7.0 Evaluation of Combined Sewer Overflow Control Alternatives

7.1 Introduction

This section presents the evaluation of the CSO control alternatives selected as a result of the screening analysis in Section 6. In this section, the selected CSO control alternatives consist of the following:

- Centralized storage in the vicinity of the Wellington Avenue CSO Facility or decentralized (multiple locations) storage;

- Conveyance and treatment of flow at the Water Pollution Control Plant (WPCP), either directly via a new pump station and force main from the Wellington Avenue CSO Facility; or from a new pump station and force main from the Wellington facility to the Long Wharf Pump Station for pumping and conveyance via the existing 36-inch force main to the WPCP; and

- Sewer separation consisting of identification and elimination of direct sources of rainfall dependent infiltration and inflow (RDII) such as: connected catch basins on public property; connected roof leaders, driveway and yard drains, sump pumps, and leaking sewer services on private property; and rehabilitation and/or replacement of existing sanitary sewers and manholes to repair system defects associated with rainfall dependent infiltration.

Included in the alternatives analysis are evaluation of the impacts from Middletown via the Wave Avenue Pumping Station and impacts of system optimization, such as: 1) elimination of existing inverted weirs on the Wellington Avenue tributary area collection system hydraulics and; 2) on the peak flow and volume of combined sewer overflows at both the Wellington Avenue CSO and Washington Street CSO Facilities. These impacts are also evaluated with regard to the sizing of CSO controls. The evaluation of each of the alternatives includes analysis of the performance of the CSO controls' ability to eliminate the CSO for the largest rainfall event in the design year of 1996 as presented in Section 4, which is the October 19, 1996 rainfall event. This rainfall event had a depth of rain of 3.05 inches with a peak intensity of 0.63 inches per hour and duration of 17 hours. The CSO control alternatives for the Wellington Avenue CSO Facility will also include impacts on the Washington Street CSO Facility, Long Wharf Pump Station and the WPCP. The CSO control alternatives will also be evaluated with respect to technical feasibility, siting, institutional, and regulatory issues. The capital and operation and maintenance costs of the alternatives will be presented in Section 8.

7.1.1 Existing Conditions 2008 Baseline Model

As noted in Section 3, the City's Enhanced Sewer Separation Program has been ongoing from 2007 through 2008 in the Wellington Avenue CSO Facility tributary area. The Wellington Avenue existing conditions' calibrated model was modified to account for the reductions in flow to the system for catch basins and roof leaders that have been disconnected after the completion of the flow metering program in November 2007. The Existing Conditions 2008 Baseline Model was used to simulate flows for the typical year 1996 to determine the estimated reduction in annual CSO volume and annual number of events in a typical year due to the sewer separation work that has been completed in the Wellington Avenue CSO Facility tributary catchment area. Table 7.1 summarizes the results predicted by the model:

TABLE 7.1
WELLINGTON AVENUE CSO FACILITY
ANNUAL CSO VOLUMES AND EVENTS
TYPICAL YEAR 1996 SIMULATIONS

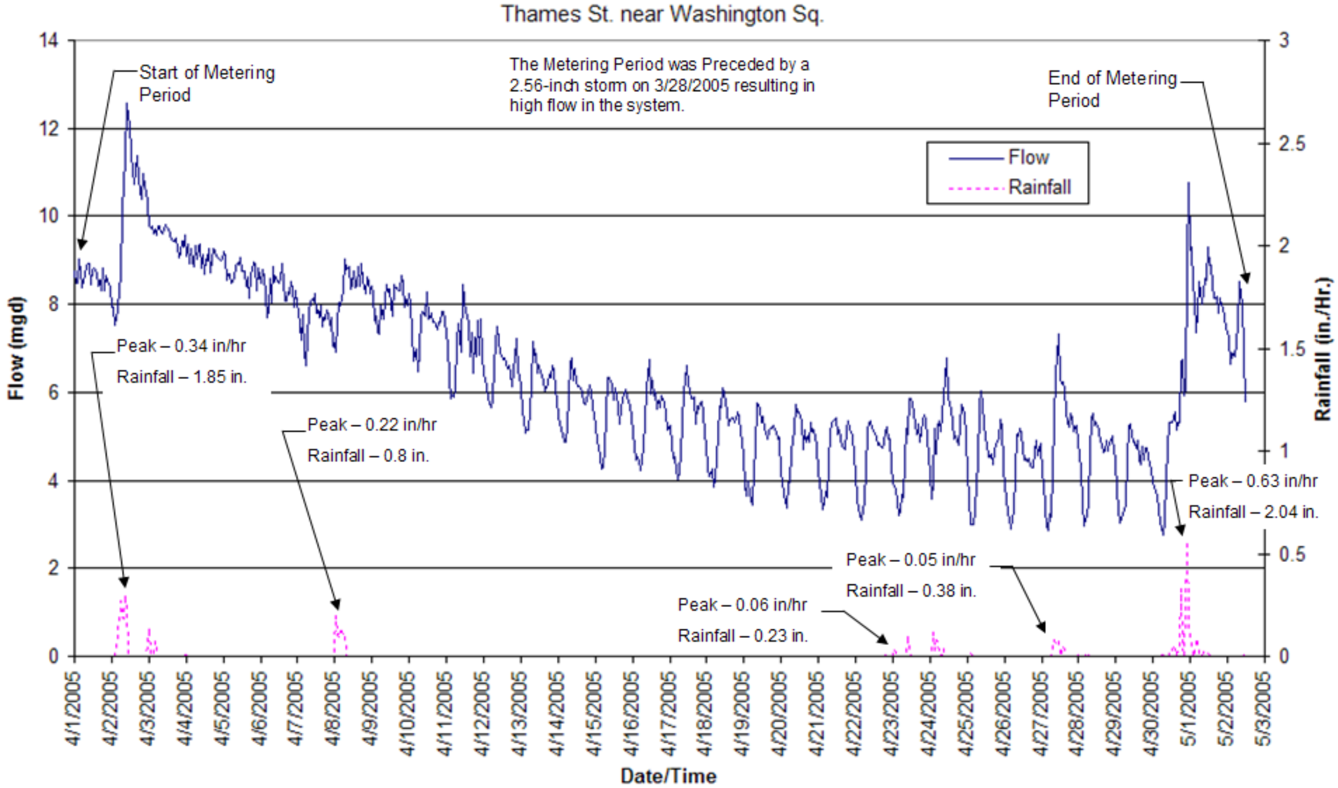
	Annual CSO Volume	CSO Events	Largest CSO Event Volume
Existing Conditions 2007	22.8 million gallons	14	6.9 million gallons
Existing Conditions 2008 Baseline Model	20.0 million gallons	11	6.4 million gallons

Review of Table 7.1 indicates that based on the model simulations of the typical year 1996, the sewer separation work completed as of December 2008 in the Wellington Avenue CSO Facility Tributary catchment area estimates a 12% reduction in annual CSO volume, a 20% reduction of CSO events, and a 7% reduction in the largest CSO event volume. It should be noted that the preliminary estimated volume of infiltration and inflow used in the Phase 1 Part 2 Report was approximately four million gallons based on the removal of connected catch basins, roof drains, and sump pumps. This preliminary estimate was based on the use of the Rational Method formula, which only uses a single rainfall event with a high peak rainfall intensity of 1inch/hour for the calculation. As noted above, using the Baseline Conditions 2008 Model developed in this phase of the project, the estimated removal of infiltration and inflow is reduced to 2.8 million gallons based on simulation of all the rainfall events in a typical year.

In addition, the modeling analysis has indicated that the system is not only impacted by direct inflow sources, but is also impacted significantly by tidal inflow, specifically in the Thames Street Interceptor and the Wellington Avenue sewer, and also by rainfall induced infiltration combined with high groundwater elevations in the Wellington Avenue tributary catchment area. During Phase 1 Part 2, it was surmised that the increased wet weather flows were more impacted by direct inflow sources and that infiltration sources were of lesser impact. The modeling results in Phase 2 have indicated that rainfall induced infiltration is a more significant component of the total wet weather flow than previously envisioned.

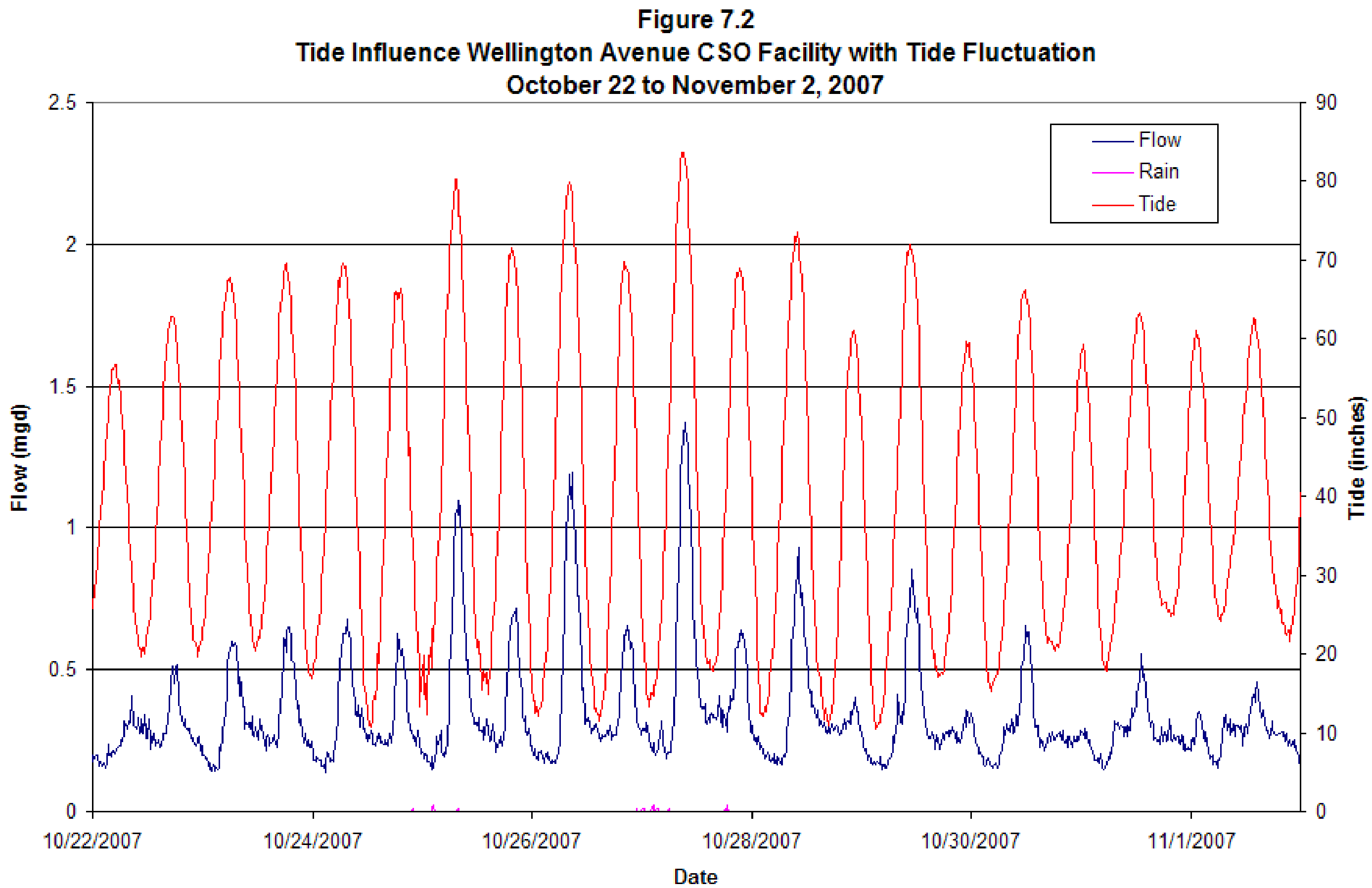
The significant rainfall dependant infiltration volumes after a storm event result in flows remaining elevated for several days before returning to the pre-existing condition (assuming no “back-to-back” rain events). This system “drain down” period or elevated system flow level after the storm event(s) reduces the capacity of the collection system and can result in higher CSO volumes. Figure 7.1 presents the flow at the terminus of the Thames Street Interceptor near Washington Square. It should be observed that as a result of large storms on March 28, 2005 (2.56 inches of total rainfall) and April 2, 2005 (1.85 inches of total rainfall), the sanitary flows in the Thames Street Interceptor remain elevated for approximately 21 days after the second storm event. This rainfall dependant infiltration is likely related to the significant quantity (approximately 70% of the Wellington Avenue CSO Facility Tributary Area) of older vitrified clay (VC) pipe that comprises the Newport sanitary sewer system. The VC pipe observed during CCTV inspection work performed in Phase 1 Part 2 included 2-foot pipe sections, which create a larger number of potential locations for various types of defects, including: separated or misaligned joints; pipe sags, and cracked and broken pipe, which all have the potential to permit infiltration to enter the system. Mineral deposits were observed at pipe joints during the CCTV pipe inspection, which indicates infiltration at the joint.

Figure 7.1
Flow Hydrograph
Thames St. near Washington Sq.



The impact of rainfall induced infiltration on flows in the system was noted during the model calibration process. It was determined that the flow generated from inflow sources only accounted for a portion of the wet weather flow (i.e., peak flows) and that the remaining component of the flow was from rainfall induced infiltration.

In addition, tidal influence in the sanitary sewer was observed in 2005 but was inconclusive as a result of the high baseflows and long system draindown times (as noted above) observed at the time. Tidal influence was more pronounced in the 2007 flow metering period because of the low baseflow conditions resulting from the dry weather conditions during the metering period. Distinct increases in flow rate to the Wellington Avenue CSO Facility were observed during this 2007 flow metering period when peak diurnal flows correlated with high tides. This phenomenon was most pronounced between October 22, 2007 and November 3, 2007 and is presented in Figure 7.2 – Catchment Area 4 Tidal Influence. The infiltration observed during tidal fluctuations is also attributed to flow entering the system through defects in the vitrified clay pipes as noted above. During high tides, the system is impacted by tidal infiltration during both dry weather and wet weather. During dry weather, the impact from the tidal infiltration results in increased flows to the Long Wharf Pump Station and the WPCP. During wet weather, the tidal infiltration reduces the available system capacity for wet weather flows, which then impacts the potential for CSOs to occur at the Wellington Avenue Facility.



The Existing Conditions 2008 Baseline Model is used as the existing conditions model for each of the following alternatives that are evaluated in this section.

7.2 Off-Line Storage

Off-line storage facilities would typically consist of a diversion structure, a subsurface storage tank equipped with coarse screening, chlorination/dechlorination equipment for odor control, a flushing system to clean the tank bottom after an event, and dewatering pumps to return the stored contents to the collection system when capacity in the system and at the WPCP for treatment become available after the storm. The tank would be divided into a number of smaller storage bays, which would be designed to fill successively. Following completion of the event, the tank channels and storage bays would be cleaned using a flushing system and readied for the next overflow event.

7.2.1 Centralized Storage

Conceptually, the centralized storage alternative would consist of one or more subsurface storage tanks adjacent to the Wellington Avenue CSO Facility in King's Park, which currently consists of a parking area and Little League baseball fields and/or within Spencer Park which is open space bordered by Marchant Avenue, Wellington Avenue, Clinton Street, and Connection Street located across the street from the Wellington Avenue CSO Facility. For this CSO control alternative, the model was utilized to determine the tank volume required to capture the CSO peak flow and volume generated from the largest storm in the design year of 1996, as noted above.

7.2.2 Modeling Analysis of Centralized Storage Alternative

The model was simulated for the typical year 1996 to determine the largest volume of overflow that occurs during the typical year. Based on the model simulation, the model predicted that the CSO volume of overflow associated with the largest storm in the typical year (October 19, 1996 event) was 6.4 million gallons (mg). The CSO data at the Wellington Avenue CSO Facility were reviewed from 2000 - 2008 to determine the frequency of CSO events that exceeded 6.4 mg. Review of the data indicated that there were 7 events over the period that exceeded 6.4 mg. Based on the 9 years of record, this indicates that the October 19, 1996 storm generating a volume of 6.4 mg appears to be equivalent to a 1.25 year storm. Therefore, using a tank volume of 6.4 million gallons is reasonable for capturing all CSO events up to the 1-year storm during the typical year.

Centralized storage requires some upgrades to the existing Wellington Avenue CSO Facility in addition to the construction of a new storage tank(s). The conceptual upgrades required to eliminate CSOs at the Wellington Avenue CSO Facility up to the largest storm of the typical year 1996 would include the following:

- Based on the model simulation, the required tank volume to store the CSO from the largest event in the design year is 6.4 million gallons. Based on this volume requirement, a storage tank could be provided adjacent to the Wellington Avenue CSO Facility and in Spencer Park. At the Wellington Avenue CSO Facility, a tank of 1 to 2 million gallons (approximate footprint of 15,000 square feet based on a storage depth of 20 feet could be provided on the Wellington Ave. CSO Facility site, with the remaining 5 to 5.5 million gallons provided at Spencer Park (approximate footprint of 40,000 square feet based on a storage depth of 20 feet). Alternatively, all of the storage consisting of a single tank with an approximate footprint of 50,000 square feet with a storage depth of 20 feet could be located at either Spencer Park, King's Park, or a combination of the two.

- The storage tank would be constructed below existing grade and would not be influenced by intermittent surface flooding or over topping of the sea wall by tidal flows.

- Reconfigure the current micro-strainer chamber at the Wellington Avenue CSO facility to direct flow to the storage tank(s).

- If two tanks are utilized, connection piping to direct flow from one tank to the other tank.

- Approximately 800 feet of force main to dewater the storage tank(s) to the Thames Street Interceptor. The force main would be connected to the Thames Street Interceptor at a point downstream of the regulator structure that directs flow to Wellington Avenue.

- The existing overflow pump wet well, effluent pumps, and outfall at the Wellington Avenue CSO will remain in service to allow overflows of storm events that exceed the largest storm in the design year.

Figure 7.3 depicts a preliminary plan of the Centralized Storage Alternative.

Impacts of Centralized Storage to the Washington Street CSO Facility and WPCP

The following assumptions were initially used to evaluate the centralized storage option with regard to operation of the storage tank in retention mode and its impacts on the Washington Street CSO Facility and the WPCP:

- The storage tank dewatering pumps do not operate during the rainfall event;
- The tank was modeled with the provision of two dewatering pumps with a capacity of 2 million gallons per day (mgd) each;
- The model pump control logic was set to start the pumps based on the hydraulic grade line of the Thames Street Interceptor. This was established to prevent the pumps from turning on after a large rainfall event (such as the design event) and causing an overflow to occur at the Wellington Avenue CSO Facility when the system is draining down from surcharged conditions. In addition, the pump start elevations were also set to start only if the pumping rate at the Long Wharf Pump Station is less than 10.7 mgd, the permitted average daily flow at the WPCP. Each of these pump controls were incorporated to only discharge flow from the storage tank to the system when there is adequate capacity available in the Wellington Avenue collection system and at the WPCP.

These controls were established to prevent a negative impact at the Washington Street CSO Facility (i.e., increasing the volume of CSO for the design event), and also impacting the WPCP such that a permit exceedence occurs. During the typical design year event, these requirements significantly impact the time required to dewater the storage tank directly after the conclusion of the design event.

Due to the system surcharge that occurs during the design event, the hydraulic gradeline of the Wellington Avenue collection system remains elevated for approximately 10 days and flows at the Long Wharf Pump Station remain above 10.7 mgd. This results in the tank not being fully emptied for 10 days after this event. In addition, with these constraints on the pumping, the model indicated the following impacts on the WPCP as presented in Table 7.2.

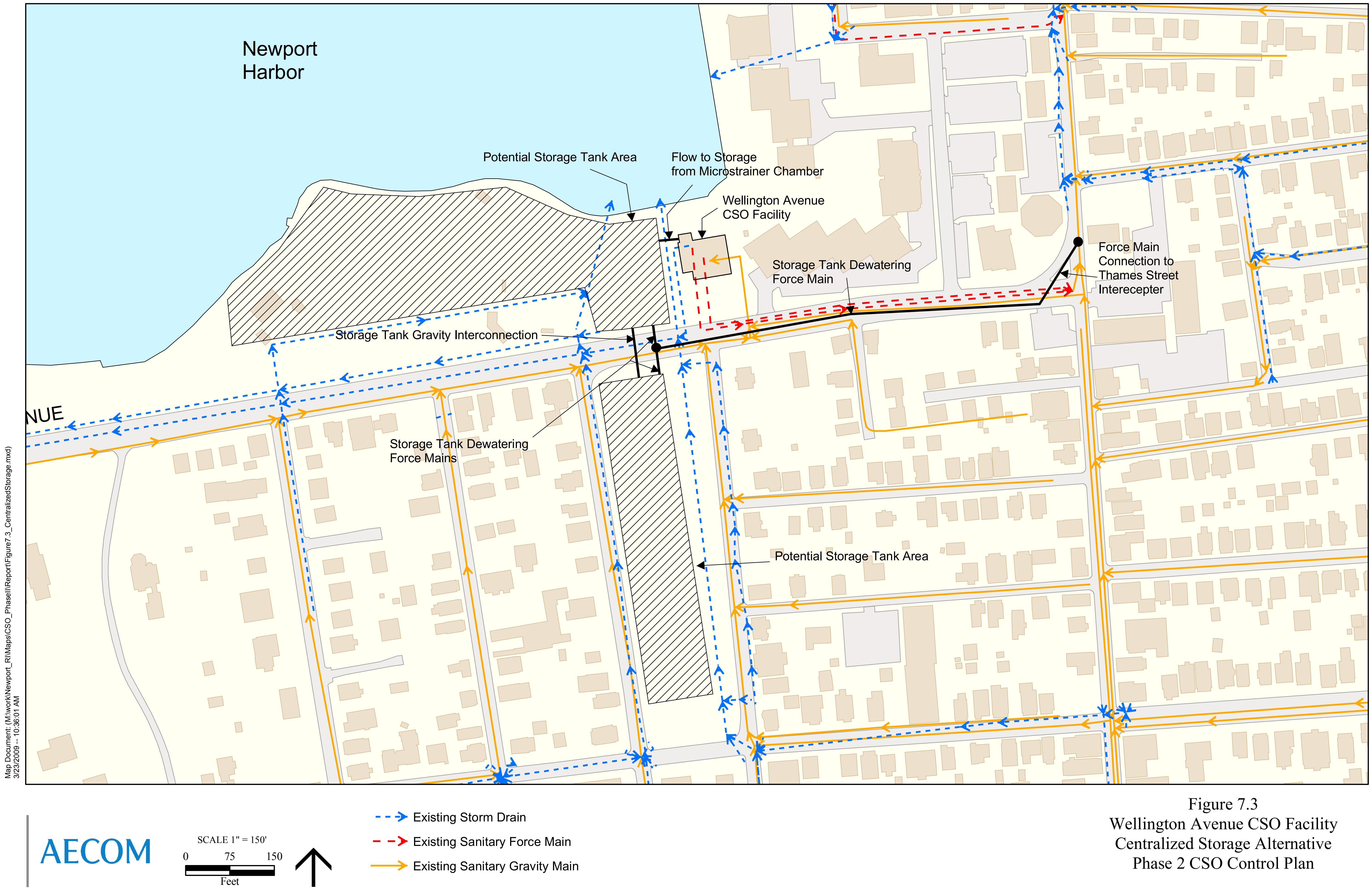


Figure 7.3
Wellington Avenue CSO Facility
Centralized Storage Alternative
Phase 2 CSO Control Plan

TABLE 7.2
TYPICAL YEAR (1996) FLOWS AT WPCP
6.4 MG CENTRALIZED STORAGE ALTERNATIVE

Month	Average Daily WPCP Flow (ADF) (mgd)	Permit Exceedence for ADF	Maximum Daily WPCP Flow (MDF) (mgd)	Permit Exceedence for MDF
January	10.5	No	15.6	No
February	9.9	No	13.7	No
March	9.9	No	13.9	No
April	10.2	No	16.0	No
May	10.1	No	12.7	No
June	9.2	No	10.7	No
July	9.7	No	15.0	No
August	9.1	No	11.1	No
September	**10.8**	Yes	18.2	No
October	**11.9**	Yes	18.8	No
November	10.3	No	14.4	No
December	**12.3**	Yes	17.8	No

Based on the WPCP's current permit, the allowable monthly average daily flow is 10.7 and the maximum daily flow for the month is 19.7 mgd. As noted in Table 7.2, exceedences of the average daily WPCP flow are predicted by the model to occur during three months of the year, but there are no exceedences predicted by the model for maximum daily WPCP flow. An additional impact at the WPCP includes increased operation and maintenance costs for solids handling and disinfection of the increased flows.

With respect to impacts to CSO frequency and volume at the Washington Street Facility, the model indicated that the annual volume of overflow increased by 20% and the frequency increased by 30% for the typical year design storm. The average annual CSO volume and frequency of events from 2001 to 2008 at the Washington Street Facility was 30 million gallons and 10 events. Therefore, in an average year, this could result in an annual increase of 6 million gallons and 3 events at the Washington Street CSO Facility, if pumpback rates of this magnitude were utilized to dewater the centralized storage.

Based on these results, operation of the storage tank in detention mode with pumpback during an event for the largest rainfall event in the typical year is not feasible due to the hydraulic constraints of the system with respect to the time it takes for the system to drain down and provide conditions that will prevent any impact to the Washington Street CSO Facility or the WPCP. This also limits the ability of the storage tank to handle another rainfall event (i.e., back to back storms) within 7 days of the largest event in the typical year, since the Wellington Avenue collection system takes 10 days to fully drain down such that capacity is again available to pump back from the storage tanks. It should be noted that the flow metering that was performed in 2005 during Phase 1 Part 1 was conducted during a wet spring, and system drain down times of the magnitude being predicted by the model were observed after large rainfall events with rainfall depths between 2 and 3 inches that occurred during the metering period.

Therefore, the model results indicate that centralized storage is required to operate in retention mode with a key parameter for the design being the post event dewatering rate. To test the sensitivity of this parameter, the model was run for just the largest event in the typical year with storage pumpback equal to zero, and the overflow at Washington Street actually decreased by 7%. Simulation of the model with a reduction of the pump back rate from 4 mgd to 1 mgd reduces the impact on overflows at the Washington Street CSO Facility. One approach to the development of a dewatering rate may be to design the tank to be dewatered within 1 to 2 days for the volumes up to the annual average CSO volume event. The annual average CSO volume event from 2001 through 2008 at the Wellington Avenue CSO Facility is 1.50 mg. Assuming capacity is available in the system, dewatering the tanks at a rate between 0.5 and rate up to 1.0 mgd would allow the tank to be emptied and readied for another event. This would address handling most back-to-back rainfall events during a typical year and mitigate any impacts to the Washington Street CSO Facility and the WPCP with the understanding that if two large (i.e., rainfall of 2 to 3 inches) back-to- back events occur, the system would likely experience an overflow, because capacity will not be available to empty the centralized storage tank at Wellington Avenue. Therefore, in addition to synchronizing the pump back of flow from centralized storage with the hydraulic gradeline in the Thames Street Interceptor and with flows at the WPCP, the dewatering rate must also be synchronized with the hydraulic elevations at the Washington Street CSO Facility to minimize increases in overflows at Washington Street during drain down.

Model output for the analysis of the centralized storage alternative is presented in Appendix F.

7.2.3 Decentralized Storage

Decentralized storage consists of storage elements at multiple potential locations around the City of Newport. The locations considered for decentralized storage are presented in Figure 7.2.

It was assumed that the decentralized storage tanks could include conduit or box culvert type tanks similar to the Narragansett Storage conduit. However, due to the large storage, volumes required, the limits in the hydraulic characteristics of the system, and the space limitations throughout the City, there are significant size limitations for the in-road conduit tanks. Larger tanks in areas with more open space are required in addition to any conduit-type in-road storage tanks.

Similar to centralized storage, the contents of the tanks are pumped back to the sewer system after the storm event; however, it was assumed that the storage conduits could operate as a gravity conduit similar to the Narragansett Storage Conduit. For this alternative, a gate at the downstream end of the conduit would close during wet weather and the conduit would fill. After the storm event, the gate would open and release flow back into the sewer system. Model simulations of this alternative, however, indicated that to operate the decentralized storage conduits in this way would limit the overall capacity of the conduit because of available space and hydraulics. The alternate operating scenario would be to install the storage conduits below the level of the adjacent sewer invert and pump the flow back to the sewer system at the conclusion of the wet weather event. This would require installing pumps at the downstream terminus of each storage conduit. The pump back conduits remain limited by available space within the roadways.

Table 7.3 summarizes the locations and their suitability. Each location is identified in Figure 7.4. As a result of the large volume of flow that must be detained (i.e., storage designed with flow through capability during rain event) or retained (i.e., flow is stored and returned to the system after an event), many of the sites are not suitable due to the available space for gravity storage or a pump back storage conduit.

Storage Locations

1	WPCP
2	Long Wharf
3	Washington St. CSO Facility
4	Broadway
5	Blissmine PS
6	Wave Ave. PS (Middletown)
7	Memorial Blvd. (Middletown)
8	Wellington CSO Facility
9	Marchant at Wellington Ave
10	Narragansett Ave.
11	Morton Park
12	Ruggles Ave.
13	Lawrence Ave.
14	Middleton Ave.
15	Old Fort Road
16	Wellington Ave.

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● Potential Storage Locations

Figure 7.4
Wellington Avenue CSO Facility
Conceptual Decentralized Storage Locations
Phase 2 CSO Control Plan

**TABLE 7.3
DECENTRALIZED STORAGE CONDUIT/TANK LOCATIONS
SUITABILITY FOR USE TO REDUCE OVERFLOWS AT THE WELLINGTON AVENUE CSO FACILITY**

Loc. No.	Description of Location	Reduction of Overflows at Wellington Avenue Facility	Suitability	Comment
1	WPCP	None	Unsuitable	Downstream of Wellington Avenue Facility
2	Long Wharf	None	Unsuitable	Downstream of Wellington Avenue Facility
3	Washington Street CSO Facility	None	Unsuitable	Downstream of Wellington Avenue Facility
4	Broadway	None	Unsuitable	Downstream of Wellington Avenue Facility
5	Bliss Mine Pump Station	None	Unsuitable	Downstream of Wellington Avenue Facility
6	Wave Avenue Pump Station	Minimal	Unsuitable	Downstream of Wellington Avenue Facility, minimal impact on Wellington. Possible improvement to limit flows to Washington Street
7	Memorial Blvd	Minimal	Unsuitable	Downstream of Wellington Avenue Facility, minimal impact on Wellington. Possible improvement to limit flows to Washington Street
8	Wellington CSO Facility	Yes	Suitable	Preferred Location for both Centralized and Decentralized tanks due to flows and open space.
9	Marchant Street at Wellington Avenue (Spencer Park)	Yes	Suitable	Preferred Location for both Centralized and Decentralized tanks due to flows and open space.
10	Narragansett Avenue	Yes	Suitable	Limited space due to existing storage conduit, local sewers, drain, natural gas, and underground electric, requires replacement of existing storage conduit with larger storage conduit.
11	Morton Park	Yes	Suitable	Adjacent to main sewer line with significant open space. Storage could include additional capacity for drainage issues at southern end of the park. Likely significant rock excavation costs.
12	Ruggles Avenue	Yes	Unsuitable	Limited width of roadway and required capacity would result in appropriately sized storage conduit to be above the existing deep brick sewer limiting access.

**TABLE 7.3 (CONTINUED)
DECENTRALIZED STORAGE CONDUIT/TANK LOCATIONS
SUITABILITY FOR USE TO REDUCE FLOWS AT
THE WELLINGTON AVENUE CSO FACILITY**

Loc. No.	Description of Location	Reduction of Overflows at Wellington Avenue Facility	Suitability	Comment
13	Lawrence Avenue	Yes	Unsuitable	Available space limited by side-by-side sewer and storm drain.
14	Middleton Avenue	Yes	Unsuitable	Available space limited by side-by-side 36-inch sewer and 48-inch storm drain.
15	Old Fort Road	Minimal	Unsuitable	Limited space and insufficient variation between wet weather and dry weather flow. Resulting storage is less than 100,000 gallons.
16	Wellington Avenue	Yes	Unsuitable	Existing system hydraulics limits the capacity of the conduit to less than 300,000 gallons.

7.2.4 Modeling Analysis of Decentralized Storage

Based on the evaluations of the potential storage locations presented in Table 7.3, the decentralized storage alternative was modeled with storage elements at the following locations:

- Wellington Avenue CSO Facility;
- Kings Park;
- Spencer Park;
- Morton Park; and
- Narragansett Avenue.

Based on the model simulation of the typical year 1996, the CSO from the largest event is approximately 6.4 million gallons. In order to capture this volume, the model indicated storage requirements of 4.7 million gallons at Spencer Park (approximate footprint of 30,000 square feet based on a storage depth of 20 feet); 3.4 million gallons of storage at Morton Park (approximate footprint of 30,000 square feet based on a storage depth of 15 feet); and 1.0 million gallons of storage at Narragansett Avenue (replace the existing 7-foot diameter, 1,700 foot long storage conduit with an 8-foot high by 8-foot wide by 2,500-foot long box culvert to provide 1 million gallons of storage operating with a control gate). In addition, this alternative would include the following features:

- Reconfigure the current micro-strainer chamber at the Wellington Avenue CSO facility to direct flow to the proposed new storage tank at Spencer Park or Kings Park.

- Install approximately 800 feet of force main to dewater the storage tank to the Thames Street Interceptor. The force main would be connected to the Thames Street Interceptor at a point downstream of the regulator structure that directs flow to Wellington Avenue.

- The storage tank at Morton Park would be constructed in the vicinity of the existing cross country sewer. This tank was modeled as a gravity influent with a pump and force main connected to the cross country sewer to dewater the tank.

- The existing overflow pump wet well, effluent pumps, and outfall at the Wellington Avenue CSO Facility will remain in place to allow overflows of storm events that exceed the largest storm in the design year.

- Each of tanks was designed with a pumpback capacity of 1 mgd.

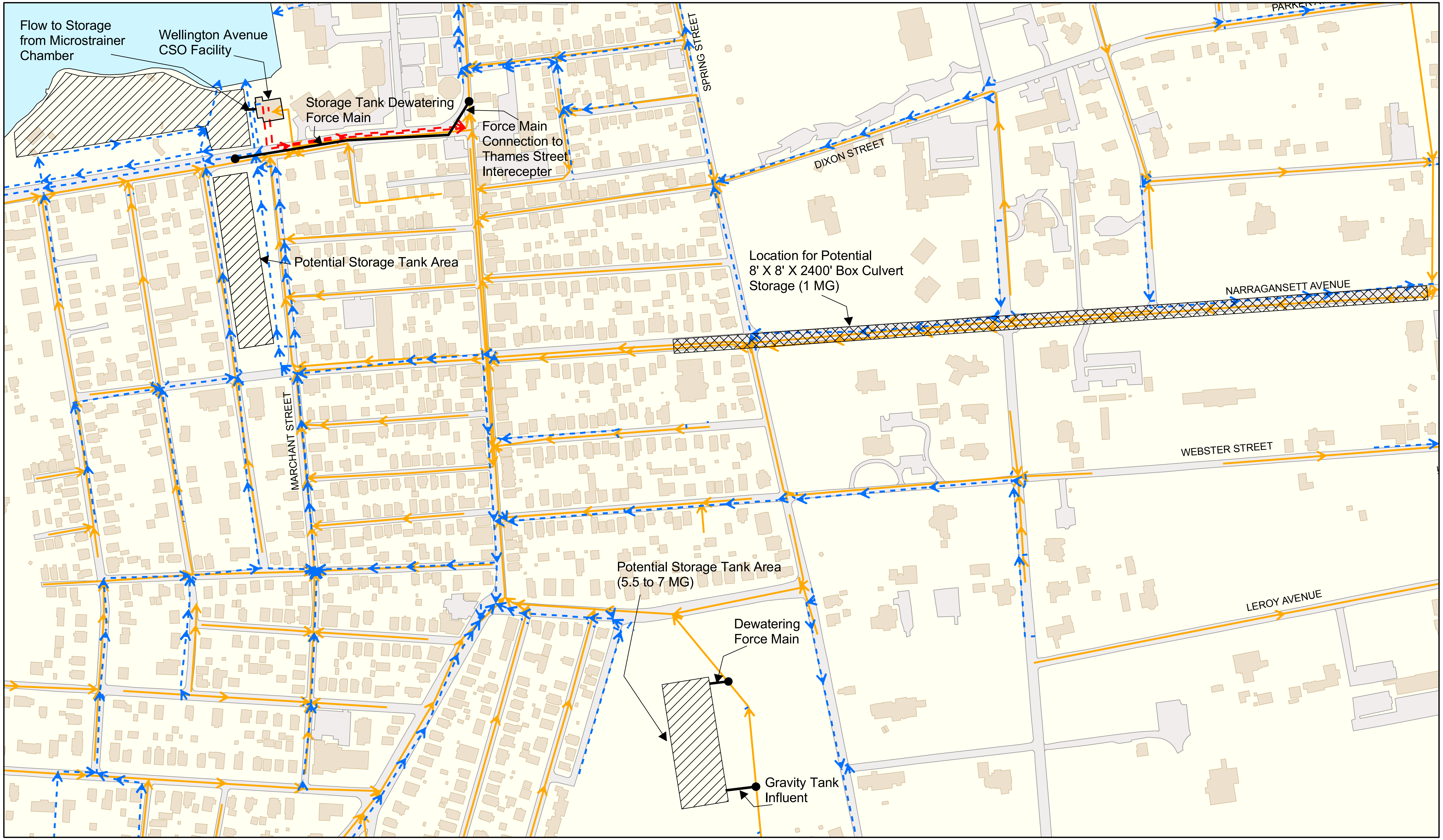
Figure 7.5 depicts the preliminary decentralized storage alternative.

Impacts of Decentralized Storage to the Washington Street CSO Facility and WPCP

Based on the results presented in the Centralized Alternative with regard to the impact of the dewatering rate on the volume and frequency of overflows at Washington Street, decentralized storage was simulated with a pumpback rate of 1 mgd for dewatering each of the tanks. This simulation resulted in a 5% reduction in annual CSO volume and no change in the number of CSO events at the Washington Street CSO Facility. In a typical year, this could result in a 1.5 million gallon annual reduction of overflows at the Washington Street CSO Facility. Table 7.4 presents the results of the model simulation of the typical year for this alternative with respect to flows at the WPCP.

TABLE 7.4
TYPICAL YEAR (1996) FLOWS AT WPCP
DECENTRALIZED STORAGE ALTERNATIVE

Month	Average Daily WPCP Flow (ADF) (mgd)	Permit Exceedence for ADF	Maximum Daily WPCP Flow (MDF) (mgd)	Permit Exceedence for MDF
January	10.5	No	15.9	No
February	9.6	No	11.8	No
March	9.7	No	14.2	No
April	10.3	No	16.0	No
May	9.9	No	13.2	No
June	9.2	No	10.8	No
July	9.5	No	14.8	No
August	9.1	No	11.2	No
September	**10.9**	Yes	17.5	No
October	**12.0**	Yes	18.7	No
November	10.1	No	13.8	No
December	**12.4**	Yes	16.4	No



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Existing Storm Drain
Existing Sanitary Force Main
Existing Sanitary Gravity Main

Figure 7.5
Wellington Avenue CSO Facility
Decentralized Storage Alternative
Phase 2 CSO Control Plan

As noted previously, the permitted monthly average daily flow discharged by the WPCP is 10.7 mgd and the maximum daily flow in a month is 19.7 mgd. As noted in Table 7.4, exceedences of the average daily WPCP flow are predicted by the model to occur during three months of the year, with no exceedences of maximum daily flow predicted by the model. An additional impact at the WPCP includes increased operation and maintenance costs for solids handling and disinfection of the increased flows. Appendix F includes the modeling results for this alternative.

7.3 Conveyance to the Long Wharf Pumping Station and Treatment at the Water Pollution Control Plant

Conveyance to the Long Wharf Pump Station would consist of a provision of increased pumping capacity at the Wellington Avenue CSO Facility and a force main conveying flow from the Wellington Avenue CSO Facility to the Long Wharf Pump Station directly. Two routes for the force main for conveyance to the Long Wharf Pump Station were considered in the evaluation of this alternative. The first route was a sub-aqueous force main under Newport Harbor as shown in Figure 7.6 and the second option would consist of an overland route between the Wellington Avenue CSO and Long Wharf Pump Station as also shown in Figure 7.6. The potential overland routes would be via Wellington Avenue to either Thames Street or Spring Street, then to the Long Wharf Pump Station via America's Cup Boulevard or the pedestrian mall near Washington Square. Under these alternatives, all flows conveyed to the Long Wharf Pump Station would be pumped via the existing 36-inch force main to the WPCP.

Based on model simulation of the typical year 1996, it was determined that the peak flow required to capture all the CSO events at the Wellington Avenue CSO Facility was 6.5 mgd. The upgrades to the existing infrastructure that are required to convey flow from the Wellington Avenue CSO Facility to the Long Wharf Pump Station include upgrading pumps and reconfiguring tanks at the Wellington Avenue CSO Facility, modifications to the Long Wharf pump station to increase its flow capacity, and upgrading the WPCP to treat and discharge the additional wet weather flows. The upgrades required to convey flow from the Wellington Avenue CSO Facility to the Long Wharf Pump Station would consist of the following:

- Reconfigure the existing micro-strainer well at the Wellington Avenue facility to serve as the conveyance wet well/equalization tank (approximate capacity 77,000 gallons); or construction of a new holding tank/wet well at the Wellington Avenue CSO facility,

- Provision of 6.5 mgd pumping capacity to the Long Wharf Pump Station;

- Approximately 4,000 feet of 24-inch sub-aqueous force main between Wellington Avenue and Long Wharf pump station under Newport Harbor, or approximately 6,800 feet of 24-inch force main for the overland route along existing streets between the Wellington Avenue CSO Facility and Long Wharf Pump Station;

- Demolition of the existing Long Wharf Pump Station and construction of a new station with a 65,000 gallon wet well with pumping capacity up to 30.5 mgd;

- Construction of a new equalization tank/headworks modifications at the WPCP to allow for controlled introduction of wet weather flows to the facility headworks;

- Upgrades to the existing primary treatment tanks at the WPCP to treat up to 6.5 mgd of additional flow;

- Upgrade the disinfection capacity to treat an additional 6.5 mgd;

- Upgrade the effluent pump station at the WPCP to handle additional flow; and

- Construction of a new 42-inch outfall to provide capacity for additional flow. Previous investigations by Metcalf & Eddy in 1966 indicated that the increasing flows to the existing WPCP 36-inch outfall would be problematic due to its structural strength and its ability to handle increased hydraulic pressure from an increase in flow velocity.

Figure 7.7 presents the preliminary upgrades at the WPCP for this alternative.

The permitting/regulatory aspects of a potential increase in the RIPDES discharge permit at the WPCP are discussed in Section 7.8.4.

7.3.1 Modeling Analysis of Conveyance to the Long Wharf Pump Station

Table 7.5 presents the results of the model simulation of the typical year for this alternative with respect to flows at the WPCP.

TABLE 7.5
TYPICAL YEAR (1996) FLOWS AT WPCP
CONVEYANCE TO LONG WHARF PUMP STATION ALTERNATIVE

Month	Average Daily WPCP Flow (ADF) (mgd)	Permit Exceedence for ADF	Maximum Daily WPCP Flow (MDF) (mgd)	Permit Exceedence for MDF
January	10.3	No	17.1	No
February	10.1	No	15.0	No
March	9.2	No	14.6	No
April	10.3	No	17.2	No
May	9.8	No	12.4	No
June	8.7	No	11.6	No
July	9.2	No	16.9	No
August	8.7	No	11.5	No
September	10.4	No	**21.4**	Yes
October	**12.1**	Yes	**24.5**	Yes
November	9.8	No	15.3	No
December	**12.3**	Yes	**21.6**	Yes

As noted previously, the permitted monthly average daily flow is 10.7 mgd and the maximum daily flow in a month is 19.7 mgd. As noted in Table 7.5, exceedences of the average daily WPCP flow are predicted by the model to occur during two months of the year, with exceedences of maximum daily flow predicted by the model to occur during three months of the year. An additional impact at the WPCP includes increased operation and maintenance costs for solids handling and disinfection of the increased flows.

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SCALE 1" = 2000'
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Feet

Force Main
Force Main (Alternate Route)
Sub-aqueous Force Main

Figure 7.6
Wellington Avenue CSO Facility
Conveyance to Long Wharf Pump Station
Phase 2 CSO Control Plan

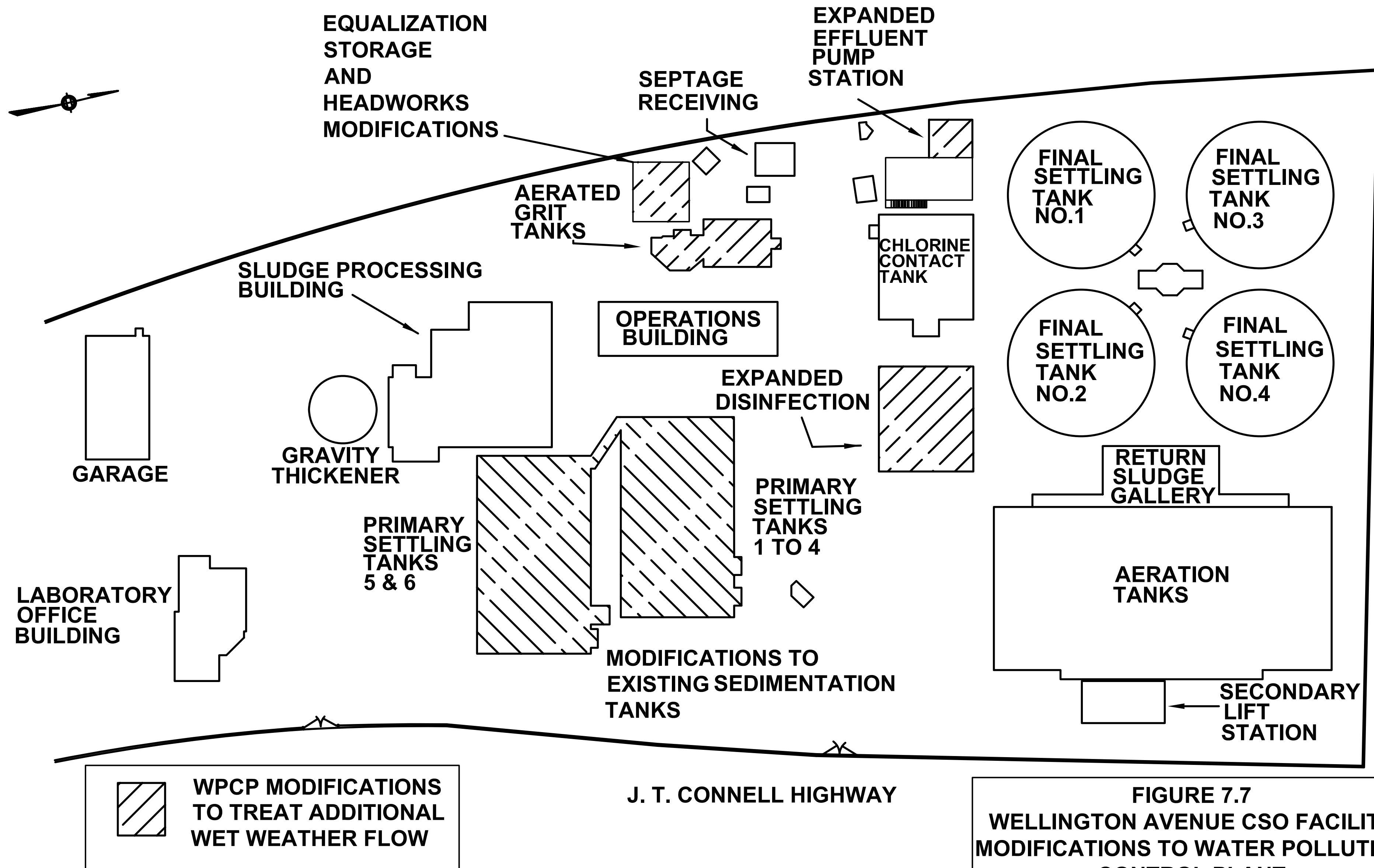

FIGURE 7.7
WELLINGTON AVENUE CSO FACILITY
MODIFICATIONS TO WATER POLLUTION CONTROL PLANT
PHASE 2 CSO CONTROL PLAN

Impacts to the Washington Street CSO Facility

Based on the simulation of the typical year, conveyance of flow directly to the Long Wharf Pump Station from the Wellington Avenue CSO Facility significantly impacts overflows at the Washington Street Facility. The model predicted a 40% increase in the annual volume of overflow and a 20% increase in the number of events. As noted previously, the average annual CSO volume and frequency of events from 2001 to 2008 at the Washington Street Facility was 30 million gallons and 10 events, respectively. This alternative could potentially increase these totals to 42 million gallons and 12 events on an average annual basis. Appendix F includes the model results for this alternative.

7.4 Conveyance and Treatment at the Water Pollution Control Plant

Conveyance and treatment at the WPCP would include provision of increased pumping capacity at the Wellington Avenue CSO Facility and a force main directly conveying flow between the Wellington Avenue CSO Facility and the WPCP. The conveyance to the WPCP from the Wellington Avenue CSO facility included evaluation of two routes for the force main. The first route is a sub-aqueous force main under Newport Harbor as shown in Figure 7.8 and the second option would consist of an overland route between the Wellington Avenue CSO Facility and the WPCP as also shown in Figure 7.8. The likely overland route would transit Wellington Avenue to Thames Street or Spring Street, then paralleling the existing 36-inch Long Wharf Pump Station force main route to the WPCP.

Based on model simulation of the typical year 1996, it was determined that the peak flow required to capture all the CSO events at the Wellington Avenue CSO Facility was 6.5 mgd. Various upgrades are required to convey flow from the Wellington Avenue CSO facility to the WPCP including pump upgrades and additional tanks for equalization, storage, and treatment. The upgrades required to convey flow directly between the Wellington Avenue CSO facility and the WPCP are as follows. The length of force main would increase if a route other than the route along Thames Street were selected.

- Approximately 14,000 LF of 24-inch sub-aqueous pipe between the Wellington Avenue CSO Facility and the WPCP under Newport Harbor, or approximately 13,500 LF of 24-inch pipe along an overland route between the Wellington Avenue CSO Facility and the WPCP under various City thoroughfares,

- Provision of 6.5 mgd pumping capacity from the Wellington Avenue CSO Facility to the WPCP;

- Reconfigure of the micro-strainer chamber to serve as a wet well for the new conveyance pumps (Capacity approx. 77,000 gallons); or construction of a new holding tank/wet well at the Wellington Avenue CSO facility,

- Construction of a new equalization tank/headworks modifications at the WPCP to allow for controlled introduction of wet weather flows to the facility headworks;

- Upgrades to the existing primary treatment tanks at the WPCP to treat up to 6.5 mgd of additional flow;

- Upgrade the disinfection capacity to treat an additional 6.5 mgd;
- Upgrade effluent pump station at the WPCP to handle flows; and
- Construction of a new 42-inch outfall to provide capacity for additional flow.

The WPCP upgrades were presented previously in Figure 7.7. As noted in Section 7.3, the capacity of the existing 36-inch outfall would require structural analysis to determine if it can withstand the additional hydraulic pressure from an increase in discharged flow for this alternative.

7.4.1 Modeling Analysis of Conveyance to the WPCP

Table 7.6 presents the results of the model simulation of the typical year for this alternative with respect to flows at the WPCP.

TABLE 7.6
TYPICAL YEAR (1996) FLOWS AT WPCP
CONVEYANCE TO WPCP ALTERNATIVE

Month	Average Daily WPCP Flow (ADF) (mgd)	Permit Exceedence for ADF	Maximum Daily WPCP Flow (MDF) (mgd)	Permit Exceedence for MDF
January	10.3	No	16.2	No
February	9.6	No	13.5	No
March	9.7	No	14.9	No
April	10.2	No	17.0	No
May	9.9	No	11.5	No
June	9.1	No	10.7	No
July	9.4	No	14.9	No
August	9.1	No	11.6	No
September	10.7	No	**20.0**	Yes
October	**12.0**	Yes	**24.7**	Yes
November	10.1	No	15.1	No
December	**12.2**	Yes	**20.9**	Yes

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SCALE 1" = 2000'
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Force Main
Force Main (Alternate Route)
Sub-aqueous Force Main

Figure 7.8
Wellington Avenue CSO Facility
Conveyance to Water Pollution Control Plant
Phase 2 CSO Control Plan

As noted previously, the permitted monthly average daily flow is 10.7 mgd and the maximum daily flow in a month is 19.7 mgd. As noted in Table 7.6, exceedences of the average daily WPCP flow are predicted by the model to occur during two months of the year, with exceedences of maximum daily flow predicted by the model to occur during three months of the year. An additional impact at the WPCP includes increased operation and maintenance costs for solids handling and disinfection of the increased flows.

Impacts to the Washington Street CSO Facility

Based on the simulation of the typical year, conveyance of flow directly to the WPCP from the Wellington Avenue CSO Facility impacts the overflows at the Washington Street Facility. The model predicted a 16% increase in the annual volume of overflow and a 40% increase in the number of events at Washington Street. As noted previously, the average annual CSO volume and frequency of events from 2001 to 2008 at the Washington Street Facility was 30 million gallons and 10 events, respectively. This alternative could potentially increase these totals to 35 million gallons and 14 events on an average annual basis. These increases are due to the pumping limits established at the Long Wharf Pumping Station. The increase in direct flow to the WPCP impacts the ability of the Long Wharf Pump Station to convey the flows from the Wellington Avenue and Washington Street systems, which results in the increase in overflows at Washington Street. Appendix F includes the model results for this alternative.

7.5 Sewer Separation

As noted previously in Sections 2 and 3, the City has performed sewer separation in the Wellington Avenue CSO Facility tributary catchment area. This has included large scale sewer separation projects in the 1970s and more recently, from 2006 through the present. Recent projects have included enhanced sewer separation projects that have included disconnection of roof leaders, catch basins, and sump pumps that were identified as connected to the sanitary sewer system by field investigation work performed as part of Phase 1 Part 1, Phase 1 Part 2, and Phase 1 Part 3. Other work included rehabilitation of manholes with potential or observed leaks and replacement of sanitary sewer pipe with various defects including broken or damage sections, leaks, or sags as observed in the Phase 1 manhole inspection and CCTV inspections programs, respectively.

However, based on the flow metering performed in 2005 and 2007 and the subsequent model calibration, the Wellington Avenue CSO Facility tributary catchment area still exhibits significant quantities of rainfall dependent infiltration and inflow.

Completion of sewer separation in the Wellington Avenue CSO Facility tributary area would consist of the following activities:

- Identification of remaining public and private sources of inflow including connected catch basins, area drains, sump pumps, and roof drains in Catchment Areas 2 and 7 and the private sewer catchment, tributary to Catchment Areas 4 and 7;

- Identification of manhole and pipeline defects contributing to increases in rainfall dependent infiltration in Catchment Areas 1 through 7 and the private sewer catchment, tributary to Catchment Areas 4 and 7; and

- Identification of sewer service defects contributing to increases in rainfall dependent infiltration in Catchment Areas 1 through 7 and the private sewer catchment, tributary to Catchment Areas 4 and 7.

The work required to identify the sources of rainfall dependent infiltration and inflow would include the following:

- Development of a flow metering program in each of the Wellington Avenue tributary catchment areas and at the private sewer catchment connection locations to Catchment Areas 4 and 7 to identify and isolate the subareas within each catchment area with the highest wet weather flows.

- Field investigations, including: infiltration field investigations consisting of closed circuit television inspection, flow isolation, and manhole inspections; and inflow investigations consisting of building inspections, smoke testing, and dye testing. These investigations would be performed on the remainder of the Wellington Avenue system, including the private sewer catchment, which was not field investigated in Phase 1 Part 2 and Phase 1 Part 3.

Figure 7.9 presents the Wellington Avenue tributary catchment areas and the further infiltration and inflow field investigations required to identify these sources for separation.

In addition to disconnecting catch basins, roof leaders and sump pumps, the sewer separation alternative includes pipeline, sewer service lateral, and manhole rehabilitation and replacement to eliminate sources of rainfall dependent infiltration and tidal infiltration. As noted previously, sewer separation work has been completed in Phase 1 Part 3 and the disconnection of catch basins in Catchment Area 6 and the manhole rehabilitation will be performed in 2009. As part of Phase 2, the City is preparing plans and specifications for the construction in 2009 of the High Priority Sewer Pipeline Project, which includes replacement of approximately 11,000 feet of existing vitrified clay and asbestos cement sewer mains.

7.5.1 Modeling Analysis of Sewer Separation

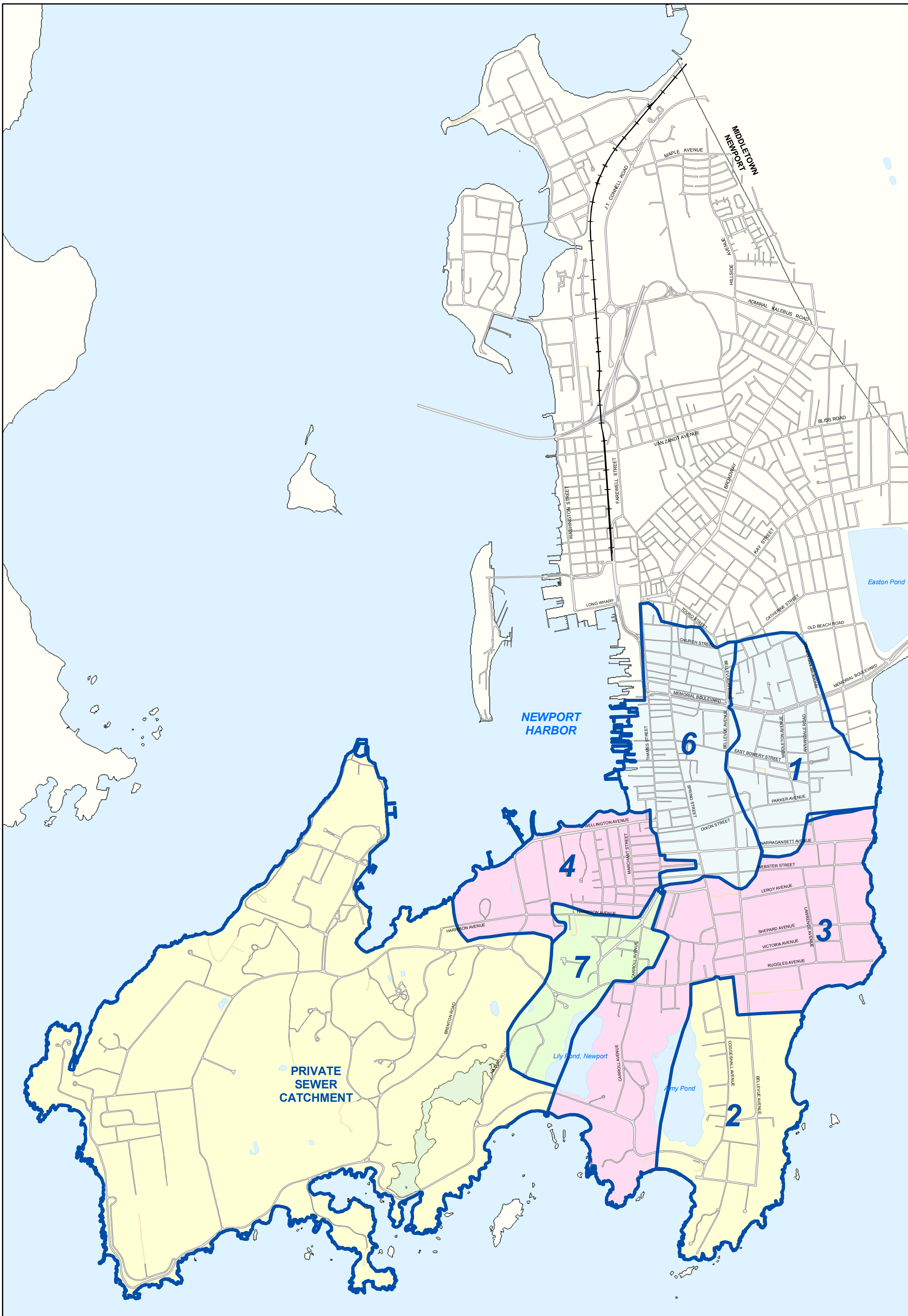
The impacts of sewer separation were analyzed in the model on a "global" or non-site specific basis in the Wellington Avenue catchment area. Since the specific sources of inflow and infiltration remaining to be separated are not known at this time, the model was adjusted by reducing the area contributing inflow and infiltration in each area until the desired reduction in total flow was obtained. This is defined as the "global" reduction. As additional separation work is preformed, the individual catchment areas can be adjusted within the model to reflect the actual removal of identified inflow and infiltration sources. The model was simulated for the typical year with the following sewer separation scenarios:

- Reduction of 30% of the rainfall dependent infiltration and 30% of the inflow;

- Reduction of 50% of the rainfall dependent infiltration and 50% of the inflow; and,

- Reduction of 80% of the rainfall dependent infiltration and 80% of the inflow.

For each scenario, tidal infiltration was eliminated. The results of these simulations at the Wellington Avenue CSO Facility for the typical year simulation are presented in Table 7.7



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Legend

- Perform Infiltration Field Investigations
- Perform Inflow and Infiltration Field Investigations
- Perform Inflow Field Investigations
- Infiltration Field Investigation Partially Complete. Perform Additional Infiltration Field Investigations
- Sewer Catchment Areas

Figure 7.9
Wellington Avenue CSO Facility Infiltration/Inflow Field Investigation Requirements Phase 2 CSO Control Plan

TABLE 7.7
SEWER SEPARATION ALTERNATIVE
WELLINGTON AVENUE CSO FACILITY

Sewer Separation Alternative	Annual CSO Volume	Annual Number of Events	Largest CSO Volume
30% Infiltration and Inflow Reduction	4.0 MG	6	2.3 MG
50% Infiltration and Inflow Reduction	0.35 MG	2	0.34 MG
80% Infiltration and Inflow Reduction	0	0	0

As expected, the sewer separation scenarios reduce the annual volume and frequency of overflows at the Wellington Avenue CSO Facility for the typical year simulations.

Impacts to the Washington Street CSO Facility and WPCP

Based on the simulation of the sewer separation scenarios noted in Table 7.7, sewer separation has positive impacts to annual CSO volume and frequency at the Washington Street Facility. Table 7.8 presents the reductions predicted by the model at the Washington Street Facility for each scenario.

TABLE 7.8
SEWER SEPARATION IMPACTS TO WASHINGTON STREET CSO FACILITY
CSO VOLUME AND FREQUENCY

Sewer Separation Alternative	Predicted Reduction in CSO Volume	Predicted Reduction in CSO Frequency
30% Infiltration and Inflow Reduction	20%	0%
50% Infiltration and Inflow Reduction	50%	15%
80% Infiltration and Inflow Reduction	80%	67%

Tables 7.9 through 7.11 present the results of the sewer separation scenarios for this alternative with respect to flows at the WPCP.

TABLE 7.9
TYPICAL YEAR (1996) FLOWS AT WPCP
SEWER SEPARATION
30% INFILTRATION AND INFLOW REDUCTION

Month	Average Daily WPCP Flow (ADF) (mgd)	Permit Exceedence for ADF	Maximum Daily WPCP Flow (MDF) (mgd)	Permit Exceedence for MDF
January	9.6	No	15.5	No
February	9.0	No	11.1	No
March	9.2	No	12.7	No
April	9.5	No	15.6	No
May	9.2	No	11.5	No
June	8.6	No	9.7	No
July	8.9	No	14.0	No
August	8.6	No	11.0	No
September	9.8	No	17.2	No
October	10.7	No	18.5	No
November	9.4	No	13.2	No
December	**11.1**	Yes	16.7	No

TABLE 7.10
TYPICAL YEAR (1996) FLOWS AT WPCP
SEWER SEPARATION
50% INFILTRATION AND INFLOW REDUCTION

Month	Average Daily WPCP Flow (ADF) (mgd)	Permit Exceedence for ADF	Maximum Daily WPCP Flow (MDF) (mgd)	Permit Exceedence for MDF
January	9.3	No	14.3	No
February	8.7	No	10.6	No
March	8.8	No	11.8	No
April	9.2	No	14.2	No
May	9.0	No	11.0	No
June	8.4	No	9.6	No
July	8.7	No	13.3	No
August	8.4	No	10.2	No
September	9.5	No	17.1	No
October	10.3	No	17.7	No
November	9.1	No	12.6	No
December	10.6	No	15.8	No

TABLE 7.11
TYPICAL YEAR (1996) FLOWS AT WPCP
SEWER SEPARATION
80% INFILTRATION AND INFLOW REDUCTION

Month	Average Daily WPCP Flow (ADF) (mgd)	Permit Exceedence for ADF	Maximum Daily WPCP Flow (MDF) (mgd)	Permit Exceedence for MDF
January	8.7	No	12.0	No
February	8.4	No	9.5	No
March	8.4	No	10.8	No
April	8.7	No	12.7	No
May	8.4	No	9.5	No
June	8.2	No	9.2	No
July	8.3	No	12.2	No
August	8.1	No	9.6	No
September	8.9	No	15.4	No
October	9.5	No	16.3	No
November	8.5	No	11.1	No
December	9.6	No	14.1	No

As expected, review of Tables 7.9 through 7.11 indicates that each of the sewer separation scenarios reduces average daily and maximum daily flows to the WPCP.

7.5.1.1 Enhanced Sewer Separation to be Performed in 2009/2010

As the City continues to disconnect sources identified during the Phase 1 Fieldwork with catch basin disconnection work, manhole rehabilitation and limited sewer pipe replacement, which are scheduled for 2009/2010, a model simulation was run to evaluate the impact on flows as a result of the completion of this work. Table 7.12 presents the Wellington Avenue CSO Facility Annual CSO volumes and events for the typical 1996 simulations and the with the system improvements indicated above through 2009/2010.

TABLE 7.12
WELLINGTON AVENUE CSO FACILITY
ANNUAL CSO VOLUMES AND EVENTS
TYPICAL YEAR 1996 SIMULATIONS

	Annual CSO Volume	CSO Events	Largest CSO Event Volume
Existing Conditions 2007	22.8 million gallons	14	6.9 million gallons
Existing Conditions 2008 Baseline Model	20.0 million gallons	11	6.4 million gallons
Future Conditions 2010 Model	19.2 million gallons	11	6.25 million gallons

7.5.2 Sewer Separation Alternatives

Based on the modeling results of the sewer separation alternative, it appears that in order to eliminate overflows at the Wellington Avenue CSO Facility, approximately 80% of the extraneous infiltration and inflow would need to be removed from the system that would require virtually full replacement of the existing collection system to approach such a high removal rate. This alternative would likely not only eliminate overflows at the Wellington Avenue facility for the largest storm in the typical year, but also for storms greater than this storm as well. However, reconstruction of the entire system would be extremely expensive, highly disruptive, and would need to be constructed over at least 20 years. However, reduction of flows generated by rainfall induced infiltration and inflow in combination with storage is a viable CSO control alternative. Larger reductions of inflow and infiltration would require less storage, 350,000 gallons for the 50% inflow and infiltration reduction and zero storage for the 80% inflow and infiltration reduction. Both alternatives require much more extensive sewer system rehabilitation and replacement.

Alternatively, reduction of flows generated by rainfall induced infiltration and inflow by 30% in combination with storage on the order of 2 mg is a more attainable CSO control alternative. This sewer separation alternative, and the full (80%) sewer separation alternative are evaluated with respect to cost in Section 8.

Appendix F includes the model results for this set of alternatives.

7.6 Thames Street Flow Regulator Analysis

The model was used to evaluate the impact of removing the existing inverted weirs located in structures at the intersection of Wellington Avenue and Thames Street, Young Street and Thames Street, and Franklin Street and Thames Street. These weirs serve to provide hydraulic control on the existing system flows.

This optimization feature was analyzed with respect to its impacts on the overflows at the Wellington Avenue and Washington Street CSO Facilities and the flows to the WPCP. The model was simulated for the scenarios of either maintaining or eliminating the flow control weirs at the three locations on the Thames Street Interceptor. The model was simulated for the wettest period in the typical year, which occurred from September 16, 1996 through October 30, 1996. The storms with the largest rainfall depth occurred during this period. The results of this model simulation are presented in Table 7.13.

TABLE 7.13
SYSTEM OPTIMIZATION IMPACT ON THE VOLUME OF CSO AT THE WELLINGTON AVENUE AND WASHINGTON STREET CSO FACILITY AND THE WPCP FLOW

Facility	Existing Conditions With Inverted Weirs	Elimination of Inverted Weirs,
Wellington Avenue Total CSO Volume (mg)	12.9	11.4
Washington Street Total CSO Volume (mg)	4.1	4.6
WPCP Flow (mg)	507.3	525.8

Review of Table 7.13 indicates that while removal of the inverted weirs along the Thames Street Interceptor allows more flow to be conveyed out of the Wellington Avenue CSO Facility Tributary Area, it results in an increased volume of CSOs at the Washington Street CSO Facility.

7.7 Wave Avenue Pump Station Analysis

Impacts of flows from the Wave Avenue Pump Station in Middletown were evaluated with the model. It was determined that high wet weather flows from the Wave Avenue Pump Station increase the frequency and volume of CSOs at both the Wellington Avenue CSO Facility and the Washington Street CSO Facility, with a much more significant impact on the Washington Street CSO Facility. This is illustrated in Table 7.14 which summarizes the impacts to overflows at the Wellington Avenue CSO Facility and the Washington Street CSO Facility for the three largest rain events that occurred in the typical year.

TABLE 7.14
IMPACTS TO CSO FACILITIES FROM WAVE AVENUE PUMP STATION FLOWS
TYPICAL YEAR 1996 SIMULATION SEPTEMBER THROUGH OCTOBER

Flow From Wave Avenue Pump Station (mgd)	CSO Volume at Wellington Avenue CSO Facility (MG)			CSO Volume at Washington Street CSO Facility (MG)		
	9/17/96	10/8/96	10/20/96	9/17/96	10/8/96	10/20/96
	2.78 inches	2.36 Inches	3.05 inches	2.78 inches	2.36 inches	3.05 inches
1.5	3.37	2.98	6.29	0.38	0.22	0.95
3.7	3.45	3.04	6.39	0.62	1.32	2.19
7.2	3.57	3.17	6.56	6.74	4.15	7.55

The flows used for the model simulation from the Wave Avenue Pump Station were developed as follows:

- 1.5 MGD – Obtained from recent flow data recorded by the SCADA system at the WPCP measuring the Wave Avenue Pump Station output during dry weather.
- 3.7 MGD – The assumed flow from the Wave Avenue Pump Station to the WPCP under maximum daily flow conditions; and
- 7.2 MGD – Obtained from recent flow data recorded by the SCADA system at the WPCP measuring the Wave Avenue Pump Station output during wet weather.

Based on the results presented in Table 7.14, while the flows from Wave Avenue have a relatively minor effect on the Wellington Avenue CSO Facility, there is a much more significant effect of the Wave Avenue Pump Station’s flows on the Washington Street Facility. The CSO volumes at the Wellington Avenue CSO Facility decrease when the flow from Wave Avenue is reduced. However, the overflows at the Washington Street CSO Facility are more directly impacted from flows from Wave Avenue. Increases in flow from the Wave Avenue Pump Station result in an increase in overflow volume at Washington Street.

7.8 Evaluation of Alternatives

7.8.1 Siting Issues

7.8.1.1 Centralized and Decentralized Storage

Potential locations for the centralized storage alternative were presented in Figure 7.1 and proposed locations for decentralized storage were presented in Figure 7.2 and 7.3. Due to the large land area requirements for storage facilities of the magnitude required to capture large CSO volumes, these locations include the Kings Park ball field adjacent to the Wellington Avenue CSO Facility and Spencer Park for the centralized alternative. For the decentralized alternative, in addition to the noted locations for centralized storage, Morton Park was also considered. The land use for these areas is currently recreational. Short-term impacts due to construction activities associated with the storage alternatives would include dust, noise, and traffic impacts to businesses and residents in the vicinity of the project site. Utility relocations would likely be required. Due to the volume and depth requirements for the subsurface storage tanks, construction would include deep excavations, extensive construction dewatering, pouring of concrete, and backfill. These activities would be strictly controlled and monitored during construction to prevent impacts to abutting properties. Recreational activities in the parks would be required to cease during the construction of the storage tanks. However, since the storage tanks would be largely constructed underground, the design of the tanks could incorporate mitigation measures to restore or enhance the recreation uses upon project completion. This could include landscaping and walking trails, parking areas, play yards, construction of additional features for the ball field (such as dugouts, fixed seating, scoreboards, concession stands etc.), or other amenities.

With respect to expanding the storage capacity of the Narragansett Avenue Storage Conduit, this work would be performed in the City’s right-of-way. Construction impacts would include noise, dust, and traffic.

7.8.1.2 Conveyance to the Long Wharf Pump Station

The work associated with this alternative includes upgrades at the Wellington Avenue CSO Facility and the Long Wharf Pump Station. The upgrades to the Long Wharf Pump Station could impact adjacent City owned lots if expansion or reconstruction of the pump station is required. Construction at the Wellington Avenue Facility to expand its pumping capacity could be accomplished on-site with minimal impacts to abutting properties. Construction activities would be disruptive to local businesses and residents. Utility relocations would be significant.

Reconstruction of the Long Wharf Pump Station would be problematic due to its downtown location and the constraints on space for contractor staging. In addition, this alternative considered construction of a force main between the two facilities either via a sub-aqueous route across Newport Harbor or along City streets. In addition to the typical noise, dust, and traffic impacts, construction of the force main would have significant impacts. The overland force main route would be highly disruptive to existing downtown businesses and residents and would require significant utility relocation.

With regard to the sub-aqueous route, construction in Newport Harbor would impact shore based recreation, bathing, boating, and fishing activities. In addition to recreational boating, construction within Newport Harbor would have to be highly planned and coordinated with the Harbormaster to determine impacts to local commercial fishing, shipping, ferries and other passenger and commuter boats, the U.S. Coast Guard and the U.S. Navy. Impacts to these activities could be mitigated by requiring construction in the late fall, winter, and early spring. Construction of a force main along City streets, via Wellington Avenue, Thames Street (or Spring Street) to America's Cup Avenue to the Long Wharf Pump Station would be highly disruptive to existing traffic, businesses, and residences and would likely require significant utility relocation. Again, construction could be limited to late fall and winter months to minimize these impacts.

This alternative also requires improvements to be constructed at the WPCP. The expansion of the plant unit processes would include construction of additional storage tanks, pumping, disinfection and solids handling equipment within the existing WPCP property. Construction impacts would include dust, noise and occasional traffic disruptions. Construction of a new 42-inch outfall would be highly disruptive and problematic due to the requirement to route it through the existing US Navy property and then to extend the outfall into Newport Harbor.

7.8.1.3 Conveyance to the WPCP

The work associated with this alternative includes upgrades at the Wellington Avenue CSO Facility and the WPCP. The requirements at the Wellington Avenue CSO Facility are noted in Section 7.8.1.2.

This alternative considered construction of a force main between the Wellington Avenue CSO Facility and the WPCP either via a sub-aqueous route across Newport Harbor or along City streets. The impacts for each route are similar to those presented in Section 7.8.1.2; however, the length of the force main for each alternative route is 3.5 times longer. This would result in much more widespread impacts to activities either within Newport Harbor or to residents and businesses along the City streets and along the railroad easement along the overland force main route. The overland routing would be highly problematic where the force main is required to cross Route 138.

The siting issues associated with the upgrades at the WPCP are the same as those noted in Section 7.8.1.2.

7.8.1.4 Sewer Separation

Work associated with the sewer separation alternative would occur in two phases:

- Field activities to locate the sources of rainfall dependent inflow and infiltration on public and private property; and

- Construction activities to eliminate the sources of inflow and infiltration.

The construction would include work on existing City streets to replace or rehabilitate existing sewer pipelines and manholes and to disconnect catch basins from the sanitary sewer system and reconnect the catch basins to the storm drain system. Construction impacts would include dust, noise, and traffic disruptions in the areas of work as well as utility relocations. Inflow and infiltration sources that are identified on private property would include disconnection of roof leaders, replacement or rehabilitation of sewer service laterals, and disconnection of yard/area drains connected to the sanitary sewer. Construction would involve work on individual properties. Impacts from work on private properties could be significant but usually occurring over a short (1 to 2 days) period of time.

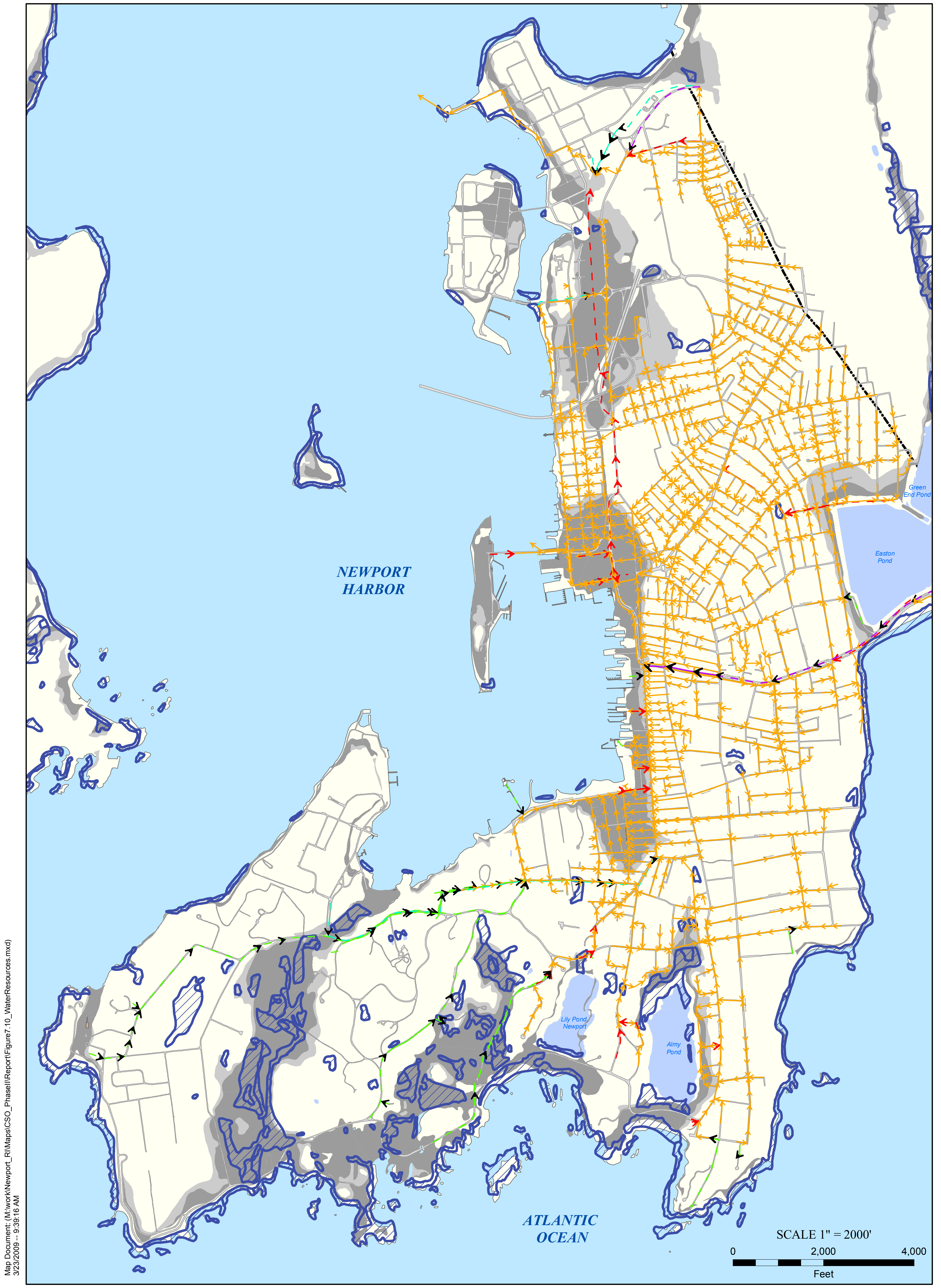
7.8.2 Environmental Issues

Rhode Island Geographic Information System (RIGIS) data were reviewed to determine potential environmental issues and constraints related to the CSO control alternatives. Figure 7.10 presents water resources areas, such as wetlands and 100-year and 500-year floodplains in Newport, and Figure 7.11 presents historic districts and sites, conservation land, leaking underground storage tank and hazardous materials locations, and rare species. Environmental issues relative to the CSO control alternatives are presented in Table 7.15.

TABLE 7.15
ENVIRONMENTAL ISSUES

CSO Control Alternative	Floodplains	Wetlands	Rare Species	Hazardous Materials	Historic Sites and Districts	Conservation Land
Centralized Storage	Yes	No	No	No	No	Yes
Decentralized Storage	Yes	Yes	No	No	No	Yes
Conveyance to Long Wharf Pump Station	No	Yes (Sub-aqueous Route)	No	No	Yes	No
Conveyance to the WPCP	No	Yes (Sub-aqueous Route)	No	Yes	Yes	No
Sewer Separation	Site Specific, To Be Determined	Site Specific, To Be Determined	Site Specific, To Be Determined	Site Specific, To Be Determined	Site Specific, To Be Determined	Site Specific, To Be Determined

Each of these issues would require further analysis and evaluation during the permitting and design phases. The environmental review process for the marine pipeline construction and the construction of the new WPCP outfall would be especially arduous and would likely take several years to complete. Environmental issues related to sewer separation projects would likely be limited since the majority of the construction activities occur either on public streets or on private property. However, once the location and extent of the sewer separation projects are determined, the issues can be identified and addressed.



MARCH 2009

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FEMA Floodplain

Flood Zone

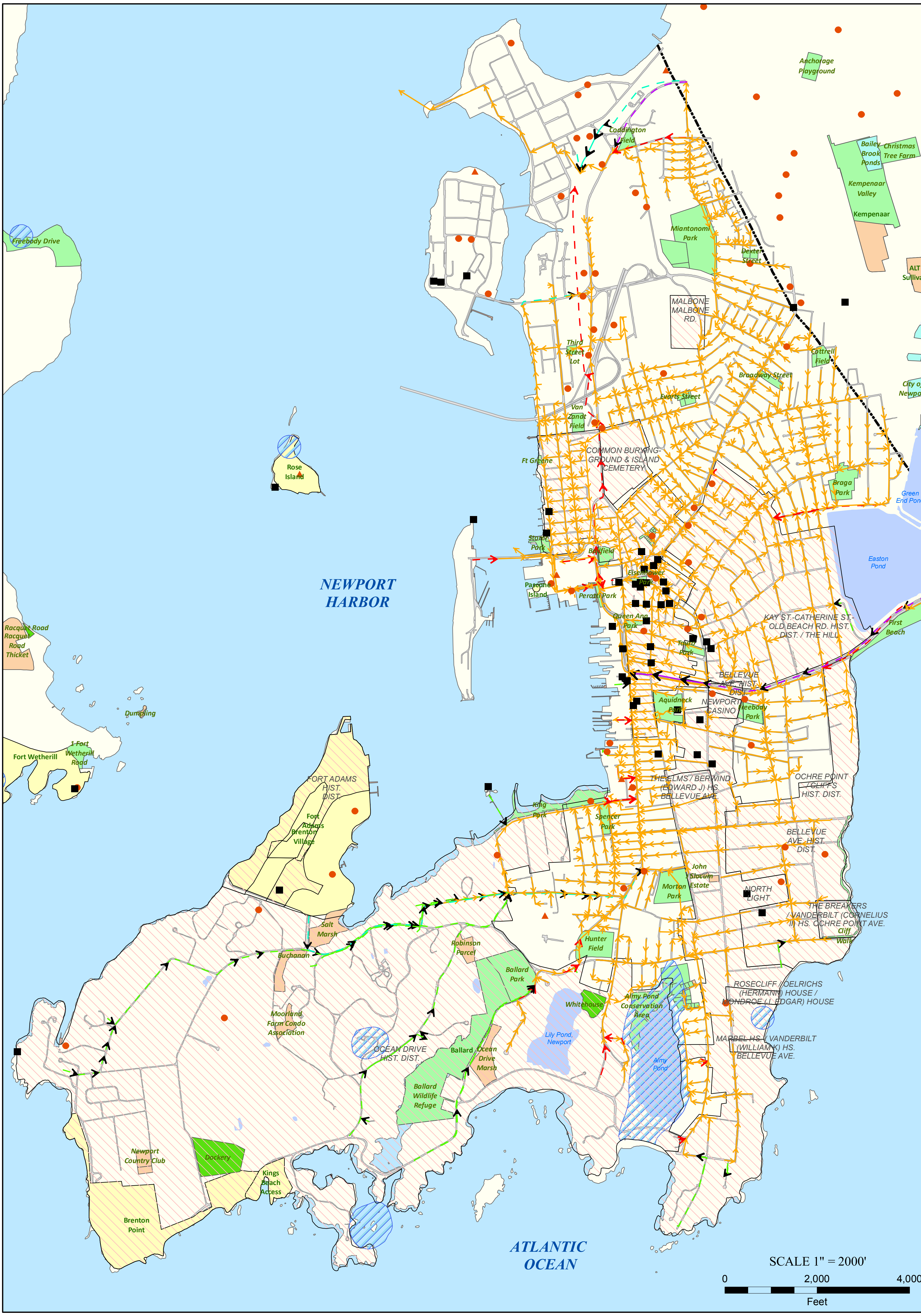
- 100-Year
- 500-Year
- Wetland

- Force Main - Public
- Force Main - Private
- Force Main - Navy
- Force Main - Middletown
- Gravity Main - Public
- Gravity Main - Private
- Gravity Main - Navy
- Gravity Main - Middletown

Resource data provided by:

RIGIS

Figure 7.10
Wellington Avenue CSO Facility
Water Resources
Phase 2 CSO Control Plan



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AECOM

Resource data provided by:

RIGIS

- CERCLIS Site
- Leaking Underground Storage Tank
- Historic Site
- Historic District
- Rare Species
- State Conservation Land

Non-State Conservation Land
Jurisdiction

- Federal
- Municipal
- NGO
- Private
- Utility

- Force Main - Public
- Force Main - Private
- Force Main - Navy
- Force Main - Middletown
- Gravity Main - Public
- Gravity Main - Private
- Gravity Main - Navy
- Gravity Main - Middletown

Figure 7.11
Wellington Avenue CSO Facility
Resource Areas
Phase 2 CSO Control Plan

7.8.3 Institutional Issues

The City of Newport provides wastewater collection and treatment for the majority of its residents, and treatment of wastewater for the Town of Middletown and the U.S. Navy. Policy and financial decisions regarding wastewater collection and treatment are made by the City Council in consultation with the Department of Utilities. Presently, the wastewater collection system, pump stations, CSO treatment facilities, and the water pollution control plant are operated and maintained by United Water, a private operator under contract to the City.

The institutional issues related to the CSO control alternatives include the impacts of construction of new facilities (i.e., storage tanks, wet weather pumping improvements, WPCP wet weather improvements) on existing operation and maintenance costs and staffing levels and the impact of the increased flows to the existing wastewater pumping and treatment facilities. Institutional issues relative to the CSO control alternatives are summarized in Table 7.16.

TABLE 7.16
INSTITUTIONAL ISSUES

CSO Control Alternative	Increased Flows to Long Wharf Pump Station	Increased Flow and Treatment at WPCP	Impacts to Washington Street CSO Facility CSO Frequency and Volumes	Increased Operation and Maintenance Requirements	Increased Staffing Requirements
Centralized Storage	Yes	Yes	Reduces	Yes	Yes
Decentralized Storage	Yes	Yes	Reduces	Yes	Yes
Conveyance to Long Wharf Pump Station	Yes	Yes	Increases	Yes	Yes
Conveyance to the WPCP	Yes	Yes	Increases	Yes	Yes
Sewer Separation	No	No	Reduces	Yes	To Be Determined

Although the sewer separation alternative results in a decrease in flows to the Long Wharf Pump Station, the Washington Street CSO Facility and the WPCP, increased operation and maintenance of the storm drain system would be anticipated due to construction of new catch basins and storm drains. Increases in staffing levels would need to be determined based on the extent of new storm drain systems that are constructed.

7.8.4 Regulatory/Permitting Issues

Each of the CSO control alternatives will involve a rigorous permitting process. Table 7.17 includes a summary of major permits that are likely required for each of the CSO control alternatives.

TABLE 7.17
MAJOR PERMITTING REQUIREMENTS

CSO Control Alternative	Army Corps of Engineers Dredge and Fill Permit	USEPA NPDES Permit (Land Disturbance of 1 acre or more)	RIDEM	Coastal Resources Management Program	RIDOT	Natural Heritage Program
Centralized Storage	Yes	Yes	Yes	Yes	No	No
Decentralized Storage	Yes	Yes	Yes	Yes	No	No
Conveyance to Long Wharf Pump Station	Yes (Sub-aqueous FM route)	No	Yes	Yes (Sub-aqueous FM route)	No	Potential, To Be Determined
Conveyance to the WPCP	Yes (Sub-aqueous FM route)	No	Yes	Yes (Sub-aqueous FM route)	Yes (Overland FM Route)	Potential, To Be Determined
Sewer Separation	No	No	Site Specific, To Be Determined	Site Specific, To Be Determined	Site Specific, To Be Determined	Site Specific, To Be Determined

USEPA: United States Environmental Protection Agency
RIDEM: Rhode Island Department of Environmental Management
RIDOT: Rhode Island Department of Transportation

The permitting process for the marine pipeline conveyance options would be long and difficult. In addition, increasing the flows to the WPCP and construction of a new outfall would be highly scrutinized by RIDEM and the USEPA and gaining approval would be problematic.

7.9 Preliminary Selection of Recommended Alternative Based on Non-Cost Considerations

The CSO control alternatives were evaluated with respect to eliminating CSO's at the Wellington Avenue CSO Facility; the impacts to CSO frequency and volume at the Washington Street CSO Facility; total flows to the WPCP and with regard to the siting, environmental, institutional, and permitting issues presented above. Table 7.18 summarizes the results.

Review of Table 7.18 indicates that the alternative that eliminates CSOs during the typical year reduces impacts to the Washington Street CSO Facility and the WPCP as well as with the least potential siting (i.e., construction impacts), environmental, institutional, and permitting issues appears to be a combination of aggressive sewer separation with centralized storage. The costs associated with the individual CSO controls are included in Section 8, Cost Analysis.

TABLE 7.18
CSO CONTROLS ALTERNATIVES ANALYSIS SUMMARY

CSO Control Alternative	Elimination of CSOs at the Wellington Avenue CSO Facility for the Typical Year	Impacts to CSO Frequency and Volume at the Washington Street CSO Facility	Impacts to Water Pollution Control Plant Average Daily and Maximum Flows	Construction Impacts	Floodplain Impacts	Wetlands Impacts	Rare Species	Hazardous Materials	Conservation Land Impacts	Institutional Impacts	Rigorous Permitting Required
Centralized Storage	Yes	Reduces	Increases	Yes	No	No	No	No	Yes	Yes	Yes
Decentralized Storage	Yes	Reduces	Increases	Yes	No	Yes	No	No	Yes	Yes	Yes
Conveyance to Long Wharf Pump Station	Yes	Increases	Increases	Yes	No	Yes (Sub-aqueous Route)	No	No	No	Yes	Yes
Conveyance to the WPCP	Yes	Increases	Increases	Yes	No	Yes (Sub-aqueous Route)	No	Yes	No	Yes	Yes
Sewer Separation	Yes	Reduces	Reduces	Yes	Site Specific, To Be Determined	Site Specific, To Be Determined	Site Specific, To Be Determined	Site Specific, To Be Determined	Site Specific, To Be Determined	Yes	No