FINAL
CSO CONCEPTUAL PLAN
AND SYSTEM MASTER PLAN

PART II
CSO STRATEGIES

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Massachusetts Water Resources Authority

Metcalf & Eddy
An Air & Water Technologies Company

PART II

CHAPTER FIVE

INTRODUCTION

This part of the report presents the watershed-based planning approach used to develop and evaluate CSO control alternatives for the MWRA study area, as well as descriptions of the alternatives evaluated and a summary of the recommended alternatives. Together, the individual recommended alternatives for each receiving water segment constitute an overall CSO control strategy. The impacts and interrelationships among the CSO strategy and each of the other strategy areas addressed in the SMP (I/I, transport, and secondary treatment strategies) were evaluated during the CSO strategy development process.

The watershed-based planning approach presented in Chapter Six involved a series of sequential steps to identify existing and designated uses within receiving water segments, sources of pollutants causing non-attainment of uses, appropriate water body goals, and CSO control alternatives which would control the CSO-component of pollutants causing non-attainment of desired goals. Using a watershed approach was critical in that in many areas, sources of pollutants other than CSO discharges contribute significantly to non-attainment of uses. Addressing CSOs alone is therefore not sufficient to achieve beneficial uses. The watershed-based approach highlights the importance of non-CSO sources of pollution and provides the initial steps towards identification of what sources must be controlled in order to meet existing water quality standards.

The CSO alternatives presented in Chapter Seven represent those alternatives which passed the initial screening process conducted through a series of workshops held in the spring of 1994. The initial screening process involved primarily consideration of the cost, CSO control benefit, and general implementation issues associated with each alternative. The alternatives passing the initial screening process were evaluated in more detail to determine specific water quality benefits, cost/benefit relationships, and siting issues. The alternatives were then developed to a master planning level of detail.

Chapter Eight presents descriptions of the recommended alternative for each receiving water segment, including additional details on predicted performance, water quality impacts, siting considerations, and cost.

PART II

CHAPTER SIX

PLANNING APPROACH

A watershed approach was used for CSO planning. This approach addressed site-specific water quality conditions and CSO impacts, and developed CSO controls for each CSO receiving water. This approach was utilized to be consistent with the USEPA and state CSO policies. It allowed a focussed assessment on the causes of non-attainment of uses in each CSO-impacted receiving water, development of site-specific control goals, and development and analysis of CSO control alternatives which addressed the non-attainment.

The watershed approach for CSO planning involved the following major steps:

- Identify receiving water segments (and associated watersheds and CSO systems)
- Assess baseline conditions (pollutant sources and impacts) for each receiving water segment and define causes of non-attainment of uses
- Develop a range of water quality goals for each receiving water segment
- Develop CSO control goals corresponding to water quality goals for each receiving water segment
- Develop and screen CSO control alternatives for each receiving water segment, as well as regional and system-wide alternatives, to meet CSO control goals
- Assess CSO control alternatives in terms of cost, performance, water quality impacts and siting issues
- Evaluate and rank the CSO alternatives based on assessment criteria
- Review top-ranked alternatives to ensure appropriate water quality goals are supported, and select preferred alternative

Each of the steps in the planning process is described in this chapter.

RECEIVING WATER SEGMENTS

All of the CSOs in the MWRA and CSO community systems discharge into waterbodies that are classified under the Massachusetts water quality regulations as Class B or Class SB waters. Class B waters are designated as a habitat for fish, other aquatic life and wildlife, and for primary (swimming) and secondary (fishing and boating) contact recreation. Class SB waters (marine waters) also include restricted shellfishing. The designated beneficial uses are supported by minimum water quality criteria, as well as specific water quality standards for dissolved oxygen, fecal coliform bacteria, solids, toxics, and other parameters. Because of the diversity and geographic separation of the CSO receiving waters, they were divided into the following 14 receiving water segments, shown in Figure 6-1:

- North Dorchester Bay
- South Dorchester Bay
- Neponset River
- Constitution Beach
- Upper Charles River
- Lower Charles River
- Back Bay Fens
- Alewife Brook
- Upper Mystic River
- Upper Inner Harbor
- Lower Inner Harbor
- Mystic/Chelsea Confluence
- Reserved Channel
- Fort Point Channel

BASELINE CONDITIONS

The baseline conditions assessment was performed to identify the causes of existing beneficial use impairment in the CSO receiving water segments and the potential sources of pollutants contributing to the use impairments in these segments. To this end, a matrix was developed for each receiving water segment, identifying existing beneficial uses, a series of use criteria, and under what conditions the criteria are not attained for the given uses. An

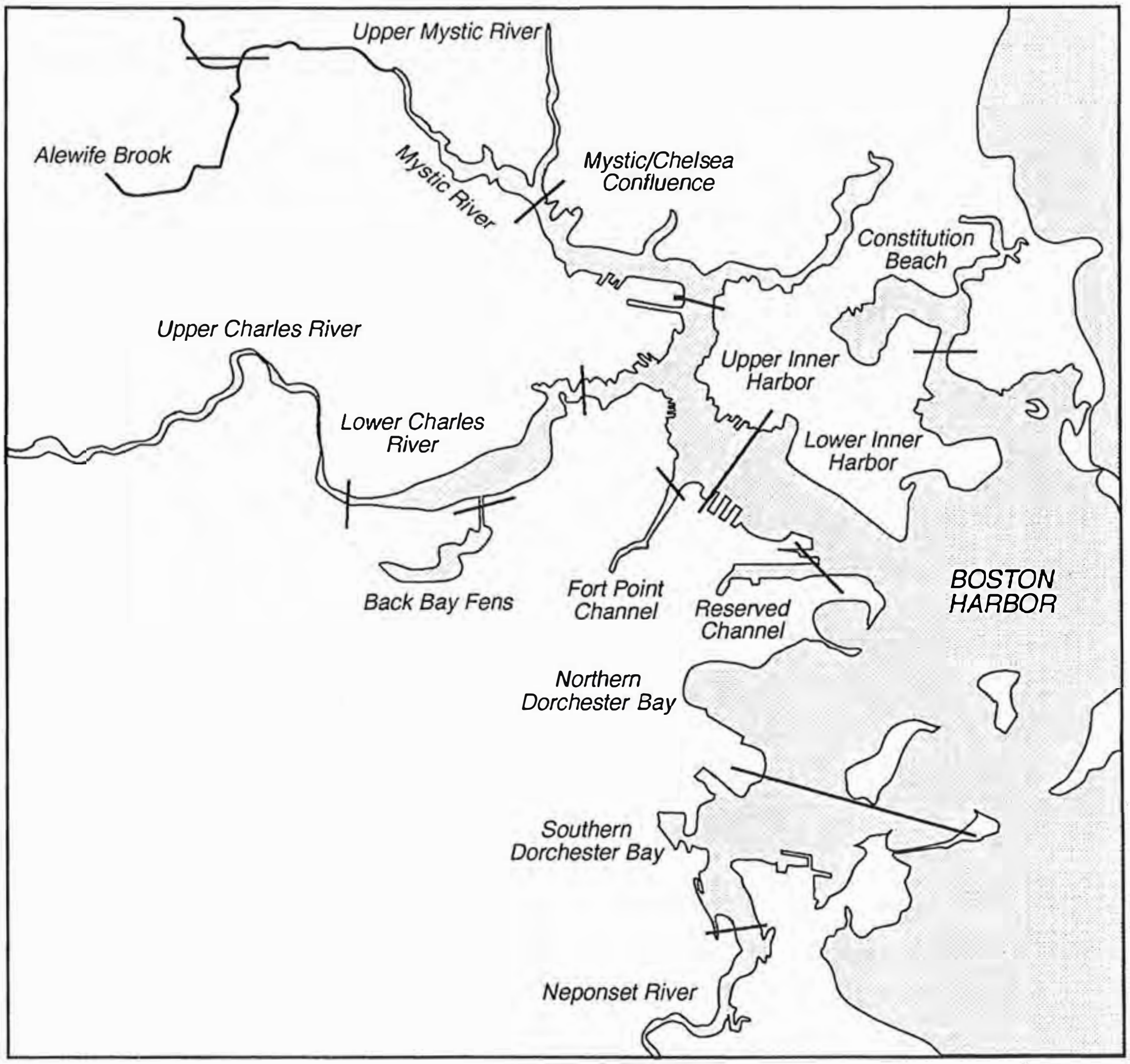


FIGURE 6-1. RECEIVING WATER SEGMENTS

example of this matrix for the North Dorchester Bay receiving water segment is presented in Figure 6-2. Matrices for all of the receiving water segments are presented in the MWRA's August, 1994 "Baseline Water Quality Assessment." As indicated in Figure 6-2, fecal coliform criteria for shellfishing and primary contact recreation are exceeded during wet weather, causing non-attainment of these uses. The dissolved oxygen criterion for aquatic life is also not attained during wet weather. This information indicates that to achieve primary contact recreation and shellfishing uses for North Dorchester Bay, wet weather (CSO, stormwater, and non-point source) fecal coliform bacteria loads must be controlled.

Three general sources of pollutant loads were identified for each receiving water segment: CSO, stormwater discharges, and "boundary" sources. Boundary sources are upstream waterbodies which discharge into downstream receiving water segments. For example, the Charles River upstream of the Watertown Dam is a boundary source for the Upper Charles receiving water segment. CSO, stormwater, and boundary flows and loads for selected pollutants under future planned conditions were estimated (using various models) for each receiving water segment, and the relative values determined. The MWRA's August, 1994 "Baseline Water Quality Assessment" provides a detailed description of how CSO, stormwater, and boundary loads were computed.

Throughout the discussion of water quality in this report, reference is made to the "three-month storm," the "one-year storm," and "annual" data. The three-month and one-year storms refer to storms of approximately 24-hour duration which, *on average*, would occur once every three months and once per year, respectively. The characteristics of these storms were defined by the hyetographs of two selected historical storms which, based on an analysis conducted as part of the 1990 Facilities Plan, met the criteria for average recurrence interval and duration for a three-month, 24-hour and one-year, 24-hour storm, respectively.

North Dorchester Bay **Water Quality Assessment**

Class SB **MWRA CSO/System Master Plan**

Use Criteria (1)

Beneficial Uses	D. O.	T	pH	Cl	WET	Toxics	BIP	Fecal Coliform	Turbidity	Color	Oil and Grease	Taste and Odor	Nutrients	Floatables	Other
Fish Consumpt.						ok					?	?			FCA for Lobster
Aquatic Life	W	ok		ok	ok	ok ?	ok ?		?		ok		?		
Primary Contact Rec.								W	ok		ok	ok		ok	
Secondary Contact Rec.								ok							
Aesthetics									ok	?	ok	ok	?	ok	
Shell Fishing (Rest.)								W							

WET: Whole Effluent Toxicity
Toxics: Pesticides, Other Organics & Inorganics and Chronic Bioaccum.
BIP: Balanced Indigenous Population
FCA: Fish Consumption Advisory
(1) Use Criteria per WQS and 305(b) Use Attainment Guidelines

Legend:
ok Attained for Criteria
(shaded) Proven or Probable Non-Attainment
W Wet Weather Non-Attainment
C Wet and Dry Weather Non-Attainment

FIGURE 6-2. BENEFICIAL USES AFFECTED BY WATER QUALITY IN NORTH DORCHESTER BAY

Using the same "design" storms as the 1990 Facilities Plan facilitated the comparison of performance of the recommended plan to the 1990 tunnel plan. The characteristics of the three-month and one-year storms are presented in Table 6-1.

TABLE 6-1. CHARACTERISTICS OF DESIGN STORMS

Approximate Recurrence Interval	Actual Storm Date	Storm Duration (hours)	Storm Depth (inches)	Maximum Intensity (inch/hr)	Average Intensity (inch/hr)
3 months	7/20/82	21	1.84	0.40	0.09
1 year	9/20/61	22	2.79	0.65	0.13

The design storms provide a convenient basis for sizing CSO facilities, as SWMM can predict CSO volumes and peak flow rates at each outfall and regulator for these storm events. In a general sense, control of overflows from the three-month storm would likely leave an average four-to-seven overflows per year, while control of the one-year storm would likely leave an average one-to-three overflows per year. The variability in overflow frequencies would be due to the impact of antecedent storms, as well as the impact of storms which might, for example, have shorter duration and smaller depth, but higher peak intensity than the design storm.

To account for these factors, alternatives are also evaluated using a simulation of a typical rainfall year. The distribution of storms in the typical year simulation is discussed in more detail in the MWRA's June, 1994 Draft System Master Plan Baseline Assessment. As indicated in Table 2-9 of that report, nine storms in the typical year simulation have one or more characteristics (depth, average intensity, peak intensity) greater than the three-month storm, and two storms have at least one characteristic greater than the one-year storm. The annual simulation provides another measure of the anticipated average performance of the CSO control alternatives.

Pollutant loading data is presented for the three-month and one-year storms, as well as on an annual basis. The three-month and one-year loads provide an indication of the acute effects of wet weather pollutants on receiving waters, while the annual loads provide an indication of the chronic effects. For example, three-month storm fecal coliform loads will be directly related to violations of standards during wet weather, while three-month storm nutrient loads may not exert as much of an immediate impact. Annual fecal coliform loads are less meaningful, since bacteria die off, and the annual total may include continuous background levels (such as from upstream sources) which may or may not be causing continuous violations. Annual solids and nutrient loads, however, would provide an indication of the contributions to sedimentation and eutrophication problems, which would develop more gradually, and would tend to be more persistent.

Figures 6-3 to 6-5 present the relative flows and pollutant loadings for North Dorchester Bay. As shown in Figure 6-3, the CSO fecal coliform bacteria load for the one-year storm is approximately twice the stormwater fecal coliform load, while the stormwater volume discharged to North Dorchester Bay during the one-year storm is more than six times greater than the CSO volume. The BOD load from stormwater is greater than the BOD load from CSO during the one year storm, and as indicated in Figures 6-3 to 6-5, the annual CSO BOD, TSS, metals and nutrient loads are in closer proportion to the annual stormwater loads. These data suggest that controlling CSOs would have a substantial impact on wet weather fecal coliform bacteria loads, but would have less impact on BOD, TSS, metals and nutrient loads. In other receiving water segments, non-CSO loadings (e.g., stormwater and boundary sources) predominate. In these segments, a critical review of flow and load data indicated that even high levels of CSO control would not enable the attainment of water quality standards.

Quantitative information was developed for each existing CSO outfall and included predicted overflow volumes for existing and future planned conditions for the three-month and one-year storms, as well as the annual overflow frequency and volume. Examples of this information for North Dorchester Bay are presented in Tables 6-2 and 6-3. These tables

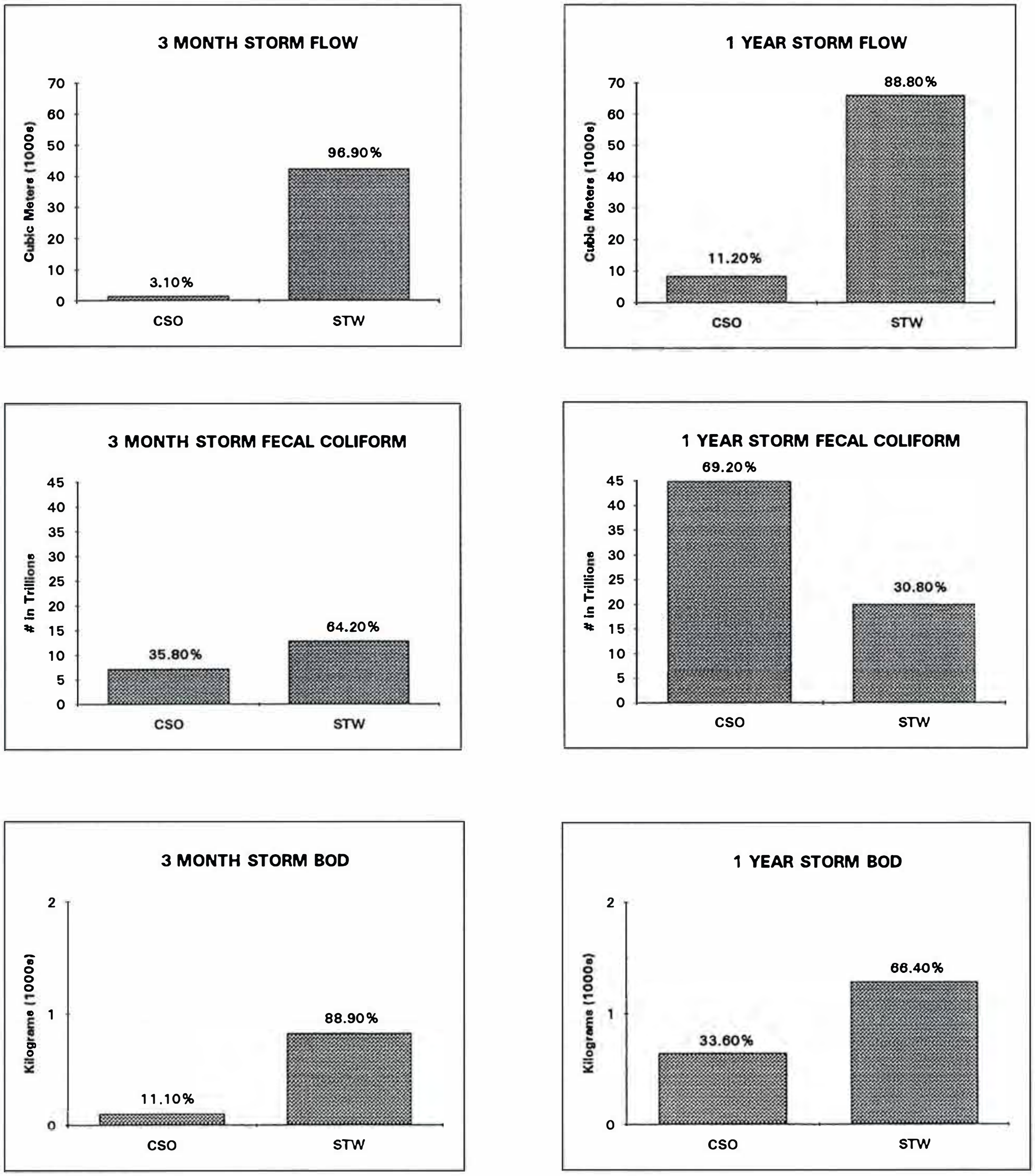


FIGURE 6-3. FLOWS AND LOADS FOR THREE MONTH AND ONE YEAR STORM EVENTS UNDER FUTURE PLANNED CONDITIONS - NORTH DORCHESTER BAY

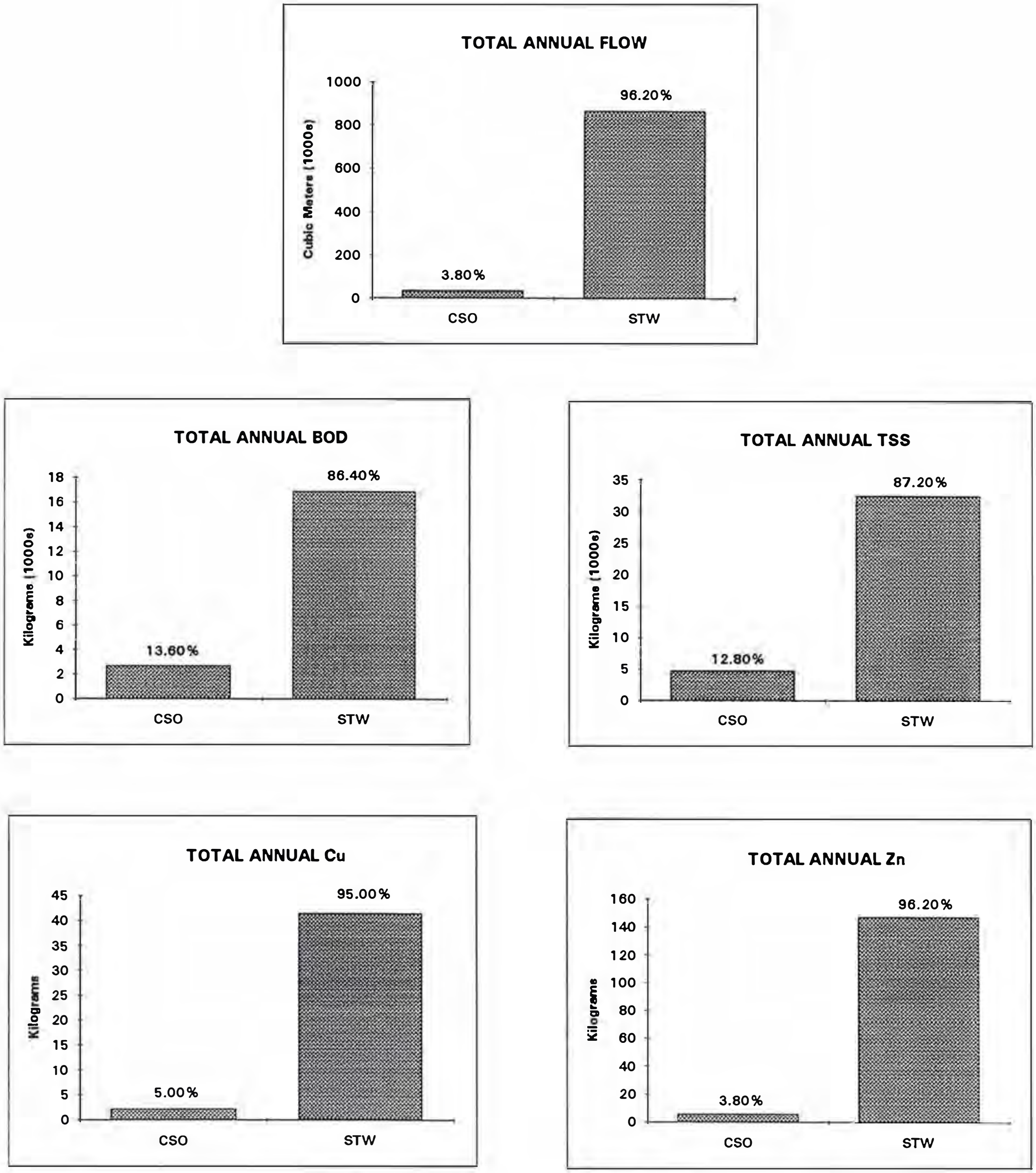


FIGURE 6-4. FLOW, BIOCHEMICAL OXYGEN DEMAND, TOTAL SUSPENDED SOLIDS, COPPER AND ZINC LOADS UNDER FUTURE PLANNEDCONDITIONS - NORTH DORCHESTER BAY

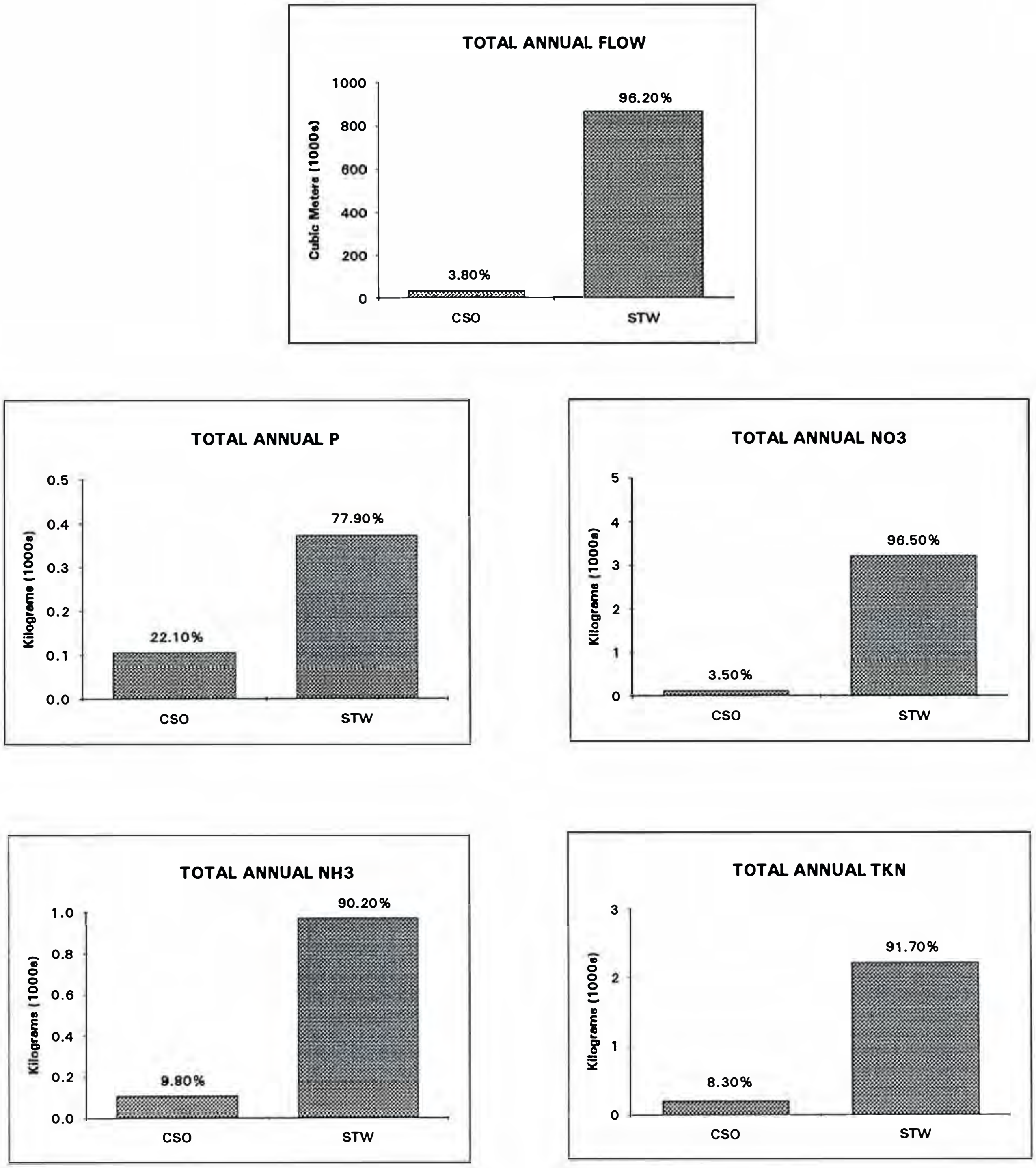


FIGURE 6-5. FLOW, TOTAL PHOSPHORUS, NITRATE, AMMONIA, AND TOTAL KJELDAHL NITROGEN LOADS UNDER FUTURE PLANNED CONDITIONS - NORTH DORCHESTER BAY

TABLE 6–2. CSO VOLUMES FOR DESIGN STORMS UNDER FUTURE PLANNED CONDITIONS – NORTH DORCHESTER BAY

	FUTURE PLANNED CONDITIONS				PRESENT CONDITIONS			
	3 MONTH		1 YEAR		3 MONTH		1 YEAR	
	Low Tide	High Tide	Low Tide	High Tide	Low Tide	High Tide	Low Tide	High Tide
OUTFALL	CSO Volume (MG)	CSO Volume (MG)	CSO Volume (MG)	CSO Volume (MG)	CSO Volume (MG)	CSO Volume (MG)	CSO Volume (MG)	CSO Volume (MG)
BOS 081	0.01	0.00	0.14	0.03	0.00	0.00	0.09	0.06
BOS 082	0.18	0.07	0.73	0.68	0.24	0.06	0.83	0.76
BOS 083	0.04	0.05	0.23	0.27	0.03	0.13	0.28	0.31
BOS 084	0.08	0.00	0.58	0.44	0.20	0.00	0.85	0.53
BOS 085	0.00	0.00	0.21	0.16	0.60	0.04	0.39	0.27
BOS 086	0.04	0.00	0.30	0.15	0.11	0.00	2.67	0.19
BOS 087	0.00	0.00	0.01	0.00	0.00	0.25	9.84	0.15
TOTAL	0.35	0.11	2.20	1.72	0.63	0.48	14.94	2.27
TOTAL UNTREATED	0.35	0.11	2.20	1.72	0.63	0.48	14.94	2.27

TABLE 6–3. ANNUAL CSO DISCHARGE FREQUENCY AND VOLUME – NORTH DORCHESTER BAY

OUTFALL	FUTURE CONDITION: 1/1–12/31		PRESENT CONDITION: 1/1–12/31	
	CSO VOLUME (MG)	ACTIVATION FREQUENCY	CSO VOLUME (MG)	ACTIVATION FREQUENCY
BOS 081	0.42	12	0.32	13
BOS 082	2.99	22	3.75	28
BOS 083	0.90	13	1.05	14
BOS 084	2.13	19	3.22	15
BOS 085	0.66	4	1.31	12
BOS 086	1.45	78	3.31	80
BOS 087	0.48	3	1.27	9
TOTAL	9.03		14.23	
TOTAL UNTREATED	9.03		14.23	

provide the current status of CSO discharges, as well as the expected reduction in CSO frequency and volume to be achieved through currently on-going improvements to the transport system, particularly the increased pumping capacity at the North Main Pumping Station at Deer Island.

From Table 6-2, it is apparent that the overflows into North Dorchester Bay are relatively inactive during the three-month storm, and slightly more active during the one-year storm. The improvement between current and future planned conditions is apparent in both Tables 6-2 and 6-3, where the one-year low tide volume is predicted to decrease by 85 percent, and the annual overflow volume is predicted to decrease by 37 percent. This reduction in overflow volume would be due primarily to decreased choking of wet weather flows at the Columbus Park Headworks, which in turn would be a direct result of increased pumping capacity at Deer Island. Implementation of recommended SOPs would also contribute to this reduction in overflow volumes.

WATER QUALITY GOALS

Using the information from the baseline conditions assessment, in conjunction with an analysis of existing or desirable beneficial uses, a range of water quality goals was defined for each receiving water segment. In general terms, these goals were defined as follows:

- Level I: Attain beneficial uses to the fullest extent possible.
- Level II: Attain beneficial uses for most of the year.
- Level III: Attain modest improvements over existing conditions (while other sources of pollution are addressed).

The water quality goals are not constant for all receiving water segments, but rather have been tailored to the beneficial uses and other factors pertinent to a particular receiving water segment. Thus, a Level III water quality goal in one receiving water segment may represent a higher level of beneficial uses than a Level II water quality goal in another receiving water segment.

In all cases, however, Level I is consistent with the state CSO policy of elimination of CSOs from a receiving water segment. Level II is generally consistent with the acknowledgement in the state CSO policy that elimination of CSOs is not always "feasible." Receiving water segments with higher levels of existing or potential use (such as North Dorchester Bay) generally were assigned more stringent Level II goals than receiving water segments with lower levels of uses (such as the Reserved Channel). Level III goals were developed in recognition that in some receiving water segments, other non-CSO sources of pollution may predominate to the extent that it would make no sense from either a water quality or economic standpoint to invest in extensive CSO controls, until the non-CSO sources could also be controlled. The Level III goals also provided a useful reference point on cost/benefit curves. All of the alternatives in the recommended plan support at least Level II or higher water quality goals.

Table 6-4 provides an example of the water quality goals and CSO control goals for the North Dorchester Bay receiving water segment, as well as a listing of the types of CSO control alternatives that could achieve the CSO control goals.

CSO CONTROL GOALS

CSO control goals were defined that would contribute to achievement of Level I, Level II, and Level III water quality goals for each receiving water segment. The CSO control goals address only the CSO-related conditions that contribute to non-attainment of beneficial uses. In several receiving water segments, pollution contributed by CSOs is only a fraction of the total pollutant loads from other sources. In these areas, even complete elimination of CSO discharges would not achieve the water quality goals, since the other sources prevent the attainment of beneficial uses. The CSO control goals were developed with the assumption that if the other sources were remediated by the appropriate responsible parties, then the

TABLE 6–4. WATER QUALITY GOALS AND CSO CONTROL GOALS FOR NORTH DORCHESTER BAY

CSO Program Development NORTHERN DORCHESTER BAY			
Control Level	I	II	III
Waterbody Goals	➡ Meet Unrestricted Shell–fishing and Swimming Bacteria Standard (All Times) ➡ Meet Aesthetics Criteria ➡ Meet D. O. Standard ➡ Control Nutrient Load	➡ Meet Restricted Shellfishing and Swimming Bacteria Standard Except 4 (–) Overflows Per Year ➡ Meet All Other Level I Goals	➡ No Nutrient Control ➡ Meet All Other Level II Goals
CSO Control Goal	➡ Eliminate CSOs	➡ Limit Untreated CSO Discharges to 4 (–) Per Year	➡ Same as Level II Goal
CSO Control Strategies	➡ Sewer Separation ➡ CSO Relocation	➡ Partial Separation ➡ CSO Relocation ➡ Tunnel Storage/Treatment ➡ Old BMI/Calf Pasture ➡ Stormwater Removal	➡ Storage and Treatment ➡ Partial Separation ➡ CSO Relocation ➡ Tunnel Storage/Treatment ➡ Old BMI/Calf Pasture ➡ Stormwater Removal

CSO control goals would be stringent enough for water quality goals to be met. In general, CSO control goals were defined as follows:

Level I:	Eliminate all CSOs by sewer separation or relocation of the outfalls
Level II:	Reduce untreated CSOs to about 4 overflows per year.
Level III:	Control floatables and, in some cases, bacteria.

Just as the water quality goals vary with the receiving water segments, the CSO control goals also vary, based on the impact of CSOs on the level of beneficial uses specified for the given receiving water segment. Level II CSO control goals in a less sensitive waterbody may be equivalent to Level III CSO control goals in a more sensitive waterbody, where a high degree of control was desirable to achieve greater water quality improvements.

Water quality goals that identified particular site-specific water quality problems were a factor in the development of CSO control goals. For example, concerns over the nutrient level in North Dorchester Bay required that CSO storage be considered as a Level II CSO control. Options for CSO treatment and discharge would meet only Level III water quality goals.

The impacts of one receiving water segment on another were also considered in setting CSO control levels. For example, the Upper Mystic River segment receives flow from Alewife Brook, therefore, CSO control goals in the upstream segment had to be consistent with the goals in the downstream segment. The impacts of the Neponset River on South Dorchester Bay is another example of where upstream CSO controls would affect the achievement of downstream control goals.

DEVELOPMENT AND SCREENING OF CSO CONTROL ALTERNATIVES

Once a range of CSO control goals was established to address the corresponding range of water quality goals in each receiving water segment, engineering and hydraulic analyses were conducted to develop feasible CSO control alternatives to meet the range of CSO control goals. Alternatives for individual receiving water segments were presented at a series of workshops which were attended by MWRA staff, Project Team staff, Technical Review Team members, CSO community engineering staff, regulatory agency representatives, as well as MWRA Advisory Board and Wastewater Advisory Committee representatives. Alternatives were discussed in detail and screened based on a range of criteria, including cost, performance, construction risks, mitigation concerns, water quality improvements, and short-term and long-term environmental impacts.

Following this process for the 14 individual receiving water segments, compatible alternatives for the receiving water segments were combined to form regional and system-wide CSO control strategies. The system-wide strategies included alternative tunnel plans based on the current assessment of CSO flows and volumes, and a CSO peak shaving alternative. These system-wide strategies were compared to the deep tunnel plan recommended in the 1990 CSO Facilities Plan.

CSO Control Technologies

Technically and hydraulically feasible alternatives for meeting the CSO control goals were identified based on a detailed knowledge of the layout, hydraulics, and predicted behavior of the conveyance systems tributary to and downstream of the CSO regulators and outfalls. A list was developed of CSO control technologies capable of meeting the range of control goals identified. This list was intended to be representative of a broad range of feasible CSO control technologies. Additional discussion and schematic depictions of most of these technologies are presented in Appendix E. Alternative technologies to those listed below, such as swirl/vortex devices or chemically-enhanced primary treatment, were also evaluated on a site-specific basis.

Sewer Separation. In a combined sewer system, stormwater and sanitary sewage are collected in the same pipe, and conveyed to the wastewater treatment plant. Depending on the size of the storm, the combined sewer may not have sufficient capacity to convey the large quantities of stormwater runoff, causing the mixture of sanitary sewage and stormwater to overflow at certain points within the combined system (the combined sewer overflow, or "CSO"). In a separate sewer system, one pipe conveys only sanitary sewage to the wastewater treatment plant, while a separate pipe conveys stormwater to a stormwater outfall, eliminating the opportunity for sanitary sewage to overflow to receiving waters. The process of sewer separation is the conversion of a combined system into separate stormwater and sanitary sewer systems.

Sewer separation can be accomplished either by constructing new storm drains, and allowing the existing combined sewer to function as a separate sanitary sewer, or by constructing new sanitary sewers, and allowing the existing combined sewer to function as a storm drain. Selection of the method of separation depends on a number of factors. One advantage to using the existing combined sewer as the sanitary sewer is that all of the separate sanitary building connections would already be connected to the "converted" combined sewer. The overflow connections at the regulators should be bulkheaded, and the new storm drains could be connected to the existing outfall downstream of the former regulator. Where the existing combined sewer is an older brick sewer, infiltration may be significant. The cost-effectiveness of rehabilitating or relining the existing combined sewer would have to be evaluated.

Using the existing combined sewer as the sanitary sewer may not be appropriate where the existing combined sewer is of relatively large diameter, and laid on a shallow slope. In this case, the sanitary flow alone may not be sufficient to develop suitable flushing velocities, without the periodic peak flows contributed by stormwater runoff. A new, smaller-diameter sanitary conduit would then be appropriate. Existing area drains, catchbasins, and roof leaders could remain connected to the existing combined sewer, which would be converted into a storm drain. The interceptor connection at the regulator would have to be plugged, and the regulator itself may require further modifications, depending on the existing configuration. If the existing regulator is a high outlet type, it may need to be abandoned, and part or all of the outfall reconstructed, to avoid creating stagnant water in the pipe upstream of the former regulator following the end of the storm event. Another potential drawback to using the existing combined sewer as a storm drain is that it may be difficult to determine during construction whether all sanitary inputs have been removed from the combined sewer. Post construction sampling may be required to demonstrate the elimination of all sanitary connections. Methods for implementing sewer separation in a particular area would be evaluated during facilities planning and preliminary design.

CSO Consolidation. Consolidation of CSOs involves constructing a consolidation conduit to capture and convey CSO from a series of two or more overflow locations. Three general applications for CSO consolidation include the following:

- **Consolidation of Multiple Overflows to a Single Location for Storage or Treatment.** This approach eliminates the need to provide a CSO control facility at each overflow location, and may allow the CSO to be conveyed to a location where it is easier to site a facility. For alternatives which include consolidation conduits for this purpose, the conduits have been sized to convey flow from the two-year storm. For larger storms, overflows from the consolidation conduit would occur.

- **CSO Consolidation/Relocation.** Regarding the mitigation of the impacts of CSOs on a receiving water segment, the state CSO policy allows that "the impacts on any particular segment may be eliminated by relocating a CSO to another (less sensitive) segment." This technology would involve constructing a new outfall pipe, and sufficient consolidation or connecting conduits such that all flows which were physically able to pass out the old outfall would now be discharged at the new outfall. A consolidation conduit for this purpose would be sized to convey the maximum flow that could possibly be discharged at each CSO to be relocated, allowing the outfalls into the more sensitive receiving water to be closed off. This technology would be most appropriate where flows to a critical use area such as a beach or shellfishing area could be relocated to an area with limited uses, such as a shipping channel.

- **CSO Consolidation/Storage.** In some cases, the storage volume within a consolidation conduit may provide a sufficient level of control without the need for a downstream facility. In this case, a dewatering pump station would be provided to return the contents of the conduit to the collection system at the end of the storm.

Interceptor Relief. Interceptors are generally larger diameter sewers which collect flow from a number of smaller sewers and convey the flow to the wastewater treatment plant. If a section of an interceptor downstream of CSOs does not have sufficient capacity to carry the combined flows during wet weather, flow can back up in the interceptor, contributing to the frequency and/or duration of upstream overflows. If sufficient capacity is available further downstream of the segment of restricted flow, then relief of the segment may reduce the upstream CSOs. Interceptor relief could be achieved by constructing a new conduit parallel to the existing interceptor. If the existing interceptor was old or in poor condition, the new interceptor would likely replace the existing interceptor. Otherwise, the existing interceptor could remain in service after the relief conduit was installed and the relief interceptor would not have to be as large. A weir could direct dry-weather flow into the existing interceptor. During wet weather, when the capacity of the existing interceptor was exceeded, flow could pass over the weir, into the relief interceptor. Relief interceptors also provide a degree of in-system storage, equivalent to the volume of the new interceptor. Interceptor relief may avoid the need to build surface structures such as tanks for controlling CSOs, and also provides an opportunity for updating aging infrastructure.

In-System Storage. This technology optimizes the use of existing storage capacity within the collection and transport system. Where a large diameter pipe is known to flow less-than-full during a given storm event, the empty space between the water surface and the crown (top) of the pipe could potentially be used for storage.

In-system storage facilities may be configured in a number of different ways, depending on the existing system layout and hydraulics. Two of the more common locations for utilizing in-system storage are in combined sewers immediately upstream of CSO regulators, and in outfall conduits downstream of CSO regulators. Typical features may include one or more of the following: downstream gate, to hold back flow in the conduit used for storage, opening to release flow at the end of the storm or to prevent upstream flooding; remote control system to automatically control the downstream gate; dewatering pump station, in locations such as an outfall pipe, where it may not be possible to drain the pipe by gravity back to the collection system at the end of a storm. Control of in-line storage in multiple locations can be integrated into a centralized, computer operated system, which optimizes the storage and routing of flows as the storm occurs ("real-time control").

Near Surface Storage/Treatment. These facilities feature a tank which provides storage of CSO, and may provide flow-through treatment of CSO flows in excess of the volume of the tank. At the end of the storm, the contents of the tank would be returned to the collection system for treatment at the Deer Island wastewater treatment plant. "Near surface" indicates that the facilities are constructed at relatively shallow depths (typically less than 30 ft.) using traditional open-cut excavation techniques. Variations of this technology include the following:

- Storage-only: flow in excess of the tank volume is diverted to an outfall upstream of the tank.
- Storage/sedimentation: flow in excess of the tank volume passes through the tank, receiving treatment (floatables control, solids removal, disinfection). Degree of treatment depends on rate of flow through tank.
- Detention/treatment: similar to storage/sedimentation tank but with smaller volume and surface area, providing less storage, and lower level of treatment.

While the size of each type of facility will vary for a given overflow volume and peak flow rate, the features of each facility will generally be similar. In addition to the tank, these facilities would include: influent bar screens, located upstream of the tank, to capture large objects (planks, bricks) and floatable material before they get into the tanks; disinfection, to reduce pathogens in the flow, if flow passes through the facility and is discharged to receiving waters; pumping systems, for the flow into the facility, the flow passing out of the facility to the receiving water, or the contents of the tank being returned to the collection system; and odor control, to eliminate odors in the exhaust air discharged from the facility ventilation system.

Preliminary sizing of these facilities was based on SWMM output from the one-year or three month storm, depending on the intended level of control. Storage facilities were sized based on the predicted overflow volumes. Storage/sedimentation facilities were sized based on a peak overflow rate of 2500 gpd/sf and a 12-ft side water depth. For preliminary sizing purposes, these criteria were assumed to provide the equivalent of primary treatment under wet weather conditions. A definition of "equivalent primary treatment" is currently being debated in the development of a guidance document for the EPA CSO Policy.

Storage facilities sized for the three-month storm are assumed to be provided with disinfection equipment, while storage facilities sized for the one-year storm are not. The rationale for these assumptions is that flows would exceed the storage capacity of the three-month facility approximately four times per year, making it worthwhile to allow these flows to pass through the facility and be disinfected. Flows would exceed the storage capacity of the one-year facility approximately once per year, meaning that disinfection equipment would sit idle for longer periods.

Disinfection of CSOs is usually accomplished with sodium hypochlorite solution (commonly known as bleach). Disinfection equipment typically includes a chemical storage tank, metering pumps, a diffuser to disperse the hypochlorite into the combined flow, and automatic controls to regulate the dosage of the disinfectant. Having the appropriate dose rate, mixing, and contact time between the disinfectant and the microorganisms in the flow are all key to achieving sufficient disinfection. Since residual chlorine concentrations may also harm aquatic organisms in the receiving water, sodium bisulfite solution can be added to the flow to convert the potentially harmful chlorine compounds into the harmless chloride ion. This process is called dechlorination. Wherever disinfection is to be provided, it is assumed that sodium hypochlorite disinfection systems and dechlorination equipment will be provided.

Non-chlorine-based disinfectants such as ultraviolet (UV) radiation and ozone have been used successfully at wastewater treatment plants, but to date have had limited application for the treatment of CSOs. A UV system specifically for CSOs is currently being developed by at least one manufacturer, but full-scale performance data is limited. If a UV device could be shown to be effective for treating CSOs, it would be worthy of serious consideration, as concerns regarding chlorine toxicity and limited available contact times would be alleviated.

Deep Tunnel Storage. Deep tunnel systems provide storage for large volumes of CSO in tunnels constructed in bedrock, up to hundreds of feet below grade. After a storm event, the flow stored in the tunnel is pumped back to the transport system and conveyed to the Deer Island wastewater treatment plant. If the tunnel storage capacity is exceeded, excess CSO volume may be discharged to receiving waters.

While the size, depth and complexity of a tunnel system will vary depending on the overflow volume to be captured and subsurface conditions, a tunnel system will generally include the following features:

- Consolidation conduits: In most cases, it is not practical to connect every CSO location directly to a deep tunnel. Consolidation conduits, built nearer to the surface, can convey overflows from multiple CSOs to the deep tunnel.
- Vertical drop shafts: to deliver flow from CSOs or consolidation conduits near the surface to the deep tunnel.

- Coarse bar screens: may be located at each drop shaft or just upstream of the pump-out system, to protect downstream pumps by removing large objects from the combined flow.

- Deep tunnel: sized to store and convey flows for storms of a given magnitude. Usually constructed in bedrock using tunnel boring machines (TBMs).

- Access shafts: to provide a means of access for personnel and equipment.

- Vent shafts: to allow for the balancing of air pressure in the tunnel as the tunnel is filling or being pumped out.

- Dewatering system: to pump stored combined sewage out of the tunnel after the storm event.

- Odor control systems: may be required at vent shafts to eliminate odors in vented air.

Screening and Disinfection. These facilities provide flow-through treatment of CSOs. Mechanically-cleaned bar screens remove large objects, such as planks and bricks, and floatable materials from the combined sewage. Disinfection reduces bacterial concentrations, and if chlorine-based disinfectants are used, dechlorination eliminates the potential toxic effects of chlorine on the receiving water.

Mechanically-cleaned bar screens consist of vertical or inclined steel bars spaced evenly across the flow channel, with 0.25 to 1.00-inch of clear spacing between bars. Debris retained on the bars as flow passes through is automatically cleared by a rake mechanism, and is typically deposited into a collection bin for off-site disposal. Rags, stringy material, papers, and other objects with a smallest dimension less than the bar spacing may pass through the bars. However, it may be feasible to provide finer-mesh screens downstream of the bar screens, to improve solids removals. A number of products are now on the market for providing finer screening of CSOs. Underflow baffles may also be provided to assist in control of floatables.

Disinfection is assumed to be provided by liquid sodium hypochlorite, using similar equipment as described under Near Surface Storage/Treatment. Dechlorination equipment is also assumed to be provided. The efficiency of disinfection in screening and disinfection facilities is expected to be lower than in storage/sedimentation facilities, due to the higher solids concentrations in the effluent. For modeling purposes, screening and disinfection facilities were assumed to provide approximately 2 logs of kill (for example, from 500,000 to 5,000 counts/100 ml) as compared with 2.7 logs of kill (from 500,000 to 1,000 counts/100 ml) for storage/sedimentation facilities.

Costs of screening and disinfection facilities were based on the one-year storm peak flows. Final sizing criteria for these facilities will be resolved in facilities planning, based on a number of considerations. For example, if screens are sized for the one-year storm, the two-year storm flows may still pass through, but at a higher-than-design velocity.

Manually-Cleaned Bar Screens. This technology is intended to improve aesthetics during large storm events by controlling the larger, more visible solids and floatables in the CSO discharge. Manually-cleaned bar screens would be installed in a manhole or similar structure on a relatively inactive CSO outfall, providing treatment during the occasional activation of the overflow. The bar screens consist of inclined steel bars with approximately one-inch clear spacings. The screens would retain objects whose smallest dimension is larger than the openings between the bars. Materials that are retained on the bars as flow passes through must be manually raked off the bars and disposed off site. Baffles may be provided in the screening structure to assist in control of floatable material. In general, manually-cleaned bar screens are proposed where the annual activation frequency of an outfall is in the range of approximately four per year or less, which would correspond approximately to activation by the three-month storm or greater.

Initial Development and Screening of CSO Alternatives

Using the CSO system hydraulic model output and the water quality and CSO control goals as a guide, initial CSO control alternatives were identified for hydraulically-defined subareas during a series of Project Team brainstorming sessions. Subareas consisting of hydraulically-related outfalls were generally defined as in the June, 1993 SOP Report. In some cases, such as the Alewife Brook receiving water segment, CSOs from the subarea discharged to a single receiving water segment. In some cases, however, either the subarea discharged CSOs to more than one receiving water segment (e.g., East Boston, which discharges into the Mystic/Chelsea confluence, Upper Inner Harbor, and Lower Inner Harbor receiving water segments), or the receiving water segment to which the subarea discharged received discharges from other subareas as well (e.g., Stony Brook and Cottage Farm, which both discharge into the Lower Charles receiving water segment). Thus, for modeling purposes and for developing alternatives for hydraulically-related regulators and outfalls, the subarea definitions were appropriate. To match the alternatives to water quality and CSO control goals, however, the subareas were then desegregated into the appropriate outfall groupings by receiving water segment.

Initial alternatives were analyzed using SWMM on a subarea basis to evaluate impacts on the hydraulic features of the subarea, and on a receiving water segment basis, to evaluate performance with respect to defined CSO control goals. For most subareas, alternatives were developed to meet the specific Level I, II and III CSO control goals. Level III CSO control goals were not defined in some subareas, due to anti-backsliding considerations. For Level II and some Level III alternatives, proposed controls were initially sized for both the 3-month and 1-year storms. The performance of Level I sewer separation alternatives were evaluated against both the 3-month and 1-year storm.

Generalized cost data for the alternatives were developed from cost curves. Costs were updated to a current Engineering News Record Construction Cost Index (ENR CCI). Construction and engineering/administration contingencies were added to construction costs to develop capital costs in accordance with the MWRA's Life Cycle Cost Analysis (LCCA) methodology. Annual operations and maintenance (O&M) costs were also developed based on cost curves. The development of costs is described in more detail in the section to follow.

In the identification of alternatives, a cursory evaluation of siting potential was performed. Areas where siting was known to be restrictive were identified, but specific sites were not selected for the alternatives. Issues of construction impacts, public acceptance, water quality impacts, and short- and long-term environmental impacts were considered for each hydraulically feasible alternative. These factors, along with cost and performance, were presented for each alternative during the workshop sessions described above. An example of the alternative development worksheets presented at the workshops for the North Dorchester Bay receiving water segment is presented in Table 6-5.

During the workshops, input on the various factors was obtained from the participants and the factors were assigned relative ratings (+, 0, -) for the purposes of developing an initial screening of the alternatives. In some receiving water segments, the screening process identified clearly favored or clearly disfavored alternatives, while for other receiving water segments, the results of the screening were less conclusive. The ratings were generally applied without regard to CSO control level. Thus, in some areas, a Level I alternative received the highest rating, while in others, a Level II alternative was rated highest. The intent of the screening was to identify a manageable array of initially favored alternatives which could be carried forward in the evaluation process.

Where appropriate, regional alternatives were identified which impacted more than one subarea, or receiving water segment. These regional alternatives were compared with combinations of subarea or receiving water segment alternatives which collectively achieved the same level of control as the regional alternative. System-wide and regional deep tunnel alternatives were similarly identified. System-wide deep tunnel alternatives were developed to provide control of the 3-month and 1-year storm.

TABLE 6-5. ALTERNATIVES EVALUATION - NORTH DORCHESTER BAY

EVALUATION FACTOR	CSO CONTROL ALTERNATIVES — LEVEL I: COMPLETE SEWER SEPARATION	LEVEL I: CSO RELOCATION TO RESERVED CHANNEL (2.7 MG CONDUIT VOL.)	LEVEL II - CONTROL OF 1-YEAR STORM: CONSOLIDATED NEAR SURFACE STORAGE FACILITY NEAR CALF PASTURE (0.40 MG TANK VOLUME)	LEVEL II - CONTROL OF 1-YEAR STORM: CONSOLIDATED STORAGE AT CALF PASTURE/MOON ISLAND
Cost	Total Construction Cost $ $ 49.1 MILLION	Total Construction Cost $ $ 35.7 MILLION O & M Cost $ 1,300,000 / YR	Total Construction Cost $ $ 27.5 MILLION O & M Cost $ 72,000 / YR	Total Construction Cost $ $ 29.6+ MILLION O & M Cost $ 833,000 / YR
Performance	-Eliminates overflow. 3-month; 0.37 MG ($ 133/gal) 1-year; 3.36 MG ($ 14.61/gal)	-Provides control for up to the maximum runoff collection capacity of the collection system. 1-year storm ($ 10.63/gal).	-Provides control for up to the 1-year storm ($ 8.18/gal).	-Provides control for up to the 1-year storm ($ 8.81+/gal).
Construction Risk	-Illegal connections must be identified and eliminated.	-Soft ground tunneling for outfall consolidation/relocation conduit. -Assume screening/pumping facilities at new outfall to Reserved Channel.	-Soft ground tunneling for consolidation conduit.	-Soft ground tunneling for consolidation conduit. -Rehabilitation of storage capacity in Deposit Sewers.
Public Acceptance	-Disruption of streets. -No need to site new facility.	-Public resistance to consolidation work? -Public resistance to siting screening/ pumping facility/availability of suitable site?	-Public/private resistance to siting. -Availability of suitable site?	-Public resistance to consolidation work? -New pump station required near existing Calf Pasture P. S.
Water Quality	-Stormwater discharge more frequent and higher volume. -For 3-mo. storm, additional stormwater discharged is 13 percent of total stormwater volume to receiving waters. -Trade off between decrease in CSO and increase in stormwater loads.	-Benefit to North Dorchester Bay; tradeoff of increased load to mouth of Reserved Channel.	-Benefit	-Benefit
Environmental -Construction	-Noise, dust, traffic impacts at locations to be separated.	-Noise, dust, traffic impacts at facility site, and at consolidation tunnel shafts.	-Noise, dust, traffic impacts at facility site, and at consolidation tunnel shafts.	-Noise, dust, traffic impacts at consolidation tunnel shafts, at new p. s. site, and at Deposit Sewers.
-Long Term		-Impacts associated with operation of pumping/screening facilities.	-Impacts associated with facility operation.	-Impacts associated with operation of new pump station and rehabbed Deposit Sewers.
Affected Receiving Waters	North Dorchester Bay	North Dorchester Bay Reserved Channel	North Dorchester Bay	North Dorchester Bay

RECEIVING WATER	ANNUAL VOLUME (MG) CSO	ANNUAL VOLUME (MG) STORMWATER	3-MONTH STORM VOLUME (MG) CSO	3-MONTH STORM VOLUME (MG) STORMWATER
N. Dorchester Bay	9.3	192.0	0.37	67.2

TABLE 6-5 (Cont). ALTERNATIVES EVALUATION - NORTH DORCHESTER BAY

EVALUATION FACTOR	CSO CONTROL ALTERNATIVES: LEVEL II - CONTROL OF 1-YR STORM: CONSOLIDATED NEAR SURFACE STORAGE CONDUIT (3.49 MG CONDUIT VOLUME)	LEVEL II - CONTROL OF 1-YR STORM: SOUTH BRANCH, SOUTH BOSTON INTERCEPTOR RELIEF, WITH BMI RELIEF TO CALF PASTURE/MOON ISLAND	LEVEL II - CONTROL OF 3-MONTH STORM: CONSOLIDATED NEAR SURFACE STORAGE CONDUIT (1.06 MG CONDUIT VOLUME)	LEVEL II - CONTROL OF 3-MONTH STORM: SOUTH BRANCH, SOUTH BOSTON INTERCEPTOR RELIEF, WITH BMI RELIEF TO CALF PASTURE/MOON ISLAND
Cost	Total Construction Cost $ $ 24.6 MILLION O & M Cost $ 90,000 / YR	Total Construction Cost $ $ 26.1+ MILLION O & M Cost $ 749,000 / YR	Total Construction Cost $ $ 11.9 MILLION O & M Cost $ 73,000 / YR	Total Construction Cost $ $ 16.8+ MILLION O & M Cost $ 450,000 / YR
Performance	-Provides control for up to the 1-year storm ($ 7.32/gal).	-Provides control for up to the 1-year storm ($ 7.77+/gal).	-Provides control for up to the 3-month storm ($ 32.16/gal).	-Provides control for up to the 3-month storm ($ 45.41+/gal).
Construction Risk	-Soft ground tunneling for consolidation conduit.	-Open cut or microtunneling to install replacement interceptor upstream of BOS 082; relief interceptor from BOS 082 to the NBMI. -Rehabilitation of storage capacity at Moon Island facilities.	-Soft ground tunneling for consolidation conduit.	-Open cut or microtunneling to install replacement interceptor upstream of BOS 082; relief interceptor from BOS 082 to the NBMI. -Rehabilitation of storage capacity at Moon Island facilities.
Public Acceptance	-Public resistance to consolidation work? -New dewatering pump station required near existing Calf Pasture P. S.	-Disruption of streets. -New pump station required near existing Calf Pasture P. S.	-Public resistance to consolidation work? -New dewatering pump station required near existing Calf Pasture P. S.	-Disruption of streets. -New pump station required near existing Calf Pasture P. S.
Water Quality	-Benefit	-Benefit	-Benefit	-Benefit
Environmental -Construction	-Noise, dust, traffic impacts at consolidation tunnel shafts, and at new p. s. site.	-Noise, dust, traffic impacts along route of relief interceptor, at new p.s. site, and on Moon Island.	-Noise, dust, traffic impacts at consolidation tunnel shafts, and at new p. s. site.	-Noise, dust, traffic impacts along route of relief interceptor, at new p.s. site, and on Moon Island.
-Long Term	-Impacts associated with operation of new dewatering pump station.	-Impacts associated with operation of new pump station and rehabbed storage facilities on Moon Island.	-Impacts associated with operation of new dewatering pump station.	-Impacts associated with operation of new pump station and rehabbed storage facilities on Moon Island.
Affected Receiving Waters	North Dorchester Bay	North Dorchester Bay	North Dorchester Bay	North Dorchester Bay

RECEIVING WATER	ANNUAL VOLUME (MG)		3-MONTH STORM VOLUME (MG)	
	CSO	STORMWATER	CSO	STORMWATER
N. Dorchester Bay	9.3	192.0	0.37	67.2

Upon completion of the seven workshops in which CSO control alternatives were presented for each of the fourteen receiving water segments, selected alternatives from each receiving water segment or subarea were combined to create a series of system-wide strategies. These strategies encompassed a range of control goals, from system-wide elimination of CSO outfalls to minimum controls at most outfalls. These strategies were presented in a separate workshop as a matrix, an updated version of which, including the recommended plan ("Strategy M3"), is presented in Figure 6-6, bound in back.

The matrix in Figure 6-6 was initially constructed by grouping the highest rated alternatives for each subarea by CSO control level. Thus, lines IA, IIA, and III represent the initially-preferred alternative within each receiving water segment for CSO control levels I, II and III, respectively. Lines IB, IIB and IIC represent relatively minor variations to lines IA and IIA. Lines IID and IIE represent alternatives which provide the highest and lowest degree of control, respectively, within level II. As noted above, the overall initially-preferred alternative for each receiving water was in some cases a Level I control, and in others a Level II control. Line M on Figure 6-6 represents a mixed level of control, comprised of the overall initially-preferred alternatives in each subarea. Lines M1, M2, and M3 represent the evolution of the recommended plan through the more detailed CSO alternatives evaluation process described below. Lines T1 through T3 represent variations on tunnel-based strategies.

CSO ALTERNATIVES EVALUATION

The CSO control alternatives which were not eliminated during the workshop screening process described above were subject to more detailed evaluations of cost/performance relationships, impacts on water quality, and siting considerations. Additional workshops were conducted to refine the preferred alternative based on the additional analyses, and a final workshop session was conducted to review the preferred alternatives selected through this methodology. Since this methodology focussed on cost effectiveness and relative water quality impact, the water quality goal for each receiving water segment (Level I, II, or III) was not pre-selected, but rather was determined as a function of the preferred CSO control alternative and its corresponding CSO control goal. Thus, developing a preferred CSO control alternative in a sense also resulted in the identification of an appropriate water quality goal based on analyses of cost effective controls, sources of pollutants, and other issues which comprised the evaluation methodology.

The purpose of the last workshop was to "step back" from this process, and evaluate whether the water quality goals supported by the "preferred" alternatives were consistent with the desired uses of the waterbodies. In certain cases (i.e. in critical use areas), the preferred alternative was changed to support a less cost-effective, but higher, water quality goal. Based on this workshop, the CSO control strategy recommended in the MWRA's September 1994 Draft CSO Conceptual Plan and System Master Plan was identified (line "M2" in Figure 6-6). Based on comments received on the September Draft Plan and additional hydraulic analyses conducted since the draft submittal, the recommended plan was modified slightly to the form presented in line "M3" in Figure 6-6, and described in more detail in Chapters 7 and 8.

The following elaborates on the more detailed CSO alternatives evaluation process.

Cost of CSO Alternatives

Costs for CSO alternatives were presented in the form of capital and annual O&M costs, and net present worth. Net present worth was computed in accordance with the MWRA's LCCA methodology. Table 6-6 provides an example of the costs for alternatives in North Dorchester Bay as presented in the CSO evaluation workshops. Similar cost tables for all receiving water segments are provided in Appendix I. Cost assumptions for CSO control alternatives are as follows:

TABLE 6-6. COST OF CSO ALTERNATIVES IN NORTH DORCHESTER BAY

	NDB1 Sewer Separation	NDB2 CSO Relocation to Reserve Channel	NDB3 Consolidation/ Storage Conduit (1 Yr)	NDB4 Interceptor Relief; System Optimization 081,082 (1 Yr)	NDB5 Consolidation/Storage Conduit (3 Mo)
Capital Cost $ Million	80.9	86.1	41.4	22.3	26.5
Annual O&M Cost $	0	845,000	99,000	0	99,000
Present Worth $ Million	65	77.8	34.3	18	22.3
Alternative Ranking	3	3	2	1	2

Capital Costs.

- Construction costs were estimated from cost curves based on facility sizing parameters such as volume or peak flow (as predicted by SWMM), or other parameters such as conduit length and diameter.

- Cost sources included the EPA Manual, Combined Sewer Overflow Control (EPA/625/R-93/007, Sept. 93) and the MWRA 1990 CSO Facilities Plan.

- The total cost for primary treatment was taken as the sum of the cost for the primary treatment tank, plus disinfection and dechlorination.

- The construction cost was adjusted to a March, 1994 ENR CCI. The LCCA contingencies of 25% for construction and 20% for engineering and construction management were also applied. For the draft and final CCP/SMP, costs were further escalated to a December, 1995 ENR CCI of 6936 (provided by MWRA).

- Capital costs for sewer separation were based on cost per acre values developed in CH_2MHill Technical Memorandum No. 7-8 (May, 1989). The computed construction costs were updated to the appropriate ENR index, then burdened with the 25% and 20% contingencies. In Cambridge, the cost/acre values compared reasonably well with the actual cost of ongoing separation work in that community.

- Construction costs for open cut pipe installation (such as for interceptor relief) were based on a unit cost of approximately $1030/ft (varying with pipe size). The pipe work construction costs were adjusted to the appropriate ENR, and the 25% and 20% contingencies added to develop the capital cost.

O&M Costs.

- O&M costs for CSO technologies were initially estimated from cost curves, using parameters developed from SWMM output. "Annual hours of activation" were assumed to be the annual activation frequency x 24 hrs/activation. The computed values were compared with current costs for MWRA CSO facilities, and were found to be lower, even with ENR adjustments. Multipliers were then added to adjust the O&M costs to a range which seemed reasonable based on the information on current costs. Comparison and adjustment of the costs based on current facilities costs provides calibration of these estimates.

Present Worth Costs.

- The net present worth of alternatives was computed in accordance with MWRA's LCAA guidelines (see sample computation in Table 6-7).
- The capital costs for the various technologies comprising an alternative were combined to form a total capital cost for the alternative.
- To this capital cost, a "Site Factor" was added to obtain a final capital cost. The magnitude of the site factor was estimated based on engineering judgement and a preliminary understanding of siting issues. Following the workshop discussions, site factors at individual locations required some adjustment. Issues such as site access, mitigation requirements, and potential for utility interference contributed to the value of the site factor.
- For present worth of capital costs, the base year was December 1995, and the midpoint of construction was assumed to be January 2003.
- For O&M costs, the base year was December 1995, and the start of operations was assumed to be on January 2004.

Performance of CSO Alternatives

Performance of CSO alternatives was presented as a function of cost, allowing for evaluation of cost/performance relationships, as required in federal and state CSO policies. Performance factors evaluated in this manner included percent reductions in fecal coliform bacteria, BOD and TSS loads for the three-month and one-year storms. Percent reductions were computed as the reduction in CSO load as a percent of baseline CSO load, and the reduction in total load as a percent of baseline total load ("baseline" represents future planned conditions). Comparison of these two factors highlighted the relative impact of non-CSO pollutant sources on the receiving water segment. Examples of these cost/benefit relationships for alternatives in North Dorchester Bay are presented in Figures 6-7 and 6-8. Figures showing cost/performance relationships for all receiving water segments are presented in Appendix G. Figures 6-7 and 6-8 represent a cost/benefit analysis using pollutant load reduction as the measure of benefit. Other benefits such as the elimination of outfalls from beach areas were also considered in evaluating the alternatives.

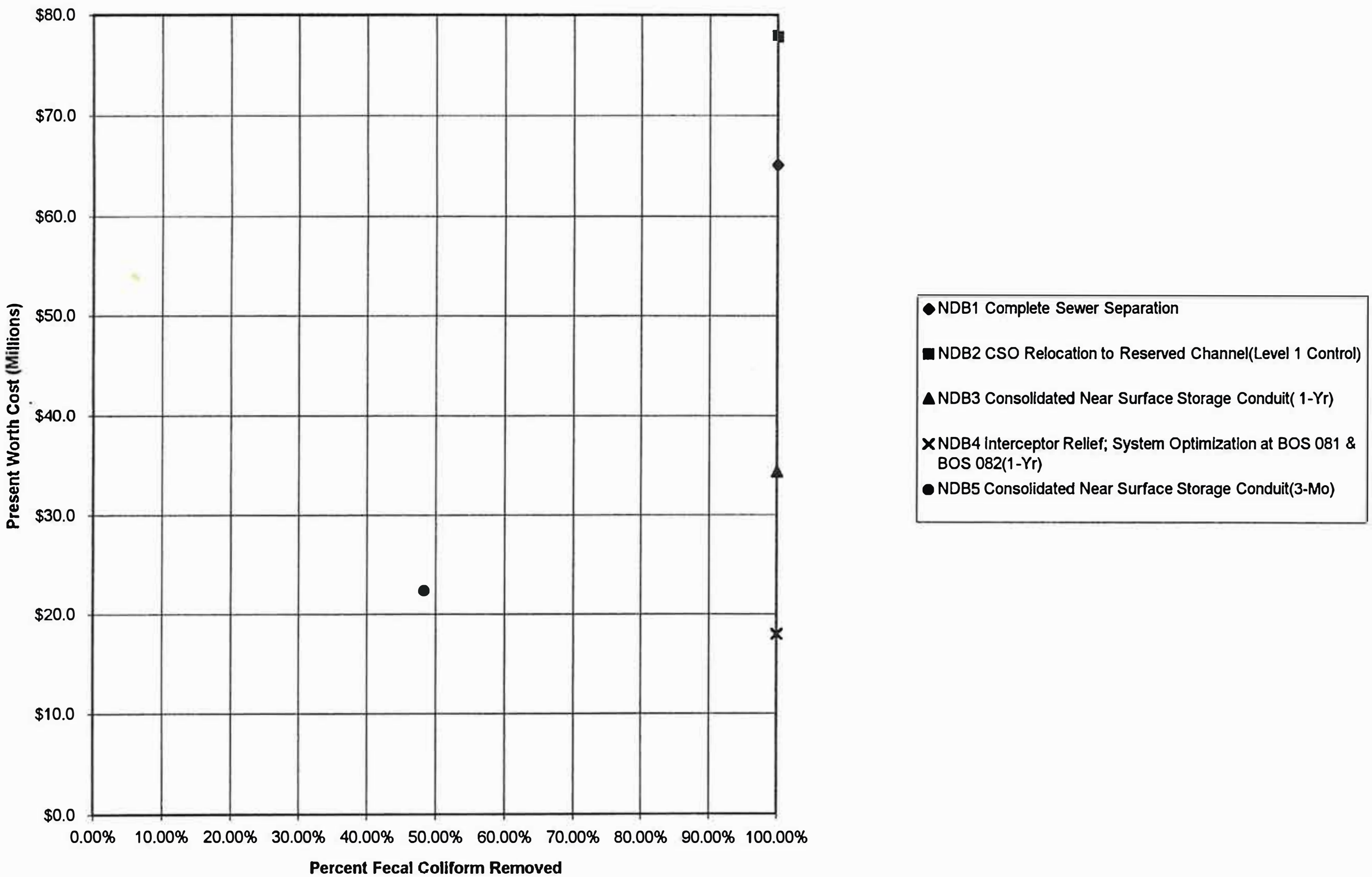


FIGURE 6-7. CSO LOAD REDUCTIONS AS A PERCENT OF BASELINE CSO LOAD (1-YEAR STORM) - NORTH DORCHESTER BAY

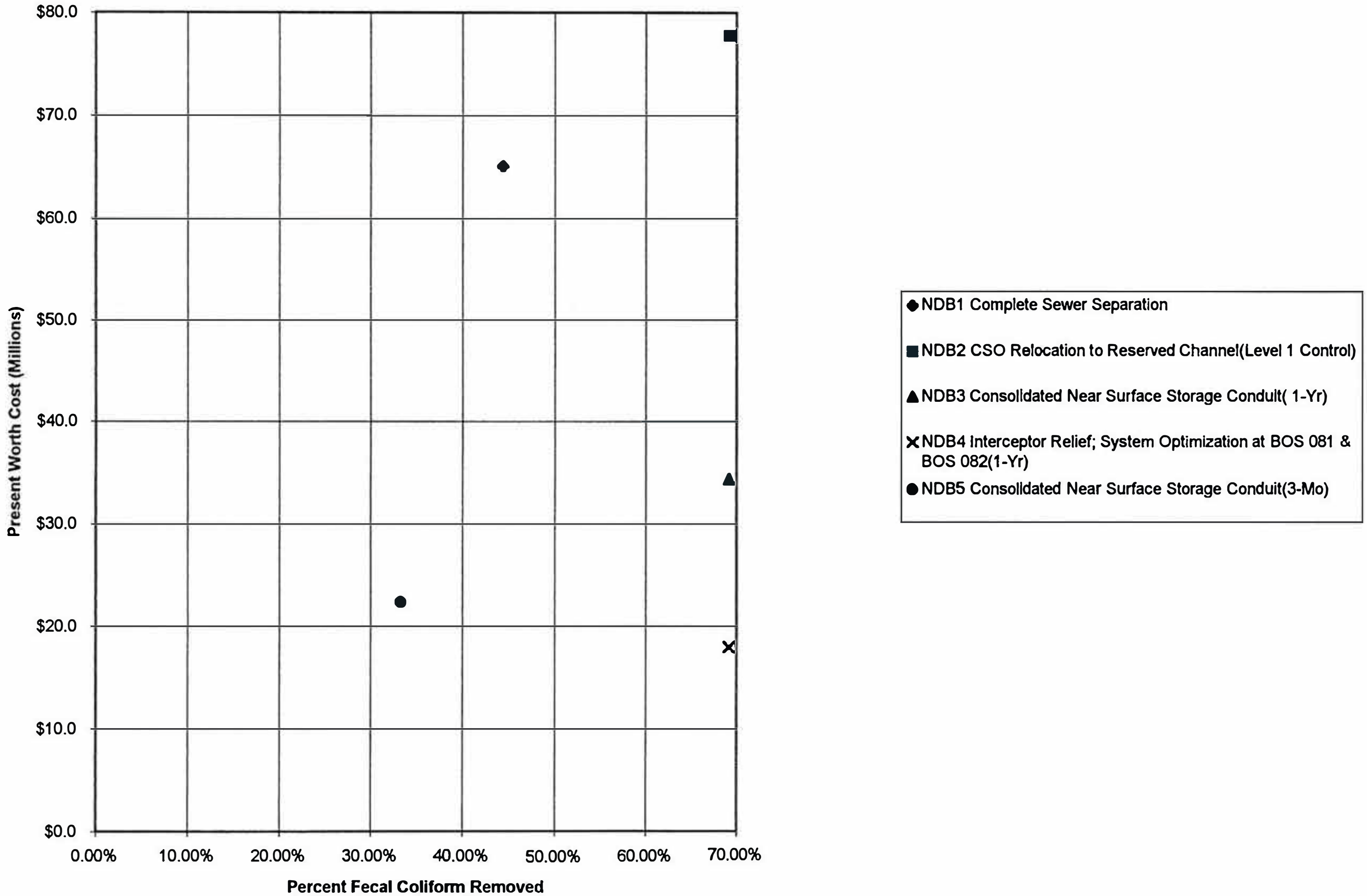


FIGURE 6-8. TOTAL LOAD REDUCTIONS AS A PERCENT OF BASELINE TOTAL LOAD (1-YEAR STORM) - NORTH DORCHESTER BAY

TABLE 6-7. SAMPLE COMPUTATION OF NET PRESENT WORTH

Example: Determine net present value of cost for relocation of CSO to Reserved Channel, using MWRA's LCCA methodology.

1. Capital and O&M Costs

   a. Capital cost, adjusted to Dec. 1995 ENR CCI (includes LCCA contingencies) — $82.1M

   b. Site Factor — 4.0M

   c. Total Capital Cost — $86.1M

   d. Annual O&M Cost — $845,000/yr

2. Net Present Worth of Capital Cost

   a. Apply effective capital discount rate to midpoint of construction. At the time that present worth costs were developed, the midpoint of construction was uniformly assumed to be 1/03. The base year was assumed to be 12/95, making the discount term 7 years.

   b. For a 7-year term, and effective construction discount rate of 3.17 percent (provided by MWRA - discount rate of 7.4 percent with 4.1 percent inflation), the single payment present worth (SPPW) factor is 0.8038.

   c. Net present worth of capital cost: $86.1M x 0.8038 = $69.2M

3. Net Present Worth of Annual O&M Costs

   a. Determine present worth of O&M costs at start of operations, then discount to base year 12/95.

   b. Assume period of operation of 20 years. For a 20-year period and an effective O&M discount rate of 3.87 percent (provided by MWRA - discount rate of 7.4 percent and 3.4 percent inflation) the uniform series present worth (USPW) factor is 13.75.

c. Present worth of O&M at start of operations:

845,000 x 13.75 = $11.6M

d. At the time that present worth costs were developed, the start of operations was uniformly assumed to be 1/04, making the discount term from the base year (12/95) to start of operations 8 years.

e. For an 8-year term and effective O&M discount rate of 3.87 percent, the SPPW factor is 0.7831

f. Net present worth of O&M costs: $11.6M x 0.7381 = $8.6M

4. Compute Overall Net Present Worth of Alternative

$69.2M Net Present Worth of Capital Cost (Line 2.c)
$ 8.6M Net Present Worth of O&M Cost (Line 3.f.)
$77.8M Total Net Present Worth

Figure 6-7 presents the relationship between net present worth and reduction of fecal coliform bacteria from CSOs as a percent of the baseline load of fecal coliform bacteria from CSOs to North Dorchester Bay during the one-year storm. As shown in Figure 6-7, sewer separation, CSO relocation, and the two one-year storm control alternatives achieve 100-percent reduction in CSO fecal coliform load, as a percent of the baseline CSO load during the one-year storm. The three-month control alternative achieves just under 50 percent removal. Based on this figure, the most cost effective alternative would be interceptor relief with system optimization at BOS081 and BOS082.

Figure 6-8 presents the relationship between net present worth and reduction of total fecal coliform load from all sources as a percent of the total fecal coliform load to North Dorchester Bay during the one-year storm. Referring to Figure 6-8, the fecal coliform reductions for CSO relocation, and the one-year control alternatives drop to 70 percent of the total load, as these alternatives do not impact non-CSO fecal coliform sources, in particular, stormwater. The overall removal achieved by sewer separation drops to approximately 45 percent, due to the introduction of additional stormwater to the receiving water. In this case, interceptor relief would still be most cost effective, but it is apparent that the water quality goals may not be achieved due to remaining loads from stormwater.

Impact of CSO Alternatives on Water Quality

Performance of CSO control alternatives was also evaluated in terms of receiving water impacts. Based on the existing beneficial uses and associated water quality parameters identified for each receiving water segment (as was presented in Figure 6-2 for North Dorchester Bay), a series of measures were identified to quantify the impact of the CSO control alternatives on water quality. For fecal coliform criteria, receiving water models were developed to allow prediction of the changes in fecal coliform densities in the receiving water over time. One model was developed for Boston Harbor, extending from the mouth of the Neponset River north to the Mystic/Chelsea Confluence and Constitution Beach. A separate model was developed for the Upper and Lower Charles River Basin. The Upper Mystic River, Alewife Brook, and Back Bay Fens receiving water segments were not modeled. The models simulated conditions for a period of 99 hours, beginning six hours before the start of a design storm event, with simulations run for both the three-month and one-year storms. SWMM output hydrographs for CSO and stormwater, combined with average pollutant concentrations, were used as input to the receiving water model. Boundary conditions were also estimated, as described in the MWRA's August, 1994 "Baseline Water Quality Assessment."

Due to the number of receiving water segments and number of alternatives within each receiving water segment, it was not possible to model every combination of alternatives. Instead, representative combinations were modeled, such as area-wide sewer separation (line IA on Figure 6-6), the high and low Level II controls (lines IID and IIE on Figure 6-6), and the "mixed" levels (lines M, M2, and M3 on Figure 6-6).

Typical output from the receiving water model used in evaluation of CSO control alternatives included the duration of violation of fecal coliform standards (Figure 6-9), predicted fecal coliform density eight hours after the peak of the storm, broken down by source (Figure 6-10), and fecal coliform density isopleths (available only for the Boston Harbor model, Figure 6-11).

Figure 6-9 compares the duration of violations during the one-year storm of the restricted shellfishing, swimming, and boating fecal coliform standards (88, 200, and 1000 counts/100ml, respectively), for future planned conditions, system-wide sewer separation, and CSO relocation to Reserved Channel. As noted above, the total duration of the model simulation was 99 hours, starting six hours before the start of the storm. The duration of the one-year storm is 22 hours. Under future planned conditions, the restricted shellfishing standard will be violated for approximately 30 hours, the swimming standard for just over 20 hours, and the boating standard for about 5 hours. Violations of the boating standard are eliminated by sewer separation and CSO relocation, but the impact of non-CSO sources of pollution can be inferred by the remaining violations of the restricted shellfishing and swimming standards under these alternatives which both eliminate CSOs to North Dorchester Bay.

Figure 6-10 provides an indication of the relative contributions of CSO and stormwater to the violations of the bacteria standards. This figure indicates the predicted fecal coliform density at a single point in time, eight hours after the peak of the one-year storm. The impact of CSO as a source of bacteria under future planned conditions is evident by the height of the red bar. It also appears that with CSO relocation, the swimming standard is not violated eight hours after the peak of the storm. This prediction is consistent with Figure 6-9, which indicated a duration of violation of the swimming standard of less than five hours.

Figure 6-11 presents isopleths of the fecal coliform densities in Boston Harbor eight hours after the peak of the one year storm for future planned conditions. For example, the blue indicates areas where the bacteria density is between one and 14 counts per 100 ml, the green indicates areas between 14 and 200 counts per 100 ml, and so forth. The upper plot presents the densities due to all sources, while the lower plot presents the densities due to

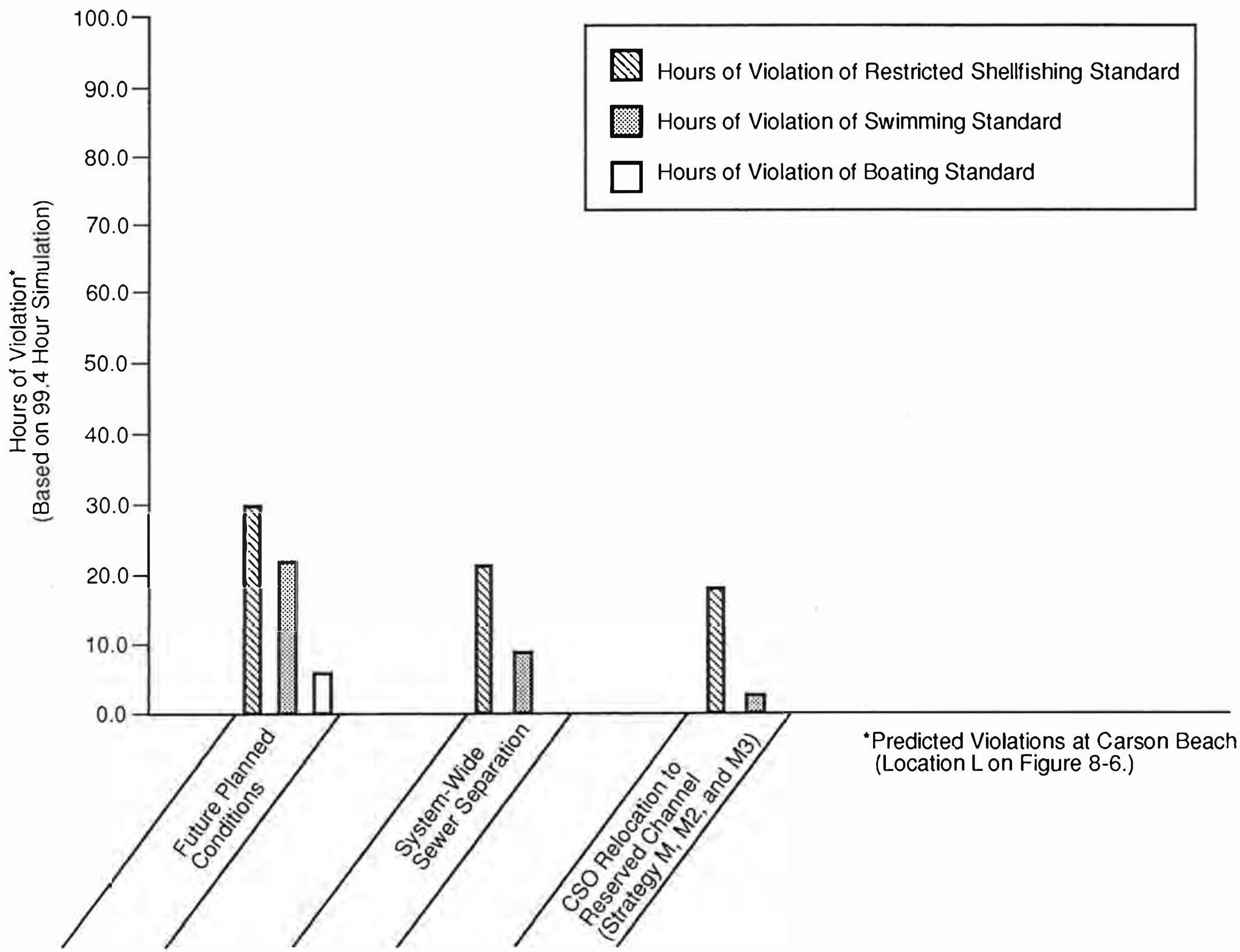


FIGURE 6-9. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, NORTH DORCHESTER BAY

4184jp

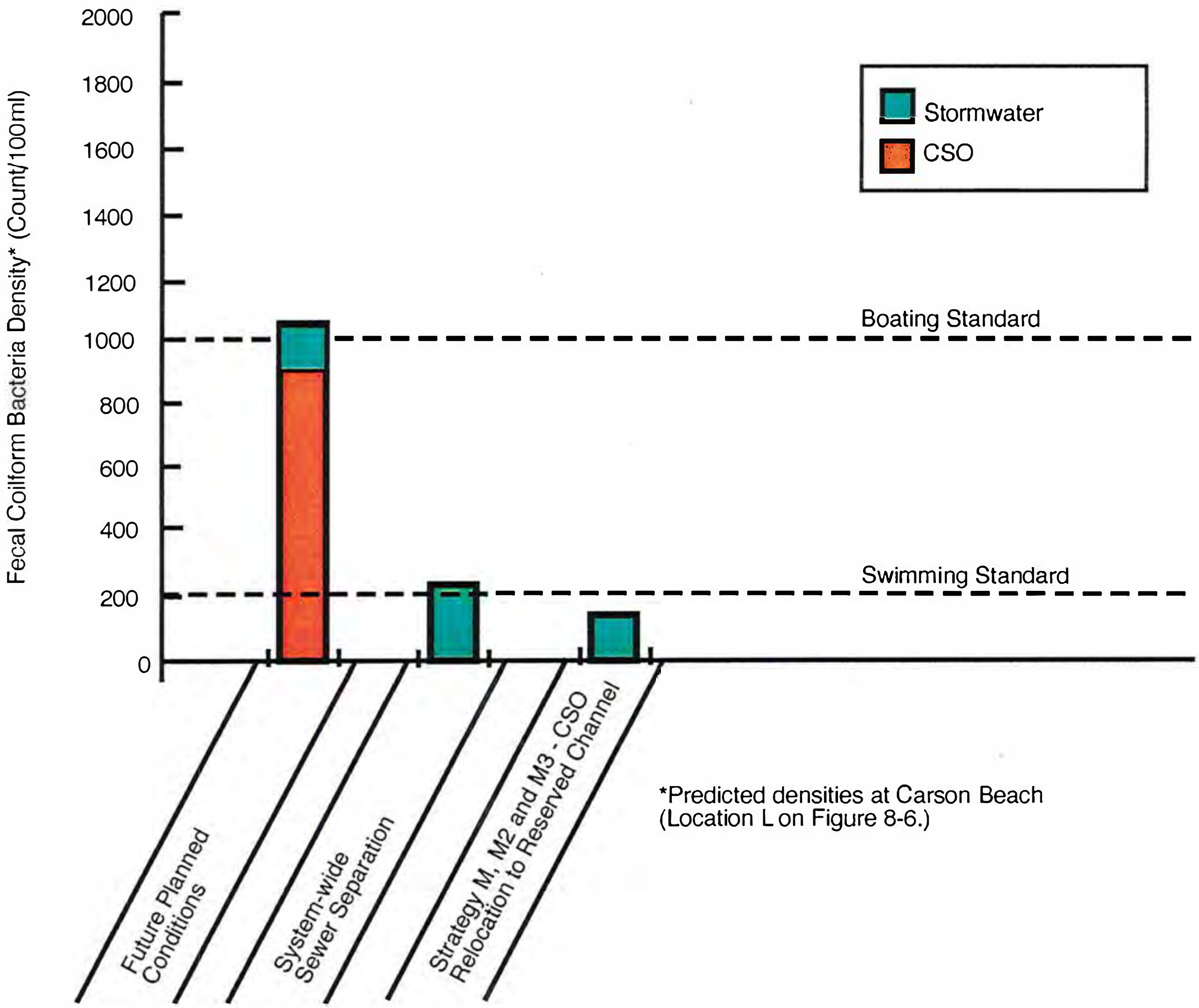
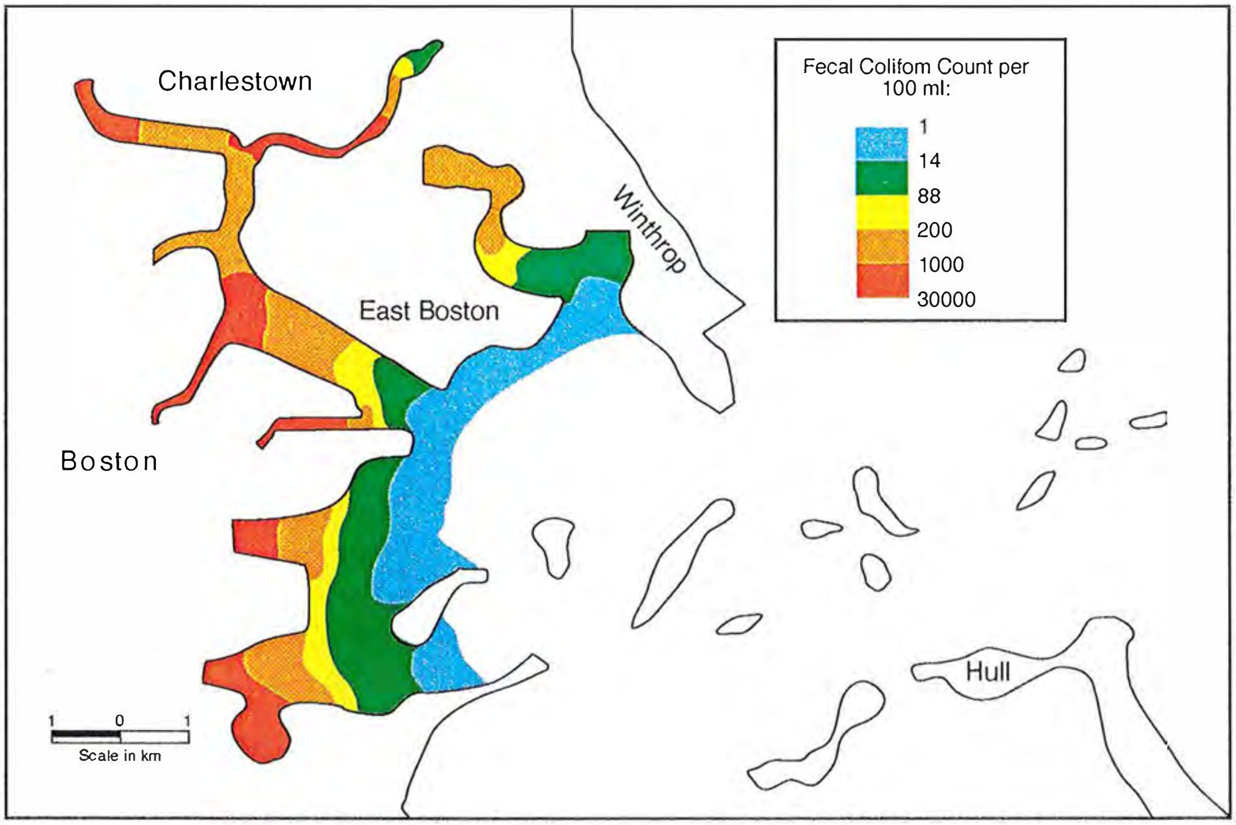
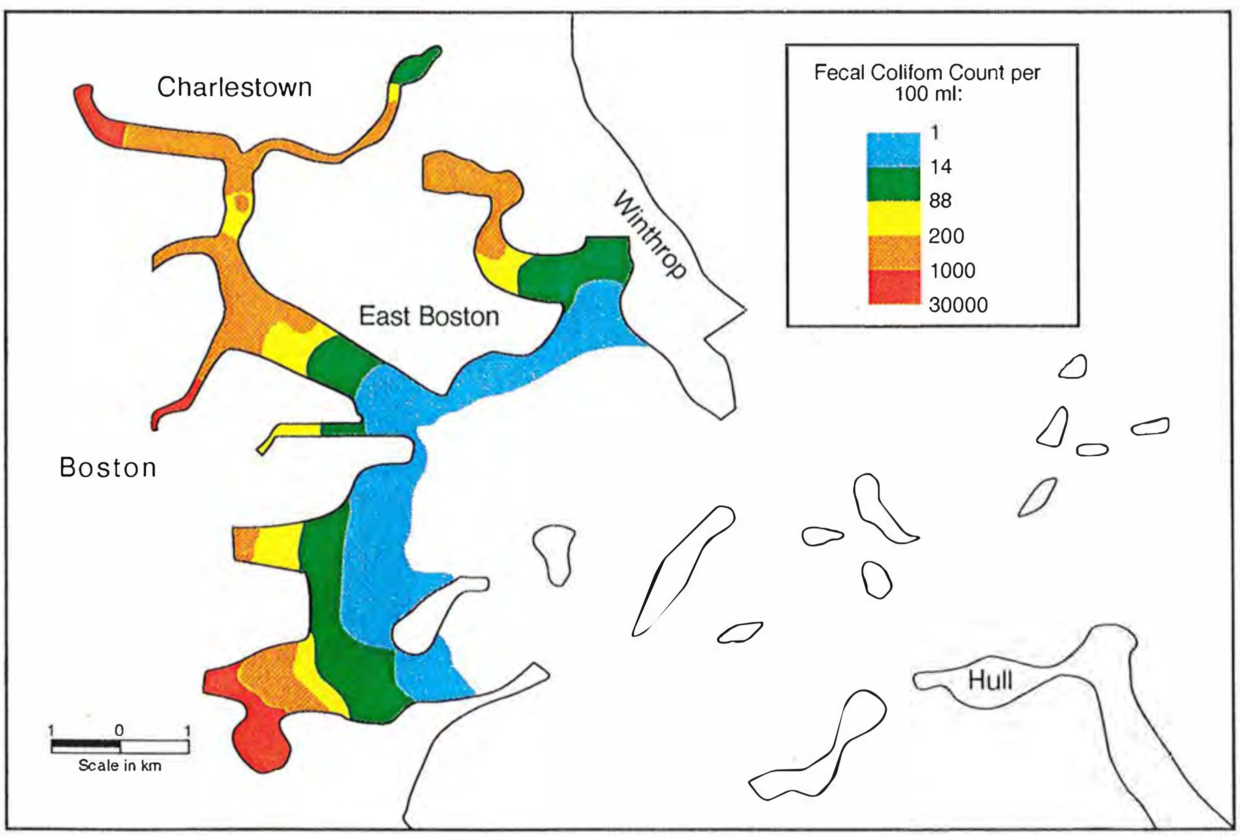


FIGURE 6-10. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1-YEAR STORM, NORTH DORCHESTER BAY

4190jp



A: BACTERIA DENSITIES DUE TO ALL SOURCES



B: BACTERIA DENSITIES DUE TO NON-CSO SOURCES, ONLY

FIGURE 6-11. FECAL COLIFORM BACTERIA DENSITIES IN BOSTON HARBOR EIGHT HOURS AFTER PEAK OF ONE-YEAR STORM, FUTURE PLANNED CONDITIONS

non-CSO sources, only. In both plots, the higher densities within the relatively confined waters at Carson Beach are evident, as is a gradual reduction in density moving east into more open water. The lower plot clearly shows the impact of non-CSO sources, as this plot essentially represents the conditions if every CSO regulator were plugged.

Collectively, the receiving water modeling data presented in Figures 6-9 to 6-11 might support a cost-effective level of CSO control in North Dorchester Bay which provided less than complete elimination of CSOs through either sewer separation or CSO relocation, since elimination will not ensure full attainment of critical uses (swimming, shellfishing) in this receiving water segment. However, as described below, strict cost-effectiveness was not the only consideration in selecting alternatives, particularly in critical use areas.

In addition to receiving water modeling, water quality impacts were also evaluated by computing estimated loads to the receiving water segment for selected pollutants, determining the number of remaining untreated overflows, determining the number of outfalls remaining within computed Division of Marine Fisheries shellfishing closure zones, and other appropriate factors depending on the receiving water segment. Selected performance criteria, including level of control (I, II or III), number of untreated overflows per year, closure of CSOs, and whether the alternative treats stormwater, were also presented. Table 6-8 summarizes the water quality impacts of CSO Alternatives in North Dorchester Bay. As indicated in Table 6-8, the water quality impacts of each alternative can be readily compared with other alternatives, and with future planned conditions. Water quality impact summary tables for the other receiving water segments are included in Appendix H.

Siting Considerations

Potential sites for each CSO control alternative in each receiving water segment were identified and preliminary site investigations conducted by teams of environmental planners and engineers. Field investigations were limited to a visual inspection of the proposed sites.

TABLE 6-8. WATER QUALITY IMPACTS OF CSO ALTERNATIVES IN NORTH DORCHESTER BAY

Use	Use Attainment	Parameter	Measures	Future Planned Conditions	NDB1 Sewer Separation	NDB2 CSO Relocation to Reserved Channel	NDB3 Consolidation/ Storage Conduit (1 Yr)	NDB4 Interceptor Relieef: System Optimization 081,082 (1 Yr)	NDB5 Consolidation/Storage Conduit (3 Mo)
Shellfishing	0	bacteria*	hours > 14***(1) after 1 yr storm	54.9	45.5	44.5	44.5	44.5	
			hours > 88 (1) after 1 yr storm	29.0	20.7	17.6	17.6	17.6	
		CSO proximity**	# outfalls within closure zone active in 1 yr storm	6	0	0	0	0	6 (est.)
Swimming	0	bacteria	total 1 yr storm load (CSO+SW)	6.47 E13	3.60 E13	1.99 E13	1.99 E13	1.99 E13	4.31 E13
			hours > 200 (1) after 1 yr storm	20.7	8.3	3.1	3.1	3.1	
Boating	+	bacteria	hours > 1000 (1) after 1 yr storm	5.2	0	0	0	0	
Aquatic life	0	sediment	CSO+SW load TSS (lbs) after 1 yr storm	8,010	9,830	5,440	5,440	5,440	6,710
			after 3 mo storm	3,890	6,260	3,481	3,481	3,481	3,481
Alternative Performance			Level of Control		I	I	II	II	II
			# of untreated overflows/yr	78	0	0	1 - 3	0	4 - 7
			Closure of CSOs	0	8	7	1 - 7	0	1 - 7
			Treat stormwater	N	N	N	N	N	N
Alternative Summary Rating					8	6	7	7	9
Alternative Ranking					3	1	2	2	3

*The duration of simulation period was 99.4 hours.

** DMF has a formula that calculates closure distance as fcn. of CSO flow, vol. of receiving water segment, and bacteria load (assuming total chorination failure); number of outfalls indicated are within closure zone for unrestricted shellfishing.

***OPEN shellfishing requires geom. mean fecal coliform counts below 14/100 ml

To avoid toxicity, all chlorinated CSO discharges are assumed to be dechlorinated as well

Reserved Channel currently has pretty good water quality in spite of a large CSO load, to which relocation would add only a little

No aesthetics parameters because currently no CSO-associated aesthetic problem observed in N. Dorchester Bay

(1) Model data at Carson Beach

0 Indicates non-attainment of use during wet weather

+ Indicates use is attained

Siting issues evaluated included the existence of a potentially available site (e.g., was a parcel available that could accommodate the CSO control technology); the constructability of a site (e.g., analysis of construction issues and engineering requirements for the proposed CSO control technology; community impacts, both short-term (construction time period) and long-term (post construction), such as traffic, noise, and odor as well as a preliminary assessment of community acceptance of the impacts; and environmental concerns, including an analysis of natural resources impacts and permitability of the alternative. In addition, other siting factors, such as zoning, presence of endangered species, and potential for the presence of hazardous materials were reviewed for supplementary analysis. An example of a matrix for siting issues in North Dorchester Bay is presented in Table 6-9. The remaining siting matrices are included in Appendix J. Additional site investigations were conducted in November, 1994, in response to siting concerns raised during the public meetings held following release of the September, 1994 Draft CCP/SMP.

Evaluation Process

In order to systematically evaluate the range of data available on each CSO control alternative, rating and ranking systems were developed. These systems evolved to a certain extent during the workshop evaluation process, with the final process involving primarily water quality impacts and costs. For water quality impacts, individual measures of pollutant parameters were rated on a scale of one to three, with the ratings defined as in Table 6-10. Where more than one measure was presented for a given beneficial use, the individual ratings were combined to a single rating for each use. The ratings for each use were then summed and the totals assigned a rating of one to three. Costs were assigned a rating of one to three, based on net present worth. Siting issues were also rated one to three. A rating of one indicated that a site had few, if any, siting problems observed; a rating of two signified moderate siting issues or problems; and a rating of three indicated that significant potential problems were noted.

TABLE 6-9. SITING ISSUES FOR NORTH DORCHESTER BAY

PARAMETER	NUMERICAL VALUE*/ MEASURE	NDB-1 Sewer Separation 373 Acres	NDB-2 CSO Relocation to Reserved Channel 1.0 Acres, 11,00 L.F. Conduit	NDB-3 Consolidation/Storage Conduit (1 year) Pump-out BOS087 0.4 Acres, 7500 L.F. Conduit	NDB-4 Relief of SBI, System op. BOS081,082 (1 year) 9500 L.F.	NDB-5 Consolidation, Near Surface Storage Conduit (3 month) 0.4 Acres, 7500 L.F. Conduit	Deep Rock Tunnel
SITE AVAILABILITY o Vacant land o Park land o Residential o Commercial/Industrial o Vacant industrial	1) Multiple sites/few restrictions 2) Limited sites/site restrictions 3) No site/severe restrictions	Primarily in existing ROWs 1	Pipe located under beach or Day Boulevard, Farragut Street (appears wide enough), Conley Terminal or Old Power Plant 2	Pipe located under Carson Beach and/or Day Boulevard. Bayside parking area or MDC park 1	Existing SBI-Day Boulevard 1	Pipe located under Carson Beach and/or Day Boulevard 1	Koscuisko Circle site for tunnel shaft- tight siting issues, road network problems 3 F***
CONSTRUCTABILITY o Deep Execution o Tunneling o Special Techniques o Potential Hazardous Waste	1) Standard construction 2) Construction constraints 3) Unique & /or special construction required	Typical ROW construction issues 2	No construction during beach season if on beach, marine terminal facilities may be underground 3	Soft ground tunnel 2	Utility relocations 2	2	Complex traffic patterns, and difficult 3
SHORT TERM COMMUNITY IMPACTS o Traffic impacts o Sensitive receptors	1) Low 2) Moderate 3) Severe	Local street closing 2	Traffic impacts, beach impacts, BHA housing, residences 2	Beach, traffic impacts 2	Traffic impacts on Day Boulevar disruption to bath houses and yacht clubs 2	Beach, traffic impacts 2	Bank of Boston, Bayside Expo., extensive road network/traffic issues 3
LONG TERM COMMUNITY IMPACTS o Public acceptance o Maintenance impacts o Operations impacts	1) Low 2) Moderate 3) Severe	No maintenance or operations impacts 1	No maintenance or operations impacts. Assuming facility on Industrial site 2**	Maintenance and operation impacts with storage and pump-out 2	Minor maintenance and operatio impacts 1	Minor maintenance and operation impacts 2	Maintenance and operation impacts (pump station-odors) 2
ENVIRONMENTAL IMPACTS o Wetlands o Tidelands o Other	1) Low 2) Moderate 3) Severe	Not Applicable	Beach area is a wetland resource 2	Beach area is a wetland resource 2	Beach area is a wetland resource 1	Beach area is a wetland resource 2	No impacts anticipated 1
ALTERNATIVE SUMMARY/ RATING		7	11	9	7	9	

* Numerical values: 1 = Few, if any, implementation constraints; 2 = Potential difficult implementation; 3 = Potentially prohibits implementaion.
** Assuming facility at Conley Terminal
*** F signifies condition may preclude use of site

TABLE 6–10. DEFINITION OF WATER QUALITY RATING FACTORS

WATER QUALITY INPACT RATING SYSTEM

ATTAINMENT STATUS	SYMBOL	ATTAINMENT WITH CSO ALTERNATIVE		
		IMPROVES (30% REDUCTION)	SAME	DEGRADES
Non–Attainment of Use Wet and Dry Weather	–	1	2	3
Non–Attainment of Use Wet Weather	0	1	2	3
Use Attained	+	1	1	2 or 3

WATER QUALITY ALTERNATIVE PERFORMANCE RATING SYSTEM

MEASURE	RATING		
	1	2	3
Level of Control	I	II	III
Number of Untreated Overflows per Year	0	1 – 7	Same as Future Planned Conditions
Closure of CSOs (Number)	All	Some	None
Treat Stormwater	Yes	No	

The cost and water quality impact ratings for each alternative were summed, to create an overall rating. The alternative with the best overall rating was generally selected as the initially preferred alternative, and in most instances one or more alternates were also selected. The siting matrix for the selected alternative was then reviewed to evaluate the feasibility of its implementation. An example of the matrix of water quality impacts showing the various ratings for North Dorchester Bay is presented in Table 6-11.

It should be noted that the rating methodology was intended to be a reasonably uniform and systematic means for evaluating sets of data for each CSO control alternative, but was not intended to be the sole means for selecting a preferred alternative. Once initially preferred alternatives were identified for all receiving water segments through the rating methodology, the resulting system-wide strategy was reviewed as a whole for consistency and appropriateness. As noted earlier, a separate workshop session was devoted to this process of "stepping back" and looking at the plan as a whole. For this process, all of the initially-preferred alternatives were presented in a matrix along with three deep tunnel alternatives. Costs for individual alternatives, and total costs for system-wide strategies were also presented. Comments, concerns, and judgements from workshop participants were then solicited and revisions made to the selected alternatives until general agreement was reached as to the overall preferred strategy. In this sense, the rating methodology provided an initial focus for the group evaluation process, but was not the only criterion by which the preferred alternative was identified for each receiving water segment.

For example, in North Dorchester Bay, interceptor relief with system optimization at BOS081 and BOS082 was the initially preferred alternative based on the rating methodology. This alternative would provide control of overflows up to the one-year storm. However, the opinion among workshop participants was that elimination of CSOs from the Dorchester beaches was a desired and worthwhile goal of the CSO program that warranted the additional cost over interceptor relief. Since CSO relocation to the Reserved Channel achieved the elimination of CSOs without the discharge of additional stormwater associated with sewer

TABLE 6-11. WATER QUALITY IMPACTS OF CSO ALTERNATIVES IN NORTH DORCHESTER BAY

Use	Use Attainment	Parameter	Measures	Future Planned Conditions	NDB1 Sewer Separation	NDB1 rating	NDB2 CSO Relocation to Reserved Channel	NDB2 rating	NDB3 Consolidation/ Storage Conduit (1 Yr)	NDB3 rating
Shellfishing	0	bacteria*	hours > 14***(1) after 1 yr storm	54.9	(2) 45.5	2	(2) 44.5	1	(2) 44.5	1
			hours > 88 (1) after 1 yr storm	29.0	(2) 20.7		(1) 17.6		(1) 17.6	
		CSO proximity**	# outfalls within closure zone active in 1 yr storm	6	(1) 0		(1) 0		(1) 0	
Swimming	0	bacteria	total 1 yr storm load (CSO+SW)	6.47 E13	3.60 E13 (1)	1	1.99 E13 (1)	1	1.99 E13 (1)	1
			hours > 200 (1) after 1 yr storm	20.7	(1) 8.3		(1) 3.1		(1) 3.1	
Boating	+	bacteria	hours > 1000 (1) after 1 yr storm	5.2	(1) 0	1	(1) 0	1	(1) 0	1
Aquatic life	0	sediment	CSO+SW load TSS (lbs) after 1 yr storm	8,010	(3) 9,830	3	(1) 5,440	2	(1) 5,440	2
			after 3 mo storm	3,890	6,260 (3)		3,481 (2)		3,481 (2)	
Alternative Performance			Level of Control		(1) I	1	(1) I	1	(2) II	2
			# of untreated overflows/yr	78	(1) 0		(1) 0		(2) 1 - 3	
			Closure of CSOs	0	(1) 8		(2) 7		(2) 1 - 7	
			Treat stormwater	N	(2) N		(2) N		(2) N	
Alternative Summary Rating					8		6		7	
Alternative Ranking					3		1		2	

*The duration of simulation period was 99.4 hours.

** DMF has a formula that calculates closure distance as fcn. of CSO flow, vol. of receiving water segment, and bacteria load (assuming total chorination failure); number of outfalls indicated are within closure zone for unrestricted shellfishing.

***OPEN shellfishing requires geom. mean fecal coliform counts below 14/100 ml

To avoid toxicity, all chlorinated CSO discharges are assumed to be dechlorinated as well

Reserved Channel currently has pretty good water quality in spite of a large CSO load, to which relocation would add only a little

No aesthetics parameters because currently no CSO-associated aesthetic problem observed in N. Dorchester Bay

(1) Model data at Carson Beach

0 Indicates non-attainment of use during wet weather

+ Indicates use is attained

TABLE 6-11(con't). WATER QUALITY IMPACTS OF CSO ALTERNATIVES IN NORTH DORCHESTER BAY

Use	Use Attainment	Parameter	Measures	NDB4 Interceptor Relieef: System Optimization 081,082 (1 Yr)		NDB5 Consolidation/Storage Conduit (3 Mo)	
Shellfishing	0	bacteria*	hours > 14*** (1) after 1 yr storm	(2) 44.5		(2)	
			hours > 88 (1) after 1 yr storm	(1) 17.6	1	(2)	2
		CSO proximity**	# outfalls within closure zone active in 1 yr storm	(1) 0		(2) 6 (est.)	
Swimming	0	bacteria	total 1 yr storm load (CSO+SW)	1.99 E13 (1)	1	4.31 E13 (1)	1
			hours > 200 (1) after 1 yr storm	(1) 3.1		(2)	
Boating	+	bacteria	hours > 1000 (1) after 1 yr storm	(1) 0	1	(2)	2
Aquatic life	0	sediment	CSO+SW load TSS (lbs) after 1 yr storm after 3 mo storm	(1) 5,440 3,481 (2)	2	(2) 6,710 3,481 (2)	2
Alternative Performance			Level of Control	(2) II		(2) II	
			# of untreated overflows/yr	(1) 0	(2)	(2) 4 - 7	(2)
			Closure of CSOs	(2) 0		(2) 1 - 7	
			Treat stormwater	(2) N		(2) N	
Alternative Summary Rating				7		9	
Alternative Ranking				2		3	

*The duration of simulation period was 99.4 hours.

** DMF has a formula that calculates closure distance as fcn. of CSO flow, vol. of receiving water segment, and bacteria load (assuming total chorination failure); number of outfalls indicated are within closure zone for unrestricted shellfishing.

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+ Indicates use is attained

separation, CSO relocation replaced interceptor relief as the preferred alternative for North Dorchester Bay.

Data used in the evaluation process, including baseline pollutant loads, cost/performance curves, water quality impact rating tables, cost rating tables, and siting issues for each receiving water segment are included in Appendices F through J, respectively, of this report.

Using the methodology presented above, the alternatives presented in Chapter Seven were evaluated, and recommended alternatives were selected as presented in Chapter Eight.

PART II

CHAPTER SEVEN

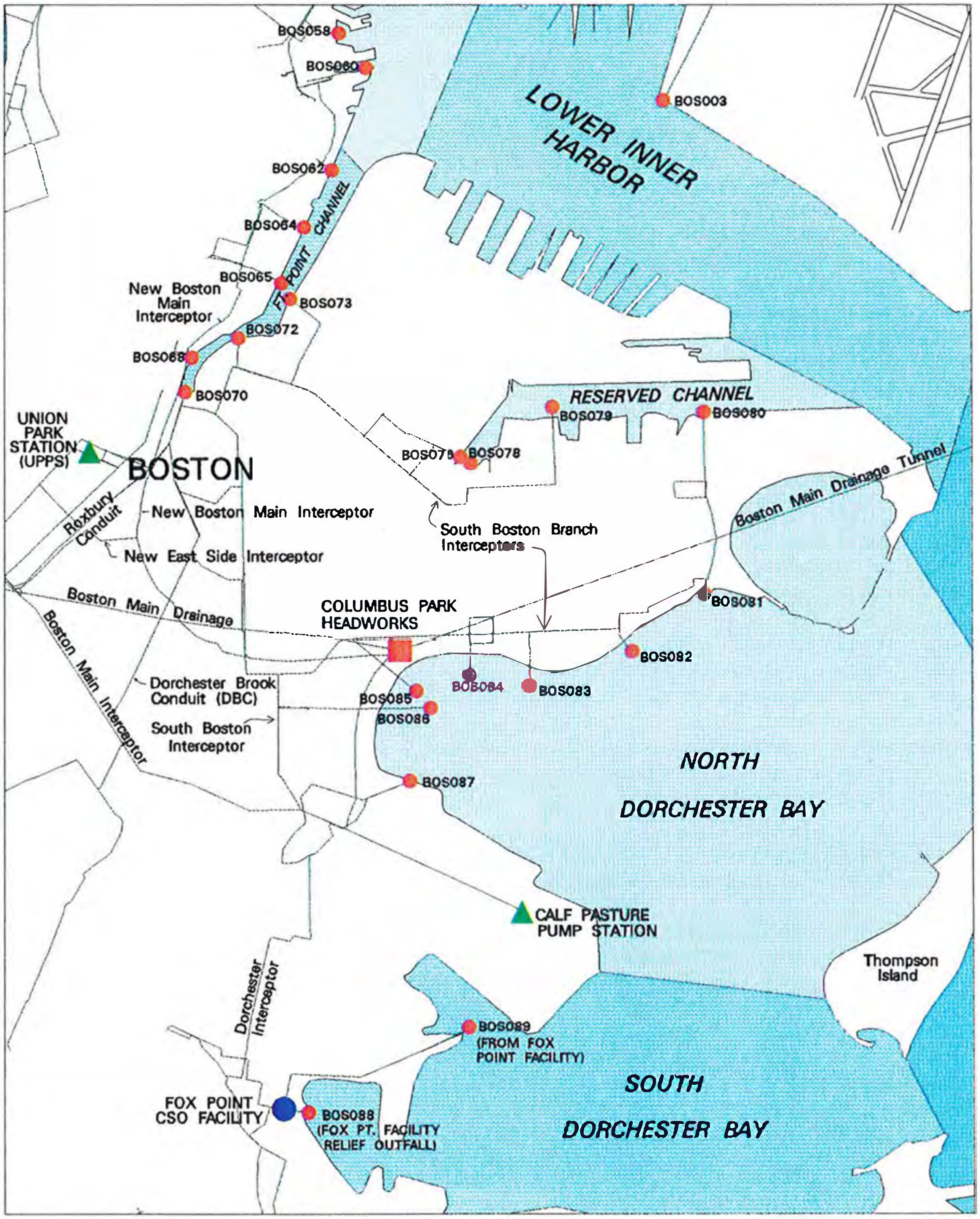
ALTERNATIVES FOR CSO CONTROL

This chapter presents a description of each of the 14 receiving water segments within the project study area, as well as the CSO control alternatives evaluated for each segment. The descriptions of receiving water segments include definition of existing water quality standards and designated uses, existing waterbody and adjacent land uses, and an identification of the types and sources of pollutants causing non-attainment of uses. The CSO control alternatives described are only those which were not screened out during the workshops conducted in April through June of 1994. Additional details on these alternatives are available in the June, 1994 report on Alternatives for CSO Control. This chapter also includes a discussion of regional and area-wide deep tunnel alternatives. The recommended alternative for each receiving water segment is described in more detail in Chapter Eight.

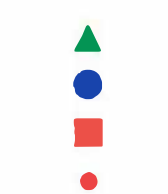
NORTH DORCHESTER BAY

Description of the Receiving Water Segment

The North Dorchester Bay receiving water segment extends from the mouth of the Reserved Channel to Columbia Point in Dorchester, including Pleasure Bay and Carson Beach, and offshore to Spectacle and Thompson's Islands (Figure 7-1). This area is classified as SB-Fishable/Swimmable with restricted shellfishing in approved areas. Massachusetts DEP-designated critical uses for this receiving water segment include swimming and shellfishing. Existing water-based uses within this area are primarily recreational and include powerboating and sailboating, swimming, and fishing. Although the Division of Marine Fisheries has identified a significant shellfish resource in the Carson Beach area, shellfishing in this area is currently prohibited due to the fecal coliform levels in the overlying waters and the proximity of the CSOs. Pleasure Bay also contains shellfish beds, which are currently closed for management reasons.



LEGEND



Line	Existing Conduit
Green triangle	Pump Station
Blue circle	CSO Treatment Facility
Red square	Headworks
Red dot	CSO Outfall

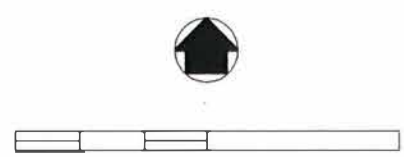


Figure 7-1
Reserved Channel
Fort Point Channel
North Dorchester Bay

Many of the land uses along northern Dorchester Bay support water-based recreational uses. The MDC controls much of the waterfront in this area although there are parcels controlled by both the City and by private interests. Much of the waterfront is used for passive recreation, and a number of separate beach areas, some including bathhouse facilities, exist along this area. Some commercial and residential land uses border the waterfront or the beaches. The Southeast Expressway runs adjacent to part of the receiving water segment. The University of Massachusetts at Boston (UMass/Boston) and the John F. Kennedy Library are located at Columbia Point, on the border between the North and South Dorchester Bay receiving water segments.

A total of seven untreated CSOs discharge to North Dorchester Bay. Figure 7-2 presents the total pollutant load and relative contributions to the load from CSO and stormwater for pollutants causing non-attainment of designated uses in North Dorchester Bay. For each receiving water segment in Figure 7-2, where a designated use criterion is violated in either wet or dry weather, pie charts are shown, indicating the estimated relative contributions of CSOs, stormwater, and boundary sources (if appropriate) to the total load of the pollutant causing non-attainment. Pie charts are presented for loads from the one-year storm, and annual loads. The numerical value of the total load is indicated above each "pie." Also summarized on Figure 7-2 are the existing water quality standard, existing uses, recommended CSO control plan, and the water quality goal supported by the recommended plan. As indicated in Figure 7-2, CSOs are the predominant source of fecal coliform bacteria during the one-year storm. For parameters other than fecal coliform bacteria, the loads from stormwater appear to be substantially greater than the loads from CSOs. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

FIGURE 7-2. SUMMARY OF FUTURE PLANNED CONDITIONS WATER QUALITY PARAMETERS AND RECOMMENDED CSO CONTROL PLAN BY RECEIVING WATER SEGMENT

	DORCHESTER BAY / NEPONSET RIVER				CHARLES RIVER		
	NORTH DORCHESTER BAY	SOUTH DORCHESTER BAY	NEPONSET RIVER	CONSTITUTION BEACH	UPPER CHARLES RIVER	LOWER CHARLES RIVER	BACK BAY FENS
EXISTING WATER QUALITY STANDARD [1]	SB	SB	SB	SB	B	B	B
EXISTING USES (* = CRITICAL USE)	FISHING SHELLFISHING* SWIMMING* BOATING AESTHETIC VALUE	FISHING SHELLFISHING* SWIMMING* BOATING AESTHETIC VALUE	FISHING SHELLFISHING* BOATING AESTHETIC VALUE	FISHING SHELLFISHING* SWIMMING* BOATING AESTHETIC VALUE	BOATING AESTHETIC VALUE	FISHING BOATING AESTHETIC VALUE	AESTHETIC VALUE
SELECTED USE CRITERIA; AND SOURCES OF POLLUTANTS AND TOTAL POLLUTANT LOAD CAUSING NON-ATTAINMENT [2]	1 YEAR / ANNUAL	1 YEAR / ANNUAL	1 YEAR / ANNUAL	1 YEAR / ANNUAL	1 YEAR / ANNUAL	1 YEAR / ANNUAL	1 YEAR / ANNUAL
BACTERIA (FC, count, trillions)	60 / 450	30 / 380	140 / 6,700	60 / 490	310 / 11,800	610 / 7,500	140 / 1,200
FLOATABLES (CSO & SW VOLUME, MG)		40 / 490			210 / 3,030	160 / 1,780	
DO (BOD, lbs)	4,300 / 43,000	16,700 / 162,200				130,800 / 9,232,000	12,900 / 160,200
NUTRIENTS (TOTAL P, lbs)		590 / 5,490	390 / 44,250		1,030 / 64,090	2,130 / 68,630	320 / 3,590
TOXICS (Cu, lbs)		20 / 220	30 / 2,480		100 / 3,790	100 / 3,760	30 / 390
RECOMMENDED WATER QUALITY GOAL	- Meet unrestricted shellfishing and swimming bacteria standards - Meet aesthetic criteria - Meet DO standard - Control nutrients	- Meet restricted shellfishing bacteria standard - Meet aesthetic criteria	- Meet restricted shellfishing bacteria standard - Meet aesthetic criteria	- Meet unrestricted shellfishing bacteria standard - Eliminate potential Chlorine toxicity	- Meet swimming bacteria standard except for ± 4 overflows per year - Meet aesthetic criteria	- Meet swimming bacteria standard except for ± 4 overflows per year - Meet boating standard - Meet aesthetic criteria - Improve DO - Reduce nutrients - Reduce metals	- Meet Class B water quality standard except for less than 4 overflows per year
RECOMMENDED CSO CONTROL PLAN	CSO Relocation to Reserved Channel, and screening/disinfection	Upgrade Existing Facilities to Dechlorination; Sewer Separation	Sewer Separation	Sewer Separation	Screen and Disinfect CAM005; Enlarge interceptor connection at BOS032; Install manually-cleaned bar screen at 5 outfalls	Screen/ Disinfect Stony Brook Conduit;Upgrade Cottage Farm screens, dechlorination outfall; Plug regulators at 2 outfalls, Install manually-cleaned bar screens at 9 outfalls	Install manually-cleaned bar screen at BOS046

[1] Designated uses for Class SB water include: Aquatic life habitat, Primary Contact Recreation (swimming), Secondary Contact Recreation (boating), Restricted shellfishing, and Aesthetic value
Designated uses for Class B water include: Aquatic life habitat, Primary Contact Recreation (swimming), Secondary Contact Recreation (boating), Public water supply (with treatment), Irrigation/agricultural uses, Industrial cooling/process uses, and Aesthetic value

[2] Where a designated use criteria is currently not attained, the relative contributions of sources of the pollutant causing non-attainment are represented by the pie charts. Where no pie chart is indicated, the use is currently attained. The pie charts are color coded as follows: CSO STORMWATER BOUNDARY OR UPSTREAM FLOW, IF APPLICABLE

FIGURE 7-2 (continued). SUMMARY OF FUTURE PLANNED CONDITIONS WATER QUALITY PARAMETERS AND RECOMMENDED CSO CONTROL PLAN BY RECEIVING WATER SEGMENT

	ALEWIFE BROOK / UPPER MYSTIC RIVER		BOSTON HARBOR				
	ALEWIFE BROOK	UPPER MYSTIC RIVER	UPPER INNER HARBOR	LOWER INNER HARBOR	MYSTIC/CHELSEA CONFLUENCE	RESERVED CHANNEL	FORT POINT CHANNEL
EXISTING WATER QUALITY STANDARD [1]	B	B	SB	SB	SB	SB	SB
EXISTING USES (* = CRITICAL USE)	FISHING BOATING AESTHETIC VALUE	FISHING BOATING AESTHETIC VALUE	FISHING BOATING AESTHETIC VALUE	FISHING BOATING AESTHETIC VALUE	FISHING BOATING AESTHETIC VALUE	FISHING BOATING AESTHETIC VALUE	FISHING BOATING AESTHETIC VALUE
SELECTED USE CRITERIA; AND SOURCES OF POLLUTANTS AND TOTAL POLLUTANT LOAD CAUSING NON-ATTAINMENT [2]	1 YEAR / ANNUAL	1 YEAR / ANNUAL	1 YEAR / ANNUAL	1 YEAR / ANNUAL	1 YEAR / ANNUAL	1 YEAR / ANNUAL	1 YEAR / ANNUAL
BACTERIA (FC, count, trillions)	180 / 1,520	230 / 4,280	190 / 3,370	200 / 390	260 / 2,450	180 / 1,470	610 / 3,970
FLOATABLES (CSO & SW VOLUME, MG)	70 / 1,020	180 / 2,720	70 / 620	100 / 130	140 / 1,800		70 / 650
DO (BOD, lbs)	6,500 / 174,500	42,600 / 1,239,500	155,700 / 9,585,100	27,500 / 784,200	60,200 / 2,236,500		24,100 / 187,700
NUTRIENTS (TOTAL P, lbs)	370 / 4,060	820 / 19,820	1,980 / 68,180	210 / 1,610	1,030 / 21,310	250 / 2,050	850 / 6,050
TOXICS (Cu, lbs)	30 / 410	80 / 1,610	80 / 3,480	50 / 490	70 / 1,380	10 / 70	120 / 280
RECOMMENDED WATER QUALITY GOAL	- Meet swimming bacteria standard except for ± 4 overflows per year - Meet DO standard - Meet aesthetic criteria - Control nutrients - Control toxics	- Meet swimming bacteria standard except for ± 4 overflows per year - Meet boating standard - Meet aesthetic criteria	- Meet swimming bacteria standard except for ± 4 overflows per year - Meet DO standard - Meet aesthetic criteria - Reduce toxics	- Meet swimming bacteria standard except for ± 4 overflows per year - Meet DO standard - Meet aesthetic criteria - Reduce toxics	- Meet swimming bacteria standard except for ± 4 overflows per year - Meet DO standard - Meet aesthetic criteria	- Meet swimming bacteria standard except for ± 4 overflows per year - Meet aesthetic criteria	- Meet swimming bacteria standard except for ± 4 overflows per year - Meet aesthetic criteria
RECOMMENDED CSO CONTROL PLAN	Separate CAM002 and CAM004 Tributary Areas; Separate baffle MHs at SOM001; Install manually-cleaned bar screens at 8 outfalls	Separate baffle MHs at SOM006 and SOM007	Relieve East Boston Branch Sewer; Screen and disinfect BOS019; Add dechlorination at Prison Point; Install manually-cleaned bar screens at 6 outfalls	Relieve East Boston Branch Sewer; Install manually-cleaned bar screens at 5 outfalls	Screen and Disinfect BOS017 and MWR205; Interceptor Relief for CHE002-004; Install manually-cleaned bar screens at 6 outfalls	Consolidate, Screen and Disinfect near BOS080; Install manually-cleaned bar screens at 4 outfalls	Detention/Treatment at UPPS; Storage at BOS072&073 Storage in Dorchester Conduit; Install manually-cleaned bar screens at 3 regulators, 2 outfalls and in D.B.C.

[1] Designated uses for Class SB water include: Aquatic life habitat, Primary Contact Recreation (swimming), Secondary Contact Recreation (boating), Restricted shellfishing, and Aesthetic value
Designated uses for Class B water include: Aquatic life habitat, Primary Contact Recreation (swimming), Secondary Contact Recreation (boating), Public water supply (with treatment), Irrigation/agricultural uses, Industrial cooling/process uses, and Aesthetic value

[2] Where a designated use criteria is currently not attained, the relative contributions of sources of the pollutant causing non-attainment are represented by the pie charts.
Where no pie chart is indicated, the use is currently attained. The pie charts are color coded as follows: CSO STORMWATER BOUNDARY OR UPSTREAM FLOW, IF APPLICABLE

TABLE 7-1. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR NORTH DORCHESTER BAY

Evaluation Criteria	Future Planned Conditions	NDB2 Recommended Plan CSO Relocation to Reserved Channel	NDB1 Complete Sewer Separation	NDB3 Consolidation Near Surface Storage Conduit (Sized for 1 Yr. Storm)	NDB4 Interceptor Relief	NDB5 Consolidation Near Surface Storage Conduit (Sized for 3 Mo. Storm)
Water Quality Benefit (1)						
• Unrestricted Shellfishing (Bacteria Std. Exceedance, hrs.)	55	47	45	44	44	50
• Restricted Shellfishing (Bacteria Std. Exceedance, hrs.)	29	19	21	18	18	28
• Swimming (Bacteria Std. Exceedance, hrs.)	21	3	8	3	3	19
• Boating (Bacteria Std. Exceedance, hrs.)	5	0	0	0	0	2
• Aquatic Life (Solids Load, lbs.)	8,000	5,400	9,800	5,400	5,400	6,700
• Performance						
(Untreated Overflows, no./yr.)	78	0	0	1-3	1-3	4-7
(Closure of CSOs)	0	7	7	0	0	0
Critical Siting Concerns		Impacts traffic, beach use, and residences	Local street closings during construction	Impacts traffic and beach	Impacts traffic, bath house and yacht clubs	Impacts traffic and beach
Capital Cost (millions)		$86.1	$80.9	$41.4	$22.3	$26.5
Annual O & M Cost		$845,000	$0	$99,400	$0	$99,400
Present Worth (millions)		$77.8	$65.0	$34.3	$18.0	$22.3

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, and solids loads are derived based on a 1-year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml; unrestricted shellfishing 14/100ml; restricted shellfishing 88/100ml.
   c. The duration of the simulation period for in-receiving water modeling was 99.4 hours; predicted duration of violations at Carson Beach.
   d. Solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. A dash "-" indicates that the alternative was not evaluated with the receiving water model.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-1, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of each alternative are provided below, and additional details on the recommended plan, CSO relocation to Reserved Channel, are provided in Chapter Eight.

CSO Relocation to Reserved Channel. This alternative is the recommended plan. A consolidation conduit would be constructed to pick up outfalls BOS087 through BOS081 and convey all overflows to a screening and disinfection facility in the vicinity of outfall BOS080. This facility would discharge treated overflows to the Reserved Channel. All outfalls to Northern Dorchester Bay would be bulkheaded.

Sewer Separation. This alternative would involve separation of combined areas tributary to the South Boston Interceptor (SBI) South Branch and Main Branch, as well as a portion of the Dorchester Interceptor. Complete separation may be difficult in this area due to the potential for older houses having roof leaders connected to sanitary drainage within the internal house plumbing.

Consolidation/Storage Conduit (1-Year Storm Control). A consolidation conduit running along the shore of North Dorchester Bay, picking up outfalls BOS081 to BOS087, would have sufficient volume to capture the one-year storm overflow volume from those outfalls. This consolidation conduit would have a pump-out station in the vicinity of BOS087, to return the contents of the conduit to the Columbus Park Connection following the end of the storm.

Interceptor Relief and System Optimization at BOS081, BOS082 (1-Year Storm Control.) This alternative would involve providing relief of the SBI South Branch, and further system optimization at outfalls BOS081 and BOS082. Relief of the SBI South

Branch, which may involve a combination of replacement of existing sections and installation of parallel relief pipe for other sections, is predicted to eliminate overflows at outfalls BOS083 to BOS087 for the one-year storm. It is expected that relatively minor overflows remaining at BOS081 and BOS082 during the one-year storm would be controlled by further system optimization, such as weir adjustments.

Consolidation/Storage Conduit (3-Month Storm Control). This alternative would be similar to the consolidation/storage conduit for one-year storm control, except that the conduit would not extend to outfall BOS087, which is not active during the 3-month storm.

SOUTH DORCHESTER BAY

Description of the Receiving Water Segment

The South Dorchester Bay receiving water segment extends from Columbia Point to the Port Norfolk Yacht Club in Dorchester, and offshore to Thompson's Island and Squantum (Figure 7-3). South Dorchester Bay includes a portion of the Neponset River mouth, specifically Commercial Point and Tenean Beach. This area is classified as SB-Fishable/Swimmable with restricted shellfishing. The Squantum section of Quincy has restricted shellfish beds; however, several dozen shellfish beds in this area are classified as prohibited. Massachusetts DEP-designated critical uses in this receiving water segment include swimming and shellfishing. Water-based uses in this segment include swimming, boating, and fishing. This area contains Malibu Beach and Savin Hill Beach in Dorchester, and the city of Quincy maintains additional public beaches.

In addition to water-based recreational facilities, other public facilities in this area include parks, and the UMass/Boston campus, John F. Kennedy Library, and State Archives, located at Columbia Point, on the border with the North Dorchester Bay receiving water segment. This area includes high density residential housing, and industrial and commercial operations. The narrow sandy coastline in this area generally is bordered by roadways and some

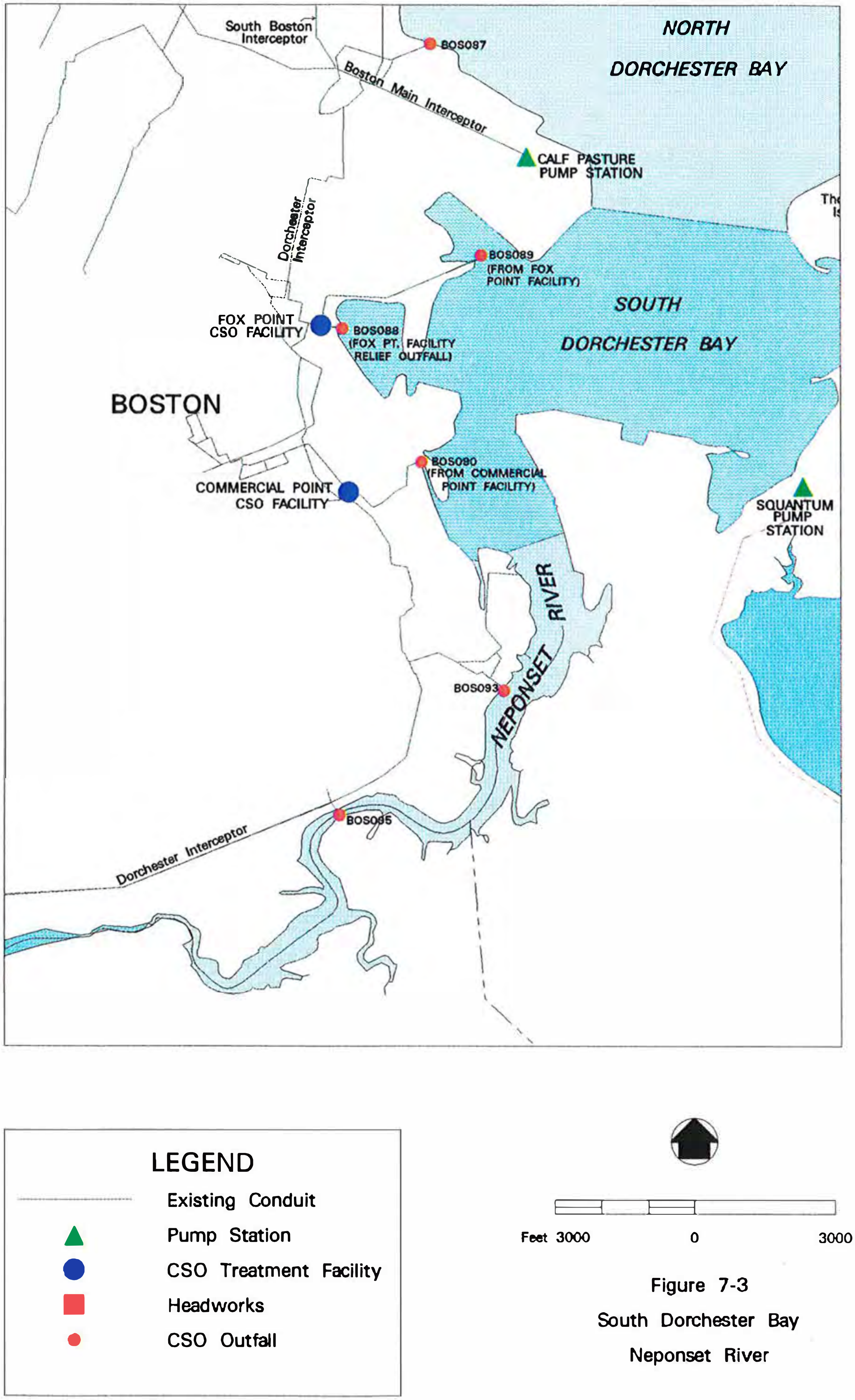


Figure 7-3
South Dorchester Bay
Neponset River

parkland. The Southeast Expressway runs through this area, with industrial and commercial activities adjacent to it.

The two CSO treatment facilities located at Fox Point and Commercial Point in South Dorchester Bay discharge treated combined sewage. The only source of untreated CSO is a bypass outfall for the Fox Point CSO treatment facility. Figure 7-2 presents the estimated total pollutant load and relative contributions to the load from CSO and stormwater for pollutants causing non-attainment of designated uses in South Dorchester Bay. Data for both the 1-year storm and for a typical year are presented. As shown in Figure 7-2, CSO discharges contribute only a minimal percentage of fecal coliform bacteria during the 1-year storm. This is a result of the generally effective disinfection of CSO flows provided by the Fox Point and Commercial Point facilities. Upstream flow from the Neponset River appears to be a major source of bacteria in South Dorchester Bay. For other parameters such as nutrients, BOD, and toxics, CSO discharges contribute a greater percentage of the loadings. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-2, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of each alternative are provided below, and additional details on the recommended plan, upgrading the existing CSO facilities to dechlorination and complete sewer separation (phased), are provided in Chapter Eight.

Upgrade the Existing CSO Facilities to Dechlorination and Complete Sewer Separation (phased). This alternative is the recommended plan. The existing Commercial Point and Fox Point CSO facilities would be upgraded with new dechlorination equipment to eliminate the potentially toxic chlorine residual. At the same time, a phased sewer separation program

TABLE 7–2. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR SOUTH DORCHESTER BAY

Evaluation Criteria	Future Planned Conditions	SDB1 & SDB5 **Recommended Plan** Sewer Separation and Upgrade Existing Facilities for Dechlorination	SDB2 Storage Facilities at Both CSOs (1–year)	SDB3 Consolidation / Storage of CSOs (1–year)	SDB4 Primary Treatment at Both CSOs (1–year)
Water Quality Benefit (1)					
• Restricted Shellfishing (Bacteria Std. Exceedance, hrs.)	(2) MB: 46 TB: 47	MB: 46 TB: 46	MB: 43 TB: 44	MB: 43 TB: 44	–
• Swimming (Bacteria Std. Exceedance, hrs.)	MB: 35 TB: 38	MB: 36 TB: 38	MB: 33 TB: 34	MB: 33 TB: 34	–
• Boating (Bacteria Std. Exceedance, hrs.)	MB: 15 TB: 17	MB: 17 TB: 17	MB: 7 TB: 15	MB: 7 TB: 15	–
• Aesthetics (Untreated CSO vol., MG)	0	0	0	0	0
• Aquatic Life (Solids Load, lbs.)	23,100	9,900	3,600	3,600	13,300
• Performance					
(Untreated Overflows, no./yr.)	0	0	1–3	1–3	0
(Closure of CSOs)	0	3	1	1	1
Critical Siting Concerns		Local Street Closing During Construction	Traffic/Truck access to school Rodent Control	Traffic, Residential Area, school Rodent Control	Traffic/Truck access to school Rodent Control
Capital Cost (millions)		$94.8	$93.6	$100.5	$29.4
Annual O & M Cost		$230,000	$1,440,000	$1,420,000	$1,780,000
Present Worth (millions)		$78.5	$89.8	$95.2	$41.7

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, and solids loads are derived based on a 1–year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml, restricted shellfishing 88/100ml.
   c. The duration of the simulation period for in–receiving water modeling was 99.4 hours.
   d. Solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. A dash "–" indicates that the alternative was not evaluated with the receiving water model.
2. Predicted violations at Malibu Beach (MB) and Tenean Beach (TB).

TABLE 7–2(con't). COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR SOUTH DORCHESTER BAY

Evaluation Criteria	SDB6 Storage Facilities at Both CSOs (3–Month)	SDB7 Consolidation / Storage of CSOs (3–Month)	SDB8 Primary Treatment at Both CSOs (3–Month)
Water Quality Benefit (1)			
• Restricted Shellfishing (Bacteria Std. Exceedance, hrs.)	–	–	–
• Swimming (Bacteria Std. Exceedance, hrs.)	–	–	–
• Boating (Bacteria Std. Exceedance, hrs.)	–	–	–
• Aesthetics (Untreated CSO vol., MG)	0	0	0
• Aquatic Life (Solids Load, lbs.)	17,600	17,600	20,000
• Performance (Untreated Overflows, no./yr.)	0	0	0
(Closure of CSOs)	1	1	1
Critical Siting Concerns	Traffic/Truck access to school Rodent Control	Traffic, Residential Area, school Rodent Control	Traffic/Truck access to school Rodent Control
Capital Cost (millions)	$42.0	$51.7	$20.8
Annual O & M Cost	$1,210,000	$1,200,000	$1,500,000
Present Worth (millions)	$46.1	$53.8	$31.9

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, and solids loads are derived based on a 1–year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml; restricted shellfishing 88/100
   c. The duration of the simulation period for in–receiving water modeling was 99.4 hours.
   d. Solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. A dash "–" indicates that the alternative was not evaluated with the receiving water model.

will be implemented, which will ultimately result in the separation of all combined areas tributary to the two CSO facilities, eliminating the CSO discharges. Once separation is completed, the CSO facilities at Fox Point and Commercial Point will be decommissioned. SWMM output suggests that even with complete separation of the combined areas tributary to the regulators upstream of the Fox Point and Commercial Point CSO Facilities, backwater from the Columbus Park Headworks would cause periodic activation of BOS088 and BOS090 regulators during severe storm events such as the two-year storm unless the regulators are blocked. If blocked, SWMM output suggests that localized flooding could result due to the backwater effect. Additional measures may be required to isolate the South Dorchester system from the backwater effects of the Columbus Park Headworks, in order to allow the recommended complete closure of all regulators in the BOS088/089 and BOS090 tributary areas without risk of flooding. One such measure could be to construct a pump station on the Dorchester Interceptor downstream of the BOS088 regulators. This issue will be evaluated in more detail during facilities planning.

Near Surface Storage at BOS090, Commercial Point CSO Facility, and BOS088/089, Fox Point CSO Facility (1-Year Storm Control). Storage tanks and facilities would be constructed at or near the existing CSO facilities with sufficient volume to capture one-year storm overflows. These new storage tanks would be dewatered, following the end of the storm, to the Dorchester Interceptor. This alternative was eliminated from consideration due to insufficient space for a one-year storage tank at Fox Point and construction difficulties in expanding Commercial Point.

Consolidated Near Surface Storage, Near Fox Point (1-Year Storm Control). A consolidation conduit would convey flow from upstream of the Commercial Point CSO facility to a new storage tank near Fox Point. Flows tributary to Fox Point would also be diverted to this tank. The combination of the tank and the consolidation conduit would have sufficient capacity to capture the one-year storm overflow volume from these outfalls. The contents of the tank and the conduit would be returned to the Dorchester Interceptor following the end of the storm. This alternative was also eliminated from consideration due to insufficient space at Fox Point.

Primary Treatment at BOS090 and BOS088/089 (1-Year Storm Control). The existing CSO facilities would be upgraded with sedimentation tanks and dechlorination equipment. Whether the existing screening and disinfection facilities could be reused, or if the existing facilities would be abandoned or demolished, and new equipment incorporated into the new sedimentation facilities, would be evaluated during later planning and design phases. The upgraded facility would have sufficient capacity to provide the equivalent of primary treatment for one-year storm overflow volumes. Treated overflows would be discharged to South Dorchester Bay. Overflows from some storms smaller than the one-year storm may be entirely captured in the tanks and returned to the Dorchester Interceptor after the storm is over.

Near Surface Storage at BOS090 and BOS088/089 (3-Month Storm Control). This alternative is similar to the individual near surface storage facilities sized for the one-year storm described above, except that the facilities would be sized to capture the overflow volume from the three-month storm at each location. It appears that the smaller tank could be sited at Fox Point.

Consolidated Near Surface Storage, Near Fox Point (3-Month Control). This alternative is similar to the consolidated near surface storage alternative described above, except that the facilities would capture the three-month storm overflow volume.

Primary Treatment at BOS090 and BOS088/089 (3-Month Storm Control). This alternative is similar to the individual primary treatment facilities described above, except that the facilities would provide primary treatment for up to the three-month storm. Flows greater than the three-month storm would pass through the facilities receiving a reduced level of treatment.

NEPONSET RIVER

Description of the Receiving Water Segment

The Neponset River, which flows from the Neponset Reservoir in Foxboro, drains into Dorchester Bay southwest of Boston. The receiving water segment is defined as that portion of the river which is impacted by CSOs and includes the area downstream of Mattapan Square in Boston to the mouth of the river down to the Port Norfolk Yacht Club in Dorchester (Figure 7-3). This segment is classified as SB-Fishable/Swimmable with restricted shellfishing. Shellfishing is designated as a critical use for the receiving water segment. Existing water-based uses are confined to boating. The last four miles of the Neponset River, below Milton Lower Mills Dam, are tidal. Shellfish beds along this portion of the river have been identified, but harvesting currently is prohibited.

Land uses along the lower portion of the Neponset River consist of residential and urban areas, with some protected public open spaces, including the Neponset Marshes and the Blue Hills Reservation. Near the mouth of the river, land has been designated by the MDC for future park development.

Two untreated CSOs discharge to the Neponset River, but stormwater and upstream river flow are the major sources of non-attainment of water quality standards. Figure 3-2 presents the total pollutant load and relative contributions to the load from CSO and stormwater for pollutants causing non-attainment of designated uses. As illustrated in Figure 3-2, CSO discharges contribute a small percentage of fecal coliform bacteria during the 1-year storm, while upstream flow and stormwater contribute the majority of the bacterial load. This trend is mirrored in the contributions of nutrients and toxics to this receiving water segment. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-3, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of each alternative are provided below, and additional details on the recommended plan, complete sewer separation, are provided in Chapter Eight.

Complete Sewer Separation. This alternative is the recommended plan. It would involve separation of all combined areas tributary to the Dorchester Interceptor in the vicinities of outfalls BOS093 and BOS095, eliminating these CSOs. As noted above, backwater from the Columbus Park Headworks may impact outfalls along the Dorchester Interceptor even with complete sewer separation in this area. Additional work may be required to hydraulically isolate the Dorchester Interceptor from the backwater effects of the Columbus Park Headworks.

Individual Near Surface Storage at BOS095 and BOS093 (One-Year Storm Controls). This alternative would involve constructing two storage facilities, one in the vicinity of BOS095 and the other in the vicinity of BOS093. Each would have sufficient capacity to capture the one-year storm overflow volumes for these outfalls. Following the storm, the contents of the two facilities would be pumped to the Dorchester Interceptor.

Individual Near Surface Storage at BOS093 and Primary Treatment at BOS095 (One-Year Storm Controls). This alternative is similar to the individual near surface storage for one-year storm control, except a much smaller tank would be required at BOS095, to provide primary treatment for the peak flow from the one-year storm.

Consolidation Conduit with Near Surface Primary Treatment Near BOS093 (One-Year Storm Control). This alternative would involve constructing a consolidation conduit running along the shore of the Neponset River picking up outfalls BOS093 and BOS095. This

TABLE 7–3. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR NEPONSET RIVER

Evaluation Criteria	Future Planned Conditions	N1 **Recommended Plan** Sewer Separation	N2 Indiv. Near Surface Storage Tanks at BOS095 & 093 (1 yr)	N3 Storage at BOS093, Primary Treat. at BOS095 (1 yr)	N4 Consolidated Primary Treat. Near BOS093 (1 yr)
Water Quality Benefit (1)					
• Restricted Shellfishing (Bacteria Std. Exceedance, hrs.)	47	46	44	–	–
• Swimming (Bacteria Std. Exceedance, hrs.)	38	38	34	–	–
• Boating (Bacteria Std. Exceedance, hrs.)	17	17	15	–	–
• Aesthetics (Untreated CSO vol., MG)	2.77	0	0	0	0
• Performance (Untreated Overflows, no./yr.)	17	0	1–3	1–3(BOS093)	0
(Closure of CSOs)	0	2	0	0	0–1
Critical Siting Concerns		Local street closings during construction	Parking, traffic impacts near BOS095	Parking, traffic impacts near BOS095	Elderly housing along cons. conduit
Capital Cost (millions)		10.7	17.8	10.4	18.8
Annual O & M Cost		0	347,000	405,000	125,000
Present Worth (millions)		8.6	17.8	12.5	16.4

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours and untreated CSO volumes are derived based on a 1–year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml; restricted shellfishing 88/100ml.
   c. The duration of the simulation period was for in–receiving water modeling was 99.4 hours; duration of predicted violations at Tenean Beach.
   d. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   e. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   f. A dash "–" indicates that the alternative was not evaluated with the receiving water model.

TABLE 7–3(con't). COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR NEPONSET RIVER

Evaluation Criteria	N5 Indiv. Screen/Disinf. at BOS093 & 095	N6 Indiv. Storage Tanks at BOS093 & 095 (3 mo)	N7 Screens at Outfalls
Water Quality Benefit (1)			
• Restricted Shellfishing (Bacteria Std. Exceedance, hrs.)	–	44	–
• Swimming (Bacteria Std. Exceedance, hrs.)	–	35	–
• Boating (Bacteria Std. Exceedance, hrs.)	–	15	–
• Aesthetics (Untreated CSO vol., MG)	0	0	2.77
• Performance			
(Untreated Overflows, no./yr.)	0	0	17
(Closure of CSOs)	0	0	0
Critical Siting Concerns	Parking, traffic impacts at BOS095	Parking, traffic impacts at BOS095	
Capital Cost (millions)	4.7	4.9	1.7
Annual O & M Cost	260,000	226,000	10,000
Present Worth (millions)	6.4	6.2	1.4

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours and untreated CSO volume are derived based on a 1–year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml; restricted shellfis
   c. The duration of the simulation period for in–receiving water modeling was 99.4 hours; duration of predicted violations at Ten
   d. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   e. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. A dash "–" indicates that the alternative was not evaluated with the receiving water model.

conduit would convey flow to a primary treatment facility in the vicinity of BOS093. The facility would have sufficient capacity to capture and treat one-year storm overflow volumes from the two outfalls. Overflows from some smaller storms may be entirely captured within the volume of the conduit and facility, and returned by pumps to the Dorchester Interceptor following the storm.

Individual Screening and Disinfection Facilities at both BOS095 and BOS093 (One-Year Storm Control). One screening and disinfection facility would be constructed in the vicinity of outfall BOS095 and the other in the vicinity of BOS093. Both facilities would have the capacity to provide flow-through treatment of the one-year overflow volumes at these outfalls.

Individual Near Surface Storage at BOS095 and BOS093 (Three-Month Storm Controls). This alternative is similar to the individual near surface storage for one-year storm control, except the facilities would have a three-month storm overflow volume capacity.

Screening at BOS095 and BOS093. This alternative would involve constructing manually-cleaned bar screens within a simple chamber at each outfall. The screens would remove large objects from the overflows.

CONSTITUTION BEACH

Description of the Receiving Water Segment

The Constitution Beach receiving water segment consists of the relatively isolated water body which lies between Logan Airport and the Orient Heights section of East Boston (Figure 7-4). This area is classified as SB-Fishable/Swimmable with restricted shellfishing. A large area north of the airport runways is currently designated for restricted shellfishing by commercial harvesters. Additional beds, designated as prohibited, lie along the northern part

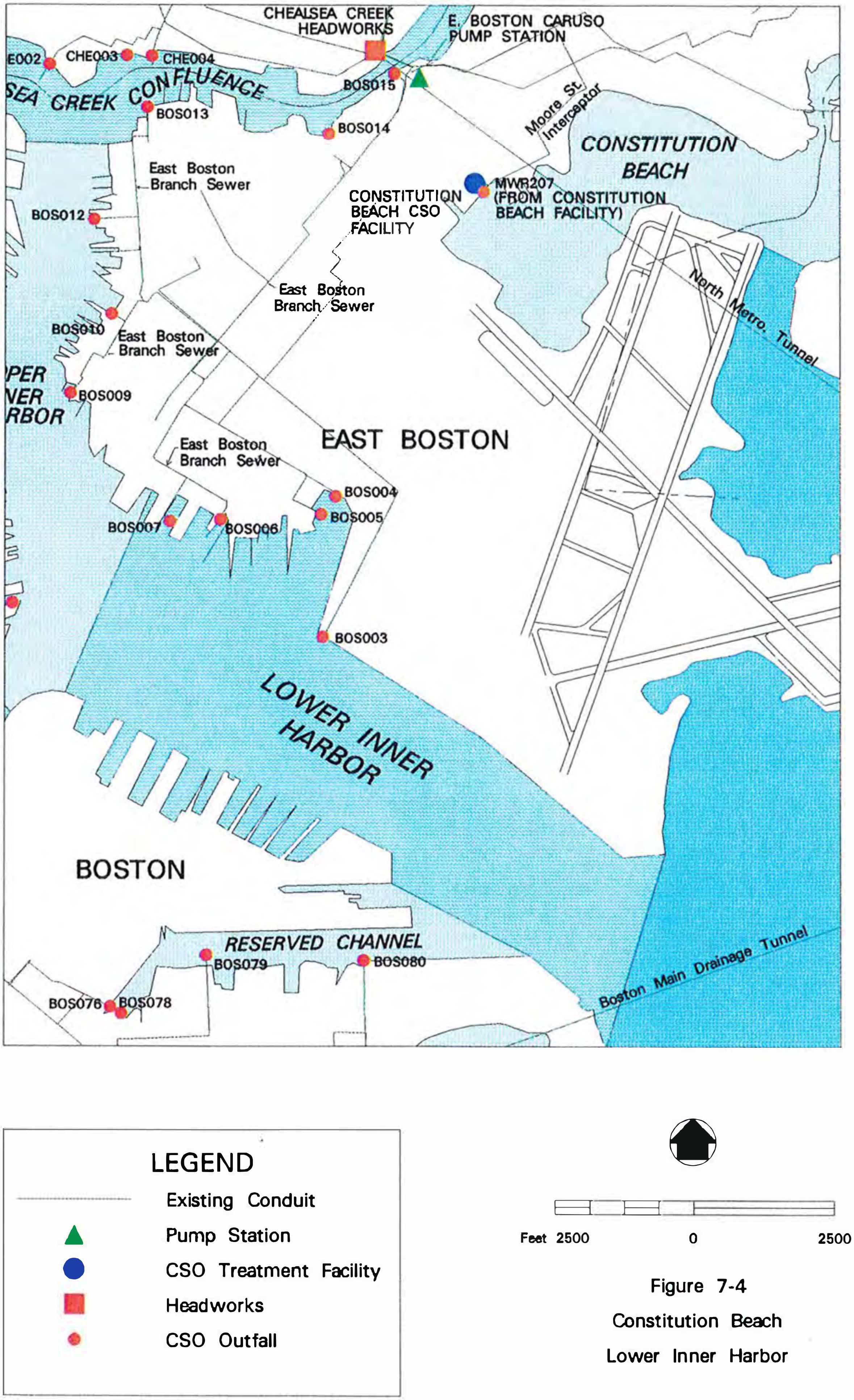


Figure 7-4
Constitution Beach
Lower Inner Harbor

of the embayment. The designated critical uses for this area are swimming and shellfishing. Swimming at Constitution Beach is the main existing water-based use.

Multi- and single family housing and commercial activities surround the beach. Logan Airport and its entrances border the beach area. Marinas and yacht clubs are also located in the area.

The only CSO in the Constitution Beach receiving water segment is screened and disinfected at the Constitution Beach CSO facility. Figure 7-2 presents the estimated total pollutant load and relative CSO and stormwater loads for pollutants causing non-attainment of designated uses in this segment. As indicated in Figure 7-2, fecal coliform bacteria is the only criterion that prevents the attainment of designated uses, but CSO discharges appear to contribute only a very small proportion of the fecal coliform load for the 1-year storm. Stormwater is the predominant source of the total fecal coliform bacteria loads. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-4, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of each alternative are provided below, and additional details on the recommended plan, complete sewer separation, are presented in Chapter Eight.

Complete Sewer Separation. This alternative is the recommended plan. It would involve separation of all combined areas tributary to CSO regulator RE002-2, eliminating the CSO. Upon completion of the separation work, the existing Constitution Beach CSO facility will be decommissioned.

TABLE 7–4. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR CONSTITUTION BEACH

Evaluation Criteria	Future Planned Conditions	CB1 Recommended Plan Complete Sewer Separation	CB2 Moore Street Interceptor Relief (1–year)	CB3 Near Surface Storage (1–year)	CB4 Near Surface Storage (3–month)
Water Quality Benefit (1)	(2)				
• Unrestricted Shellfishing (Bacteria Std. Exceedance, hrs.)	BH2: 43 BHD: 60	BH2: 43 BHD: 60	BH2: 43 BHD: 60	BH2: 43 BHD: 60	BH2: 43 BHD: 60
• Restricted Shellfishing (Bacteria Std. Exceedance, hrs.)	BH2: 5 BHD: 38	BH2: 5 BHD: 38	BH2: 5 BHD: 38	BH2: 5 BHD: 38	BH2: 5 BHD: 38
• Swimming (Bacteria Std. Exceedance, hrs.)	BH2: 0 BHD: 27	BH2: 0 BHD: 29	BH2: 0 BHD: 28	BH2: 0 BHD: 28	BH2: 0 BHD: 28
• Boating (Bacteria Std. Exceedance, hrs.)	BH2: 0 BHD: 0	BH2: 0 BHD: 2	BH2: 0 BHD: 0	BH2: 0 BHD: 0	BH2: 0 BHD: 0
• Performance					
(Untreated Overflows, no./yr.)	16	0	1 – 3	1 – 3	0
(Closure of CSOs)	0	1	0	0	0
Critical Siting Concerns		Local street closings during construction	Traffic impacts on local streets.	None	None
Capital Cost (millions)		8.7	7.0	5.7	2.0
Annual O & M Cost		0	0	121,000	57,000
Present Worth (millions)		7.1	5.6	5.8	2.2

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours are derived based on a 1–year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml; unrestricted shellfishing 14/100 ml; restricted shellfishing 88/100 ml
   c. The duration of the simulation period for in–receiving water modeling was 99.4 hours.
   d. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   e. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
2. Predicted duration of violations along the east shore of Logan Airport (BH2), and at Orient Heights Beach (BHD).

Moore Street Interceptor Relief (One-Year Storm Control). Relief of the Moore Street Interceptor, which may involve a combination of replacement of existing sections and installation of parallel relief pipe for other sections, is predicted to eliminate overflows at MWR207 for the one-year storm.

Near Surface Storage (One-Year Storm Control). This alternative would involve upgrading the existing Constitution Beach Facility with a storage tank with sufficient capacity to capture overflow volume from the one-year storm. Following the storm, the contents of the tank would be returned to the interceptor.

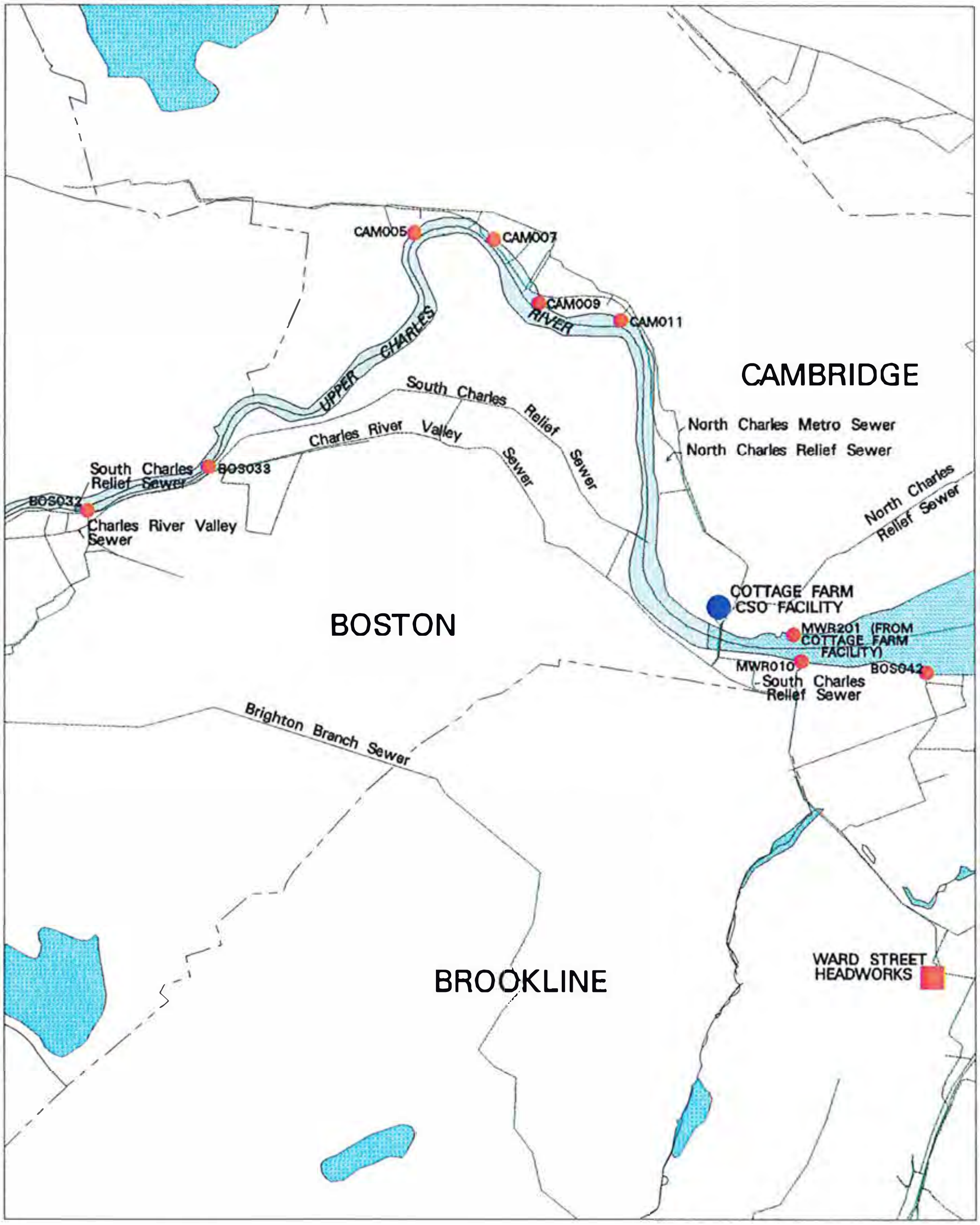
Near Surface Storage (Three-Month Storm Control). This alternative is similar to near surface storage with one-year control, except that the tank would have a three-month storm capacity.

UPPER CHARLES RIVER

Description of the Receiving Water Segment

The Upper Charles River segment extends from the Watertown Dam to the Cottage Farm CSO facility near the B.U. Bridge (Figure 7-5). The river is bounded on the north by Watertown and Cambridge, and on the south by Newton and Boston. The Upper Charles segment of the river is classified as Class B-Fishable/Swimmable and other compatible uses. There are no Massachusetts DEP-designated critical uses for this receiving water segment. The dominant water-based recreational uses in the Upper Charles River are canoeing, rowing, sailing, and powerboating. Three public boat landings, as well as private boating facilities and collegiate crew boathouses are located along the banks of the river.

The land along the Upper Charles River segment is heavily developed and used for nearshore recreation (the Charles River Reservation) including playgrounds, skating rinks, recreation centers, and pools. This area is bordered by major roads, including Soldiers Field Road,



LEGEND

Existing Conduit
Pump Station
CSO Treatment Facility
Headworks
CSO Outfall

Feet 3000 0 3000

Figure 7-5
Upper Charles

Storrow Drive and Memorial Drive. Parkland and/or developed walkways provide linkages along much of the river; the bicycle path along either side of the river is used by pedestrians as well as cyclists. Magazine Beach near the B.U. Bridge was historically used for swimming; an MDC pool is now operated in this area. Away from the river's edge, land uses are mainly urban residential.

A total of six untreated CSOs discharge to the Upper Charles receiving water segment. Figure 7-2 presents the estimated total pollutant load and relative contributions to the load from CSO and stormwater for pollutants causing non-attainment of designated uses in this segment. As shown in Figure 7-2, stormwater appears to be the predominant source of fecal coliform bacteria for the 1-year storm. Annually, upstream flow is the overwhelming contributor of nutrients and toxics; whereas stormwater is the largest contributor of these pollutants for the 1-year storm. Receiving water data also indicate that dry weather bacteria sources probably exist all along the segment. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-5, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of each alternative are provided below, and additional details on the recommended plan are provided in Chapter Eight.

Screening and Disinfection Facility at CAM005; Relief of Interceptor Connection and Screen at BOS032; Screens at Remaining Four Outfalls. This alternative is the recommended plan. A screening and disinfection facility would be constructed at CAM005, and the connection between regulator RE-032-1 and the Charles River Valley Sewer would be enlarged, eliminating the overflow from the one-year storm at BOS032. Manually-cleaned screens would be installed at outfalls BOS032, BOS033, CAM007, CAM009, and CAM011.

TABLE 7–5. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR UPPER CHARLES RIVER

Evaluation Criteria	Future Planned Conditions	UC8 Recommended Plan Screening and Disinfection at CAM005, Int. Conn. Relief at BOS032	UC5 Screening & Disinfection at Individual CSOs	UC1 Complete Sewer Separation	UC2 Partial Sewer Separation (1–Year)	UC3 Storage Facilities at Individual CSOs (1–Year)	UC7 Screening at Individual CSOs
Water Quality Benefit (1)							
• Swimming (Bacteria Std. Exceedance, hrs.)	99	99	99	99	99	99	99
• Boating (Bacteria Std. Exceedance, hrs.)	72	72	72	72	72	73	72
• Aesthetics (Untreated CSO vol., MG)	1.67	0	0	0	0	0	1.67
• Aquatic Life							
(Nutrient (TP) Load, lbs.)	800	800	800	990	910	750	800
(Solids Load, lbs.)	89,400	88,200	89,400	108,200	101,000	87,450	89,400
• Performance							
(Untreated Overflows, no./yr.)	11	0–4	0–2	0	1–3	1–3	11
(Closure of CSOs)	–	0	0	6	0–3	0	0
Critical Siting Concerns		Sensitive site for Screening/Disinfection Facility	Sensitive sites for Screening/Dis–infection Facilities	Local Street Closings During Construction	Local Street Closings During Construction	Tight Sensitive Sites for Storage Facilities	
Capital Cost (millions)		$5.4	$5.1	$87.2	$27.5	$11.8	$1.0
Annual O & M Cost		$115,000	$140,000	$0	$0	$100,000	$33,000
Present Worth (millions)		$3.9	$5.5	$70.1	$22.1	$10.5	$0.7

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, nutrient and solids loads are derived based on a 1–year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in–receiving water modeling was 99.4 hours; predicted duration of violations at Weld Boathouse.
   d. Nutrient load is from stormwater and CSO; solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.

Individual Screening and Disinfection Facilities at Outfalls CAM005, CAM009, and BOS032. A separate screening and disinfection flow-through treatment facility would be constructed for each of the three outfalls. These facilities would discharge treated overflows to the Charles River.

Complete Sewer Separation. This alternative would involve separation of combined areas upstream of regulators tributary to the North Charles Metropolitan Sewer, the North Charles Relief Sewer, the Charles River Valley Sewer, and the South Charles Relief Sewer, west of the Cottage Farm CSO facility.

Partial Sewer Separation (One-Year Storm Control). This alternative would involve separation of the outfalls which are active in the 1-year storm (BOS032, CAM005, CAM009).

Storage at CAM005, CAM009, and Enlarging the Interceptor Connection at BOS032 (One-Year Storm Control). This alternative would involve constructing storage facilities in the vicinity of CAM005 and CAM009 with sufficient capacity to capture the overflow volumes for the one-year design storm at the outfalls. Following the storm, the storage facilities would be dewatered by pumping the contents of the tanks back to the North Charles Metropolitan Sewer. Also, this alternative would involve increasing the pipe size between CSO regulator RE032-1 and the Charles River Valley Sewer. This increase is predicted to eliminate overflows at outfall BOS032 for the one-year storm.

Screening at all Outfalls. This alternative would involve constructing manually cleaned bar screens in the outfall conduits for all outfalls into the Upper Charles. These screens would reduce solids and floatables in the overflows before being discharged to the Charles River, and would address one of the nine minimum control provisions of the 1994 federal CSO Policy.

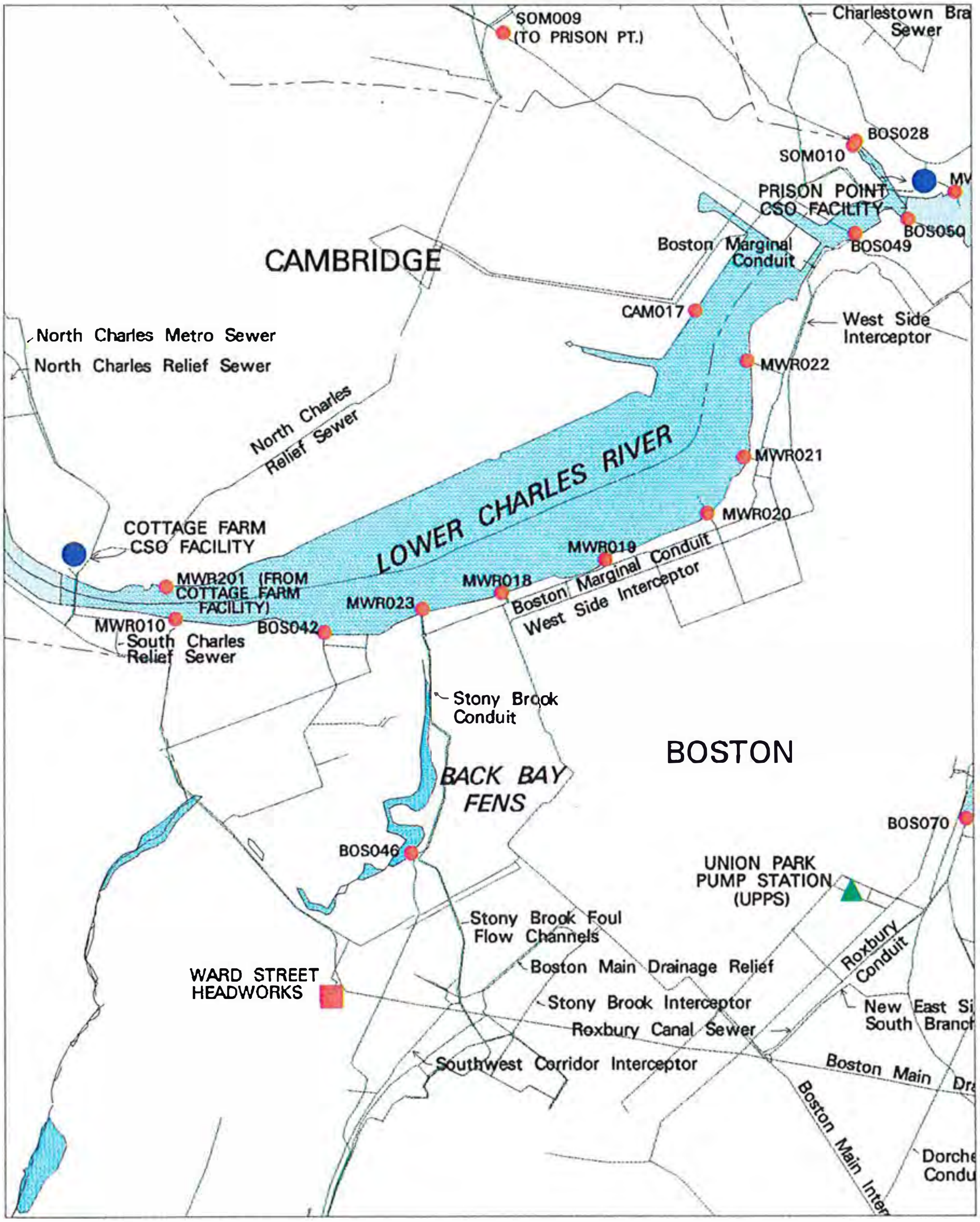
LOWER CHARLES RIVER

Description of the Receiving Water Segment

The Lower Charles River receiving water segment extends from the Cottage Farm CSO facility to the new Charles River Dam and Locks (Figure 7-6). This stretch of the river is bounded on the north by Cambridge and Charlestown, and on the south by Boston. The Lower Charles River segment is classified as Class B-Fishable/Swimmable and other compatible uses. There are no Massachusetts DEP-designated critical uses for this segment. The predominant water-based recreational use of the Lower Charles River is boating, including powerboating, sailing, and rowing, although windsurfing is also common. The Community Boating program which provides sailing instruction and rental opportunities to the public operates along this section of the river. Two powerboat marinas are located on the Cambridge side of the river.

The Lechmere Canal enters the Charles River just above the old dam. The canal is surrounded by an upscale shopping mall and residences, and is used for paddle boating and by river sightseeing tour boats. The Miller's River enters between the two dams. The area around the Miller's River is used for industry and transportation (elevated highways, railroads). The Charles River Reservation is prominent along this river section and is heavily used by the public for passive recreation. MDC recreational facilities are also located along the river. Paths along the banks of the Lower Charles River are heavily used by pedestrians as well as cyclists. The Hatch Shell is a major focal point for public activities during the summer. Beyond the river's edge, land uses are dense urban residential and commercial.

There are 13 CSO outfalls located in the Lower Charles River receiving water segment, including the Cottage Farm CSO facility (MWR201) which is the only treated discharge. With the exception of MWR201 and Stony Brook (MWR023), CSOs in this segment occur only rarely after large storm events. Most of the untreated combined sewage entering the



LEGEND

- Existing Conduit
- Pump Station
- CSO Treatment Facility
- Headworks
- CSO Outfall

Feet 2500 0 2500

Figure 7-6
Lower Charles
Back Bay Fens

Lower Charles River is discharged via Stony Brook. As discussed in Chapter Three, CSO discharge volumes to the Charles River from the Cottage Farm CSO facility, which provides screening and disinfection, and 1.2 million gallons of storage/detention treatment, have been dramatically reduced due to system improvements.

Figure 7-2 presents the estimated total pollutant load and relative contributions from CSO and stormwater for pollutants causing non-attainment of designated uses in the Lower Charles River receiving water segment. As indicated in Figure 7-2, a significant percentage of the pollutant loads to this segment are contributed by upstream flow, especially on an annual basis. CSO discharges do contribute a large portion of the fecal coliform bacteria load and nutrient load for the 1-year storm. For the other parameters, stormwater and upstream flow are the predominant sources. Receiving sampling data indicate that dry weather sources of bacteria probably exist all along the segment, and in the Stony Brook System. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-6, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of each alternative are provided below, and additional details on the recommended plan are presented in Chapter Eight.

Screening and Disinfection of Stony Brook Conduit Flows, Improvements to the Cottage Farm CSO Facility, Block Regulators at BOS042 and MWR010, and Screen Remaining Outfalls. This alternative is the recommended plan. A flow-through screening and disinfection facility would be constructed in the vicinity of Ward Street Headworks to treat flows in the Stony Brook Conduit (SBC), including CSOs, prior to being discharged to the Charles River. The existing Cottage Farm CSO Facility would be upgraded to include dechlorination equipment, new effluent screens, and a new outfall diffuser. Regulators which

TABLE 7-6. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR LOWER CHARLES RIVER

Evaluation Criteria	Future Planned Conditions	LC5 **Recommended Plan** Screen/Disinfect SBC Flows, Upgrade CF, plug regulators at BOS042 & MWR010, Screen Outfalls	LC1 Complete Sewer Separation	LC2 Stony Brook Consolidation to Storage; Cottage Farm Storage (1 yr)
Water Quality Benefit (1)				
• Swimming (Bacteria Std. Exceedance, hrs.)	BU: 99 CBH: 99	BU: 99 CBH: 99	BU: 99 CBH: 99	BU: 99 CBH: 99
• Boating (Bacteria Std. Exceedance, hrs.)	(2) BU: 84 CBH: 81	BU: 80 CBH: 45	BU: 84 CBH: 58	BU: 79 CBH: 37
• Aesthetics (Untreated CSO vol., MG)	19.9	1.5	0	2.1
• Aquatic Life (Nutrient (TP) Load, lbs.)	1,600	1,600	730	400
(Solids Load, lbs.)	140,000	137,300	115,100	86,200
• Performance (Untreated Overflows, no./yr.)	30	1-3	0	1 - 3
(Closure of CSOs)	0	2 - 7 (h)	7 (g)	2 - 7 (h)
Critical Siting Concerns		Disruption of parking lots for Stony Brook Facility	Local street closings during construction; extensive area to be separated	SB: Conduit impacts schools, housing, parks and residences CF: Impacts ballfield use
Capital Cost (millions)		$31.8	$485	$249
Annual O & M Cost		$1,250,000	$0	$1,550,000
Present Worth (millions)		$38.2	$390	$216

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, nutrient and solids loads are derived based on a 1-year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in-receiving water modeling was 99.4 hours.
   d. Nutrient load is from stormwater and CSO; solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. CSOs BOS028, BOS049 and CAM017 provide relief for Prison Point, and may not be closed as a result of separation of areas tributary to Stony Brook and Cottage Farm.
   h. CSOs BOS042 and MWR010 can be closed based on SOP Report findings. From 0 to 5 of outfalls MWR018 and MWR022 may be closed.
2. Predicted duration of violations at Boston University Sailing (BU) and Community Boat House (CBH).

TABLE 7-6 (con't). COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR LOWER CHARLES

Evaluation Criteria	LC3 Stony Brk Consolid. to Storage w/ Diversion at RE-046-381; Cottage Farm Storage (3 mo)	LC4 Stony Brk Consolid. to Screen/ Disinfection; Cottage Farm detention/disinfect. (3 mo)	LC6 Stony Brk Conduit Swirl, Foul Flow pump to HLS Cottage Farm detent./disinfect.
Water Quality Benefit (1)			
• Swimming (Bacteria Std. Exceedance, hrs.)	–	BU: 99 CBH: 99	–
• Boating (Bacteria Std. Exceedance, hrs.)	–	BU: 79 CBH: 39	–
• Aesthetics (Untreated CSO vol., MG)	3.6	3.6	1.5
• Aquatic Life (Nutrient (TP) Load, lbs.) (Solids Load, lbs.)	1,200 122,600	1,500 132,500	1,400 132,300
• Performance (Untreated Overflows, no./yr.) (Closure of CSOs)	4 – 7 2 –7 (h)	4 – 7 2 –7 (h)	1 – 3 2 –7 (h)
Critical Siting Concerns	SB: Conduit impacts schools, elderly housing, parks and residences CF: Storage Facility would temporarily impact ballfield	SB: Conduit impacts schools, elderly housing, parks and residences	SB: Large site required for swirl concentrators not available
Capital Cost (millions)	$98.0	$74.0	$68.0
Annual O & M Cost	$1,100,000	$880,000	$1,700,000
Present Worth (millions)	$90.3	$68.2	$71.8

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, nutrient and solids loads are derived based on a 1-year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in-receiving water modeling was 99.4 hours.
   d. Nutrient load is from stormwater and CSO; solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. CSOs BOS028, BOS049 and CAM017 provide relief for Prison Point, and may not be closed as a result of separation of areas tributary to Stony Brook and Cottage Farm.
   h. CSOs BOS042 and MWR010 can be closed based on SOP Report findings. From 0 to 5 of outfalls MWR018 and MWR022 may be closed.
   i. A dash "–" indicates that the alternative was not evaluated with the receiving water model.
2. Data locations at Boston University Sailing (BU) and Community Boat House (CBH).

discharge overflows to outfalls BOS042 and MWR010 would be plugged, converting these outfalls to strictly storm drains. Screens would be installed at the remaining 10 outfalls along the Lower Charles, which are predicted to activate less than four times per year.

Complete Sewer Separation. This alternative would involve separation of all combined areas tributary to the Ward Street Headworks east of the Cottage Farm CSO Facility. Complete separation of this area would be difficult, since much of it is a highly developed urban area.

Stony Brook Consolidation to Storage and Cottage Farm Storage (One-Year Storm Control). This alternative would involve the construction of a consolidation conduit running along the SBC, which would pick up overflows from the multiple regulators tributary to the SBC. The conduit would convey flows to a storage tank in the vicinity of the Ward Street Headworks which, combined with the consolidation conduit, would have sufficient capacity to capture all overflow volumes for the one-year storm. At the Cottage Farm Facility additional storage tanks would be constructed to allow capture of the overflow volume for the one-year storm. Following the storm, both the Stony Brook and Cottage Farm Facilities would be dewatered back to MWRA Interceptors. Siting requirements of the one-year tanks limited the feasibility of this alternative.

Stony Brook Consolidation to Storage with Diversion at CSO Regulator RE-046-381; Storage at Cottage Farm (Three-Month Storm Control). This alternative is similar to Stony Brook consolidation to storage and Cottage Farm storage with one-year storm control, except that in the Stony Brook system, a flow diversion would be constructed at RE-046-381 on the Southwest Corridor Interceptor, which would reduce the required length of the consolidation conduit. The flow diversion structure would have the capability of completely diverting the three-month storm overflow volume from RE-046-381 to the Stony Brook Valley Sewer. The storage facilities at Ward Street and Cottage Farm would be sized to capture the three-month storm.

Stony Brook Consolidation to Screening and Disinfection Facility and Less Than Primary Treatment at Cottage Farm. This alternative is similar to the alternative described above for the Stony Brook System except that a flow through treatment facility would be constructed in the vicinity of Ward Street Headworks at the downstream end of the consolidation conduit, instead of a storage tank. This facility would provide screening and disinfection for the overflow volume captured by the consolidation conduit. No change to the tank capacity would be provided at the Cottage Farm facility, although dechlorination equipment would be added.

Stony Brook Consolidation to Swirl Concentrator, Less Than Primary Treatment at Cottage Farm. This alternative is similar to the alternative described above, except that swirl concentrators or vortex separators would be constructed in the vicinity of Ward Street Headworks, instead of a screening and disinfection facility. Underflow from the swirl/vortex devices would be pumped to the High Level Sewer, while overflow would be disinfected before being discharged back to the SBC and outfall MWR023. Site requirements of the swirl/vortex devices appeared to limit the feasibility of this alternative.

BACK BAY FENS

Description of the Receiving Water Segment

The Back Bay Fens receiving water segment comprises the farthest downstream section of the Muddy River; however, most of the Muddy River flow is diverted around the Fens through the Muddy River Conduit directly to the Charles River (Figure 7-6). The Back Bay Fens receiving water segment is classified as Class B-Fishable/Swimmable and other compatible uses. There are no Massachusetts DEP-designated critical uses for this receiving water segment and no existing water-based uses.

The Back Bay Fens receiving water segment includes a portion of the Olmstead Park System, a National Historic Register District, consisting of a series of parks linked by continuous parkways curving south from the mouth of the Muddy River to Franklin Park. Beyond the banks of the Fens the area consists of dense residential and commercial land uses.

Boston Gatehouse 1 (BOS046) is an overflow on the SBC, and the only CSO to the Back Bay Fens receiving water segment. This overflow is relatively inactive, discharging only during storms on the order of the one-year storm or greater. Figure 7-2 presents the total pollutant load and relative contributions from CSO and stormwater for pollutants causing non-attainment of designated uses for this segment. Upstream or boundary sources were not quantified for the Back Bay Fens. As shown in Figure 7-2, CSO discharges contribute a large percentage of fecal coliform bacteria loads for the 1-year storm. For parameters other than fecal coliform bacteria, the loads from stormwater are substantially greater than the loads from CSOs. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

Screens at BOS046. The recommended plan is to install manually-cleaned bar screens at BOS046. This equipment would be installed either within Gatehouse No. 1, or on the outfall adjacent to the gatehouse. The recommended plan for Lower Charles, which features screening and disinfection of SBC flows upstream of BOS046, also provides a level of control for discharges at BOS046. Additional details on the recommended plan are presented in Chapter Eight. Other alternatives for this receiving water were evaluated as part of alternatives for the Stony Brook system in the Lower Charles (consolidation of Stony Brook flows eliminated overflows at BOS046).

ALEWIFE BROOK

Description of the Receiving Water Segment

Alewife Brook is a narrow, slow-moving waterbody that flows from the Little River in Belmont to the Mystic River in Arlington/Medford (Figure 7-7). The Alewife Brook receiving water segment is classified as a Class B-Fishable/Swimmable waterbody. There are no Massachusetts DEP-designated critical uses for this receiving water segment. Existing water-based uses of Alewife Brook include fishing and canoeing, although the latter is somewhat restricted. The brook is a critical part of the annual alewife migration to upstream spawning areas.

Much of the land along the Alewife Brook is owned by the Metropolitan District Commission (MDC) as part of the Alewife Brook Reservation. However, this is a heavily developed urban area with major roads crossing the brook, and residential, commercial and office developments abutting the MDC properties. Current park uses adjacent to the Alewife Brook include pools, playgrounds and playing fields. Alewife Brook Pump Station, which pumps sewage from portions of Somerville, Cambridge, Belmont, Arlington, Lexington and Medford to the North Metropolitan Relief Sewer and North Metropolitan Trunk Sewer in Medford, also abuts the brook.

A total of 11 CSO outfalls potentially discharge untreated overflows to the Alewife Brook receiving water segment. At two of these outfall locations, CAM004/401 and SOM002A/003, two separate CSOs (i.e., CAM004 and CAM401) essentially discharge at the same outfall. Figure 7-2 presents the total pollutant load and relative contributions to the load from CSO and stormwater for pollutants causing non-attainment of designated uses in this segment. As indicated in Figure 7-2, CSOs are a predominant source of fecal coliform bacteria for the 1-year storm. For parameters other than fecal coliform bacteria, the loads from stormwater are substantially greater than the loads from CSOs, both for the one-year

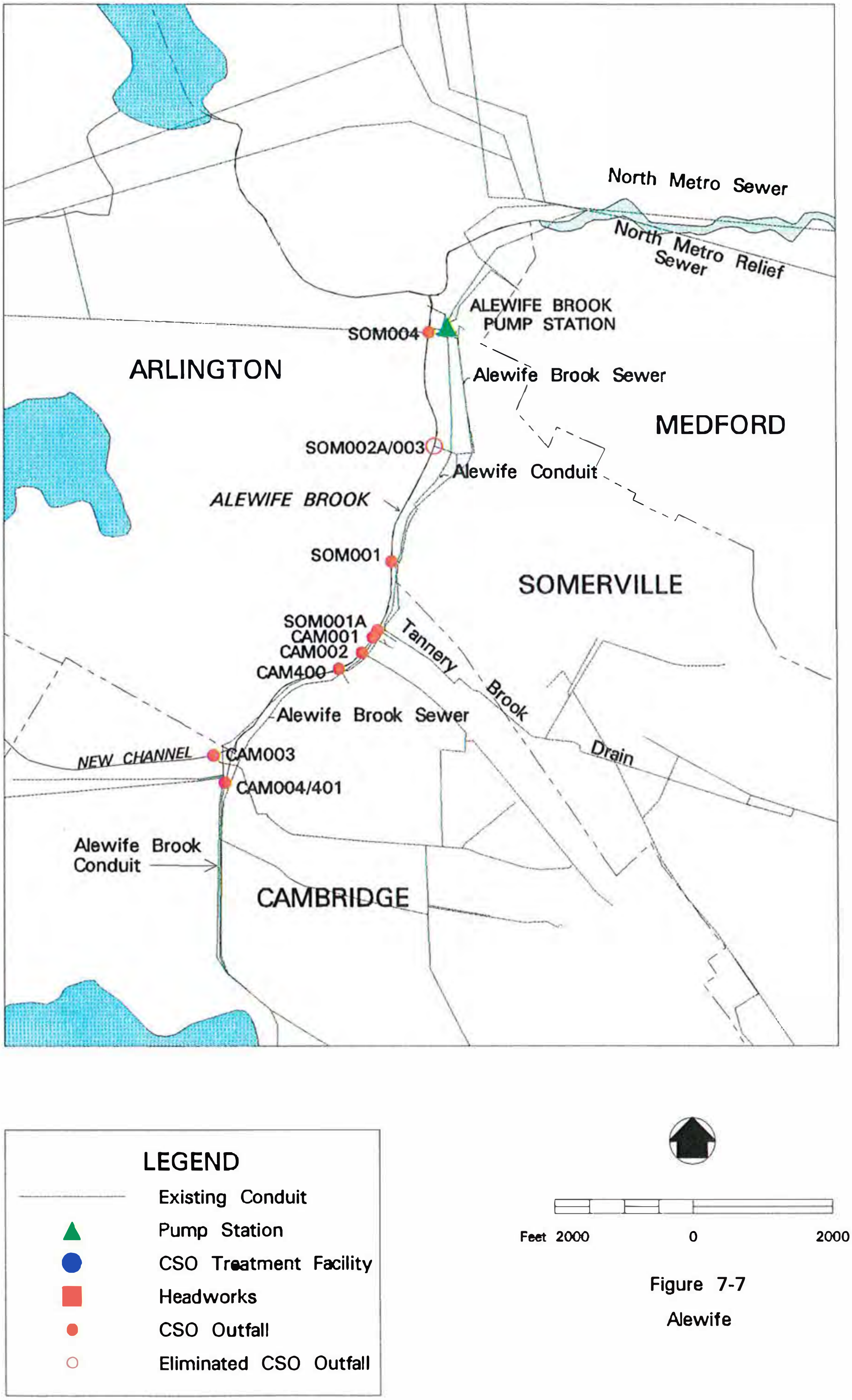


Figure 7-7

Alewife

storm, and on an annual basis. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-7, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of each alternative are presented below, and additional details on the recommended plan are presented in Chapter Eight.

Separation of CAM002, CAM004, and SOM001; Screens at Remaining Outfalls. This alternative is the recommended plan. Tributary areas upstream of CAM002 and CAM004, many of which are currently served by two-pipe systems, would be completely separated. Common manholes upstream of SOM001 would be separated, allowing elimination of this outfall as a CSO. Screens would be installed at the eight outfalls remaining open along the Alewife Brook. This alternative would eliminate overflows from the three-month storm.

Separation of CAM004. The combined areas tributary to CAM004 would be separated, and separate storm drains tributary to RE041 would be routed around the regulator. This alternative would provide control of approximately the three month storm, except at CAM002.

Complete Sewer Separation. This alternative would involve separation of combined areas tributary to the Alewife Brook Sewer and the Alewife Brook Conduit.

Consolidation to Near Surface Storage Facility (One-Year Storm Control). This alternative would involve constructing a consolidation conduit running parallel to Alewife Brook, picking up outfalls CAM004 to SOM004. This conduit would convey overflows to a storage tank in the vicinity of the Alewife MBTA station. The storage tank and conduit

TABLE 7–7. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR ALEWIFE BROOK

Evaluation Criteria	Future Planned Conditions	AB9 **Recommended Plan** Separation at CAM002, CAM004, & SOM001 (3 mo)	AB6 Separation at CAM004 (3 mo)	AB1 Complete Sewer Separation	AB2 Consolidated Near Surface Storage Facility (1 yr)	AB3 Consolidation/ Storage Conduit (1 yr)
Water Quality Benefit (1)						
• Swimming (Bacteria Std. Exceedance, hrs.)	–	–	–	–	–	–
• Boating (Bacteria Std. Exceedance, hrs.)	–	–	–	–	–	–
• Aesthetics (Untreated CSO vol., MG)	5.1	1.3	2.7	0	0	0
• Aquatic Life (Nutrient (TP) Load, lbs.)	370	390	390	370	240	240
(Solids Load, lbs.)	27,000	25,300	25,800	32,700	21,100	13,400
• Performance (Untreated Overflows, no./yr.)	16	1 – 4	4 – 9	0	1 – 3	1 – 3
(Closure of CSOs)	0	1	0	11	0	0
Critical Siting Concerns		Local street closings during construction	Local street closings during construction	Local street closings during construction	Tight corridor for conduit; traffic impacts	Tight corridor for conduit; traffic impacts
Capital Cost (millions)		$12.4	$3.4	$55.0	$54.0	$68.5
Annual O & M Cost		$40,000	$0	$0	$400,000	$55,000
Present Worth (millions)		$10.4	$2.8	$44.2	$47.6	$55.6

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, nutrient and solids loads are derived based on a 1–year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. Nutrient load is from stormwater and CSO; solids load is from stormwater, CSO, and upstream boundary, if applicable.
   d. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   e. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   f. A dash "–" indicates that the alternative was not evaluated with a receiving water model.

TABLE 7–7 (con't). COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR ALEWIFE BROOK

Evaluation Criteria	AB4 Consolidated Near Surface Storage with Separation at CAM004 (1 yr)	AB5 Consolidation/Storage Conduit with Separation at CAM004 (1 yr)	AB7 Consolidation/Storage Conduit (3 mo)	AB8 Screening at Outfalls
Water Quality Benefit (1)				
• Swimming (Bacteria Std. Exceedance, hrs.)	–	–	–	–
• Boating (Bacteria Std. Exceedance, hrs.)	–	–	–	–
• Aesthetics (Untreated CSO vol., MG)	0	0	4.2	5.1
• Aquatic Life (Nutrient (TP) Load, lbs.)	320	320	350	370
(Solids Load, lbs.)	22,800	22,800	25,700	27,000
• Performance (Untreated Overflows, no./yr.)	1 – 3	1 – 3	4 – 7	16
(Closure of CSOs)	0	0	0	0
Critical Siting Concerns	Tight corridor for conduit; traffic impacts	Tight corridor for conduit; traffic impacts	Tight corridor for conduit; traffic impacts	Outfalls located along Alewife Brook's bank
Capital Cost (millions)	$38.8	$47.7	$32.8	$7.4
Annual O & M Cost	321,000	$33,000	$44,000	$50,000
Present Worth (millions)	$34.4	$38.7	$26.8	$6.4

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, nutrient and solids loads are derived based on a 1–year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. Nutrient load is from stormwater and CSO; solids load is from stormwater, CSO, and upstream boundary, if applicable.
   d. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   e. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   f. A dash "–" indicates that the alternative was not evaluated with a receiving water model.

would have sufficient capacity to capture the one-year storm overflows for these outfalls. The tank would be dewatered by pumping the contents back into the Alewife Brook Conduit, following the end of the storm.

Consolidation/Storage Conduit (One-Year Storm Control). A consolidation conduit running parallel to Alewife Brook, from RE041 to the Alewife Brook Pump Station, picking up outfalls CAM004 to SOM004, would have sufficient capacity to capture the one-year storm overflow volume from those outfalls. This consolidation conduit would have a pump out station in the vicinity of the Alewife Brook Pump Station to return the contents of the conduit to the Alewife Brook Conduit, downstream of the pump station, following the end of the storm.

Consolidation to Near Surface Storage with Separation at CAM004 (One-Year Storm Control). This alternative would be the same as the consolidation to near surface storage with one-year storm control, however, the separation of the combined areas tributary to outfall CAM004 would reduce the overall size of the facilities required to provide control of the one-year storm.

Consolidation/Storage Conduit with Separation at CAM004 (One-Year Storm Control). Separation of the combined areas tributary to outfall CAM004 would allow downsizing of the consolidation/storage conduit required to capture the one-year storm.

Consolidation/Storage Conduit (Three-Month Storm Control). This alternative would be similar to the consolidation/storage conduit for one-year storm control, except that the conduit would not extend to outfall SOM004, which is not active during the three-month storm. This conduit would be dewatered to the Alewife Brook Conduit upstream of the Alewife Brook Pump Station at the end of the storm.

Screening at Outfalls. This alternative would involve the construction of manually cleaned bar screens in small chambers on each outfall conduit. The screens would remove large objects from the overflows prior to being discharged to the Alewife Brook.

UPPER MYSTIC RIVER

Description of the Receiving Water Segment

The Upper Mystic River receiving water segment includes the Mystic River between the southern end of Mystic Lakes down to the Amelia Earhart Dam (Figure 7-8). The Mystic River forms part of the border between Arlington and Medford and between Somerville and Medford. Tributaries to the Mystic River include the Mill Brook, which enters just below the Lower Mystic Lake, the Alewife Brook, which flows in a little further downstream, and the Malden River, which enters just above the dam.

This receiving water segment is classified as a SB-Fishable/Swimmable waterbody. There are no Massachusetts DEP-designated critical uses for this segment. Water-based uses of this section of the Mystic River are varied, including powerboating, canoeing, and fishing. Several yacht clubs and marinas are located along this stretch of the river and some of the homes adjacent to the river upstream in Medford have small piers. Public launching areas are also available. Although sailboat use is limited in some sections due to fixed bridges, instruction in small sailboats has historically been available. The Upper Mystic River is an anadromous fish run (alewives). There is no commercial shipping activity upstream of the Earhart Dam.

Land uses adjacent to the river include a large area on the north side of the river under the control of the MDC, known as the Mystic River Reservation. This area is extensively used for recreation, including walking, biking, and birdwatching. Land uses abutting the Reservation include heavily developed residential and commercial areas. Other developed park and playground facilities exist in both Somerville and Medford. The overall area is a

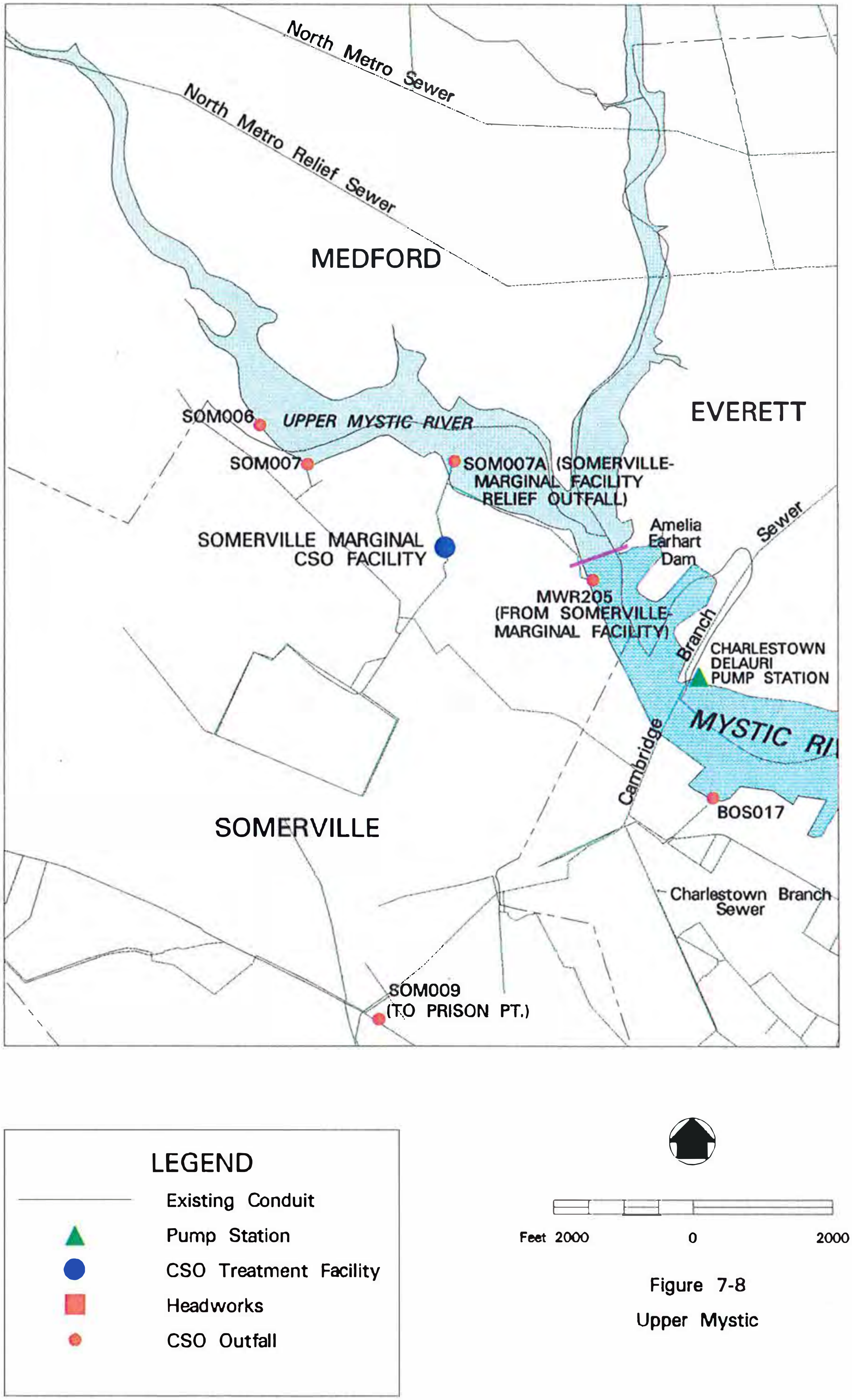


Figure 7-8

Upper Mystic

significant transportation corridor with several major roads and rail corridors crossing or running along the river. Immediately upstream of the Alewife Brook confluence, the river is bordered by broad grassy parkways. Between the Alewife Brook Pump Station and Route 93, there is parkland on the left side of the river bordered by a parkway. Beyond the parklands is predominantly residential land use. There is some commercial activity near the confluence with Alewife Brook.

Two CSO outfalls are located at the downstream end of the receiving water segment near the Amelia Earhart Dam, while a third may also be located in this area. One of these CSOs (SOM007A) is a relief point on the effluent conduit from the Somerville Marginal CSO Facility. Under low tide conditions, screened and disinfected flows from the Somerville Marginal Facility are discharged at CSO outfall MWR205, downstream of the Amelia Earhart Dam. At high tide, tidal backwater can throttle the flow at MWR205, causing flow to back up in the Somerville Marginal Conduit until outfall SOM007A activates. Outfall SOM007A discharges treated flows upstream of the dam. The other known CSO, outfall SOM007, is untreated. Outfall SOM006 is located upstream of SOM007 along the Mystic River. This outfall was originally believed to discharge only stormwater, but recent information suggests that CSOs may also discharge at SOM006 through common manholes. Figure 7-2 presents the total pollutant load and relative contributions to the load from CSO and stormwater for pollutants causing non-attainment of designated uses in the Upper Mystic River. As indicted in Figure 7-2, stormwater is the predominant source of fecal coliform bacteria for the 1-year storm. For parameters other than fecal coliform bacteria, stormwater and upstream flow are also the predominant sources. Additional data on pollutant loads from CSO, stormwater and upstream sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-8, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. A brief description of the alternatives is

TABLE 7–8. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR UPPER MYSTIC RIVER

Evaluation Criteria	Future Planned Conditions	UM3 **Recommened Plan** Sewer Sep. SOM006, 007 Con't Treat. at SOM007A	UM1 Sewer Separation SOM007 and CSO Relocation
Water Quality Benefit (1)			
• Swimming (Bacteria Std. Exceedance, hrs.)	–	–	–
• Boating (Bacteria Std. Exceedance, hrs.)	–	–	–
• Aesthetics (Untreated CSO vol., MG)	.03	0	0
• Aquatic Life (Solids Load, lbs.)	23,900	23,400	13,500
• Performance (Untreated Overflows, no./yr.) (Closure of CSOs)	 2 0	 0 2	 0 3
Critical Siting Concerns		None	None
Capital Cost (millions)		$0.2	$23.3
Annual O & M Cost		$0	$160,000
Present Worth (millions)		$0.2	$20.4

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, nutrient and solids loads are derived based on a 1–year storm event
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. Nutrient load is from stormwater and CSO; solids load is from stormwater, CSO, and upstream boundary, if applicable.
   d. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   e. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   f. A dash "–" indicates that the alternative was not evaluated with a receiving water model.

presented below, and additional details on the recommended plan are presented in Chapter Eight.

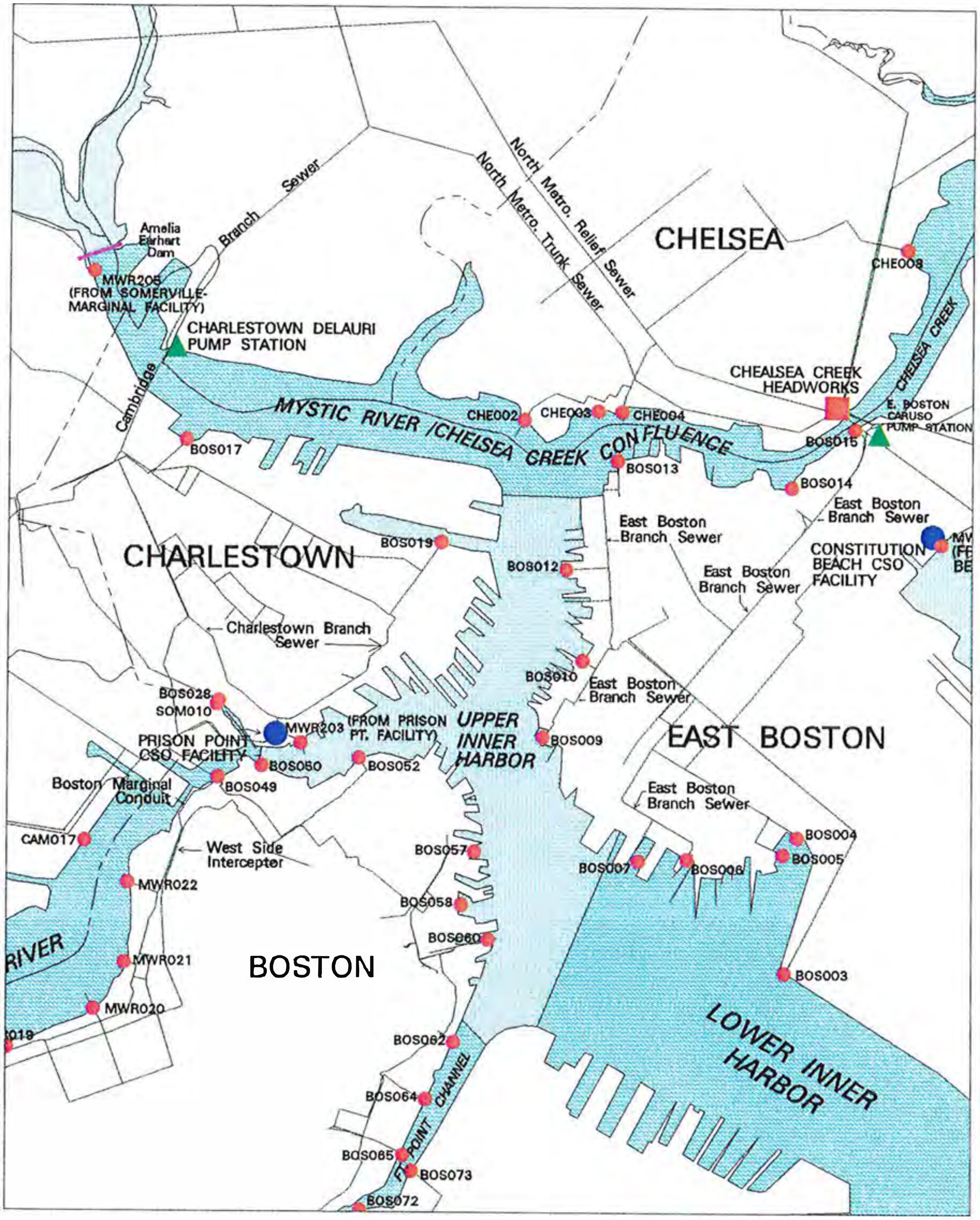
Separation of SOM006 and SOM007; No Change at SOM007A. This alternative is the recommended plan. The common stormwater, sanitary sewer manholes upstream of SOM007 would be separated. Manholes upstream of SOM006 would be inspected, and if necessary, also separated. SOM007A would continue to discharge treated flows from the upgraded Somerville Marginal CSO Facility (as described below) at high tide during large storm events.

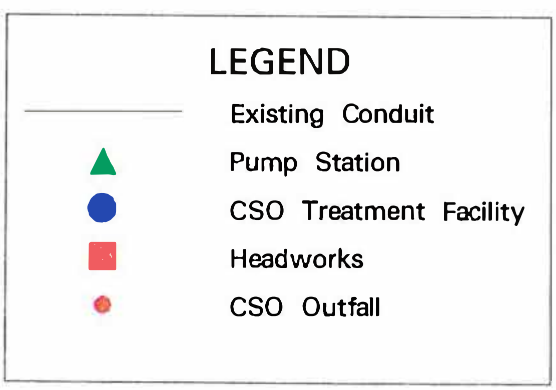
Sewer Separation at SOM007 and CSO Relocation at SOM007A. This alternative involves separating common stormwater, sanitary sewer manholes at SOM007 and the installation of a pump on the outfall conduit of the Somerville Marginal Facility. The pump would allow for discharge of overflows at MWR205 during high tide, and elimination of outfall SOM007A. Alternatives for the Somerville Marginal Facility and MWR205 are presented under the Mystic/Chelsea Confluence.

UPPER INNER HARBOR

Description of the Receiving Water Segment

The Upper Inner Harbor receiving water segment lies between downtown Boston, Charlestown, and East Boston. It includes the Charles River below the new Charles River Dam, the Mystic River below its confluence with Chelsea Creek, and the area between downtown Boston and East Boston (Figure 7-9). The harbor is channelized and deep in this segment. Freshwater from the two rivers mixes with seawater creating a salt-stratified region. The Inner Harbor is designated as Class SB-Fishable/Swimmable with restricted shellfishing. At this time, the only shellfish resource identified within this segment is one bed at the mouth of Chelsea Creek, but harvesting is prohibited. There are no Massachusetts DEP-designated critical uses in this segment.





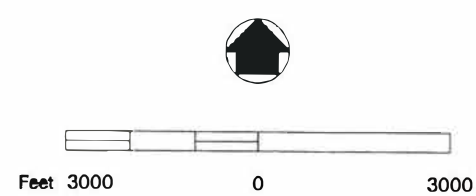


Figure 7-9
Mystic / Chelsea Confluence
Upper Inner Harbor

Existing water-based uses in the Upper Inner Harbor predominantly involve maritime activities. The Upper Inner Harbor includes the main shipping channels (inbound/outbound) used by large freighters and tankers for deliveries to the industrial, energy and shipping facilities located along the waterfront, including a container facility in Charlestown and tank farms in the Chelsea Creek. Other water uses include the major public ferries located at Long and Rowes Wharves. The Coast Guard base is also located in this area of the Harbor. Other boating uses in the Upper Inner Harbor include marinas and mooring areas associated with mixed use developments. Fishing off the harbor side of the new Charles River Dam and many other wharves and bridges is popular. Recreational fishing from small boats is also common, although commercial ship traffic sometimes restricts this activity. Some commercial lobstering takes place in this segment, especially in the early spring. A major offloading facility and pound for the commercial lobster fishery is located next to the Coast Guard Base.

Land uses in the area vary from maritime industrial uses in Charlestown and East Boston, where there is a federally designated port, to under-utilized piers along a portion of the East Boston waterfront. Much of the downtown Boston area and a portion of the Charlestown Navy Yard is dominated by mixed use developments of residential, office, and commercial space. Several waterfront parks exist in this segment. The shoreline of the area is bordered by busy downtown streets, the elevated Southeast Expressway, high density apartments, and Fanueil Hall Marketplace. The New England Aquarium on the downtown waterfront and the U.S.S. Constitution ship and museum, within the National Park in the Charlestown Navy Yard, are also located in this segment.

A total of ten CSOs discharge to the Upper Inner Harbor receiving water segment, including the Prison Point CSO facility (MWR203) which is the only treated discharge. Figure 7-2 presents the total pollutant load and relative contributions from CSO and stormwater for pollutants causing non-attainment of designated uses in the Upper Inner Harbor. As shown in Figure 7-2, CSOs contribute a significant percentage of the fecal coliform bacteria load during the 1-year storm. CSOs also contribute substantially to nutrient loadings and floatables for the 1-year storm, but upstream flow predominates for most parameters, especially on an annual basis. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-9, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of the alternatives are presented below, and additional details on the recommended plan are provided in Chapter Eight.

Dechlorination at MWR203; Screen and Disinfect BOS019; Interceptor Relief and Screens for BOS009 through BOS013; and Screens at Outfalls BOS050 through BOS060. This alternative is the recommended plan. The existing Prison Point CSO facility would be upgraded with dechlorination equipment. In addition, the operational procedures at Prison Point would be optimized, to minimize the volume of untreated overflows discharged upstream in the Charles River. Potential flow obstructions in the influent conduits to the Prison Point facility would also be cleared. A screening and disinfection facility would be constructed in the vicinity of BOS019. Interceptor relief would increase the capacity of the East Boston Branch Sewer thus reducing overflow volumes at outfalls BOS009 through BOS013. Manually cleaned screens would be installed in the outfall conduits of the relatively inactive outfalls BOS050, BOS057, and BOS060, as well as outfalls BOS009 to BOS013.

Dechlorination at MWR203; storage at BOS019 (3-Month Storm Control); Interceptor Relief for BOS009 Through BOS013; and Screens at Outfalls BOS050 through BOS060. This alternative would be similar to the above alternative, except that a storage facility for the three-month storm would be constructed at BOS019, instead of the screening and disinfection facility.

TABLE 7–9. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR UPPER INNER HARBOR

Evaluation Criteria	Future Planned Conditions	UIH7 **Recommended Plan** Add dechlorination to Prison Point; screen/dis–infect BOS019; Int. Relief BOS009–014; Screens at remaining outfalls	UIH8 Add dechlorination to Prison Point; 3–MO storage at BOS019; Int. Relief BOS009–014; Screens at remaining outfalls	UIH1 Complete Sewer Separation	UIH2 Individual Storage at MWR203 & BOS019; Consol. to Storage BOS009 – 013 Consol/Storage Conduit BOS050 – 060 (1 yr)
Water Quality Benefit (1)					
• Swimming (Bacteria Std. Exceedance, hrs.)	38	23	–	23	15
• Boating (Bacteria Std. Exceedance, hrs.)	0	0	0	0	0
• Aesthetics (Untreated CSO vol., MG)	5.8	2.5	2.9	0	0
• Aquatic Life (Dissolved Oxygen – BOD Load, lbs.)	159,000	161,000	158,000	131,000	132,000
(Solids Load, lbs.)	111,000	109,000	106,000	91,700	85,400
• Performance (Untreated Overflows, no./yr.)	36	1–5	4–7	0	1 – 3
(Closure of CSOs)	0	0	0	10	0 – 3
Critical Siting Concerns		For East Boston, local street closings during construction; sensitive site at BOS019	For East Boston, local street closings during construction; sensitive site at BOS019	Local street closings during construction	Difficult/tight consol./ storage conduit route; siting constrants for storage facilities
Capital Cost (millions)		$22.7	$22.0	$88.5	$214
Annual O & M Cost		$756,000	$863,000	$0	$1,700,000
Present Worth (millions)		$25.9	$25.9	$71.2	$189

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, nutrient and solids loads are derived based on a 1–year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in–receiving water modeling was 99.4 hours. Predicted duration of violations at mouth of Charles River.
   d. Nutrient load is from stormwater and CSO; solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. A dash "–" indicates that the alternative was not evaluated with the receiving water model.

TABLE 7–9(con't). COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR UPPER INNER HARBOR

Evaluation Criteria	UIH3 Primary Treatment at MWR203 & BOS019; Consol. to Primary Treat. BOS009 – 013; Consol./Storage BOS050 – 060 (1 yr)	UIH4 Individual Storage at MWR203 & BOS019; Interceptor relief BOS009 – 013; Screens at remaining outfalls (3 mo)	UIH5 Primary Treatment at MWR203 & BOS019; Consol. to Primary Treat. BOS009 – 013; Screens at remaining outfalls (3 mo)	UIH6 Upgrade MWR203; Screens at remaining outfalls (3 mo)
Water Quality Benefit (1)				
• Swimming (Bacteria Std. Exceedance, hrs.)	–	–	19	–
• Boating (Bacteria Std. Exceedance, hrs.)	0	0	0	0
• Aesthetics (Untreated CSO vol., MG)	0	3.78	1.24	5.81
• Aquatic Life (Dissolved Oxygen – BOD Load, lbs.)	146,000	146,000	155,000	158,000
(Solids Load, lbs.)	105,000	105,000	125,000	130,000
• Performance (Untreated Overflows, no./yr.)	1 – 3	4 – 7	4 – 7	36
(Closure of CSOs)	0 – 3	0	0 – 2	0
Critical Siting Concerns	Difficult siting for treatment facility	Sensitive site for BOS019 Facility	Tight corridor for colsolidation conduit	None
Capital Cost (millions)	$109	$85.0	$60.0	$12.1
Annual O & M Cost	$2,090,000	$791,000	$1,810,000	$672,00
Present Worth (millions)	$108.7	$76.2	$66.6	$20.6

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, nutrient and solids loads are derived based on a 1–year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in–receiving water modeling was 99.4 hours. Predicted duration of violations at mouth of Charles River.
   d. Nutrient load is from stormwater and CSO; solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. A dash "–" indicates that the alternative was not evaluated with the receiving water model.

Complete Sewer Separation. This alternative would involve separating combined areas in Boston's North End, Charlestown, Cambridge, East Boston, and Somerville. Complete sewer separation of these areas would be difficult, since they are highly developed urban areas.

Storage at MWR203, Prison Point CSO Facility, and BOS019; Consolidation to Storage at BOS009 to BOS013; Consolidation/Storage Conduit from BOS057 to BOS060; Screens at BOS050 (One-Year Storm Control). This alternative would involve constructing additional storage at the Prison Point CSO Facility and constructing a storage facility at BOS019. These facilities would have the capacity to capture the one-year overflow volumes from these outfalls. This alternative would also involve constructing a consolidation conduit to capture one-year overflow volumes from BOS009 through BOS013 and convey them to a storage facility. A consolidation conduit would be constructed to capture and store one-year overflow volumes from outfalls BOS057 through BOS060. Manually cleaned bar screens would be installed on the overflow conduit for outfall BOS050, which is not active during the one-year storm. The screens would remove large objects from the overflows before the flow is discharged to the Upper Inner Harbor. All storage facilities/conduits would be dewatered by pumps following the storm, returning the captured overflows to the wastewater collection system.

Primary Treatment at MWR203 and BOS019; Consolidation to Primary Treatment for BOS009 through BOS013; Consolidation/Storage Conduit for BOS057 through BOS060; Coarse Screens at BOS050 (One-Year Storm Control). This alternative is similar to above except that the facilities at Prison Point and BOS019, and the consolidation facility for BOS009 through BOS013 would be sized to provide primary treatment for the one-year storm. Some smaller storms may be completely stored by these facilities and returned to the interceptors following the storms.

Storage at MWR203 and BOS019; Interceptor Relief at BOS009 through BOS013; and Screening for Outfalls BOS050 through BOS060 (Three-Month Storm Control). This alternative is similar to the recommended plan, except that storage would be added to the Prison Point Facility sufficient to capture three-month storm overflow volumes at this outfall.

Primary Treatment at MWR203 and BOS019; Consolidation to Primary Treatment for BOS009 through 013; and Screens for Outfalls BOS050 through BOS060 (Three-Month Storm Control). This alternative is similar to the alternative to provide primary treatment at MWR203 with one-year control, except that no consolidation/storage conduit would be constructed for BOS057 through BOS060, and the treatment facilities would be sized for the three-month storm. Screens would be installed in outfalls BOS057 through BOS060, which are not active during the three-month storm.

Dechlorination at MWR203 and Screens at all Other Outfalls. This alternative involves upgrading the existing Prison Point CSO Facility for dechlorination, which is part of the recommended plan. Manually cleaned bar screens would be installed in the outfall conduits for all other outfalls tributary to the Upper Inner Harbor.

LOWER INNER HARBOR

Description of the Receiving Water Segment

The Lower Inner Harbor receiving water segment lies between South Boston and East Boston near Logan Airport (Figure 7-4). It includes the two shipping channels for the port of Boston. The Third Harbor Tunnel is currently being constructed in this area. The Lower Inner Harbor is classified as SB-Fishable/Swimmable with restricted shellfishing. At this time, there are no identified shellfish resources within this area. There are no Massachusetts DEP-designated critical uses in this segment.

Water-based uses primarily consist of maritime industrial facilities, including the Boston Marine Industrial Park. The Fish Pier, a landing area for offshore and local fisheries, is also located here. Fishing is popular where there is public access to wharves and bridges along the waterfront. Recreational fishing from small boats is also common, but restricted by commercial ship traffic. Some commercial lobstering takes place.

Land uses along the waterfront in South Boston support maritime industries, and fish landing and processing. On the East Boston side of the harbor, land use is dominated by Logan International Airport and related facilities. Northwest of the airport, the shore is lined with dilapidated piers, ship drydock and repair facilities. Behind these facilities there are multi-family housing developments.

Five untreated CSOs discharge to the Lower Inner Harbor receiving water segment. Figure 7-2 presents the total pollutant load and relative contributions to the load from CSO and stormwater for pollutants causing non-attainment of designated uses. As indicated in Figure 7-2, CSOs contribute about one-half of the fecal coliform bacteria load for the 1-year storm. During a 1-year storm, CSOs also contribute the majority of the nutrient loading. For other parameters, stormwater is the predominant source of pollutant loads for the 1-year storm and on an annual basis. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-10, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of the alternatives are presented below, and additional details on the recommended plan are provided in Chapter Eight.

TABLE 7-10. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR LOWER INNER HARBOR

Evaluation Criteria	Future Planned Conditions	LIH4 **Recommended Plan** Interceptor Relief (3 mo)	LIH1 Complete Sewer Separation	LIH2 Consolidation to Near Surface Storage BOS003 - 007 (1 yr)
Water Quality Benefit (1)				
• Swimming (Bacteria Std. Exceedance, hrs.)	37	22	15	11
• Boating (Bacteria Std. Exceedance, hrs.)	4	0	0	0
• Aquatic Life (Dissolved Oxygen - BOD Load, lbs.)	17,700	17,200	16,200	14,600
(Solids Load, lbs.)	33,700	32,500	31,200	28,100
• Performance (Untreated Overflows, no./yr.)	29	1-5	0	1-3
(Closure of CSOs)	0	0	5	1-2
Critical Siting Concerns		Local street closings during construction	Local street closings during construction	Residences and local traffic impacted by facility
Capital Cost (millions)		$19.5	$58.4	$43.0
Annual O & M Cost		$25,000	$0	$470,000
Present Worth (millions)		$15.9	$46.9	$39.3

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, BOD and solids loads are derived based on a 1-year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in-receiving water simulation was 99.4 hours. Predicted duration of violations at middle of Inner Harbor.
   d. BOD and solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.

TABLE 7-10 (con't). COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR LOWER INNER HARBOR

Evaluation Criteria	LIH3 Consolidation to Primary Treatment (1 yr)	LIH5 Diversion to Storage in BOS003 Outfall (3 mo)	LIH6 Screening at Outfalls
Water Quality Benefit (1)			
• Swimming (Bacteria Std. Exceedance, hrs.)	–	15	37
• Boating (Bacteria Std. Exceedance, hrs.)	–	0	4
• Aquatic Life			
(Dissolved Oxygen – BOD Load, lbs.)	16,100	17,200	17,700
(Solids Load, lbs.)	30,100	32,500	33,400
• Performance			
(Untreated Overflows, no./yr.)	0	4-7	29
(Closure of CSOs)	1-2	0-1	0
Critical Siting Concerns	Local traffic impacts	Local traffic impacts	None
Capital Cost (millions)	$33.0	$15.0	$13.0
Annual O & M Cost	$594,000	$66,000	$39,000
Present Worth (millions)	$32.5	$12.3	$11.0

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, BOD and solids loads are derived based on a 1-year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in-receiving water modeling was 99.4 hours. Predicted duration of violations at middle of Inner Harbor.
   d. BOD and solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. A dash "–" indicates that the alternative was not evaluated with the receiving water model.

Interceptor Relief and Screens for BOS003 through BOS007 (3-Month Storm Control). This alternative is the recommended plan. The capacity of the East Boston Branch Sewer would be increased, which would eliminate 3 month storm overflows at outfalls BOS003 through BOS007. Manually-cleaned screens would be installed on the remaining outfalls.

Complete Sewer Separation. This alternative would involve separation of combined areas upstream of regulators along the East Boston Branch Sewer discharging to outfalls BOS003 through BOS007.

Consolidation to Near Surface Storage for BOS003 through BOS007 (1-Year Storm Control). This alternative would involve constructing a consolidation conduit, running along the harborfront, picking up outfalls BOS003 through BOS007 and conveying their overflows to a near surface storage facility. This facility would have a sufficient capacity to capture one-year storm overflow volumes. Following the storm, the contents of the facility would be pumped to the East Boston Branch Sewer.

Consolidation to Primary Treatment for BOS003 through BOS007 (1-Year Storm Control). This alternative is similar to consolidation to near surface storage with one-year storm control, except overflow would receive primary treatment and be discharged to the Lower Inner Harbor. Overflows from some smaller storms would be entirely captured and returned to the East Boston Branch Sewer following the storms.

Diversion to Storage in BOS003 Outfall (3-Month Storm Control). This alternative would involve constructing a consolidation conduit to divert flow from outfalls BOS004 through BOS007 to the BOS003 outfall conduit. An hydraulic gate on the BOS003 outfall would retain flow in the outfall conduit, opening only to relieve volumes in excess of the storage capacity of the conduit. The existing outfall conduit and the consolidation conduit would have sufficient capacity to store 3-month storm overflow volumes from outfalls BOS003 to

BOS007. A pump out station would be provided so that following the storm, the contents of the outfall conduit would be pumped back to the East Boston Branch Sewer.

Screening. Bar screens would be installed in each outfall conduit tributary to the Lower Inner Harbor. The screens would remove large objects from overflows before they are discharged to the harbor.

MYSTIC/CHELSEA CONFLUENCE

Description of the Receiving Water Segment

The Mystic/Chelsea Confluence receiving water segment includes the marine portion of the Mystic River, below the Amelia Earhart Dam, and Chelsea Creek (Figure 7-9). It is relatively deep with tidal flushing. The segment is surrounded by East Boston, Chelsea, Everett, and Charlestown. The Mystic River/Chelsea Creek Confluence receiving water segment is classified as Class SB-Fishable/Swimmable with restricted shellfishing. No shellfish resources are currently identified in this segment, and there are no Massachusetts DEP-designated critical uses. Existing water-based uses in this segment include fishing and boating, but most of the waterfront is dominated by industrial maritime uses. Much of this area falls into either the Mystic River or Chelsea Creek Designated Deep Port Area.

The Moran Container Terminal is on the south side of the Mystic River above the Tobin Bridge. Opposite the terminal is a scrap metal loading facility. The Chelsea River has several tank farms on its banks, and a minerals unloading and storage area is located on the north side of the river. The Boston Edison Power Plant is located along the Everett shore. The Chelsea waterfront is primarily industrial land with some smaller vacant parcels. Behind these activities is dense urban housing. The Tobin Bridge passes over the Mystic River and the McClellan Highway is on the east bank of Chelsea Creek.

There are nine CSOs along both banks of the Chelsea Creek and along the south bank of the Mystic River. Except for the Somerville Marginal CSO facility (MWR205), none of the CSO discharges is treated. Figure 7-2 presents the total pollutant load and the relative contributions from CSO and stormwater to the load of pollutants causing non-attainment of designated uses in the Mystic/Chelsea Confluence receiving water segment. As indicated in Figure 7-2, upstream river flow contributes significantly to pollutant loads, especially on an annual basis. CSOs contribute a large percentage of the fecal coliform bacteria load for the 1-year storm. CSOs also contribute a large percentage of the nutrient load for the 1-year storm, but not as large as the percentage from stormwater and upstream sources combined. Additional data on pollutant loads from CSO and stormwater sources is presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-11, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of the alternatives are presented below, and additional details on the recommended plan are presented in Chapter Eight.

The existing Somerville Marginal CSO Facility must be relocated as part of planned modifications to Route I-93/Exit 29. A common aspect of all alternatives is that regardless of the proposed level of control for MWR205, use of the existing Somerville Marginal CSO Facility will not be part of the alternatives. Another project common to all alternatives will be trunk sewer relief and screens for Chelsea outfalls CHE002 to CHE004. This project was originally developed as an intermediate project, and is now being incorporated into the recommended CSO control plan. Relieving the trunk sewer which conveys dry weather flow from regulators RE-021, RE-031, and RE-041 to the North Metropolitan Trunk Sewer will eliminate overflows form CHE002 to CHE004 during the one-year storm.

TABLE 7-11. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR MYSTIC / CHELSEA CONFLUENCE

Evaluation Criteria	Future Planned Conditions	MCC8 **Recommended Plan** Screen/Disinfect. MWR205, BOS017; Int. Rel. CHE002,3,4; Rep. outfall CHE008	MCC9 Storage at MWR205; Screen/ Disinfect BOS014, BOS017 & CHE008 (3 mo)	MCC1 Complete Sewer Separation	MCC2 Storage at MWR205; BOS014, BOS017 and CHE008 (1 yr)	MCC3 Primary Treatment at MWR205, BOS017 & CHE008; storage at BOS014 (1-yr)
Water Quality Benefit (1)						
• Swimming (Bacteria Std. Exceedance, hrs.)	(2) CC: 34 MR: 34	CC: 28 MR: 28	–	CC: 27 MR: 28	CC: 25 MR: 27	–
• Boating (Bacteria Std. Exceedance, hrs.)	CC: 10 MR: 0	CC: 0 MR: 0	–	CC: 0 MR: 0	CC: 0 MR: 0	–
• Aesthetics (Untreated CSO vol., MG)	4.6	0.4	0	0	0	0
• Aquatic Life (Dissolved Oxygen – BOD Load, lbs.)	29,400	27,200	26,200	27,700	20,000	24,700
(Solids Load, lbs.)	55,300	50,800	49,200	17,200	38,500	45,000
• Performance (Untreated Overflows, no./yr.)	35	1-6	4-7	0	1 - 3	1 - 3
(Closure of CSOs)	0	0	0	8	0	0
Critical Siting Concerns		Siting of MWR205 coordinate with I-93 relocation	Siting of MWR205 coordinate with I-93 relocation	Local street closings during construction	Siting of MWR205 coordinate with I-93 relocation	Siting of MWR205 coordinate with I-93 relocation
Capital Cost (millions)		$12.3	$25.2	$112.6	$75.4	$39.4
Annual O & M Cost		$535,000	$770,000	$0	$670,000	$1,390,000
Present Worth (millions)		$15.4	$28.1	$90.5	$67.4	$45.8

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, and solids loads are derived based on a 1-year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in-receiving water modeling was 99.4 hours.
   d. Solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. A dash "-" indicates that the alternative was not evaluated with the receiving water model.
2. Data locations at Mystic River, near mouth (MR) and Chelsea Creek, near mouth (CC).

TABLE 7-11(con't). COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR MYSTIC / CHELSEA CONFLUENCE

Evaluation Criteria	MCC5 Storage MWR205, BOS017 and CHE008; Screen BOS014 (3 mo)	MCC6 Primary Treat. MWR205, BOS017; Storage CHE008; Screen BOS014 (3 mo)	MCC4 Dechlorination MWR205, Screen/Disinfection BOS014, BOS017 and CHE008 (1 yr)
Water Quality Benefit (1)			
• Swimming (Bacteria Std. Exceedance, hrs.)	(2) CC: 28 MR: 29	–	–
• Boating (Bacteria Std. Exceedance, hrs.)	CC: 2 MR: 0	–	–
• Aesthetics (Untreated CSO vol., MG)	0.6	0.6	0
• Aquatic Life (Dissolved Oxygen – BOD Load, lbs.) (Solids Load, lbs.)	26,000 48,900	27,700 51,200	29,400 54,600
• Performance (Untreated Overflows, no./yr.) (Closure of CSOs)	1-3 0	1-3 0	1-3 0
Critical Siting Concerns	Siting of MWR205 coordinate with I-93 relocation	Siting of MWR205 coordinate with I-93 relocation	Siting of MWR205 coordinate with I-93 relocation
Capital Cost (millions)	$29.9	$16.0	$7.2
Annual O & M Cost	$380,000	$700,000	$820,000
Present Worth (millions)	$27.9	$20.0	$14.2

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, and solids loads are derived based on a 1-year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in-receiving water modeling was 99.4 hours.
   d. Solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.
   g. A dash "-" indicates that the alternative was not evaluated with the receiving water model.
2. Data locations at Mystic River, near mouth (MR) and Chelsea Creek, near mouth (CC).

Screening and Disinfection at MWR205 and BOS017; Outfall Repair and Screens at CHE008; Screens at Remaining Outfalls. This alternative is the recommended plan. The relocated Somerville Marginal CSO facility would provide the same level of treatment as the current facility (with dechlorination added). A similar screening and disinfection facility would be constructed at BOS017. The existing outfall pipe at CHE008 would either be replaced or repaired, and manually-cleaned screens would be installed at CHE008 and the remaining outfalls.

Storage at MWR205; Screening and Disinfection at BOS014, BOS017 and CHE008. The Somerville Marginal Facility would be upgraded to provide storage for 3 month storm overflow volumes. Individual screening and disinfection facilities would be constructed in the vicinities of BOS014, BOS017 and CHE008. These facilities would provide flow through treatment of overflows at the three outfalls.

Complete Sewer Separation. This alternative would involve separation of combined areas in portions of Somerville, Charlestown and East Boston and all of Chelsea.

Storage at MWR205, BOS014, BOS017 and CHE008 (1 Year Storm Control). Storage facilities would be constructed in the vicinities of these four outfalls. The facilities would have sufficient capacity to capture one-year storm overflow volumes. Following the storm, the captured volume would be returned to the interceptor system.

Primary Treatment at MWR205, BOS017, and CHE008; Storage at BOS014 (One-Year Storm Control). This alternative involves the construction of primary treatment facilities in the vicinities of outfalls MWR205, BOS017, and CHE008. These facilities would have the capacity to provide primary treatment to one-year storm overflow volumes at these outfalls. The treated flow would be discharged to the Mystic River/Chelsea Creek Confluence. Some smaller storm overflow volumes would be completely captured by the facilities and returned to the interceptor system following the storm. This alternative would also involve the construction of a storage facility in the vicinity of outfall BOS014 with the capacity to capture one-year storm overflow volumes at this outfall. The contents of the tank would be returned to the East Boston Branch Sewer following the end of the storm. A primary treatment facility at BOS014 would require a tank volume greater than the one-year storm volume.

Storage at MWR205, BOS017, and CHE008; Screening at BOS014 (Three-Month Storm Control). This alterative is similar to the alternative for storage at MWR205, BOS014, BOS017 and CHE008 for one-year storm control, except that the facilities would be sized for the three-month storm. Manually cleaned bar screens would be installed in the BOS014 outfall conduit, since BOS014 is not active during the three-month storm.

Primary Treatment at MWR205 and BOS017; Storage at CHE008; and Screening at BOS014 (3-Month Storm Control). Under this alternative, primary treatment facilities at MWR205 and BOS017 would be sized for the three-month storm. A storage facility would be constructed in the vicinity of outfall CHE008 and manually cleaned bar screens would be installed in the BOS014 outfall conduit.

Screening and Disinfection at MWR205, BOS014, BOS017, and CHE008. This alternative would involve constructing screening and disinfection facilities at outfalls BOS014, BOS017, and CHE008, as well as replacing the existing Somerville Marginal CSO facility with a similar facility (with dechlorination added).

RESERVED CHANNEL

Description of the Receiving Water Segment

The Reserved Channel is a narrow shipping channel located in South Boston. Its mouth lies at the mouth of the Inner Harbor (Figure 7-1). The Reserved Channel is classified as Class SB-Fishable/Swimmable with restricted shellfishing. There are no shellfish resources identified within the channel, and no Massachusetts DEP-designated critical uses. Existing water-based uses are confined to boating and industrial maritime activities. The Reserved Channel is a designated port area. There is deep water access and adjacent land uses include large pier and wharf areas used for container shipping. The north side of the channel is bordered by a ship terminal and warehouses. The south side has a container port at the mouth extending to Castle Island. Upstream is an oil tank farm, and a large thermal power station. There is also some commercial activity and several small marinas. A low bridge crosses the channel near the upstream end. Residential areas in South Boston abut these maritime areas.

Four untreated CSOs discharge to the Reserved Channel. Figure 7-2 presents the total pollutant load and the relative contributions to the load from CSO and stormwater for pollutants causing non-attainment of designated uses in the Reserved Channel receiving water segment. As indicated in Figure 7-2, CSOs contribute a far greater percentage of the fecal coliform bacteria load than stormwater. CSOs are also the predominant source of nutrients and a substantial source of toxics in this segment. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-12, along with water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of the alternatives are presented below, and additional details on the recommended plan are presented in Chapter Eight.

Consolidation to Screen and Disinfection Facility, BOS076 to BOS080; Screens at Remaining Outfalls. This alternative is the recommended plan. A consolidation conduit running from outfall BOS076 to outfall BOS080 would convey overflow volumes to a flow through, screening and disinfection facility located in the vicinity of outfall BOS080. This facility would also treat flows from the North Dorchester Bay CSO relocation conduit.

TABLE 7-12. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR RESERVED CHANNEL

Evaluation Criteria	Future Planned Conditions	RC7 **Recommended Plan** Consolidation to Screen & Disinf. Fac. BOS076-080	RC1 Complete Sewer Separation	RC3 Consolidated Storage BOS076-080 (1 Yr)	RC4 Consolidated Storage BOS080-076 (1 Yr)	RC5 Consolidated Primary Treatment BOS076-080 (1 Yr)
Water Quality Benefit (1)						
• Swimming (Bacteria Std. Exceedance, hrs.)	24	0	0	0	0	0
• Boating (Bacteria Std. Exceedance, hrs.)	0	0	0	0	0	0
• Aquatic Life (Solids Load, lbs.)	12,800	9,400	2,800	2,300	2,300	4,300
• Performance						
(Untreated Overflows, no./yr.)	44	0	0	1-3	1-3	0
(Closure of CSOs)	0	0-2	4	0-2	0-2	0-2
Critical Siting Concerns		Use of industrial site, potential impact on playground	Local street closings during construction	Residences and play-ground impacted	Residences and truck traffic impacted; restricted site BOS076	Residences and truck traffic impacted
Capital Cost (millions)		$34.5	$54.8	$68.1	$65.5	$57.3
Annual O & M Cost		$40,000	$0	$836,000	$839,000	$1,045,000
Present Worth (millions)		$28.1	$44.0	$63.2	$61.2	$56.7

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, and solids loads are derived based on a 1-year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in-receiving water modeling was 99.4 hours; predicted duration of violations at mouth of Reserved Channel.
   d. Solids load is from stormwater, CSO, and upstream boundary, if applicable
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.

TABLE 7-12(cont). COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR RESERVED CHANNEL

Evaluation Criteria	RC6 Consolidate BOS080-076 to Primary Treatment (1Yr)	RC8 Consolidate BOS080-076 to Screen/Disinf. Facility (1Yr)	RC9 Consolidate BOS076-080 to Storage Facility (3 Mo)	RC10 Consolidate BOS080-076 to Storage Facility (3 Mo)	RC11 Consolidate BOS080-076 to Primary Treatment (3 Mo)	RC12 Screens at Outfalls BOS080-076
Water Quality Benefit (1)						
• Swimming (Bacteria Std. Exceedance, hrs.)	0	0	0	0	0	3
• Boating (Bacteria Std. Exceedance, hrs.)	0	0	0	0	0	0
• Aquatic Life (Solids Load, lbs.)	5,200	10,800	8,200	8,200	8,900	12,300
• Performance (Untreated Overflows, no./yr.)	0	0	0	0	0	44
(Closure of CSOs)	0-2	0-2	0-2	0-2	0-2	0
Critical Siting Concerns	Residences and truck traffic impacted; restricted site at BOS076	Residences and truck traffic impacted; restricted site at BOS076	Residences and play-ground impacted	Residences and truck traffic impacted; restricted site at BOS076	Residences and truck traffic impacted; restricted site at BOS076	None
Capital Cost (millions)	$49.5	$33.4	$41.6	$40.6	$38.1	$4.0
Annual O & M Cost	$1,048,000	$552,000	$592,000	$792,000	$990,000	$260,000
Present Worth (millions)	$50.4	$32.4	$39.4	$40.6	$40.7	$5.9

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, and solids loads are derived based on a 1-year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in-receiving water modeling was 99.4 hours; predicted duration of violations at mouth of Reserved Channel.
   d. Solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.

Screens would be installed on the outfall conduits for BOS076 to BOS080, to provide a level of solids control for flows in excess of the capacity of the consolidation conduit. The cost for this alternative indicated in Table 7-12 is for the consolidation conduit and outfall screens, only. The cost of the screening and disinfection facility has been included under the recommended alternative for North Dorchester Bay.

Complete Sewer Separation. This alternative would involve the separation of combined areas upstream of regulators discharging to BOS076 to BOS080. Complete separation of these areas would not allow elimination of the outfalls unless downstream areas on the South Boston Interceptor North Branch are also separated. Otherwise, surcharging in the interceptor may still cause overflow activations to the Reserved Channel.

Consolidation to Near Surface Storage Facility for BOS076 to BOS080 (One-Year Storm Control). A consolidation conduit running parallel to the Reserved Channel, picking up outfalls BOS076 to BOS080, would have sufficient capacity in combination with the storage facility to capture the one-year storm overflow volume from the outfalls. A storage facility would be constructed in the vicinity of BOS080. The contents of the conduit and storage facility would be returned to the SBI/North Branch following the end of the storm.

Consolidation to Near Surface Storage Facility for BOS080 to BOS076 (One-Year Storm Control). This alternative is similar to consolidation to a near surface storage facility for BOS076 to BOS080 with one-year storm control, except that the storage facility would be constructed in the vicinity of BOS076. Also, the consolidation conduit would be smaller and the storage facility larger in this alternative, since outfall BOS076 has the largest overflow volume of the outfalls in this receiving water segment.

Consolidation to Near Surface Primary Treatment BOS076 to BOS080 (One-Year Storm Control). This alternative is similar to consolidation to a near surface storage facility for BOS076 to BOS080 with one-year storm control, except the facility would have the capacity to provide primary treatment of one-year storm overflow volumes. Treated overflow would be discharge to the Reserved Channel. Some smaller storms would be completely captured by the consolidation conduit and facility. These storm overflow volumes would be returned to the SBI, following the storm.

Consolidation to Near Surface Primary Treatment BOS080 to BOS076 (One-Year Storm Control). This alternative is similar to the alternative above, except that the consolidation conduit would flow from BOS080 to BOS076 and the primary treatment facility would be in the vicinity of outfall BOS076.

Consolidation to Screen and Disinfection Facility, BOS080 to BOS076 (One-Year Storm Control). This alternative involves a consolidation conduit running from BOS080 to BOS076 and a flow through screening and disinfection facility located near outfall BOS076. This alternative is similar to the recommended plan except for the direction of flow in the consolidation conduit and the location of the facility.

Consolidation to Near Surface Storage Facility BOS076 to BOS080 (3-Month Storm Control). This alternative is the same as consolidation to a near surface storage facility at BOS080 for the one-year storm except the consolidation conduit and storage facility would store the three-month storm.

Consolidation to Near Surface Storage Facility BOS080 to BOS076 (3-Month Storm Control). This alternative is the same as consolidation to a near surface storage facility at BOS076 for the one-year storm except the consolidation conduit and storage facility would store the three-month storm.

Consolidation to Near Surface Primary Treatment Facility BOS080 to BOS076 (3-Month Storm Control). This alternative is the same as the above alternative, except the tank would be sized for primary treatment.

Screens at Outfalls. This alternative involves the construction of mechanically-cleaned bar screens in all the outfall conduits tributary to the Reserved Channel. The screens would remove large objects from the overflows before they are discharged to the Reserved Channel.

FORT POINT CHANNEL

Description of the Receiving Water Segment

Fort Point Channel is a narrow, shallow embayment off the upper part of the Inner Harbor, which separates South Boston from the downtown area (Figure 7-1). Fort Point Channel is classified as Class SB-Fishable/Swimmable with restricted shellfishing. No shellfish resources have been identified within the channel, and there are no Massachusetts DEP-designated critical uses for this segment. Existing water-based uses include recreational fishing from the bridges and wharves lining the channel, and both powerboating (including fishing vessels) and barge activities.

Land-side uses in the vicinity of Fort Point Channel include a mix of industrial facilities, seafood handling facilities, transportation corridor uses, and cultural uses (Tea Party Ship, Children's Museum). The Childrens' Museum has constructed a barge in the channel to conduct an urban ecology program. Other major land uses include a large Post Office facility, an MBTA train maintenance facility, and large parking areas. The upstream end of the channel is bordered by a major highway interchange. The channel itself is lined with granite, with five low bridges over it, limiting upstream access to small boats.

Seven untreated CSOs are tributary to the Fort Point Channel. The large CSO at the head of the channel (BOS070) is the terminus of the Roxbury Canal and Dorchester Brook Conduits, which drain a large combined sewer tributary area. BOS070 is the largest untreated CSO and it dominates the impacts of CSOs in this receiving water segment. Overflows from the Union Park Pump Station are the predominant source of CSOs to BOS070, as the overflows to the Dorchester Brook Conduit are relatively small in comparison. Figure 7-2 presents the total pollutant load and the relative contributions to the load from CSO and stormwater for pollutants causing non-attainment of designated uses in Fort Point Channel. As indicated in Figure 7-2, no upstream or boundary sources were identified for this receiving water segment. CSOs are the predominant source of fecal coliform bacteria for both the 1-year storm. CSOs also contribute the majority of the BOD and nutrient loads for the 1-year storm and annually. Additional data on pollutant loads from CSO and stormwater sources are presented in Appendix F.

Description of CSO Alternatives

The CSO control alternatives evaluated in detail for this receiving water segment are summarized in Table 7-13, along with the water quality benefits as compared with future planned conditions, critical siting issues, and costs. Brief descriptions of the alternatives are presented below, and additional details on the recommended plan are presented in Chapter Eight.

Screening for BOS062 through BOS068; Detention/Treatment of the Union Park Pump Station Overflows; In-line Storage in the Dorchester Brook Conduit and Consolidation/Storage Conduit and Screens for BOS072 and BOS073. This alternative is the recommended plan. Manually cleaned screens would be installed in the outfall conduits for BOS062 through BOS068, which are inactive in the three-month storm. Detention and disinfection would be provided for overflows from the Union Park Pump Station. A hydraulic gate and pump out facility would be constructed near the downstream end of the Dorchester Brook Conduit, returning captured overflows to the New Boston Main Interceptor following the end of the storm. A consolidation conduit between BOS072 and BOS073 would have sufficient capacity to capture 3-month storm overflow volumes. Screens would provide a measure of solids control for flows greater than the three-month storm. A pump out station would be provided to return stored volumes to the South Boston Interceptor North Branch.

TABLE 7-13. COMPARISON OF RECOMMENDED PLAN AND OTHER CONTROL ALTERNATIVES FOR FORT POINT CHANNEL

Evaluation Criteria	Future Planned Conditions	FPC2 **Recommended Plan** Deten./Treat. UPPS; In-line Storage, DBC; Consol./Stor. BOS072-073; Screen BOS062-068	FPC1 Complete Sewer Separation	FPC3 Screen/Disinf. UPPS; In-line Storage, DBC; Scr./Disinf. BOS072-073; Screen BOS062-068	FPC4 In-Receiving Water Controls BOS070; Screen BOS072-073 Screen BOS062-068	FPC5 3-MO storage at UPPS; In-line Storage, DBC; Consol./Stor. BOS072-073; Screens at 5 locations
Water Quality Benefit (1)						
• Swimming (Bacteria Std. Exceedance, hrs.)	40	26	24	24	40	–
• Boating (Bacteria Std. Exceedance, hrs.)	20	0	0	0	20	–
• Aesthetics (Untreated CSO vol., MG)	27.8	1.4	0	0.2	27.8	1.4
• Aquatic Life (Dissolved Oxygen – BOD Load, lbs.) (Solids Load, lbs.)	24,200 44,200	20,500 36,400	22,500 43,200	22,200 39,300	24,200 42,600	15,100 25,100
• Performance (Untreated Overflows, no./yr.) (Closure of CSOs)	40 –	1-2 0	0 7	4-7 0	40 0	1-2 0
Critical Siting Concerns		Impacts on parking and housing adjacent to UPPS	Local street closings during construction	Impacts on parking and housing adjacent to UPPS	Aesthetic impact from receiving water controls	Impacts on parking and housing adjacent to UPPS
Capital Cost (millions)		$26.2	$249.8	$13.7	$2.5	$49.4
Annual O & M Cost		$916,000	$0	$700,000	$350,000	$916,000
Present Worth (millions)		$30.6	$200.8	$20.4	$5.6	$50.6

1. The following notes apply to the measures of water quality benefit:
   a. Bacteria standard exceedance hours, untreated CSO volume, and solids loads are derived based on a 1-year storm event.
   b. The bacteria standards applied are for fecal coliform, as follows: boating, 1000/100ml; swimming 200/100ml.
   c. The duration of the simulation period for in-receiving water modeling was 99.4 hours; predicted duration of violations at mouth of Fort Point Channel.
   d. Solids load is from stormwater, CSO, and upstream boundary, if applicable.
   e. The number of untreated overflows per year is based on expected performance in a typical rainfall year.
   f. The closure of CSOs represents the number of CSO outfalls that could be permanently closed.

Complete Sewer Separation. This alternative would involve separation of combined areas tributary to the New Boston Main Interceptor and the South Boston Interceptor/North Branch. It should be noted that the Union Park Pump Station was constructed to alleviate flooding during rain storms. Stormwater must be pumped to the Fort Point Channel during high tide.

Screening for BOS062 through BOS068; Screening and Disinfection of the Union Park Pump Station Overflows; In-line Storage in the Dorchester Brook Conduit, Screening and Disinfection for BOS072 and BOS073. This alternative would involve installing manually cleaned screens in the outfall conduits for BOS062 through BOS068. The screens would remove large objects from the overflows before being discharged to the Fort Point Channel. Screening and disinfection would be provided for overflows from the Union Park Pump Station. The Dorchester Brook Conduit would be modified to provide in-line storage, as described in the recommended plan. Screening and disinfection facilities would be constructed in the vicinities of BOS072 and BOS073. These facilities would provide flow through treatment for overflows at these outfalls.

Screening for BOS062 through BOS068, BOS072 and BOS073 and In-Receiving Water Controls for BOS070. This alternative would involve the installation of manually-cleaned bar racks at BOS062 through BOS068, BOS072 and BOS073, and devices to control floatables in the Fort Point Channel near the BOS070 outfall. The in-receiving water controls at BOS070 would involve floating booms, trash nets, or similar technologies designed to retain or collect floatables.

Screening for BOS062 through BOS068; Storage of the Union Park Pump Station Overflows (3-Month Storm); In-Line Storage in the Dorchester Brook Conduit; and Consolidation/Storage Conduit and Screens for BOS072 and BOS073. This alternative would be similar to the recommended plan, except that the storage facility for the overflows from the Union Part Pump Station would be sized to capture the volume from the three-month storm.

DEEP TUNNEL ALTERNATIVES

In addition to the receiving water segment-specific alternatives described above, one regional and two area-wide alternatives involving deep-rock tunneling technology were carried forward in the evaluation process. Features of each of the tunnel alternatives are summarized in Table 7-14, and layouts of the tunnels are presented in Figures 7-10 to 7-12.

TABLE 7-14. DESCRIPTION OF CSO TUNNEL ALTERNATIVES(1)

Description	3-Month	1-Year	1-Year Charles
Tunnel Diameter, Ft.	10	19	20
Tunnel Length, Ft.	74,000	74,000	18,000
Tunnel Volume, MG	41	155	40
Consolidation Conduit Volume, MG	20	28	7
Total Volume, MG	61	183	47
Pump-out Station Capacity, MGD	15N(2) 15S(2)	50N 50S	25
Active CSOs Not Controlled (Within Tunnel Alternative Coverage)	SOM007A(3) MWR207	SOM007	MWR010 MWR018 to MWR022

Notes:
1. Refer to Figures 7-10 to 7-12, which illustrate these alternatives.
2. N = North and S = South, refer to Figures.
3. By providing tunnel control at MWR205 (outfall from Somerville Marginal CSO Facility), discharges will not occur at SOM007A.

The layouts of the area-wide alternatives providing control of the three-month and one-year storms were based on the layout of the recommended plan from the 1990 CSO Facilities Plan. Essentially, CSOs in the Inner Harbor, Lower Charles River, and Dorchester Bay

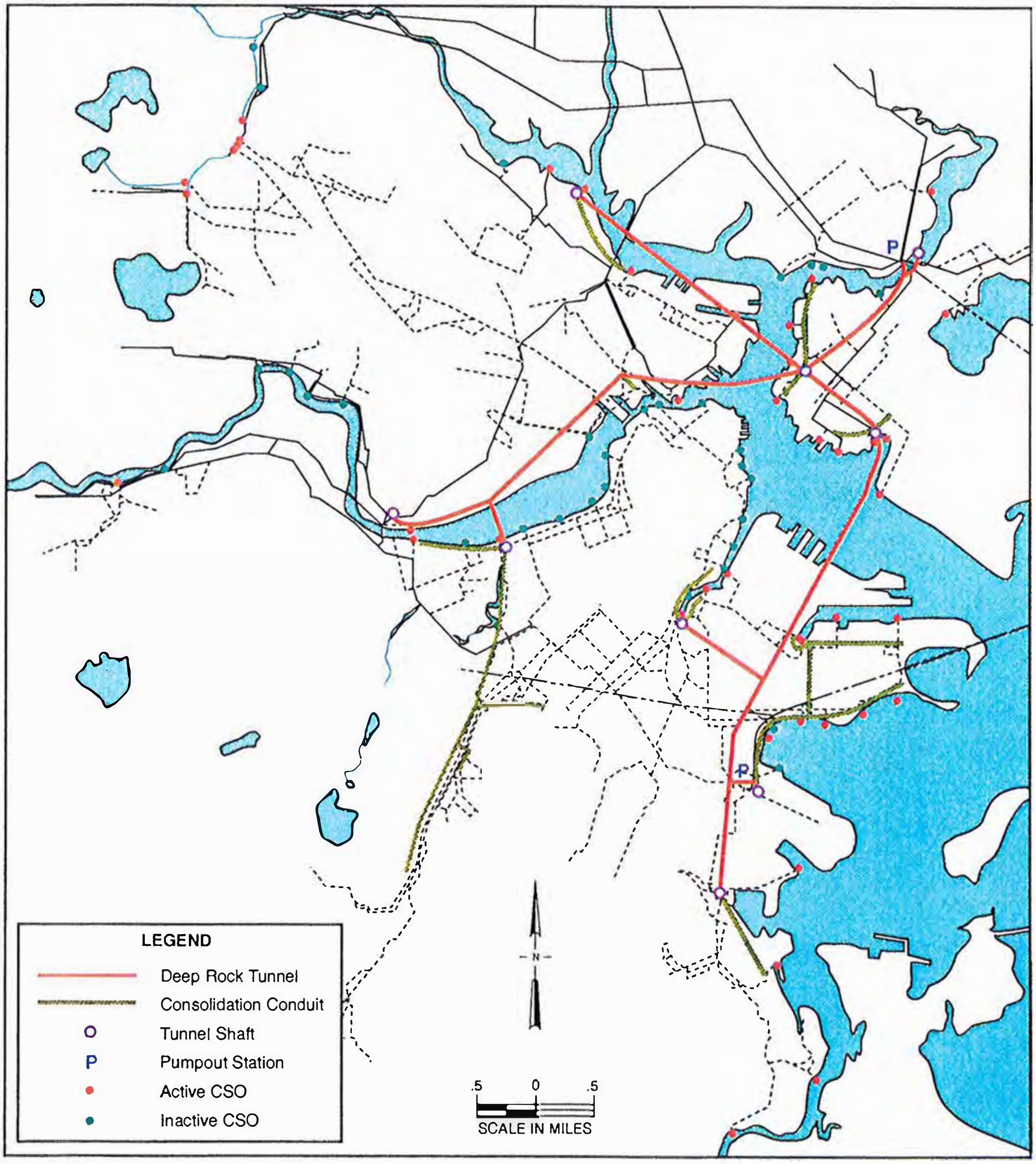


FIGURE 7-10. CSO TUNNEL PLAN FOR 3-MONTH STORM

3a mo/3852jl/138WW

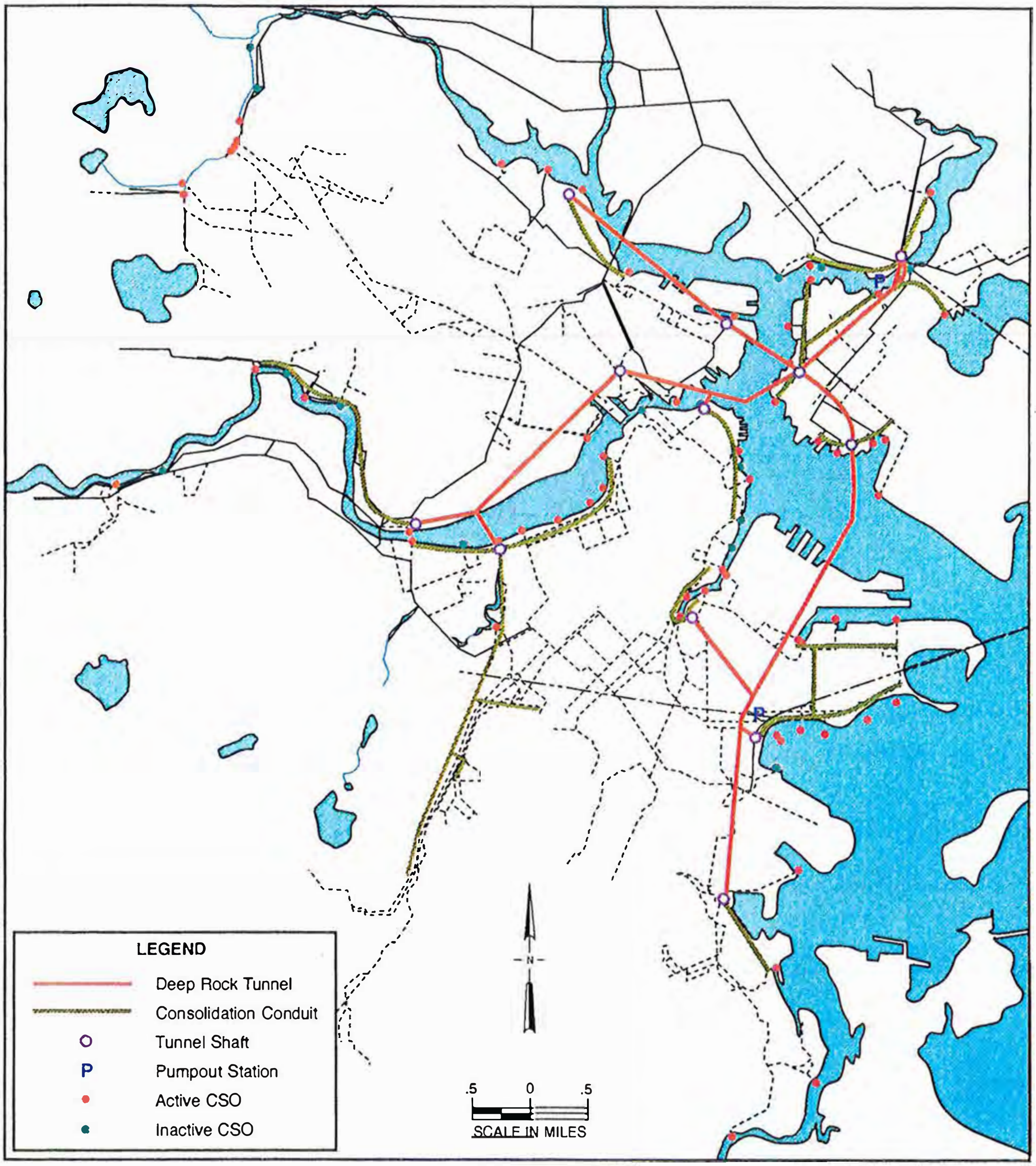


FIGURE 7-11. CSO TUNNEL PLAN FOR 1-YEAR STORM

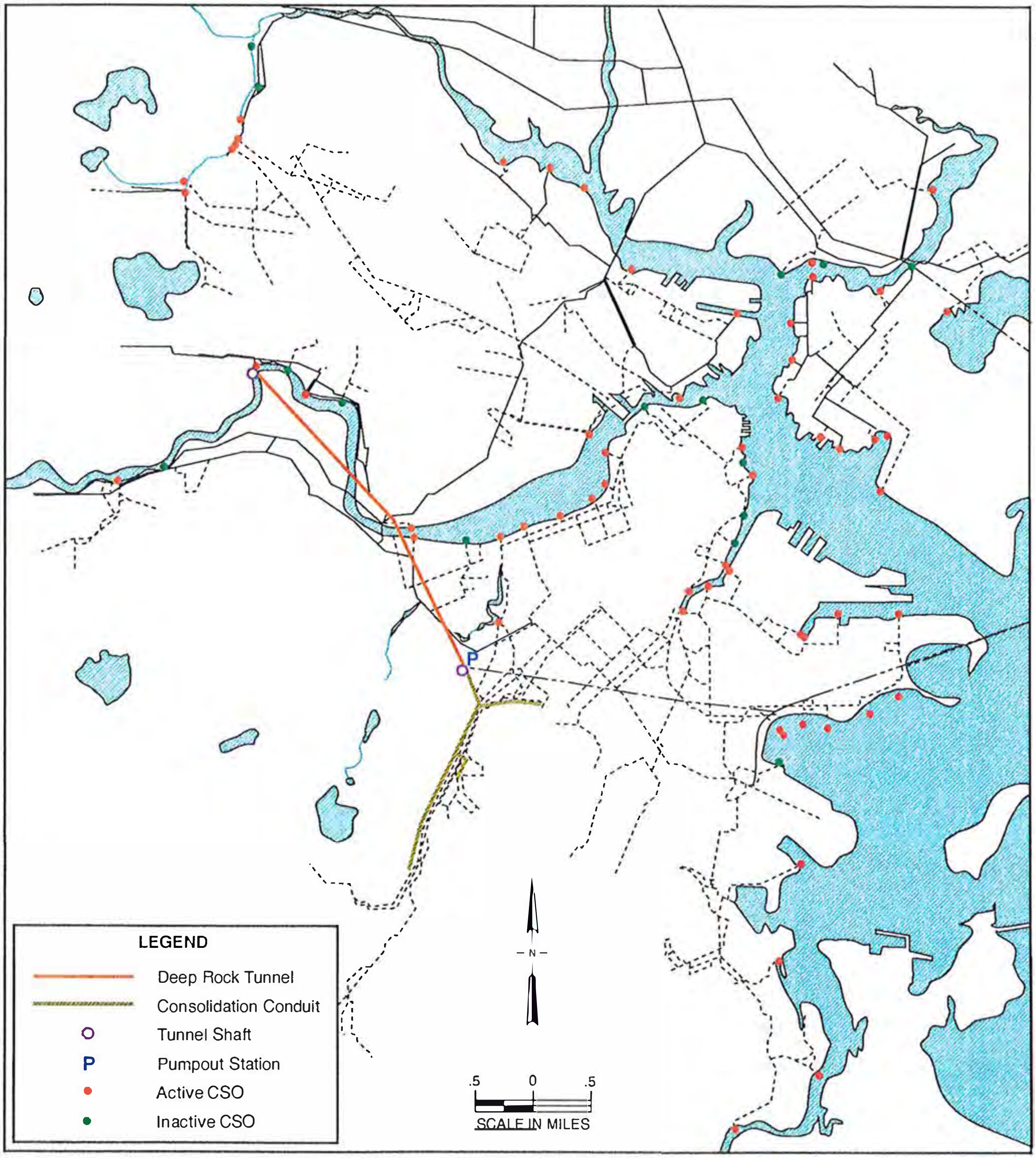


FIGURE 7-12. CSO TUNNEL PLAN FOR CHARLES RIVER, 1-YEAR STORM

1a yr/3852i/1 38WW

would be controlled by deep tunnel alternatives, while CSOs in the Alewife Brook, Upper Charles, and Neponset River would be controlled locally by near-surface alternatives. If upstream CSOs within the areas to be controlled by a tunnel had zero or very low CSO volume at the design condition, the tunnel and/or consolidation conduits would not be extended upstream to those CSOs, and local CSO controls would be applied. Other assumptions used in developing the tunnel alternatives are detailed in the MWRA's June, 1994 report titled "Alternatives for CSO Control."

Table 7-15 summarizes the comparison of the tunnel alternatives against the recommended alternative for each receiving water segment. For areas not addressed by the area-wide tunnels, it is assumed that a similar level of control would be provided by local alternatives. For the areas not addressed by the Charles River Tunnel, it is assumed that the recommended receiving water-specific alternative would be implemented. The capital costs for the tunnel and non-tunnel areas are presented in Table 7-15, along with a comparison of the relative impacts on water quality.

As indicated in Table 7-15, the area-wide tunnel alternatives would provide a lower level of control in the critical use areas of Dorchester Bay and Constitution Beach, and would generally provide a higher level of control in the other receiving waters with the exception of Alewife Brook. As indicated in the series of tables comparing water quality impacts of alternatives by receiving water segment presented earlier in this section, however, it is apparent that providing a higher level of CSO control in non-critical use areas does not result in substantial improvements in water quality.

Given that the substantial additional costs of the tunnel alternatives did not provide significant improvements in water quality over the receiving water specific recommended alternatives, and in fact provided a lower level of control in critical use areas, none of the tunnel alternatives were recommended for implementation.

TABLE 7-15. COMPARISON OF CAPITAL COST AND PERFORMANCE OF TUNNEL ALTERNATIVES WITH RECOMMENDED PLAN

Receiving Water Segment	Area-Wide Tunnel, 3-Month		Area-Wide Tunnel, 1-Year		Charles River Tunnel 1-Year		Recommended Plan
North Dorchester Bay	--		--		0	$86	$86
South Dorchester Bay	--		--		0	$95	$95
Neponset River	--	$2	--	$15	0	$11	$11
Constitution Beach	--	$1	--	$6	0	$9	$9
Upper Charles	+	$1	+	$9	+		$5
Lower Charles	+		+		+		$32
Back Bay Fens	+		+		+		$0
Alewife Brook	0	$12	0	$32	0	$12	$12
Upper Mystic	0		+		0	$0	$0
Upper Inner Harbor	+		+		0	$23	$23
Lower Inner Harbor	+		+		0	$20	$20
Mystic/Chelsea(1)	+	$2	+	$2	0	$12	$12
Reserved Channel	+		+		0	$35	$35
Fort Point Channel	+		+		0	$26	$26
Cost for Tunnel, only	$991		$1,251		$388		$0
TOTAL COST	$1,009		$1,315		$723(2)		$372(2)

Key:

[shaded box] = Area is addressed by tunnel.
-- = Tunnel plan provides lower level of control than recommended plan.
0 = Tunnel plan provides same level of control as recommended plan.
\+ = Tunnel plan provides higher level of control than recommended plan.
$X = Cost in $ million for local control alternative for area not addressed by tunnel.

Note (1) Interceptor relief at Chelsea outfalls CHE002 to CHE004, at a cost of $2 million, is required in addition to tunnel.

(2) Values include an estimated $6 million for facilities planning.

The tunnel alternatives were, however, also evaluated as potential means for providing equalization of flows to the Deer Island WWTP. Under this concept, also known as "peak shaving", additional storage capacity would be provided in the tunnels, such that flows to Deer Island above a given design peak would be diverted into the tunnels. If the design peak were set at the capacity of two batteries of secondary treatment, then it would be possible to eliminate the third battery. In evaluating the peak shaving alternative, the cost to provide sufficient additional tunnel storage and pump-out capacity to allow the elimination of the third battery of secondary treatment was found to be approximately $200 million greater than the cost to provide the third battery. Since peak shaving was clearly not cost effective, it was not evaluated further.

PART II
CHAPTER EIGHT
SUMMARY OF THE RECOMMENDED PLAN

This chapter presents descriptions of the recommended CSO control alternatives for each receiving water segment. Included in the descriptions are details on water quality impacts, siting issues, cost, and requirements for partial use designation, if appropriate. These alternatives were selected based on the evaluation process presented in Chapter Six, including a public comment and review period for the alternatives presented in the September, 1994 Draft CCP/SMP. Following submittal of the draft report, the recommended alternatives were presented to the public in a series of community meetings. Based on comments from the public, as well as from regulatory agencies and other interested parties, certain alternatives recommended in the draft report were modified or replaced with other alternatives, as described below. In general, the combination of receiving water-specific alternatives presented below provides varying levels of control cost-effectively matched to the current status of use attainment and sources of non-attainment within the receiving water segments, with an emphasis on protection of critical uses from CSO-related degradation.

WATER QUALITY BENEFITS

In reviewing the water quality benefits of the recommended plan, it must be remembered that the CSO control alternatives described in this report represent only part of the MWRA's on-going CSO control program. Since 1988, the MWRA has already invested over $200 million in CSO-related system improvements. These improvements, which included increasing the transport capacity to Deer Island, rehabilitating existing CSO control facilities, and building three new CSO screening and disinfection facilities, have already resulted in a 55-percent reduction in annual overflow volume since 1988. Currently, 50-percent of remaining annual overflow volumes receive at least screening and disinfection treatment. As on-going system optimization plans and other improvements to Deer Island are completed, by 1997 the annual CSO volume will have been reduced by 70 percent as compared to 1988 conditions, with approximately 60 percent of the volume receiving at least screening and disinfection. With implementation of the recommended CSO control alternatives, the reduction in annual overflow volume versus 1988 conditions will be almost 85 percent, with approximately 95 percent of remaining overflow volume receiving at least screening and disinfection.

A comparison of the impact of the recommended plan on annual activation frequencies and volumes for treated and untreated discharges is presented in Table 8-1. As indicated in this table, the recommended plan is predicted to reduce annual untreated overflow volumes by approximately 95 percent, while treated overflow volumes will increase by approximately 15 percent. Substantial reductions will also be achieved in annual activation frequencies. Table 8-2 presents a comparison of the overflow volumes for the three-month and one-year storms for future planned conditions and the recommended plan. For the three-month storm, untreated overflow volume is reduced by almost 100 percent, while treated overflow volumes increase by 20 percent. For the one-year storm, the untreated overflow reduction is 89 percent, while treated overflow volumes will increase by 42 percent. Additional receiving water modeling data is presented in the discussion of water quality impacts of the recommended alternative for each receiving water segment, below. The recommended plan is summarized by receiving water segment in Table 8-3, and by outfall in Table 8-4.

CONSIDERATIONS FOR PARTIAL USE DESIGNATIONS

As discussed in Chapter Two, both the national and the state CSO policies acknowledge that in certain cases it may be appropriate to modify water quality standards to allow for "partial use" designations in CSO-impacted waters. The national policy requires that DEP, the state authority for establishing and enforcing water quality standards, be actively involved in long-term CSO control planning and determine whether revisions to water quality standards are appropriate. Since CSOs will continue to be discharged after implementation of the recommended plan, information must be provided that justifies the need for a partial use designation in any receiving water segment that will continue to receive CSO discharges under the recommended plan.

TABLE 8-1. CSO VOLUMES AND ACTIVATIONS FOR TYPICALIZED YEAR

OUTFALL	FUTURE PLANNED CONDITION				RECOMMENDED PLAN			
	CSO VOLUME (MG)		ACTIVATION FREQUENCY		CSO VOLUME (MG)		ACTIVATION FREQUENCY	
	TREATED	UNTREATED	TREATED	UNTREATED	TREATED	UNTREATED	TREATED	UNTREATED
ALEWIFE BROOK								
CAM 001		0.19		7		0.08		3
CAM 002		3.26		11		0.09		1
CAM 003		1.48		7		0.55		3
CAM 004		9.10		16		0.17		2
CAM 400		0.47		7		0.21		4
CAM 401		0.01		4		0.00		2
SOM 001		0.40		7	plugged (1)		NA	
SOM 001A		3.36		7		1.74		3
SOM 002A	plugged (2)		NA		plugged (2)		NA	
SOM 003	plugged (2)		NA		plugged (2)		NA	
SOM 004		0.03		11		0.02		2
TOTAL		18.30				2.86		
UPPER MYSTIC RIVER								
SOM 007		0.04		2	plugged (1)		NA	
SOM 007A	6.72		11		6.94		8	
TOTAL	6.72	0.04			6.94	0.00		
MYSTIC / CHELSEA CONFLUENCE								
MWR 205 (Somerville Margi	99.95		32		88.76		31	
BOS 013		4.38		35		0.24		3
BOS 014		1.47		8		1.02		6
BOS 015	plugged (2)		NA		plugged (2)		NA	
BOS 017		2.53		18	2.15		15	
CHE 002		0.04		2		0.05		2
CHE 003		0.35		8		0.06		1
CHE 004		0.27		2		0.32		3
CHE 008		8.32		8		0.42		2
TOTAL	99.95	17.36			90.91	2.11		
UPPER INNER HARBOR								
BOS 009		3.94		34		0.53		5
BOS 010		8.34		35		1.34		5
BOS 012		6.65		36		0.49		5
BOS 019		3.61		18	3.31		14	
BOS 050		0.00		1		0.04		1
BOS 052	plugged (3)		NA		plugged (3)		NA	
BOS 057		0.38		5		0.54		1
BOS 058	plugged (3)		NA		plugged (3)		NA	
BOS 060		2.53		4		1.21		2
MWR 203 (Prison Point)	196.68		21		236.32		25	
TOTAL	196.68	25.45			239.63	3.61		
LOWER INNER HARBOR								
BOS 003		3.20		13		4.41		5
BOS 004		4.17		23		0.20		2
BOS 005		0.06		4		0.00		0
BOS 006		1.18		14		0.05		1
BOS 007		4.26		29		0.27		5
TOTAL		12.87				4.93		
CONSTITUTION BEACH								
MWR 207	1.35		16		plugged (1)		NA	
TOTAL	1.35	0.00						
FORT POINT CHANNEL								
BOS 062		0.00		0		0.23		1
BOS 064		0.04		5		0.02		2
BOS 065		0.15		1		0.08		1
BOS 068		0.00		0		1.72		4
BOS 070		160.05		74	74.64		15	
BOS 072 & BOS 073		7.44		23		1.68		2
TOTAL		167.68			74.64	3.73		
RESERVED CHANNEL								
BOS 076 to BOS 080		66.53		44	12.34 (4)		6 (4)	
TOTAL		66.53			12.34			
NORTHERN DORCHESTER BAY								
BOS 081 to BOS 087		9.03		78	0.00 (4)		0 (4)	
TOTAL		9.03			0.00			

TABLE 8-1. CSO VOLUMES AND ACTIVATIONS FOR TYPICALIZED YEAR

OUTFALL	FUTURE PLANNED CONDITION				RECOMMENDED PLAN			
	CSO VOLUME (MG)		ACTIVATION FREQUENCY		CSO VOLUME (MG)		ACTIVATION FREQUENCY	
	TREATED	UNTREATED	TREATED	UNTREATED	TREATED	UNTREATED	TREATED	UNTREATED
SOUTHERN DORCHESTER BAY								
BOS 088		0.01		1		0.00		0
BOS 089 (5)	34.97		22			0.00		0
BOS 090 (5)	5.34		14			0.00		0
TOTAL	40.31	0.01			0.00	0.00		
UPPER CHARLES								
BOS 032		1.92		10		0.02		4
BOS 033		0.07		5		0.06		3
CAM 005		3.77		11	3.30		10	
CAM 007		0.78		1		0.00		0
CAM 009		0.13		12		0.01		1
CAM 011		0.07		1		0.00		0
TOTAL		6.74			3.30	0.09		
LOWER CHARLES								
BOS 028		0.02		6		0.00		0
BOS 042		0.00		0	plugged (1)		NA	
BOS 049		0.00		0		0.01		1
CAM 017		4.79		6		1.35		2
MWR 010		0.00		0	plugged (1)		NA	
MWR 018		2.25		2		1.20		2
MWR 019		1.00		2		0.43		3
MWR 020		0.53		3		0.18		2
MWR 021		0.42		2		0.14		2
MWR 022		0.37		2		0.11		2
MWR 201 (Cottage Farm)	127.99		22		66.57		18	
MWR023 (6)		76.31		30	41.16		26	
SOM 010		0.12		1		0.01		1
TOTAL	127.99	85.81			107.73	3.43		
NEPONSET RIVER								
BOS 093		1.21		11	plugged (1)		NA	
BOS 095		4.58		17	plugged (1)		NA	
TOTAL		5.79						
BACK BAY FENS								
BOS046 (7)		4.91		2	6.13		2	
TOTAL		4.91			6.13			
GRAND TOTAL	473.00	420.52			541.62	20.76		

Notes:
(1) Regulators tributary to outfall will be plugged as part of recommended plan; outfall will remain for stormwater.
(2) Regulators tributary to outfall will be plugged as part of SOPs; outfall will remain for stormwater.
(3) CSO outfalls to be eliminated as part of CA/T changes.
(4) Volumes and frequencies reflect discharge from consolidation conduit. No overflows predicted at individual outfalls.
(5) Volumes and frequencies reflect regulator activations upstream of existing CSO facilities.
When separation is complete in Dorchester, the BOS088 and BOS090 regulators will be plugged.
(6) Volumes and frequencies reflect regulator activations into Stony Brook Conduit.
(7) Volumes reflect stormwater and CSO from Stony Brook Conduit overtopping weir at BWSC Gatehouse No. 1.

TABLE 8-2. CSO VOLUMES FOR 3 MONTH AND 1 YEAR DESIGN STORMS

OUTFALL	FUTURE PLANNED CONDITION				RECOMMENDED PLAN			
	3 MONTH STORM (1) CSO VOLUME (MG)		1 YEAR STORM (1) CSO VOLUME (MG)		3 MONTH STORM (1) CSO VOLUME (MG)		1 YEAR STORM (1) CSO VOLUME (MG)	
	TREATED	UNTREATED	TREATED	UNTREATED	TREATED	UNTREATED	TREATED	UNTREATED
ALEWIFE BROOK								
CAM 001		0.00		0.05		0.00		0.12
CAM 002		0.14		0.88		0.00		0.10
CAM 003		0.05		0.51		0.00		0.49
CAM 004		0.70		2.41		0.00		0.19
CAM 400		0.05		0.13		0.00		0.12
CAM 401		0.00		1.01		0.00		0.03
SOM 001		0.02		0.00	plugged (2)		plugged (2)	
SOM 001A		0.00		0.00		0.00		0.18
SOM 002A	plugged (3)		plugged (3)		plugged (3)		plugged (3)	
SOM 003	plugged (3)		plugged (3)		plugged (3)		plugged (3)	
SOM 004		0.00		0.01		0.00		0.01
TOTAL		0.96		5.14		0.00		1.34
UPPER MYSTIC RIVER								
SOM 007		0.00		0.01	plugged (2)		plugged (2)	
SOM 007A	0.00		0.00		0.00		0.00	
TOTAL	0.00	0.00	0.00	0.01	0.00		0.00	
MYSTIC / CHELSEA CONFLUENCE								
MWR 205 (Somerville Marg.)	4.82		10.79		4.78		10.32	
BOS 013		0.22		0.71		0.00		0.04
BOS 014		0.00		0.57		0.00		0.31
BOS 015	plugged (3)		plugged (3)		plugged (3)		plugged (3)	
BOS 017		0.14		0.53	0.13		0.52	
CHE 002		0.00		0.00		0.00		0.00
CHE 003		0.00		0.13		0.00		0.00
CHE 004		0.00		0.00		0.00		0.01
CHE 008		0.20		2.61		0.00		0.00
TOTAL	4.82	0.55	10.79	4.55	4.92	0.00	10.84	0.36
UPPER INNER HARBOR								
BOS 009		0.18		0.56		0.00		0.19
BOS 010		0.46		1.69		0.00		0.73
BOS 012		0.38		0.82		0.00		0.22
BOS 019		0.21		0.79	0.22		0.79	
BOS 050		0.00		0.00		0.00		0.00
BOS 052	plugged (4)		plugged (4)		plugged (4)		plugged (4)	
BOS 057		0.00		0.00		0.01		0.00
BOS 058	plugged (4)		plugged (4)		plugged (4)		plugged (4)	
BOS 060		0.00		1.24		0.00		1.35
MWR 203 (Prison Point)	14.11		35.79		16.21		43.28	
TOTAL	14.11	1.24	35.79	5.10	16.43	0.01	44.07	2.49
LOWER INNER HARBOR								
BOS 003		0.25		3.14		0.00		2.08
BOS 004		0.21		0.73		0.00		0.05
BOS 005		0.00		0.01		0.00		0.00
BOS 006		0.04		0.25		0.00		0.00
BOS 007		0.29		0.70		0.00		0.23
TOTAL		0.79		4.82		0.00		2.36
CONSTITUTION BEACH								
MWR 207	0.04		0.40		plugged (2)		plugged (2)	
TOTAL	0.04		0.40					
FORT POINT CHANNEL								
BOS 062		0.00		0.00		0.00		0.00
BOS 064		0.00		0.00		0.00		0.00
BOS 065		0.00		0.00		0.00		0.00
BOS 068		0.00		0.00		0.00		0.00
BOS 070		8.70		26.01	6.70		24.21	
BOS 072 & BOS 073		0.42		1.74		0.00		1.42
TOTAL		9.13		27.75	6.70	0.00	24.21	1.42
RESERVED CHANNEL								
BOS 076 to BOS 080		3.65		8.58	0.76 (5)		4.94 (5)	
TOTAL		3.65		8.58	0.76		4.94	
NORTHERN DORCHESTER BAY								
BOS 081 to BOS 087		0.35		2.20	0.00 (5)		0.00 (5)	
TOTAL		0.35		2.20	0.00		0.00	

TABLE 8-2. CSO VOLUMES FOR 3 MONTH AND 1 YEAR DESIGN STORMS

OUTFALL	FUTURE PLANNED CONDITION				RECOMMENDED PLAN			
	3 MONTH STORM (1) CSO VOLUME (MG)		1 YEAR STORM (1) CSO VOLUME (MG)		3 MONTH STORM (1) CSO VOLUME (MG)		1 YEAR STORM (1) CSO VOLUME (MG)	
	TREATED	UNTREATED	TREATED	UNTREATED	TREATED	UNTREATED	TREATED	UNTREATED
SOUTHERN DORCHESTER BAY								
BOS 088		0.00		0.00		0.00		0.00
BOS 089 (6)	1.31		6.26			0.00		0.00
BOS 090 (6)	0.08		1.18			0.00		0.00
TOTAL	1.39	0.00	7.44	0.00		0.00		0.00
UPPER CHARLES								
BOS 032		0.02		0.54		0.00		0.00
BOS 033		0.00		0.00		0.00		0.00
CAM 005		0.00		1.12	0.00		0.64	
CAM 007		0.00		0.00		0.00		0.00
CAM 009		0.00		0.01		0.00		0.00
CAM 011		0.00		0.00		0.00		0.00
TOTAL		0.02		1.67	0.00	0.00	0.64	0.00
LOWER CHARLES								
BOS 028		0.00		0.00		0.00		0.00
BOS 042		0.00		0.00	plugged (2)		plugged (2)	
BOS 049		0.00		0.00		0.00		0.00
CAM 017		0.00		2.06		0.00		0.21
MWR 010		0.01		0.03	plugged (2)		plugged (2)	
MWR 018		0.00		1.51		0.00		0.94
MWR 019		0.00		0.66		0.00		0.26
MWR 020		0.00		0.32		0.00		0.07
MWR 021		0.00		0.22		0.00		0.00
MWR 022		0.00		0.16		0.00		0.00
MWR 201 (Cottage Farm)	9.61		26.19		4.20		18.55	
MWR023 (7)		3.70		14.91	2.83		11.50	
SOM 010		0.00		0.00		0.00		0.00
TOTAL	9.61	3.71	26.19	19.87	7.03	0.00	30.05	1.48
NEPONSET RIVER								
BOS 093		0.05		0.30	plugged (2)		plugged (2)	
BOS 095		0.01		0.88	plugged (2)		plugged (2)	
TOTAL		0.06		1.18				
BACK BAY FENS								
BOS046 (8)		0.00		3.17	0.00		0.00	
TOTAL		0.00		3.17	0.00		0.00	
GRAND TOTAL	29.97	20.46	80.61	84.04	35.84	0.01	114.75	9.45

Notes:

(1) Volumes for storm with peak at low tide.

(2) Regulators tributary to outfall will be plugged as part of recommended plan; outfall will remain for stormwater.

(3) Regulators tributary to outfall will be plugged as part of SOPs; outfall will remain for stormwater.

(4) CSO outfalls to be eliminated as part of CA/T changes.

(5) Volumes reflect discharge from consolidation conduit. No overflows predicted at individual outfalls.

(6) Volumes reflect regulator activations upstream of existing CSO facilities.
When separation is complete in Dorchester, the BOS088 and BOS090 regulators will be plugged.

(7) Volumes reflect regulator activations into Stony Brook Conduit.

(8) Volumes reflect stormwater and CSO from Stony Brook Conduit overtopping weir at BWSC Gatehouse No. 1.

TABLE 8-3. RECOMMENDED CONCEPTUAL CSO CONTROL PLAN

Critical Uses in Parentheses

Basins	Level of Control	Recommended Plan	Annual CSO Activation Frequency(1): Fut. Planned Conds. Total	Annual CSO Activation Frequency(1): Fut. Planned Conds. Untreated	Annual CSO Activation Frequency(1): Recommended Plan Total	Annual CSO Activation Frequency(1): Recommended Plan Untreated	Reasons/Comments	Capital Cost (million $) (2)
Dorchester Bay								
N. Dorchester Bay (Swimming/Shellfishing)	I	CSO relocation to Reserved Channel	78	78	0	0	1. Eliminates CSOs to North Dorchester Bay; potential for SA designation 2. Relocated flow to Reserved Channel to receive screening and disinfection	$86
S. Dorchester Bay (Swimming/Shellfishing)	I	Sewer separation	22	1	0	0	1. Eliminates CSOs; potential for SA designation 2. Interim upgrade of existing facilities 3. Potential for use of Fox and Commercial Point CSO facilities for stormwater treatment by others	$95
Neponset River (Shellfishing)	I	Sewer separation	17	17	0	0	1. Eliminates CSOs 2. Requires separation of South Dorchester area also	$11
							Subtotal — Neponset River/Dorchester Bay Subarea:	$192
Constitution Beach (Swimming/Shellfishing)	I	Sewer Separation	16	0	0	0	1. Eliminates CSOs; potential for SA designation 2. Critical use area; potential for use of CSO Facility for stormwater treatment by others.	$9
							Subtotal — Constitution Beach Subarea:	$9
Charles River								
Upper Charles River	II	Screening and disinfection at CAM005; relieve interceptor connection at BOS032; provide screens at five CSO outfalls in Boston and Cambridge.	12	12	10	4	1. High recreational uses; heavy stormwater impact on Charles River 2. Reconsider after watershed planning; separation cost of $80 million	$5
Lower Charles River – Cottage Farm	II	Upgrade of Cottage Farm CSO Facility with fine screens, effluent diffuser, upgrade chlorination, provide dechlorination	22	0	18	0	1. High recreational use; heavy stormwater impact on Charles River	$7
– Stony Brook	II	Screening and disinfection facility for Stony Brook Conduit flows	30	30	26	0	1. Heavy stormwater impacts on Charles River 2. Treats stormwater and CSO from Stony Brook basin 3. Reconsider after watershed planning with State	$24
– Other Lower Charles	II	Provide screens at nine CSO outfalls; block regulators at BOS042 and MWR010	6	6	3	3	1. Minimum control; infrequent outfall activation	$1
Back Bay Fens	II	Provide screens at outfall	2	2	2	2	1. Consistent with water quality goal	
							Subtotal — Charles River Subarea:	$37
Alewife/Upper Mystic								
Alewife Brook	II	Separate CAM002, CAM004, and SOM001; provide screens at eight CSO outfalls	16	16	4	4	1. Approximately four overflows per year; large stormwater impacts 2. Reevaluate in conjunction with watershed planning by state	$12
Upper Mystic River	II	Separation of baffle manholes at SOM006 and SOM007 Continue treatment at Somerville Marginal CSO Facility (SOM007A)	11	2	8	0	1. Large stormwater impacts 2. No WQ benefit for higher controls	$0.2
							Subtotal — Alewife/Upper Mystic Subarea	$13
Boston Harbor								
Upper Inner Harbor	II	Relieve East Boston Branch Sewer; add dechlorination to existing Prison Point CSO Facility; screen and disinfect BOS019; provide screens at seven CSO outfalls	36	36	25	5	1. Approximately four overflows per year from E.Boston; industrial/shipping water uses 2. Allows full use of Caruso Pump Station capacity 3. Large impacts from stormwater and Charles R. discharge	$23
Lower Inner Harbor	II	Relieve East Boston Branch Sewer; provide screens at five CSO outfalls	29	29	5	5	1. Approximately four overflows per year from E. Boston	$20
Mystic/Chelsea	II	Screening/disinfection at BOS017 and at relocated Somerville Marginal CSO Facility; interceptor relief for CHE002–CHE004; provide screens at five CSO outfalls; repair/replace CHE008 outfall	35	35	31	3	1. Industrial/shipping water uses and Mystic R. discharge impacts 2. Dissolved oxygen deficit near existing Som. Marginal facility outfall	$12
Reserved Channel	II	Consolidation to regional screening/disinfection facility (joint with North Dorchester Bay)	44	44	8	0	1. High commercial/industrial use 2. Receives relocated CSO from N. Dorchester Bay	$34
Fort Point Channel	II	Detention treatment facility at Union Park P.S.; Consolidation storage at 072/073; screens at six CSO outfalls, three regulators, and the DBC; In-line storage in Dorchester Brook Conduit	74	74	15	4	1. Separation infeasible; aesthetics important 2. High commercial / industrial use	$26
							Subtotal — Boston Harbor Subarea:	$115
							Total – All Subareas:	$366
							Facilities Planning:	$6
							Grand Total:	$372

(1) For receiving water segments with multiple CSO outfalls, activation frequency is for the most active outfall tributary to the receiving water segment.
(2) Capital cost includes engineering, construction and contingency.

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TABLE 8-4 SUMMARY OF RECOMMENDED PLAN AT EACH CSO OUTFALL

CSO Outfall	Proposed CSO Control under Recommended Plan
BOS003	Interceptor Relief/Screen
BOS004	Interceptor Relief/Screen
BOS005	Interceptor Relief/Screen
BOS006	Interceptor Relief/Screen
BOS007	Interceptor Relief/Screen
BOS009	Interceptor Relief/Screen
BOS010	Interceptor Relief/Screen
BOS012	Interceptor Relief/Screen
BOS013	Interceptor Relief/Screen
BOS014	Screen
BOS015	Plug Regulator
BOS017	Screen & Disinfect
BOS019	Screen & Disinfect
BOS028	Screen
BOS032	Interceptor Connection Relief/Screen
BOS033	Screen
BOS042	Plug Regulators
BOS046	Screen & Disinfect
BOS049	Screen
BOS050	Screen
BOS052	Plug
BOS057	Screen
BOS058	Plug
BOS060	Screen
BOS062	Screen
BOS064	Screen
BOS065	Screen
BOS068	Screen
BOS070	Detention Treatment @ UPPS
	In-line Storage Dorch. Brook Conduit
	Screens at 3 upstream Regulators
BOS072	Storage-Consolidation Conduit/Screen
BOS073	Storage-Consolidation Conduit/Screen
BOS076	Consolidation to BOS080/Screen
BOS078	Consolidation to BOS080/Screen
BOS079	Consolidation to BOS080/Screen
BOS080	Consolidation to BOS080/Screen
	Screening/Disinfection @ BOS080
BOS081	Plug/Relocation to BOS080
BOS082	Plug/Relocation to BOS080
BOS083	Plug/Relocation to BOS080
BOS084	Plug/Relocation to BOS080
BOS085	Plug/Relocation to BOS080
BOS086	Plug/Relocation to BOS080
BOS087	Plug/Relocation to BOS080
BOS088/089	Upgrade CSO Fac. to Dechlorination
	Sewer Separation
BOS090	Upgrade CSO Fac. to Dechlorination
	Sewer Separation
BOS093	Sewer Separation
BOS095	Sewer Separation
CAM001	Screen
CAM002	Sewer Separation/Screen
CAM003	Screen
CAM004	Sewer Separation/Screen
CAM005	Screen & Disinfect
CAM007	Screen
CAM009	Screen
CAM011	Screen
CAM017	Screen
CAM400	Screen
CAM401	Screen
CHE002	Trunk Sewer Relief/Screen
CHE003	Trunk Sewer Relief/Screen
CHE004	Trunk Sewer Relief/Screen
CHE008	Outfall Repairs/Screen
MWR010	Plug Regulators
MWR018	Screen
MWR019	Screen
MWR020	Screen
MWR021	Screen
MWR022	Screen
MWR023	Screen/Disinfect Stony Brook Conduit
MWR201	Dechlorination(Upgrade Cott. Farm)
MWR203	Dechlorination(Upgrade Prison Point)
MWR205	Dechlorination (Upgrade Som. Mar.)
MWR207	Sewer Separation (Constitution Beach)
SOM001	Sewer Separation
SOM001A	Screen
SOM002A/003	Plug
SOM004	Screen
SOM006	Sewer Separation
SOM007	Sewer Separation
SOM007A	Treated at Somerville Marginal
SOM010	Screen

The technical information needed to support a partial use designation must be developed according to the procedure for establishing a long-term CSO plan described in DEP's CSO policy. Where elimination of CSOs is not feasible, the information must demonstrate that water quality impacts will be minimized to achieve the highest water quality attainable. A discussion of the information and the evaluations required to justify a partial use designation is presented in Chapter Two.

Applications for partial use designations must be made for specific receiving water segments, so that site-specific water quality conditions and technical and economic constraints of CSO control alternatives can be evaluated. Implementation of the recommended plan will require a total of ten partial use designations, including all receiving water segments except North and South Dorchester Bay, the Neponset River, and Constitution Beach.

The following segment-by-segment discussion of the recommended plan describes the information developed during the long-term CSO planning process which will support a partial use designation for the segment. Further information needed to justify modification of water quality standards will be determined through discussions with DEP and will be included with the MWRA's future petition for partial use designations. In addition, DEP will not promulgate regulations for partial use designations until the MWRA receives final MEPA certification of its CSO plan as part of the facilities planning and environmental review process. Since a partial use designation has never been requested and DEP's guidance is termed "interim", the exact procedures for completing the application process for partial use designations are not completely defined. The MWRA will work cooperatively with EPA, DEP, and MEPA to determine the scope and schedule of additional work necessary to obtain partial use designations and to expedite the evaluations requested.

DORCHESTER BAY BASIN

North Dorchester Bay

Swimming and shellfishing have been designated as critical uses for this waterbody. Consistent with the Massachusetts CSO policy regarding critical use areas, and the USEPA CSO policy regarding sensitive areas, the recommended alternative for North Dorchester Bay is to eliminate the CSOs through relocation to a less sensitive area (the Reserved Channel). A consolidation conduit sized to carry the maximum flow that could be passed through the outfalls would run parallel to Carson Beach from outfall BOS087 to BOS081, then to a screening and disinfection facility constructed near BOS080 (Figure 8-1).

The consolidation conduit for outfalls BOS081 to BOS087 would range in size from approximately 48-in. to 96-in. diameter, and would likely be installed by soft-ground tunneling. The conduit would have sufficient volume to store overflows from the one-year storm from outfalls BOS081 to BOS087. The screening and disinfection facility, located at either Conley Marine Terminal or at another industrial parcel along the waterfront, would have pumping facilities to discharge screened and disinfected flows to the mouth of the Reserved Channel, as well as to dewater the conduit to the SBI South Branch. This facility would also serve the consolidation conduit collecting CSOs located along the Reserved Channel. Once the new facilities are in place, outfalls BOS081 through BOS087 would be bulkheaded. The impacts of this alternative on water quality in the Reserved Channel appear to be relatively minor, as the recommended water quality goals for that receiving water segment are achievable with the recommended plan (see discussion of Reserved Channel below).

Water Quality Impacts. Relief of the SBI South Branch with optimization at BOS081 and BOS082 was the initially-preferred alternative for this receiving water segment, based on cost effective analysis (refer to cost/benefit curves in Appendix G). This alternative would control overflows from the one-year storm, but would not allow elimination of the CSO

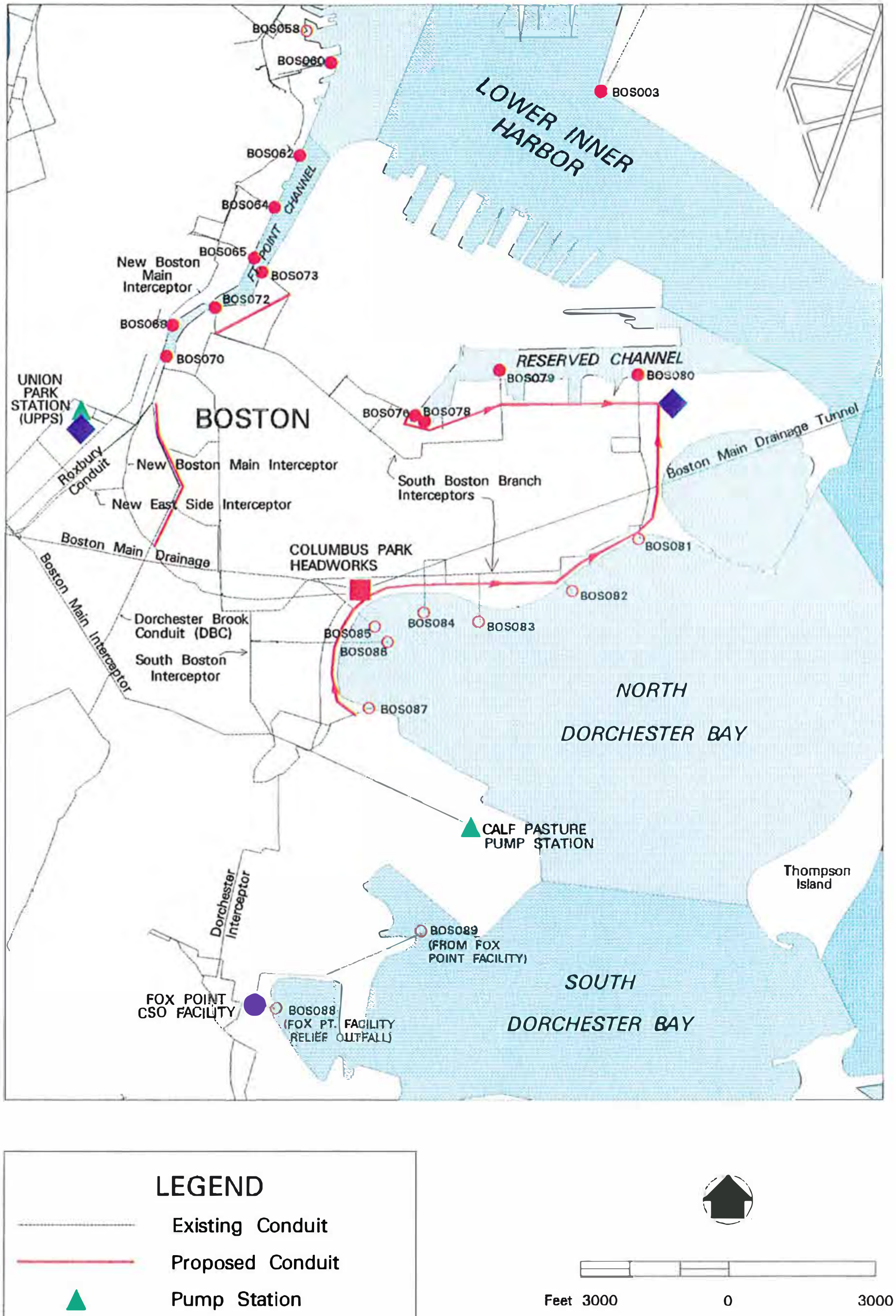

Figure 8-1
Reserved Channel
Fort Point Channel
North Dorchester Bay
Recommended Plan

outfalls to North Dorchester Bay, since these outfalls could still activate during larger storms. Since swimming and shellfishing have been designated as critical uses in this receiving water segment, the need to support Level I control goals was determined to take precedence over strictly cost-effective considerations, and an alternative which would eliminate CSOs to North Dorchester Bay was selected.

CSO relocation was preferred over sewer separation because the cost was about the same, and sewer separation would introduce additional stormwater to the receiving water (9 and 14 MG for the three-month and one-year storms, respectively). With the elimination of the CSOs, the major remaining source of pollutants causing non-attainment of uses in this receiving water segment would be stormwater. Figure 8-2 presents the predicted durations of violations of fecal coliform bacteria standards for restricted shellfishing, swimming, and boating (88, 200, and 1000 counts/100 ml, respectively) at Carson Beach for the three-month storm. Figure 8-3 presents the in-receiving water fecal coliform density at Carson Beach eight hours after the peak of the three-month storm. The relative contributions of CSO and stormwater to the coliform density are indicated by the different colors. As noted in Chapter Six, the total duration of the in-receiving water model run was 99 hours, starting six hours before the start of the storm. Figures 8-4 and 8-5 show the same type of information for the one-year storm. The locations of data points for the in-receiving water model are indicated on Figure 8-6.

As indicated in Figure 8-2, CSO relocation to the Reserved Channel eliminates violations of the swimming standard at Carson Beach during the three-month storm, while Figure 8-3 suggests that stormwater is responsible for the continued violation of the restricted shellfishing standard. The boating standard is not violated during the three-month storm, even under future planned conditions. Referring to Figure 8-4, the boating standard is violated briefly during the one-year storm under future planned conditions, while CSO relocation does not completely eliminate violations of the swimming standard. Comparing the future planned condition fecal coliform densities in Figures 8-3 and 8-5, it is evident that

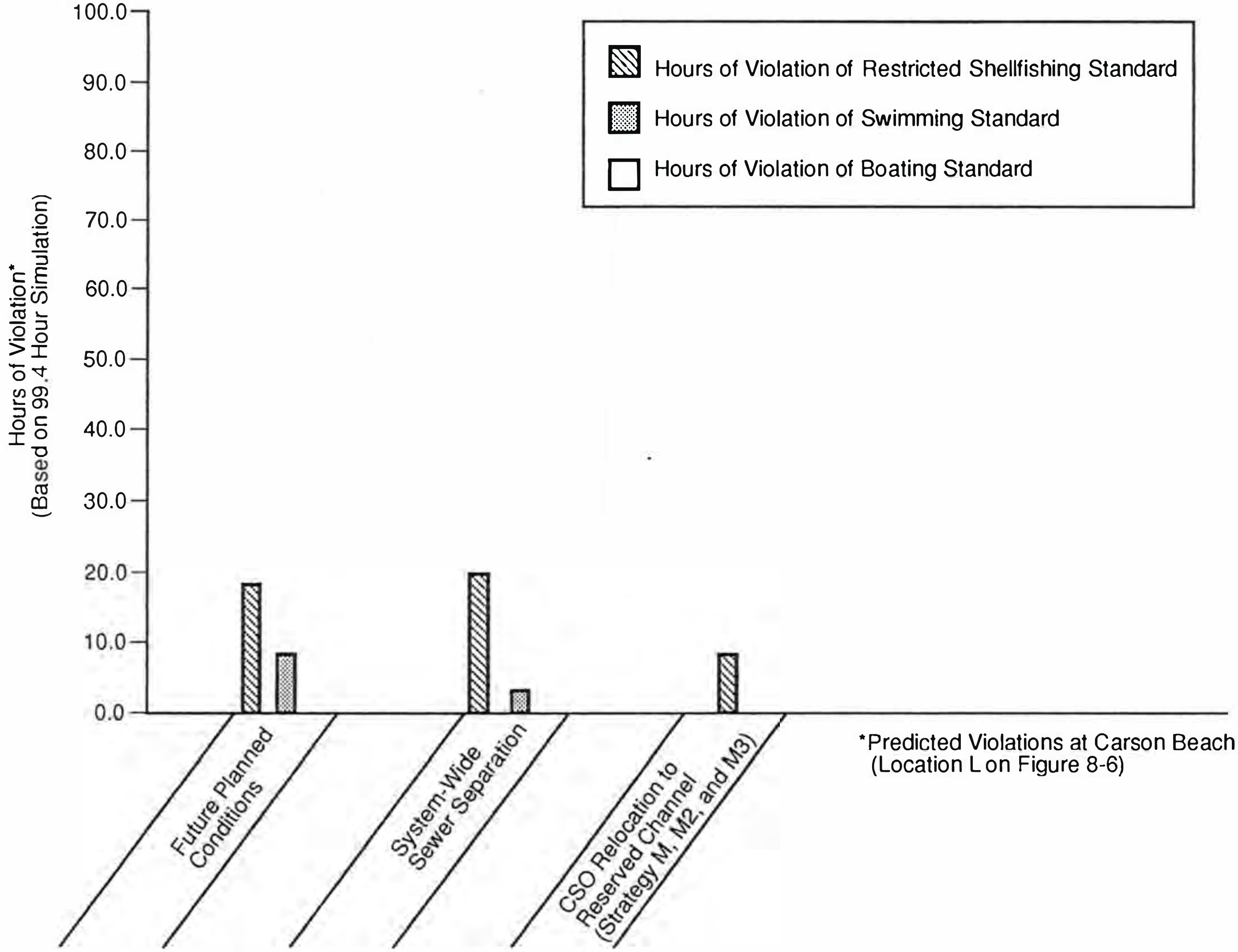

FIGURE 8-2. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 3 MONTH STORM, NORTH DORCHESTER BAY

4184jp/3mth

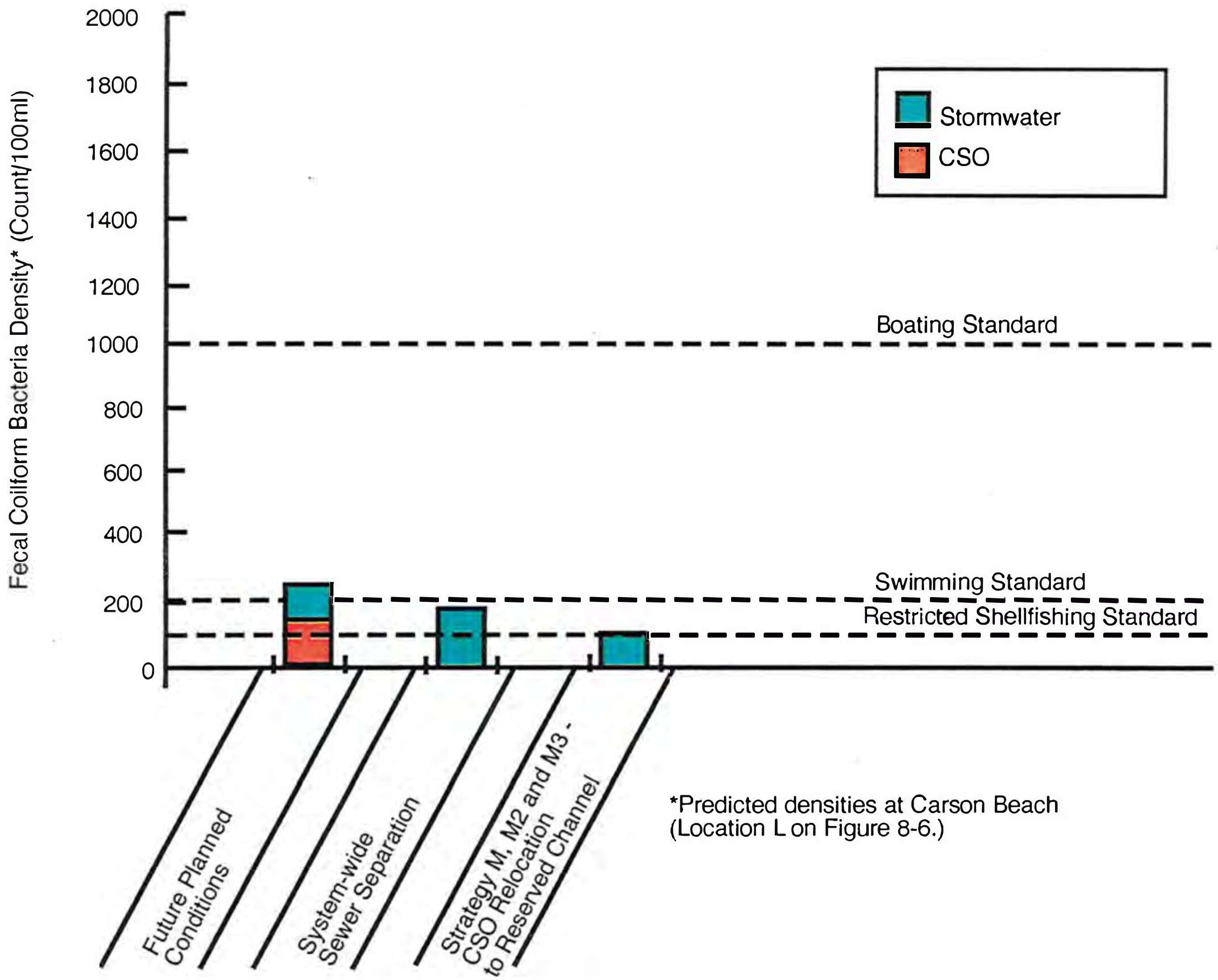

FIGURE 8-3. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 3 MONTH STORM, NORTH DORCHESTER BAY

4189JP

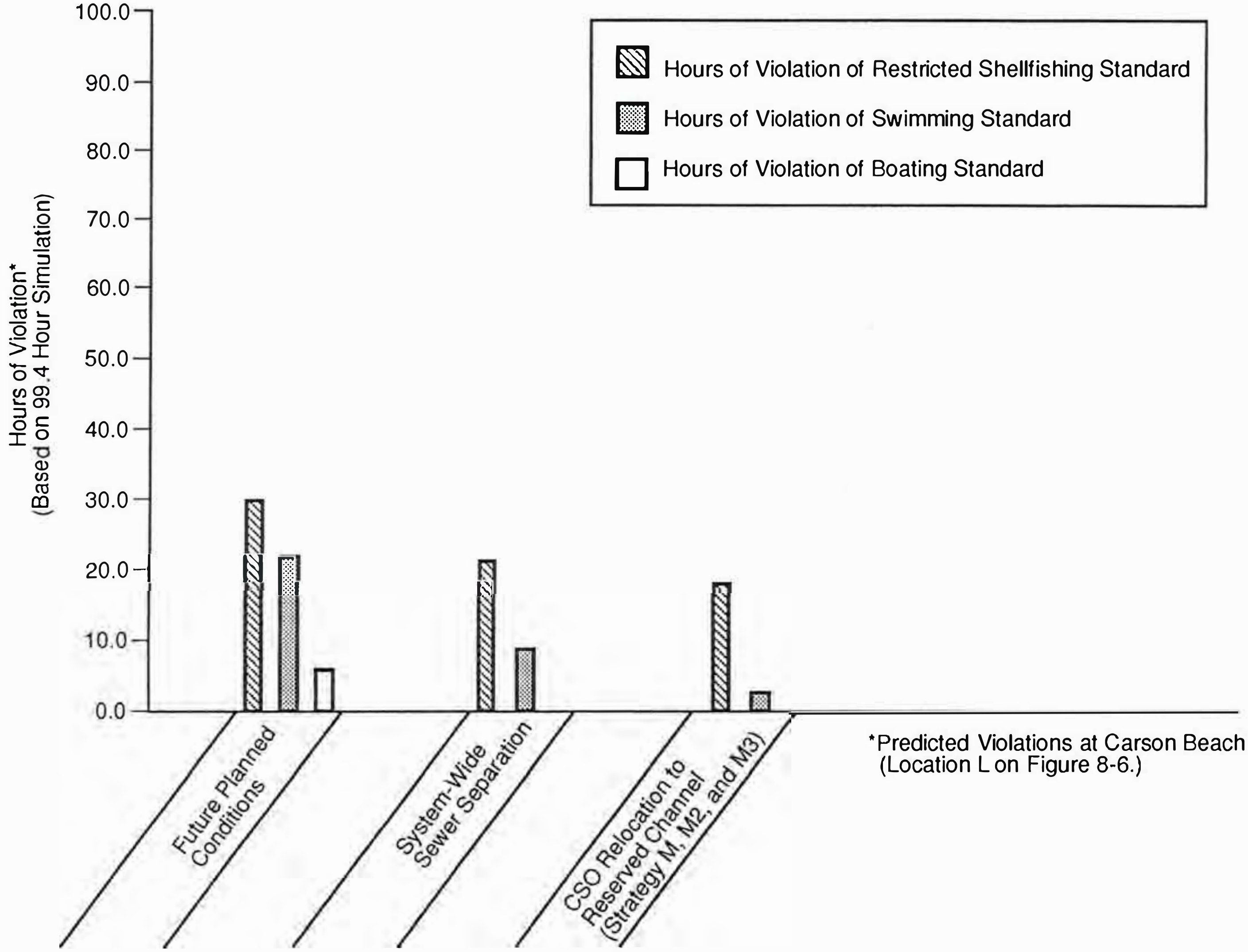

FIGURE 8-4. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, NORTH DORCHESTER BAY

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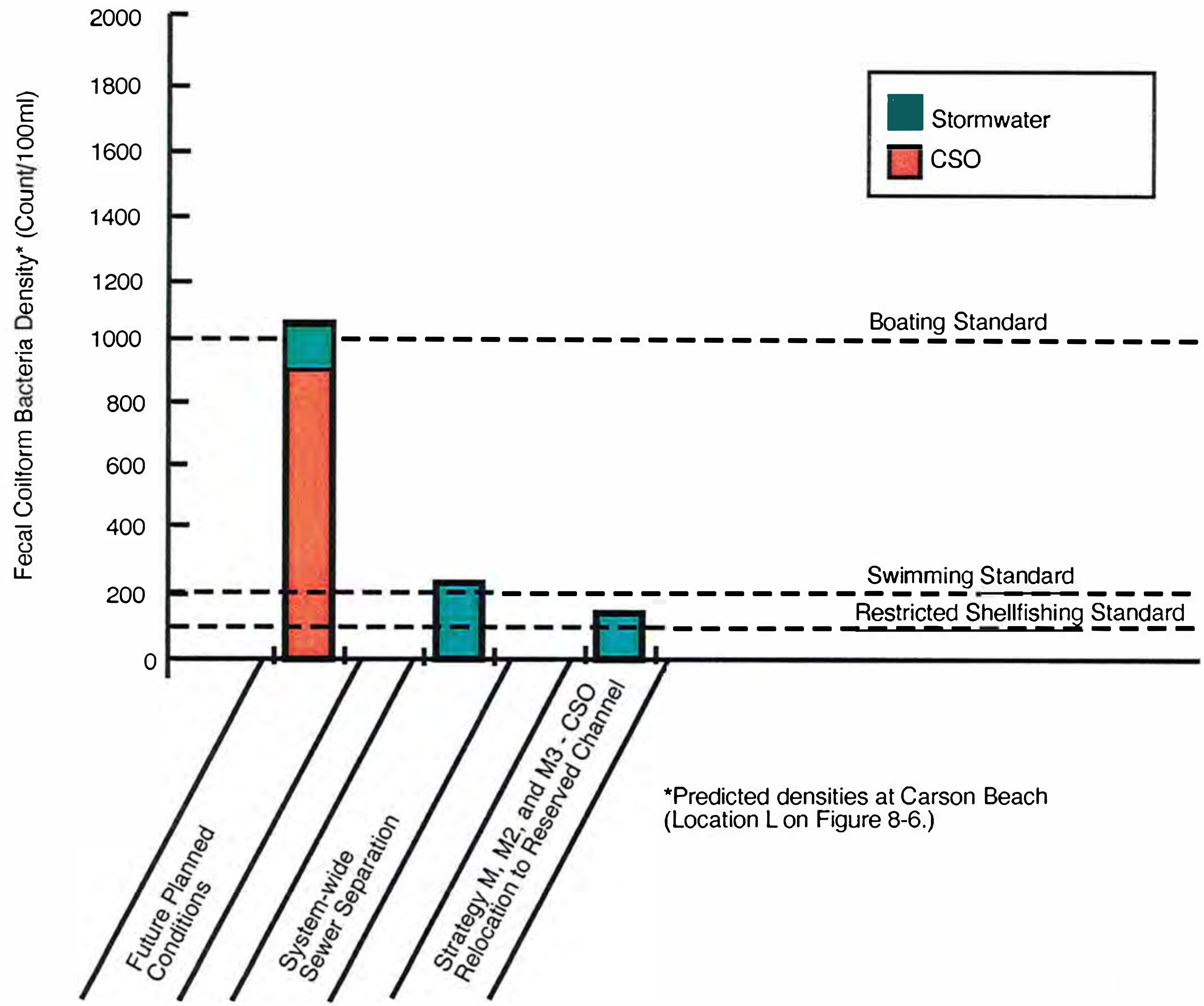

FIGURE 8-5. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1-YEAR STORM, NORTH DORCHESTER BAY

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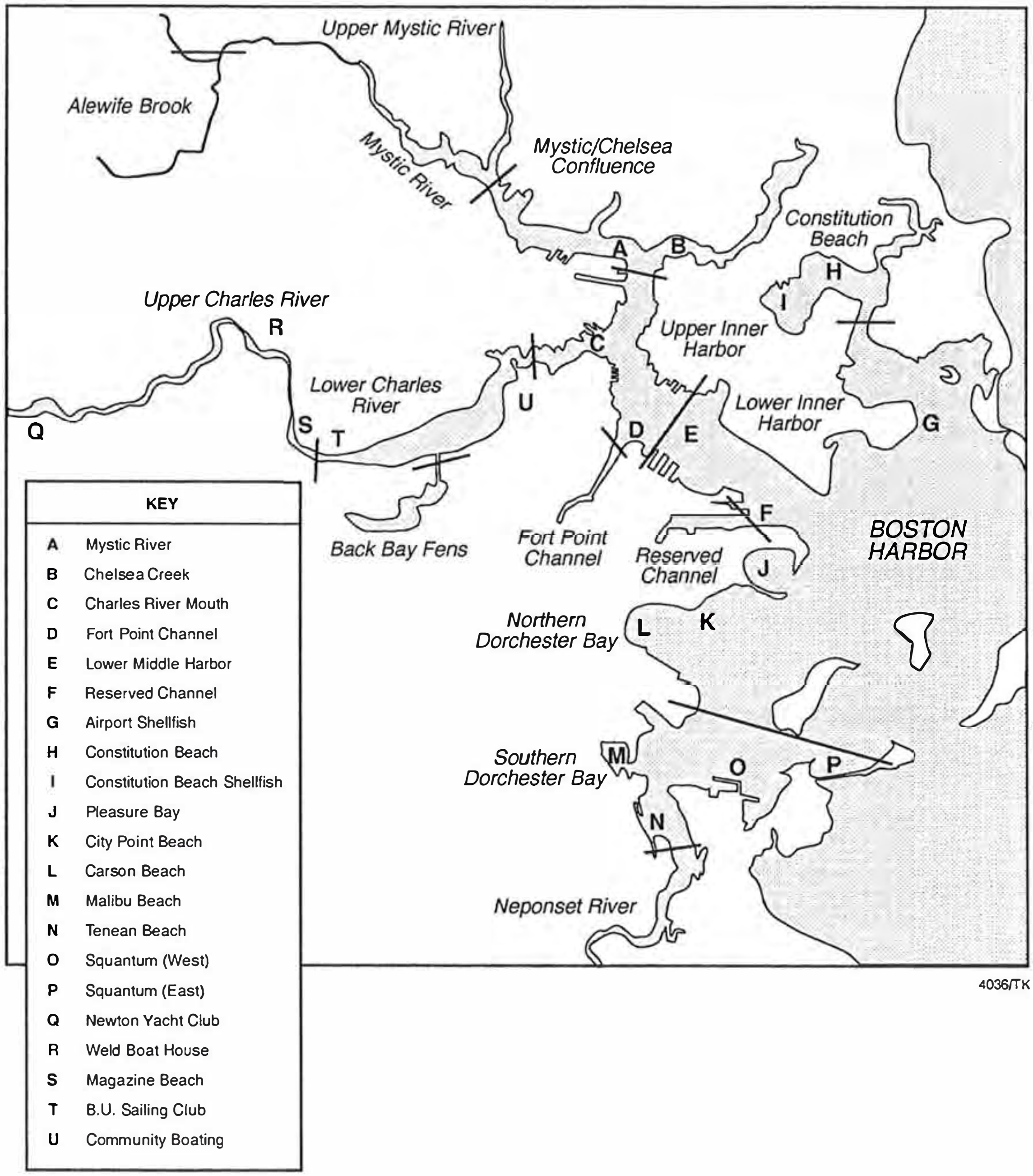


FIGURE 8-6. LOCATIONS FOR RECEIVING WATER MODELING OUTPUT

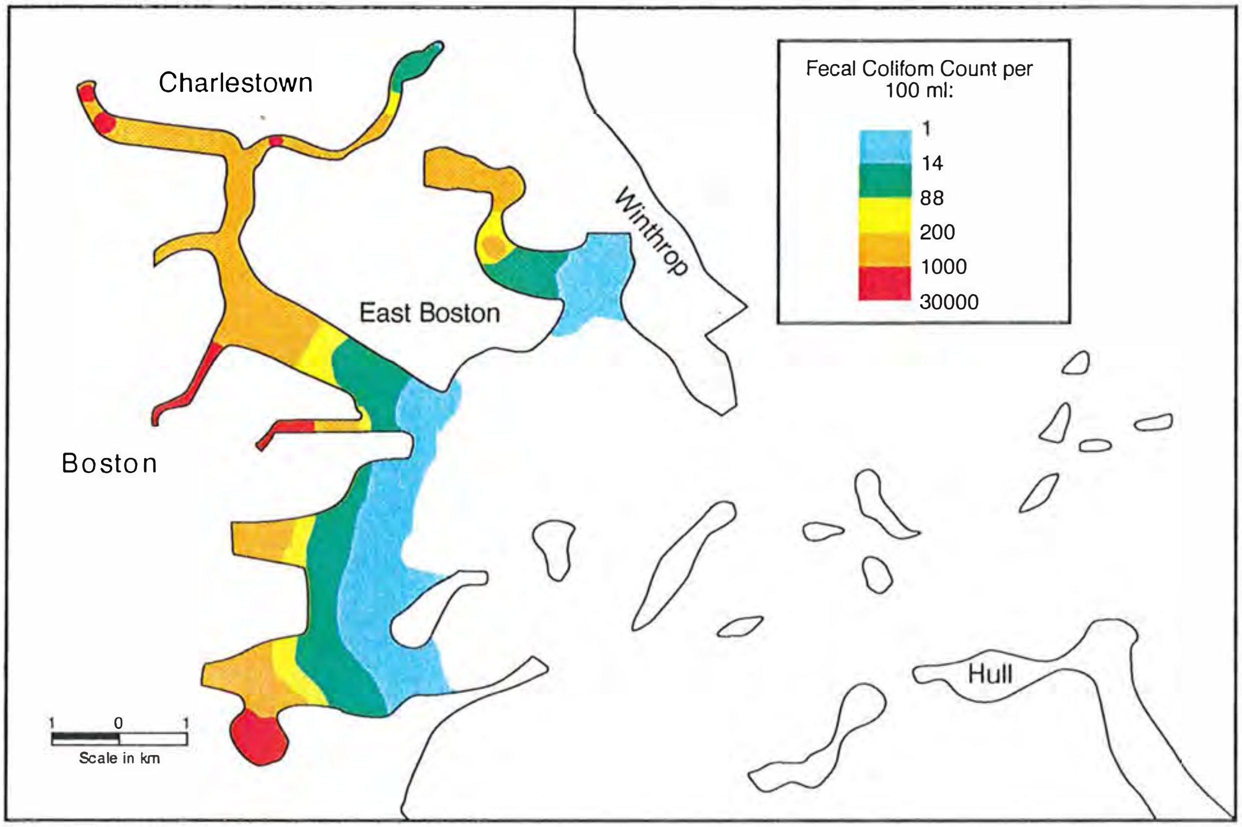
the increase in untreated CSO volumes between the three-month and one-year storm has a far greater impact on in-receiving water bacteria densities than the increase in stormwater volume.

Figures 8-7 and 8-8 present isopleths of the fecal coliform bacteria densities in Boston Harbor eight hours after the peak of the three-month and one-year storms, respectively. Each figure presents two isopleths, one showing the densities due to all sources, and one showing the densities due to non-CSO sources, only. Figure 8-9 presents the bacteria isopleths for the recommended plan, for the three-month and one-year storms. As expected, the recommended plan isopleths in North Dorchester Bay are similar to the non-CSO sources isopleths in Figures 8-7 and 8-8, as the CSOs to this receiving water segment have been eliminated.

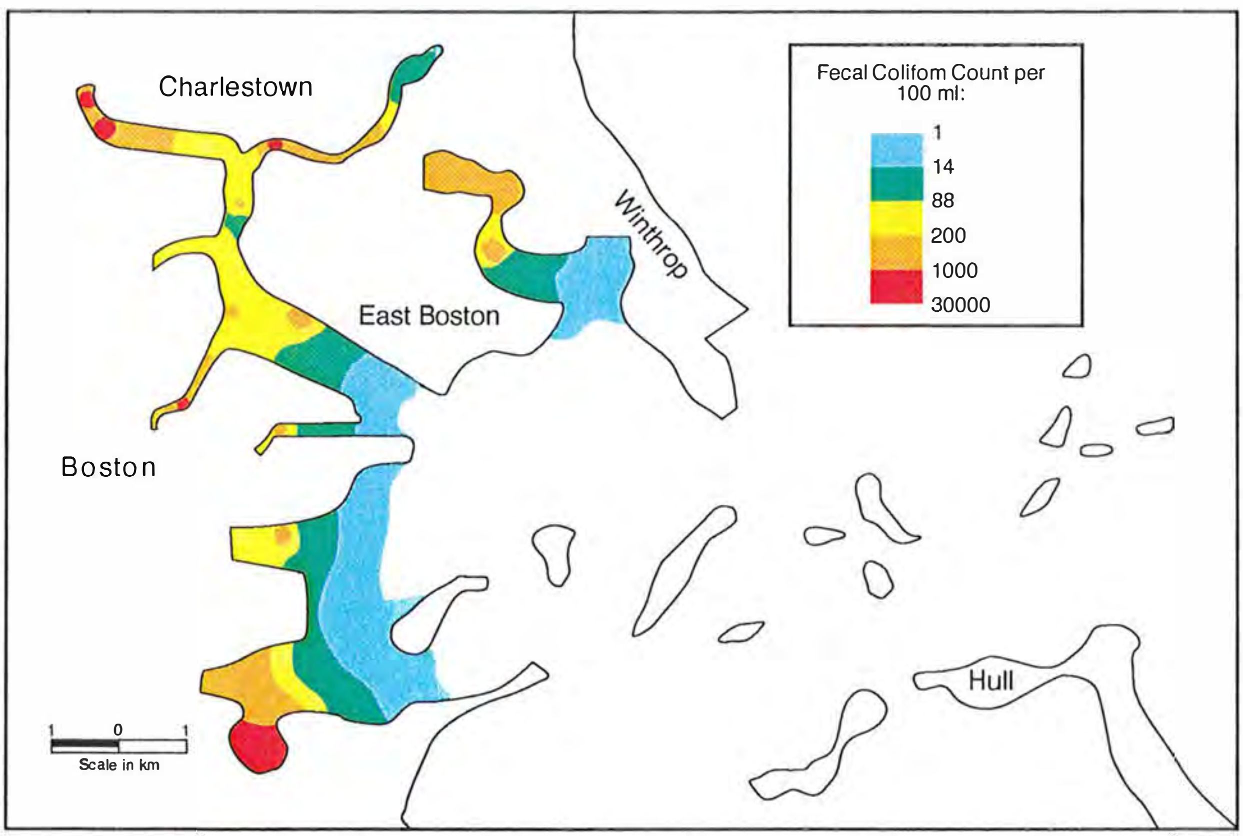
Figure 8-10 presents the annual loads of TSS and BOD for future planned conditions and the recommended plan ("M3"). Both the relative contributions of stormwater and CSO, and the impact of CSO relocation on the annual loads of these pollutants, are evident in this figure.

Although the receiving water model data indicate that even with elimination of CSOs to North Dorchester Bay violations to bacteria standards will persist during the three-month and one-year storms, elimination of CSOs will reduce the risk of contact with human pathogens and will enable achievement of designated uses should the non-CSO sources be controlled at some point in the future.

Siting Issues. The consolidation conduit would be located under Day Boulevard, Carson Beach, or parts of both. Surface disruptions would be minimized by soft-ground tunneling, although access shafts would be required. Restriction of construction activities during the swimming season could mitigate some impacts on the beach areas, but would also prolong the overall construction period. Sufficient space for the screening and disinfection facility appears to be available at or near the Conley Marine Terminal. One concern with this location would be the potential for encountering contaminated soil, as well as the proximity



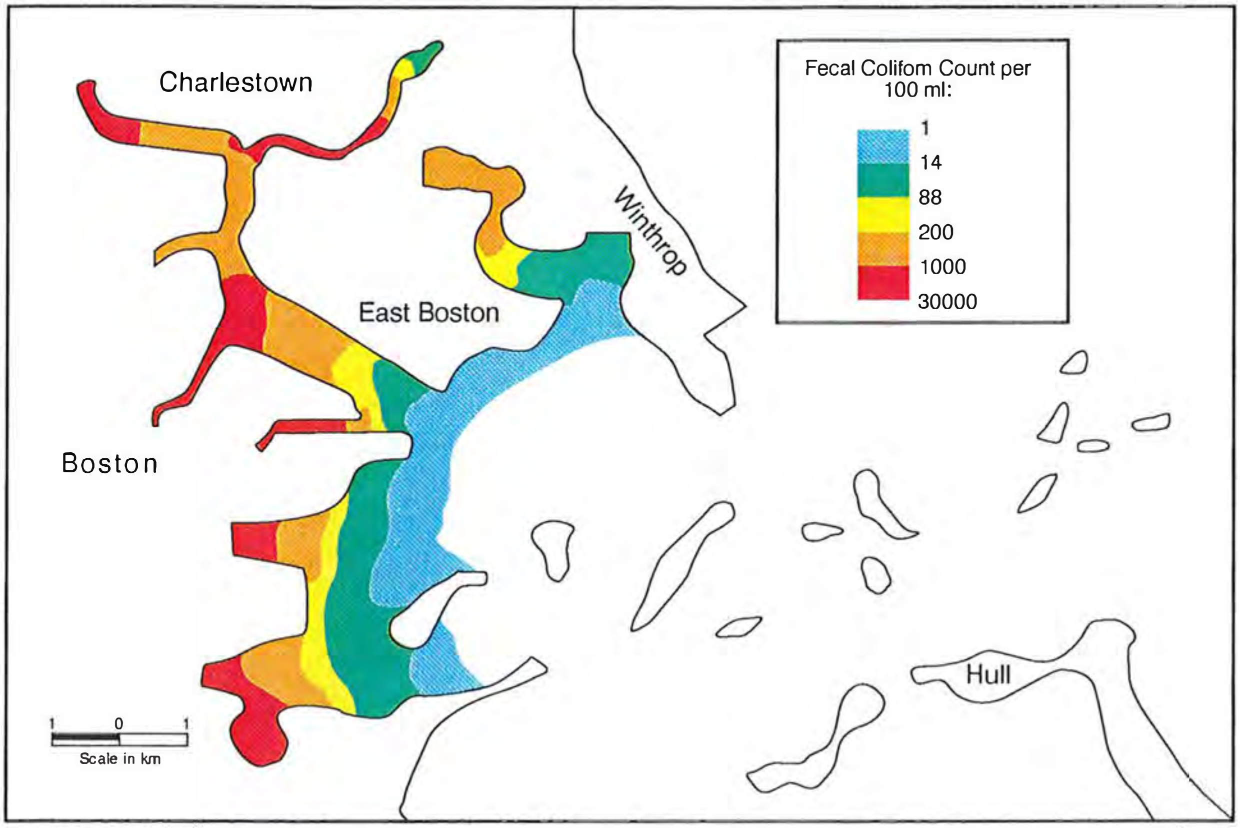
A: BACTERIA DENSITIES DUE TO ALL SOURCES



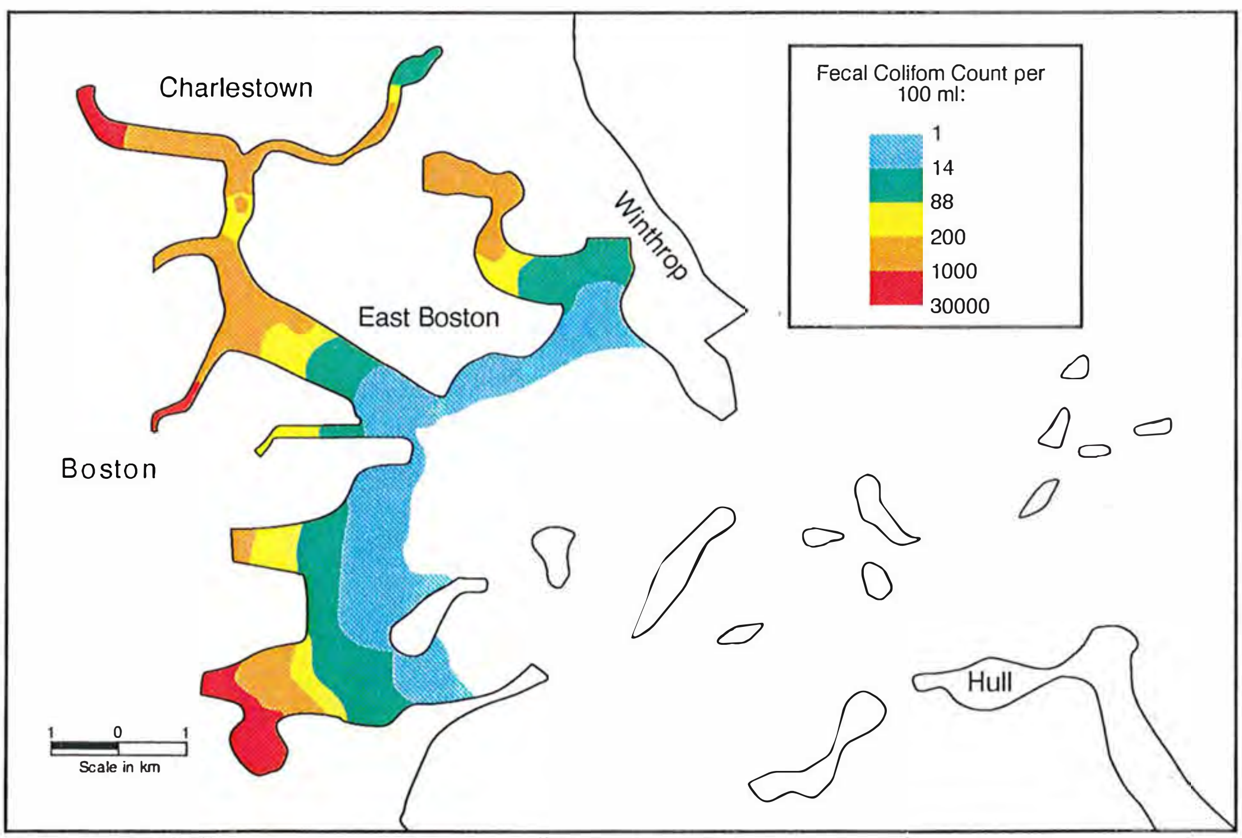
B: BACTERIA DENSITIES DUE TO NON-CSO SOURCES, ONLY

FIGURE 8-7. FECAL COLIFORM BACTERIA DENSITIES IN BOSTON HARBOR EIGHT HOURS AFTER PEAK OF THREE-MONTH STORM, FUTURE PLANNED CONDITIONS

03/4219jl

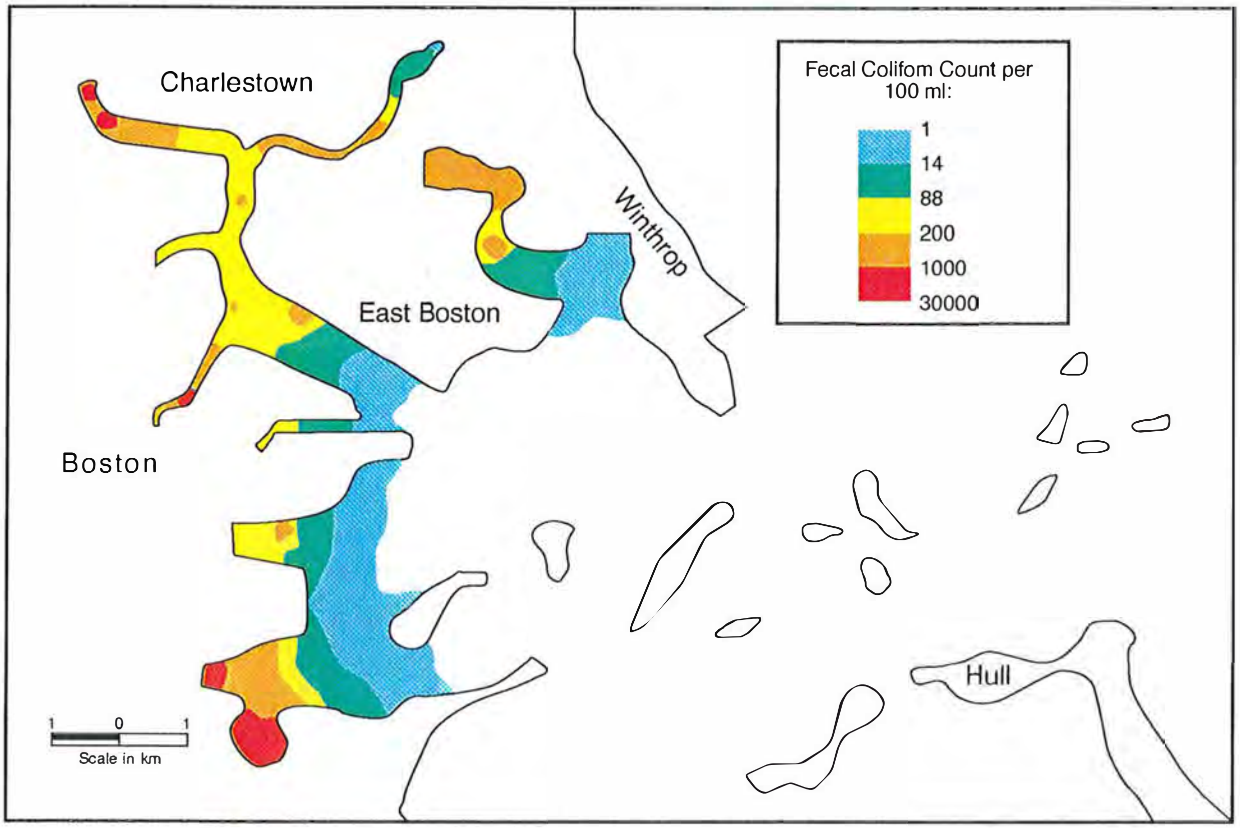


A: BACTERIA DENSITIES DUE TO ALL SOURCES

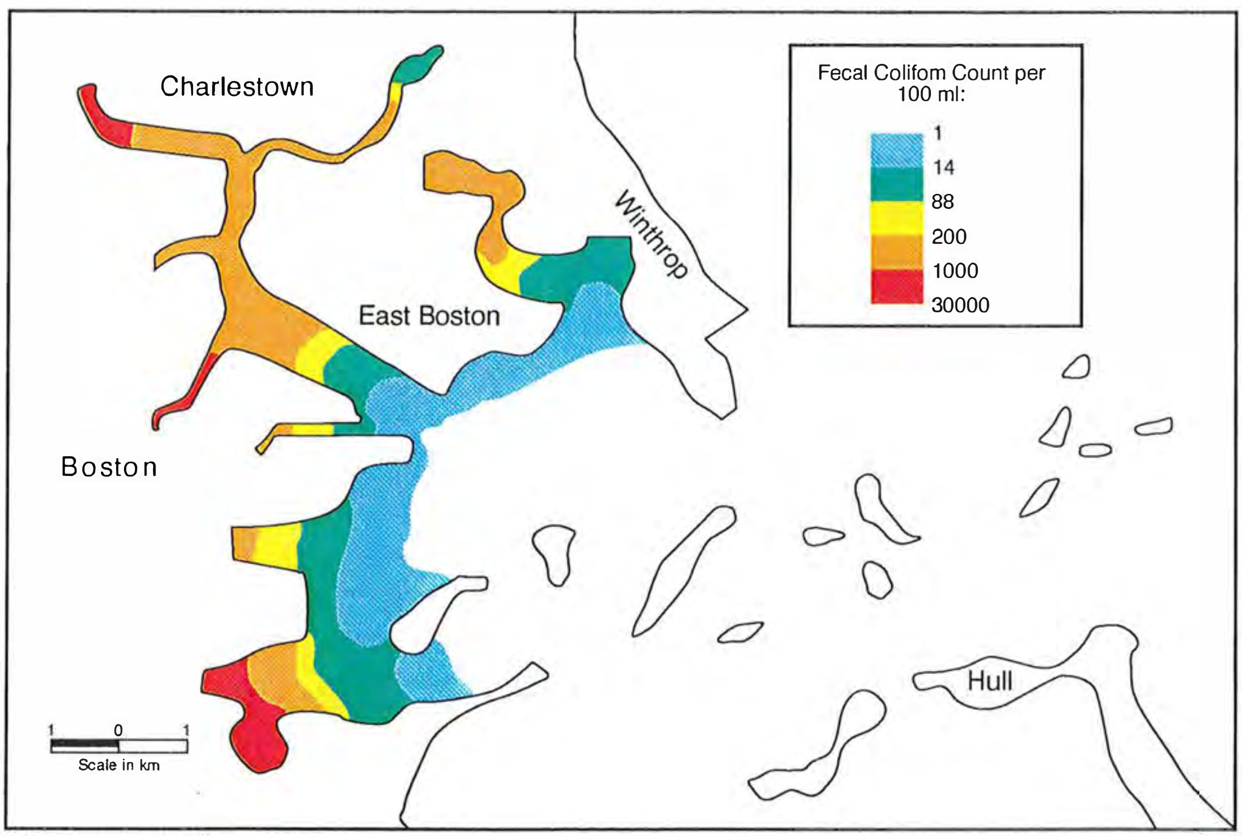


B: BACTERIA DENSITIES DUE TO NON-CSO SOURCES, ONLY

FIGURE 8-8. FECAL COLIFORM BACTERIA DENSITIES IN BOSTON HARBOR EIGHT HOURS AFTER PEAK OF ONE-YEAR STORM, FUTURE PLANNED CONDITIONS



A: DENSITIES EIGHT HOURS AFTER PEAK OF THREE-MONTH STORM



B: DENSITIES EIGHT HOURS AFTER PEAK OF ONE-YEAR STORM

FIGURE 8-9. FECAL COLIFORM DENSITIES IN BOSTON HARBOR WITH THE RECOMMENDED CSO CONTROL PLAN, ALL SOURCES

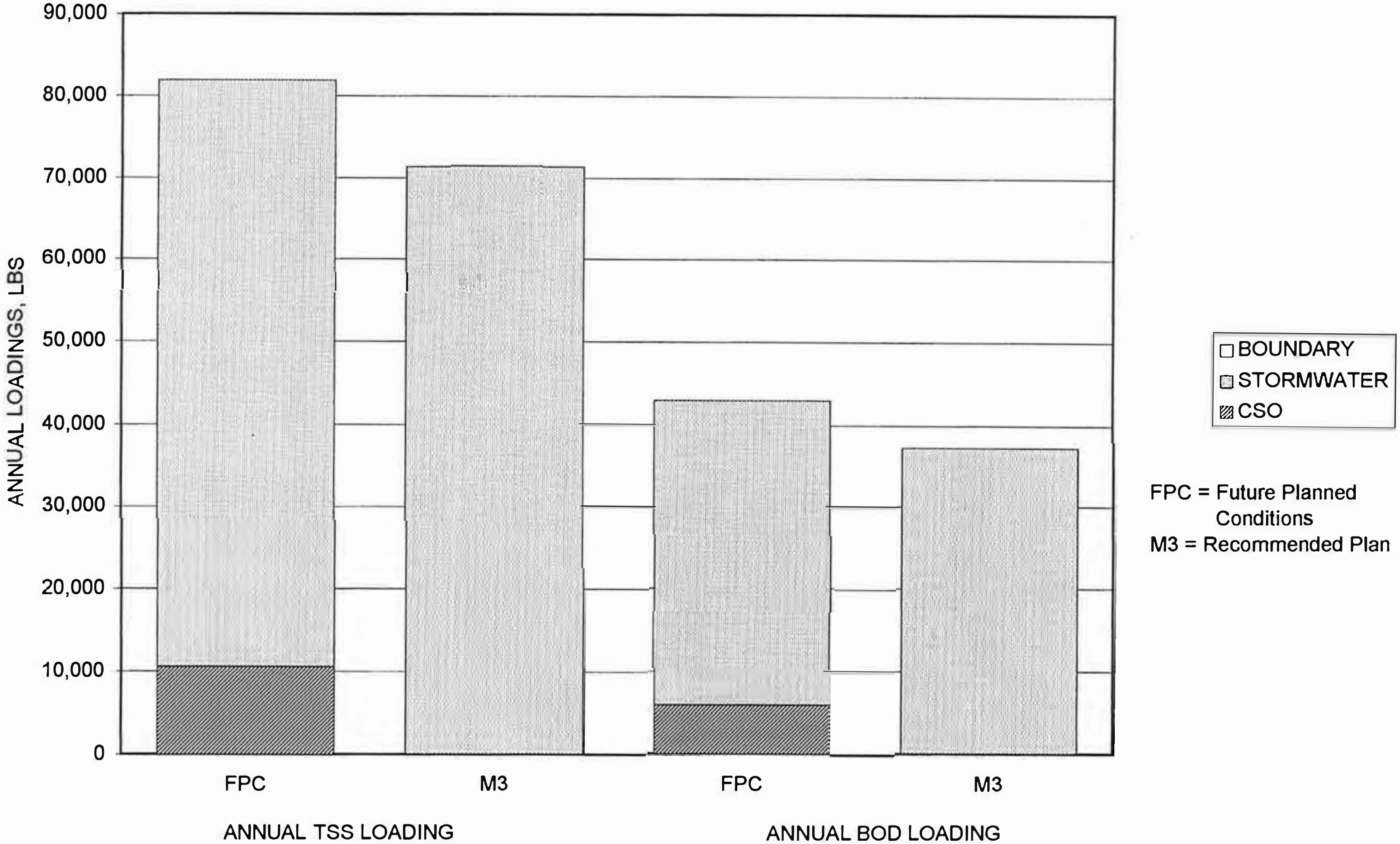


FIGURE 8-10. ANNUAL TSS AND BOD LOADINGS TO NORTH DORCHESTER BAY

of underground fuel storage tanks. Short-term construction impacts would include disruptions to traffic and beach use, as well as noise and dust impacts on residences along Day Boulevard and Farragut Street. Long-term community impacts would be minimal, assuming the facility could be located at the industrial waterfront area.

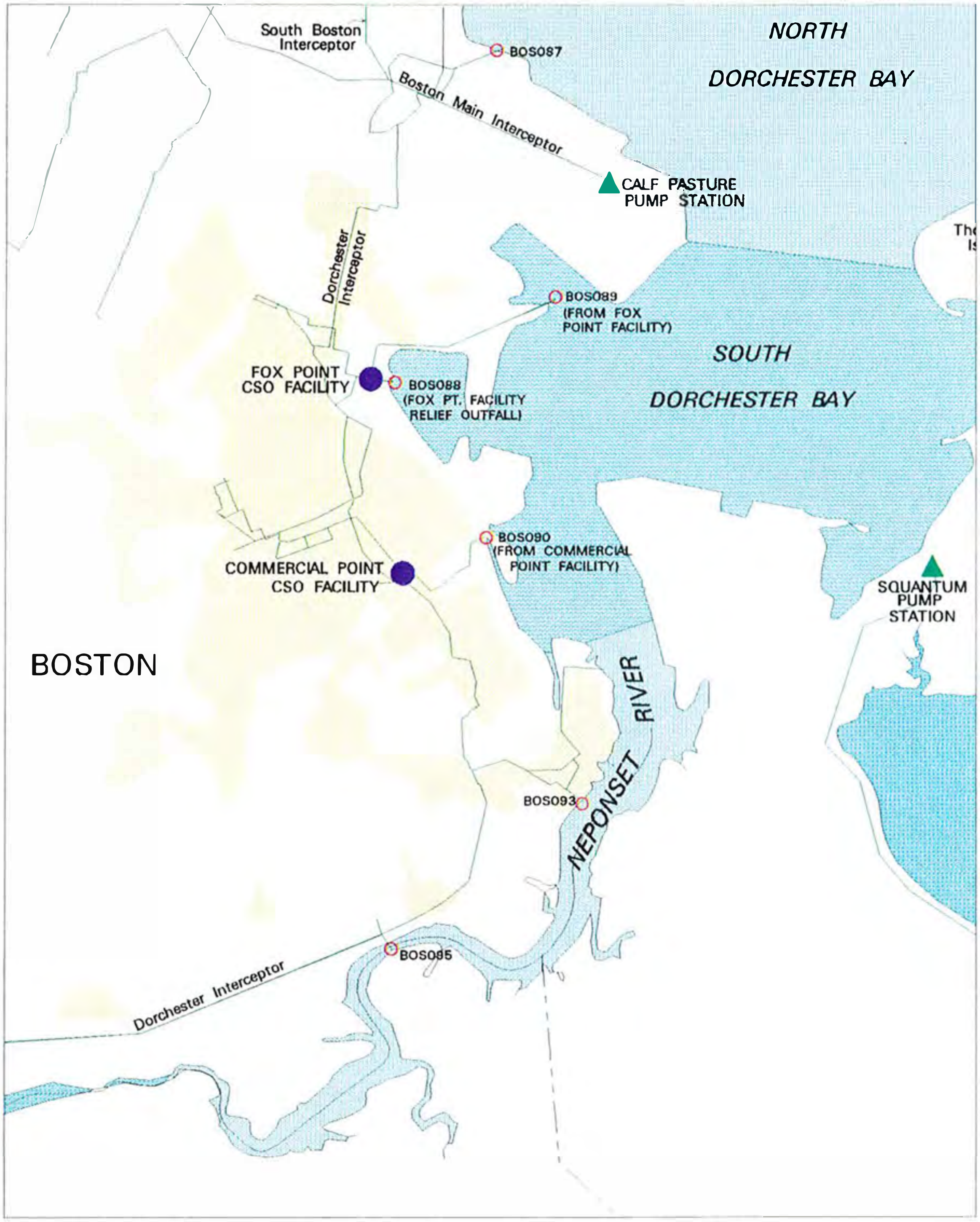
Costs. The capital cost for this alternative is estimated at $86 million, with annual O&M costs of approximately $845,000. Total present worth as of December, 1995 would be $78 million.

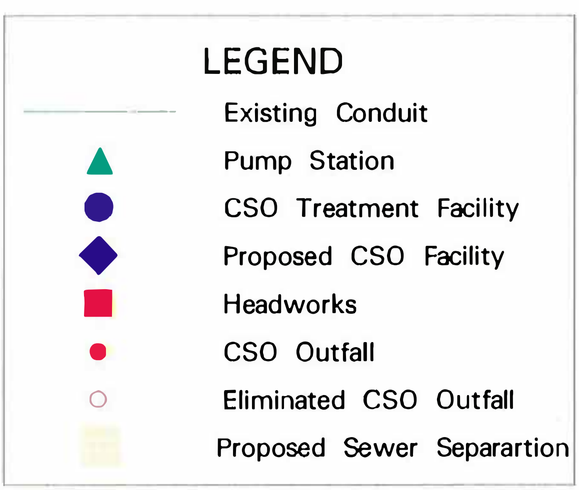
Considerations for Partial Use Designation. Since CSO discharges will be eliminated from this receiving water segment, modification of state water quality standards to create a partial use designation will not be necessary.

South Dorchester Bay

Similar to North Dorchester Bay, swimming and shellfishing have been designated as critical uses in South Dorchester Bay. The recommended alternative involves upgrading the existing screening and disinfection facilities at Fox Point and Commercial Point to provide dechlorination, and implementing a sewer separation program which would ultimately eliminate the CSOs. The general location of the separation work, covering approximately 706 acres, is presented in Figure 8-11. Adding dechlorination to the existing facilities would be a relatively easy-to-implement, low-cost project which would provide the short-term benefit of lowering effluent chlorine residuals, and reducing impacts on shellfish resources. To improve solids removals at these facilities in the short-term, installation of fine-mesh screens downstream of the existing bar racks could be evaluated during facilities planning.

Sewer separation can be accomplished either by constructing new storm drains, and allowing the existing combined sewer to function as a separate sanitary sewer, or by constructing new sanitary sewers, and allowing the existing combined sewer to function as a storm drain. As described in Chapter Six, selection of the method of separation depends on a number of





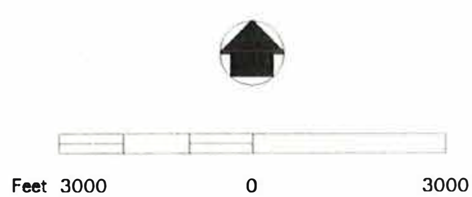


Figure 8-11
South Dorchester Bay
Neponset River
Recommended Plan

factors, and methods for implementing sewer separation in this area will be evaluated during facilities planning and preliminary design. The separation program would target the major combined sources first, while distributing the financial burden of the project over a number of years. Upon completion of the separation work, the existing facilities at Fox Point and Commercial Point would be decommissioned.

SWMM output suggests that even with complete separation of the combined areas tributary to the regulators upstream of the Fox Point and Commercial Point CSO Facilities, backwater from the Columbus Park Headworks would cause periodic activation of BOS088 and BOS090 regulators during severe storm events such as the two-year storm unless the regulators are blocked. If blocked, SWMM output suggests that localized flooding could result due to the backwater effect. Additional measures may be required to isolate the South Dorchester system from the backwater effects of the Columbus Park Headworks, in order to allow the recommended complete closure of all regulators in the BOS088/089 and BOS090 tributary area without risk of flooding. One such measure could be to construct a pump station on the Dorchester Interceptor downstream of the BOS088 regulators. This issue will be evaluated in more detail during facilities planning.

Water Quality Impacts. As with North Dorchester Bay, elimination of CSOs to South Dorchester Bay was not the initially-preferred alternative based on cost effective analysis. However, elimination of CSOs was a desired goal due to the critical uses in this receiving water segment, and this consideration was judged to take precedence over strictly cost-effective considerations in arriving at the appropriate level of control for this receiving water segment. Sewer separation was selected as the means for CSO elimination since CSO relocation was not feasible in this area. The additional stormwater introduced to South Dorchester Bay as a result of sewer separation is predicted to be approximately 13 and 20 MG for the three-month and one-year storms, respectively.

Figures 8-12 to 8-15 present results from the receiving water model for South Dorchester Bay. From Figures 8-12 and 8-14, it is evident that CSO elimination has little impact on the

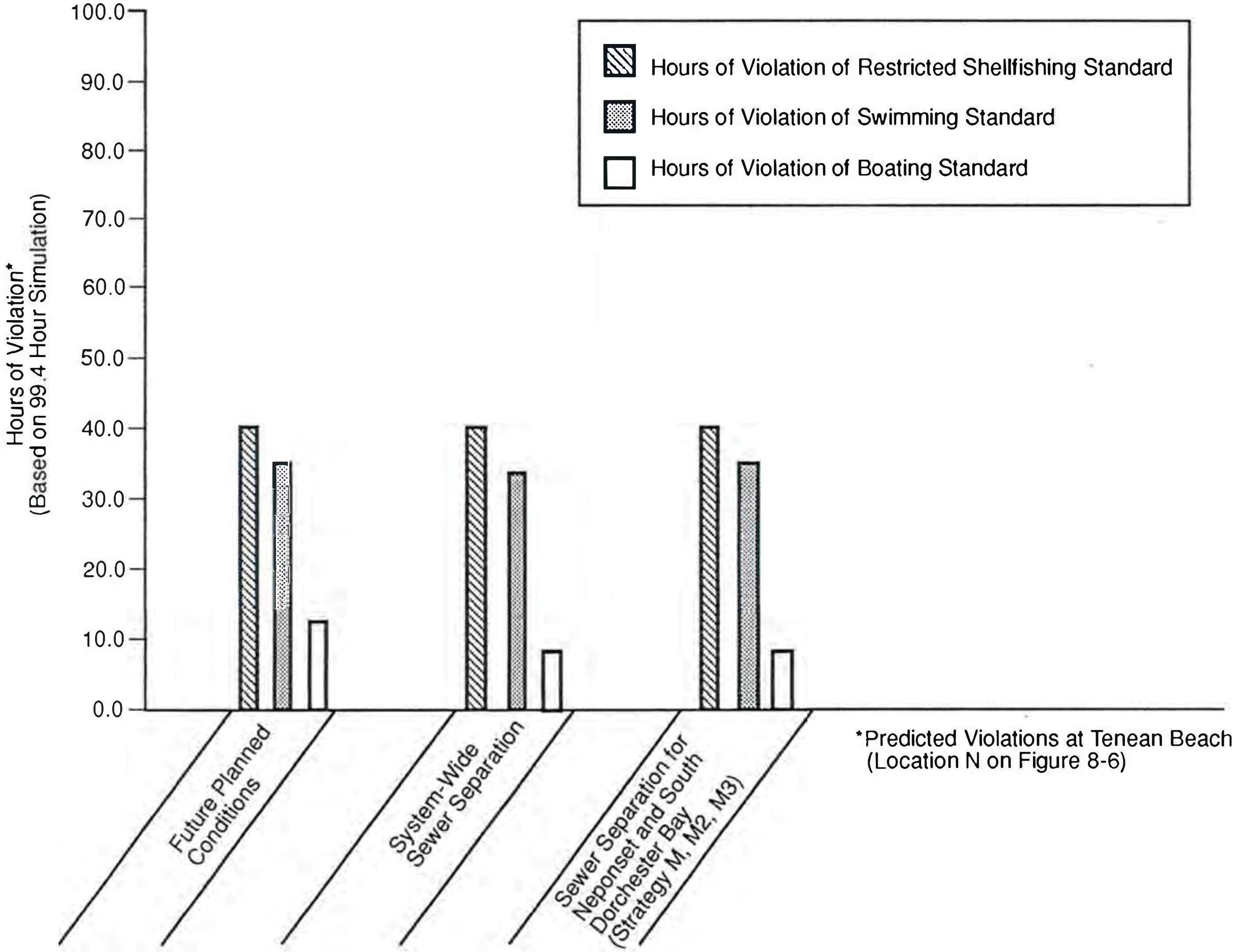


FIGURE 8-12. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 3 MONTH STORM, SOUTH DORCHESTER BAY AND NEPONSET RIVER

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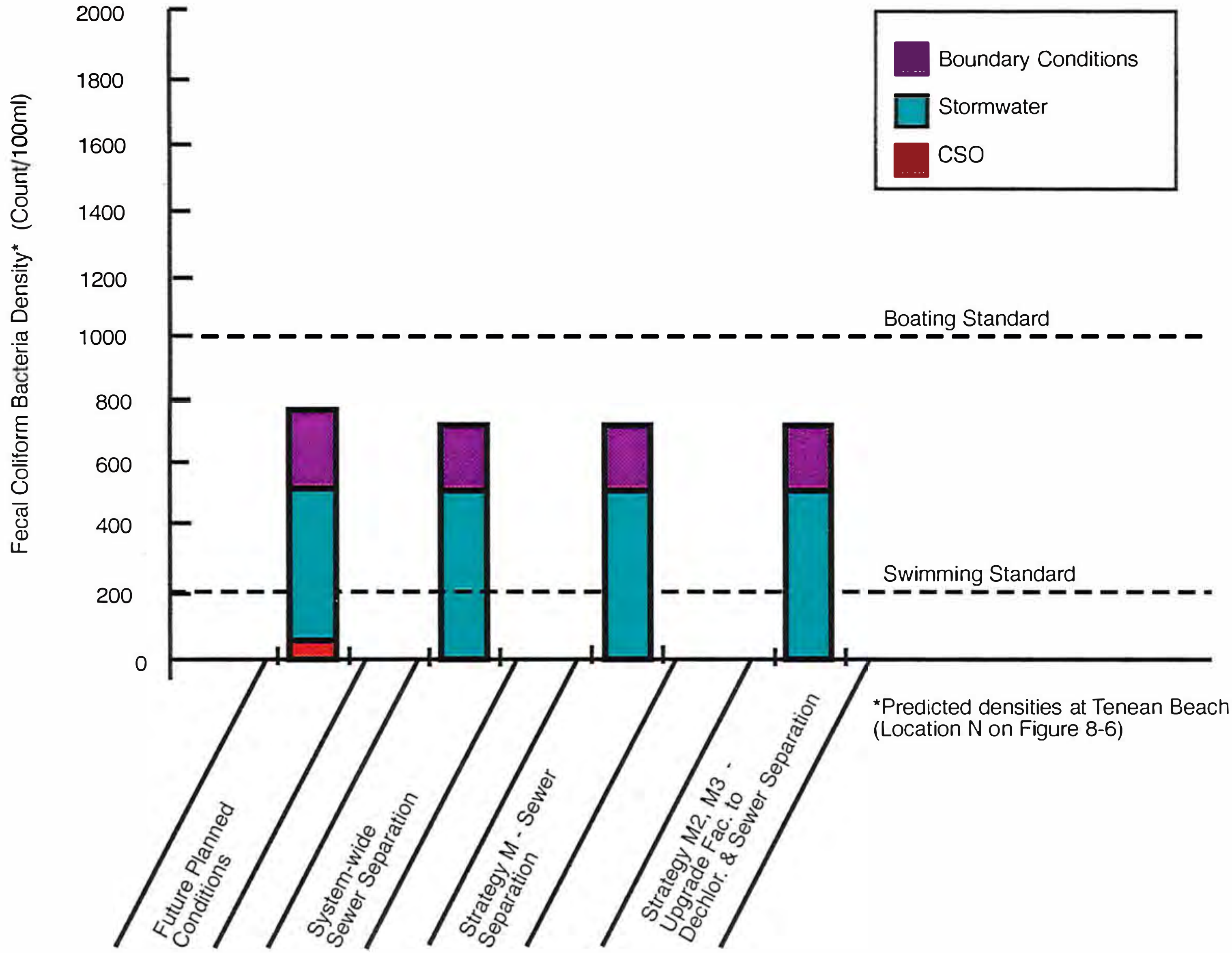

FIGURE 8-13. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 3 MONTH STORM, SOUTH DORCHESTER BAY AND NEPONSET RIVER

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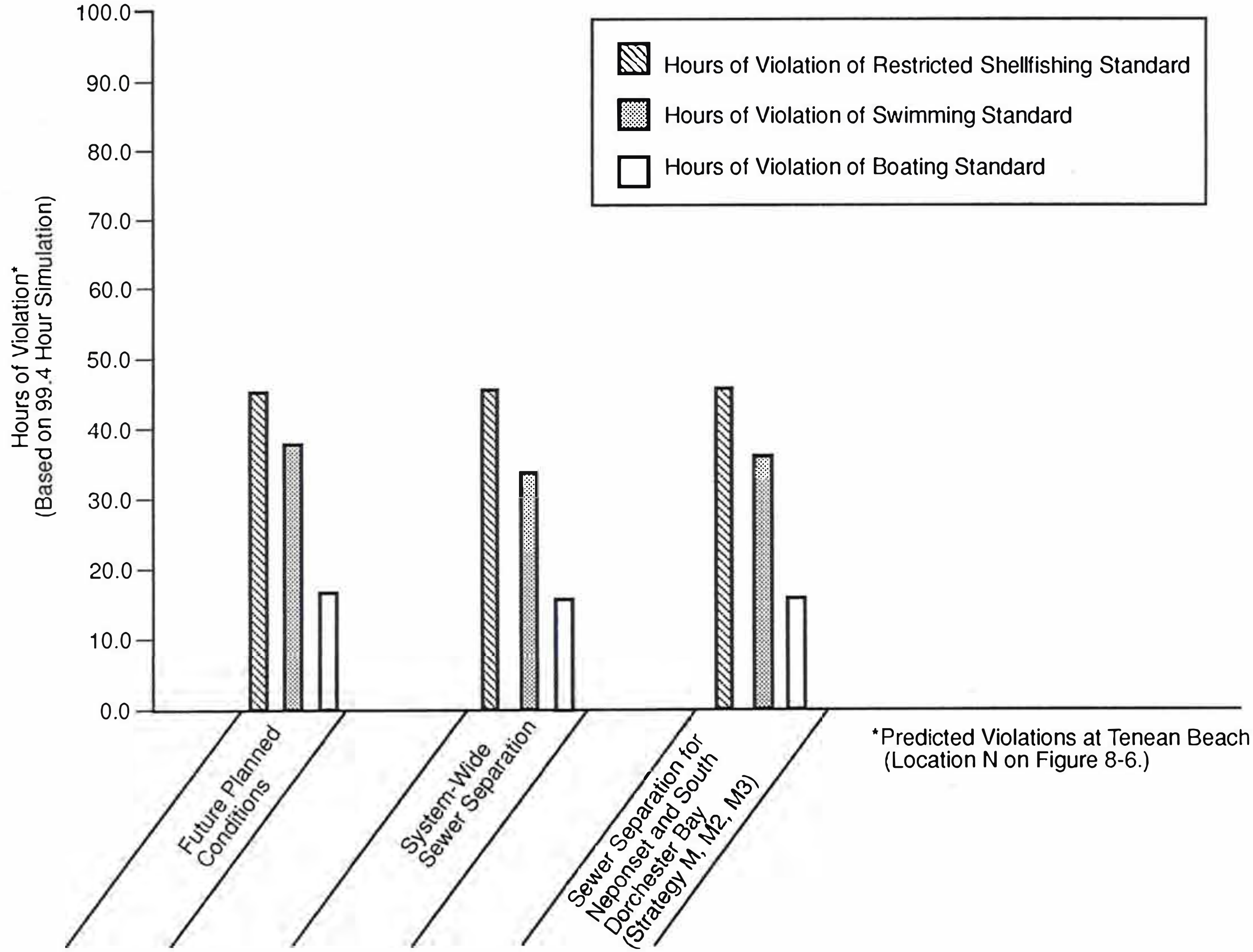

FIGURE 8-14. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, SOUTH DORCHESTER BAY AND NEPONSET RIVER

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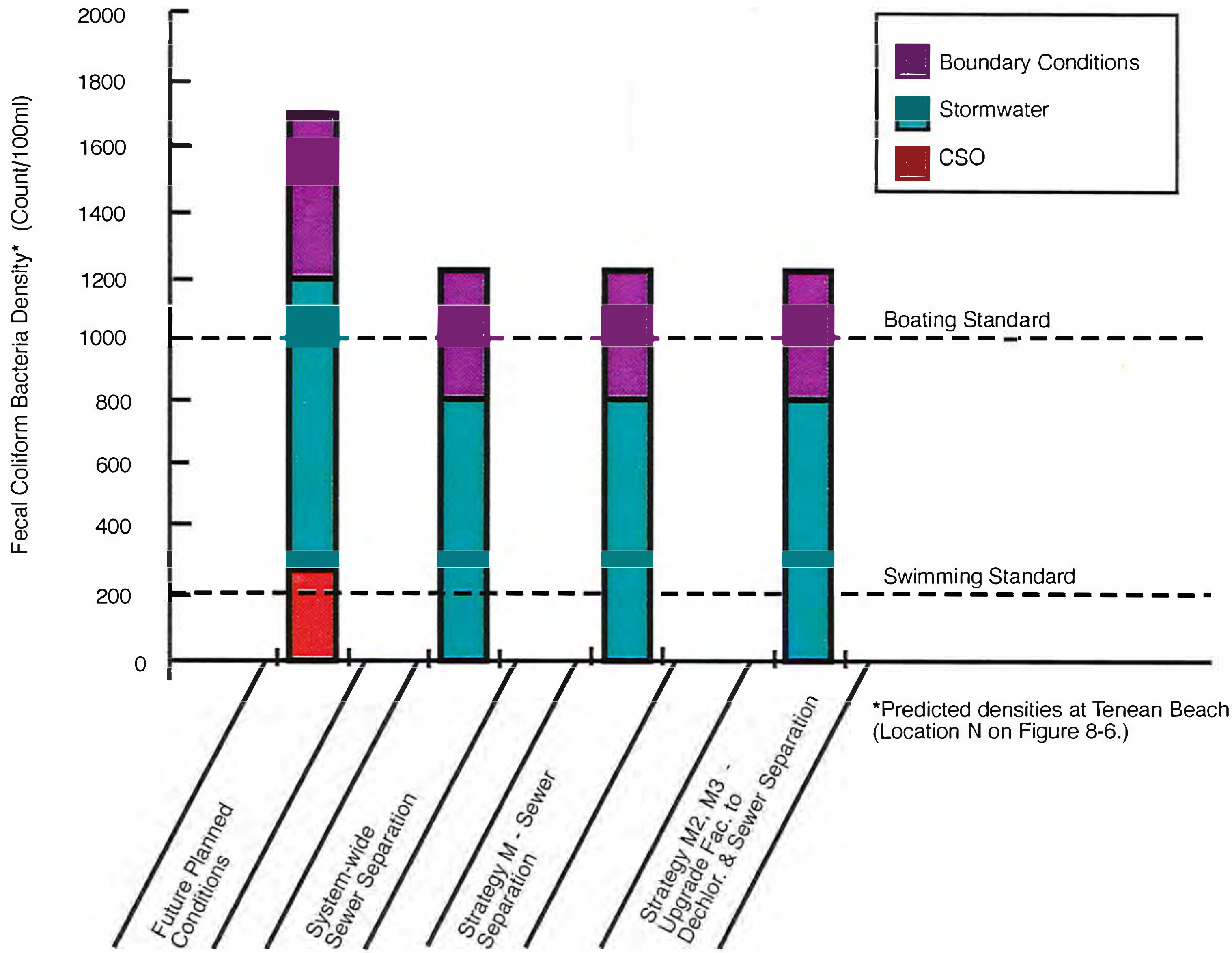


FIGURE 8-15. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1-YEAR STORM, SOUTH DORCHESTER BAY AND NEPONSET RIVER

4190jp

duration of violations of bacteria standards during the three-month and one-year storms. Figures 8-13 and 8-15 indicate the impact of stormwater and upstream sources, which in this case is the Neponset River. The similarity between the all-sources and non-CSO sources isopleths in South Dorchester Bay indicated in Figures 8-7 and 8-8 also underscores the impact of the non-CSO sources on this receiving water segment.

Figure 8-16 presents the annual loads of TSS and BOD for future planned conditions and the recommended plan ("M3"). Under the recommended plan, the CSO contributions of TSS and BOD are eliminated, but the contribution from stormwater increases, due to the additional stormwater introduced to the receiving water.

Although the receiving water model data indicates that even with elimination of CSOs, violations of bacteria standards will continue to occur in South Dorchester Bay during the three-month and one-year storms, providing dechlorination and ultimately eliminating CSOs through sewer separation will reduce the potential discharge of chlorine residuals to the bay, and in the long term reduce risk of contact with human pathogens. This alternative would then facilitate achievement of designated uses if in the future the non-CSO sources of pollutants are controlled.

Siting Issues. Installation of dechlorination equipment to the Fox and Commercial Point CSO Facilities may require additions to the existing structures, but the additional space required would not be substantial. The sewer separation work would involve open-cut excavations primarily in streets and existing rights-of-way. Short-term impacts of these projects would be limited to traffic disruptions and other local construction impacts as the separation work proceeds. These impacts would be spread over the entire phased implementation period, and would likely not be continuous. Long term impacts of separation as a CSO control measure would be negligible. However, because this work will be phased over the entire 15-year implementation period, localized construction related disruptions could be considered a long-term adverse impact.

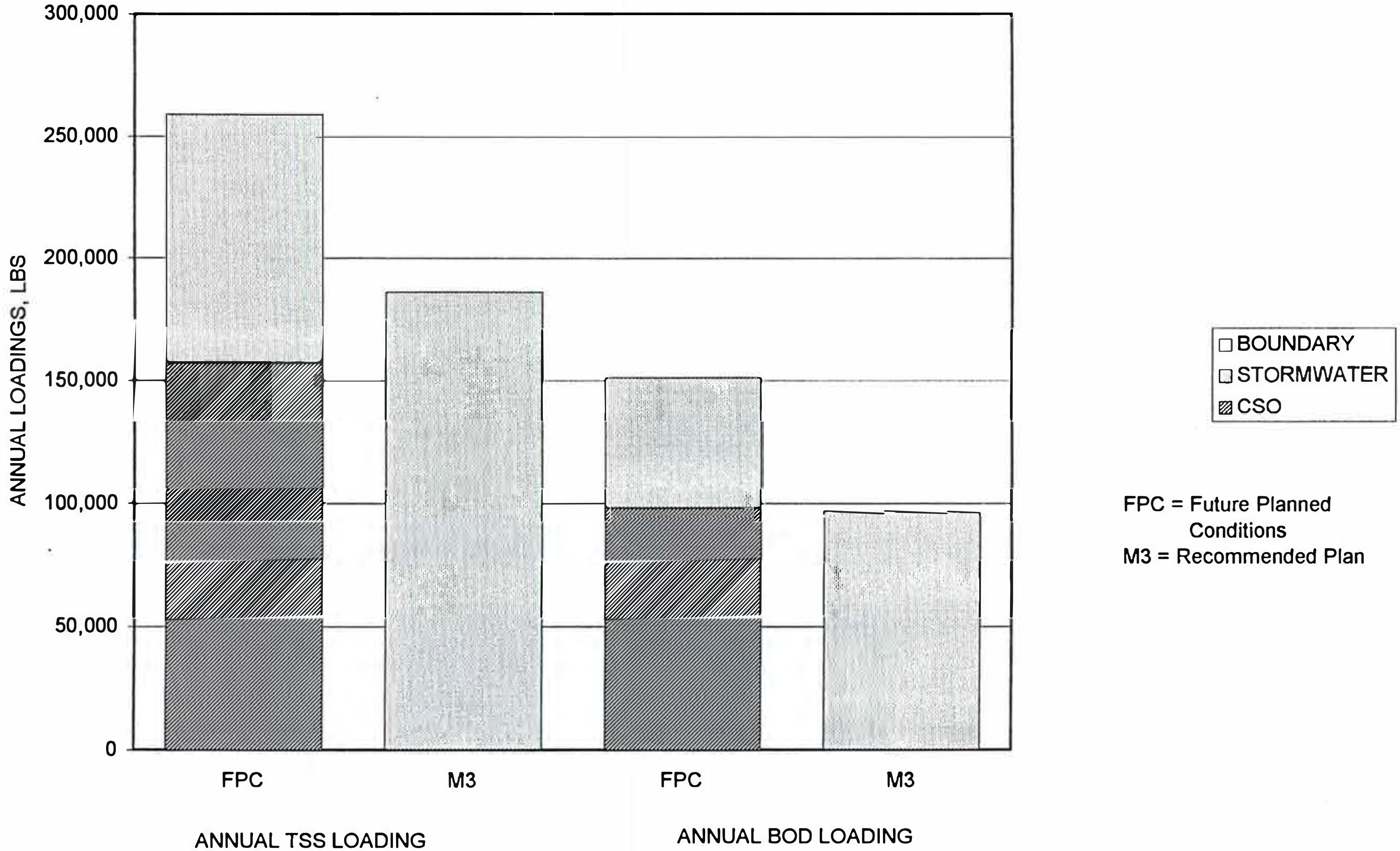


FIGURE 8-16. ANNUAL TSS AND BOD LOADINGS TO SOUTH DORCHESTER BAY

Costs. The capital cost for this alternative is estimated at $95 million, with annual O&M costs of approximately $230,000 per year (assuming the existing CSO facilities at Fox Point and Commercial Point cannot be decommissioned until sewer separation is completed). Total present worth as of December, 1995 would be $78.5 million.

Considerations for Partial Use Designation. Since CSO discharges will be eliminated from this receiving water segment, modification of state water quality standards to create a partial use designation will not be necessary.

Neponset River

Consistent with the approach taken in North and South Dorchester Bay to eliminate CSOs to critical use areas, elimination of CSOs through sewer separation was selected as the recommended alternative for the Neponset River. The general location of the sewer separation work, covering approximately 68 acres, is presented in Figure 8-11. Although the source of fecal coliform to this receiving water segment is predominantly stormwater and other upstream, non-CSO sources, sewer separation was an appropriate choice due to the critical uses in the Neponset River (shellfishing). In addition, the cost of sewer separation was less than some of the storage alternatives, and would not require siting of new facilities along the river. Sewer separation would not have been appropriate at outfall BOS095 without the proposed separation project for South Dorchester Bay, since BOS095 would still activate in large storms due to surcharging in the Dorchester Interceptor. As described above, even with complete sewer separation, backwater from the Columbus Park Headworks may impact BOS095 during large storm events, unless the Dorchester Interceptor can be hydraulically isolated from the Columbus Park Headworks. The methods for implementing sewer separation (installing new storm drains versus installing new sanitary sewers) will be evaluated during facilities planning and preliminary design.

Water Quality Impacts. With the elimination of CSOs, the primary sources of pollutants causing non-attainment of uses will be stormwater during major rainfall events such as the one-year storm, and upstream flow on an annual basis. The impact of stormwater in the three-month and one-year storm was demonstrated in Figures 8-13 and 8-15. Figure 8-17 indicates the dominance of upstream flows as a source of pollutant loads on an annual basis. As described above, elimination of CSOs in this receiving water will not result in attainment of bacteria count-related designated uses at Tenean Beach and adjacent shellfish beds for the one-year storm. However, sewer separation would allow attainment of these uses if the non-CSO sources could be controlled. Separation would also reduce the risk of contamination from human pathogens. The Massachusetts EOEA study of the Neponset River as a pilot for development of the Massachusetts Watershed Initiative may provide the framework for addressing the non-CSO sources of pollutants causing non-attainment of uses in the Neponset River.

Siting Issues. Sewer separation work would involve open cut excavations in streets and existing rights-of-way. Short-term impacts of this work would be limited to localized construction-related noise, dust, and disruptions to traffic, while long term site impacts would be negligible.

Costs. The capital cost for this alternative is estimated at $11 million, with negligible incremental O&M costs. Total present worth as of December, 1995 would be $9 million.

Considerations for Partial Use Designation. Since CSO discharges will be eliminated from this receiving water segment, modification of state water quality standards to create a partial use designation will not be necessary.

CONSTITUTION BEACH

Complete sewer separation upstream of regulator RE-002-2 will eliminate the only source of CSO to this receiving water segment. The general location of the sewer separation work, covering approximately 37 acres, is presented in Figure 8-18. Since shellfishing and swimming have been designated as critical uses in this waterbody, the elimination of the CSO

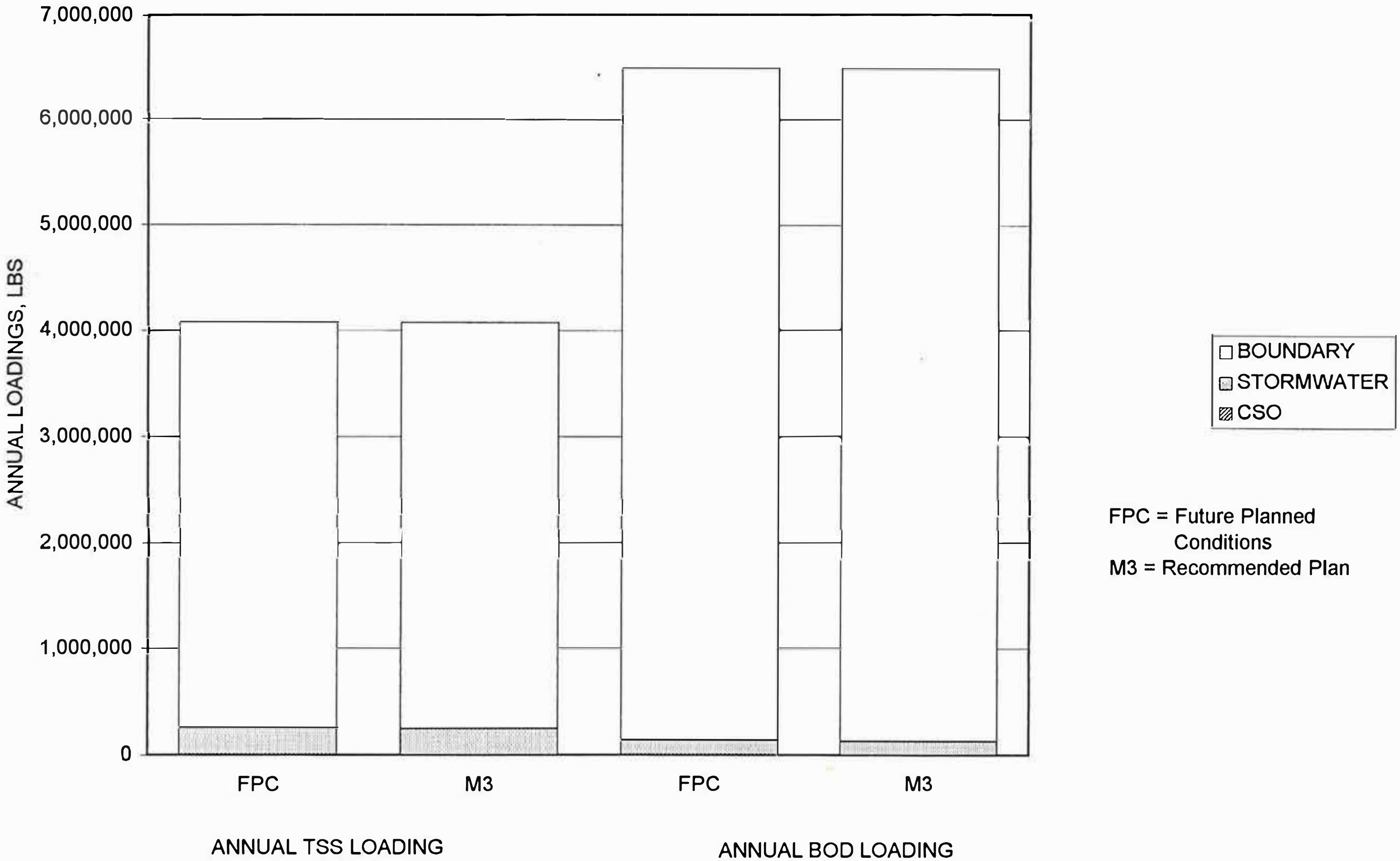
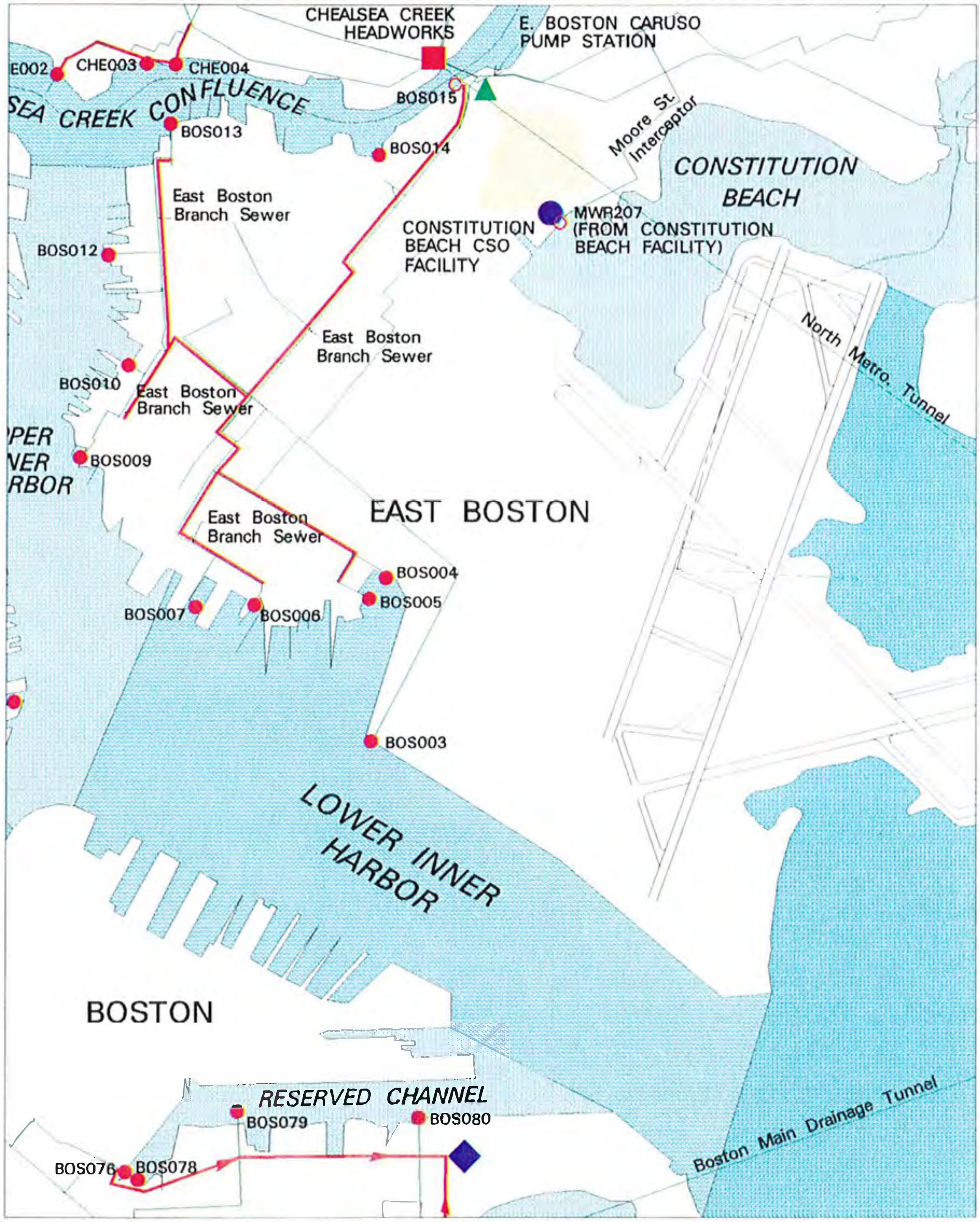


FIGURE 8-17. ANNUAL TSS AND BOD LOADINGS TO NEPONSET RIVER



LEGEND

- Existing Conduit
- Proposed Conduit
- Pump Station
- CSO Treatment Facility
- Proposed CSO Facility
- Headworks
- CSO Outfall
- Eliminated CSO Outfall
- Proposed Sewer Separartion

Feet 2500 0 2500

Figure 8-18

Constitution Beach

Lower Inner Harbor

Recommended Plan

justified the relatively small incremental cost of sewer separation over one-year storm control alternatives. The methods for implementing sewer separation will be evaluated during facilities planning and preliminary design. Once the sewer separation work is completed, the existing Constitution Beach CSO facility will be decommissioned.

Water Quality Impacts. Sewer separation was again not the initially-preferred alternative based on cost-effective analysis. However, the cost of sewer separation was not substantially higher than the cost of other alternatives evaluated, and separation supports the goal of eliminating CSOs to critical use areas. Figures 8-19 to 8-22 present results from the receiving water model for Constitution Beach. From Figures 8-19 and 8-21, it is evident that the durations of violations of bacteria standards are not noticeably impacted by CSO elimination during the three-month and one-year storms. Figures 8-20 and 8-22 indicate the impact of stormwater on the bacteria densities. The similarity between the all-sources and non-CSO sources isopleths at Constitution Beach also demonstrates the impact of non-CSO sources on this receiving water segment. Figure 8-23 presents the annual loads of TSS and BOD for future planned conditions and the recommended plan. The CSO contribution to the annual loads can not be detected on this figure.

Although the receiving water model data indicates that even with elimination of CSOs, violations of bacteria standards will continue to occur in the Constitution Beach receiving water segment during the three-month and one-year storms, eliminating the CSO will reduce the risk of contact with human pathogens in this sensitive area, and will create the opportunity to achieve designated uses should the stormwater sources ultimately be controlled.

Siting Issues. Sewer separation work would involve open cut excavations primarily in streets and existing rights-of-way. Short term impacts of this work would be limited to localized construction-related noise, dust, and disruptions to traffic, while long-term site impacts would be negligible.

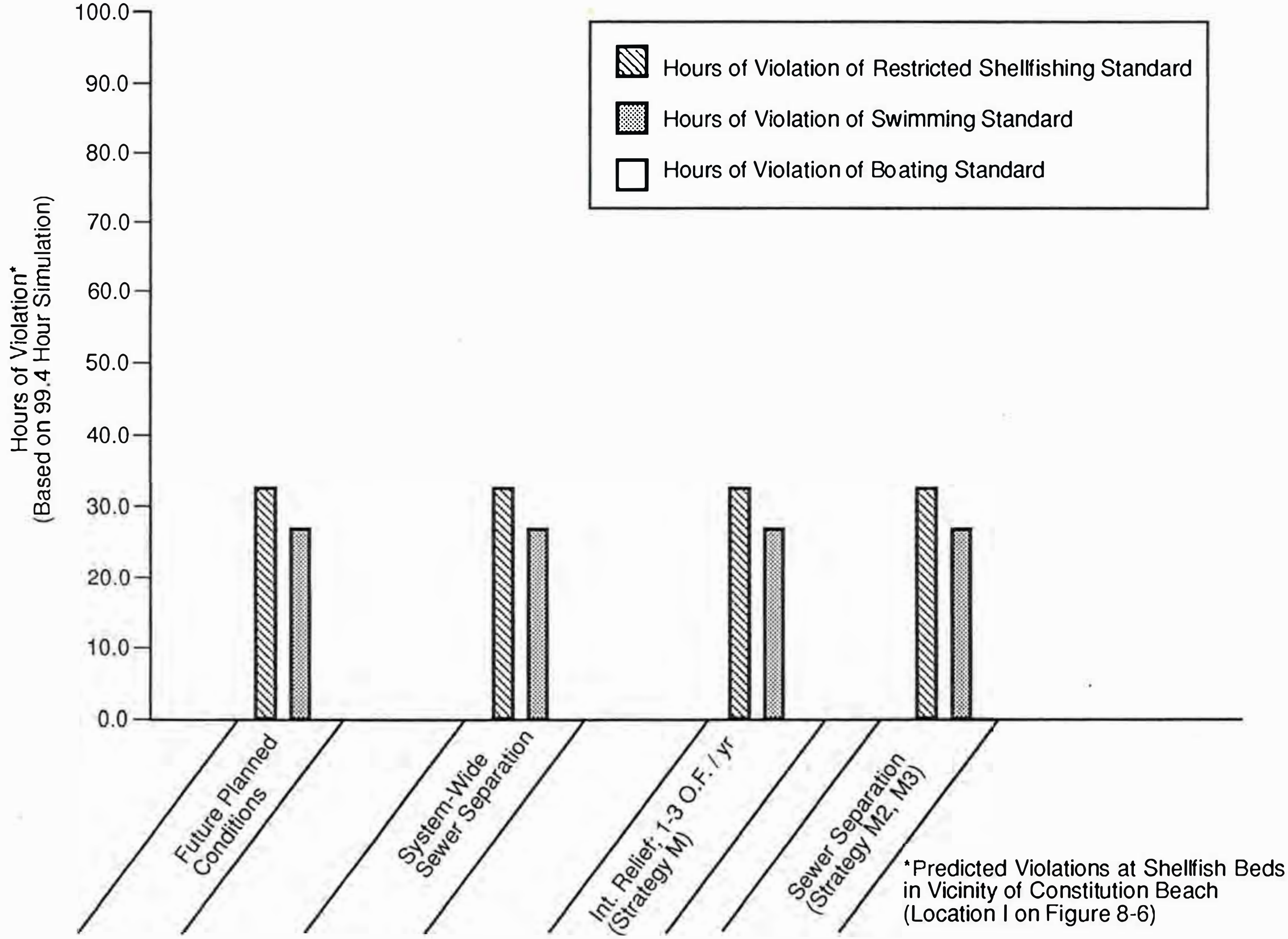


FIGURE 8-19. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 3 MONTH STORM, CONSTITUTION BEACH

4184jp/3mth

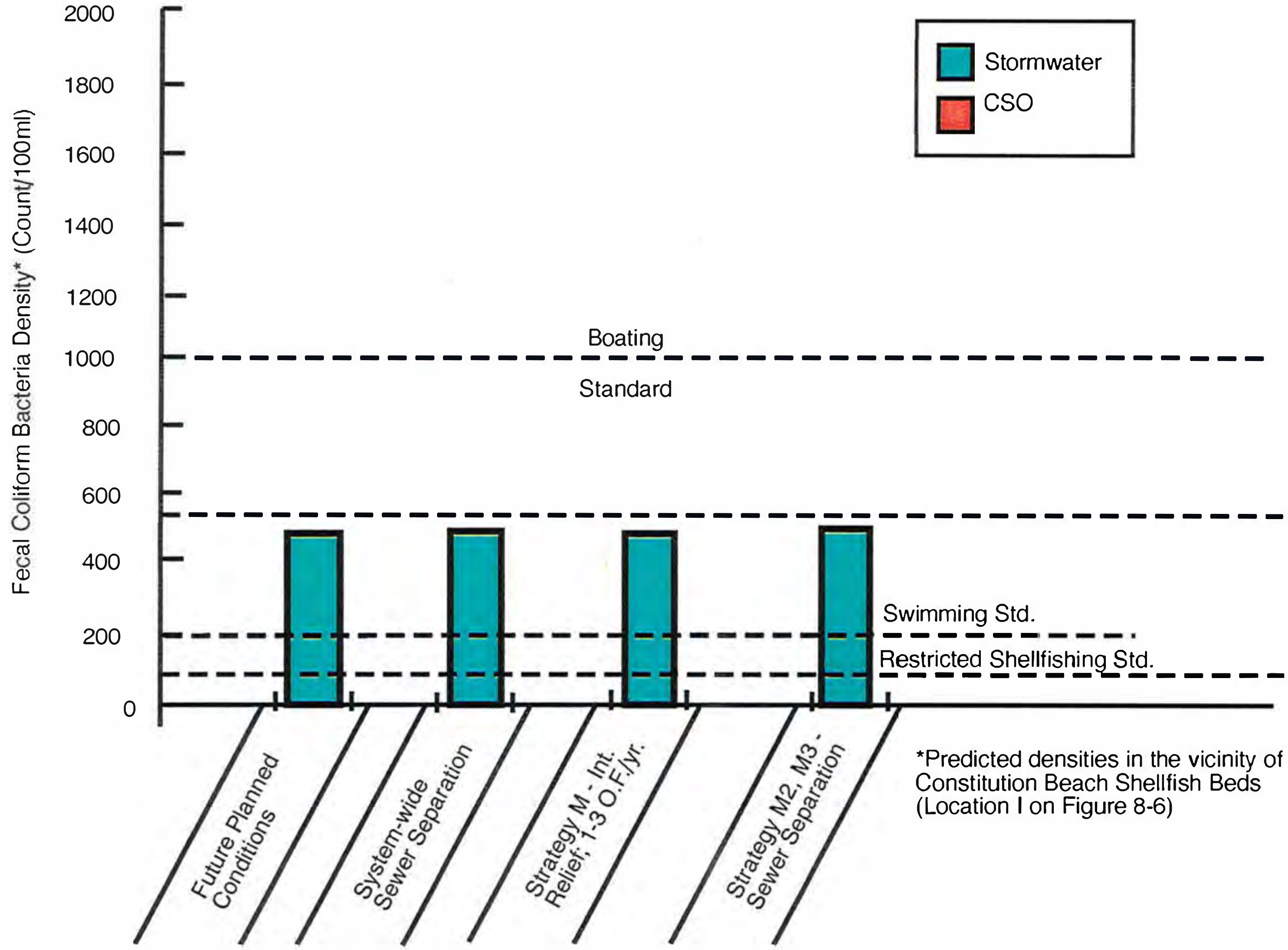
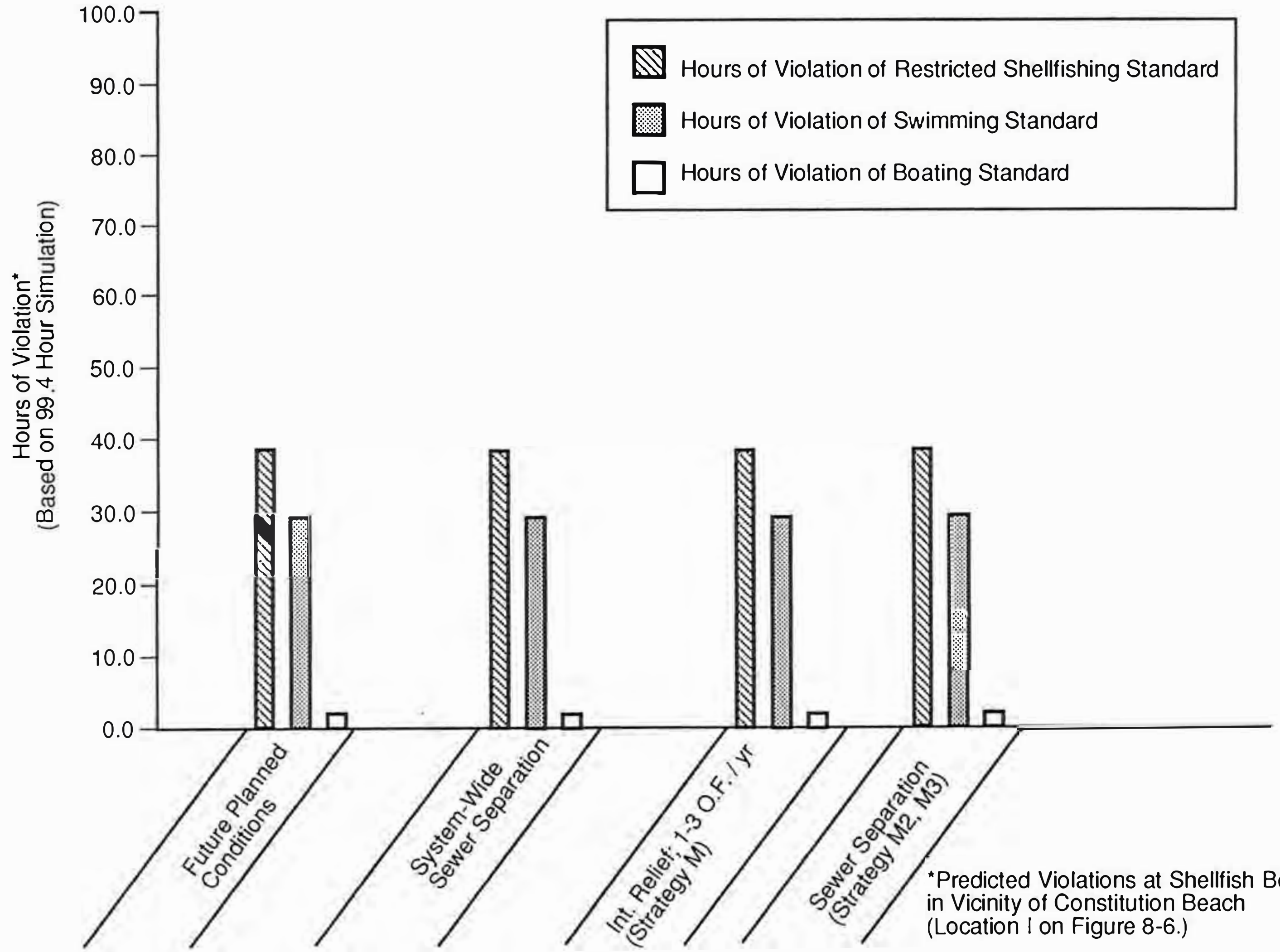


FIGURE 8-20. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 3 MONTH STORM, CONSTITUTION BEACH

4189jp



*Predicted Violations at Shellfish Beds in Vicinity of Constitution Beach (Location I on Figure 8-6.)

FIGURE 8-21. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, CONSTITUTION BEACH

4184jp

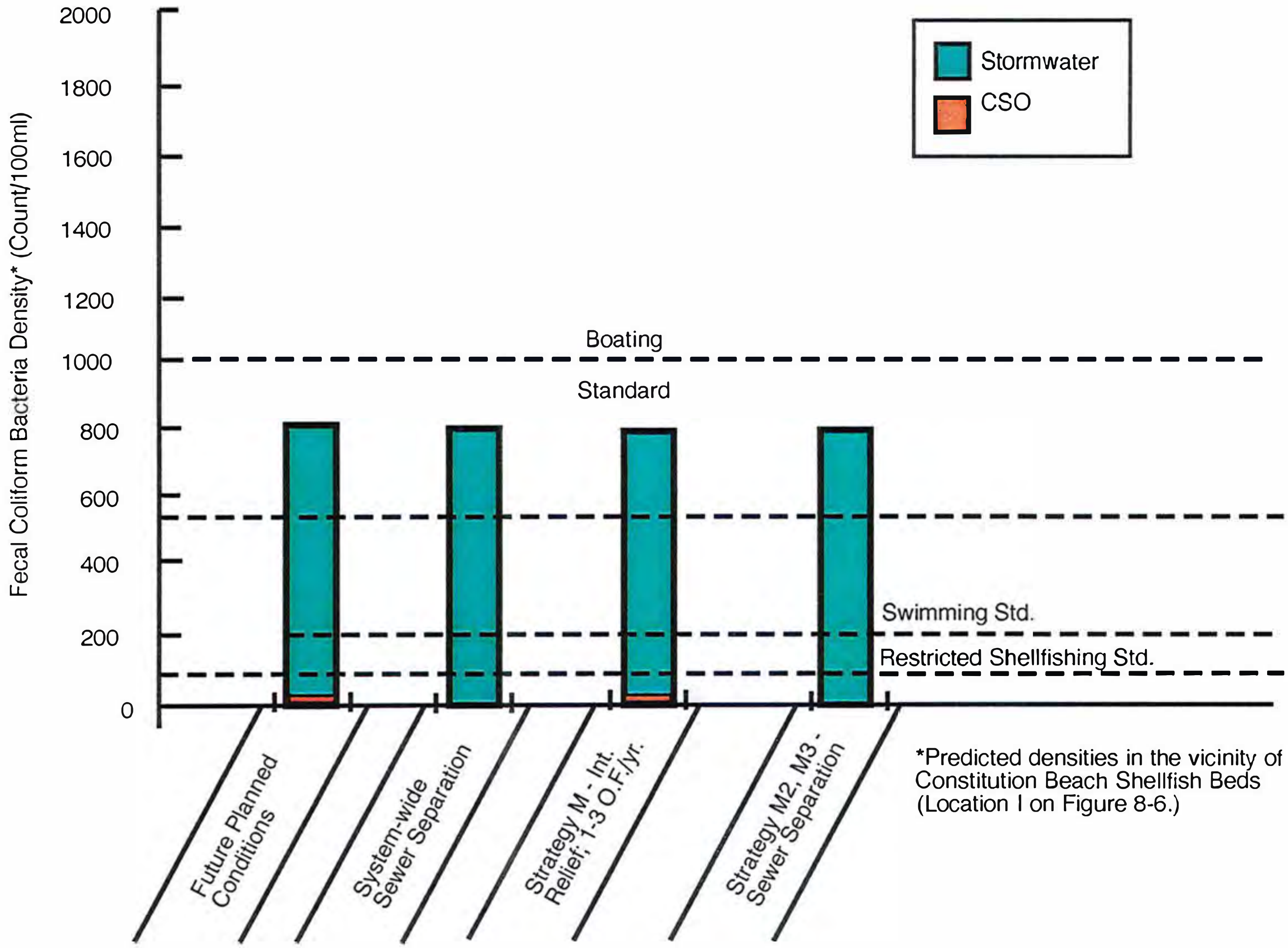


FIGURE 8-22. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1-YEAR STORM, CONSTITUTION BEACH

4190jp

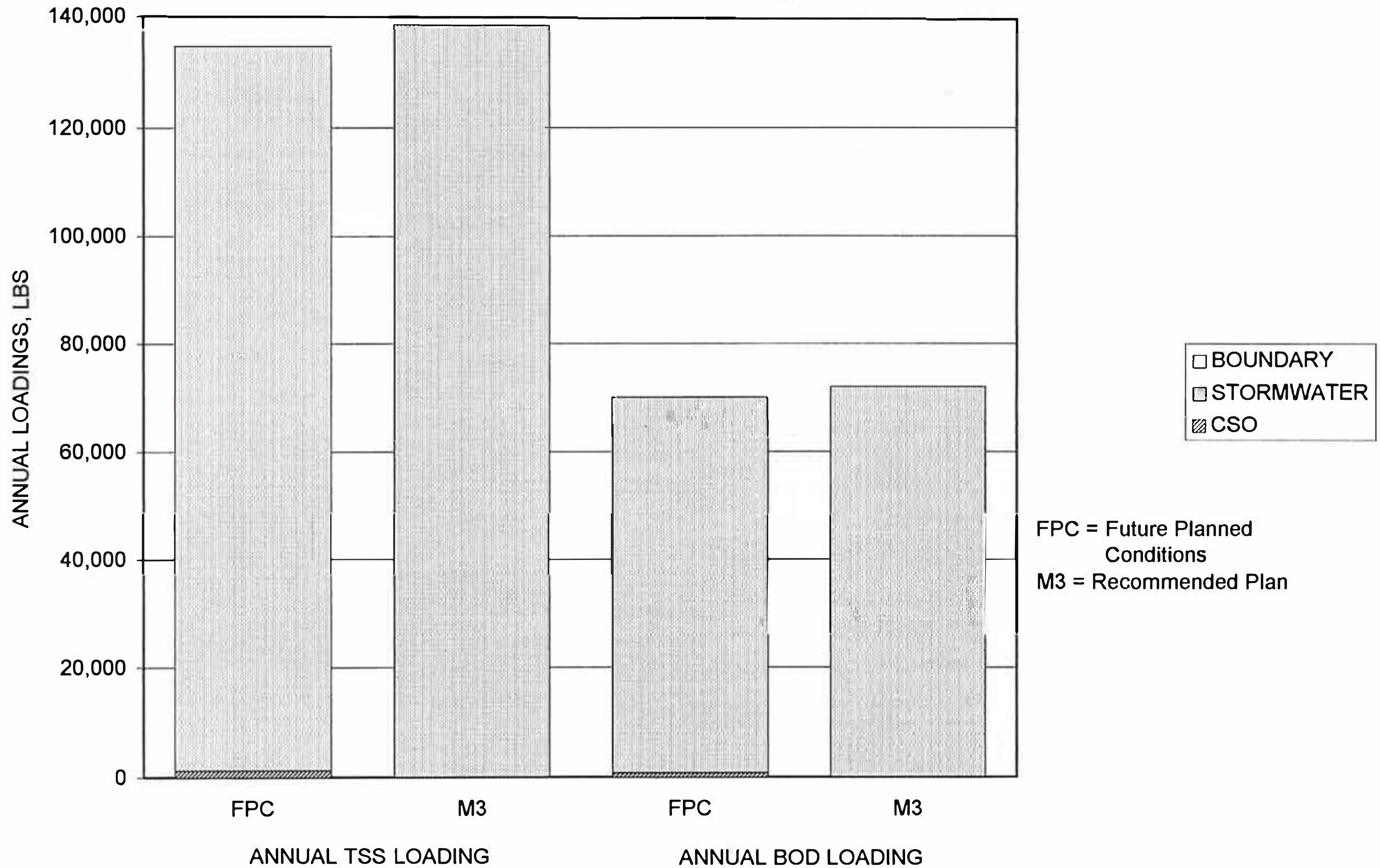


FIGURE 8-23. ANNUAL TSS AND BOD LOADINGS TO CONSTITUTION BEACH

Costs. The estimated capital cost for this alternative is $9 million, with negligible incremental O&M costs. Total present worth as of December, 1995 would be $7 million.

Considerations for Partial Use Designation. Since CSO discharges will be eliminated from this receiving water segment, modification of state water quality standards to create a partial use designation will not be necessary.

CHARLES RIVER BASIN

Upper Charles

The recommended alternative for this receiving water segment includes a screening and disinfection facility at outfall CAM005, relief of the interceptor connection between RE-032-1 and the Charles River Valley Sewer, and screens at the five outfalls that will remain (BOS032, BOS033, CAM007, CAM009, and CAM011) (Figure 8-24). The facility at CAM005 would include mechanically-cleaned bar screens, chemical storage tanks, pumps, and related chemical feed equipment for the disinfection and dechlorination systems, electrical equipment and controls, and truck access for delivery of chemicals and disposal of screenings. It may be possible to locate much of this equipment below grade. The facility could be located either along the outfall pipe, between the regulator and the shore of the Charles River, or offset from the existing outfall, if necessary, based on site availability. A screening and disinfection facility for CAM005 would be smaller and less obtrusive than a tank required to provide a higher level of control.

Approximately 10 minutes of detention time would be available in the existing CAM005 outfall pipe between the regulator and the river during the peak flow from the one-year storm. It may be necessary to lengthen the outfall pipe parallel to the river, or provide other means for increasing the contact time if sodium hypochlorite is to be used as the disinfectant.

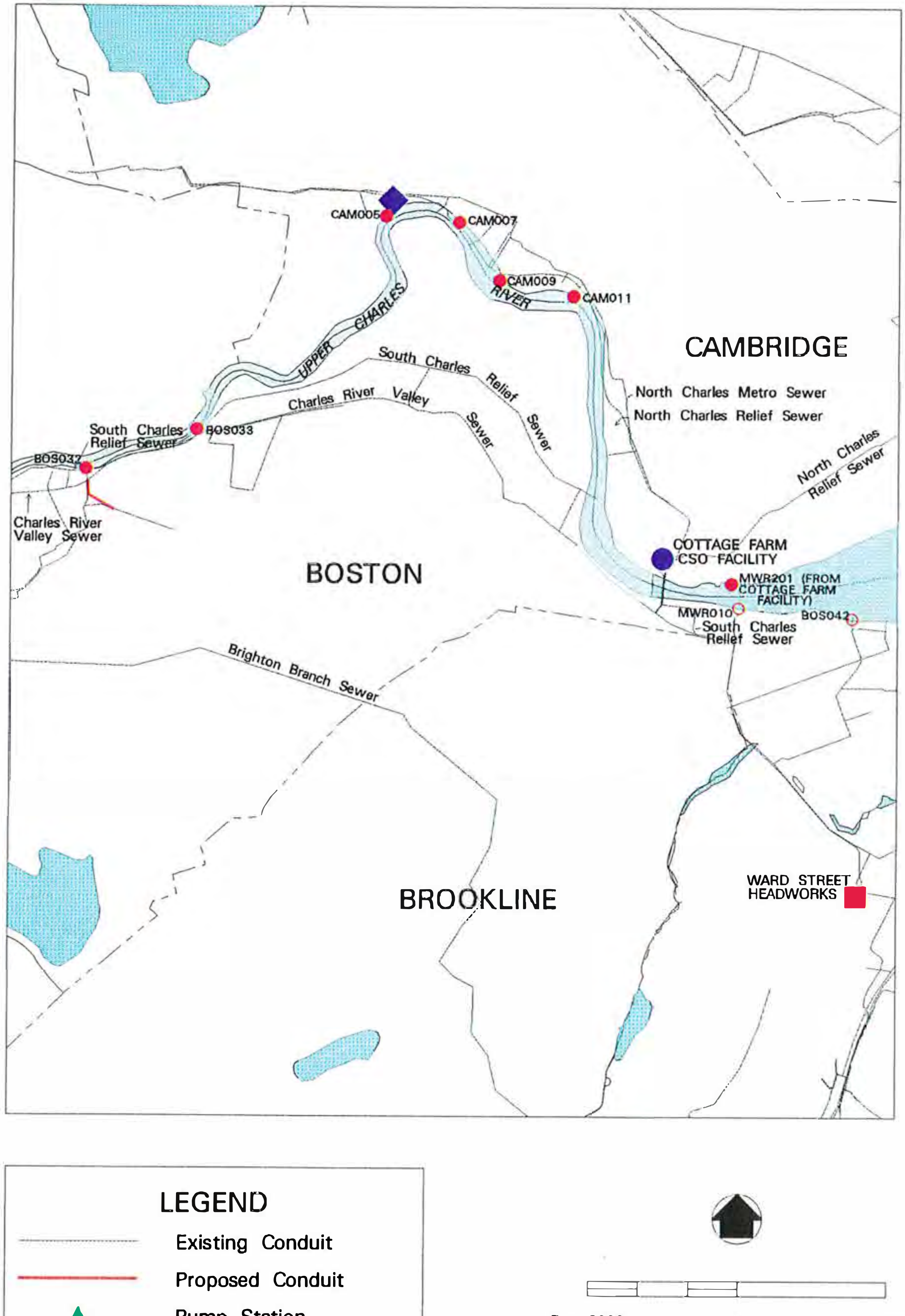


Figure 8-24
Upper Charles
Recommended Plan

Relief of the interceptor connection at RE-032-1 is predicted to eliminate the overflow at outfall BOS032 during the one-year storm, and reduce the annual activation frequency to approximately four times per year. The BWSC has identified the potential for local sewer separation work upstream of BOS032 and BOS033. This work would be generally consistent with the recommended plan, although separation of BOS032 would eliminate the need to enlarge the interceptor connection at RE-032-1.

Portions of the Cambridge Phase VI sewer separation work are currently underway upstream of CAM011. Full implementation of Phase VI would not change the recommended plan, nor would termination of Phase VI. With or without Phase VI, a treatment facility would be required at CAM005, while CAM007, CAM009, and CAM011 would activate less than four times per year. The typical year simulation was run assuming full implementation of Phase VI sewer separation. As indicated in Table 8-1, overflows were reduced at CAM007, CAM009 and CAM011, but a significant CSO discharge frequency and volume remained at CAM005.

Water Quality Impacts. While the Upper Charles supports substantial recreational use, the proportion of pollutants, such as fecal coliform, BOD, TSS, and nutrients, contributed by CSOs is relatively small compared to stormwater and other non-CSO sources (See Figure 7-2 and Appendix F). Figures 8-25 to 8-28 present results from the receiving water model for the Upper Charles. From Figures 8-25 and 8-27, it is apparent that the durations of violations of bacteria standards would not be substantially impacted even by CSO elimination. The duration of violation of the swimming standard during both the one-year and three-month storm is indicated to be approximately 99 hours. Since the model simulation was for 99 hours, starting six hours before the start of the storm, the model is demonstrating that the swimming standard is already violated before the storm starts. The relative impact of stormwater is evident in Figures 8-26 and 8-28. The contribution of bacteria from upstream sources is relatively small, due to die-off between the Watertown dam and the sample point in the model (Weld Boathouse). Since the Charles River receiving water model is a one-dimensional model, isopleths of the bacteria data are not available. The

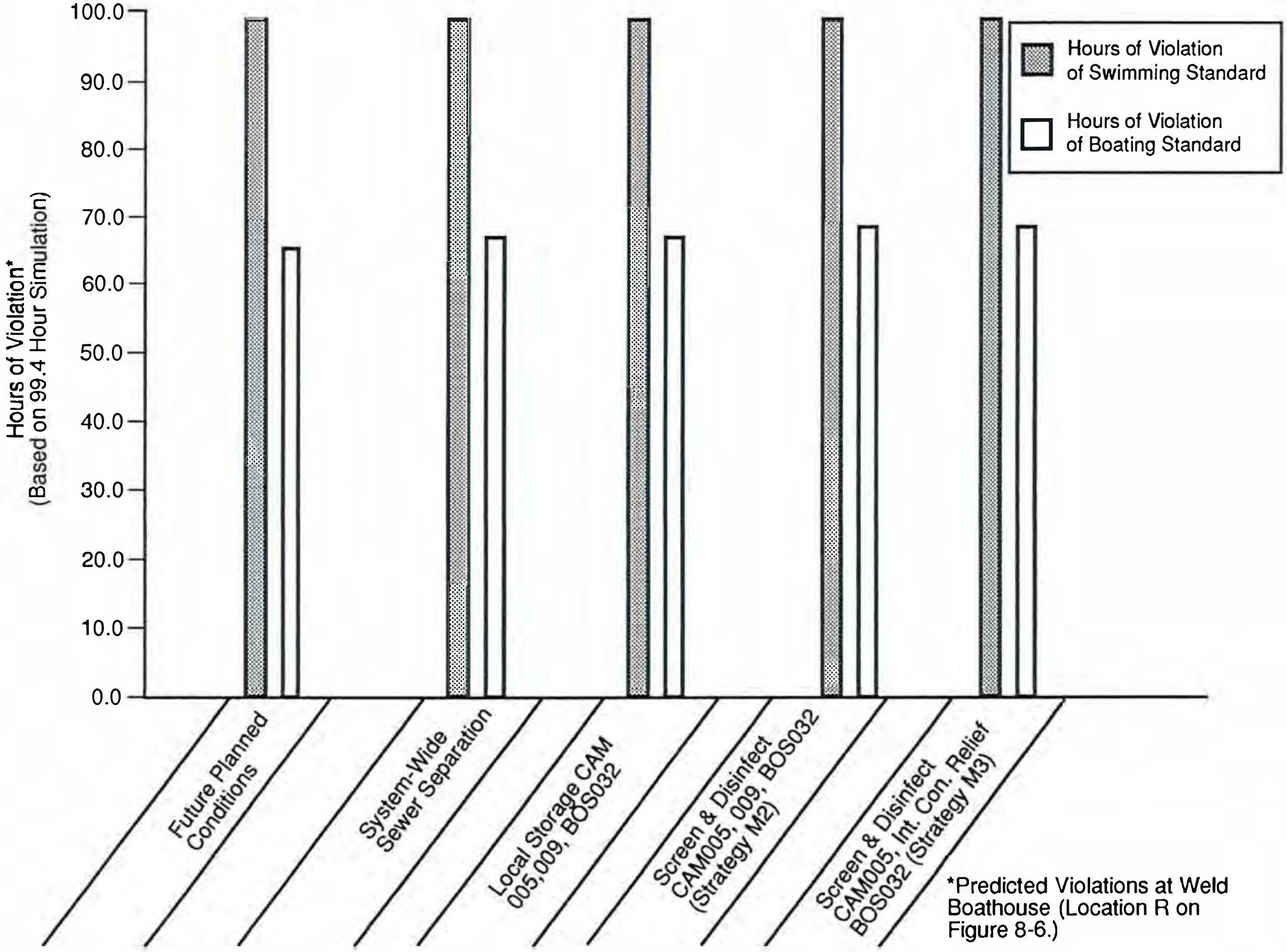
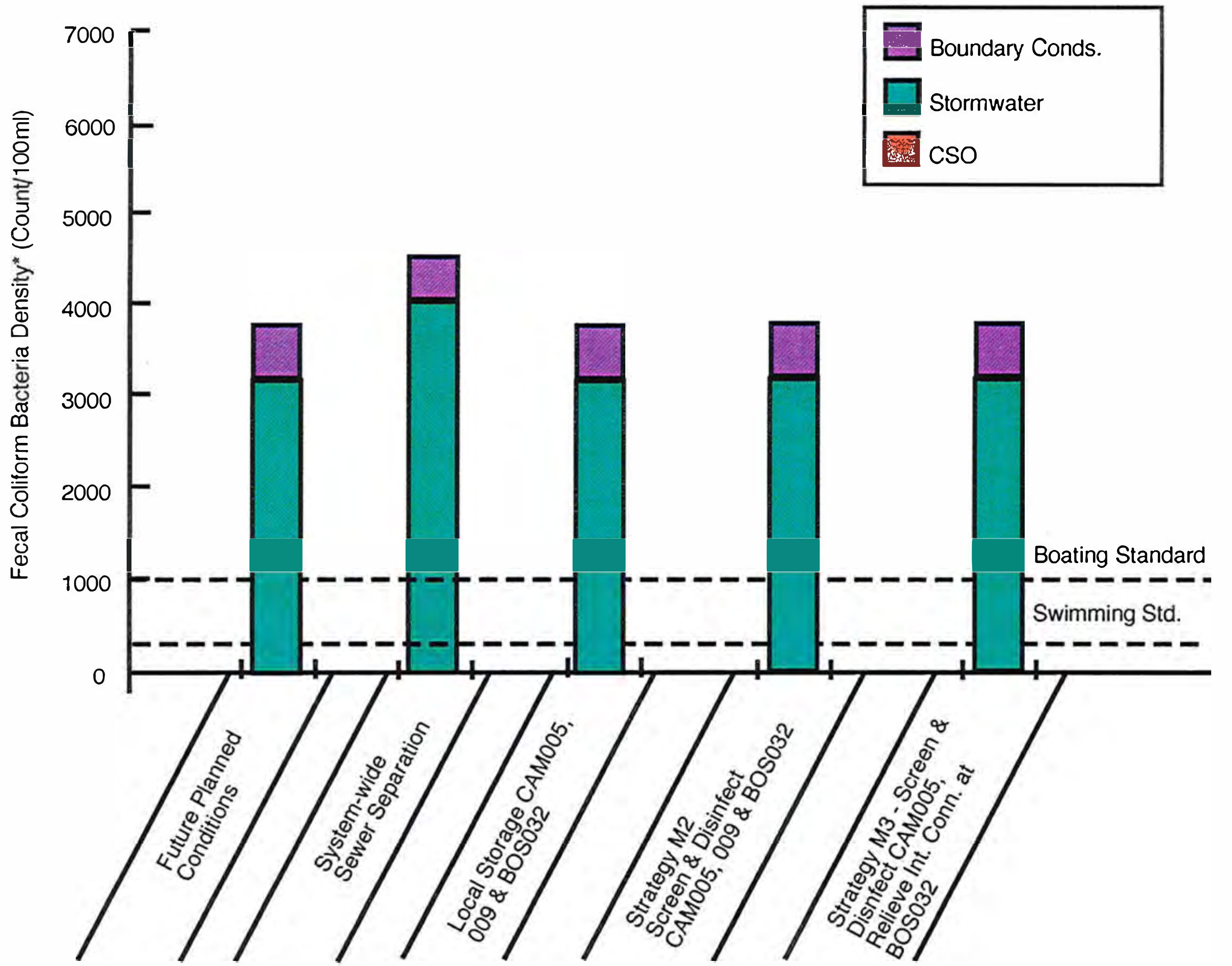


FIGURE 8-25. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 3 MONTH STORM, UPPER CHARLES

4184jp/3mth



*Predicted densities at Weld Boathouse
(Location R on Figure 8-6.)

FIGURE 8-26. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 3 MONTH STORM, UPPER CHARLES

4189JP

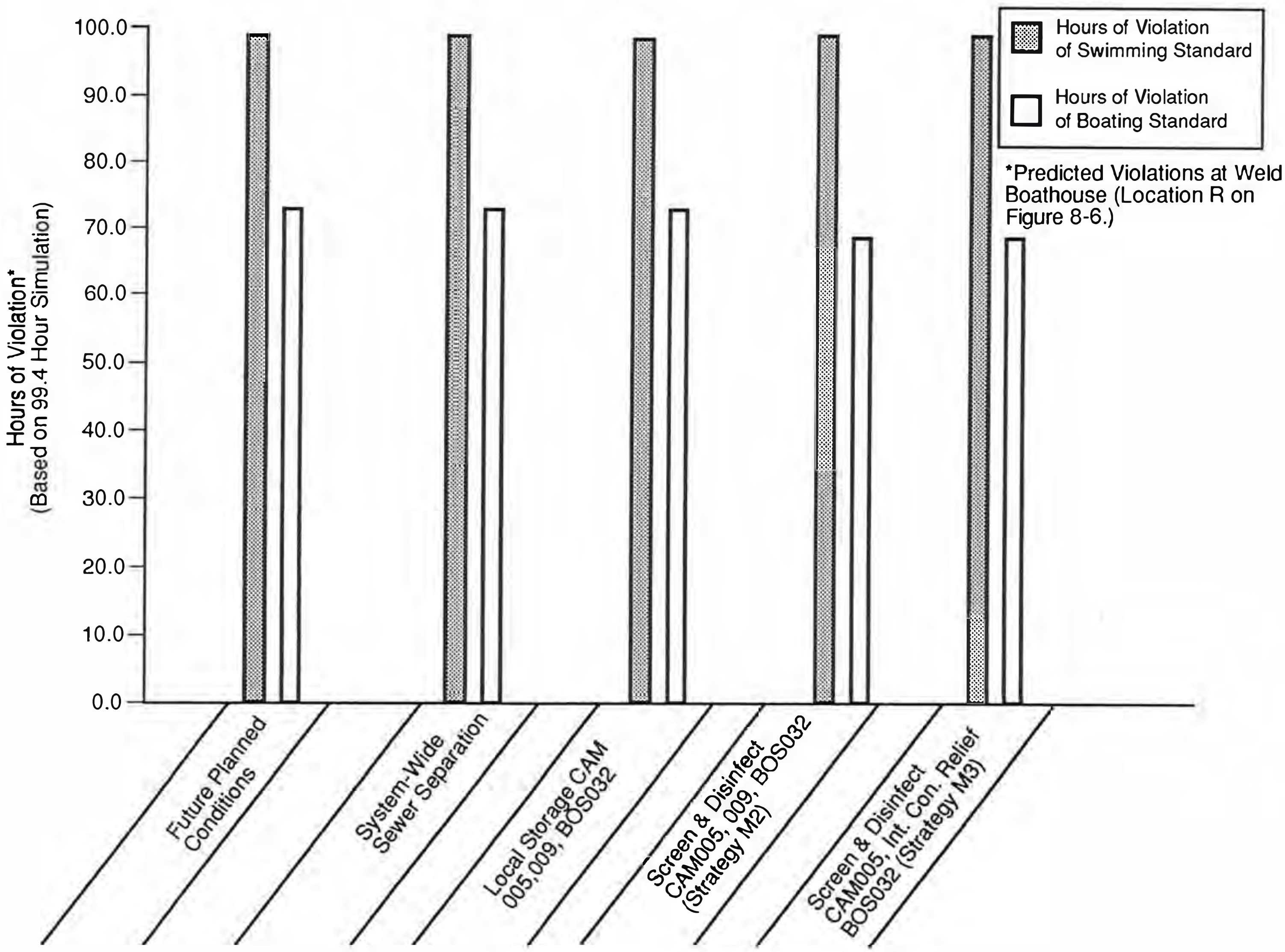


FIGURE 8-27. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, UPPER CHARLES

4184jp

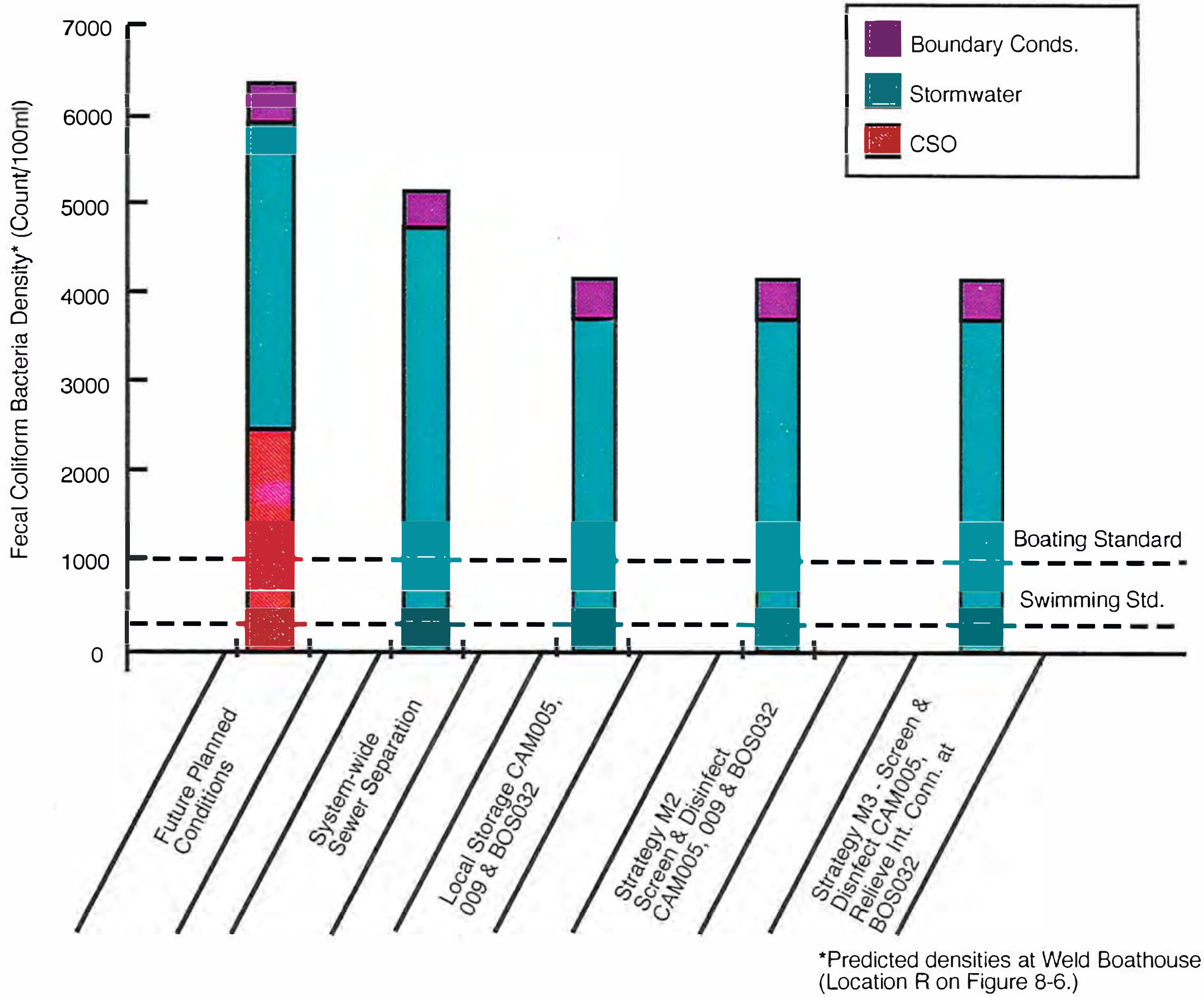


FIGURE 8-28. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1-YEAR STORM, UPPER CHARLES

4190jp

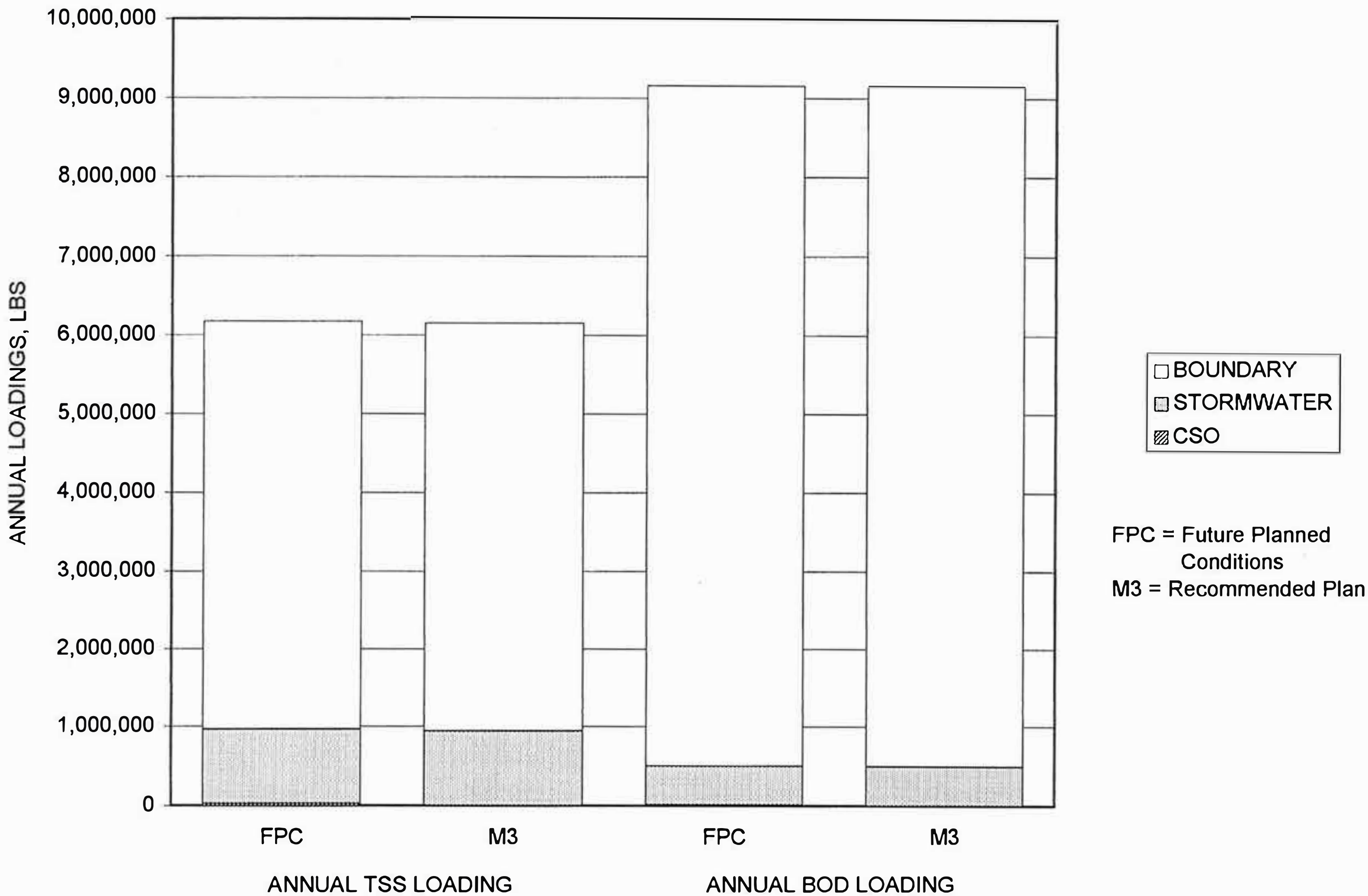


FIGURE 8-29. ANNUAL TSS AND BOD LOADINGS TO THE UPPER CHARLES RIVER

substantial impact of upstream sources on annual loads of TSS and BOD to the Upper Charles is demonstrated in Figure 8-29.

Given that higher levels of control produced no measurable improvement in attainment of uses for the Upper Charles, the most cost-effective alternative was selected. Disinfection of the CSOs at CAM005 would help to reduce the risk of contact with human pathogens. Additional controls by the MWRA could become appropriate in the Upper Charles in the future, pending completion of comprehensive watershed planning and integration with substantial control of stormwater and other non-CSO pollution sources by other parties. For example, storage of the three-month storm could be provided at CAM005, so that all CSO discharges for the Upper Charles, treated or untreated, would be reduced to approximately four per year, or less.

Siting Issues. The CAM005 facility could be located next to a playground along Mount Auburn Street, or it may be possible to locate the facility further upstream along the Charles River. Sites located away from the existing CAM005 outfall would require additional pipe installation and potentially a new outfall, which are not included in the current cost estimate. Such a location could, however, result in the creation of the additional contact time necessary to provide adequate disinfection of the one-year storm flows.

Replacing the interceptor connection at RE-032-1 would require open-cut excavation along North Beacon Street, across Birmingham Parkway, and through a parking lot. Installing screens on the outfalls would likely involve construction within existing manholes, or replacement of a manhole. Short term impacts of these facilities would include construction-related noise, dust, and traffic impacts. Traffic impacts along Memorial Drive and noise impacts on Mount Auburn Hospital may be significant, while use of the playground would be impaired if that site were selected. Long term site impacts would primarily involve a moderate increase in truck traffic associated with the CAM005 facility operation. Aesthetic impacts of the building at CAM005 could be mitigated through architectural treatments and locating facilities underground to the extent feasible.

Costs. The estimated capital cost for this alternative is $5 million, with approximately $115,000 per year in annual O&M costs. Present worth as of December, 1995 would be $4 million.

Considerations for Partial Use Designation. A request for a partial use designation in this receiving water segment will be required, since under the recommended plan ten treated overflows and approximately four untreated overflows per year are predicted to occur. Cost/performance relationships for percent removal of fecal coliform bacteria, TSS, and BOD versus present worth costs are presented in Appendix G. These analyses clearly showed that sewer separation at a cost of $70 million provided no measurable removal of pollutant loads compared to other alternatives for storage, treatment, or screening at costs ranging from less than $0.1 million to $10 million. Relocation of CSO outfalls is not feasible since there is no less sensitive receiving water in proximity.

Based on the evaluation of site-specific water quality conditions and the relatively minor impacts from CSOs compared to other sources of pollution, a higher level of CSO control would produce no measurable improvement in attainment of beneficial uses. The recommended alternative achieves the engineering target set by DEP for achievement of designated uses to the maximum extent feasible in partial use segments with an average of four untreated overflows per year. The cost of higher levels of CSO control would be excessive compared to any potential benefits to the achieved.

Lower Charles

The recommended alternative for this receiving water segment involves providing a screening and disinfection facility for the Stony Brook Conduit flows; upgrading the existing Cottage Farm CSO Facility with new effluent screens, an outfall diffuser, and dechlorination equipment; bulkheading regulators tributary to outfalls MWR010 and BOS042; and providing screens at the remaining outfalls (MWR018 to MWR022, BOS049, BOS028, SOM010, and CAM017) (Figure 8-30). The Cottage Farm facility currently provides a modest level of

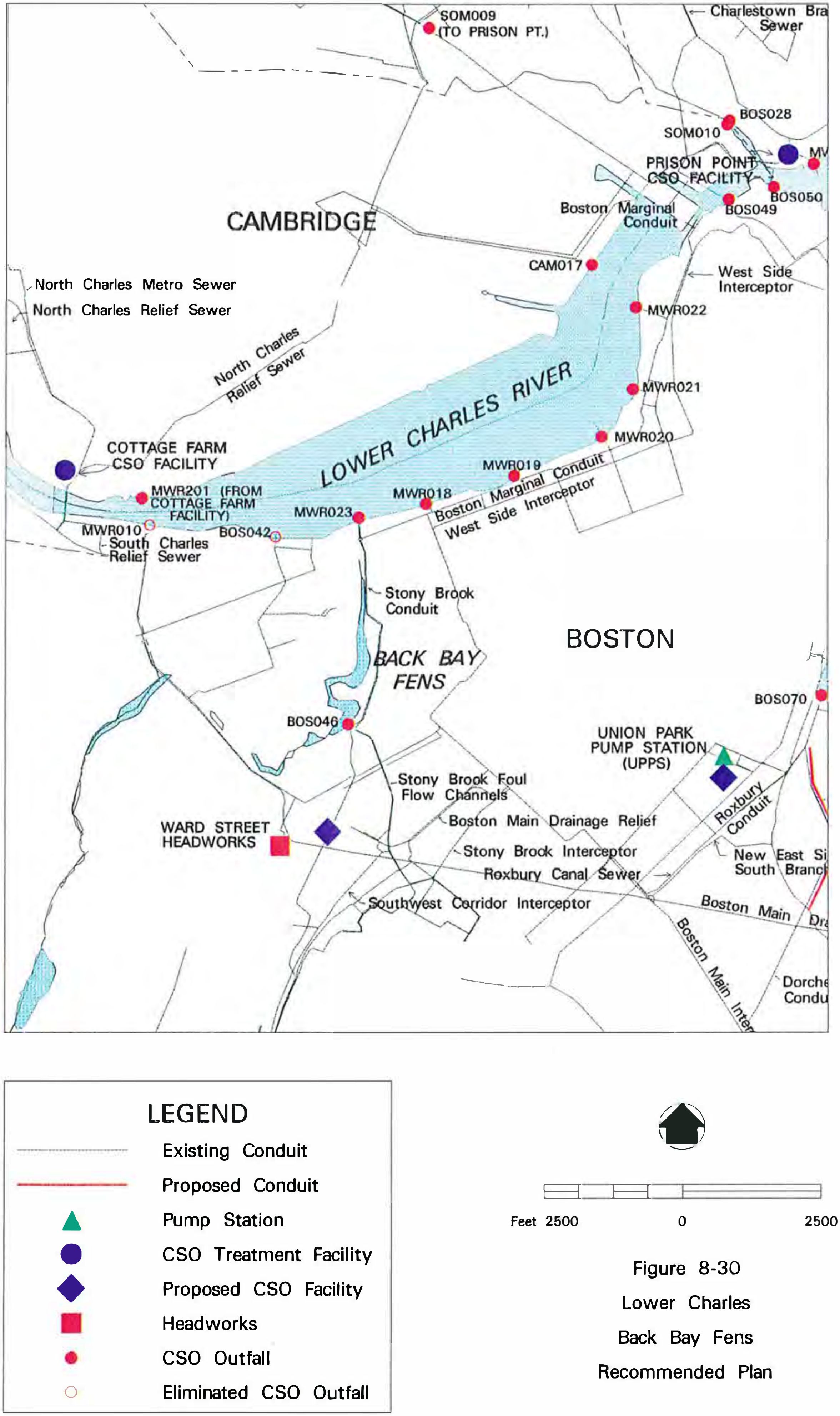


Figure 8-30
Lower Charles
Back Bay Fens
Recommended Plan

BOD, TSS, and fecal coliform reduction, particularly during small storm events. New effluent screens would improve the solids and floatables capture, while a new effluent diffuser would eliminate the boil created at times in the Charles River when the facility is discharging flow. Dechlorination would eliminate the potentially toxic chlorine residual in discharged flows. With the full implementation of Cambridge Phase VI sewer separation (upstream of CAM011), annual discharge volumes at Cottage Farm will be reduced, as indicated in Table 8-1.

A benefit of locating the screening and disinfection facility on the Stony Brook Conduit is that a substantial reduction in stormwater fecal coliform load would also be achieved, without removing this flow from the Charles River basin. It is anticipated that dry weather flow in the Stony Brook Conduit would be bypassed around the facility.

Approximately 30 minutes of detention time would be available through the Cottage Farm facility during the peak flow from the three-month storm, and 11 minutes during the peak of the one-year storm. If the screening and disinfection facility for the Stony Brook Conduit flows is located near the Ward Street Headworks, detention times of approximately 24 and 17 minutes would be available in the Stony Brook Conduit during the three-month and one-year storms.

With the blocking of the regulators tributary to outfalls MWR010 and BOS042, these CSO outfalls could be re-classified as stormwater outfalls. The remaining outfalls to the Lower Charles are predicted to activate less than four times per year.

Water Quality Impacts.

The overall water quality in the Lower Charles has already been substantially impacted by previous projects within the MWRA's CSO program. As mentioned at the beginning of this chapter, improvements to the transport system have already resulted in substantial reductions in annual CSO volumes since 1988. Increased pumping capacity and reliability at Deer

Island has reduced the need to restrict or "choke" wet-weather flows at the Ward Street Headworks, which is a primary cause of overflows into the Lower Charles. Figure 8-31 shows the relationship between the average number of hours per month that flow was restricted at Ward Street, and the annual discharge volume at the Cottage Farm CSO Facility. As the hours of choking decrease, the annual discharge volume also decreases. The increases in choking in 1992 and 1993 were caused by construction-related impacts at Deer Island, and the hours are expected to decrease again through 1997.

CSO is a significant source of fecal coliform in the Lower Charles during individual storm events, but other pollutants such as TSS and BOD are predominantly from stormwater or upstream, non-CSO sources (see Figure 7-2 and Appendix F). Treating CSO fecal coliforms is therefore appropriate for this waterbody, but providing higher levels of control for other constituents might not achieve a substantial improvement in water quality on an annual basis, as upstream areas constitute by far the most significant source of pollutant loads.
Figures 8-32 to 8-35 present results from the receiving water model for the Lower Charles. As with the Upper Charles, it is apparent from Figures 8-32 and 8-34 that elimination of the CSOs to the Lower Charles will not impact the hours of violation of the swimming standard, which extend through the six-hour period prior to the start of the storms. The recommended plan has about the same impact on the boating standard as storage of the one-year storm, but is substantially less expensive ($31 million vs. $250 million capital cost). The relative impact of stormwater and upstream flow is demonstrated in Figures 8-33 and 8-35. Comparing Figures 8-34 and 8-35, it is apparent that under the recommended plan, the violation of the boating standard occurs more than eight hours after the peak of the one-year storm. The substantial impact of upstream flow on annual TSS and BOD loads to the Lower Charles is demonstrated in Figure 8-36.

Given that higher levels of control produced no substantial improvement in attainment of uses for the Lower Charles, the most cost-effective alternative was selected. As with the Upper Charles, however, additional controls by the MWRA could become appropriate in these areas in the future, pending completion of comprehensive watershed planning and integration with

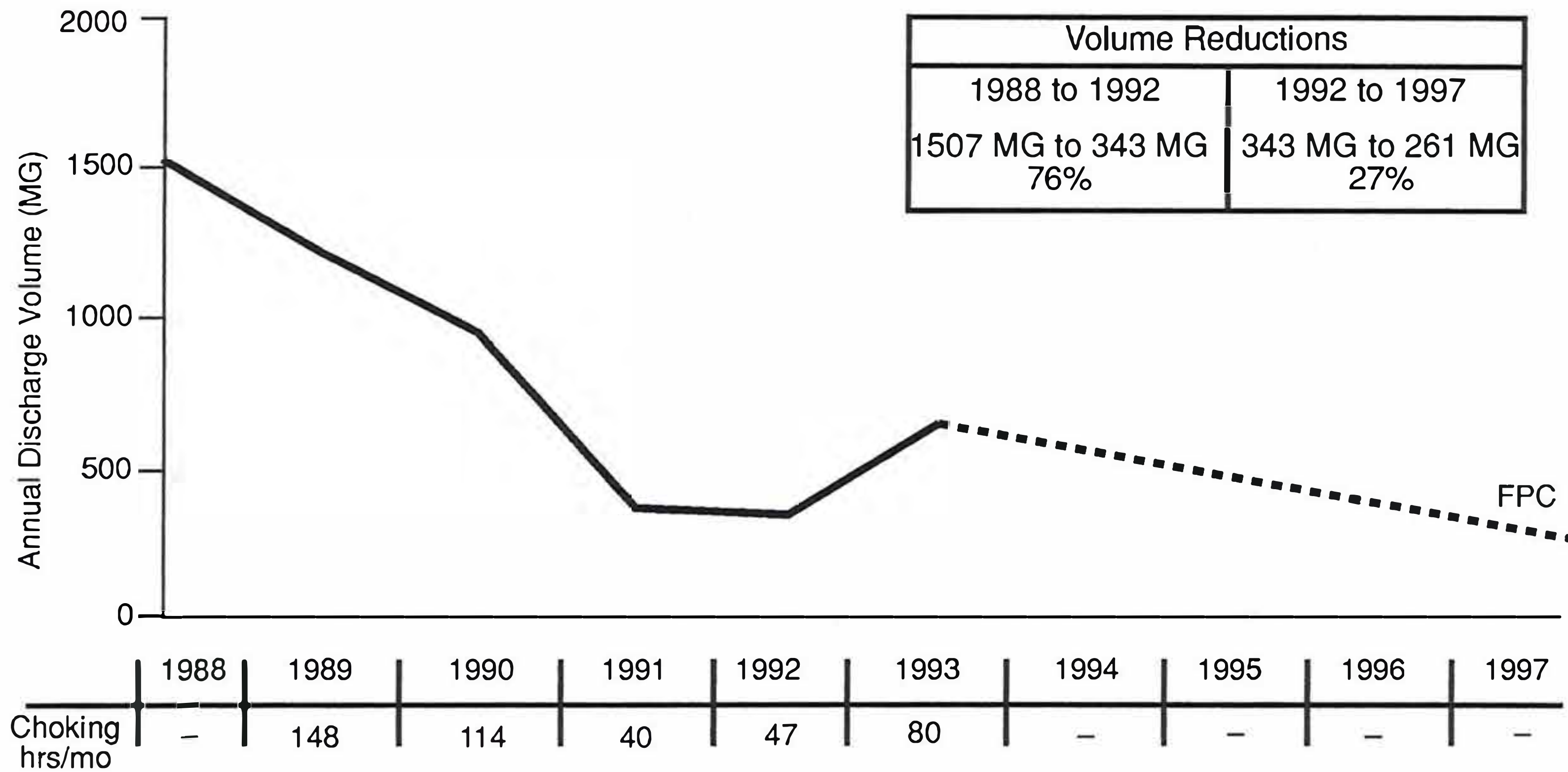


FIGURE 8-31. COTTAGE FARM CSO TREATMENT FACILITY ANNUAL DISCHARGE VOLUMES

3956jp

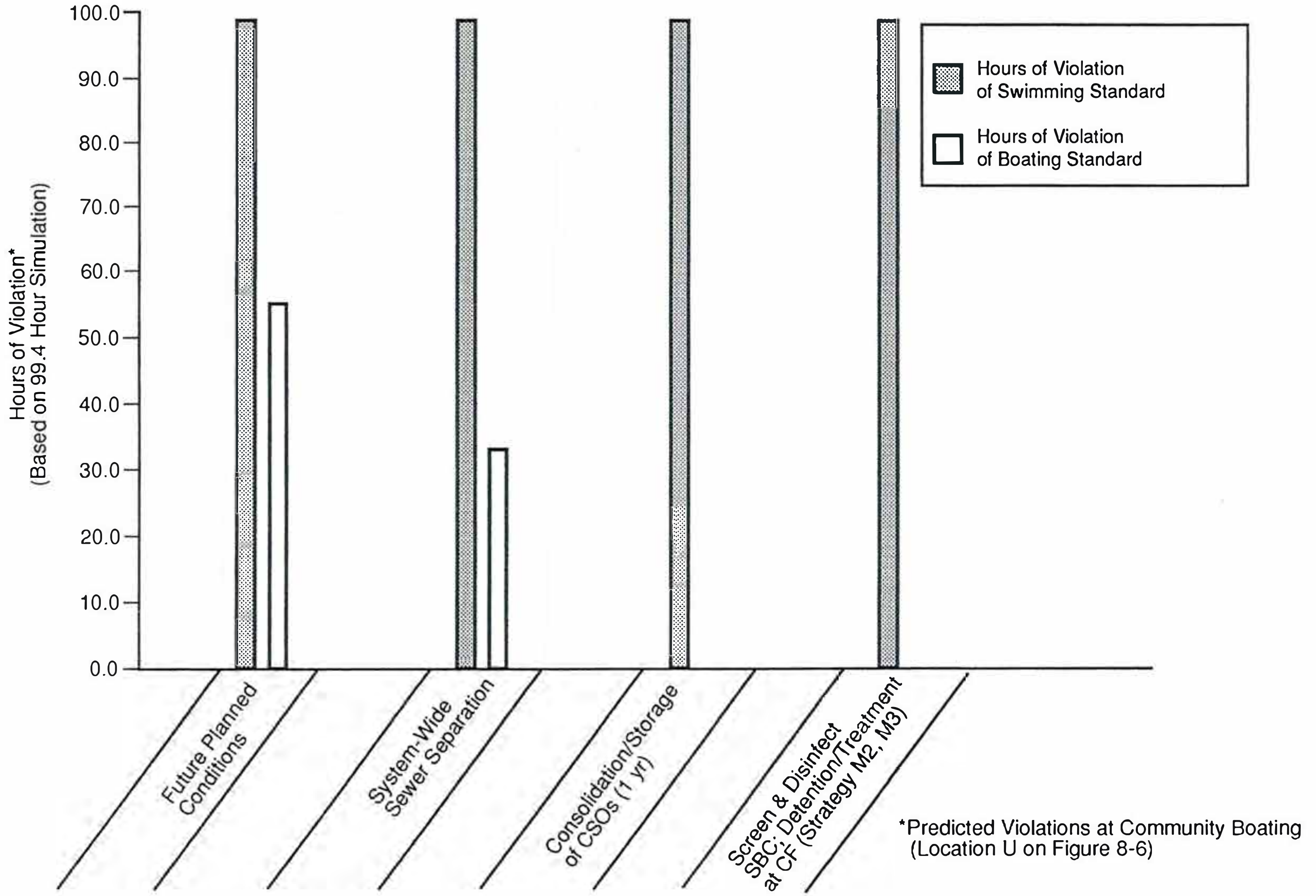


FIGURE 8-32. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 3 MONTH STORM, LOWER CHARLES

4184jp/3mth

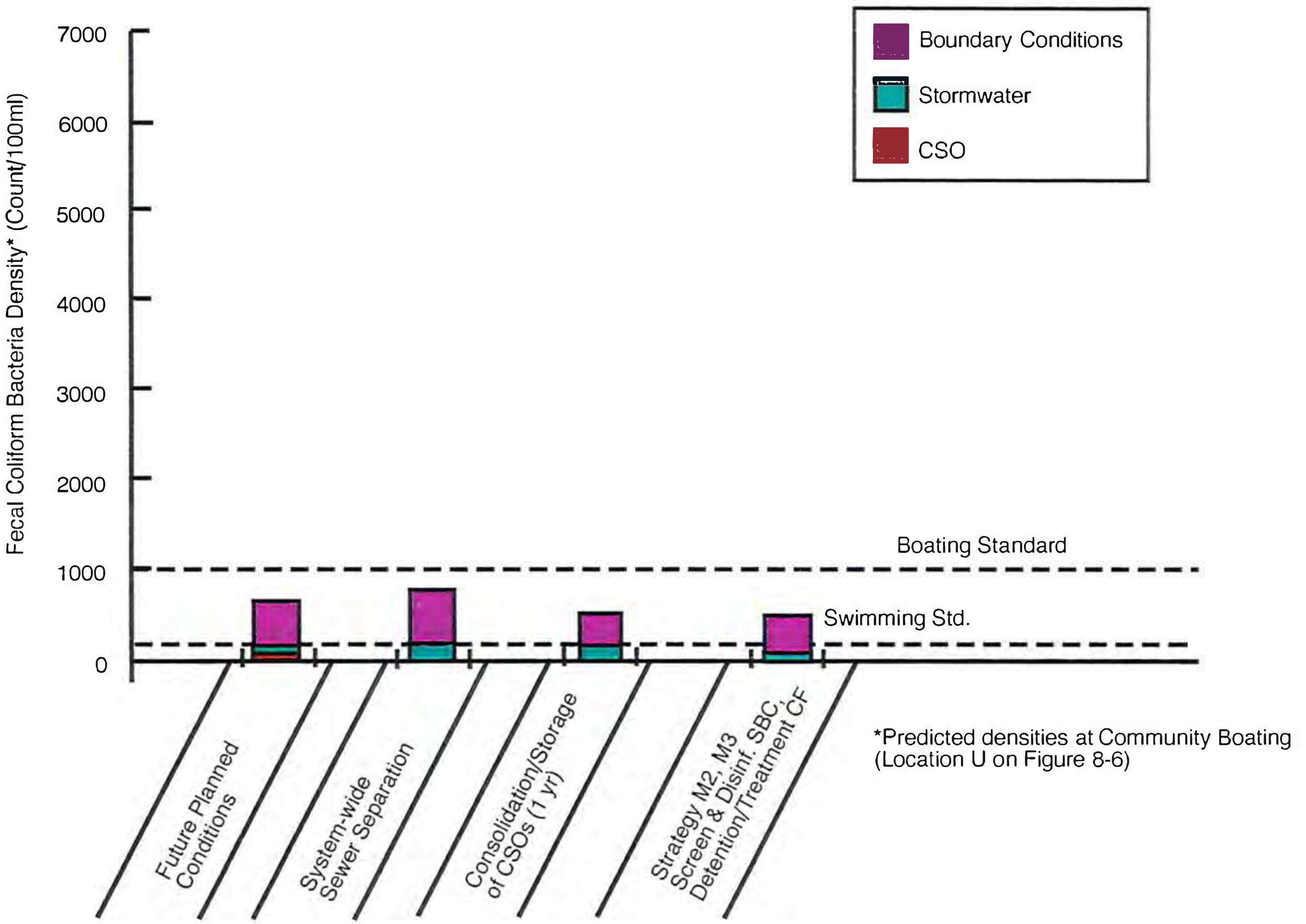


FIGURE 8-33. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 3 MONTH STORM, LOWER CHARLES

4189jp

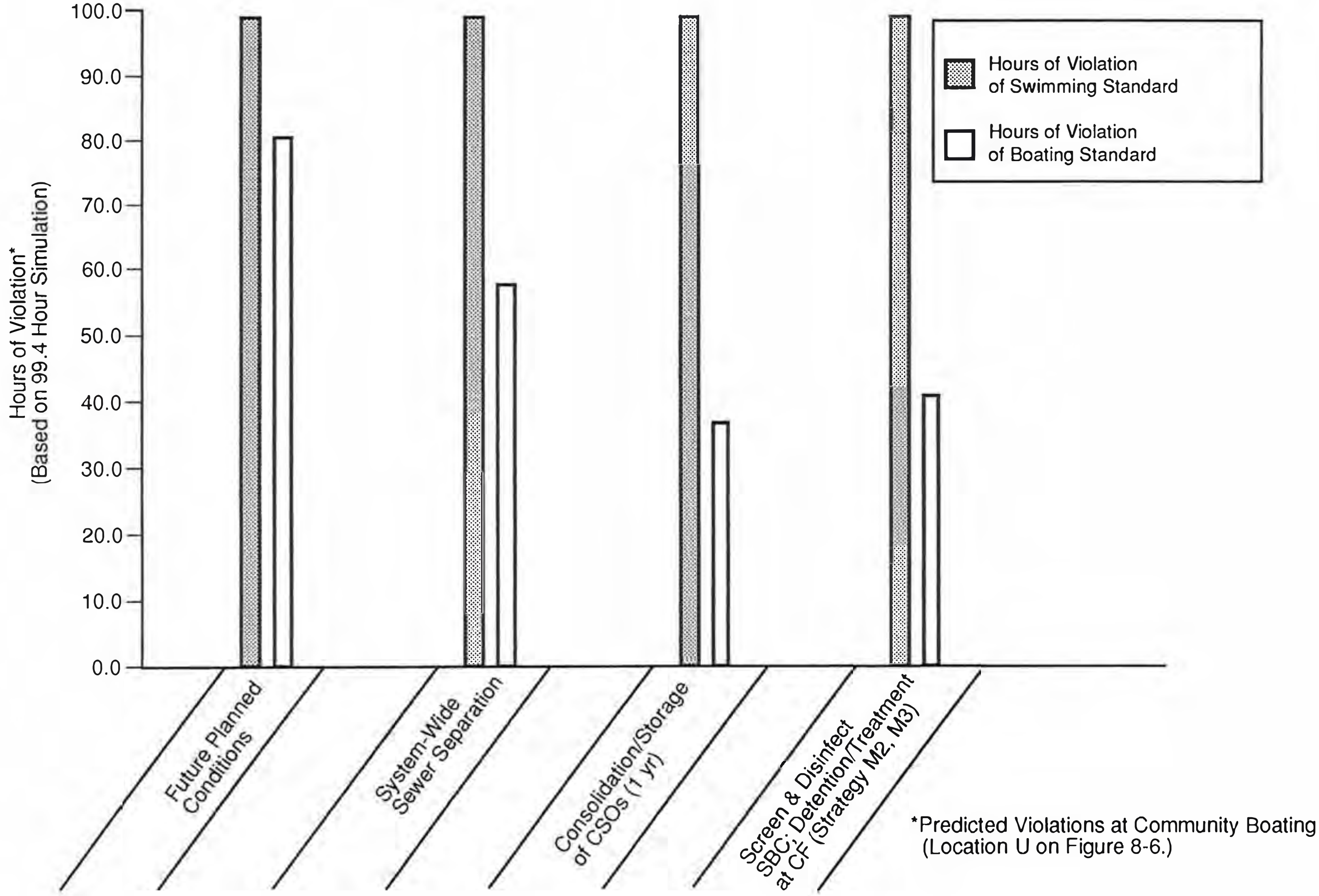
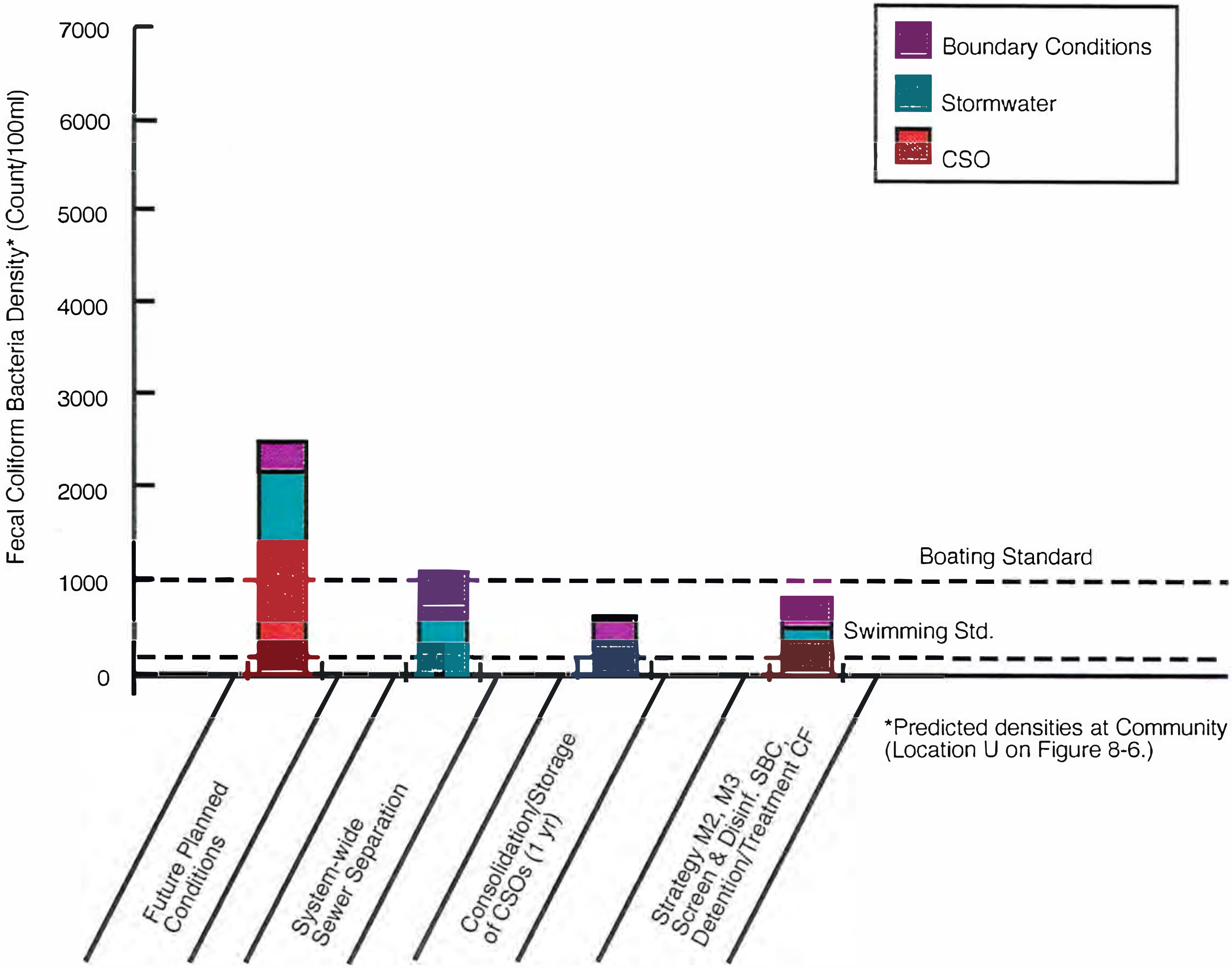


FIGURE 8-34. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, LOWER CHARLES

4184jp



*Predicted densities at Community Boating (Location U on Figure 8-6.)

FIGURE 8-35. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1-YEAR STORM, LOWER CHARLES

4190jp

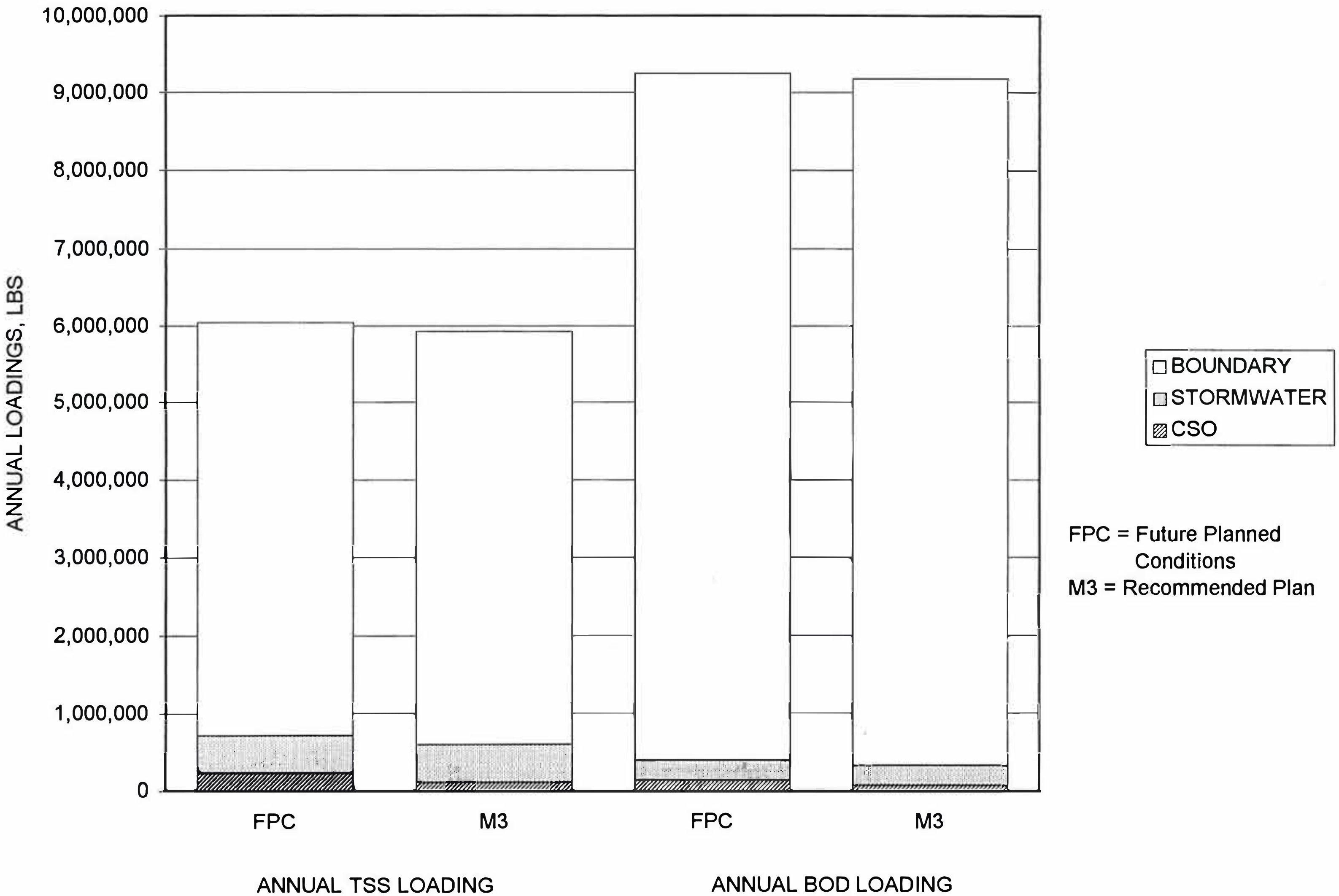


FIGURE 8-36. ANNUAL TSS AND BOD LOADINGS TO THE LOWER CHARLES RIVER

substantial control of stormwater and other non-CSO pollution sources by other parties. For example, additional tankage to provide storage of the three-month storm could be provided at Cottage Farm, and a consolidation conduit through the Stony Brook area could provide storage of the three-month storm overflows from Stony Brook regulators. With these facilities, all CSO discharges to the Lower Charles, treated or untreated, would be reduced to approximately four per year, or less.

Siting Issues. It is assumed that the new mechanical equipment at the Cottage Farm CSO Facility could fit within the existing facility. Construction of a new outfall diffuser would involve activities within the Charles River. The existing Charlesgate Gatehouse was originally proposed as a location for the screening and disinfection facility on the Stony Brook Conduit. However, locating the facility further upstream along the Stony Brook Conduit, in the vicinity of the Ward Street Headworks, would provide additional detention time for disinfection, and would also provide treatment for overflows at BOS046 to the Back Bay Fens.

Short term impacts of the work at the Cottage Farm Facility would involve impacts to the Charles River associated with installation of the new diffuser, along with construction-related truck traffic. The types of impacts would depend on the construction techniques applied, however it is unlikely that the work would prevent the passage of river traffic. If the Stony Brook Conduit facilities are located near Ward Street Headworks, short term impacts of this work would include disruption of parking lots, and construction related traffic. Long term site related impacts at the Cottage Farm Facility would be similar to existing conditions, while impacts of the Stony Brook facility would be limited to minor increases in truck traffic associated with facility operation.

Costs. The estimated capital cost for the Cottage Farm Facility work is $7 million, with annual O&M costs of approximately $700,000 per year. Capital cost for the Stony Brook facility is estimated at $24 million, with annual O&M costs of $500,000 per year. Capital cost for installation of the outfall screens and bulkheading the regulators is estimated at

$0.8 million, with annual O&M costs of $50,000 per year. Total present worth of these projects combined would be $38 million.

Considerations for Partial Use Designation. A request for a partial use designation in this receiving water segment will be required, since under the recommended plan 26 treated and approximately four untreated overflows per year are predicted to occur. Cost/performance relationships for percent removal of fecal coliform bacteria, TSS, and BOD versus present worth costs are presented in Appendix G. These analyses clearly showed that sewer separation at a cost of nearly $400 million provided less effective removal of fecal coliform bacteria and no significant removal of TSS and BOD pollutant loads compared to other alternatives for storage, treatment, or screening at costs ranging from $35 million to $215 million. Relocation of CSO outfalls is not feasible, since there is no less sensitive receiving water in proximity.

Based on the evaluation of site-specific water quality conditions, removal of fecal coliform bacteria through screening and disinfection will contribute to attainment of beneficial uses in this segment. The relatively minor impacts from CSOs compared to other sources of TSS and BOD showed that a higher level of CSO control, at more than twice the cost of the recommended plan, would produce no measurable improvement in attainment of beneficial uses. The recommended alternative achieves the engineering target set by DEP for achievement of designated uses to the maximum extent feasible in partial use segments (an average of four untreated overflows per year). The cost of higher levels of CSO control would be excessive compared to any potential benefits to be achieved.

Back Bay Fens

The recommended alternative for the Back Bay Fens is to provide manually-cleaned bar screens at outfall BOS046 (Figure 8-30). This alternative would provide control of solids and floatables during the relatively infrequent activations of this outfall (approximately twice per year). The control of solids and bacteria at BOS046 will be enhanced with the implementation of the recommended plan for the Lower Charles, which features a screening and disinfection facility for Stony Brook Conduit flows upstream of BOS046. Bulkheading of outfall BOS046 would not appear to be appropriate, since this outfall provides relief for the vast drainage system tributary to the Stony Brook Conduit. Removing a potential flow path for such a large drainage area would involve flood control issues as well as issues of CSO control. Other alternatives for BOS046 were considered as part of the Lower Charles alternatives, in that the Stony Brook consolidation alternatives would have eliminated the overflow at BOS046 during the one-year storm.

Water Quality Impacts. The predominant source of pollutants to the Back Bay Fens is stormwater (see Figure 7-2 and Appendix F), and the recommended water quality goal for this receiving water segment was to meet Class B water quality standards except for less than four times per year. Receiving water modeling was not performed for this receiving water segment. With manually cleaned bar screens at BOS046 and the upstream screening and disinfection facility near Ward Street Headworks, activation of BOS046 on average twice per year would still allow attainment of the recommended goal. This goal, however, is currently not attained due to wet and dry weather non-CSO sources. In other words, the non-CSO sources cause non-attainment of Class B standards more than four times per year.

Siting Issues. The manually-cleaned bar screens could be located within the BWSC Gatehouse No. 1 or on the BOS046 outfall adjacent to Gatehouse No. 1. Restrictions on physical modifications to Gatehouse No. 1 may prohibit use of this facility for this purpose. Short-and long-term site-related impacts of this work would be relatively minor, although measures would be required to minimize the construction impacts on the adjacent Fens.

Costs. Capital costs for this work are estimated at $0.1 million, with annual O&M costs of approximately $5,000 per year. Total present worth is approximately $0.1 million.

Considerations for Partial Use Designation. A request for a partial use designation for this receiving water segment will be required, since under the recommended plan overflows from

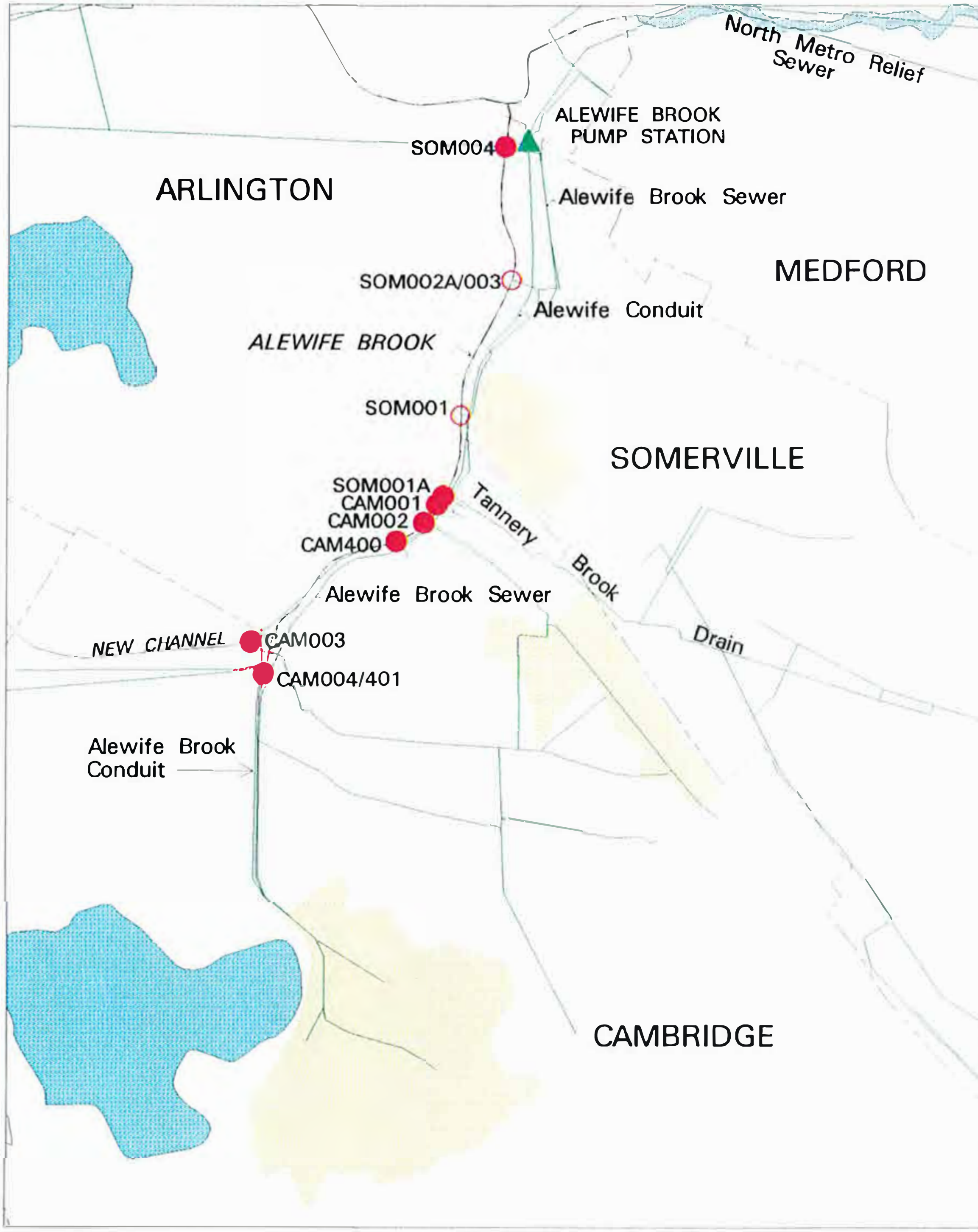
BOS046 may occur during large storm events when the capacity of the Stony Brook Conduit is exceeded. CSO controls for this segment are linked to controls for the Lower Charles River, where the cost of sewer separation was demonstrated to be excessive compared to any water quality benefits to be attained. Relocation of outfall BOS046, through consolidation of Stony Brook flows, also was shown to produce no measurable improvement in attainment of beneficial uses.

The recommended alternative achieves the engineering target set by DEP for achievement of designated uses to the maximum extent feasible in partial use segments (an average of four untreated overflows per year). In the typical year, overflows are predicted to occur no more than two times. The cost of higher levels of CSO control would be excessive compared to any potential benefits to be achieved.

ALEWIFE/UPPER MYSTIC

Alewife Brook

Sewer separation upstream of outfalls CAM002 and CAM004, separation of common manholes upstream of SOM001, and installing screens at the remaining outfalls is the recommended alternative for Alewife Brook. The general location of the separation work, covering approximately 310 acres, is presented in Figure 8-37. Much of the area tributary to CAM002 and CAM004 is currently served by two-pipe systems, so the total area actually requiring separation work is expected to be much less than 310 acres. This alternative will control overflows from the three-month storm at a substantially lower cost than other identified alternatives (see Table 7-7), since the reduction in stormwater inflow to the Alewife Brook Conduit, particularly at the upstream end near CAM004, influences the activation of the downstream regulators. Thus, no surface facilities or major consolidation conduits are required. Separation of common baffle manholes upstream of SOM001 is also recommended as a relatively low cost project which will eliminate SOM001 as a CSO outfall.



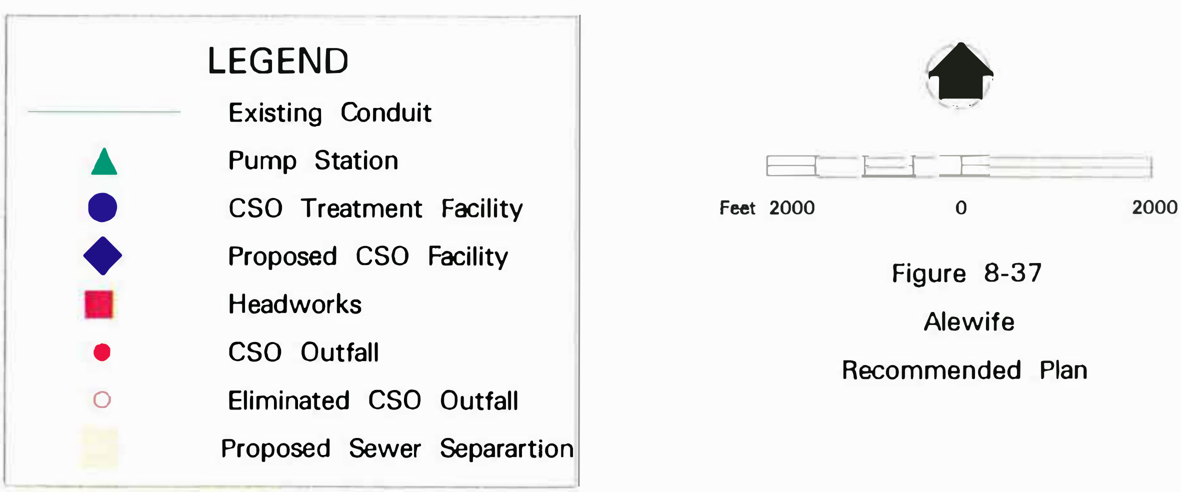


Figure 8-37

Alewife

Recommended Plan

These recommendations are consistent with planned and on-going sewer separation work in Cambridge and Somerville. Substantial separation work has been completed in Cambridge, including portions of Phase II work upstream of CAM004, while Somerville is considering plans to eliminate the CSOs into the Tannery Brook Drain. The MWRA is currently supporting separation work in Somerville under the I/I financial assistance program. Another potential benefit of sewer separation is that flows into Alewife Brook will be increased. Concerns have been raised that alternatives which would capture overflow volumes for treatment at Deer Island could have an adverse effect on Alewife Brook by removing sources of runoff and creating artificially low brook flow. Under the recommended plan, stormwater volumes to Alewife Brook will increase by approximately 5.9 and 9.0 MG for the three-month and one-year storms, respectively.

Water Quality Impacts. As indicated in Figure 7-2 and Appendix F, stormwater is the predominant source of pollutants causing non-attainment of use criteria in Alewife Brook on an annual basis. For the one-year storm, CSO contributes more than half of the fecal coliform bacteria load, approximately one quarter of the BOD load, and one third of the nutrient load. The impact of the recommended plan on the annual TSS and BOD loads to Alewife Brook is presented in Figure 8-38. For both constituents, total loadings increase slightly, due to the increase in stormwater introduced to Alewife Brook. It is apparent from this figure, however, that complete elimination of CSOs to Alewife Brook would not have a substantial impact on the annual loadings of TSS and BOD. Figure 8-39 presents the impact of the recommended plan on fecal coliform bacteria loads to Alewife Brook for the three-month and one-year storm. For the three-month storm, the CSO contribution to the bacteria load is eliminated, while for the one-year storm, the CSO component of the load is reduced by almost one half.

Separation of CAM002, CAM004 and SOM001 should prevent CSOs from causing or contributing to non-attainment of the bacteria standard for swimming except for approximately four times per year, since the remaining CSOs will only activate

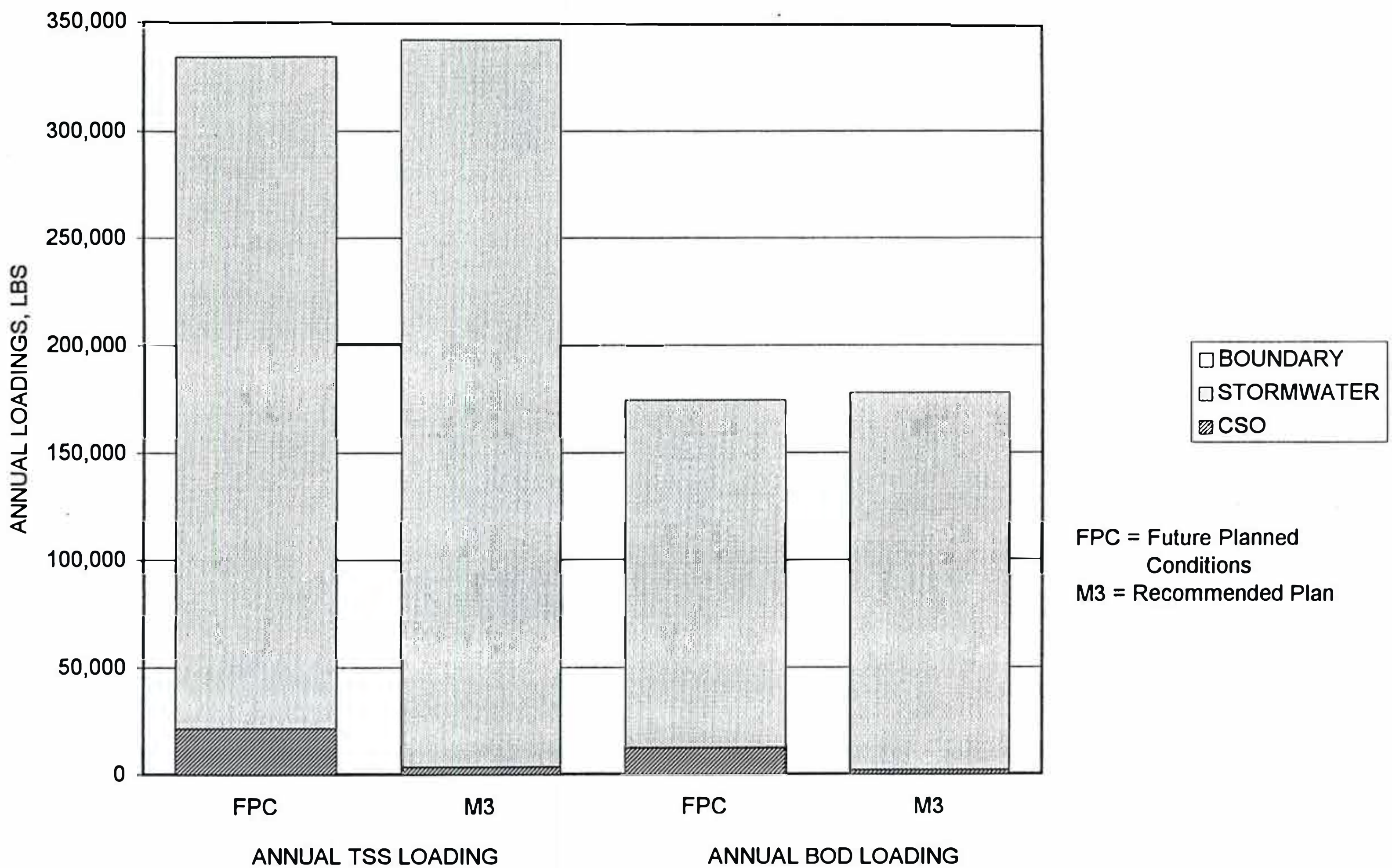


FIGURE 8-38. ANNUAL TSS AND BOD LOADINGS TO ALEWIFE BROOK

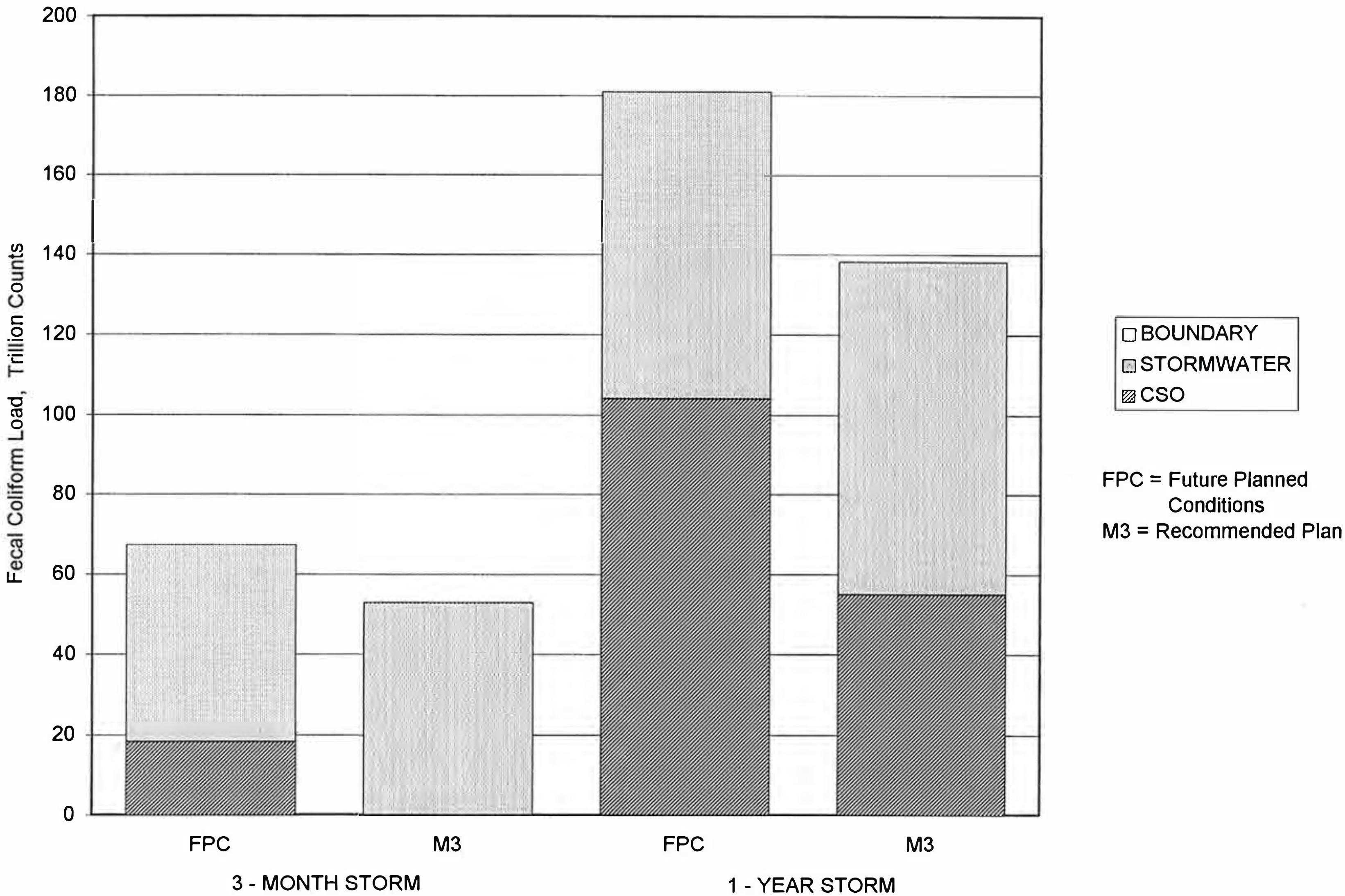


FIGURE 8-39. FECAL COLIFORM LOADS TO ALEWIFE BROOK FOR THE THREE-MONTH AND ONE-YEAR STORMS

approximately four times per year or less. Since receiving water modeling was not performed on Alewife Brook, the impacts of non-CSO sources on attainment of use criteria cannot be as clearly defined as in other receiving water segments. However, it seems likely that stormwater would still contribute to non-attainment of use criteria under the recommended plan. As the communities of Cambridge and Somerville proceed with on-going and planned separation work, it is expected that additional water quality benefits will be attained for Alewife Brook.

Siting Issues. Sewer separation work would involve open cut excavations in streets and existing rights-of-way. Installing the outfall screens and separation of common manholes would involve work in existing manholes, or construction of new manhole structures. Short term impacts of this work would be limited to localized construction-related noise, dust, and disruptions to traffic, while long term site impacts would be negligible.

Costs. The capital cost for this alternative is estimated at $12 million, with approximately $40,000 per year in O&M costs. Total present worth as of December, 1995 would be $10 million.

Considerations for Partial Use Designation. A request for a partial use designation in this receiving water segment will be required, since under the recommended plan four untreated overflows per year are predicted to occur. Cost/performance relationships for percent removal of fecal coliform bacteria, TSS, and BOD versus present worth costs are presented in Appendix G. These analyses clearly showed that complete sewer separation at a cost of $45 million provided less removal of TSS and BOD compared to all the other alternatives, due to the predominance of stormwater impacts. Complete sewer separation also was shown to provide less removal of fecal coliform bacteria compared to other alternatives for partial separation and consolidation. Relocation of CSO outfalls is not feasible since there is no less sensitive receiving water in proximity.

Based on the evaluation of site-specific water quality conditions and the relatively minor impacts from CSOs compared to other sources of pollutants, a higher level of CSO control would produce no measurable improvement in attainment of beneficial uses. The recommended alternative achieves the engineering target set by DEP for achievement of designated uses to the maximum extent feasible in partial use segments with an average of four untreated overflows per year. The cost of higher levels of CSO control would be excessive compared to any potential benefits to be achieved.

Upper Mystic River

The recommended alternative for Upper Mystic River, separation of common manholes upstream of CSO outfalls SOM006 and SOM007, is a relatively low-cost means for eliminating the CSO at these locations (Figure 8-40). Lower levels of control are not substantially less expensive. Overflows which occur at SOM007A will continue to receive treatment at the Somerville Marginal CSO Facility.

Water Quality Impacts. As indicated in Figure 7-2 and Appendix F, the impact of CSO-related pollutants on the Upper Mystic River is almost undetectable compared with stormwater and upstream sources. With the recommended plan, overflows will be eliminated at SOM006 (if this outfall is confirmed to exist) and SOM007, and remaining overflows at SOM007A would continue to be treated. The impact of the recommended plan on annual TSS and BOD loads to the Upper Mystic River is presented in Figure 8-41. The minimal impact of CSOs on annual pollutant loads is also evident in this figure. Figure 8-42 presents the impact of the recommended plan on fecal coliform bacteria loads to the Upper Mystic River for the three-month and one-year storms. It is apparent from this figure that higher levels of control at SOM007A would not affect the total bacteria load to the Upper Mystic River, due to the minimal impact of CSO sources on the total loads. Although receiving water modeling was not conducted for the Upper Mystic, Figures 8-41 and 8-42 suggest that stormwater and upstream sources would continue to cause non-attainment of use criteria, even with complete elimination of CSOs. Further watershed-based studies would be required

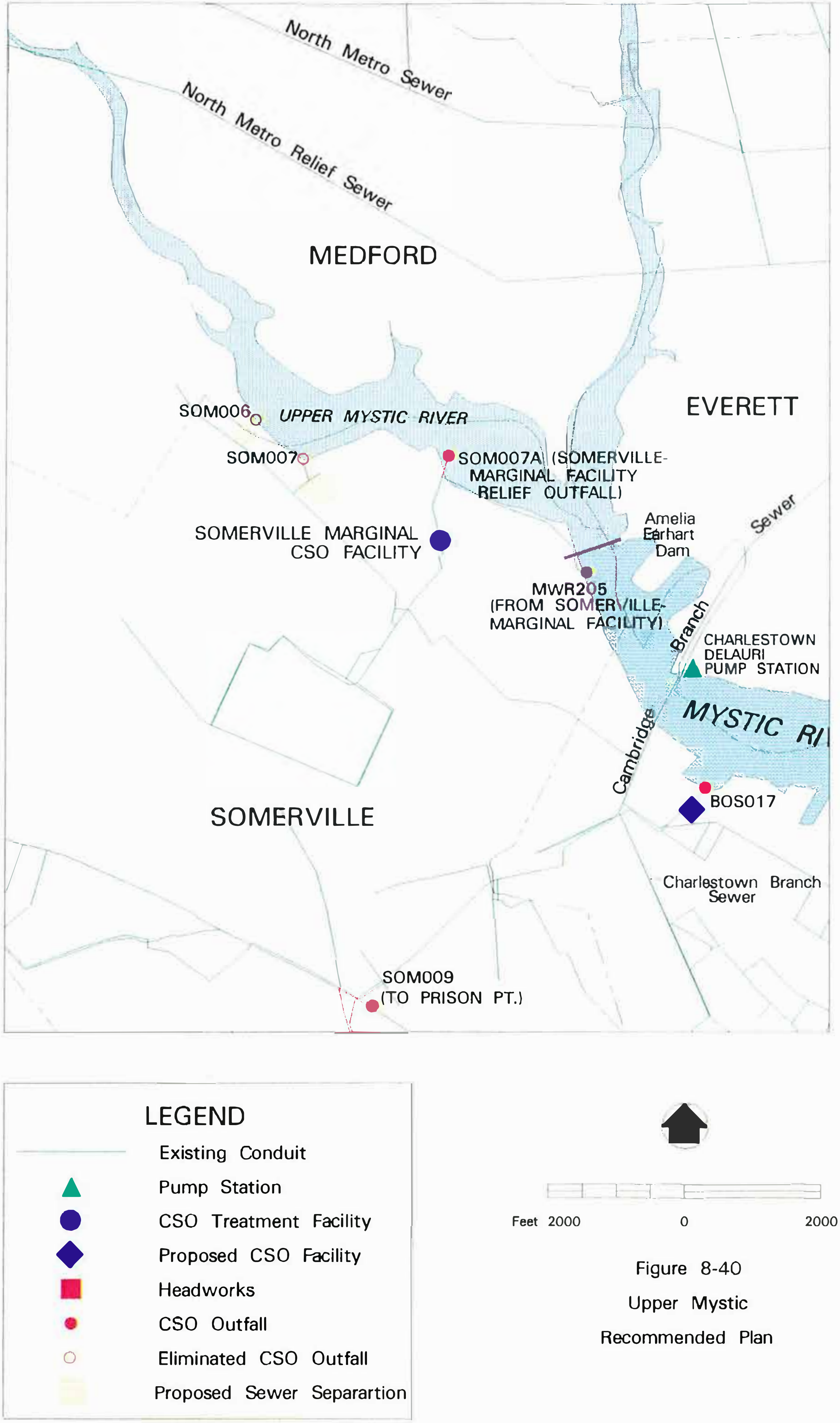


Figure 8-40
Upper Mystic
Recommended Plan

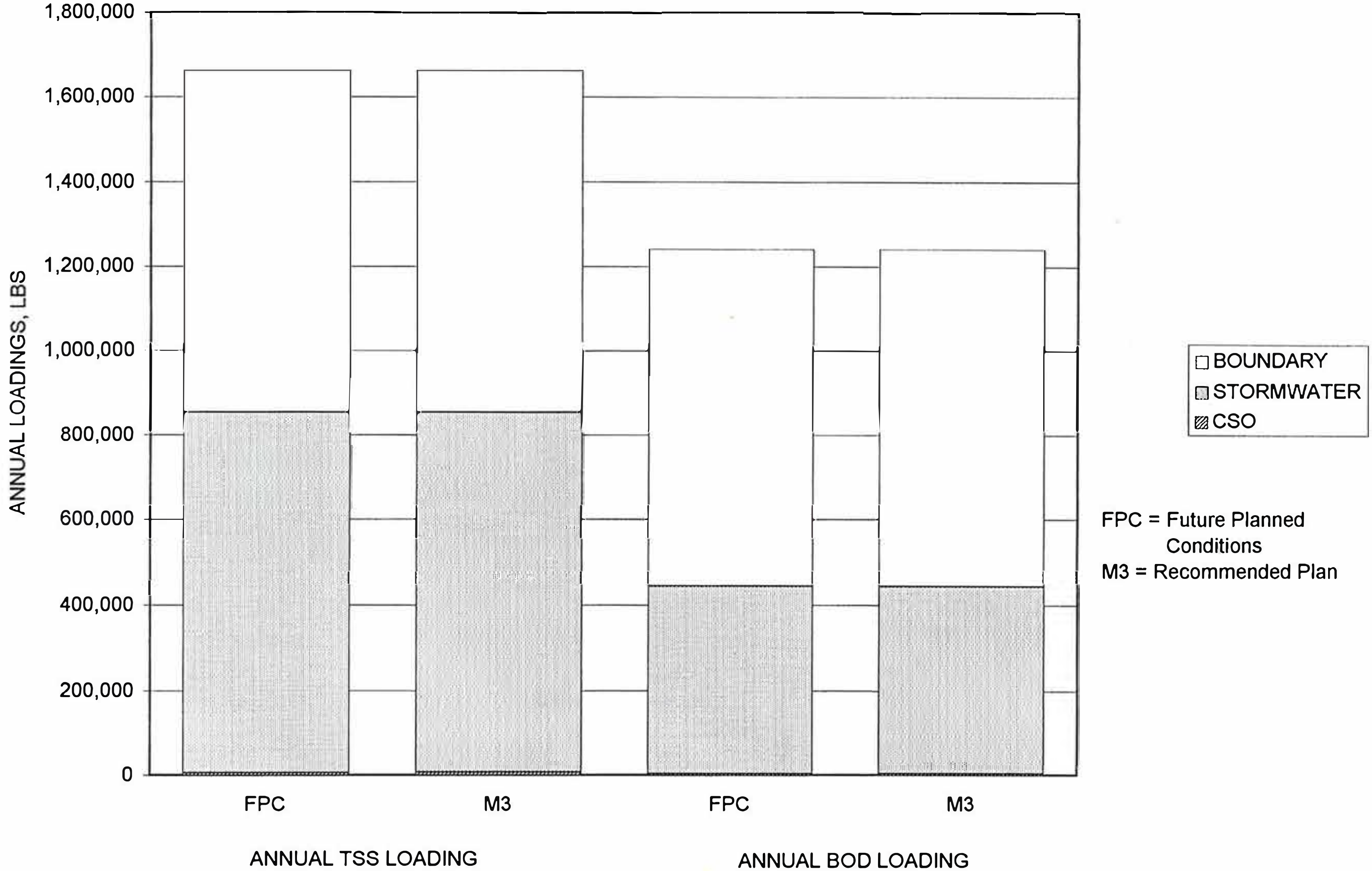


FIGURE 8-41. ANNUAL TSS AND BOD LOADINGS TO THE UPPER MYSTIC RIVER

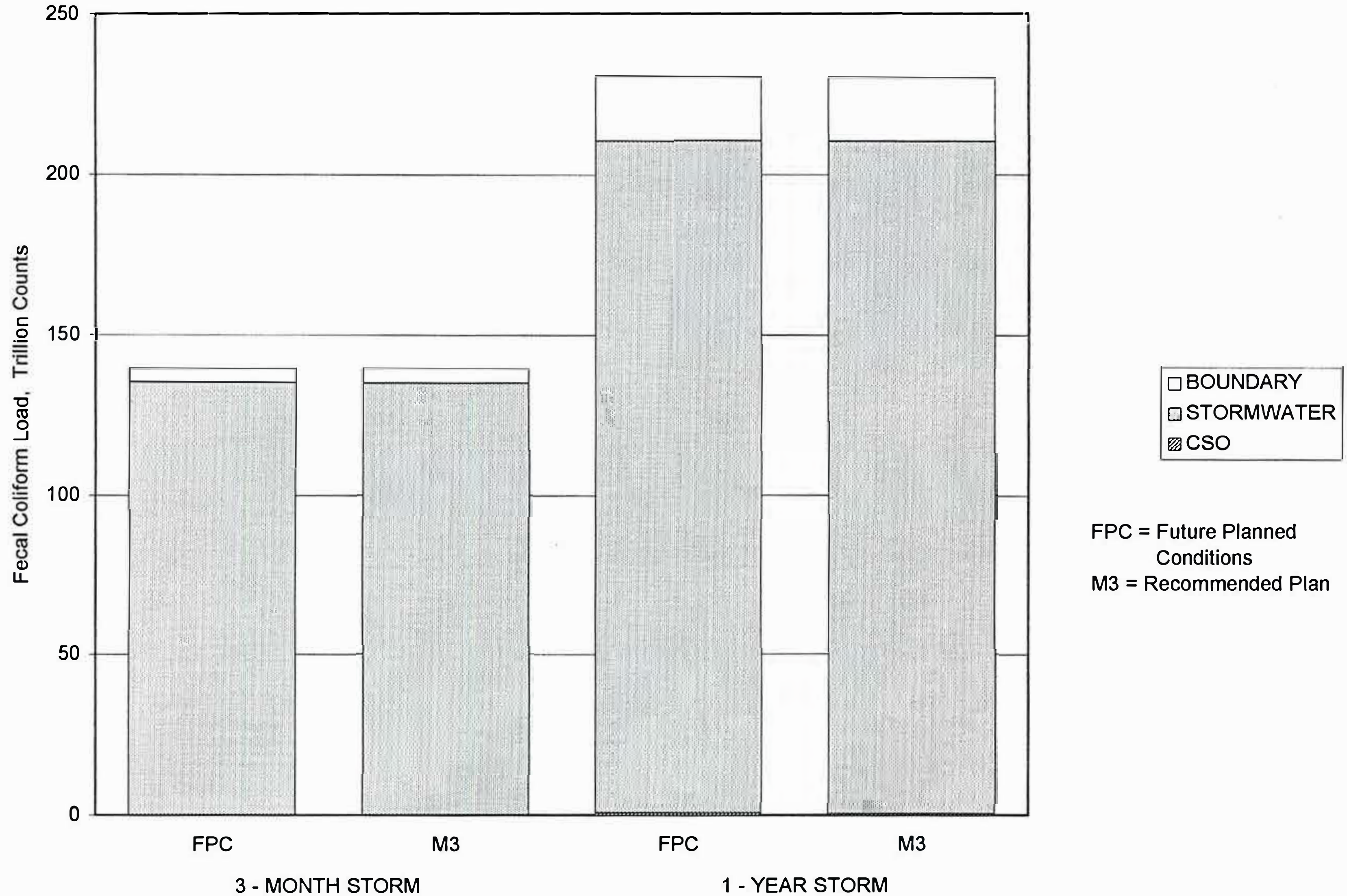


FIGURE 8-42. FECAL COLIFORM BACTERIA LOADS TO THE UPPER MYSTIC RIVER FOR THE THREE-MONTH AND ONE-YEAR STORMS

to identify and develop a framework for addressing the upstream non-CSO sources of pollutants.

Siting Issues. Separation of common manholes upstream of SOM006 and SOM007 would involve work within existing manholes, which could be completed with minimal impacts to surrounding areas. No additional work would be required at SOM007A, beyond the improvements to the Somerville Marginal CSO Facility, which are described below.

Costs. The capital cost for separation of the common manholes at SOM006 and SOM007 is estimated at $0.2 million, with negligible incremental annual O&M costs. Present worth of this alternative would be approximately $0.2 million.

Considerations for Partial Use Designation. A request for a partial use designation in this receiving water segment will be required, since under the recommended plan eight treated overflows per year are predicted to occur. Cost/performance relationships for percent removal of fecal coliform bacteria, TSS, and BOD versus present worth costs are presented in Appendix G. These analyses clearly showed that complete sewer separation and relocation of SOM007A at a cost of $20 million did not provide significant removal of pollutant loads compared to the recommended alternative at a cost of $0.2 million.

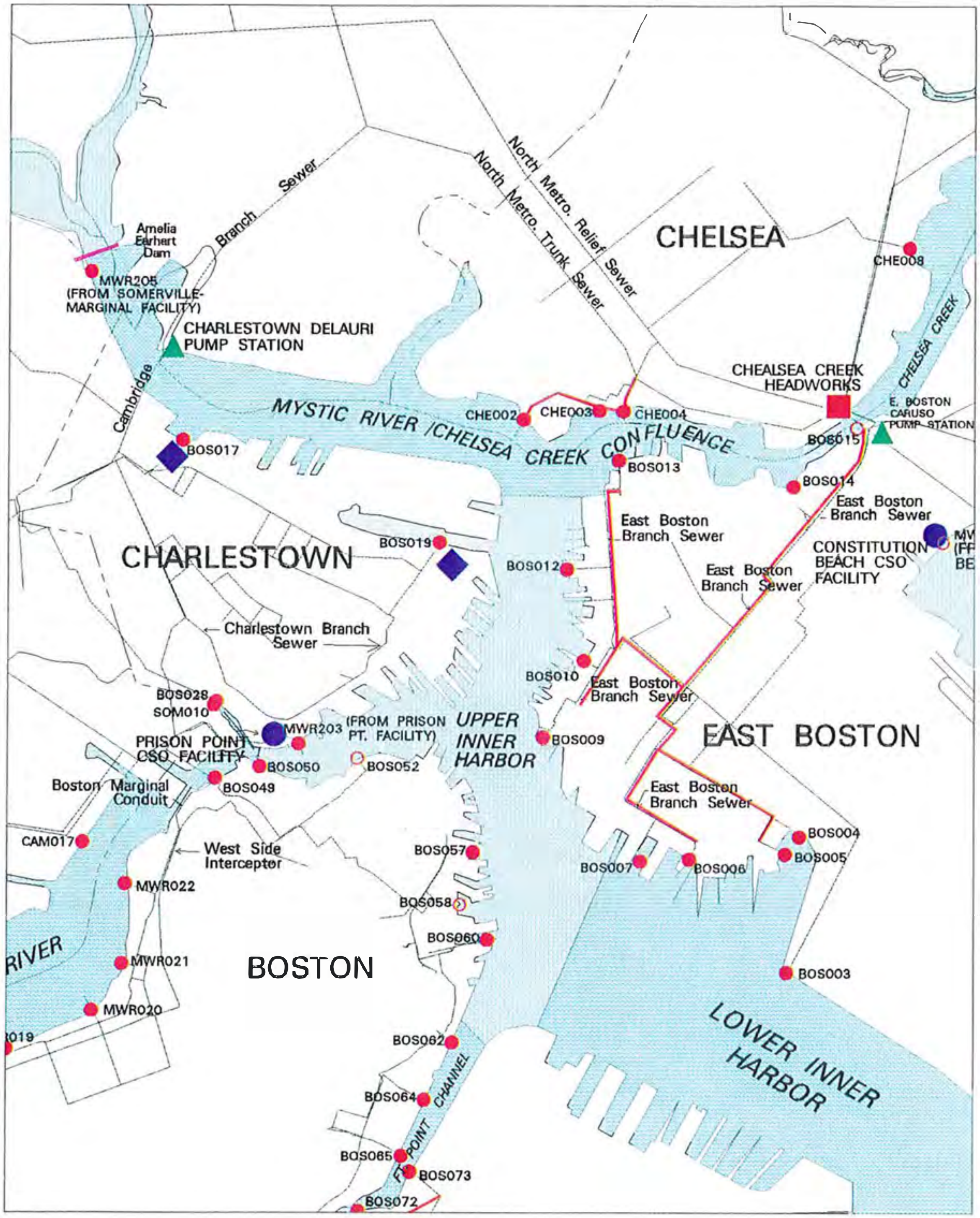
Based on the evaluation of site-specific water quality conditions and the relatively minor impacts from CSOs compared to other sources of pollution, a higher level of CSO control would produce no measurable improvement in attainment of beneficial uses. The recommended alternative exceeds the engineering target set by DEP for achievement of designated uses to the maximum extent feasible in partial use segments (an average of four untreated overflows per year). The cost of higher levels of CSO control would be excessive compared to any potential benefits to be achieved.

BOSTON HARBOR

Upper Inner Harbor

The recommended alternative for the Upper Inner Harbor includes optimizing the operation of the existing Prison Point CSO Facility, locating and eliminating possible flow restrictions in the influent conduits to the facility, and upgrading the facility for dechlorination; providing screening and disinfection at outfall BOS019; providing interceptor relief and screens for outfalls BOS009 to BOS014; and providing screens at outfalls BOS050, BOS057, and BOS060 (Figure 8-43). Providing dechlorination at the Prison Point CSO Facility will eliminate the discharge of potentially toxic chorine residuals into the Upper Inner Harbor. The recommended plan also involves removing possible upstream flow restrictions and modifying the operating procedures at Prison Point to allow flow into the facility before it starts to back up in the upstream systems. The current operating procedure is to allow ten to 14 feet of head to develop at the facility before the influent gates to the tanks are opened. If the flow were introduced with only 7.6 feet of head at the Facility, overflows at CAM017 and MWR018 to MWR022 would be reduced to the levels indicated on Table 8-1. Further study may identify an optimum balance between reducing upstream overflows, and increasing flows through the Prison Point CSO Facility. SWMM modeling indicates that restrictions may exist in the Cambridge Marginal Conduit and the Charles River Marginal Conduit upstream of the Prison Point facility. Removal of these restrictions would also decrease the upstream hydraulic gradients. The MWRA is currently in the process of inspecting these conduits.

Providing a screening and disinfection facility at outfall BOS019 will reduce the bacteria loads to the Upper Inner Harbor, as well as control the discharge of floatables from this outfall. It may be possible to locate much of the equipment for this facility below grade. Potential locations for the facility are under the Tobin Bridge or in the vicinity of the Charlestown Navy Yard. Approximately 9 minutes of detention time would be available in the BOS019 outfall pipe between the regulator and the receiving water during the peak flow from the three-month storm. It may be necessary to lengthen the outfall pipe or provide



LEGEND

- Existing Conduit
- Proposed Conduit
- Pump Station
- CSO Treatment Facility
- Proposed CSO Facility
- Headworks
- CSO Outfall
- Eliminated CSO Outfall

Feet 3000 0 3000

Figure 8-43

Mystic / Chelsea Confluence

Upper Inner Harbor

Recommended Plan

other means for increasing contact time if sodium hypochlorite is to be used as the disinfectant.

Interceptor relief in East Boston will control overflows to approximately four times per year, and will avoid the need to site a new facility in that densely populated area. This work, in conjunction with interceptor relief for outfalls BOS003 to BOS007, would likely involve replacement of the relatively small-diameter pipe in the upstream reaches of the East Boston Branch Sewer (EBBS), and a parallel relief pipe along the main branch of the EBBS between regulator RE-003-12 and the Caruso Pump Station. Manually-cleaned bar screens would be installed in the outfall conduits for outfalls BOS009 to BOS014 once the interceptor relief work was completed. In downtown Boston, manually-cleaned bar screens at outfalls BOS050, BOS057, and BOS060 were recommended due to the relative inactivity of those outfalls (less than four activations per year under future planned conditions).

The recommended alternative reflects the most cost-effective level of control in terms of reduction of fecal coliform loads to the Upper Inner Harbor (refer to cost/performance curves in Appendix G). While higher levels of control provide greater reductions of bacteria loads (at increasingly higher cost), the impact of those increased reductions on durations of violations of bacteria standards in the Upper Inner Harbor are negligible, as described below. In terms of reduction of TSS and BOD loads, the cost/benefit curve is approximately linear. However, the benefit of increased control of TSS and BOD from CSO sources would be limited, due to the predominance of upstream sources.

Water Quality Impacts. The relative contributions of pollutant sources to the Upper Inner Harbor are presented in Figure 7-2 and Appendix F. Figures 8-44 to 8-47 present results from the receiving water model for Upper Inner Harbor. Figures 8-44 and 8-45 indicate that with the recommended plan, the bacteria standards for boating and swimming will be met during the three-month storm. The more expensive levels of control are not necessary to meet these criteria for the three-month storm. Figure 8-47 indicates that the recommended plan does not provide as high of a level of control of CSO-related bacteria as the storage and

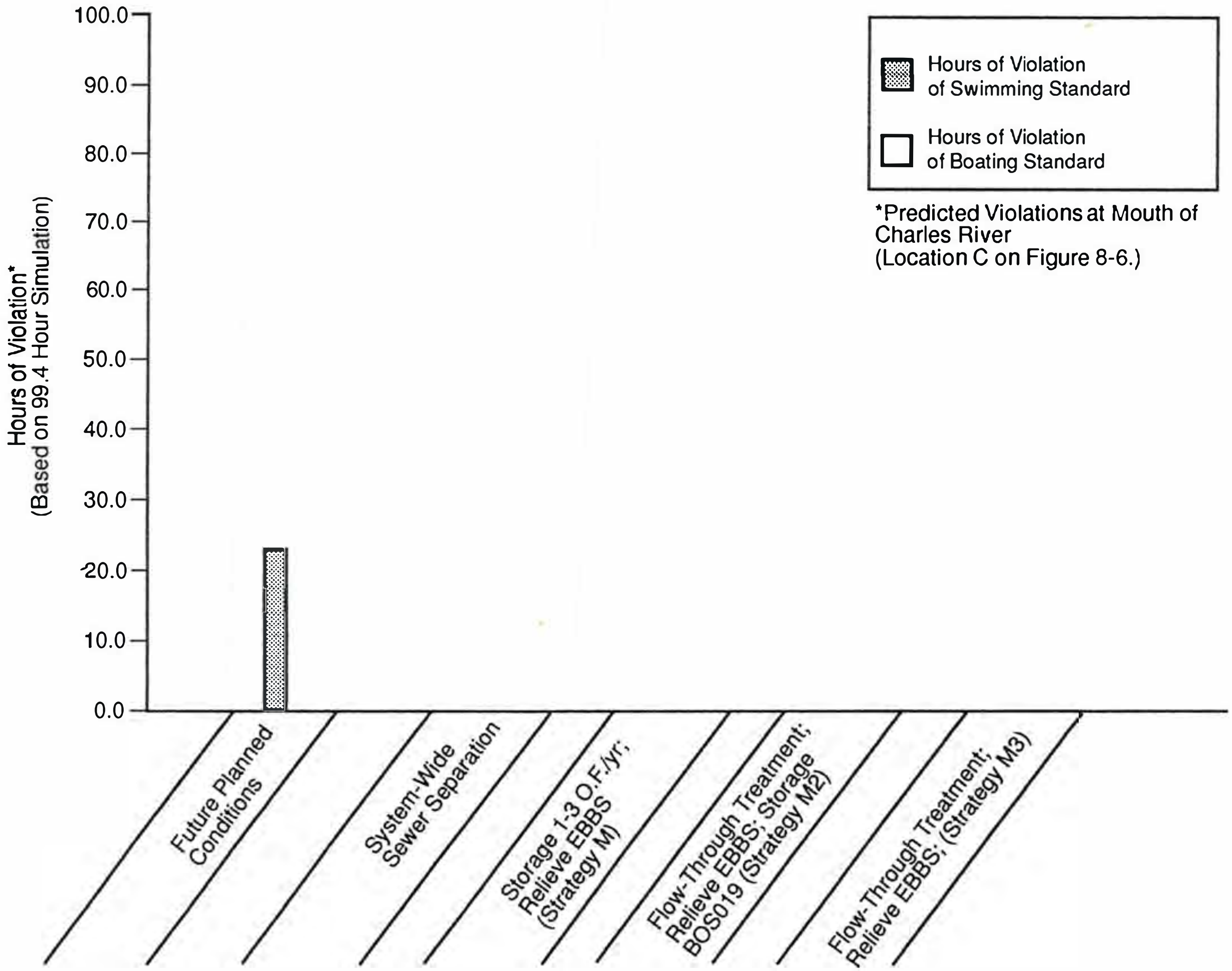


FIGURE 8-44. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 3 MONTH STORM, UPPER INNER HARBOR

4184jp/3mth

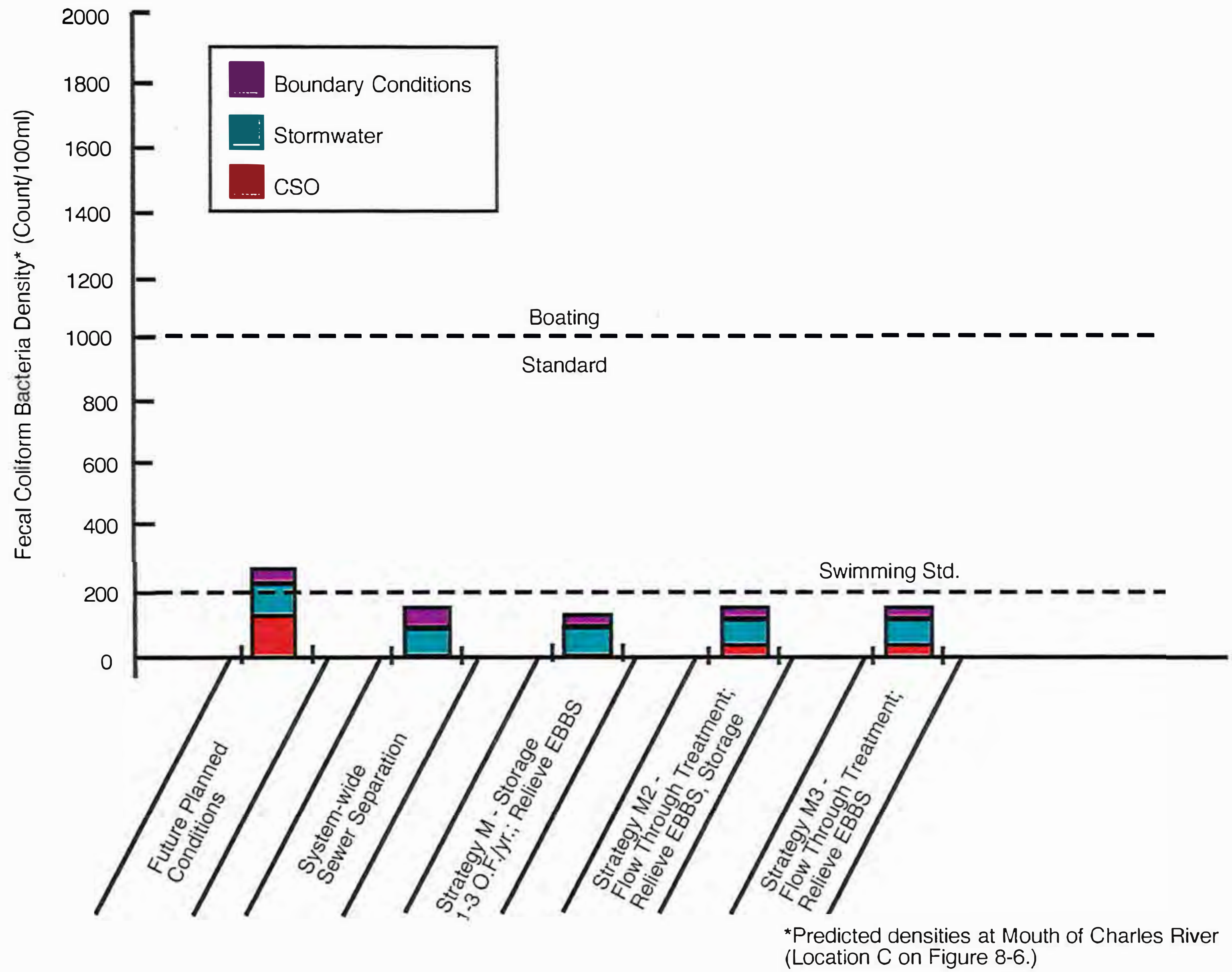


FIGURE 8-45. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 3 MONTH STORM, UPPER INNER HARBOR

4189jp

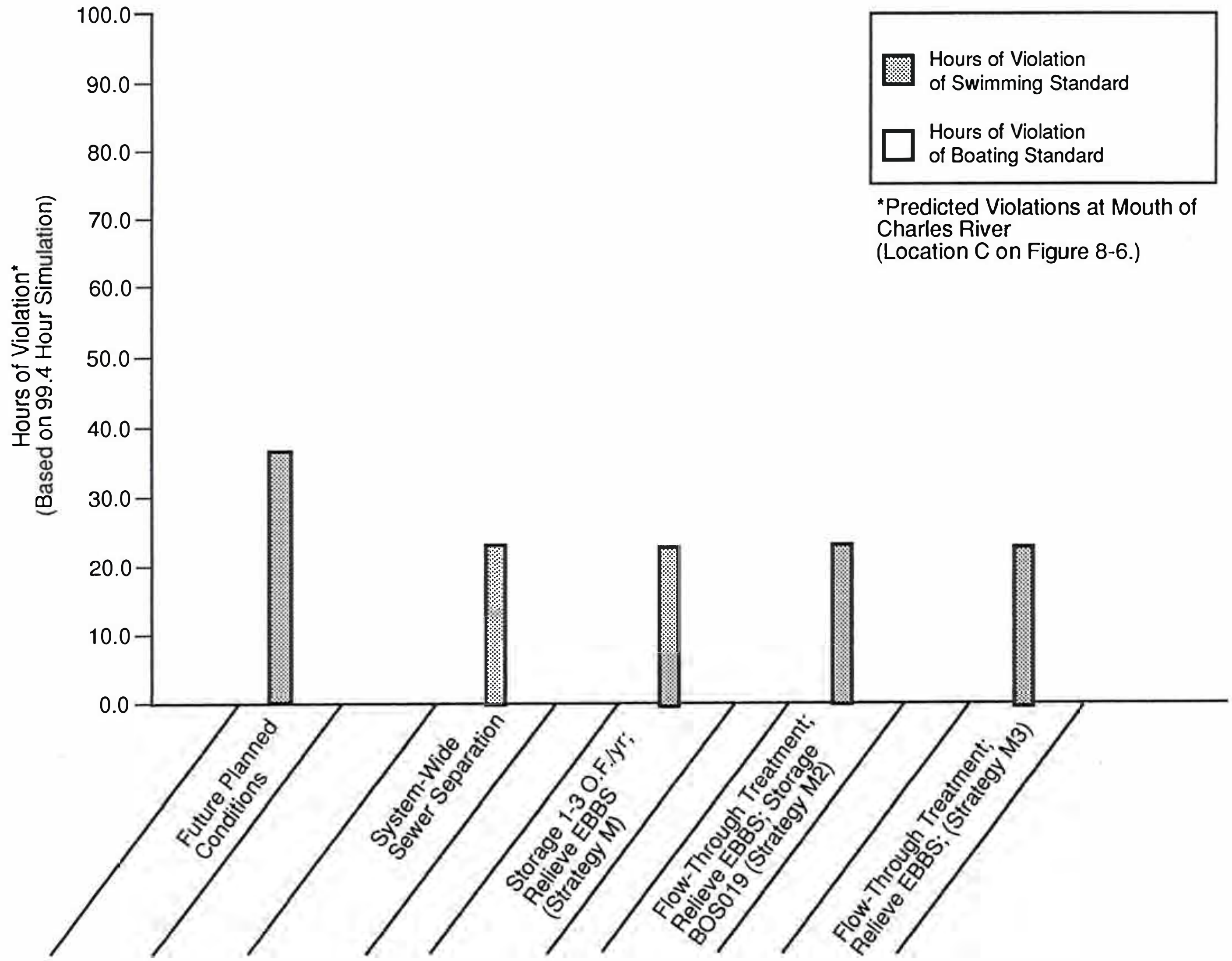
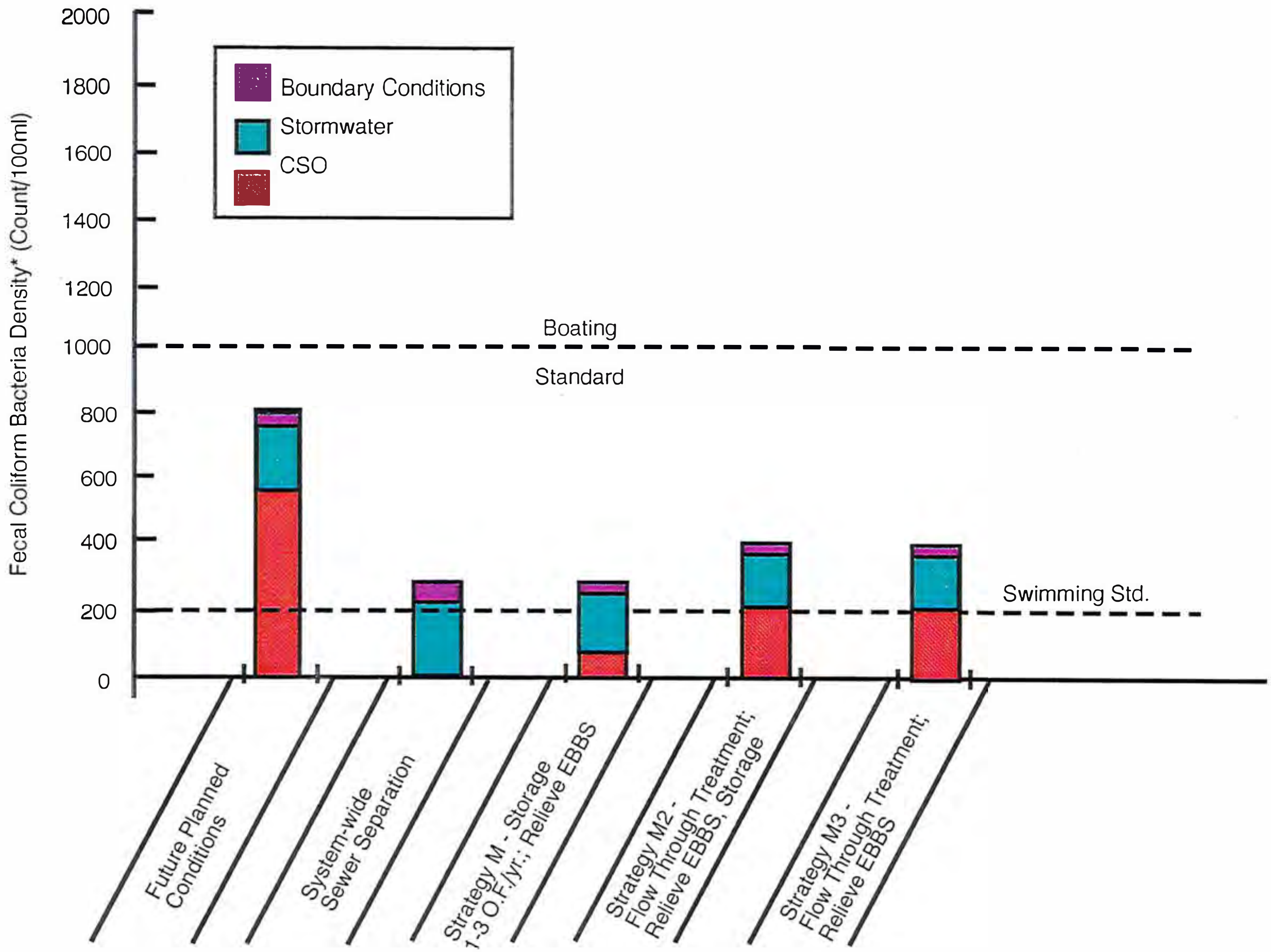


FIGURE 8-46. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, UPPER INNER HARBOR

4184jp



*Predicted densities at mouth of Charles River (Location C on Figure 8-6.)

FIGURE 8-47. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1 YEAR STORM, UPPER INNER HARBOR

4190jp

sewer separation alternatives for the one-year storm. This figure indicates that if stormwater and upstream sources were completely controlled, CSOs would still cause violations to the swimming standard. However, referring to Figure 8-46, it is apparent that the duration of violation of the swimming standard is essentially the same for the range of control levels indicated for the one-year storm. Thus, in terms of current impacts on designated uses, the recommended plan would appear to provide the same level of control as the more expensive alternatives.

Figure 8-48 presents the annual loads for TSS and BOD for future planned conditions and the recommended plan. The overwhelming impact of upstream sources on the annual loads suggests that further investment in alternatives to control the CSO component of these constituents would have minimal impact on water quality in the Upper Inner Harbor.

Additional controls by the MWRA could become appropriate in the Upper Inner Harbor, pending completion of comprehensive watershed planning and integration with substantial control of stormwater and other non-CSO pollution sources by other parties. This concept has particular relevance in the Upper Inner Harbor, where one-year storm overflows under the recommended plan would still result in violation of the swimming standard if other sources were controlled. Examples of additional controls would include expanding the tankage at the Prison Point CSO Facility, and providing storage of the three-month storm at BOS019. With these options, the overflow frequency to Upper Inner Harbor would be reduced to approximately four per year for both treated and untreated flows.

Siting Issues. It is anticipated that the dechlorination equipment for the Prison Point CSO Facility would fit within the existing facility, and that short- and long-term site impacts of this work would not be different from existing conditions. Potential impacts of the screening and disinfection facility at BOS019 depend on the final location of the facility, and to what extent the equipment can be located below grade. Interceptor relief in East Boston would involve local construction-related dust, noise, and traffic impacts, with negligible long-term site impacts.

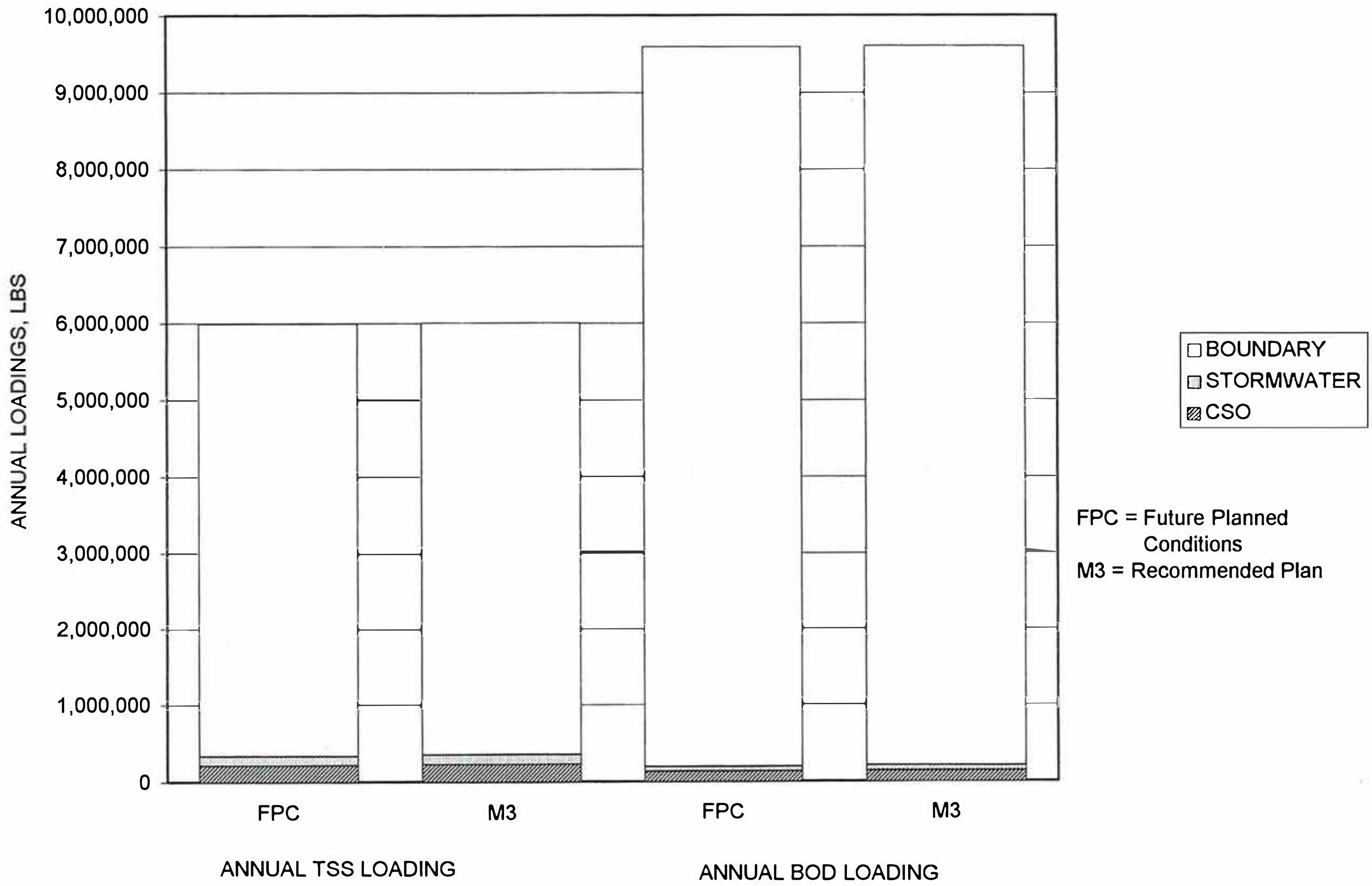


FIGURE 8-48. ANNUAL TSS AND BOD LOADINGS TO UPPER INNER HARBOR

Costs. The capital cost of the work at Prison Point is estimated at $2 million, with a total annual O&M cost for the facility of $600,000 per year. The capital cost of the BOS019 facility is approximately $2.5 million, with a $116,000 per year O&M cost. The East Boston Interceptor relief work would be approximately $18 million, with negligible incremental O&M costs. The capital cost of the outfall screens is estimated at $0.6 million, with annual O&M costs of $40,000. Total present worth of these projects would be $26 million.

Considerations for Partial Use Designation. A request for a partial use designation in this receiving water segment will be required, since under the recommended plan 25 treated and approximately four untreated overflows per year are predicted to occur. Cost/performance relationships for percent removal of fecal coliform bacteria, TSS, and BOD versus present worth costs are presented in Appendix G. Although these analyses showed that sewer separation would provide a modest improvement in pollutant load removal compared to the recommended plan, separating combined areas in densely developed areas of Boston, Cambridge, and Somerville could potentially cause construction and environmental impacts over a large area for a long period of time resulting in substantial and widespread adverse economic and social impact. Relocation of CSO outfalls is not feasible since there is no less sensitive receiving water in proximity.

Based on the evaluation of site-specific water quality conditions and the relatively minor impacts from CSOs compared to other sources of pollutants, a higher level of CSO control would produce no measurable improvement in attainment of beneficial uses. The recommended alternative achieves the engineering target set by DEP for achievement of designated uses to the maximum extent feasible in partial use segments (an average of approximately four untreated overflows per year). The cost of higher levels of CSO control would be excessive compared to any potential benefits to be achieved.

Lower Inner Harbor

Relief of the EBBS and screens for outfalls BOS003 to BOS007 in East Boston is the recommended alternative for the Lower Inner Harbor (Figure 8-43). This alternative is consistent with the recommended plan for interceptor relief for outfalls BOS009 to BOS013 in the Upper Inner Harbor, and will provide full relief of the EBBS. In turn, relief of the EBBS will more fully utilize transport and treatment capacity available through the Caruso Pump Station, North Metropolitan Trunk Sewer, Winthrop Terminal Headworks, and the Deer Island treatment plant.

Part of this alternative involves modifying the operating procedures at the Caruso Pump Station. Currently, when flow exceeds the capacity of the dry-side pumps, flows must back up to an elevation of 96.0 before passing over a weir into the wet-side wetwell. Flow from the EBBS and the East Boston Low Level Sewer enters the dry-side wetwell at the Caruso Pump Station at an invert elevation of 84.0. A gate is provided on this influent conduit to allow flow to be diverted to the wet-side wetwell. If the gate to the wet-side wetwell could be opened when the water surface in the dry-side wetwell reached elevation 84.0, an approximately 12-foot reduction in the hydraulic gradient at the pump station could be achieved during periods of high flows. This reduction in downstream hydraulic gradient would improve the performance of interceptor relief during the one-year storm.

The recommended alternative and the alternative to divert overflows to storage in the BOS003 outfall pipe were clearly the two most cost-effective alternatives for controlling bacteria loads to the Lower Inner Harbor during the three-month storm, as indicated in Appendix G. For the one-year storm, these alternatives also appeared to be the closest to the knee of the curve. Interceptor relief was selected over diversion to the BOS003 outfall to be consistent with the recommended plan for Upper Inner Harbor. The water quality impacts of the two alternatives were essentially similar (see Appendix H). Interceptor relief also avoids the need for a mechanical gate and pump-out station on the outfall.

Water Quality Impacts. The relative contributions of pollutant sources to the Lower Inner Harbor are presented in Figure 7-2 and Appendix F. Figures 8-49 to 8-52 present results from the receiving water model for Lower Inner Harbor. Figures 8-49 and 8-50 indicate that with the recommended plan, the bacteria standards for boating and swimming will be met during the three-month storm. The more expensive levels of control are not required to meet these criteria for the three-month storm. Figure 8-51 indicates that for the one-year storm, the swimming standard would be violated even with CSO elimination by sewer separation. The relatively minor difference in duration of violation between sewer separation and the recommended plan clearly would not justify the additional cost of separation. Figure 8-52 indicates that with the recommended plan, the swimming standard would be met during the one-year storm if bacteria loads from stormwater were controlled.

Figure 8-53 presents the annual loads of TSS and BOD for future planned conditions and the recommended plan. For both constituents, the recommended plan reduces the loadings from CSOs by more than half. Further reductions achieved by higher levels of control would not likely have a substantial impact on ambient water quality in Lower Inner Harbor. With the recommended plan, annual overflow frequencies to Lower Inner Harbor will be reduced to approximately four per year.

Siting Issues. Interceptor relief work in East Boston would most likely involve open cut excavation in streets and existing rights-of-way. Installation of the bar screens would involve work in existing manholes, or construction of new manhole structures. Short term impacts of this work would include localized construction-related noise, dust, and disruptions to traffic, while long term site impacts would be negligible.

Costs. Capital costs for this work are estimated at $19.5 million, with approximately $25,000 per year in O&M costs. Total present worth as of December, 1995 would be $16 million.

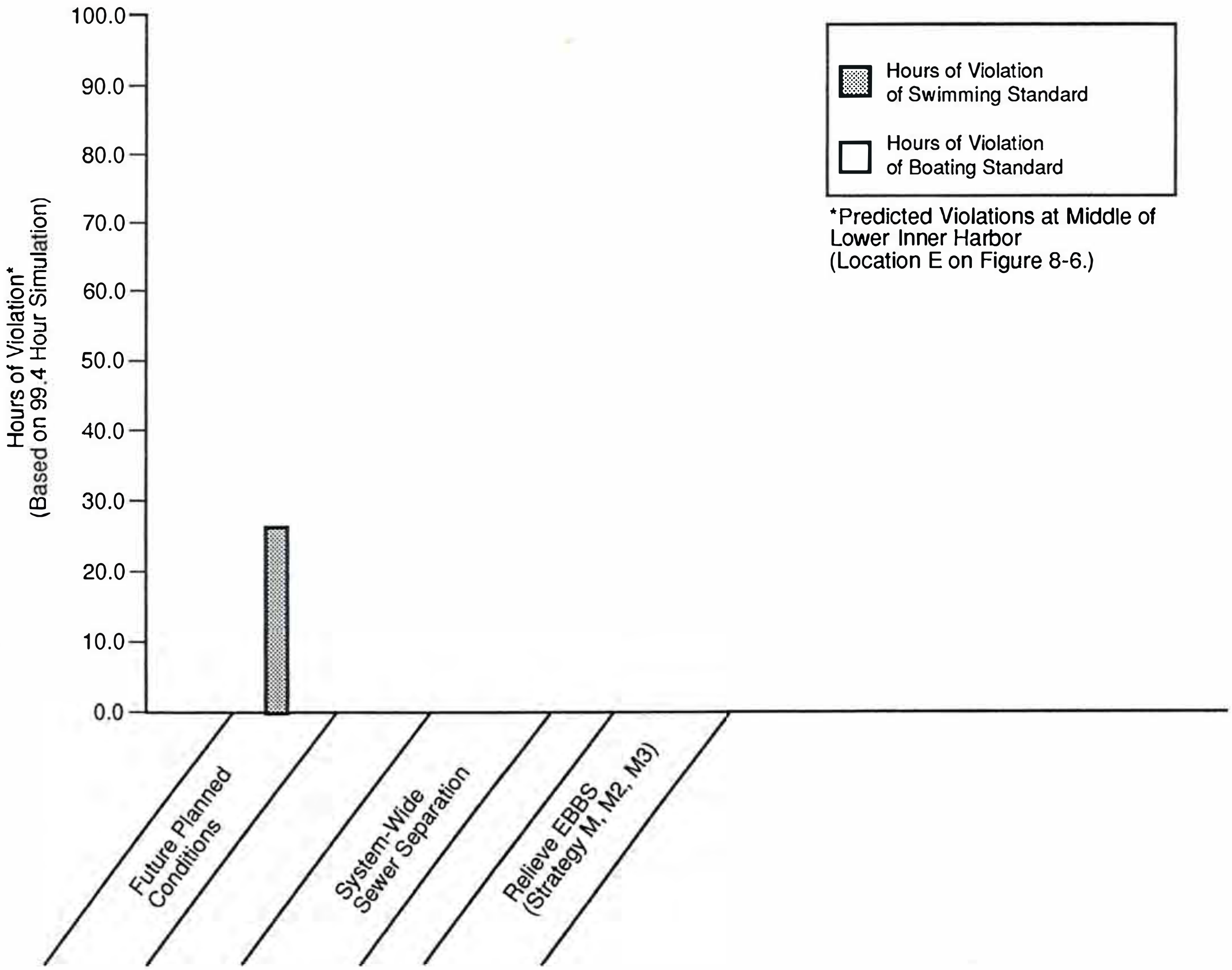


FIGURE 8-49. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 3 MONTH STORM, LOWER INNER HARBOR

4184jp/3mth

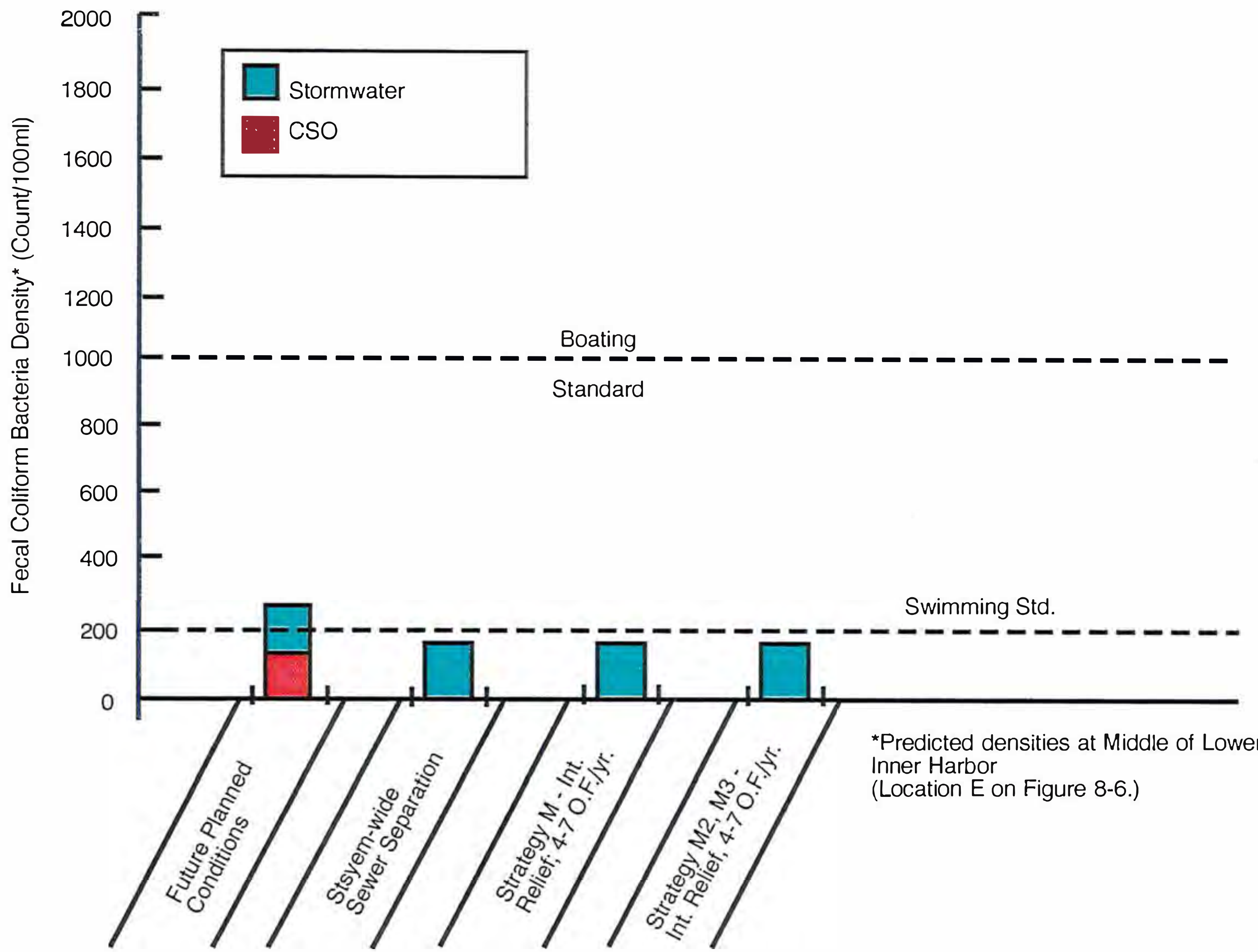


FIGURE 8-50. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 3 MONTH STORM, LOWER INNER HARBOR

4189jp

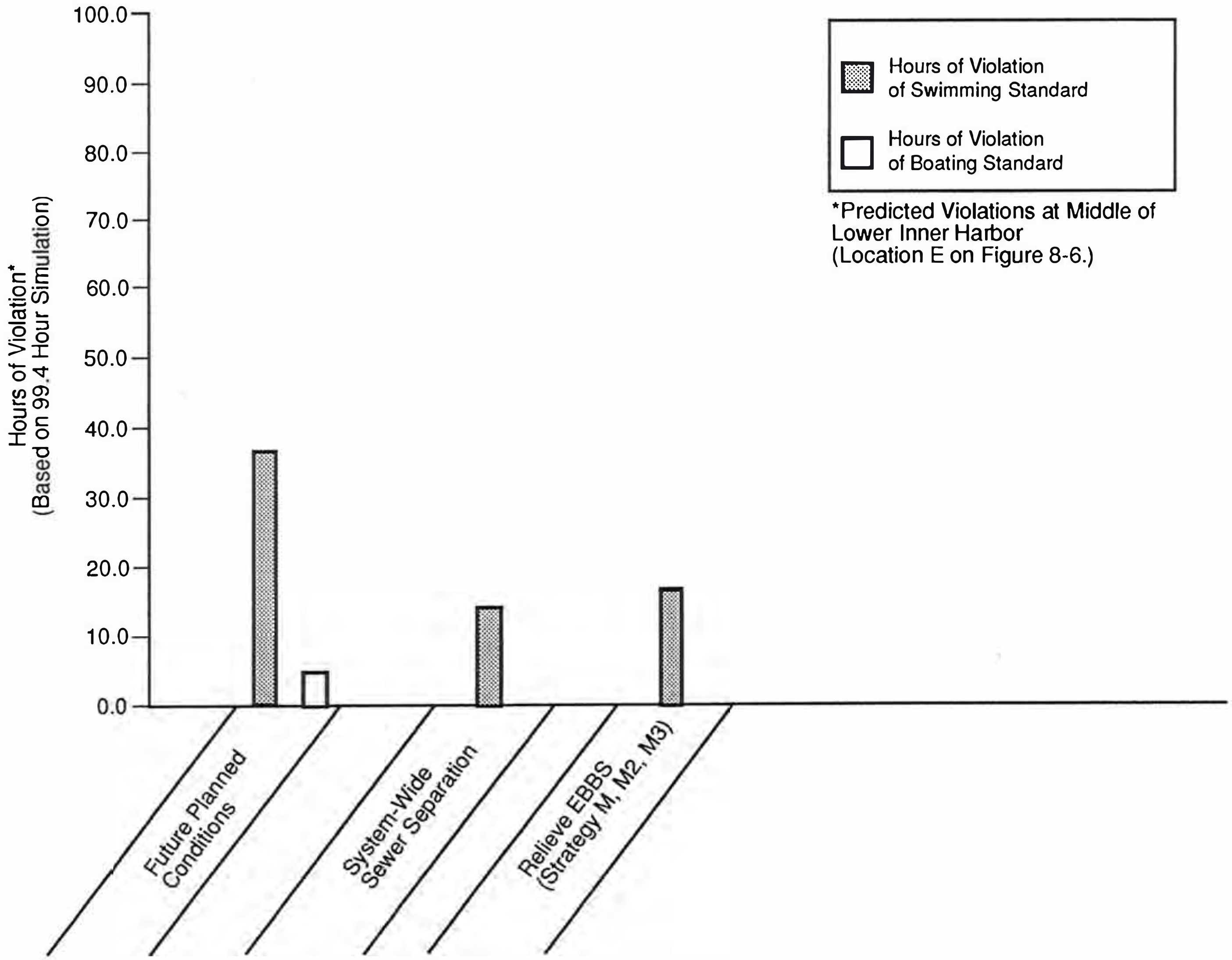


FIGURE 8-51. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, LOWER INNER HARBOR

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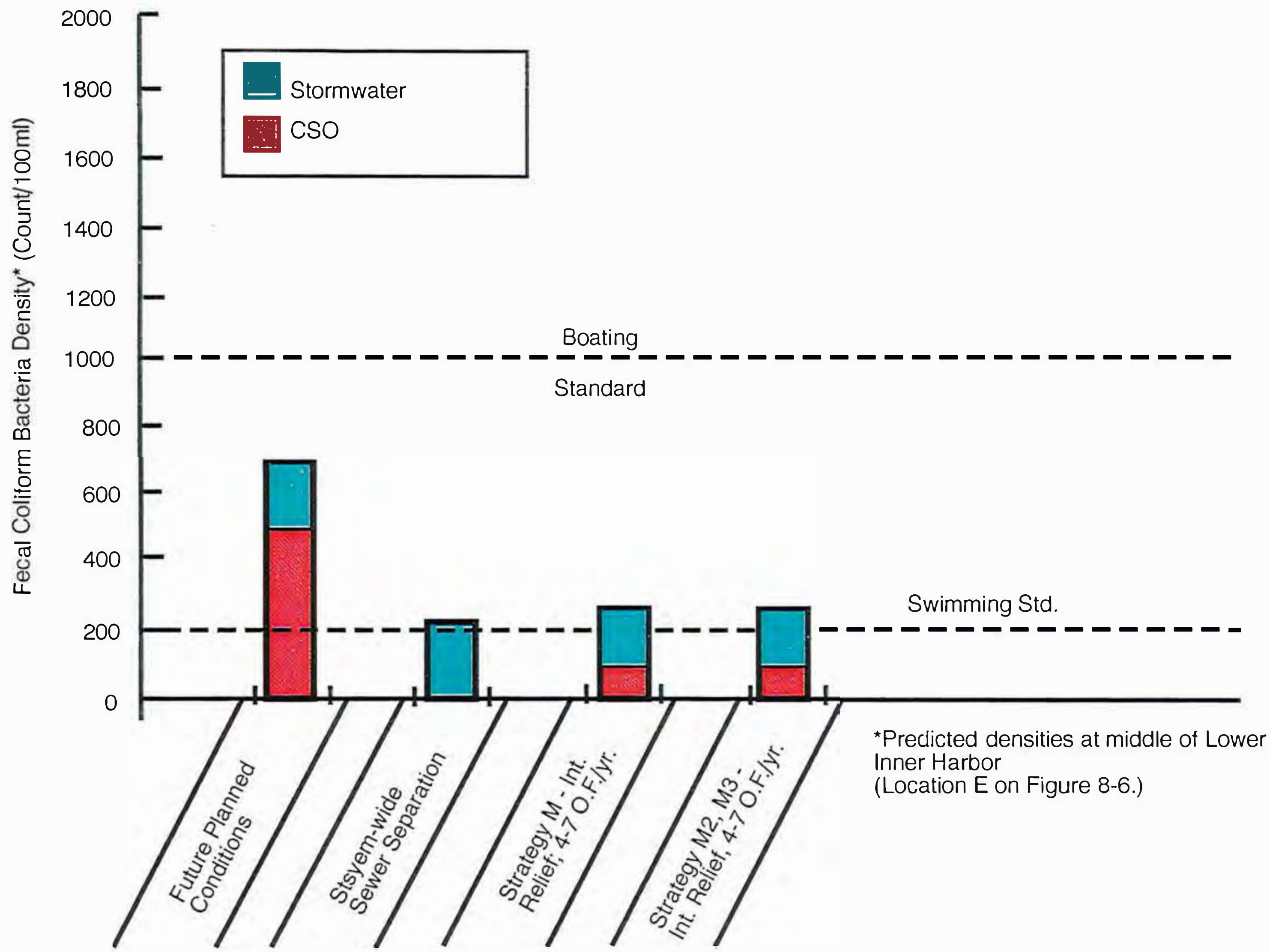

FIGURE 8-52. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1 YEAR STORM, LOWER INNER HARBOR

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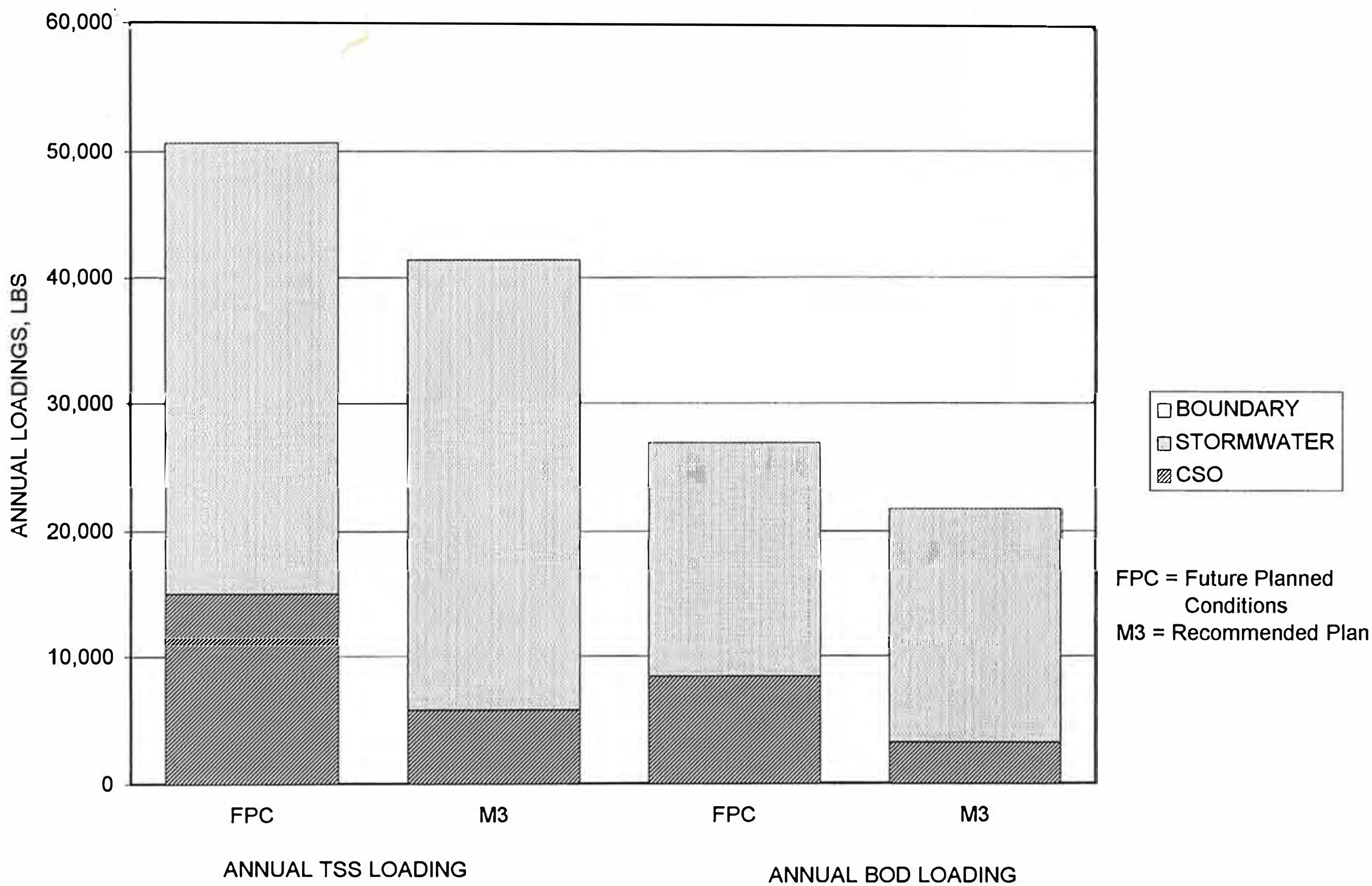

FIGURE 8-53. ANNUAL TSS AND BOD LOADINGS TO LOWER INNER HARBOR

Considerations for Partial Use Designation. A request for a partial use designation in this receiving water segment will be required, since under the recommended plan about four untreated overflows per year are predicted to occur. Cost/performance relationships for percent removal of fecal coliform bacteria, TSS, and BOD versus present worth costs are presented in Appendix G. These analyses showed that sewer separation would provide a substantially better removal of pollutant loads at an increased cost of about $30 million. Based on the evaluation of site-specific water quality conditions and the relatively minor impacts from CSOs compared to other sources of pollutants, a higher level of CSO control would produce no measurable improvement in attainment of beneficial uses. The recommended alternative achieves the engineering target set by DEP for achievement of designated uses to the maximum extent feasible in partial use segments with an average of approximately four untreated overflows per year. The cost of higher levels of CSO control would be excessive compared to any potential benefits to be achieved. Relocation of Lower Inner Harbor CSO outfalls is not feasible since there is no less sensitive receiving water in proximity.

Mystic/Chelsea Confluence

Recommended alternatives for this receiving water segment include providing screening and disinfection facilities at outfall BOS017 and at the relocated Somerville Marginal CSO Facility; providing trunk sewer relief and manually cleaned bar screens for Chelsea outfalls CHE002 to CHE004; and repairing or replacing the outfall and installing manually cleaned bar screens at CHE008 (Figure 8-43).

Flows passing through the Somerville Marginal Facility will be discharged at either outfall MWR205 or SOM007A, depending on tidal stage. The existing Somerville Marginal CSO Facility is to be relocated as part of the Massachusetts Highway Department's Rout I-93/Exit 29 project. Siting of the new facility would have to be coordinated with the Massachusetts

Highway Department. At outfalls CHE002 to CHE004, a relief trunk sewer will replace the existing undersized trunk sewer carrying flows from this area to the North Metropolitan Trunk Sewer. This project will reduce the annual overflow frequency from these three outfalls to approximately four per year or less. The CHE008 outfall has been reported to be in poor condition. Part of the work to rebuild or repair the outfall would include installing a manually-cleaned bar screen on the outfall, and implementing the recommended SOP at RE-081.

The November, 1994 Technical Memorandum on Intermediate Projects described a potential project to route separate storm drainage around regulator RE-081, directly to outfall CHE008. This project was not recommended for implementation due to uncertainties over the appropriate design stormwater flows. The existing separate drainage system tributary to RE-081 did not appear to have sufficient capacity to convey the expected flows from large storm events such as the five-year storm. Final sizing of the drainage pipe to re-route flows around RE-081 would depend on whether or not the existing upstream drainage system would be upgraded. This project was also complicated by shallow pipe depths and the need to pass under existing active railroad tracks. Implementation of this drainage project would further reduce overflow frequencies and volumes at CHE008, and would be consistent with the recommended plan. The recommended plan would, however, still be appropriate if the drainage project was not implemented. A proposed project to relieve the Chelsea Branch Sewer (described in Part IV), accounts for the change in overflow volume and frequency at CHE008 indicated in Table 8-1 between future planned conditions and the recommended plan.

Approximately 27 minutes of detention time would be available in the existing BOS017 outfall pipe between the regulator and the river during the peak flow from the one-year storm. It would appear that sufficient detention time would be available if sodium hypochlorite is to be used as the disinfectant at the BOS017 screening and disinfection facility.

The recommended alternative reflects the most cost-effective level of control in terms of reduction of fecal coliform loads to the Mystic/Chelsea Confluence (refer to cost/performance curves in Appendix G). While higher levels of control provide greater reductions of bacteria loads (at increasingly higher cost), the impact of these increased reductions on durations of violations of bacteria standards in the Mystic/Chelsea Confluence are negligible, as described below. In terms of reduction of TSS and BOD levels, the cost/benefit curves are approximately linear. However, the benefit of increased control of TSS and BOD from CSO sources would be limited, due to the predominance of upstream sources.

Water Quality Impacts. The relative contributions of pollutant sources to the Mystic/Chelsea Confluence are presented in Figure 7-2 and Appendix F. Figures 8-54 to 8-57 present results from the receiving water model for the Lower Mystic portion of the Mystic/Chelsea confluence. Figure 8-54 demonstrates that even with elimination of CSOs to the Lower Mystic, violations of the swimming standards will occur during the three-month storm. Figure 8-55 indicates that the violations occur more than eight hours after the peak of the storm, and suggests that stormwater and upstream sources are responsible for the violations. A similar pattern is evident in Figures 8-56 and 8-57 for the one-year storm. These figures suggest that higher levels of control would not result in substantial improvements in attainment of beneficial uses during the three-month and one-year storms. The data for the Chelsea Creek portion of the Mystic/Chelsea confluence essentially mirrors the data from the Lower Mystic side.

Figure 8-58 presents the annual loads for TSS and BOD for future planned conditions and the recommended plan. The substantial contributions of upstream sources and stormwater to the annual loads suggests that further investment in alternatives to control the CSO component of these constituents would have minimal impact on water quality in the Mystic/Chelsea confluence.

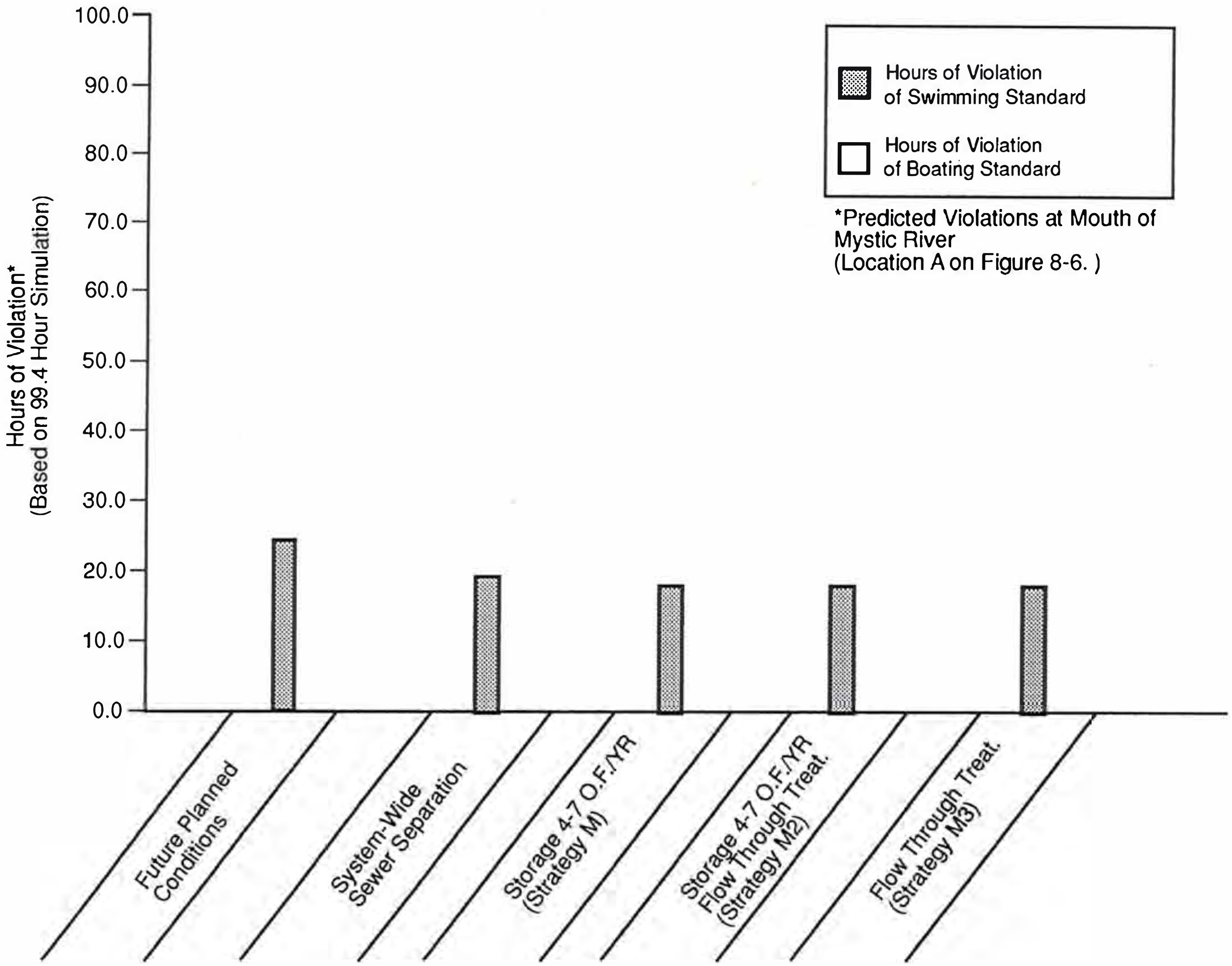

FIGURE 8-54. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 3 MONTH STORM, MYSTIC/CHELSEA CONFLUENCE (LOWER MYSTIC)

4184jp/3mth

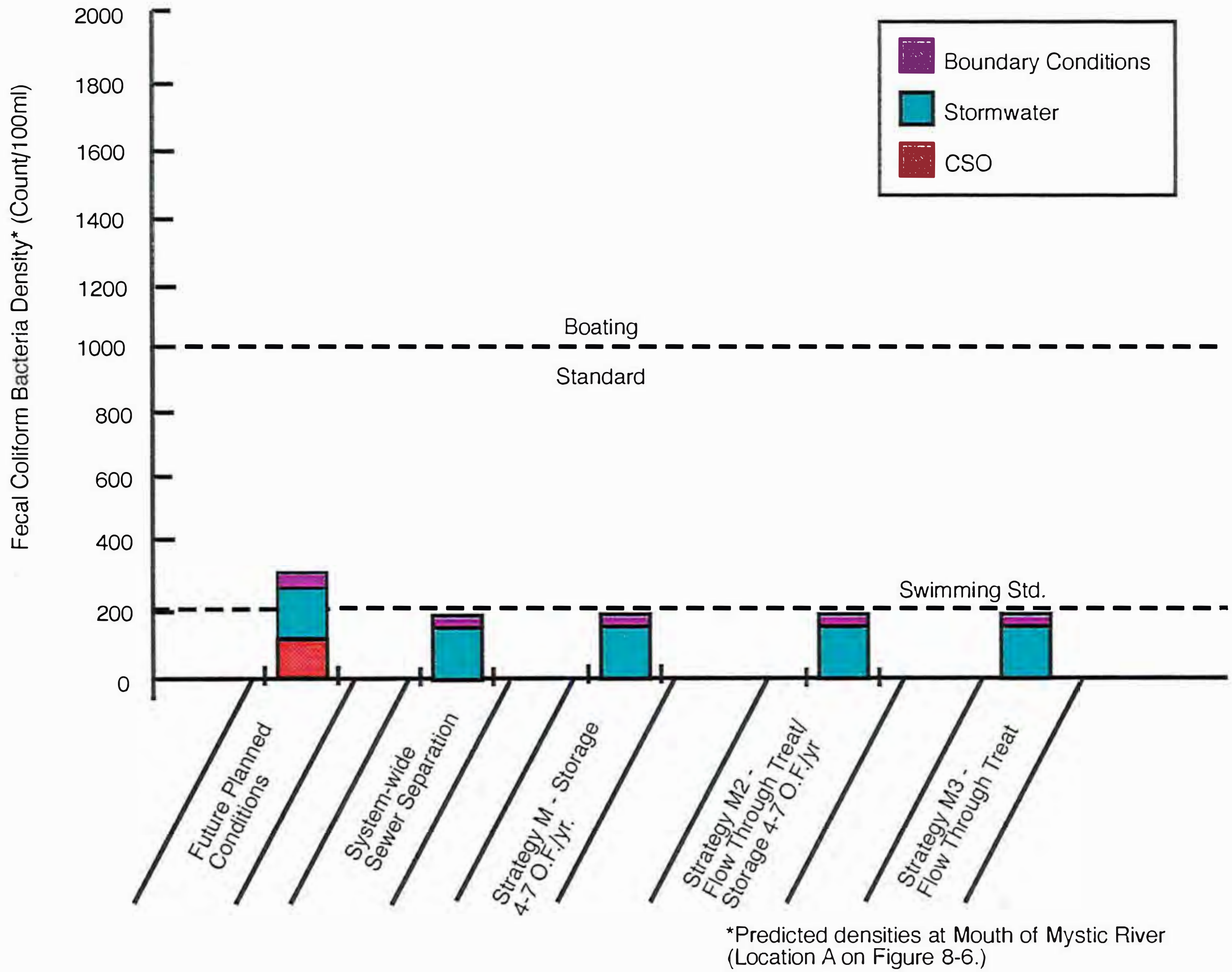

FIGURE 8-55. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 3 MONTH STORM, MYSTIC/CHELSEA CONFLUENCE (LOWER MYSTIC)

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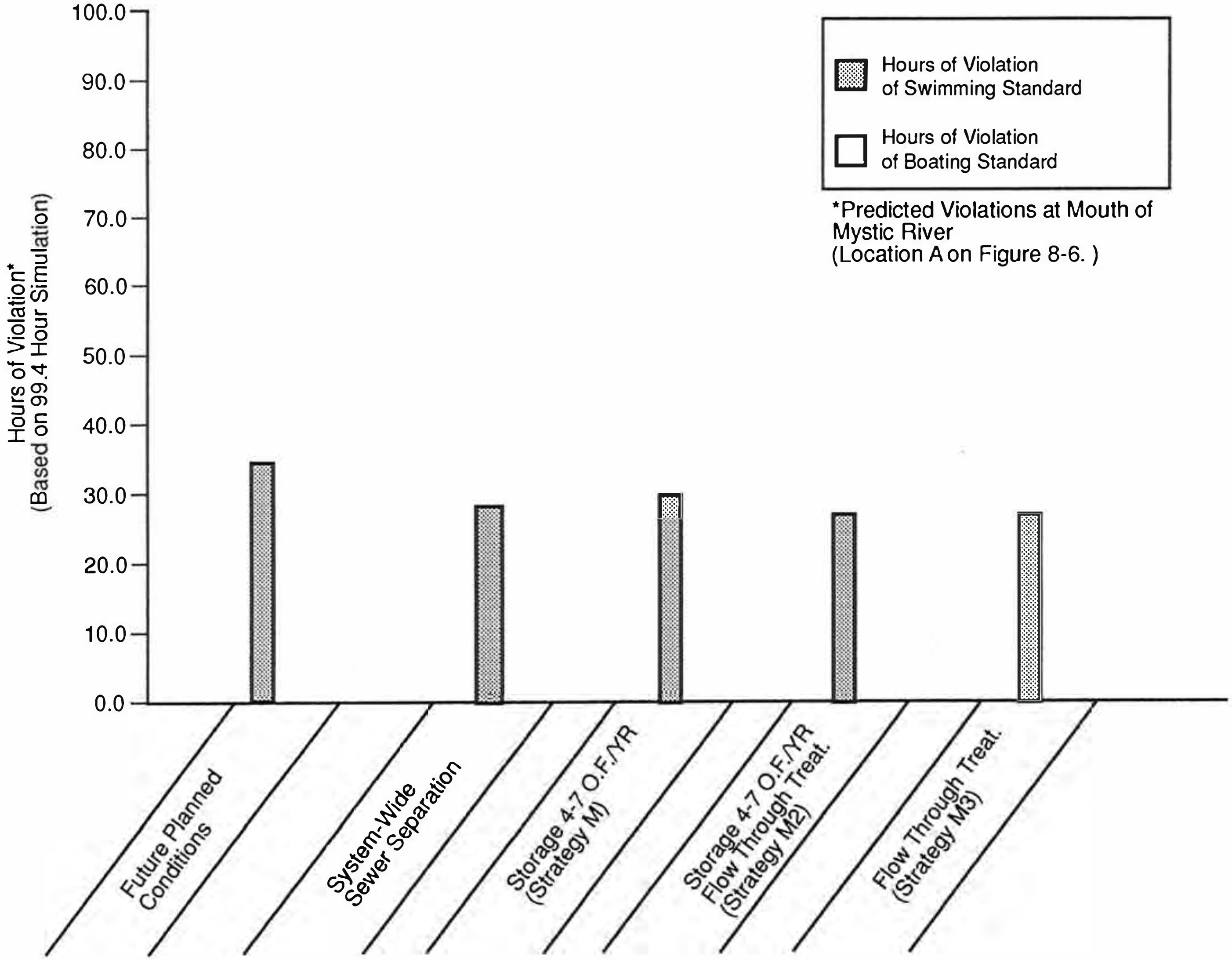
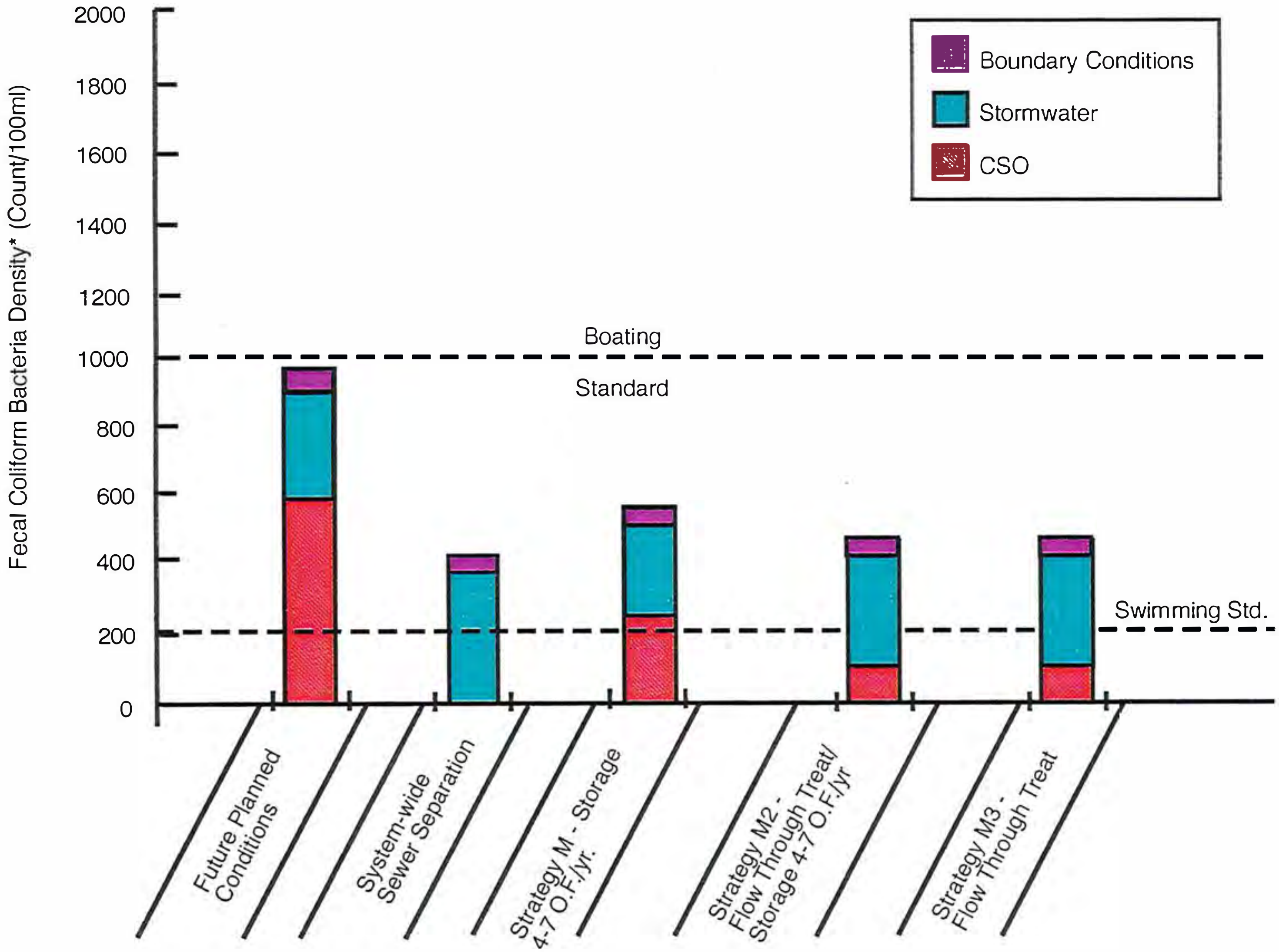


FIGURE 8-56. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, MYSTIC/CHELSEA CONFLUENCE (LOWER MYSTIC)

4184jp



*Predicted densities at mouth of Mystic River (Location A on Figure 8-6.)

FIGURE 8-57. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1-YEAR STORM, MYSTIC/CHELSEA CONFLUENCE (LOWER MYSTIC)

4190jp

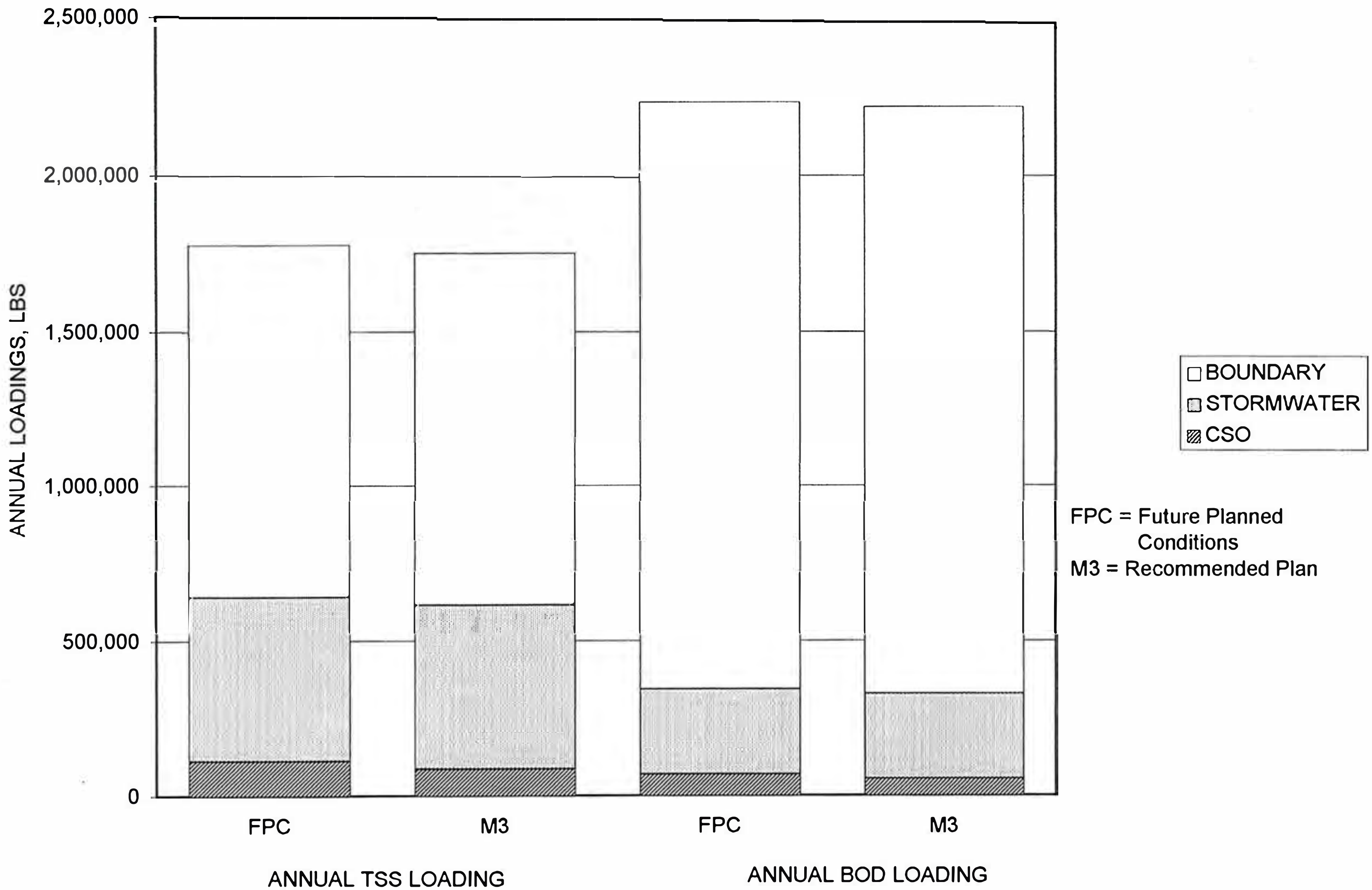


FIGURE 8-58. ANNUAL TSS AND BOD LOADINGS TO THE MYSTIC / CHELSEA CONFLUENCE

Additional controls by the MWRA could become appropriate in the Mystic/Chelsea Confluence, pending future comprehensive watershed planning and integration with substantial control of stormwater and other non-CSO pollutant sources by others. Examples of additional controls would include providing for storage of three-month storm volumes at the Somerville Marginal CSO Facility, and at BOS017. With these options, the overflow frequency to the Mystic/Chelsea Confluence would be reduced to approximately four per year for both treated and untreated flows.

Siting Issues. Short-term impacts of the relocation of the Somerville Marginal Facility will depend on the final location of the facility, which in turn must be coordinated with the Massachusetts Highway Department I-93/Exit 29 project. Depending on the timing of the work, the construction-related impacts may be incidental to the I-93 work. Long-term site impacts would not be substantially different from existing conditions, other than that the actual location of the facility may be different.

The screening and disinfection facility at BOS017 would be located on the overflow conduit. Short-term disruptions to sensitive receptors would be minimal, while long term site impacts would be limited to a slight increase in truck traffic.

Interceptor relief work at CHE002 to CHE004 would involve open cut excavation in existing streets and rights-of-way. Short-term impacts would include localized construction-related noise, dust, and traffic disruptions. The most severe traffic impacts would be at the busy intersection of Pearl and Marginal Streets. Long-term site impacts of this work would be negligible.

Repair work on the CHE008 outfall would take place within the Star Enterprises lot, and would also impact traffic on Eastern Avenue. Within the Star Enterprises property, there would be a potential for encountering contaminated soils.

Costs. The capital cost for relocating the Somerville Marginal screening and disinfection facility is estimated at $7 million, with $406,000 per year in annual O&M costs. The capital cost for the screening and disinfection facility at BOS017 would be $2 million, with approximately $109,000 per year in O&M costs. Interceptor relief in Chelsea would have a capital cost of $2 million, with negligible incremental O&M costs. Repair of the outfall and other work associated with CHE008 would have a capital cost of $1.3 million. Total present worth for these projects would be approximately $15 million.

Considerations for Partial Use Designation. A request for a partial use designation in this receiving water segment will be required, since under the recommended plan 31 treated and approximately four untreated overflows per year are predicted to occur. Cost/performance relationships for percent removal of fecal coliform bacteria, TSS, and BOD versus present worth costs are presented in Appendix G. These analyses clearly showed that sewer separation at a cost of $90 million provided no measurable removal of pollutant loads compared to other alternatives for storage, treatment, or screening at costs ranging from $14 million to $68 million. Relocation of CSO outfalls is not feasible since there is no less sensitive receiving water in proximity.

Based on the evaluation of site-specific water quality conditions and the relatively minor impacts from CSOs compared to other sources of pollution, a level of CSO control higher than the recommended plan would produce no measurable improvement in attainment of beneficial uses. The recommended alternative achieves the engineering target set by DEP for achievement of designated uses to the maximum extent feasible in partial use segments (an average of four untreated overflows per year). The cost of higher levels of CSO control would be excessive compared to any potential benefits to be achieved.

Reserved Channel

The recommended alternative for this receiving water segment is to consolidate outfalls BOS076 to BOS080 to a screening and disinfection facility in the vicinity of BOS080, and to install screens at the four remaining outfalls (Figure 8-1). The screening and disinfection facility would also treat flow from the consolidation conduit serving to relocate overflows from North Dorchester Bay, as described above. The consolidation conduit for outfalls BOS076 to BOS080 would run parallel to East First Street, and would likely be installed using soft-ground tunneling techniques. The volume of the conduit would hold more than 70 percent of the overflow volume to the Reserved Channel from outfalls BOS076 to BOS080 for the three-month storm. Screens at outfalls BOS076, BOS078, BOS079 and BOS080 would be provided for storms which exceed the capacity of the consolidation conduit.

Based on cost-effective analysis for removal of bacteria, consolidation of Reserved Channel overflows to a screening and disinfection facility near BOS076 was the originally-preferred alternative (see Appendix G). Since the largest overflow volumes were at BOS076, consolidation in that direction allowed for a smaller (and less expensive) consolidation conduit. The selection of relocation of CSOs to a screening and disinfection facility at the Reserved Channel as the preferred alternative for North Dorchester Bay, however, created an opportunity to use a single facility to treat flows from both North Dorchester Bay and the Reserved Channel. In addition, consolidating flows to the mouth of the Reserved Channel would allow for better dispersion and dilution of the discharged flows, as compared with discharging treated flows at the upstream end of the Reserved Channel near BOS076. For these reasons, consolidation of Reserved Channel overflows to a regional screening and disinfection facility near BOS080 was selected as the recommended alternative.

Water Quality Impacts. As indicated in Figure 7-2 and Appendix F, CSOs are the predominant source of fecal coliform bacteria to the Reserved Channel. The consolidation conduit in conjunction with the screening and disinfection facility at the mouth of the Reserved Channel will substantially reduce the fecal coliform load to this waterbody. Figures 8-59 to 8-62 present results from the receiving water model for the Reserved Channel. These figures demonstrate that for the recommended plan, the bacteria standard for swimming will be met at the mouth of the Reserved Channel for both the three-month and one-year storms. The isopleths for the recommended plan in Figure 8-9, however, indicate

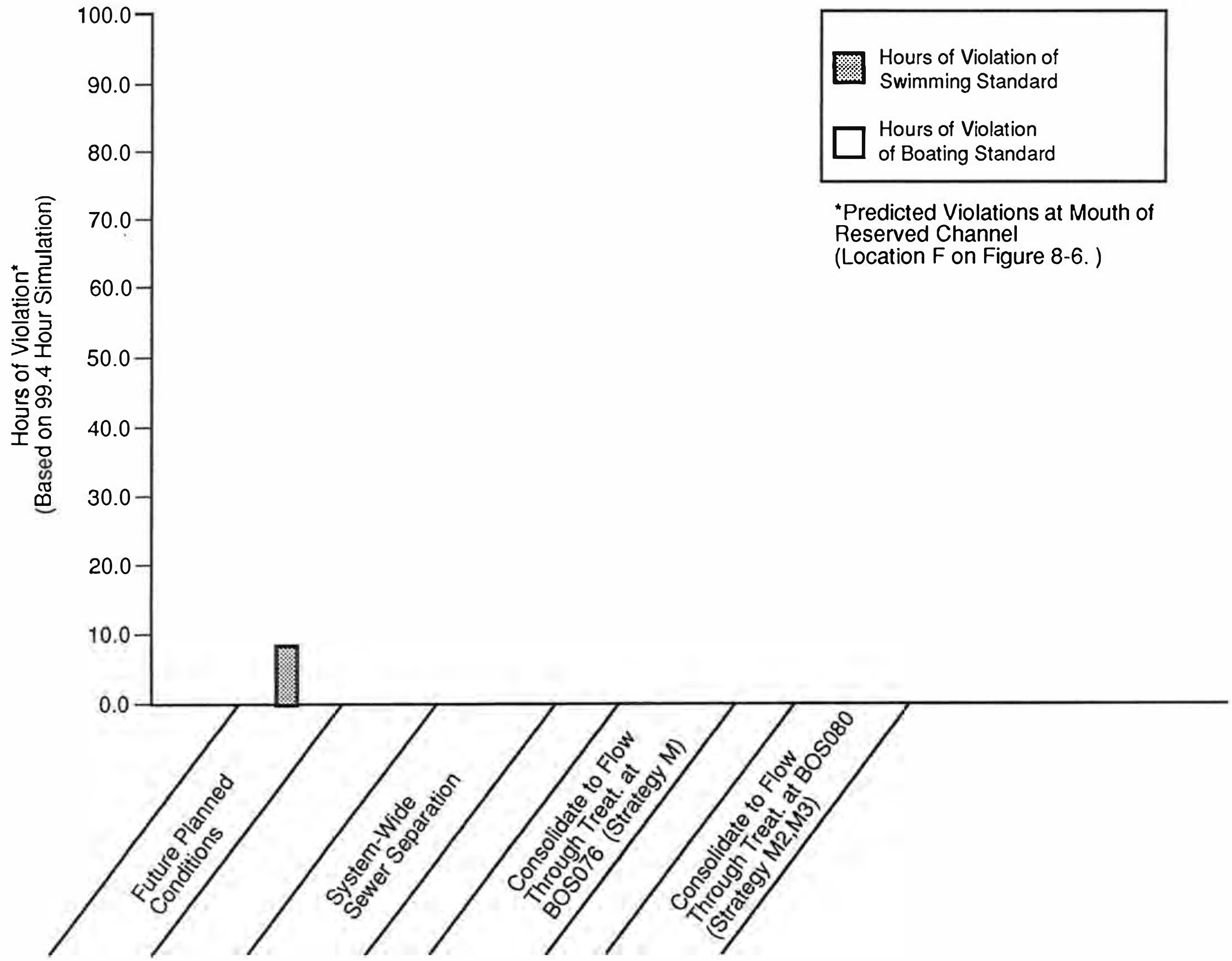


FIGURE 8-59. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 3 MONTH STORM, RESERVED CHANNEL

4184jp/3mth

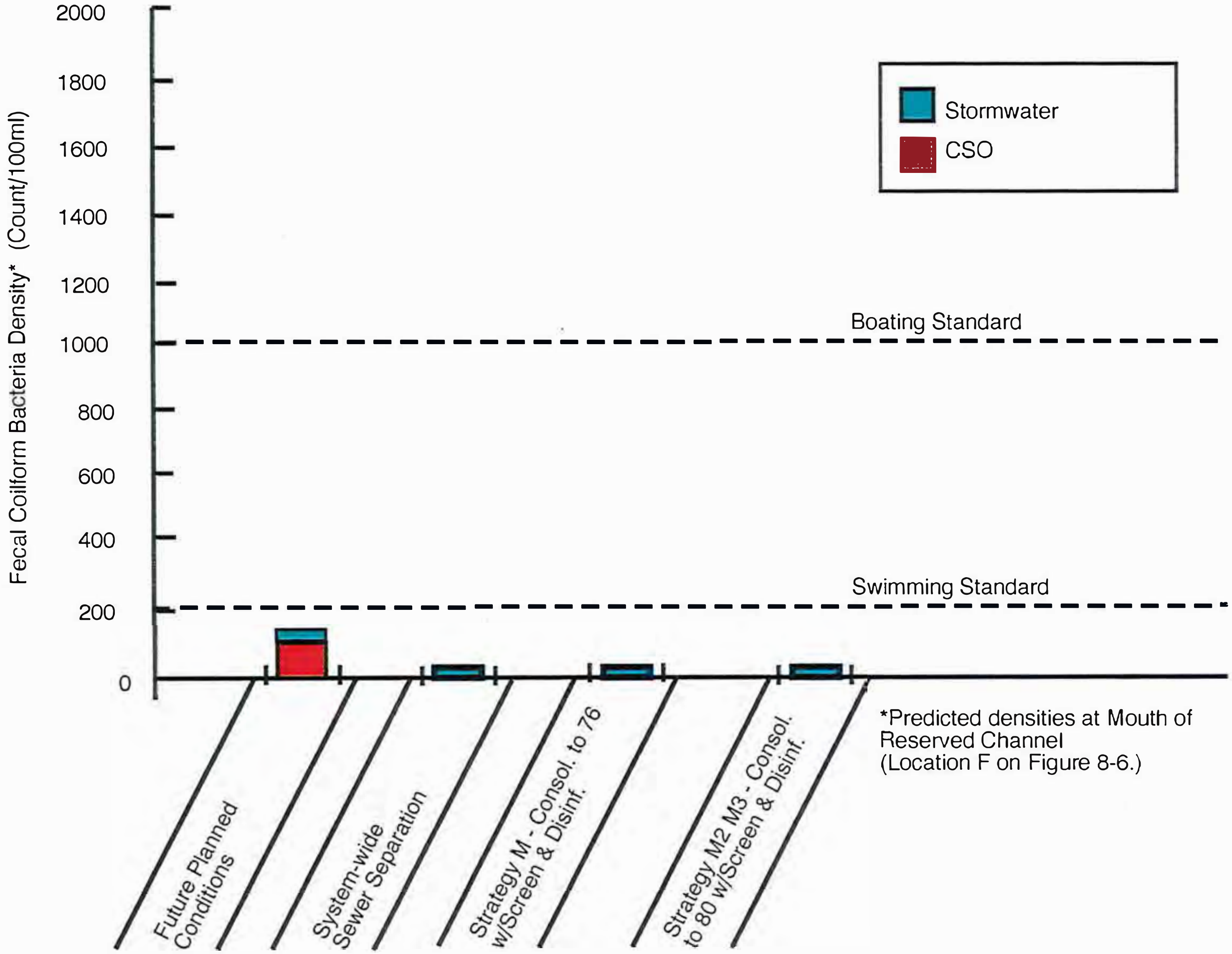


FIGURE 8-60. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 3 MONTH STORM, RESERVED CHANNEL

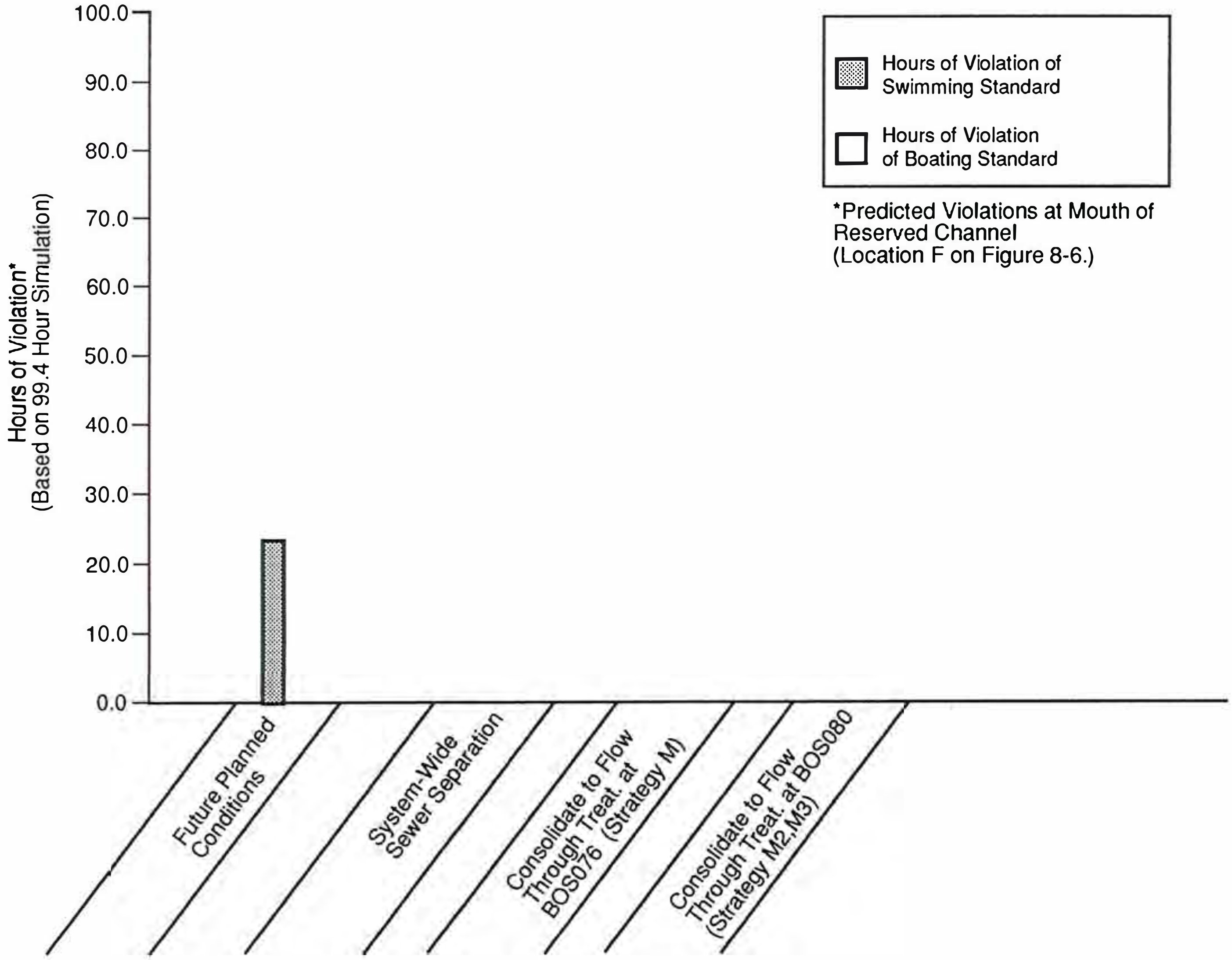


FIGURE 8-61. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, RESERVED CHANNEL

4184jp

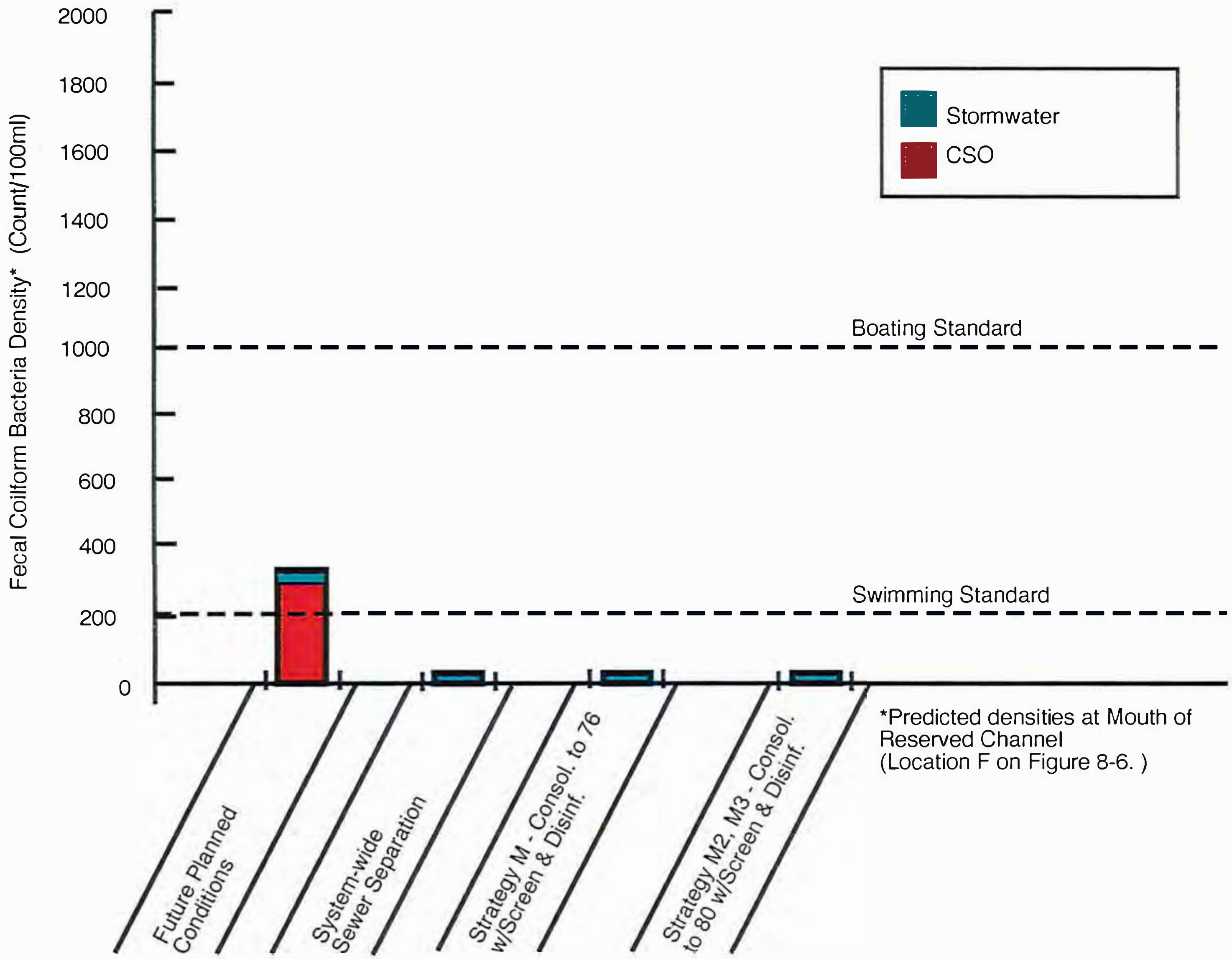


FIGURE 8-62. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1-YEAR STORM, RESERVED CHANNEL

4190jp

that the swimming standard will be violated at the upstream end of the Reserved Channel during both the three-month and one-year storm. The isopleths of the bacteria densities due to non-CSO sources in Figure 8-7 and Figure 8-8 suggest that stormwater is contributing to the violation of the standard.

Figure 8-63 presents the annual loads of TSS and BOD for future planned conditions and the recommended plan. The predominance of CSOs as a source of pollutants is evident in this figure, as are the substantial reductions in annual load predicted for the recommended plan.

Siting Issues. Assuming that soft ground tunneling techniques would be used for the consolidation conduit, construction-related surface impacts would be limited to access shafts, local traffic disruptions, and additional truck traffic for spoil disposal. Long-term site impacts of the conduit would be negligible. Impacts of the screening and disinfection facility, potentially located in the vicinity of the Conley Marine Terminal or on a similar, nearby site, were described above.

Costs. The capital costs for the consolidation conduit and outfall screens are estimated at $34.5 million, with annual O&M costs of $40,000. The capital and O&M costs for the screening and disinfection facility were included in the cost for the North Dorchester Bay alternative. Total present worth for this alternative would be $28 million.

Considerations for Partial Use Designation. A request for a partial use designation in this receiving water segment will be required, since under the recommended plan six treated overflows per year are predicted to occur. Cost/performance relationships for percent removal of fecal coliform bacteria, TSS, and BOD versus present worth costs are presented in Appendix G. These analyses clearly showed that sewer separation provided the same or lower removal of pollutant loads compared to the recommended plan. Relocation of CSO outfalls to Fort Point Channel provides only marginally increased removal of pollutant loads compared to the recommended plan and is precluded by the recommended plan for relocating outfalls in North Dorchester Bay to the Reserved Channel. The recommended consolidation

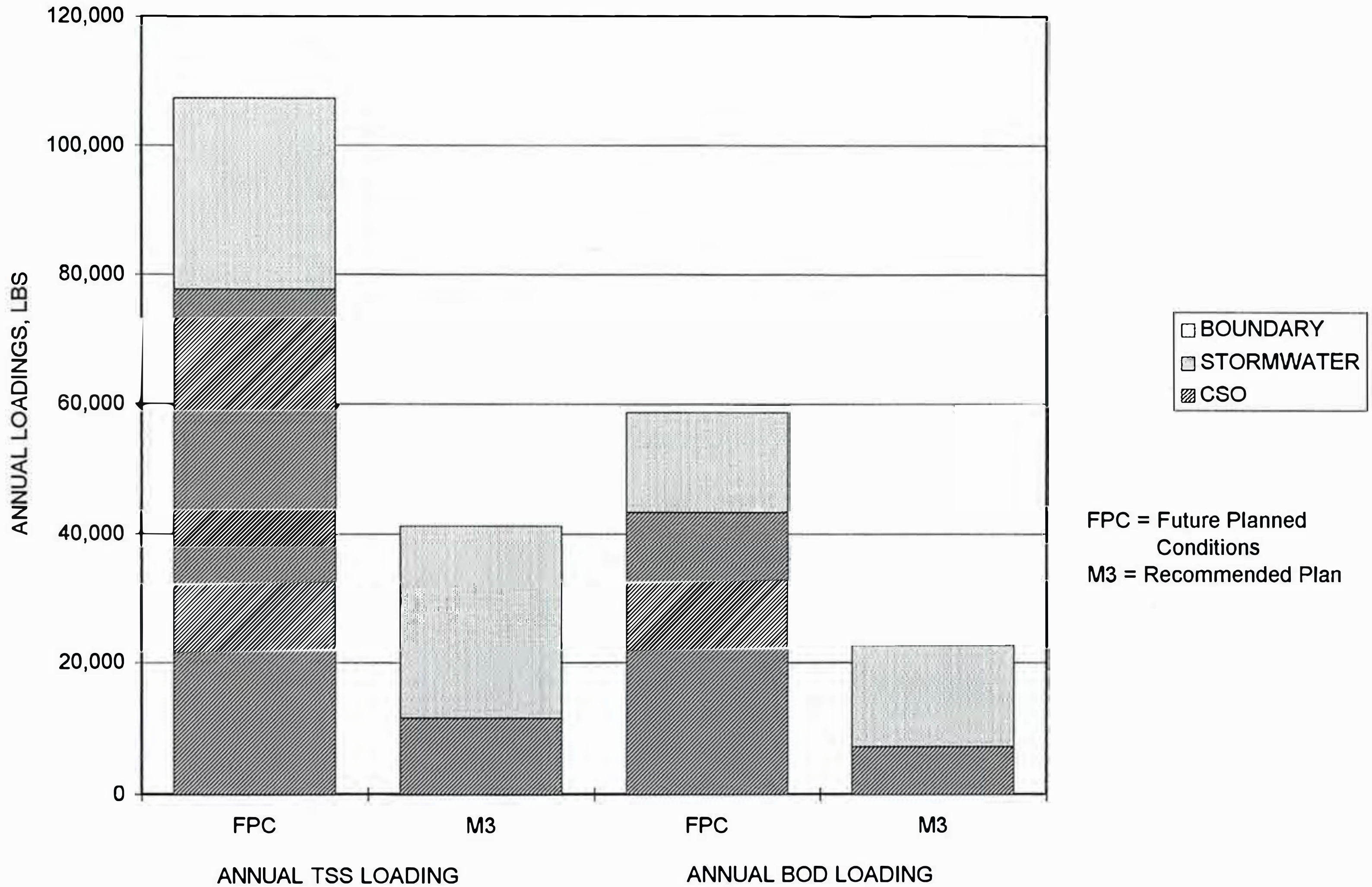


FIGURE 8-63. ANNUAL TSS AND BOD LOADINGS TO THE RESERVED CHANNEL

conduit will direct remaining overflows to outfalls located at the mouth of the Reserved Channel, providing greater dilution of discharged flow.

The recommended alternative exceeds the engineering target set by DEP for achievement of designated uses to the maximum extent feasible in partial use segments, as all remaining CSO discharges will be treated. Based on the evaluation of site-specific water quality conditions, the cost of higher levels of CSO control would be excessive compared to any potential benefits to be achieved.

Fort Point Channel

The recommended alternative for this receiving water segment includes manually-cleaned bar screens at outfalls BOS062 to BOS068, a detention and disinfection facility for overflows from the Union Park Pump Station, screens at three regulators upstream of Union Park Pump Station, in-line storage and screens in the Dorchester Brook Conduit (DBC), and a consolidation/storage conduit between outfalls BOS072 and BOS073 with screens at the outfalls (Figure 8-1). The construction of the consolidation/storage conduit for outfalls BOS072 and BOS073 will require close coordination with the Central Artery/Tunnel project. Bar screens were considered appropriate for outfalls BOS062 to BOS068, due to the relative inactivity of these outfalls as indicated in Table 8-1. The facility for the Union Park Pump Station flows will provide storage for small storms, and detention treatment (with disinfection) for the three-month storm. The detention tank, with a volume of approximately 2.2 MG, could be located in a parking lot next to the Union Park Pumping Station, or in a location near to the pump station.

Screens would be provided at regulators RE-070/5-2, RE-070/6-1 and MH-172, which discharge to the Roxbury Canal Conduit during the one-year storm. These regulators are not active during the three-month storm.

Through the installation of a hydraulic gate, a pump-out station, and piping modifications, the existing DBC can be used to store overflows from up to the one-year storm from regulators RE-070/8-11 to RE-070/10-5 along the South Boston Interceptor North Branch. The hydraulic gate would be located on the DBC just upstream of where the DBC joins the Roxbury Canal Conduit (RCC). The connections between the two-barrel DBC and the west barrel of the BOS070 outfall will be bulkheaded, and the two barrels of the DBC will be rejoined at the hydraulic gate. The gate will remain normally closed, to prevent overflows to BOS070, and to prevent the tide from backing up into the DBC. On extremely high flows, the gate will open, to prevent upstream flooding. A pump-out station will be provided upstream of the gate, to return the stored contents to either the East Side Interceptor or the South Boston Interceptor North Branch. Flows from RE-070/10-5 will either be repiped to upstream of the gate, or RE-070/10-5 could be further optimized to direct more flows to outfall BOS072. During the workshops, concern was raised over the possible presence of groundwater pressure relief openings within the walls of the DBC. The existence and condition of these holes, as well as the impact on surrounding groundwater levels, should be further evaluated.

The consolidation/storage conduit with pump-out station running between outfalls BOS072 and BOS073 would store the overflows from the three-month storm.

Based on cost-effective analysis for removal of bacteria, providing screening and disinfection of Union Park Pump Station and BOS072 and BOS073 overflows was the originally-preferred alternative. As indicated on the cost/performance curves for the three month storm in Appendix G, higher levels of control did not appreciably improve the bacteria removals. Similar to other receiving water segments, the cost/performance curves for BOD and TSS were generally linear. In the case of Fort Point Channel, where CSOs contributed a substantial portion of BOD and TSS on an annual basis, it was judged to be appropriate to select a higher level of control than screening and disinfection for Union Park Pump Station overflows and at outfalls BOS072 and BOS073, to improve the removals of these other constituents. Since locating a storage tank for the approximately 8.5 MG of overflow from the three-month storm at Union Park Pump Station would be extremely difficult, a 2.2 MG detention/treatment facility was proposed. This sizing was based on the approximate space existing at the pump station, and the final sizing may depend on the final site selected for the facility.

Water Quality Impacts. As indicated in Figure 7-2 and Appendix F, CSOs are a predominant source of pollutants to the Fort Point Channel, particularly with regard to fecal coliform bacteria. Figures 8-64 to 8-67 present results from the receiving water model for Fort Point Channel. Figures 8-64 and 8-65 indicate that with the recommended plan, the bacteria standard for swimming will be met at the mouth of Fort Point Channel during the three month storm. The isopleths for the recommended plan in Figure 8-9, however, indicate that the swimming standard will be violated within most of the channel itself, and the boating standard will be violated in one small area of the channel. Comparing Figure 8-9 with the isopleth of the bacteria density due to non-CSO sources during the three-month storm in Figure 8-7, it is apparent that the non-CSO sources are primarily responsible for the violations to the bacteria standards under the recommended plan.

Figures 8-66 and 8-67 indicate that the swimming standard would continue to be violated at the mouth of Fort Point Channel, even with CSO elimination by separation. As in the case of the three-month storm, however, it appears that stormwater is partially responsible for the violation of the standard.

Figure 8-68 presents the annual TSS and BOD loads for future planned conditions and the recommended plan. The impact of CSOs as a source of these pollutants is evident in this figure, as are the substantial reductions in annual loads predicted for the recommended plan.

Additional controls by the MWRA could become appropriate in Fort Point Channel, pending completion of comprehensive watershed planning and integration with substantial control of stormwater by others. An example of additional control would include providing for storage of the three-month storm overflow volumes from the Union Park Pump Station. With this

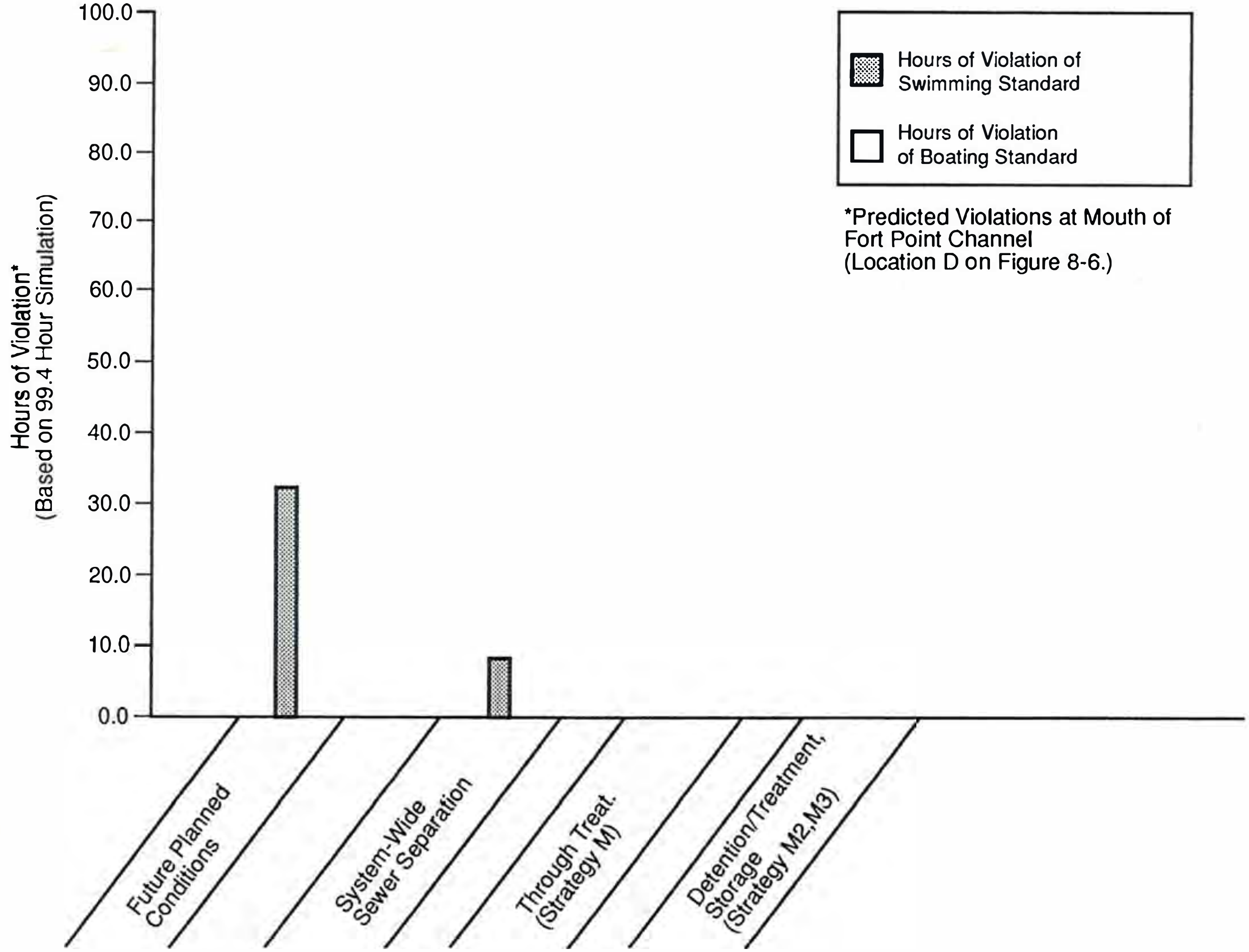


FIGURE 8-64. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 3 MONTH STORM, FORT POINT CHANNEL

4184jp/3mth

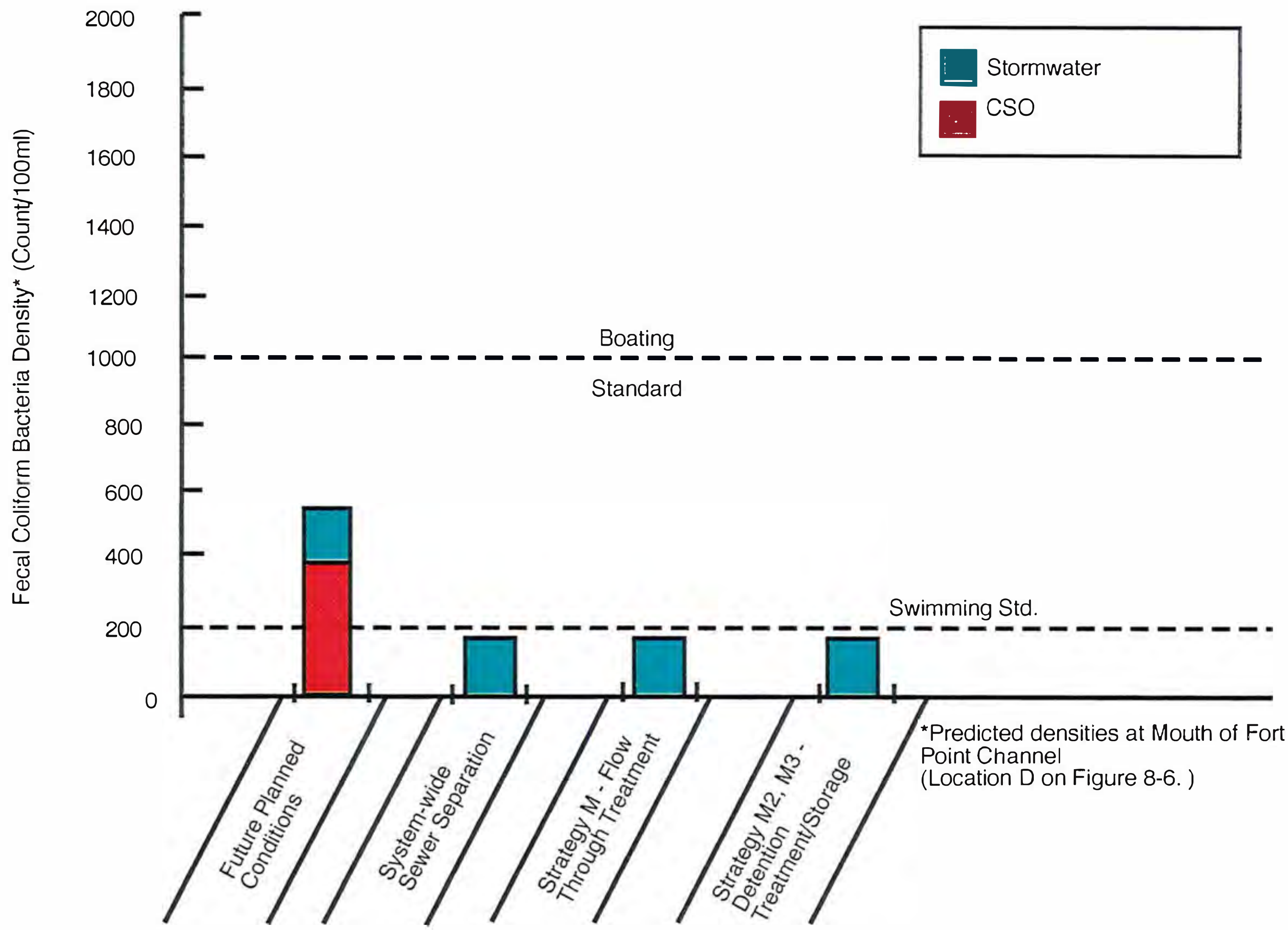


FIGURE 8-65. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 3 MONTH STORM, FORT POINT CHANNEL

4189jp

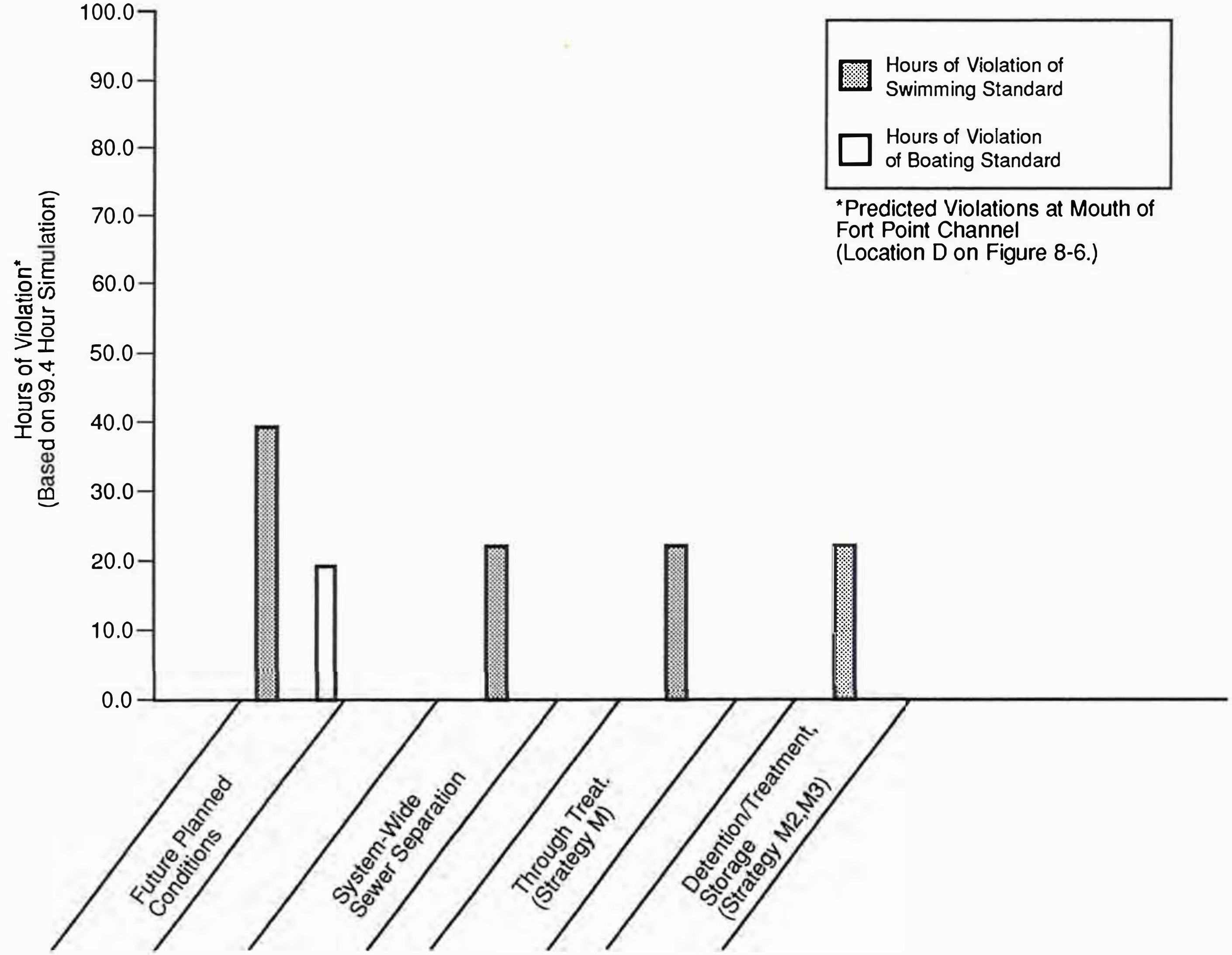


FIGURE 8-66. HOURS OF VIOLATION OF BACTERIA STANDARDS FOR 1 YEAR STORM, FORT POINT CHANNEL

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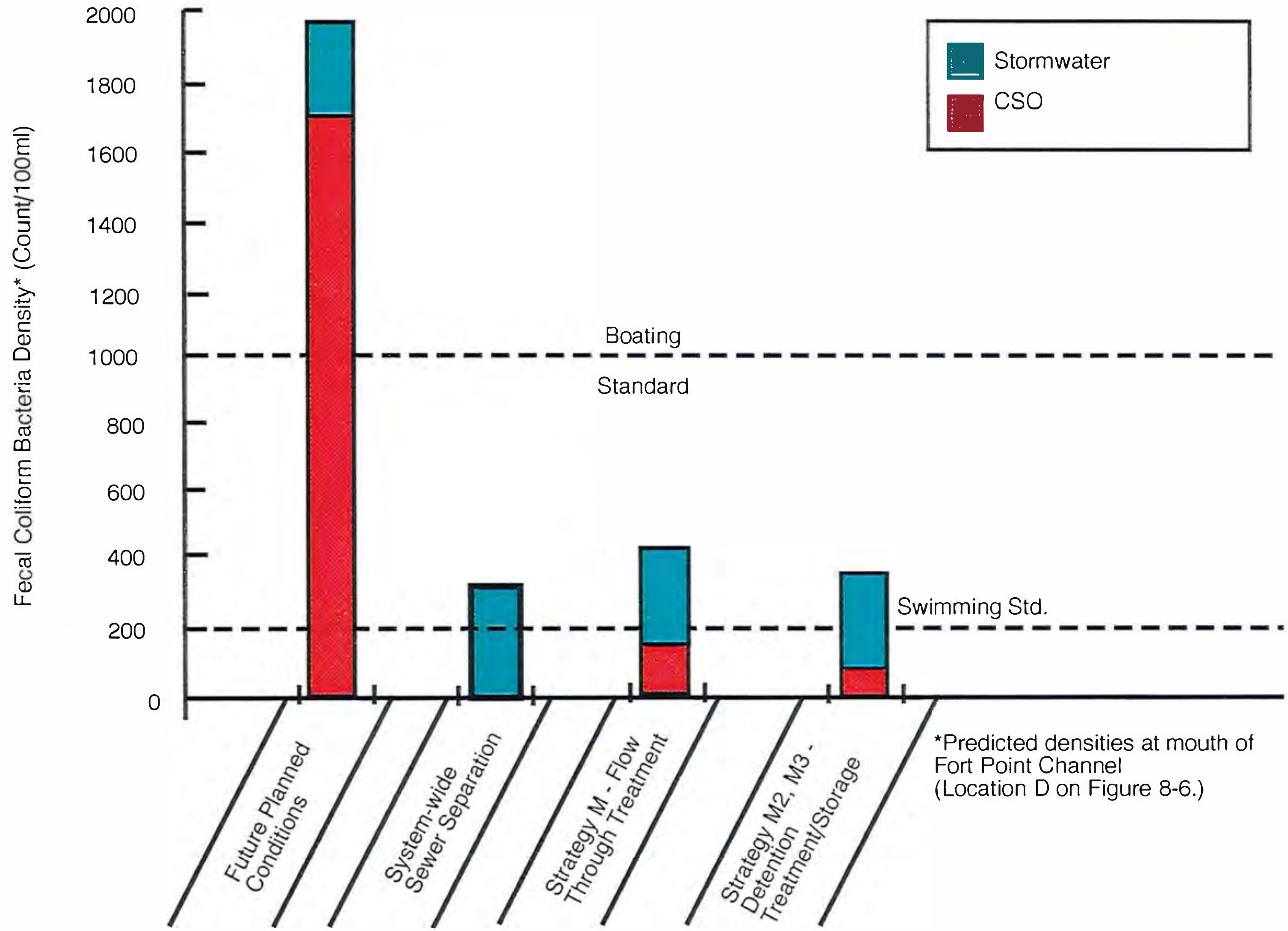

FIGURE 8-67. IN-RECEIVING WATER BACTERIA DENSITIES 8 HOURS AFTER PEAK OF 1-YEAR STORM, FORT POINT CHANNEL

4190jp

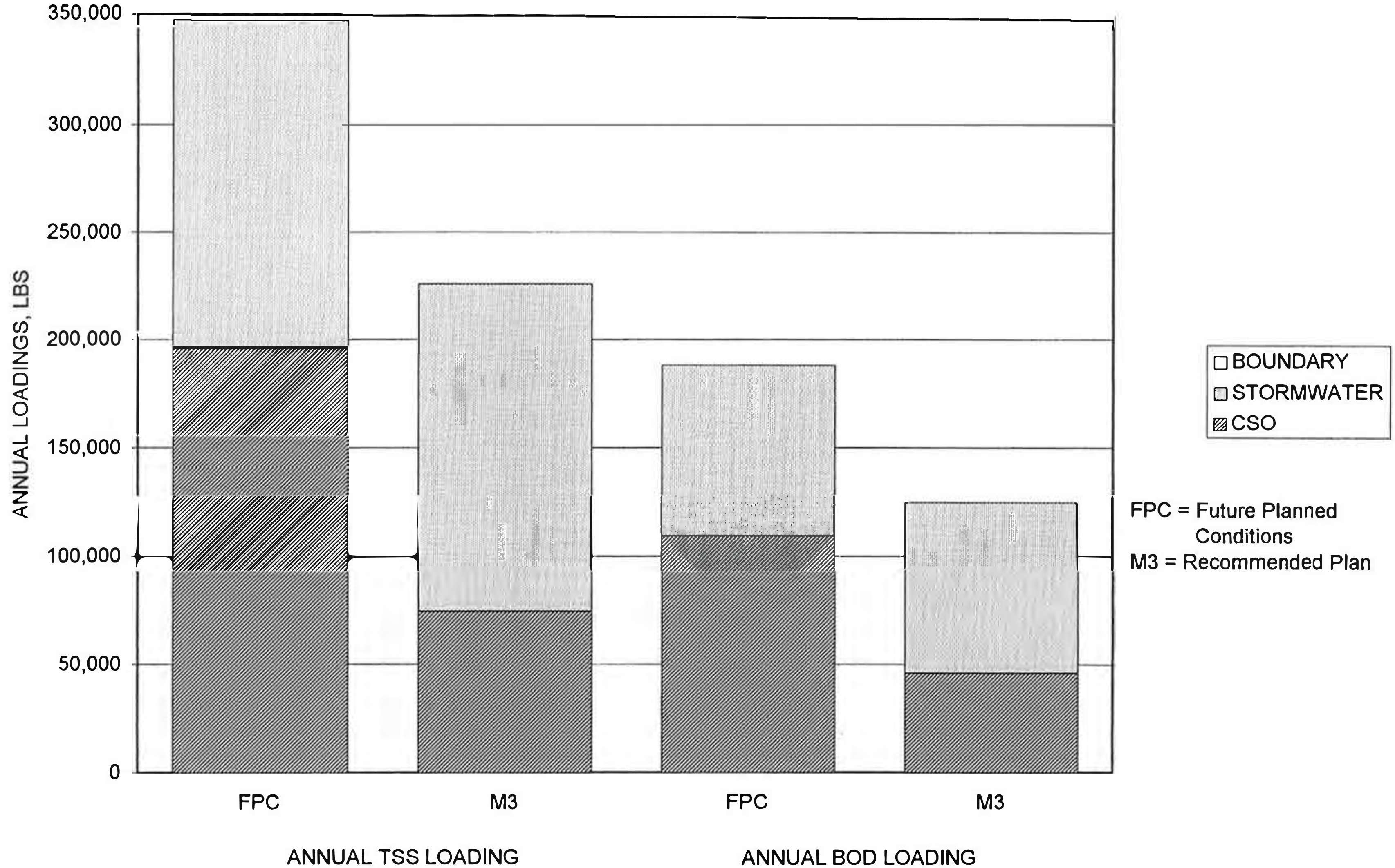

FIGURE 8-68. ANNUAL TSS AND BOD LOADINGS TO FORT POINT CHANNEL

option the overflow frequency to Fort Point Channel would be reduced to approximately four per year for both treated and untreated flows.

Siting Issues. Construction-related noise, dust and traffic could impact residences in the vicinity of the proposed detention-treatment facility for Union Park Pump Station flows. Long term impacts would not be substantially different from existing conditions. It is expected that the tanks would be located below grade, and that the area above the tanks would be available for other uses.

A potential for encountering contaminated soil has been identified along the route of the consolidation/storage conduit between outfalls BOS072 and BOS073. Short term impacts of this work would involve temporary disruption of parking facilities, while long term impacts would be relatively minor. The work to develop storage in the DBC would involve activities on the Gillette property, which may create short-term disruptions to traffic and parking. Long-term site impacts would be limited to a relatively small control structure above grade.

Costs. The capital cost of the detention-treatment facility for Union Park Pump Station flows is estimated at $16 million, with annual O&M costs of $800,000. Capital costs for the consolidation/storage facility at outfalls BOS072 and BOS073, and the in-line storage in the DBC are $5 and $4 million, respectively, with annual O&M costs of 50,000 and $16,000 per year, respectively. Capital costs for the manually cleaned bar screens at outfalls BOS062 to BOS068, BOS072, BOS073, the DBC, and at the three regulators are approximately $0.8 million, with $50,000 per year in annual O&M costs. Total present worth for this alternative is $31 million.

Considerations for Partial Use Designation. A request for a partial use designation in this receiving water segment will be required, since under the recommended plan 15 treated and approximately four untreated overflows per year are predicted to occur. Cost/performance relationships for percent removal of fecal coliform bacteria, TSS, and BOD versus present worth costs are presented in Appendix G. These analyses clearly showed that sewer separation at a cost of $200 million provided no measurable removal of pollutant loads compared to other alternatives for storage, treatment, or screening at costs ranging from $0.2 million to $25 million. Relocation of CSO outfalls is not feasible since there is no less sensitive receiving water in proximity.

Based on the evaluation of site-specific water quality conditions, even complete elimination of CSOs would produce no measurable improvement in attainment of beneficial uses. The recommended alternative achieves the engineering target set by DEP for achievement of designated uses to the maximum extent feasible in partial use segments (an average of four untreated overflows per year). The cost of higher levels of CSO control would be excessive compared to any potential benefits to be achieved.