13.0 UPDATE OF CSO REDUCTION AND CONTROL ALTERNATIVES

This Chapter presents the following:

- Review of CSO control alternatives; and,
- Review of CSO data at the Wellington Avenue CSO Facility and an update of the estimated volumes required to be removed or stored for CSO reduction to achieve the objectives of EPA and RIDEM CSO Policies.

13.1 CSO CONTROL ALTERNATIVES

The effectiveness of the following CSO control alternatives will be evaluated in a later phase (Phase 2) of the CSO Control Plan. For the convenience of the reader, these alternatives are summarized in this section.

13.1.1 Nine Minimum Controls and Best Management Practices

The City of Newport's collection system and wastewater treatment and pumping facilities are operated by Earth Tech. Through the service contract that the City has with Earth Tech, programs have been implemented to satisfy the requirements of the Nine Minimum Controls, which are part of EPA and RIDEM's CSO Control Policies. In addition to these Nine Minimum Controls, the City prepared a Phase II Stormwater Management Plan in 2004 that addresses street sweeping and catch basin inspection and cleaning.

13.1.2 Enhanced Sewer Separation

Presently, the wastewater collection system is predominately separated. However, the system exhibits a significant increase in flows due to both infiltration and inflow (I/I). Enhanced sewer separation involves activities to identify and eliminate these sources. The Phase 1 Part 1 and Phase 1 Part 2 projects have included the following:

- Field investigations to identify sources of infiltration and inflow. In Phase 1 Part 1, Priority Catchments 1, 3, 4 and 7 were identified for detailed field investigations which were performed in this Phase 1 Part 2 of work and were previously described in Chapters 2 through 8;
- Sewer system rehabilitation to repair leaky pipes and manholes to reduce impacts of infiltration. Chapter 4 presents the recommendations for rehabilitation

of the collection system's pipe and manhole defects that were identified in the Priority Catchments;

- Disconnection and relocation of inflow sources such as sump pumps, area drains and roof drains from the sewer system. As part of this phase of work, properties with roof drains, area drains and sump pumps were identified in the Priority Catchments and were notified by the City that these sources are required to be disconnected from the building's sanitary sewer in accordance with the City's Ordinance Section 13.08.030(R); and,

- Evaluation of the existing storm drain system in areas where roof drains and catch basins were identified as connected to the sanitary sewer and development of separation plans for these sources to discharge flows to the storm drain system. Chapter 12 includes the conceptual methodology and recommendation for separation of the catch basins that were identified in this phase as connected to the sanitary sewer.

Hydraulic modeling and analysis, to be included in Phase 2, will be utilized to evaluate to what extent this alternative reduces or eliminates CSOs from the Wellington Avenue CSO Facility.

13.1.3 Storage/Treatment

Storage of wet weather flows for subsequent discharge to the Wellington Avenue Facility and pumping to the WPCP, once treatment and conveyance capacity have been restored, include the following technologies:

- **In-line Storage,** which is provided in series with the existing sewer system as either construction of new tanks and/or oversized conduits to provide storage capacity, as was done with the Narragansett Avenue Storage Conduit. The oversized conduit or new tank is designed to allow dry weather flows to pass through, while flows above the design peak are restricted, causing the tank or oversized conduit to fill. This can be accomplished on an existing underused conduit with the installation of a flow regulating device;

- **Off-line Near Surface Storage**, which is constructed parallel to the existing sewer system. Storage systems can be constructed as concrete tanks or as conduits, either large round or box-culvert conduits. Storage can operate in either a retention (i.e., storage with post event pump out) or detention (i.e., flow through during the event) mode. Stored flows are returned to the sewer system for conveyance to the WPCP, once the storm subsides and capacity again becomes available; and,

- Increased storage capacity at the Wellington Avenue CSO Treatment Facility.

The hydraulic modeling and analysis that will be included in Phase 2 will be utilized to evaluate to what extent this alternative reduces or eliminates CSOs from the Wellington Avenue CSO Facility.

13.1.4 Storage, Conveyance and Treatment at the WPCP

Storage and conveyance of wet weather flows to the Newport WPCP will also be considered as an alternative. This alternative includes the following elements:

- A storage and conveyance system consisting of a new interceptor sewer, appropriate junction structures, and pumping station(s) to discharge flows to the WPCP; and,

- Expansion of the storage capacity at the WPCP by adding primary clarifiers and chlorination and dechlorination facilities to provide equivalent primary treatment and disinfection of the additional wet weather flow.

It is noted that this alternative would require discussions with RIDEM to determine the appropriate wet weather treatment scenario that could be permitted. Similar to separation and storage, the hydraulic modeling and analysis that will be included in Phase 2 will be utilized to evaluate to what extent this alternative reduces or eliminates CSOs from the Wellington Avenue CSO Facility.

13.2 Evaluation of CSO Activity 1998 - 2006

Evaluation of CSO activation data at the Wellington Avenue CSO Facility from January 1998 through April 2005 was included in the Phase 1 Part 1 report and has been updated as part of this study to include CSO activations through November 2006. Tables 13.1 and 13.2 compare the results of the evaluation of the data performed in Phase 1 Part 1 and in this phase.

Table 13.1

Summary of CSO Event Data 1998 - 2006

	Number of Events	Average Events/Year	Average CSO Volume/Event	Maximum CSO Event Volume	Percentage of Events with CSO Volume of 4 mg or Less
Phase 1 Part 1 (1/98 - 4/05)	156	21	1.5 mg	24.5 mg	92
Phase 1 Part 2 (1/98 - 11/06)	178	20	1.9 mg	24.5 mg	91

Note: mg = million gallons

It is noted that the period that the data were updated (April 2005 through November 2006) is considered to be wetter then average with record rainfall occurring during the months of October 2005 and in May through June 2006. During these months, several large CSO activations resulted which affected the average CSO volume per event that was previously calculated. However, as noted in Table 13.2, this did not affect the average number of CSO events per year or the percentage of CSO events in several volumetric categories that were evaluated in Phase 1 Part1.

TABLE 13.2
CSO ACTIVITY SUMMARY
1998-2006

Volume of CSO	Number of Events		Percent of Total Events	
	Through Phase 1 Part 1	Through Phase 1 Part 2	Through Phase 1 Part 1	Through Phase 1 Part 2
16,000,000 - 24,500,000	1	2	0.6	1.1
10,000,000 - 15,000,000	2	2	1.3	1.1
5,000,000 - 10,000,000	6	7	3.8	3.9
> 4,000,000	13	16	8.3	9.0
> 2,000,000	36	41	23	23
> 1,000,000	52	60	33	34
< 1,000,000	104	118	67	66

As noted in the Phase 1 Part 1 report, the largest CSO (24.5 mg) occurred on March 30, 2001 and appears to be an anomalous event that occurred during a month with unusually large and frequent rain events. The measured rainfall during the event was 4.32 inches. In addition, the total rainfall for the month was 11.75 inches, including rain events of 2 inches and 4 inches occurring in the two weeks prior to the March 30th event. Therefore, this large CSO event likely occurred when antecedent groundwater conditions were very high and infiltration and indirect inflow (from sump pumps) into the system were at a maximum. Similarly, on May 13 2006, a CSO event of approximately 16 mg occurred with an associated rainfall of 6.24 inches. Record rainfall was recorded during the month of May, and similar conditions to that noted for the March 2001 event likely contributed to the volume of this event.

The updated CSO data are presented in Table 13.3 chronologically and in Table 13.4 ranked from the highest to the lowest volume CSO event.

Table 13.3

Wellington Avenue CSO Facility CSO Discharges 1998 – 2006 (Chronological)

Year	Day & Month of Discharge	Wellington CSO Total Discharge (gal)	Rainfall Total (inches)
1998	7-Jan	38,400	1.6
	9-Jan	76,800	0.38
	23-Jan	3,818,400	2.4
	2-Feb	115,200	0.7
	18-Feb	8,217,600	2
	24-Feb	3,380,800	1.58
	1-Mar	153,600	0.73
	9-Mar	3,457,800	2.09
	19-Mar	2,568,000	1.85
	1-Apr	2,412,000	1.88
	17-Apr	74,400	0.91
	2-May	230,400	0.91
	9-May	76,800	0.45
	10-May	3,136,800	1.22
	13-Jun	5,971,200	3.69
	30-Jun	876,000	1.82
	17-Aug	883,200	0.76
	22-Sep	38,400	1.48
1999	3-Jan	192,000	1.09
	15-Jan	537,600	1.03
	18-Jan	115,200	0.08
	2-Feb	2,971,200	1.71
	18-Feb	192,000	0.87
	28-Feb	2,568,000	1.36
	4-Mar	466,800	0.63
	6-Mar	765,600	0.47
	8-Sep	230,400	0.63
	10-Sep	648,000	1.73
	16-Sep	304,800	1.68
	4-Oct	268,800	1.30
	14-Oct	1,072,800	2.30
	18-Oct	1,111,200	1.66
	20-Oct	1,075,200	1.33
	3-Nov	614,400	1.40
	25-Nov	384,000	0.62
2000	5-Jan	76,800	0.79
	10-Jan	614,400	0.95
	25-Jan	345,600	0.77
	14-Feb	765,600	1.18
	11-Mar	13,598,400	4.51
	17-Mar	3,873,600	1.37
	28-Mar	1,264,800	1.21
	19-Apr	230,400	0.66
	22-Apr	10,773,600	3.28
	14-May	230,400	0.56
	24-May	266,400	0.61
	2-Jun	230,400	0.6
	6-Jun	460,800	1.71
	16-Jul	652,800	1.35
	26-Jul	499,200	2.03
	31-Jul	376,000	1.05
	1-Aug	228,000	0.18
	10-Aug	345,600	0.9
	9-Sep	652,800	0.78
	13-Sep	76,800	0.44
	15-Sep	688,800	0.95
	19-Sep	1,307,400	1.71
	10-Nov	537,600	2.69
	26-Nov	153,600	1.12
	14-Dec	1,790,400	1.35
	17-Dec	3,830,400	2.06
	19-Dec	609,600	0.79
	30-Dec	38,400	0.18
2001	30-Jan	1,075,200	0.75
	5-Feb	1,305,600	1.46
	25-Feb	307,200	0.75
	5-Mar	8,071,000	1.51
	9-Mar	190,000	0.85
	13-Mar	4,709,000	2.05
	22-Mar	8,064,000	2.13
	30-Mar	24,384,000	4.32
	6-Apr	192,000	0.22
	8-Apr	384,000	0.72
	12-Apr	4,480,000	0.51
	23-May	461,000	0.31
	25-May	307,400	0.63
	2-Jun	230,000	0.99
	3-Jun	115,000	0.13
	12-Jun	1,171,000	1.50
	17-Jun	2,460,000	1.60
	5-Jul	151,000	0.55
	11-Jul	110,000	0.56
	26-Jul	1,029,000	2.62
	13-Aug	220,000	0.93
	20-Aug	429,000	1.07
	21-Sep	135,000	0.65
	16-Oct	401,000	0.00
	24-Oct	108,000	0.46
	18-Dec	34,000	0.80
2002	7-Jan	52,000	0.59
	21-Jan	27,000	0.50
	3-Mar	36,000	0.80
	20-Mar	1,415,000	0.60
	26-Mar	1,451,000	0.36
	31-Mar	3,073,000	0.04
	25-Apr	470,000	0.08
	2-May	541,000	0.78
	13-May	1,616,000	0.70
	18-May	2,980,000	1.88
	7-Jun	833,000	2.00
	29-Jul	100,000	0.69
	2-Sep	462,000	0.76
	23-Sep	797,000	1.76
	16-Oct	297,000	1.06
	13-Nov	252,000	1.23
	17-Nov	2,880,000	1.22
	12-Dec	449,000	1.35
	14-Dec	264,000	1.65
	25-Dec	659,000	0.92
2003	1-Jan	880,000	0.20
	3-Jan	3,539,000	0.10
	22-Feb	4,352,000	1.45
	2-Mar	3,297,000	1.59
	9-Mar	216,000	0.00
	21-Mar	115,000	0.55
	22-Mar	307,000	0.28
	30-Mar	5,340,000	2.84
	9-Apr	209,000	0.41
	11-Apr	6,205,000	1.00
	22-Apr	870,000	1.34
	26-Apr	3,084,000	1.61
	1-May	120,000	0.17
	26-May	270,000	1.29
	5-Jun	1,319,000	1.18
	7-Jun	121,000	0.12
	18-Jun	120,000	0.70
	22-Jun	180,000	1.09
	3-Jul	180,000	0.87
	24-Jul	200,000	0.96
	8-Aug	2,055,000	2.05
	17-Aug	2,471,000	1.31
	15-Oct	300,000	1.53
	29-Oct	70,000	1.19
	11-Dec	346,000	0.90
2003	14-Dec	500,000	1.07
2004	6-Feb	140,000	1.92
	21-Mar	100,000	0.40
	31-Mar	4,550,000	1.71
	4-Apr	279,000	0.49
	13-Apr	2,717,000	2.01
	15-Aug	787,000	2.60
	31-Aug	102,000	0.73
	18-Sep	431,000	1.90
	29-Sep	2,590,000	2.89
	19-Oct	60,000	1.12
	28-Nov	152,000	0.98
	7-Dec	330,000	1.23
	10-Dec	1,168,000	1.50
2005	12-Jan	152,388	0.61
	14-Jan	330,174	0.62
	16-Jan	203,184	0.05
	10-Feb	177,786	0.45
	8-Mar	1,066,716	1.47
	28-Mar	2,920,770	2.56
	2-Apr	2,412,810	1.72
	30-Apr	711,144	1.15
	30-Aug	761,940	3.17
	15-Sep	355,577	2.36
	14-Oct	7,797,186	2.09
	25-Oct	507,840	1.2
	22-Nov	4,216,000	3.9
	30-Nov	1,955,000	1.93
	9-Dec	254,000	1.05
	16-Dec	330,174	1.18
2006	3-Jan	965,124	1.81
	14-Jan	1,269,900	2.02
	18-Jan	203,184	0.83
	3-Feb	510,000	1.6
	13-May	16,051,536	6.24
	7-Jun	2,031,840	3.27
	24-Jun	1,625,472	2.91
	6-Jul	42,333	0.53
	13-Jul	228,582	0.95
	28-Aug	406,368	2.15
	20-Sep	457,164	1.7
	1-Oct	42,330	0.91
	28-Oct	558,756	2.05
	23-Nov	2,108,034	2.86

Table 13.4
Wellington Avenue CSO Facility CSO Discharges 1998 – 2006 (By CSO Volume)

Day & Month of discharge	Wellington CSO total discharge (gal)	Rainfall Total (inches)	Day & Month of discharge	Wellington CSO total discharge (gal)	Rainfall Total (inches)	Day & Month of discharge	Wellington CSO total discharge (gal)	Rainfall Total (inches)	Day & Month of discharge	Wellington CSO total discharge (gal)	Rainfall Total (inches)
March 30, 2001	24,384,000	4.32	March 20, 2002	1,415,000	0.60	March 4, 1999	466,800	0.63	January 18, 2006	203,184	0.83
May 13, 2006	16,051,536	6.24	June 24, 2006	1,625,472	2.91	September 2, 2002	462,000	0.76	July 24, 2003	200,000	0.96
March 11, 2000	13,598,400	4.51	June 5, 2003	1,319,000	1.18	May 23, 2001	461,000	0.31	January 3, 1999	192,000	1.09
April 22, 2000	10,773,600	3.28	September 19, 2000	1,307,400	1.71	June 6, 2000	460,800	1.71	February 18, 1999	192,000	0.87
February 18, 1998	8,217,600	2.00	February 5, 2001	1,305,600	1.46	September 20, 2006	457,164	1.70	April 6, 2001	192,000	0.22
March 5, 2001	8,071,000	1.51	January 14, 2006	1,269,900	2.02	December 12, 2002	449,000	1.35	March 9, 2001	190,000	0.85
March 22, 2001	8,064,000	2.13	March 28, 2000	1,264,800	1.21	September 18, 2004	431,000	1.90	June 22, 2003	180,000	1.09
October 14, 2005	7,797,186	2.09	June 12, 2001	1,171,000	1.50	August 20, 2001	429,000	1.07	July 3, 2003	180,000	0.87
April 11, 2003	6,205,000	1.00	December 10, 2004	1,168,000	1.50	August 28, 2006	406,368	2.15	February 10, 2005	177,786	0.45
June 13, 1998	5,971,200	3.69	October 18, 1999	1,111,200	1.66	October 16, 2001	401,000	0.00	March 1, 1998	153,600	0.73
March 30, 2003	5,340,000	2.84	October 20, 1999	1,075,200	1.33	November 25, 1999	384,000	0.62	November 26, 2000	153,600	1.12
March 13, 2001	4,709,000	2.05	January 30, 2001	1,075,200	0.75	April 8, 2001	384,000	0.72	January 12, 2005	152,388	0.61
March 31, 2004	4,550,000	1.71	October 14, 1999	1,072,800	2.30	July 31, 2000	376,000	1.05	November 28, 2004	152,000	0.98
April 12, 2001	4,480,000	0.51	March 8, 2005	1,066,716	1.47	September 15, 2005	355,577	2.36	July 5, 2001	151,000	0.55
February 22, 2003	4,352,000	1.45	July 26, 2001	1,029,000	2.62	December 11, 2003	346,000	0.90	February 6, 2004	140,000	1.92
November 22, 2005	4,216,000	3.90	January 3, 2006	965,124	1.81	January 25, 2000	345,600	0.77	September 21, 2001	135,000	0.65
March 17, 2000	3,873,600	1.37	August 17, 1998	883,200	0.76	August 10, 2000	345,600	0.90	June 7, 2003	121,000	0.12
December 17, 2000	3,830,400	2.06	January 1, 2003	880,000	0.20	January 14, 2005	330,174	0.62	May 1, 2003	120,000	0.17
January 23, 1998	3,818,400	2.40	June 30, 1998	876,000	1.82	December 16, 2005	330,174	1.18	June 18, 2003	120,000	0.70
January 3, 2003	3,539,000	0.10	April 22, 2003	870,000	1.34	December 7, 2004	330,000	1.23	February 2, 1998	115,200	0.70
March 9, 1998	3,457,800	2.09	June 7, 2002	833,000	2.00	May 25, 2001	307,400	0.63	January 18, 1999	115,200	0.08
February 24, 1998	3,380,800	1.58	September 23, 2002	797,000	1.76	February 25, 2001	307,200	0.75	June 3, 2001	115,000	0.13
March 2, 2003	3,297,000	1.59	August 15, 2004	787,000	2.60	March 22, 2003	307,000	0.28	March 21, 2003	115,000	0.55
May 10, 1998	3,136,800	1.22	March 6, 1999	765,600	0.47	September 16, 1999	304,800	1.68	July 11, 2001	110,000	0.56
April 26, 2003	3,084,000	1.61	February 14, 2000	765,600	1.18	October 15, 2003	300,000	1.53	October 24, 2001	108,000	0.46
March 31, 2002	3,073,000	0.04	August 30, 2006	761,940	3.17	October 16, 2002	297,000	1.06	August 31, 2004	102,000	0.73
May 18, 2002	2,980,000	1.88	April 30, 2005	711,144	1.15	April 4, 2004	279,000	0.49	July 29, 2002	100,000	0.69
February 2, 1999	2,971,200	1.71	September 15, 2000	688,800	0.95	May 26, 2003	270,000	1.29	March 21, 2004	100,000	0.40
March 28, 2005	2,920,770	2.56	December 25, 2002	659,000	0.92	October 4, 1999	268,800	1.30	January 9, 1998	76,800	0.38
November 17, 2002	2,880,000	1.22	July 16, 2000	652,800	1.35	May 24, 2000	266,400	0.61	May 9, 1998	76,800	0.45
April 13, 2004	2,717,000	2.01	September 9, 2000	652,800	0.78	December 14, 2002	264,000	1.65	January 5, 2000	76,800	0.79
September 29, 2004	2,590,000	2.89	September 10, 1999	648,000	1.73	December 9, 2005	254,000	1.05	September 13, 2000	76,800	0.44
March 19, 1998	2,568,000	1.85	November 3, 1999	614,400	1.40	November 13, 2002	252,000	1.23	April 17, 1998	74,400	0.91
February 28, 1999	2,568,000	1.36	January 10, 2000	614,400	0.95	May 2, 1998	230,400	0.91	October 29, 2003	70,000	1.19
August 17, 2003	2,471,000	1.31	December 19, 2000	609,600	0.79	September 8, 1999	230,400	0.63	October 19, 2004	60,000	1.12
June 17, 2001	2,460,000	1.60	October 28, 2006	558,756	2.05	April 19, 2000	230,400	0.66	January 7, 2002	52,000	0.59
April 2, 2005	2,412,810	1.72	May 2, 2002	541,000	0.78	May 14, 2000	230,400	0.56	July 6, 2006	42,333	0.53
April 1, 1998	2,412,000	1.88	January 15, 1999	537,600	1.03	June 2, 2000	230,400	0.60	October 1, 2006	42,330	0.91
November 23, 2006	2,108,034	2.86	November 10, 2000	537,600	2.69	June 2, 2001	230,000	0.99	January 7, 1998	38,400	1.60
August 8, 2003	2,055,000	2.05	February 3, 2006	510,000	1.60	July 13, 2006	228,582	0.95	September 22, 1998	38,400	1.48
June 7, 2006	2,031,840	3.27	October 25, 2005	507,840	1.20	August 1, 2000	228,000	0.18	December 30, 2000	38,400	0.18
November 30, 2005	1,955,000	1.93	December 14, 2003	500,000	1.07	August 13, 2001	220,000	0.93	March 3, 2002	36,000	0.80
December 14, 2000	1,790,400	1.35	July 26, 2000	499,200	2.03	March 9, 2003	216,000	0.00	December 18, 2001	34,000	0.80
May 13, 2002	1,616,000	0.70	April 25, 2002	470,000	0.08	April 9, 2003	209,000	0.41	January 21, 2002	27,000	0.50
March 26, 2002	1,451,000	0.36				January 16, 2005	203,184	0.05			

Further review of the data from 1998 to 2006 with regard to the number of CSO events per year, the total rainfall associated with the CSO events, and the number of events that exceed several volumetric thresholds are presented in Table 13.5

TABLE 13.5

ANNUAL CSO EVENTS, ASSOCIATED RAINFALL AND VOLUMETRIC COMPARISONS

1998-2006

Year	Number of CSO Events[1]	Total Rainfall Associated with CSO Events (inches)	Number of CSO Events that Exceed 500,000 gallons	Number of CSO Events that Exceed 2,000,000 gallons	Number of CSO Events that Exceed 4,000,000 gallons	Number of CSO Events that Exceed 5,000,000 gallons	Maximum CSO Event Volume (gallons)
1998	18	26.5	10	8	2	2	8,220,000
1999	17	19.9	9	2	0	0	2,970,000
2000	28	35.8	14	4	2	2	13,600,000
2001	26	28.1	10	6	4	3	25,000,000
2002	20	19.0	10	3	0	0	3,000,000
2003	26	25.8	11	8	3	2	6,200,000
2004	13	19.5	6	3	1	0	4,600,000
2005	16	25.5	9	4	2	1	7,780,000
2006	14	29.8	8	3	1	1	16,050,000
Average	20	25.5	10	5	2	1	N/A

1. Total events 1998 through 2005 is 164. There were 14 CSO events through November, 2006.

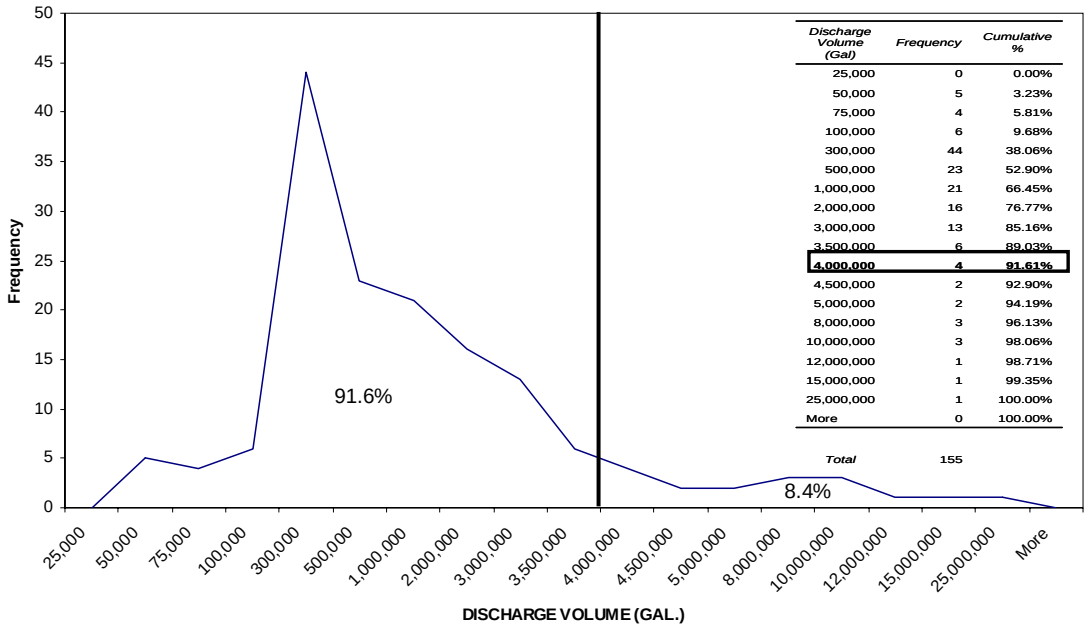
Similar to the analysis performed in Phase 1 Part 1, review of the data presented in Table 13.5, indicates that removal of approximately 4,000,000 gallons of flow from the sewer system, either by enhanced sewer separation, storage, or storage and treatment at the WPCP, either separately or in combination; would reduce the frequency of CSOs at the Wellington Avenue CSO Facility by well over 90%. This is illustrated by the following histograms, as shown graphically in Figures 13.1 and 13.2 and described below.

Figure 13.1 depicts the histogram of the frequency of events for the periods of data for the Phase 1 Part 1 analysis. (1/98 through 4/05). As was concluded from that analysis,

removal of 4,000,000 gallons of flow from the system would result in capture of approximately 92% of the CSO events. Figure 13.2 depicts the updated histogram for the period for 1/98 through 11/06. Review of this figure indicates that removal of 4,000,000 gallons of flow from the system would result in capture of over 91% of the CSO events, which is consistent with the conclusion from the Phase 1 Part 1 Report.

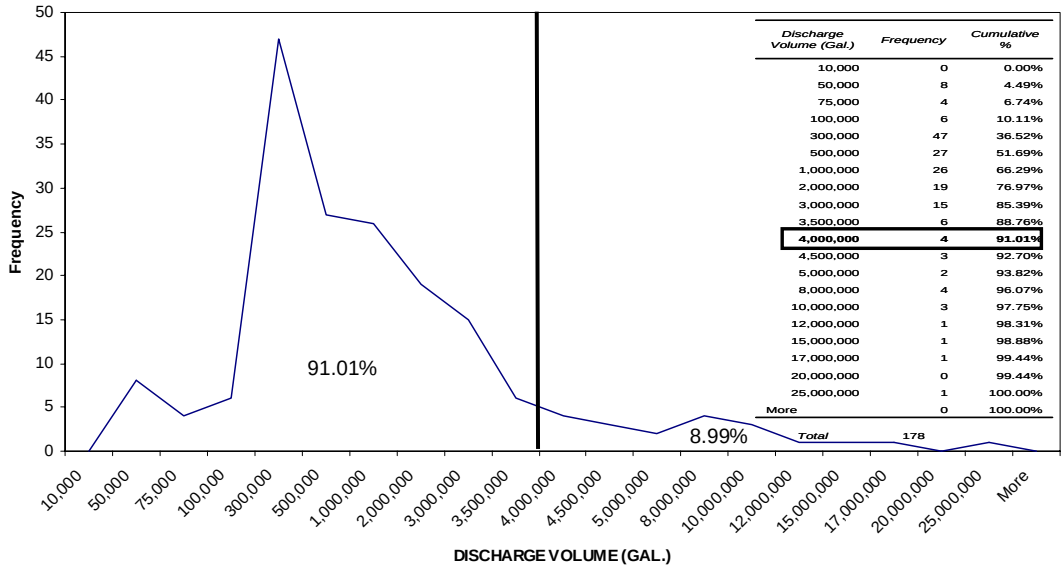
As was noted in Phase 1 Part 1, an the infiltration and inflow removal program that the City has enacted in this Phase of work, coupled with a similar program performed by the Town of Middletown, would make a meaningful impact towards reducing flow from the system. In addition, the enhanced sewer separation program, coupled with the analysis of other control alternatives mentioned above as part of the next Phase 2 should provide the City with a plan that will significantly reduce CSOs from the Wellington Avenue CSO facility.

FIGURE 13.1
WELLINGTON AVENUE CSO FACILITY DISCHARGES
JANUARY 1998 THROUGH APRIL 2005



Discharge Volume (Gal)	Frequency	Cumulative %
25,000	0	0.00%
50,000	5	3.23%
75,000	4	5.81%
100,000	6	9.68%
300,000	44	38.06%
500,000	23	52.90%
1,000,000	21	66.45%
2,000,000	16	76.77%
3,000,000	13	85.16%
3,500,000	6	89.03%
4,000,000	**4**	**91.61%**
4,500,000	2	92.90%
5,000,000	2	94.19%
8,000,000	3	96.13%
10,000,000	3	98.06%
12,000,000	1	98.71%
15,000,000	1	99.35%
25,000,000	1	100.00%
More	0	100.00%
Total	155	

FIGURE 13.2
WELLINGTON AVENUE CSO FACILITY DISCHARGES
JANUARY 1998 THROUGH NOVEMBER 2006



Discharge Volume (Gal.)	Frequency	Cumulative %
10,000	0	0.00%
50,000	8	4.49%
75,000	4	6.74%
100,000	6	10.11%
300,000	47	36.52%
500,000	27	51.69%
1,000,000	26	66.29%
2,000,000	19	76.97%
3,000,000	15	85.39%
3,500,000	6	88.76%
4,000,000	**4**	**91.01%**
4,500,000	3	92.70%
5,000,000	2	93.82%
8,000,000	4	96.07%
10,000,000	3	97.75%
12,000,000	1	98.31%
15,000,000	1	98.88%
17,000,000	1	99.44%
20,000,000	0	99.44%
25,000,000	1	100.00%
More	0	100.00%
Total	178	

13.3 Estimates of CSO Reduction

Table 13.6 presents the updated estimates of the volume required to be removed to reduce CSOs at the Wellington Avenue CSO Facility based on the review of the CSO activity data from 1998 to 2006, as presented in Tables 13.1 through 13.5 and the histograms presented in Figure 13.1 and 13.2, and using EPA's CSO Policy in the appendix. These estimates are consistent with those that were presented in the Phase 1 Part 2 report. Removal of flow would be accomplished by enhanced sewer separation, including removal of infiltration and inflow sources; storage; or storage, conveyance, and treatment at the WPCP, either separately or in combination.

TABLE 13.6
ESTIMATED VOLUMES FOR CSO REDUCTION
AT THE WELLINGTON AVENUE CSO FACILITY

CSO Frequency	Estimated Volume to be Removed to Reduce CSO (gallons)
0	5,000,000 - 25,000,000
1-3	4,000,000
4-7	2,000,000
8-12	500,000

It is noted that these estimates are based on a review of the CSO volume and frequency data as presented above. To demonstrate compliance with EPA and RIDEM CSO policies, the volumes presented in Table 13.6 will be evaluated in Phase 2 of the development of the Long Term CSO Control Plan with evaluated in greater levels of detail.