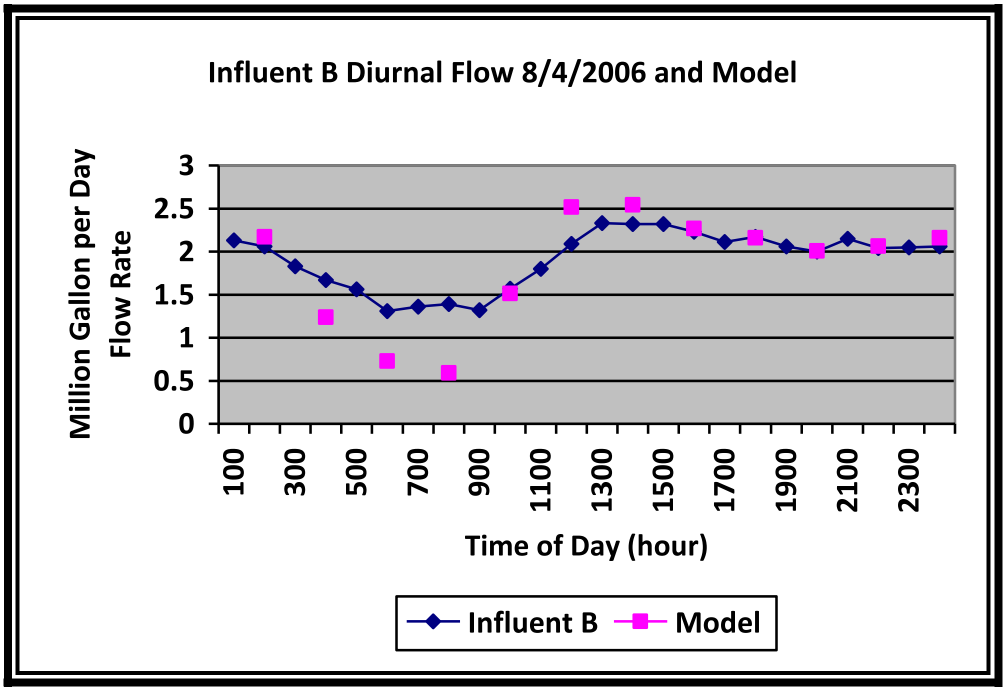

Figure 34: Influent "B" diurnal flow - modeled vs actual recording

Note in Figure 34 (Influent “B” diurnal flow) that the modeled values, while being accurate for the average conditions, nonetheless predict a lower than actual low value for the early morning low, and a higher than the actual high in the early afternoon. This is because the Influent “B” collection system reaches communities a far as 15 miles north of the City of Watertown. We know the overall population served, and the typical sanitary sewer contribution in gallons per capita per day. But where the actual population densities are centered as the 15 mile trunk sewer makes its trek to the City is not clearly known. Thus, the average flows are accurate while the “peaks” and “valleys” typically over and under shoot their mark, respectively. If the model “knew” where along the pipe the population densities occurred, then the lows and highs would blend as the times of travel would tend to “level” out the sinusoidal curve.

Table 19: % Infiltration of total dry weather flow

	Diurnal Dry Weather Flow (MGD)		
Meter	**Recorded Flow**	**Infiltration**	**% Infiltration**
Total Plant	7.58	3.38	44.6%
Influent "A"	5.71	3.08	53.9%
Influent "B"	1.87	0.30	16.0%
Basin 001	2.02	1.18	58.4%
Basin 003	1.23	0.85	69.1%
Basin 007	0.66	0.24	36.4%
Basin 019	0.18	0.08	44.4%
Basin 020	0.12	0.00	0.0%

The % infiltration present in the flows of the existing pipes in the City is worthy of emphasis. It is a significant defect and does indeed impact the performance of the collection system.

Once the diurnal flows had been entered and calibrated into the model, attention shifted to calibrating storm events. The City's consultant used a total of 14 documented rainfall events to calibrate the 5 basin model. These storms ranged from 0.34 to 1.4 inches of rain and peak intensities as high as 0.8 inches per hour. This "sandwiched" rather nicely the USEPA design storm of 1.3 inches of rain at a 0.62 inch per hour peak intensity (see Section III.F below). The rainfall events provided good data for model calibration. Stearns and Wheler published their report COMBINED SEWER OVERFLOW MODELING AND CALIBRATION REPORT CITY OF WATERTOWN, NEW YORK documenting these 14 storms used and the ultimate agreement between the actual field recordings and the modeled flows. Figures 35 and 36 below present two storms and the very favorable agreement between the modeled Plant Flows and the actual recorded Plant Flows indicated in the Figures is typical of what had been observed for the test storms not only in the Plant, but for the basins as well. Justifiably, a high degree of confidence is place in the model predictions.

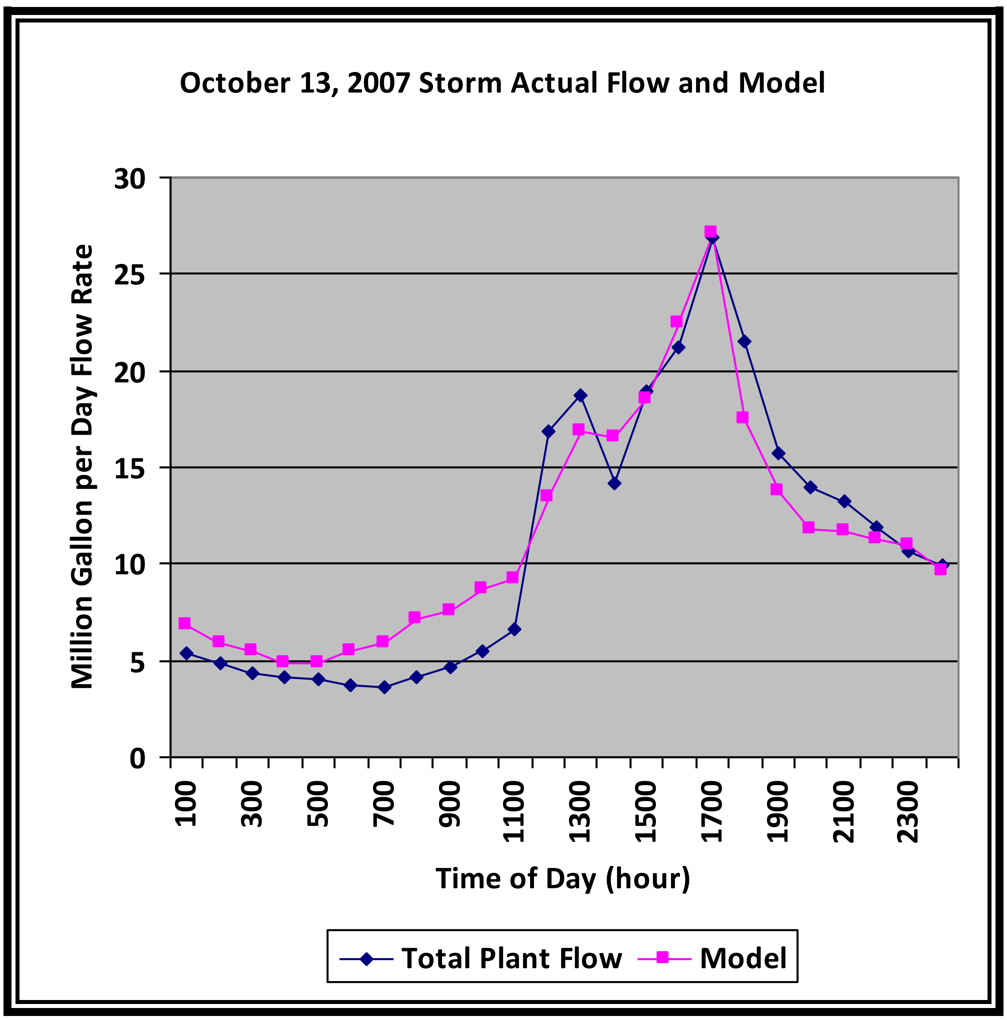

Figure 35: Total Plant Flow both modeled and actually recorded for the October 13, 2007 storm.

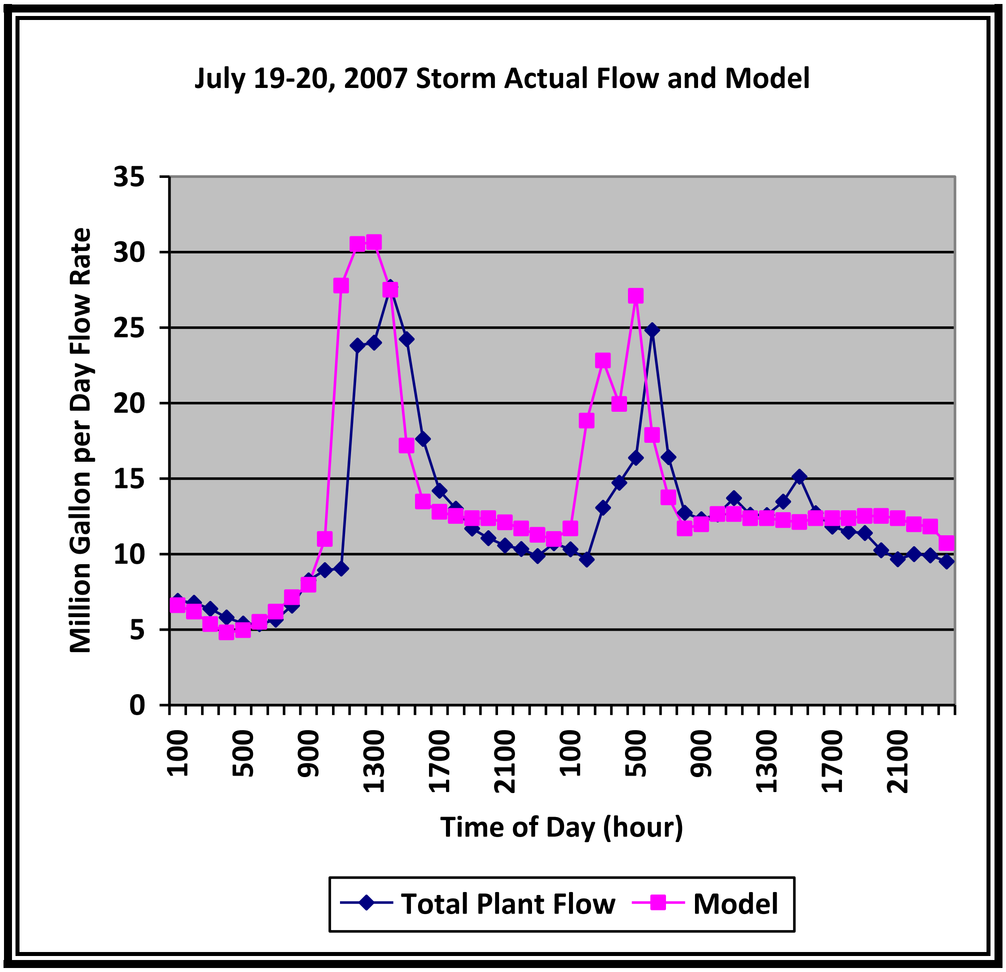

Figure 36: Total Plant Flow both modeled and actually recorded for the July 19-20, 2007 storm. Note: the rain gauge "clock" and the flow meter "clocks" are one hour out of sync. The model "believed" the storm hit one hour before it actually did.

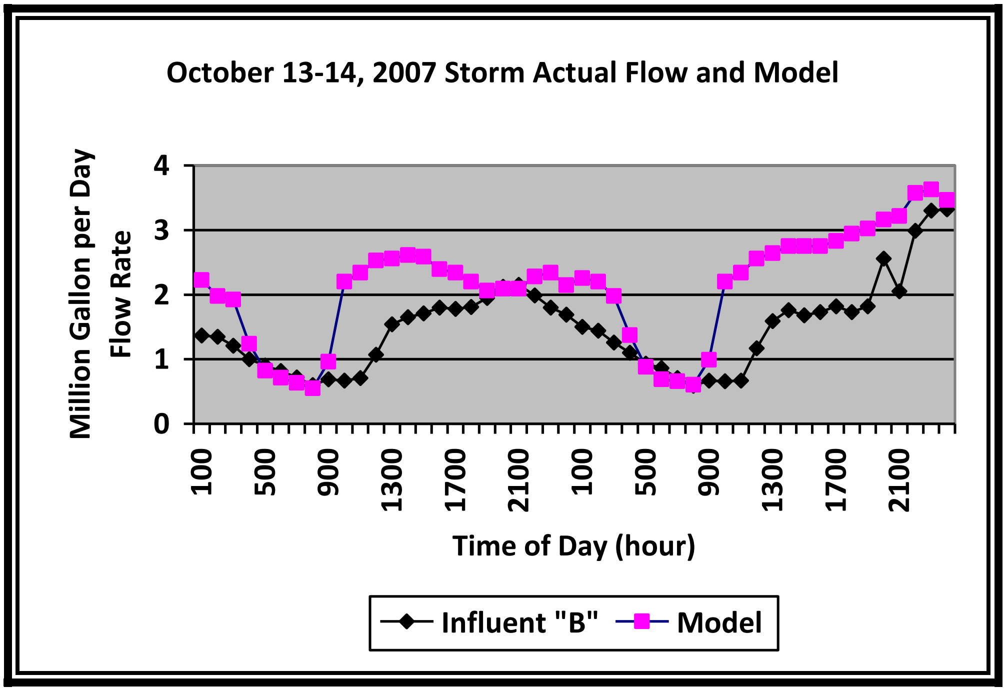

Figure 37: 48 hour tracking of Influent "B" flows (modeled and actual recording) of the October 13, 2007 storm and the 24 hour period following the day the storm occurred. Reference Figure 34 for the impact of this storm on the Total Plant Flow recorder.

Figure 37 reveals the impact the October 13, 2007 storm had on Influent "B." Note that on the day of the storm (October 13th) Influent "B" responded only with its typical diurnal flows peaking in the normal 2.5 MGD range. This is because Influent "B" is largely a separated system and responds very insignificantly to inflow. Infiltration is a different matter with "simple" or "normal" infiltration accounting for some 16% of the wastewater in the pipe. Of interest is the elevation of flows to nearly 3.5 MGD flow rates near the end of day two – a 40% increase over its typical highs. This is a response to the delayed reaction of "rapid" infiltration that does indeed impact Influent "B" flows. As indicated in Figure 37, the model correctly accounts for this "rapid" infiltration correctly predicting when and to what extent the rapid infiltration would be felt at the City's POTW.

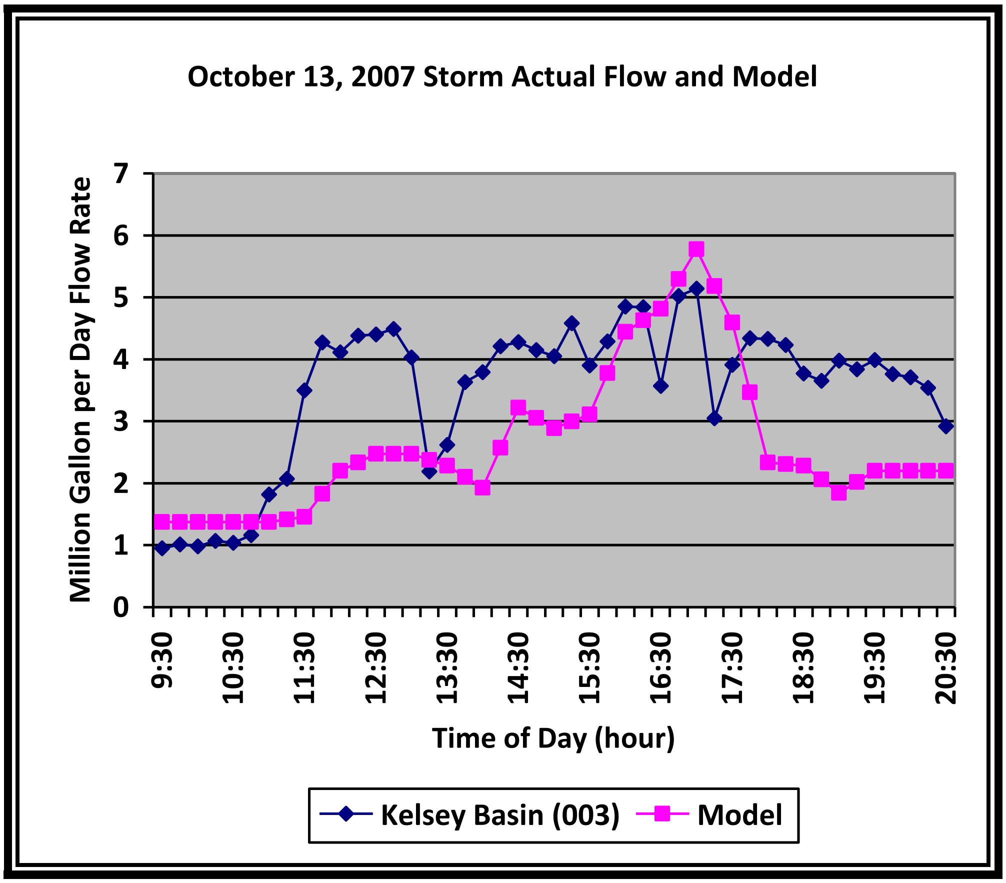

Figure 38: Kelsey System (003) response to the October 13, 2007 - model vs actual recording

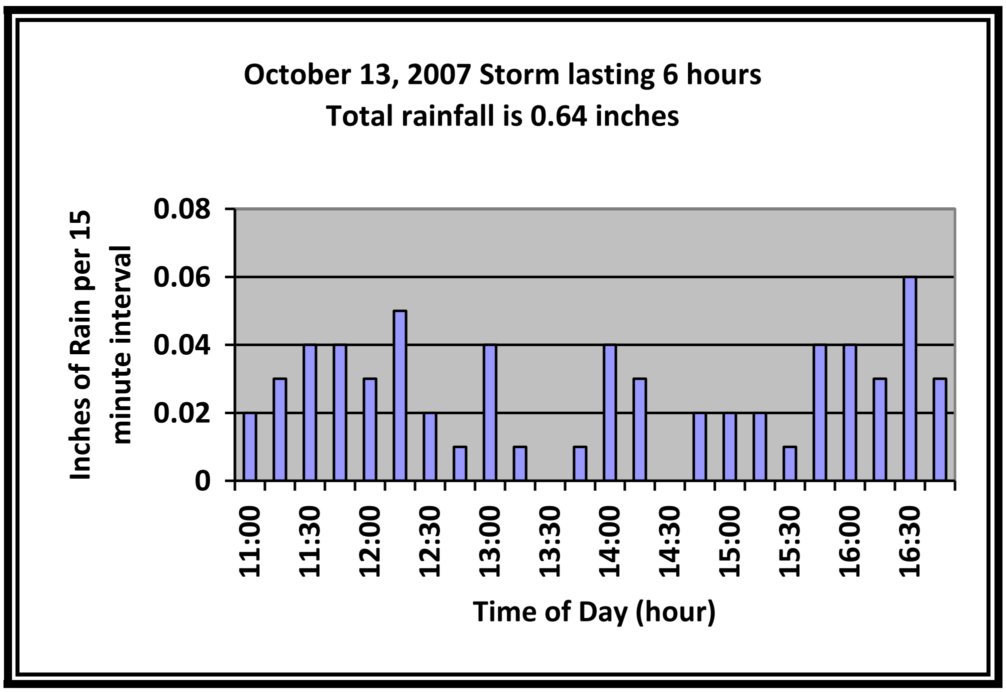

Figure 39: The rain gauge recording of the October 13, 2007 storm

F. Design Storm (3 month event as defined by EPA[15])

---

[15] THE LONG-TERM CONTROL PLAN – EZ (LTCP-EZ) TEMPLATE: A PLANNING TOOL FOR CSO CONTROL IN SMALL COMMUNITIES; EPA-833-R-07-005, May 2007, pg 16 and A-4. A small community is that with populations under 75,000. In these communities, NPDES Authorities have discretion to waiver some formal steps of the LTCP preparation.

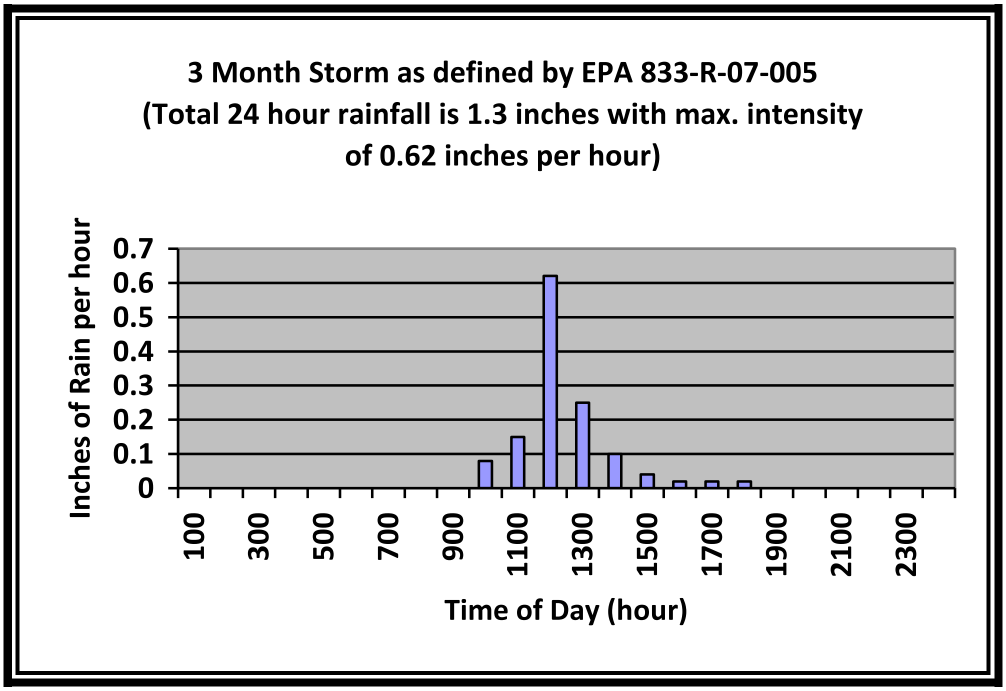

Figure 40: Design 3 month storm forming the basis of the CSS evaluation

Note that the storm represented in Figure 40 is specifically timed to "hit" with maximum intensity at 12:00 noon. Thus the storm's timing is a "worse case" as that is the time the diurnal flows in the sewer system would begin to peak. Table 20 below predicts the response of the CSS to this design storm. The model indicates that 27.37% of the total water entering the system will be diverted to the Black River untreated via the active CSOs and the Influent "A" By-pass Device (004). Note in Table 20 that CSOs 013 and 019 are inactive, and that CSOs 005, 016, 020, and 024 while active are not significantly so. Not surprisingly, Basins 001, 003, and 007 and the Influent "A" By-pass Device are the most significant contributors to the "by pass/overflow event." An "anomaly" occurs in Table 20 with respect to Basin 006. It predicts a significant overflow that the City at this point does not believe is true. This basin was not studied in this phase of LTCP and will be studied in 2009. The anomaly will be rectified one way or the other at that point.

Table 20: Summary of Influent "A" By-Pass and CSO Overflows in response to the modeled 3 month storm

	Cubic feet per second		Million gallons per day	
	Max. Flow	**Avg Flow**	**Max. Flow**	**Avg. Flow**
Total Plant	47.804	21.624	30.89	13.97
Influent "A"	43.068	18.557	27.83	11.99
Influent "B"	7.664	3.067	4.95	1.98
001 U/S of CSO	26.086	6.738	16.86	4.35
001 Overflow	7.64	0.616	4.94	0.40
003 Overflow	12.729	0.697	8.23	0.45
004 By-Pass	15.739	1.136	10.17	0.73
005 Overflow	1.004	0.04	0.65	0.03
006 Overflow	13.014	1.244	8.41	0.80
007 Overflow	39.428	1.886	25.48	1.22
010 Overflow	5.125	0.329	3.31	0.21
011 Overflow	11.751	0.395	7.59	0.26
012 Overflow	5.202	0.298	3.36	0.19
013 Overflow			0.00	0.00
016 Overflow	0.91	0.014	0.59	0.01
019 Overflow			0.00	0.00
020 Overflow	1.67	0.116	1.08	0.07
021 Overflow	14.191	1.026	9.17	0.66
022 Overflow	6.134	0.337	3.96	0.22
024 Overflow	0.461	0.014	0.30	0.01
			Total By-Passed	**5.27**
			Total In CSS	**19.24**
			% By-Passed	**27.37%**

G. Water Quality (WQ)

1. Sampling of Basins during dry weather flows

Table 21: BOD_5 and Suspended Solids loadings from specified Basins

		(MGD)	(mg/l)		(pounds/day)	
Basin	**Date**	**Flow**	**BOD_5**	**SS**	**BOD_5**	**SS**
3	10/11-12/2007	0.979	48.0	59.0	391.9	481.7
7	6/12-13/2006	0.954	159.0	190.0	1,265.1	1,511.7
10	09/4-5/2008	0.040	519.0	213.0	173.1	71.1
11	09/4-5/2008	0.080	389.0	360.0	259.5	240.2
16	06/12-13/2008	0.150	71.0	72.0	88.8	90.1
19	08/8-9/2006	0.111	296.0	460.0	274.0	425.8
20	06/12-13/2006	0.193	126.0	106.0	202.8	170.6
21	06/12-13/2008	0.450	66.6	64.0	249.9	240.2
22	06/12-13/2008	0.093	592.0	496.0	459.2	384.7
24	06/12-13/2006	0.235	170.0	130.0	333.2	254.8
Total		**3.285**			**3,697.6**	**3,870.9**

With the typical summer loading on the WPCP being in the order of 11,350 pounds per day BOD_5 and 13,375 pounds per day Suspended Solids, the by-passing of 27.37% of the total wastewater that entered the combined sewer system of the City during the design 3 month storm would result in the following impact upon the Black River (relative to the sanitary BOD_5 and suspended solids in the system):

BOD_5: 11,350 X 0.2737 = 3,106 pounds of the BOD_5 by-passing

Suspended solids: 13,375 X 0.2737 = 3,660 pounds of Suspended solids by-passing

Given that an average of 572 pounds per day BOD_5 and 710 pounds per day suspended solids is normally in the WPCP effluent, then for the day that the design storm hit, approximately 3,678 pounds of BOD_5 and 4,370 pounds of suspended solids would be discharged to the River. The City's SPDES permits a maximum average of 6,000 pounds per day discharge of BOD_5 and 6,000 pounds per day suspended solids for any one week so long as the monthly average discharge remains at or below 4,000 pounds per day and the 85% removal threshold is preserved. With the design storm in question having the frequency of hitting on the average only once each 90 days, the likelihood of two such storms the same week is remote. This means that the facility would in all likelihood meet permit for BOD_5 and suspended solids in spite of the fact that the CSOs and the Influent "A" by-pass device were active and their respective River loadings were to be accounted for against the City permissible discharges.

Table 22: Remaining analytes tested in the respective basins. Dates and flows for each are the same as for Table 21.[16]

	(mg/l)								
Basin	TP	Al	Cd	Cr	Cu	Hg	Zn	TKN	O&G
3	2.34	0.13	ND	ND	0.02	ND	ND	9.36	18.00
7	3.55	0.24	ND	ND	0.05	ND	0.09	23.50	22.00
10	9.32	0.21	ND	ND	0.11	ND	0.14	65.30	59.00
11	6.35	0.21	ND	ND	0.15	ND	9.00	62.90	39.00
16	2.76	0.11	ND	ND	0.06	ND	0.06	27.60	22.00
19	7.10	0.61	ND	ND	0.04	ND	0.20	47.30	31.00
20	2.43	ND	ND	ND	0.08	ND	0.07	19.40	20.00
21	2.13	0.07	ND	ND	0.03	ND	0.02	17.30	11.00
22	4.76	0.13	ND	ND	0.03	ND	0.17	45.20	196.00
24	2.31	ND	ND	ND	0.07	ND	0.08	18.60	38.00

TP = Total Phosphorus
Al = Aluminum
Cd = Cadmium
Cr = Chromium
Cu = Copper
Hg = Mercury
Zn = Zinc
TKN = Total Kjeldahl Nitrogen
O&G = Oil and Grease
mg/l = milligrams per liter

[16] ND = non detection; Detection limit for Al, Cd, Cr, and Zn is 0.02 mg/l. Detection limit for Hg is 0.0008 mg/l.

The City is not making the argument that the overflows and by-passes are, therefore, not an issue. Quite the contrary, the overflows and by-passes ought to be prudently addressed. Further, the presence of "floatables" (objects that float to the surface of running water such as cigarette butts, plastic items, etc. and are noticed by observers) while not a hazard, nonetheless deteriorate the visible appearance of the river banks. The City is making the argument, however, that the solids loadings are such that solids control at the combined sewer overflows and by-pass devices should not take precedence over sewer separation projects further upstream in "troubled basins." This becomes even more evident with the River sampling that has also been conducted.

Control of solids loadings in the overflows and by-passes characteristic of Watertown is not an issue that should take precedence over sewer separation projects upstream in some of the basins.

2. Sampling of River

The Black River was sampled 8 times at each of the 5 River sample points. Six of the eight were to establish "background" or base level data and were conducted when the CSOs and By-pass were not active. The City had indicated that it would capture 3 sampling events when the CSOs and By-pass were active, but were only successful in accomplishing 2 of the 3.

Table 23: Black River Sampling

Date	River Flows (cfs)	CSOs/By-pass Active?
June 14, 2007	1,400	No
July 19, 2007	1,470	Yes
August 4, 2008	2,225	No
August 6, 2008	2,840	No
August 11, 2008	6,500	No
August 13, 2008	6,900	Yes
August 25, 2008	3,500	No
August 27, 2008	3,200	No

The 80 year average flow of the Black River is 4,156 cfs. Thus the majority of the River sampling is "dry weather conditions" with only two of the eight with flows above long term average conditions (August 11 and August 13, 2008).

The result of analyses of the River sampling for all five sample points is at Appendix F. What is observed in the data is that the Black River "sensed" the presence of the Engine Street CSO (007) during storm events. This is seen in the E Coli/100 ml values that would spike dramatically at R3 sample point (immediately downstream of the CSO 007's outfall on the River). To a lesser degree, but still of significance is the River's sensing of the overflows at River Sample point 4 (downstream of Kelsey Creek) and Sample Point 5 (downstream of the Western Outfall (001) and the two plant Effluents). No other analytes measured seemed to indicate this same phenomenon.

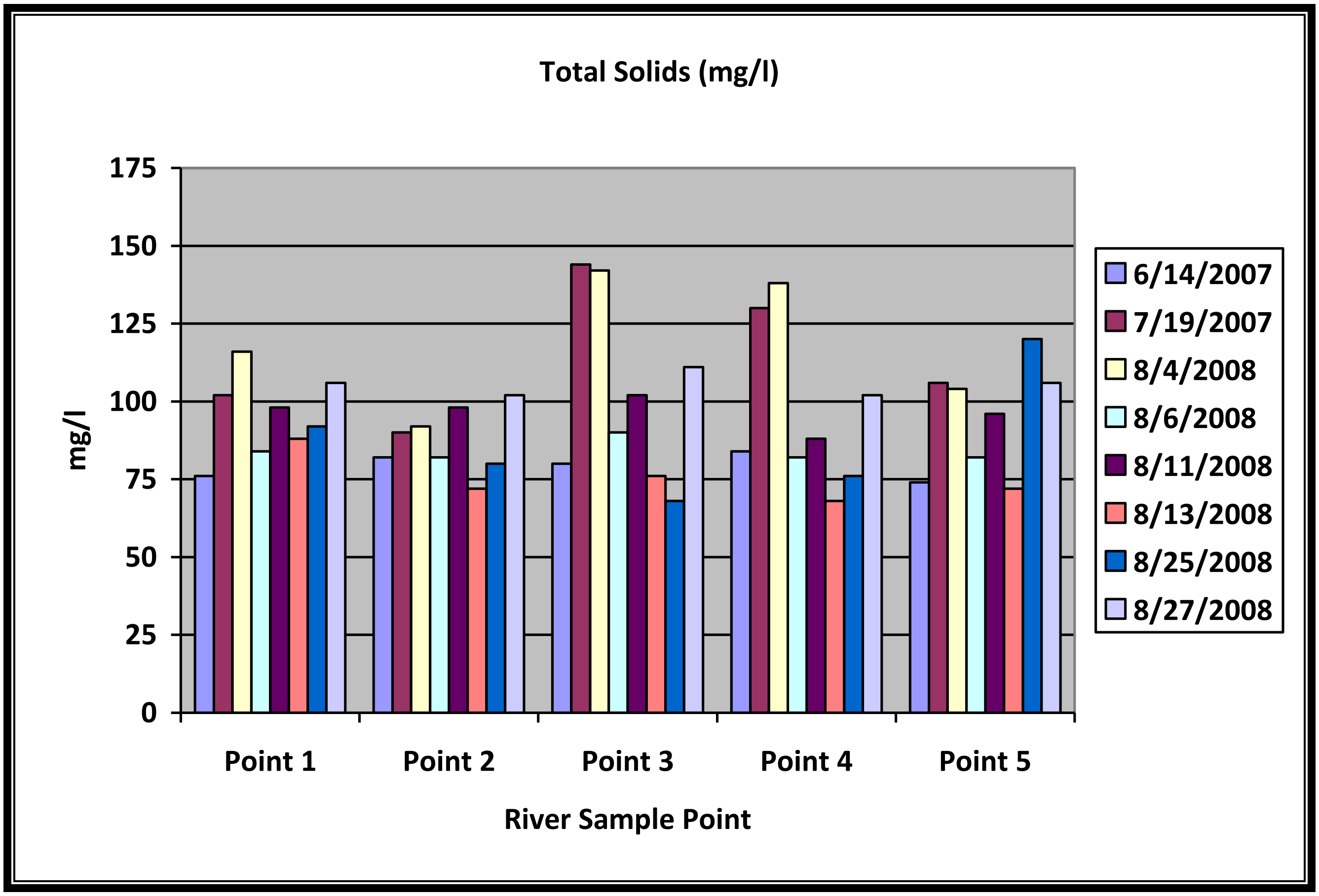

Figure 41: Total Solids at the five River Sample Points

As indicated in Table 23 above, on July 19, 2007 and August 13, 2008 the overflows and the Influent "A" By-pass were active at the time of sampling. As shown in Figure 41 above for Total Solids and Figure 42 below for Suspended Solids however, the solids levels are not impacted by the overflows.

The Total Solids loading remained uniform throughout the 5 sample points with only one exception – both sample point 3 and 4 in Figure 41 (Total Solids) seemed to have "spiked" for the same two sample events (July 19, 2007 and August 4, 2008) – the former of which was an overflow event and the latter of which was not. It is most likely that the solids that that may have been "picked up" prior to sample point 3 were then carried in the River past sample point 4. It seems evident that the solids were then deposited in the riverbed before they reached sample point 5. It is not known why the spikes occurred. They cannot be explained as due to an overflow event as one occurred during such an even while the other did not.

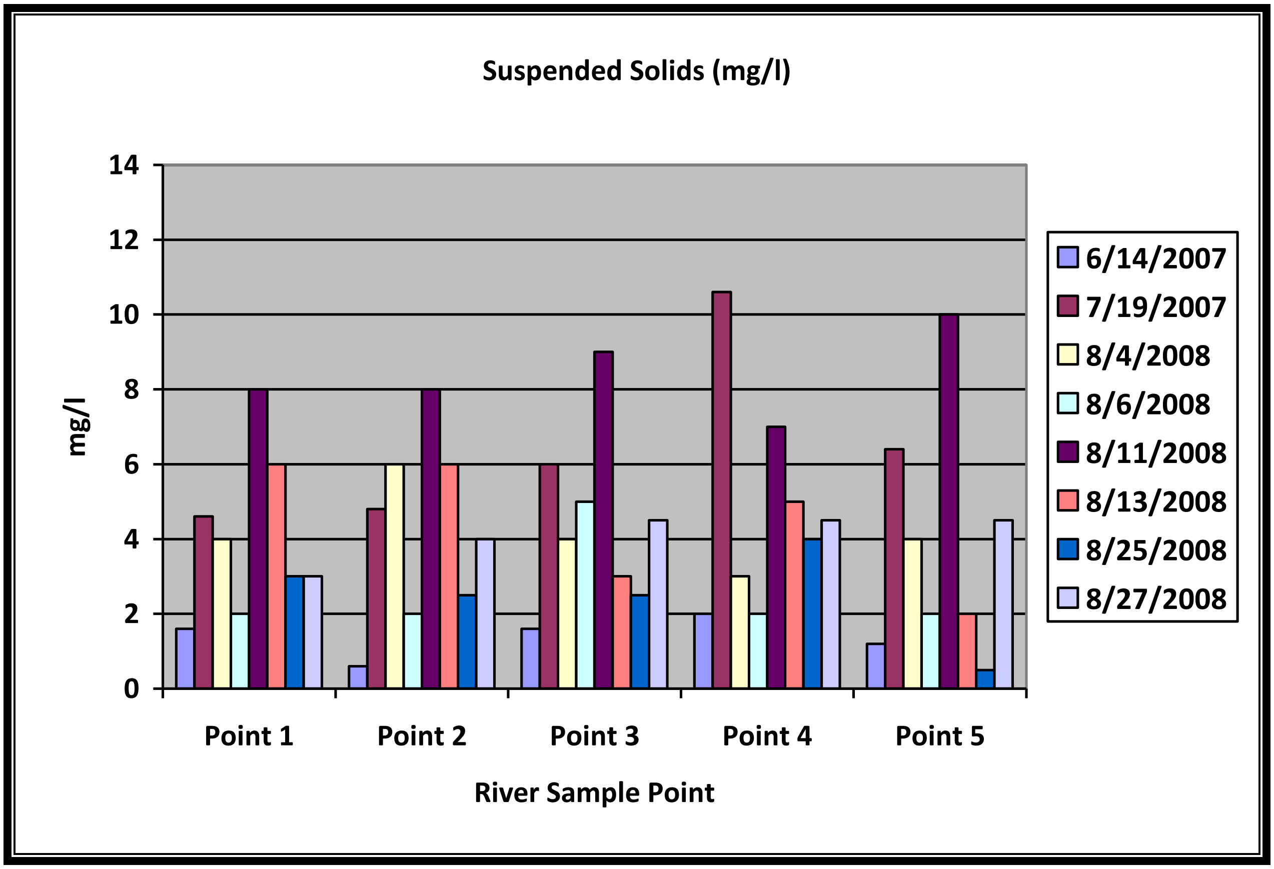

Figure 42: Suspended Solids at the five River Sample Points.

The same observation presented for the Total Solids seems to also hold for the suspended solids. The levels of suspended solids that were already in the River upstream of the City (that is, upstream of sample point 1) seemed to hold throughout the 5 sample points. For perspective, 10 mg/l suspended solids would present itself as "clear" water as the turbidity caused by it would be virtually undetectable by the unaided eye. For the two events in which CSOs and the Influent "A" By-pass were active (July 19, 2007 and August 13, 2008), suspended solids remained as "indiscernible" as did the six events with no CSO overflows or Influent "A" By-pass.

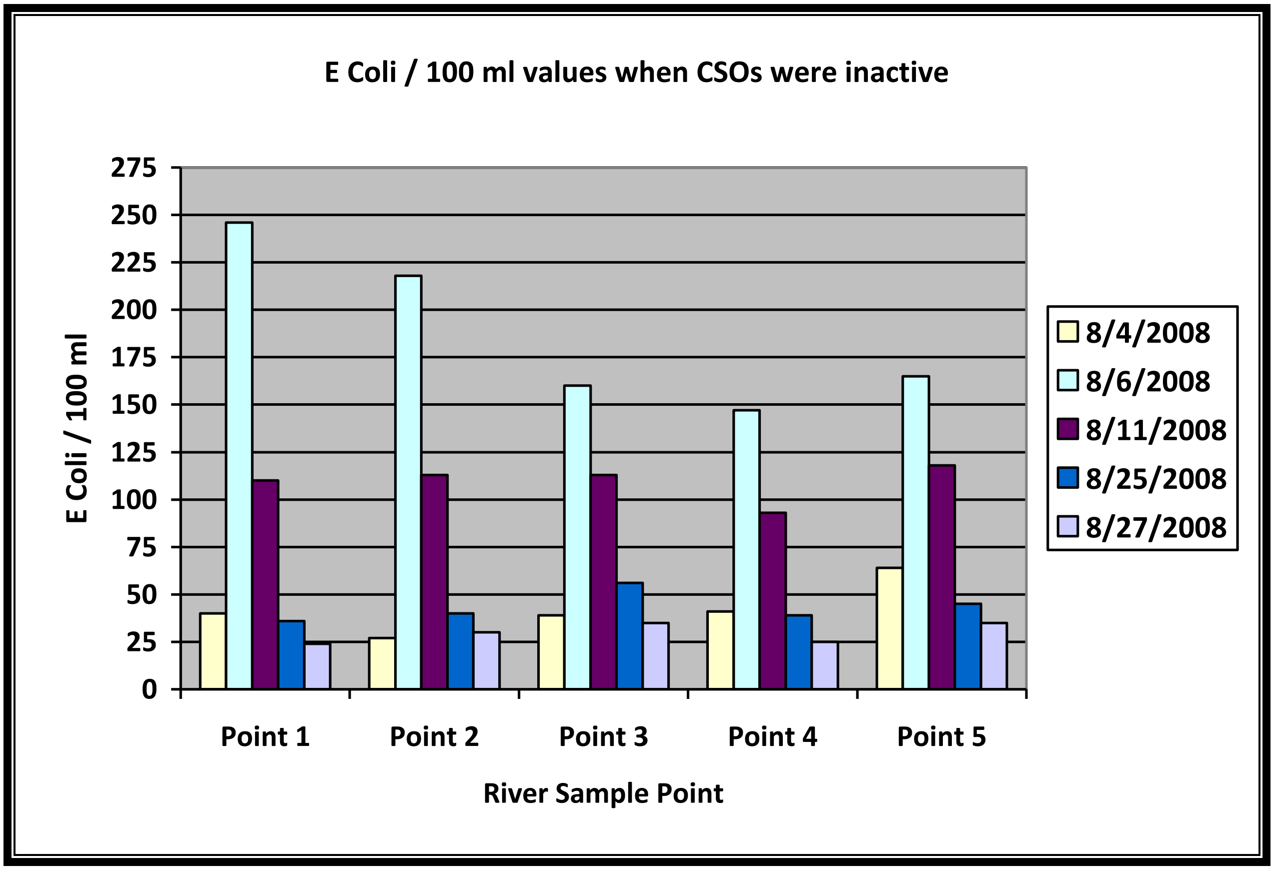

Figure 43: E Coli sampling at the five River Sample Points.

In the Figure 43 above, five sampling events all occurring in August 2008 are presented. USEPA quotes[17]:

> **EPA Criteria for Bathing (Full Body Contact) Recreational Waters – Freshwater:**
>
> **Based on a statistically sufficient number of samples (generally not less than 5 samples equally spaced over a 30-day period), the geometric mean of the indicated bacterial densities should not exceed one or the other of the following:**
>
> **E. Coli 126 per 100 ml; or**
> **Enterococci 33 per 100 ml**

[17] AMBIENT WATER QUALITY CRITERIA FOR BACTERIA – 1986; EPA 440/5-84-002; January 1986; pg 16.

The geometric mean for the sampling referenced in Figure above is:

Sample point 1: 62.26 E. Coli per 100 ml
Sample point 2: 60.32 E. Coli per 100 ml
Sample point 3: 68.92 E. Coli per 100 ml
Sample point 4: 55.91 E. Coli per 100 ml
Sample point 5: 72.21 E. Coli per 100 ml

Insufficient data was collected to develop the analogous E. Coli geometric means for the sample points when the CSOs and the Influent "A" By-pass were active as only two such samples were collected and in different calendar years. The two sets of data that were collected indicate that the presence of E. Coli in the River is impacted commencing with River Sample Point 3, and continues to some point downstream of sample point 5 (see Figure 44 below). It is not known why the E. Coli spiked so dramatically at River Sample Point 3 on July 19, 2007. River appearance during that event lends credence, however, to the validity of the spike. The River does narrow and enter a "bend" at this particular sample point allowing the hydraulics to concentrate the plume that generates from and describes the Engine Street Basin Overflow (007). The sample was taken from within the plume. The sample collected at River Sample Point 3 for both events (July 19, 2007 and August 13, 2008) were collected at the same location. River flows were 1,470 cfs for the former and 6,900 cfs for the latter. This would lead one to be tempted to offer dilution as the cause of the wide difference in the two samples at River Sample Point 3. The plume is impacted by the flow of the River. The dilution explanation is seriously challenged, however, by the failure of any of the other sample points to respond in the same manner.

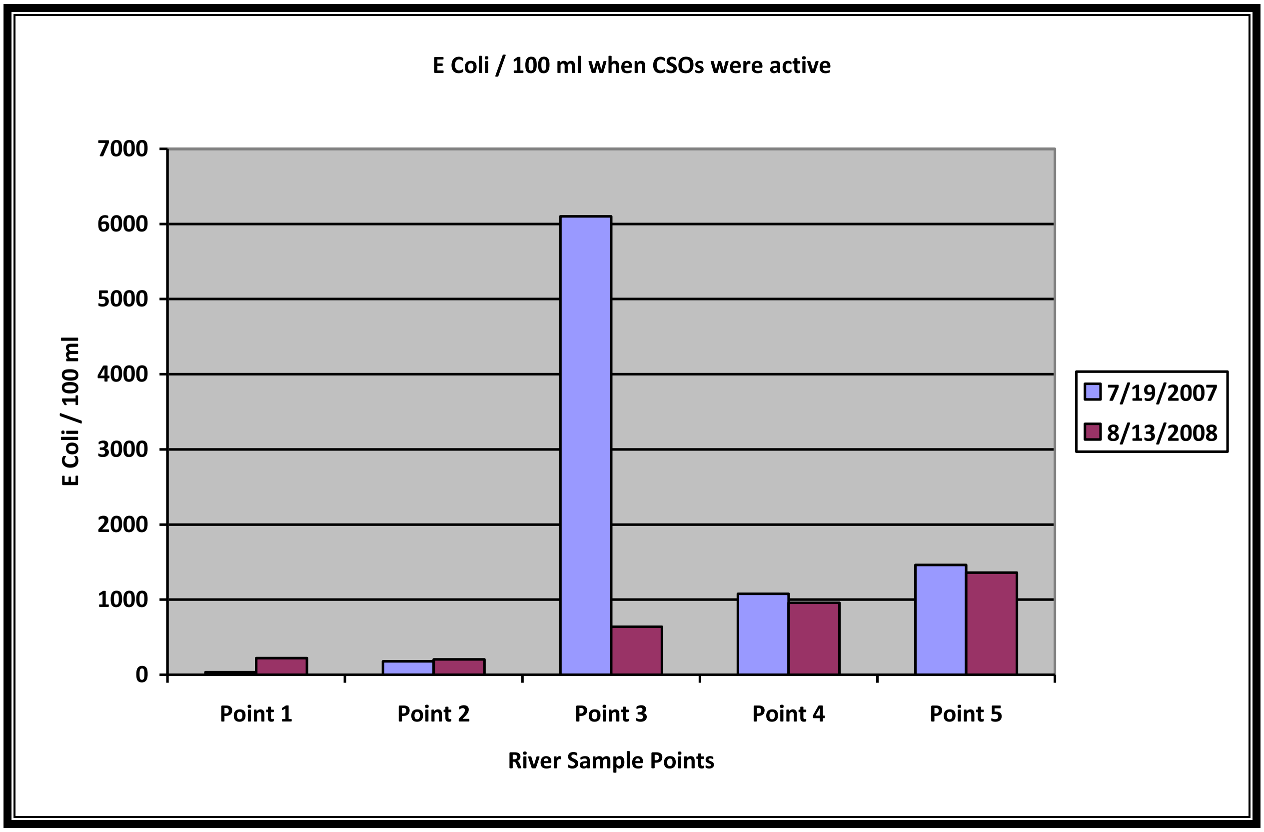

Figure 44: E Coli analyses at the five River Sample Points while the CSOs and Plant By-Pass were active.

3. Impact upon Sensitive Areas

"Sensitive Areas" are targeted because of six principle concerns:

1. Rare or endangered species of plants or animals within the river;
2. Fishing along and on the river;
3. Viewing of the river from the edges of the river or from rafting on the river;
4. Direct immersion in the river that is consistent with swimming, "play boating" or other like activities;
5. Potable water uses of the river; and/or
6. Direct discharges by categorical or significant industrial users.

There are no potable users of the Black River at or downstream of any of the City

CSO, outfall, or bypass structures. Further, there exists only one categorical or significant industrial user within the City's system and that user pretreats its discharges to a benign condition. There are no endangered species of plants or animals within the river. The only endangered species of any type in remote vicinity of the Black River in the general Watertown area is a species of bats known at times to inhabit some limestone fissures and caves adjacent to reaches of the river. Hence, any consideration given to "sensitive areas" is driven by the concerns 2, 3, and 4 above - fishing, viewing and immersion.

Fishermen have been viewed using any and all parts of the river. The largest concentrations seem to be a Waterworks Park at the northeast entrance of the river's trek through the City, and at the VanDuzee Street Bridge in the northwest quadrant of the City. The only structure upstream of Waterworks Park is the Water Filtration Plant controlled bypass device (025), thus rendering mute any potential impacts. The VanDuzee Street Bridge is 1,500 feet (0.28 miles) downstream of Engine Street (CSO 007).

Viewing of the river is most extensive at Waterworks Park (see comments above), the Memorial Riverwalk, popular kayak play spots, and at the four bridges within the City.

The City has no place on its river front that is targeted for swimming. Yet swimmers are known to be in the river on occasion at almost any location except for the immediate vicinity of the dams within the City.

Immersion would be most associated with kayak activities and river rafting. The river rafting commences at the point immediately downstream of the Mill Street Bridge in the City and proceeds downstream thereafter. Kayak activities are concentrated in two areas - vicinity of Waterworks Park, and "Hole Brothers" (located in the vicinity of the City's DPW facilities on Newell Street). The "Hole Brothers" is upstream of the Engine Street CSO 007 and is, therefore, unimpacted by it. "Hole Brothers" is downstream of CSO 010 and CSO 11, two very small and unimpacting basins comprised of 35 and 30 acres respectively.

The fact that the controlling considerations for "sensitive areas" is reduced to fishing, viewing and immersion, together with the realization that such things are uncontrolled and somewhat ubiquitous along the entire reach of the river in Watertown (except perhaps for limited and sporadic occurrences as highlighted above), the City believes that the river does not necessarily present any one area as more or less sensitive than another. Hence, selection of priority (which in truth only governs the particular order in which the work effort shall proceed) is more a function of basins than the river. Four of the five basins selected for the Phase I work, are the City's largest four basins. The total acreage of the five basins selected represent 84% of the total area in the City existing within basins with active CSOs. The City believes its approach is the correct.

IV. Impairments identified and potential responses

A. Impairments

Four significant and addressable impairments have been identified:

1. Anomalous inflow in Western Outfall downstream of Wealtha Avenue
2. Rapid infiltration in the NSTS immediately upstream of Kelsey Creek CSO (003)
3. Impacts on the River from overflows in Engine Street Basin (007)
4. General Infiltration

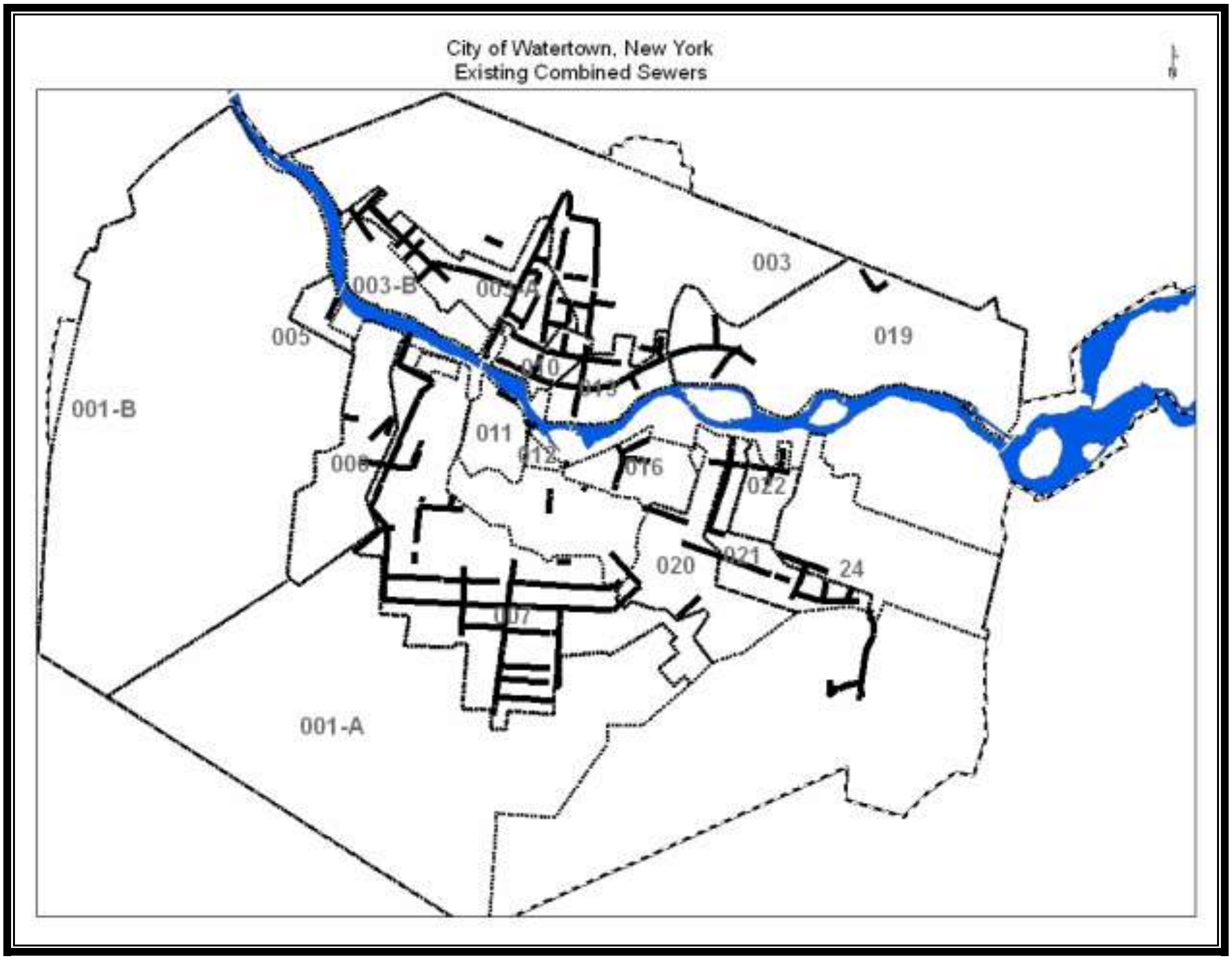

Figure 45: Location and scale of Combined Sewers in the City (according to existing records in the Engineering Department). Basin 003 and Basin 007 by far contain the preponderance.

B. Long Term Control Plan Goals

The goal of the LTCP had been indicated in Section I.A of this report – that is:

The goal of the Long Term CSO Control Plan is to positively identify, in both qualitative and quantitative terms, the actual adverse impacts that the City's active CSOs have upon the water quality of the Black River, and once identified, then to identify and enact reasonable control measures in a prudent sequence, schedule, and cost effective manner that both make sense and will reduce the identified adverse impacts in some meaningful and measurable way.

Applying the goal against the specific impairments identified above (the numbering below matches the numbering in Section IV.A above):

1. Western Outfall Basin (001): complete the study in the Basin and positively identify the cause of the anomalous inflow. Once determined, design and implement its correction. Positive identification ought to be accomplished during the spring/summer of CY 2009 with design and scheduling of the effective repair accomplished by the end of City Budget deliberations for the Fiscal Year 2010-2011 City Budget.

2. NSTS replacement at Cayuga Avenue: This project has already been scoped by the City's Engineering Department. The project is to be designed and administered through contracted services with a professional engineering consultant group. The project is scheduled to be accomplished during the 2009-10 construction seasons and a 2007 estimate placed the cost at $722,000. Assuming a 20% escalator to bring the 2007 construction estimate into a 2009 present worth would estimate the project to cost $866,000.

3. There are projects in the City's Capital Plan that would relieve storm water issues in the Engine Street Basin (007).

    - Flower Avenue Storm (FY 2010-11): This project conceptually will run from Washington Street to Massey Street, then relieving collected storm flows into the swamp areas south and west of the City (see Figure 46). According to the City's approved Capital Budget, $70,000 is set aside in Fiscal Year 2009-10 for the design and specification preparation by consultant engineers. $930,000 is set aside for construction in FY 2010-11 (this is a 2007 "order of magnitude estimate" for the storm sewer component only and given escalations in the construction market, 120% of this amount is reasonably assumed in today's market.) Two blocks of Holcomb Street and Ball Avenue already separated nonetheless currently return the collected storm flows to the Flower Avenue Combined Sewer. An immediate benefit in addition to the separation in Flower Avenue would be the permanent separation of these two additional streets. It is important to note that the project described above is to construct the storm sewer system in Flower Avenue and does not replace or reconstruct the existing infra structure (street, curbs and sidewalks; water, sanitary sewer). If total street reconstruction were to be opted for instead of simply adding storm sewers, then the project would cost in the order of $3.25 million. This too is 2007 estimation numbers which ought to be escalated an additional 20% to bring it to the present worth. Hence, the storm sewer only vs. the full street reconstruction projected cost (2009 present worth) would be $1.12 million vs. $3.90 million, respectively.

- Washington Street Reconstruction (FY 2011-12): Elements of this project would separate Washington Street northerly from Flower Avenue to Keyes Avenue and southerly from Flower Avenue to Haley Street, and direct storm flows to the new Flower Avenue Storm sewer. $511,000 is allocated in the Capital Budget for FY 2011-12, but this too is a 2007 "order of magnitude estimate of only the storm sewer component," with escalation of this amount by 20% equally prudent at this point. This project lends itself to be subdivided into two phases – the "north of Flower Avenue component," and the correlating south component. The south component, in addition to the separation of sections of Washington Street, would immediately remove Bowers Avenue storm water (already separated but currently emptying its storm back into the Washington Street combined sewer). The north component would reach the already separated sections of Keyes Avenue and accomplish the same. Again, the cost estimate above is for the storm sewer installation only. If total street reconstruction is considered, then the project would be estimated at $1.84 million (2007 dollars). The 2009 present worth value of the storm installation vs.

full street reconstruction would be $613,200 vs. $2.21 million, respectively.

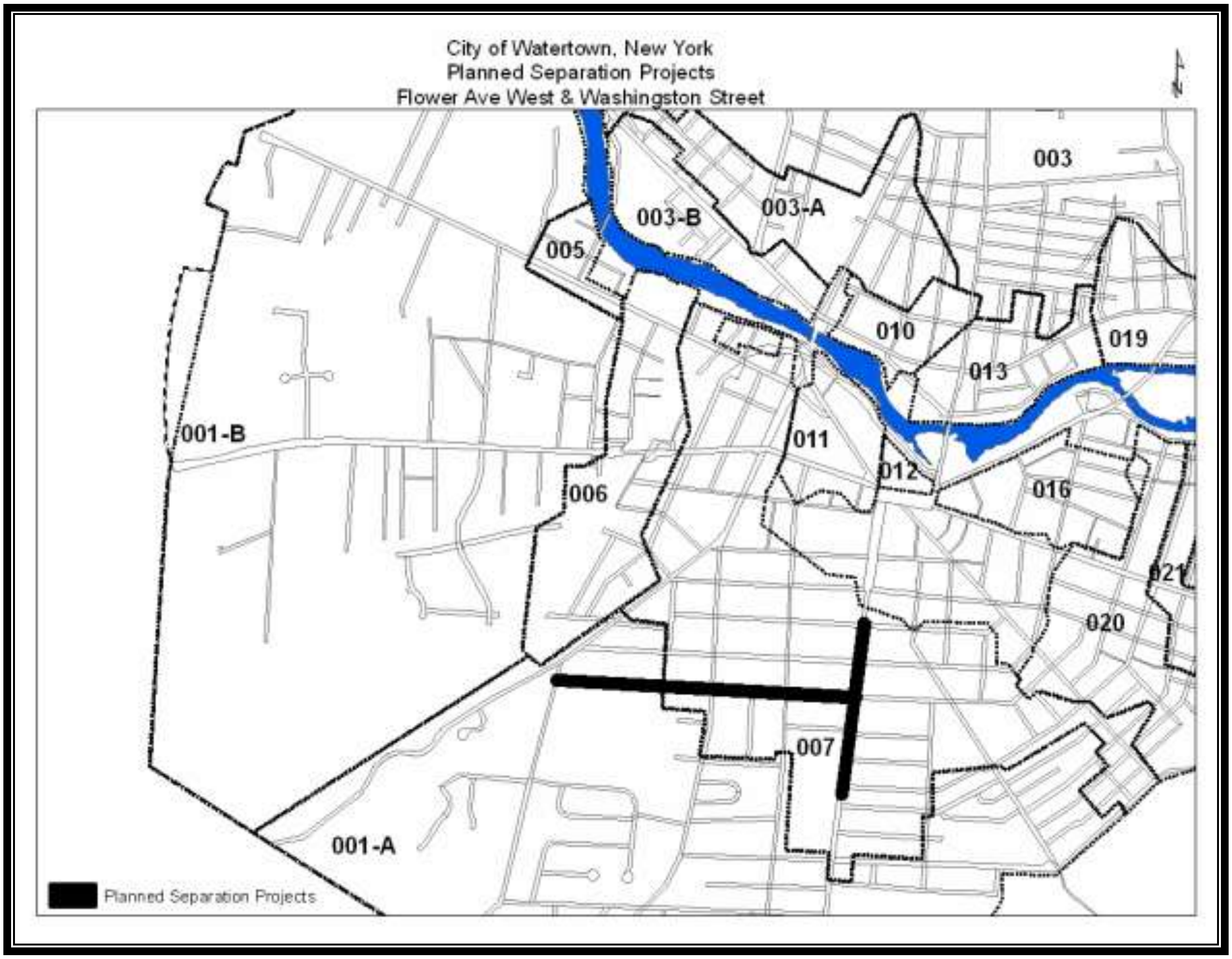

Figure 46: Proposed projects for the Engine Street Basin (007). The Flower Avenue Storm Sewer project is the east-west highlighted section originating in Basin 007 and terminating in Basin 001. The Washington Street component is the north-south oriented highlights.

- Once the two projects above are completed, the combined sewers in the vicinity of the Samaritan Medical Center (Park, Winslow, etc.) may be added to the developing storm system via the Flower Avenue Storm "trunk" (FY 2013-14 and beyond).

The Engine Street Basin (007) may be further improved with the installation of a primary control device (i.e. a vortex separator) properly sized and located in the overflow pipe of the CSO. This would address floatables and to some measure settleable solids that exist in the Basin and by-pass to the Black River during overflow events. This type of separator is an interim measure that would outlive its usefulness as separation projects upstream in the Basin are completed. The City prefers to place capital expenditures in the separation projects given the fact that the Black River can endure the overflows and the sewer separation projects upstream in the Basin 007 are the more efficient utilization of limited capital dollars.

4. Addressing infiltration would be systematic and would start with completing the modeling of the City's total CSS and updating as appropriate the LTCP Phase 1 report. Modeling should be accomplished by the end of CY 2009 with a supplement then published to this LTCP in 2010. With 1, 2, and 3 above completed and thus addressing the more significant CSS defects, subsequent storm sewer improvements could and perhaps should yield to the City's Street/Water/Sewer comprehensive capital improvement plans driven by considerations that may not be solely storm water. Table 24 below indicates the projects that would complete the combined sewer separation in the City, indicating the differential cost if only the storm sewer were to be installed versus the decision to reconstruct the entire street section in the process of installing the storm sewers.

Table 24: For the 5 Basins studied in this LTCP, the remaining storm sewer installation and potential street reconstruction.

Basin	2009 present worth $ (million)	
	Storm Installation only	Total Street Reconstruction
Basin 001	$0.10	$0.35
Basin 003	$5.04	$17.67
Basin 007	$6.35	$22.28
Basin 019	$0.38	$1.34
Basin 020	$0.78	$2.73
Total	**$12.64**	**$44.36**

V. Financial Assessment

The financial assessment that follows shall present the current annual cost to the City Users (that is, less projected cost to be borne by the Outside Users) and then shall consider a variety of scenarios for capital programs that address the combined sewer system of the City. All dollars used in the analysis shall be brought to a Fiscal Year 2009-10 present worth value such that all considerations may be evaluated against the same "valued dollars." The dollars and factors utilized below are documented relative to their respective sources.

A. Current Costs (comprised of annual O&M costs and debt service):

Annual Operations and Maintenance Expenses, and current debt service:

a.	Administration	$ 131,125	
b.	Sewer	438,215	
c.	Treatment and Disposal	2,730,089	
d.	General	158,555	$ 3,457,984
e.	Less that borne by other than City Rate Payers:		(1,104,712)[18]
Annual Debt Service:			702,204
Current Cost:			$ 3,055,476[19]

Since this value is for FY 2008-09, escalating it by 4.3% (current CPI escalation factor) brings it to FY 2009-10 (the FY that is the "present worth").

[18] Lines G2122; G2370; G2401; G2590 from the City of Watertown, New York Adopted FY 2008-09 Budget; Sewer Fund Revenues; pg. 203

[19] All information leading to this value is from City of Watertown, New York Adopted FY 2008-09 Budget; Sewer Fund Revenues and Expenditures; FY 2008-09; pg. 203

Current Cost Adjusted to FY 2009-10: $3,055,476 X 1.043 = $3,186,860

B. Projected New Debt Costs[20]:

a. Kelsey Creek NSTS replacement (Cayuga Avenue):

$70,000 FY 2008-09 Specifications and Design
$866,000 FY 2009-10 construction (storm sewer only)

b. Flower Avenue Storm Sewer:

$70,000 FY 2009-10 Specification and Design
$1,120,000 FY 2010-11 construction (storm sewer only)
$3,900,000 FY 2010-11 re-construction (Total Street)

c. Washington Street Sewer:

$70,000 FY 2010-11 Specification and Design
$613,000 FY 2011-12 construction (storm sewer only)
$2,210,000 FY 2011-12 re-construction (Total Street)

[20] Only sewer fund new capital debt caused by sewer separation projects are considered. Other new capital debts (i.e. vehicle or equipment acquisitions) are not factored in. New capital debt expenditures for projects are taken out 15 years, with the full 15 yearly increments of capital financing then brought to the FY 2009-10 present worth. The "present worth package" is financed for the 15 years at 4.75 percent. Street reconstruction is assumed. The fourth through the fifteenth years are not currently "on the books" as is indicated in footnote 21. The projects summarized as V.B.a, V.B.b, and V.B.c are contained in the currently approved Capital Budget.

d. First Project following Washington[21]
$70,000 FY 2011-12 Specification and Design
$700,000 FY 2012-13 construction (storm sewer only)
$2,000,000 FY 2012-12 reconstruction (Total Street)

e. Annual new projects following Washington to complete 15 year cycle
Initially, 11 additional projects considered, one per year[22]

$70,000 Specification and Design
$700,000 construction (storm sewer only)
$2,000,000 reconstruction (Total Street)

An adjustment factor is employed to bring future costs into the "present worth," relying upon the current 5 year average Consumer Price Index (CPI) as reported by the US Department of Labor Bureau of Labor Statistics.[23]

Average annual percentage change CPI 2004 thru Sep 2008 = 3.56[24]

$$\textbf{Adjustment Factor} = \mathbf{1 / (1 + CPI)^{years}}$$

[21] These projects (V.B.d and V.B.e) are neither scoped nor planned. The assumption is that to complete the combined sewer separation in the City of Watertown after V.B.a, V.B.b, and V.B.c were done would require a $2 million FY 2009-10 present worth commitment for reconstruction per year for 20 consecutive years. (Thus, 23 projects would be needed in total.) Each of these undefined projects would be preceded in its previous year by $70,000 design and specification expenditure. Once the routine begins, $2 million plus $70,000 would be financed per year.

[22] The 11 additional projects added to the four considered in V.B.a thru V.B.d would result in a total of 15 projects of the 23 projects necessary to completely separate the combined sewers that exist in the City. In addition to the 15 of 23 project scenario, the entire analysis was repeated for a 5 of 23 project scenario, a 10 of 23 and a 23 of 23. These additional 3 scenarios were assessed to offer a comparison with the initial 15 of 23 project scenario for the purpose of establishing a "sensitivity analysis" the various sized total capitalization would have on the Residential Indicator.

[23] Taken from EPA-833-R-07-005 dtd May 2007 THE LONG-TERM CONTROL PLAN – EZ (LTCP-EZ) TEMPLATE; pg. 28

[24] http:www.bls.gov/news.release/cpi.nr0.htm

Based upon the above equation, the adjustment factor would be for the following number of years adjustment:

1 year = 0.9656; 2 years = 0.9324; 3 years = 0.9004; 4 years = 0.8694; 5 years = 0.8395
6 years = 0.8107; 7 years = 0.7828; 8 years = 0.7559; 9 years = 0.7299; 10 years = 0.7048
11 years = 0.6806; 12 years = 0.6572; 13 years = 0.6346; 14 years = 0.6128; 15 years = 0.5917

Adjusting all above described projects to the FY 2009-10 present worth for V.B.a through V.B.e:

a.	\$936,000 X 1.0000	= \$936,000	
b.	\$3,970,000 X 0.9656	= \$3,833,432	
c.	\$2,280,000 X 0.9324	= \$2,125,872	
d.	\$2,070,000 X 1.0000	= \$2,070,000[25]	
e.	Remaining 11 years:		
	11 X \$2,070,000 X 1.0	= \$22,770,000[26]	**\$31,735,304**

Total new debt 2009-10 present worth = \$31,735,304

The present worth value of new debt would have to be reduced to an "annualization amount," that is, what would be the annual interest plus principal (I+P) payments based upon the local borrowing interest rate and the number of years the debt is financed. Herein it is assumed 4.75% interest and 15 years term.
The annual expense (I+P) is:[27]

(Present worth value of total debt) X {interest rate / [(1 + interest rate)^{years} – 1] + interest rate}

Annual (I+P) New Debt: \$31,735,304 X 0.09472 = \$3,005,968

Annual expense (interest + principal) = \$3,005,968
(NOTE: this represents the total projected WWT and CSO costs)

[25] This estimate was already in FY 2009-10 dollars

[26] These estimates were already in FY 2009-10 dollars

[27] The equation is from the same source and page as footnote 23.

Total current and projected WWT and CSO costs:
Current Adjusted Cost + Annual (I+P) for New Debt = $6,192,828

Total WWT flow (including Infiltration and Inflow) attributable to Residential Users:

City's 2007 population 27,443[28]
Hydra assumed sanitary gallons per capita day = 85
Sanitary contribution by residential population = 27,443 X 85 or 2.333 mgd

Dry weather flow at the POTW:

Total flow			7.58 mgd	
Less Outside users:	DANC	1.87		
	RT3	0.07		
	TSDs	0.32	(2.26 mgd)	
Less Infiltration:			(3.08 mgd)	
Sanitary Flow:				2.24 mgd[29]

Fraction of total WWT flow attributable to residential users: 1.0 is used herein given the comment made in footnote 29.

Residential share of Total WWT and CSO costs: **$6,192,828**

[28] http://www.city-data.com/city/Watertrown-New-York.html; 2007 population

[29] Confirmed by this analysis is the appropriateness of the statement that 100% of the flows originating within the City can be attributed to "residential use," or "household use." Household populations that perhaps migrate from inside the City to outside the City for daily employment are matched by populations that do just the opposite. Hence there is no differential of any significance to attribute to commercial or institutional use, or to attempt to differentiate same from household use. Remember, current costs and adjusted current costs have already excluded any user not considered an "Inside the City user."

Number of households in the City: 27,443 people / 2.3 people per household[30]

11,932 households

Cost per household: $6,192,828 / 11,932 = **$519**

Median Household Income (MHI): $36,600[31] as of 2007

Adjustment of MHI from 2007 to 2008:

Adjustment factor = $(1 + \text{CPI})^{\text{Current year – Census year}}$ = $(1 + 0.0430)^{2008-2007}$ = 1.0430

Adjusted MHI: $36,600 X 1.0430 = $38,175

Annual WWT and CSO control CPH as a percent of adjusted MHI:

($519 / $38,175) X 100 = 1.36%

The table below is extracted directly from EPA-833-R-07-005 dated May 2007 and indicates that the financial impact for households within the City of Watertown is in the "mid-range" as determined by the USEPA methodology:

Table 25: Financial Impact vs Residential Indicator

Financial Impact	Residential Indicator (CPH as % of adjusted MHI)
Low	Less than 1% MHI
Mid-range	1% to 2% of MHI
High	Greater than 2% MHI

[30] Same as footnote 28

[31] Same as footnote 28

C. Sensitivity analysis of the Financial Impact upon the Residential Indicator as a function of the aggressiveness of the Capitalization Program:

The above analysis assumed $2,070,000 generalized capitalization per year for years 4 through 15 of a 23 year projected program, with the first 3 years being defined by specific projects already scoped. For the purpose of "sensitivity" it is now assumed that only 5 years, and then 10 years of the program are projected (in lieu of the 15 year projection as shown above). And then the "complete 23 year program" projection is made, compressing the entire 23 year program into the 15 year capitalization package. The Table 26 below indicates the sensitivity this very large swing in excess of $40 million in the capitalization for the sewer separation program has on the Residential Indicator. As determined by the USEPA procedure, the cost per household (CPH) as a percent of the median household income (MHI) would range from 0.93% to 1.77%, resulting in the USEPA "guided determination" that impact is low to mid-range regardless. This does not mean that the impact is in fact low to mid-range but only means that this is the determination that the USEPA would guide one to make. What is shown in this sensitivity analysis concerning the financial assessment procedure developed by the USEPA is that it is not sensitive to very wide shifts in capitalization programs (a nearly fivefold increase shown herein), or in resultant annual cost to City households (nearly doubling). In short, the "guided determination" of the analysis (low to mid-range impact) would be virtually the same regardless of what the City does or does not do. The USEPA procedure must, therefore, "be embraced with a very large grain of salt" and qualifications must be imposed upon the results to temper the findings lest inappropriate conclusions be drawn.

For example, the analysis does not consider the following points. There may well be 2.3 people on the average per household for the City of Watertown. The household that has one or two people is typically the household with greater discretionary income than larger households because they are "singles" or married without children, etc., and can more easily absorb cost per household increases. Programs already in existence abate or mitigate the financial impacts upon retired individuals with fixed income. The households with greater than 2 people are typically the households with children and/or extended family and at a stage of economic stress wherein increases in costs are significantly impacting. Further, since sewer rates are a function of water consumption, the greater the number of people in the household, the greater is the proportion of cost shifting toward them. It is, therefore, the younger family with children or the household with extended family "under its roof" that is going to be the unit shouldering burdens to which this analysis developed by the USEPA does not appear to be sensitive. It is this same younger family that also has the lower household income, compounding what is already an adverse impact.

Table 26: Summary of Sensitivity Analysis

Capital program	**5 years of 23 year program**	**10 years of 23 year program**	**15 years of 23 year program**	**Complete 23 year program**
First 3 years	$6,895,304	$6,895,304	$6,895,304	$6,895,304
4th thru 15th year	$4,140,000	$14,490,000	$24,840,000	$44,360,000[32]
Total	**$11,035,304**	**$21,385,304**	**$31,735,304**	**$51,255,304**
[33]Annual (I+P)	$1,045,264	$2,025,616	$3,005,968	$4,854,902
Current and Projected costs	$4,232,124	$5,212,476	$6,192,828	$8,041,762
CPH	$355	$437	$519	$674
CPH as % of adj. MHI	**0.93%**	**1.14%**	**1.36%**	**1.77%**

Further, this analysis, while considering new capital debt caused by sewer separation projects, fails to consider new capital debt applied to the Sewer Fund

[32] See Table 24 of the LTCP Phase 1

[33] Assumed total capital program is financed at 4.75% over 15 years based upon FY 2009-10 present worth dollars.

arising from other causes (i.e. vehicle or equipment acquisitions, etc.).
No one with experience in writing municipal budgets while considering a four to fivefold increase in a capitalization program to be applied against sewer rates at the scale considered in this sensitivity analysis or an almost doubling of annual fees applied to households would ever conclude that the increases would have a "low to mid-range" impact upon its tax or rate payers.

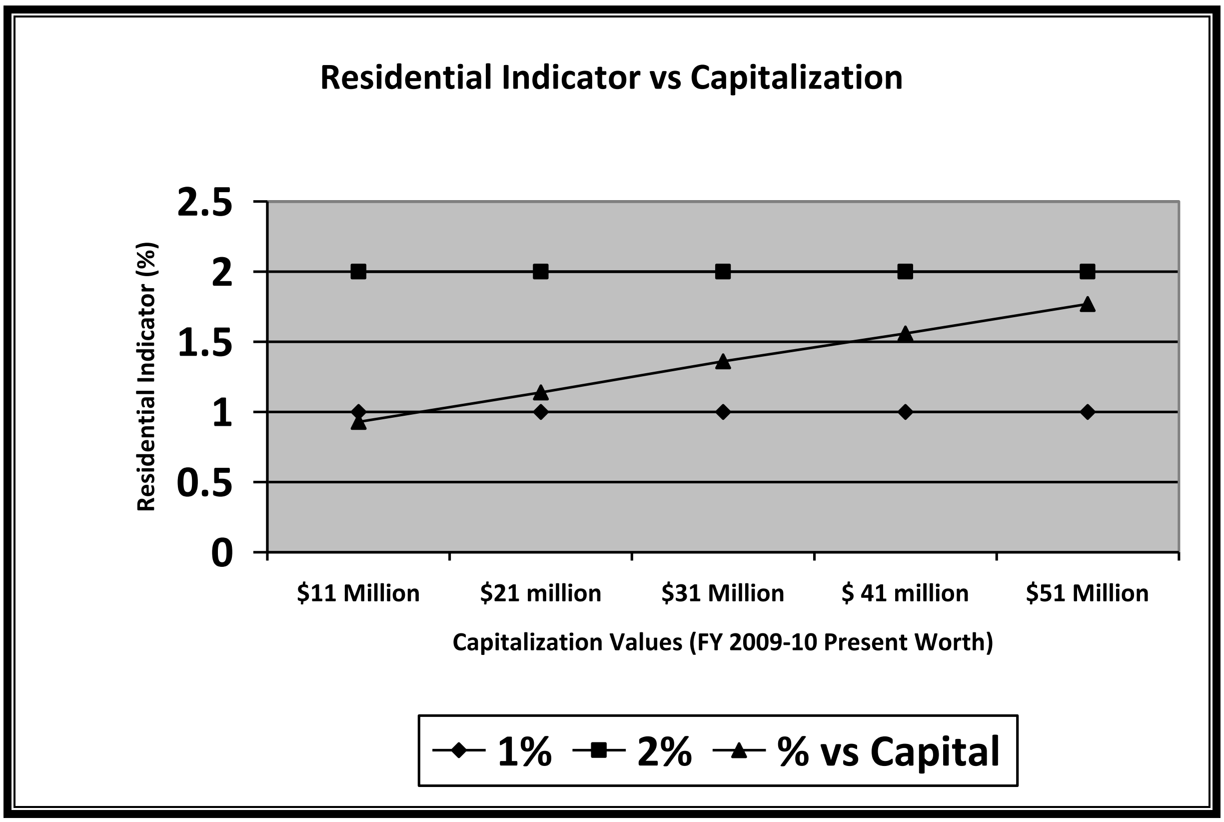

Figure 47: Residential Indicator as a Function of the Capitalization Program.

VI. Post Construction Compliance Monitoring Program

By its SPDES Permit[34] page 18 of 21, paragraph 15, the City is required to submit an annual report to the NYSDEC summarizing implementation of the best management practices (BMPs) for its combined sewer overflows (CSOs) by January 31st of each year. Amongst other things, this report is to focus upon updates and improvements in the conditions of its combined sewer system. The annual BMPs report is ideal and shall be utilized to document progress in the implementation of all referred to in this Long Term Control Plan, Phase 1.

Of great interest to the City would be the documented improvements to the CSS with the completion of projects discussed herein. The City considers the data gathered to date and summarized in this LTCP Phase 1 to be the base line by which future work shall be evaluated. The City has acquired the equipment and has the staff trained to continue selected basin monitoring. The City fully intends to repeat the steps of monitoring, recording and reporting of all basin activities consistent to that which had been conducted for the preparation of this LTCP for each basin in which separation work is performed such that a creditable "before and after" analysis may be presented. Progress shall be measured in terms of documented inflow and infiltration reductions. This, too, shall be subjects documented and reported in the annual BMP report.

The NYSDEC already possesses the necessary authority to review, respond and even direct as it deems appropriate to the reported activities of the City.

[34] SPDES No.: NY 002 5984