5.0 CSO Control

This section presents an overview of the range of CSO control alternatives evaluated as part of these Phase 2 investigations.

5.1 Overview of Abatement Technologies

In order to eliminate or minimize CSO flows and associated environmental impacts, there are a variety of abatement alternatives available, including:

- Implementation of the Nine Minimum Controls, as dictated by the EPA;
- Separation of the combined sewer system into separate sewer and stormwater systems;
- In-line storage within the existing system utilizing either tanks or oversized conduits to provide extra storage capacity;
- Off-line storage parallel to the existing system utilizing tanks, conduits, or underground tunnels;
- Satellite treatment of flow at specific CSO outfall locations;
- Elimination or relocation of CSO outfall(s); and
- Conveyance and treatment at the existing water pollution control plant (WPCP).

These alternatives vary in their complexity, effectiveness, associated capital costs, and land use. Local situations such as available space, desired CSO treatment capacity, and available financial resources will ultimately dictate the abatement technology that is selected for implementation.

5.2 Nine Minimum Controls

5.2.1 Nine Minimum Controls - Overview

The Nine Minimum Controls are minimum technology-based controls which reduce the impact of CSOs on receiving water quality, do not require significant engineering studies or major construction, and can be implemented within a relatively short timeframe. The Nine Minimum Controls are:

1. Proper operation and regular maintenance programs for the sewer system and the CSOs
2. Maximum use of the collection system for storage
3. Review and modification of pretreatment requirements to assure CSO impacts are minimized
4. Maximization of flow to the publicly owned treatment works for treatment
5. Prohibition of CSOs during dry weather
6. Control of solid and floatable materials in CSOs

7. Pollution prevention

8. Public notification to ensure that the public receives adequate notification of CSO occurrences and CSO impacts

9. Monitoring to effectively characterize CSO impacts and the efficacy of CSO controls.

Implementation of the Nine Minimum Controls is one of the first steps taken under EPA's CSO Policy to reduce CSO flow and improve environmental quality. (EPA, Combined Sewer Overflow, Guidance for Long-Term Control Plan.)

5.2.2 Nine Minimum Controls in Newport

The City has implemented a number of programs to satisfy the requirements of the Nine Minimum Controls, which are part of EPA and RIDEM's CSO Control Policy. Those programs are summarized in Table 5.1 on the following page.

In addition to these Nine Minimum Controls, the City prepared a Phase II Stormwater Management Plan in 2004. The City currently performs street sweeping and catch basin cleaning. Street sweeping of each street is performed annually, and downtown areas are swept more frequently. Inspections and cleaning of catch basin as required are performed on an annual basis using the GIS system to track the effort. In areas where chronic high sediment accumulation is observed, the catch basins are cleaned on a more frequent basis. The City also performs catch basin inspections for illicit connections and non-stormwater discharges, including illegal dumping, and hazardous waste/material spills during the annual catch basin inspection program. Areas where floatables controls are needed are identified as part of this program. A revision to the City's Zoning ordinance requires that design and construction of new stormwater systems must prepare and implement a Stormwater Management Plan consistent with the RIDEM "Rhode Island Stormwater Design and Installation Standards Manual".

TABLE 5.1
CITY OF NEWPORT'S COMPLIANCE WITH EPA'S NINE MINIMUM CONTROLS

Nine Minimum Controls	City of Newport's Compliance Effort
1. Proper operation and maintenance programs for sewer systems and CSOs	The City regularly maintains the wastewater and storm drain collection system, CSO outfalls, regulators, pump stations, CSO treatment facilities and the Newport Water Pollution Control Plant. Collection system staff inspect each underground component a minimum of once every three years and perform corrective actions when deficiencies are found.
2. Maximize use of collection system storage	The City manages diversion structures to maximize flows in the interceptors and to maximize utilization of the Narragansett Avenue Storage Conduit to store system flows and reduce CSO discharges.
3. Review and modification of pretreatment requirements to ensure CSO impacts are minimized	The City has an Industrial Pretreatment Program (IPP) that has been approved by RIDEM. The IPP consists of a final pretreatment ordinance and an enforcement response plan.
4. Maximization of flow to secondary treatment plant for treatment	The system is operated to maximize flow to the Newport Water Pollution Control Plant. Recent efforts have included upgrades to the pumping capacity of the Long Wharf Pump Station and modifications to the operation of the Narragansett Avenue Storage Conduit to maximize conveyance of flow to the WPCP. In addition, microstrainer chamber backwash pumps are used to maximize flows to the Thames Street Interceptor.
5. Elimination of CSOs during dry weather	Dry weather overflows are prohibited. Operation and maintenance activities are directed at the prevention of dry weather overflows.
6. Control of solid and floatable materials in CSOs.	Screening of influent flows is provided at the Wellington Avenue and Washington Street CSO Facility. Street sweeping is routinely performed. Catch basins are inspected and cleaned as required on an annual basis.
7. Pollution prevention programs to reduce contaminants in CSOs	The City has implemented both an Industrial Pretreatment Program (IPP) and participates in Rhode Island Resource Recovery Corporation (RIRRC) Hazardous Waste Program to reduce discharge of chemicals and other substances that negatively impact the environment and the wastewater treatment process.

TABLE 5.1 (Cont.)
CITY OF NEWPORT'S COMPLIANCE WITH EPA'S NINE MINIMUM CONTROLS

Nine Minimum Controls	City of Newport's Compliance Effort
8. Public notification program to ensure that the public receives adequate notice of CSO events and impacts	The City has a CSO posting and notification program.
9. Monitoring to effectively characterize CSO impacts and the efficiency of CSO controls.	The City conducts a Harbor Monitoring Program which includes the collection of water quality samples in Newport Harbor at 10 sites selected by the RIDEM on a weekly basis. The samples are each tested for water temperature, pH, Biochemical Oxygen Demand (BOD) Total Suspended Solids (TSS), fecal coliform, Enterococci, TKN, and salinity . In addition the program includes water quality monitoring during to CSO events per year. For the CSO monitoring water quality samples are collected at two of the sampling sites representative of the effects of the Washington and Wellington CSO outfalls before, during, and after the event. The samples are monitored for the same parameters as the weekly sampling program except Total Nitrogen replaces TKN. The monitoring results are submitted to the Rhode Island Department of Environmental Management (RIDEM).

5.3 Sewer Separation

Sewer separation is the conversion of a combined sewer system into separate sewer and stormwater systems, and has historically been used by many communities as a means of eliminating CSOs. Separating the sewer and stormwater system reduces flow into the wastewater treatment facilities by decreasing the large volume of surface run-off produced during a storm event. It also can be an effective means of preventing sanitary flow from discharging directly into the environment by eliminating the CSOs. Sewer separation, however, is an expensive means of eliminating CSOs, and causes major disruptions in traffic and community activities during construction. In addition, it may increase the amount of stormwater run-off pollutants discharged directly into the receiving waters, which would have otherwise been treated at the wastewater treatment plant. Also, sewer separation is not always totally effective due to private sources such as roof leaders, yard drains and sump pumps, which are not easily identified and removed.

For the most part, a new storm drain system was installed and the former combined sewer was left in place to serve as the sanitary sewer, but roof leaders, sump pumps, basement drains, and area drains on private property were generally not disconnected. Flows from these sources continued to be discharged into the sanitary sewer system. Based on the flow metering conducted in March 2005, the system exhibits a significant increase in flows due to rainfall dependent infiltration and inflow (I/I). Increased flows during wet weather were also observed in the subsequent 2006, 2007, and 2008 metering periods. Enhanced sewer separation involves activities to identify and eliminate these sources. Please refer to Section 2 for information regarding past studies of the sewer system.

5.4 In-line Storage

In-line storage 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.

In-line storage may be accomplished in the existing sewer system via gates or inflatable dams placed within the system to temporarily hold sewage within existing pipes to reduce the volume of flow reaching receiving waters. This is a low cost way to reduce CSO flow, and can reduce the required level of additional CSO controls, capture the heavy pollutant load in the first flush of water, and optimize the sewer flows treated at the water pollution control plant. Disadvantages to this system include potential basement or surface flooding, accelerated structural failure of the system, and possible septic odors. It is generally more suited for small, localized rainfall events, since during larger events the collection system will be needed for conveyance. A schematic diagram of in-line storage is shown in Figure 5.1.

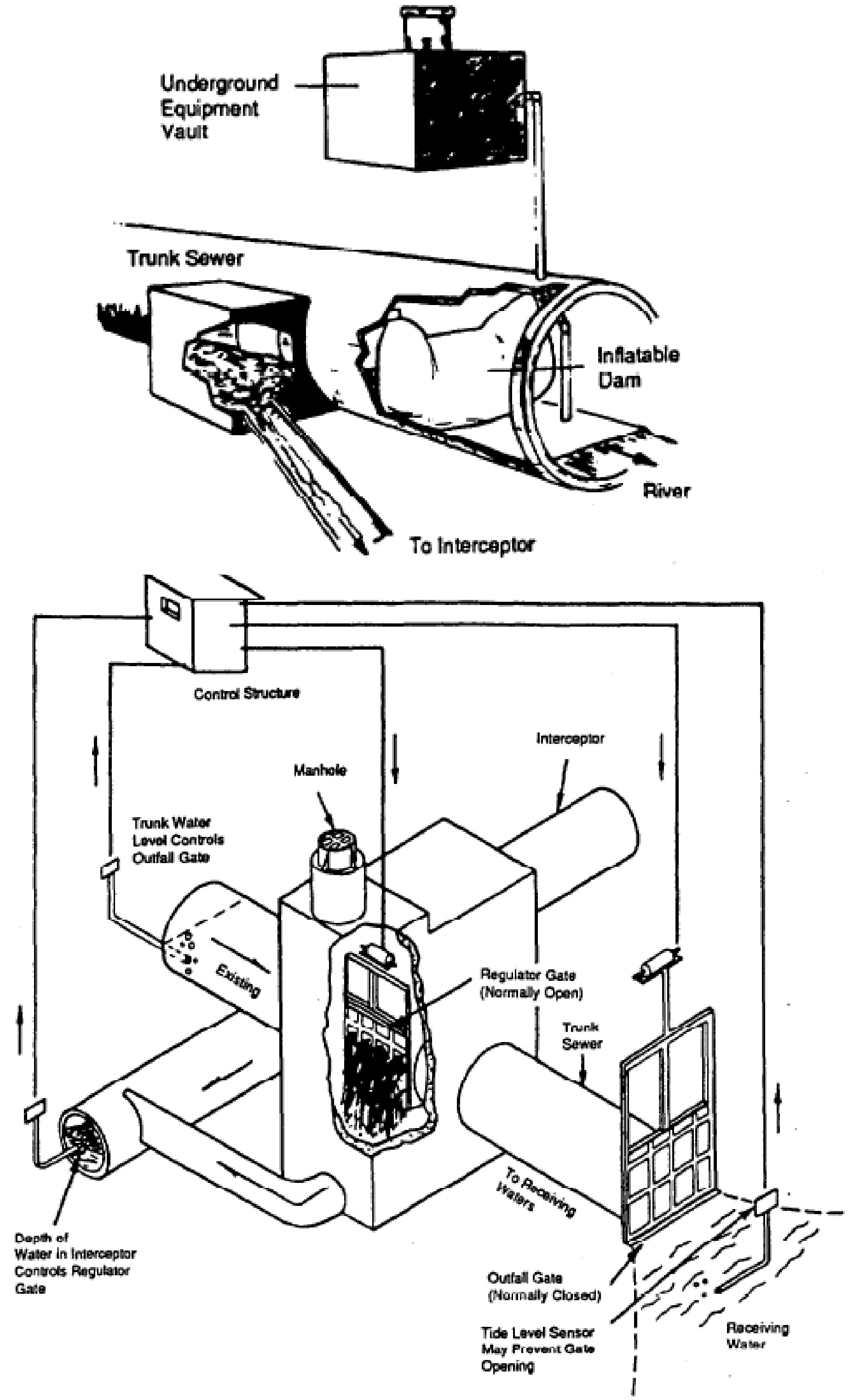

Figure 5.1
In-Line Storage Schematic Diagram
(Source: EPA Combined Sewer Overflow Control Manual, 1993)

5.5 Off-line Storage

Off-line storage 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 pumpout) 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 in the existing system again becomes available.

Storage can either be centralized (i.e. the majority of the storage is held in one location near the CSO discharge) or decentralized (i.e. stored flow is dispersed throughout various locations), depending on the system and surface layout.

5.5.1 Sedimentation Tanks

Storage or sedimentation tanks may be used for off-line storage, either as part of the system or in close proximity to the CSO. Tanks are usually fed by gravity, and the stored flow is later pumped back to the interceptor when the storm subsides. Storage tanks capture the first flush during a storm, and provide later flows with treatment up to a certain level. Sedimentation occurs during holding, allowing flow to receive solid's separation before leaving when flow exceeds the tank capacity. In some cases, treatment may also include disinfection of the water, particularly for the overflow. Storage or sedimentation tanks can effectively reduce the number of overflow events and the associated flow volume, and are good for early action at critical outfalls. However, the cost associated with these tanks is high in comparison to the volume of flow stored and treated, and the operation and maintenance costs are relatively high.

5.5.2 Tunnels

Deep tunnels may also be used to store excess flow during a storm event. Tunnels are generally constructed several hundred feet below the ground surface, and may cover a large geographical area. Because they are underground, once they are constructed, they cause minimal disturbance to the ground surface while maintaining a large storage capacity. They can be built underneath existing rights-of-ways and are generally the preferred method of storage in urban areas where the required volume of storage is high and space is limited. Tunnels may also double as conveyance facilities, and have a low maintenance cost in comparison with surface storage tanks. However, construction costs are generally much higher than for surface facilities and are highly dependent on geography, geology, and surface conditions. Storage tunnels will typically have a pump chamber at one end to pump the stored flow back to the main interceptor. An example is shown in Figure 5.3.

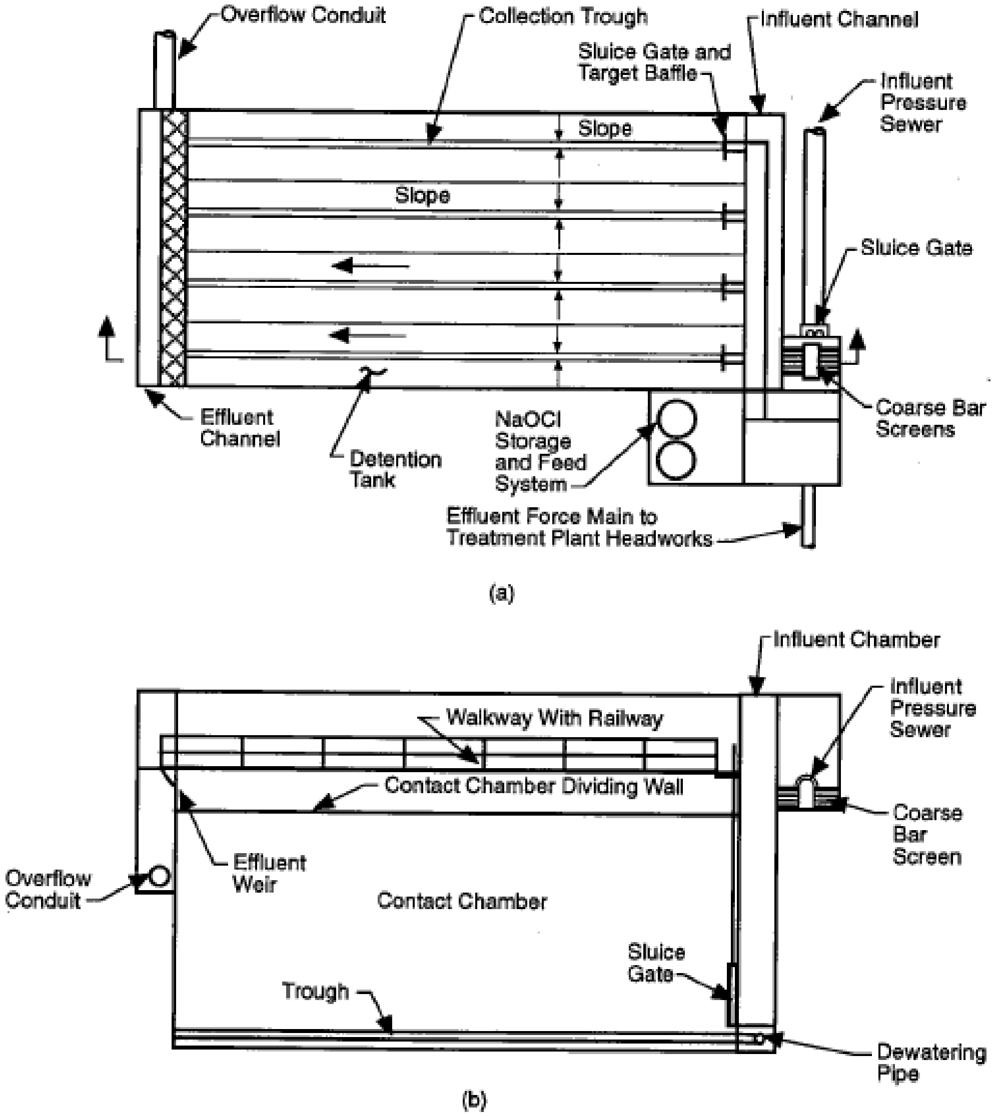

Figure 5.2
Sedimentation Tank Schematic Diagram
(Source: Metcalf and Eddy, Wastewater Engineering, 1991)

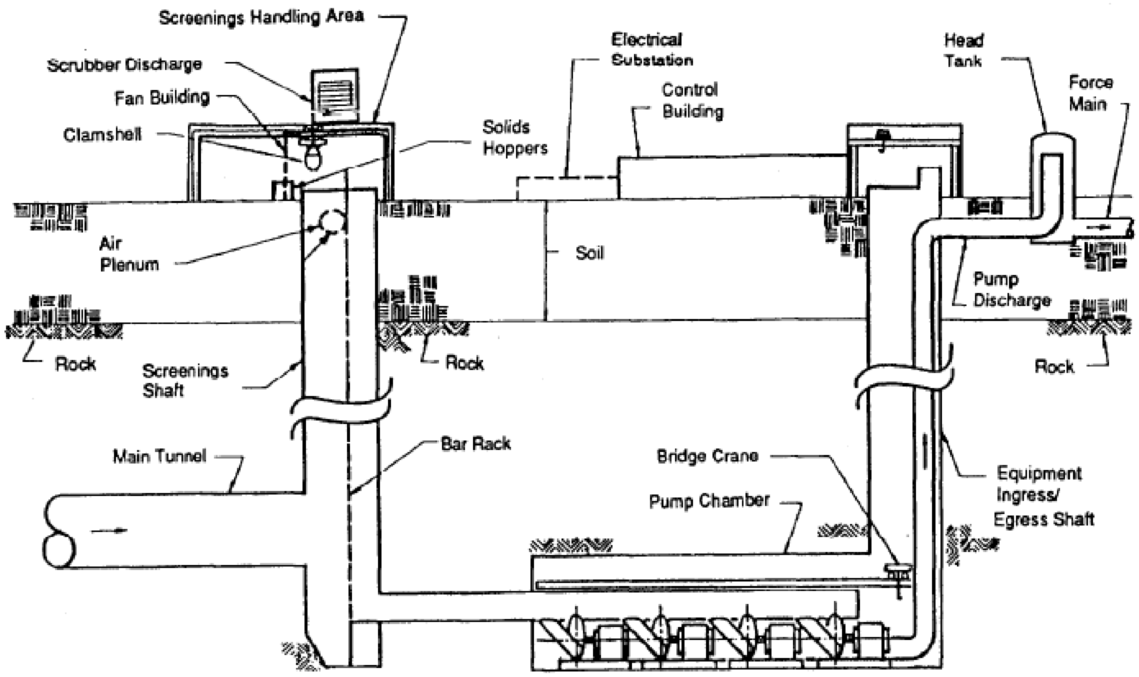

Figure 5.3
Tunnel Storage Schematic Diagram
(Source: EPA Combined Sewer Overflow Control Manual, 1993; sourced from MWRA, 1990)

5.6 Satellite Treatment

As an alternative to temporary flow storage, satellite treatment may be used for wet weather flow. A diversion structure is used to reroute wet weather flow to a storage tank, while allowing a portion of the flow to continue to the water pollution control plant. After entering the storage tank, the flow may either be treated or returned to the sewer line via post event pumping. If treated, flow will enter a vortex separator or similar device, separating the solids. The underflow, containing solids, is returned to the sewer system, while the overflow may either be discharged directly to receiving waters or may undergo disinfection before being discharged. A weir is used inside the division structure so that flow beyond the capacity of the storage tank will discharge directly to the CSO. Different treatment technologies can target specific pollutant constraints, and the level of treatment may vary from simple to complex. Satellite treatment cannot be implemented unless there is adequate space available near the CSO for installation and maintenance of the necessary equipment and appurtenant structures. While satellite treatment reduces the amount of solids and pollutants discharged to receiving waters, the associated operation and maintenance costs may be high. Figure 5.4 demonstrates a typical satellite treatment set-up.

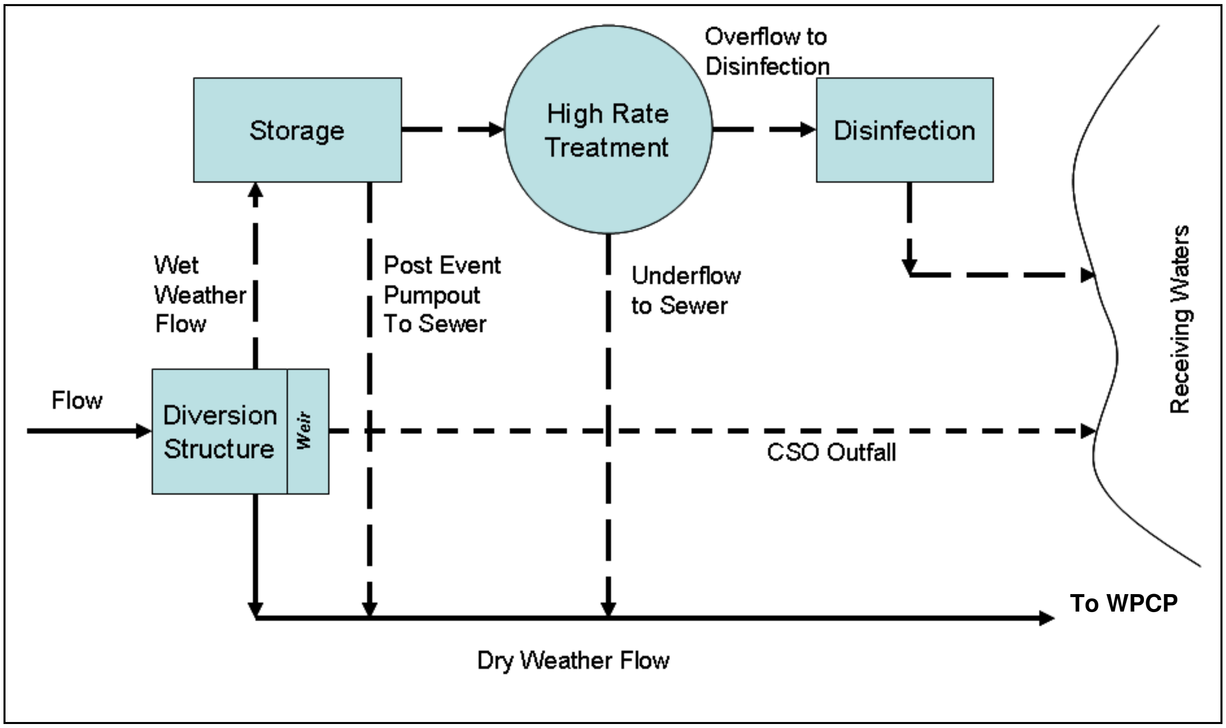

Figure 5.4
Satellite Treatment Schematic Diagram

5.7 Outfall Relocation/Elimination

Outfall relocation or elimination may be used as a method to remove pollutants from areas of environmental concern by either redirecting the flow to another outfall or by completely eliminating the outfall. This removes pollutants from specific areas of environmental concern without utilizing expensive treatment or storage options. Outfall relocation will redirect flow to a new area, and may be desirable if there are environmental concerns in the current area, if the area is sensitive, or if flow discharges near public areas or bathing beaches, as is the case at the Wellington Avenue CSO facility. New areas can be chosen which are less sensitive and away from areas of public use. Outfall elimination removes the outfall entirely by capping the pipe, but there must be capacity in the system for the flow and it may increase flows at other CSOs or cause localized upstream flooding or system backups which would raise serious health and safety concerns. If capacity does not exist in the downstream portions of the system, expensive system upgrades or replacement may be required.

5.8 Conveyance and Treatment at WPCP

5.8.1 Conveyance and Treatment Overview

Another method of eliminating or minimizing flow through CSOs is to expand the capacity at existing treatment facilities to handle the increased flow during storm events. In order to increase capacity, all flow would pass through the plant headworks and then may be split prior to primary treatment. Additional treatment at the plant could consist of the following alternatives:

1. *Primary Treatment Optimization*

   The primary treatment could be optimized, so that most or all of the flow undergoes primary treatment in the existing units. The amount of flow entering secondary treatment will depend upon system design and hydraulics, and surplus flow can either be discharged as effluent or undergo disinfection and chlorination at a separate tank. Depending on the plant hydraulics, it may be possible to configure water gates so that CSO flow can be chlorinated directly in the primary tanks. Primary treatment optimization provides extra capacity at very little capital cost, as most of the money is associated with metering and flow diversion in order to properly split the flow.

2. *Combined Storage Separator Tank*

   Rather than optimizing the current primary treatment tanks, a combined storage/separator tank may be used at the treatment facility. This will typically be done in cases where optimizing the primary treatment cannot be done or it cannot provide sufficient capacity to handle wet weather flow. Surplus CSO flow will be directed to the tank, which as it fills will act as a primary tank. Unlike a primary tank, there is typically no sludge collection at the tank, and it must be drained out and cleaned when each storm event subsides. Combined storage separator tanks are usually at the treatment facility, but may be located elsewhere if this is not feasible. It is the last choice economically because a large tank may be needed to meet the specific design intent, greatly increasing associated capital costs.

3. *Swirl concentrators*

   Swirl concentrators may also be used to provide primary treatment, either at the treatment plant or at remote locations. They do not remove settable material as efficiently as either primary treatment optimization or a storage separator tank, and are the hardest to make meet regulatory requirements. It is also usually more expensive than primary treatment optimization, but cheaper than a storage separator tank. Swirl concentrators are a good choice where space is limited; as the associated footprint is relatively small, and are usually the first choice at remote locations (refer to Section 5.6).

   All of the above options are typically designed to provide a treatment level equivalent to primary treatment. The effluent can then bypass secondary treatment and be conveyed directly to disinfection and chlorination. If space allows, it is best to have a separate CSO disinfection tank, which can be drained and cleaned after each use. The treated effluent is blended with the effluent from secondary treatment in order to meet regulatory requirements. Refer to Figure 5.5 for a schematic of CSO treatment at a water pollution control plant.

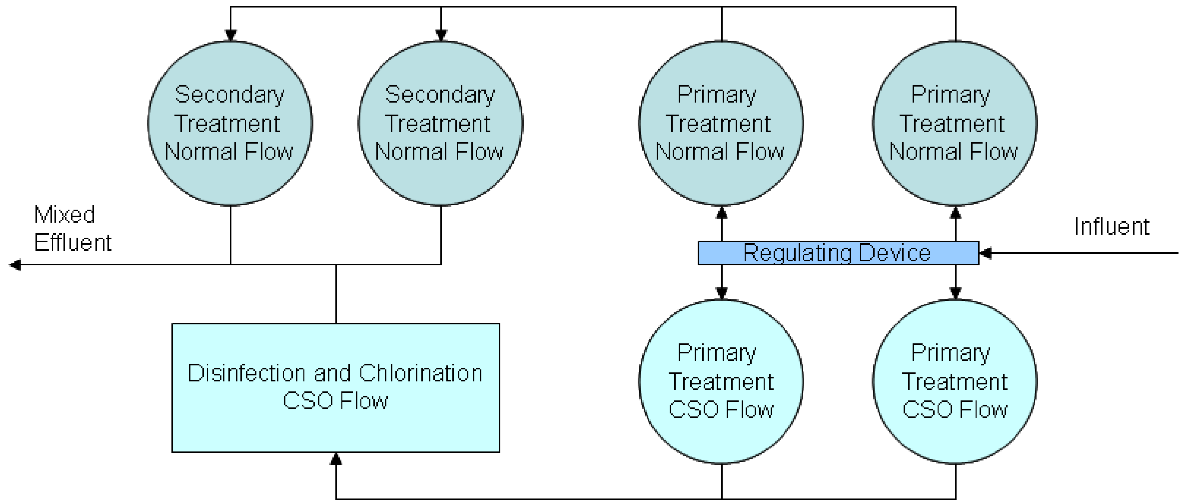

Figure 5.5
CSO Treatment at Water Pollution Control Plant Schematic Diagram

To handle the additional capacity traveling to the existing treatment plant, interceptor sewers may have to be increased, replaced, redesigned, or added, increasing the initial capital cost. Pump stations may also have to be added or upgraded depending on the situation. These are site-specific complications that must be addressed when considering CSO elimination alternatives.

5.8.2 Conveyance and Treatment at the Newport WPCP

Conveyance and treatment of wet weather flows at the Newport WPCP would consist of the following:

1. 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,

2. Expansion of the WPCP to add primary clarifiers and chlorination and dechlorination facilities to provide equivalent primary treatment and disinfection of the additional wet weather flow.

It is our understanding that RIDEM would not permit wet weather blending and that any new discharge would need to meet the current RIPDES permit. Further discussion of this alternative is provided in Section 6.

5.9 Summary

This section presented the range of CSO control alternatives that can be considered for Newport's system. Section 6 includes a screening evaluation of these alternatives which will result in selection of alternatives for detailed evaluation.