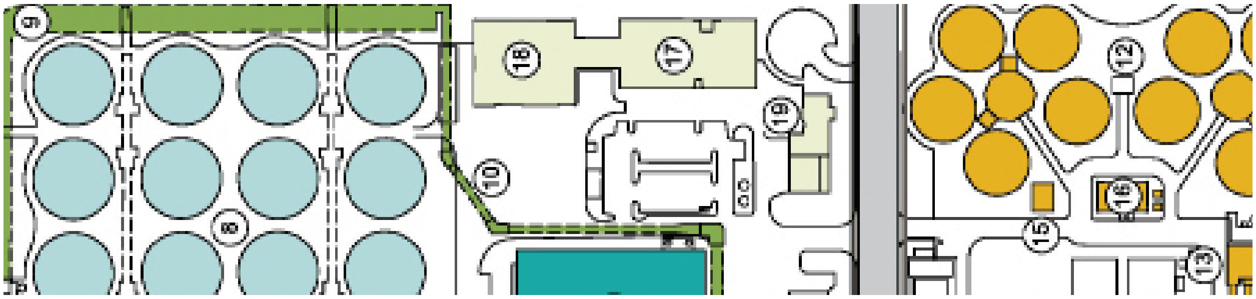

Chapter 3
Wastewater Facilities Operations and Performance

Contents

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CHAPTER 3

Wastewater Facilities Operations and Performance

The information presented in Chapter 3 is intended to provide the necessary planning parameters for renovating and sustaining the City's considerable infrastructure investment in wastewater management facilities. The principal components that comprise the wastewater management facilities for the City of San Francisco service area are described in this chapter. The watershed areas, wastewater collection system, wastewater treatment facilities, and the outfall dispersal facilities are described in Section 3.1. Operational strategies for the various components and facilities are given in Section 3.2. The corresponding performance of various components and facilities is presented in Section 3.3. The descriptions given deal with both dry- and wet-weather influent and effluent wastewater quality and quantity, as compared to the National Pollutant Discharge Elimination System (NPDES) permit requirements presented in Chapter 2. During dry weather, the influent flow is essentially sanitary flow (residential and commercial wastewater with small contributions from industrial wastewater and urban runoff). During wet weather, the combined flow of wastewater (sanitary flow) and stormwater is governed by storm patterns and intensity.

3.1 Sewer System Description

The San Francisco sewer system utilizes natural watershed areas, taking advantage of gravity whenever possible, for the collection, transport, treatment, and discharge of wastewater and stormwater. San Francisco is primarily served by a combined sewer system that collects both wastewater and stormwater for treatment at one of three City treatment facilities. There are two centralized dry-weather treatment plants, one serving each watershed. The third centralized treatment facility operates only during wet weather. **Table** 3-1 which begins on page 3-2, lists all the major WWE facilities and their year of construction.

3.1.1 Watershed Areas and Drainage Basins

San Francisco divides naturally into two major watershed areas: the Westside Watershed and the Bayside Watershed (Chapter 2, Figure 2.2). The Bayside Watershed represents 64% of the total city service area (18,597 acres) and drains to the San Francisco Bay. The Westside Watershed (11,176 acres) drains to the Pacific Ocean. Included in these two major watersheds are the

Table 3-1. SFPUC Major Facilities – Year of Construction		
All–Weather Facilities	**Location**	**Constructed/Rebuilt**
Booster Pump Station	602 Arthur Avenue	1968/2000
Channel Pump Station	455 Berry/6th Street and 7th Street	1979
Griffth Pump Station	1601 Griffth Street	1989
Hudson Avenue Pump Station	Hudson Avenue and Innes Avenue	1999
Mariposa Pump Station	851 China Basin Street	1954/1993
North Shore Pump Station	2001 Kearny Street	1982
Oceanside Water Pollution Control Plant	3500 Great Highway	1993
Palace of Fine Arts Pump Station	Marina Boulevard and Yacht Road	1994
Pine Lake Pump Station	2250 Wawona Street	1944/1954/1998
Sea Cliff #1 Pump Station	490 Sea Cliff Avenue	1929
Sea Cliff #2 Pump Station	100 Sea Cliff Avenue	1940
Southeast Water Pollution Control Plant (includes Southeast Lift Station)	750 Phelps Street	1951/1982
Tennessee Pump Station	Tennessee Street and Tubbs Street	1966
Twentieth Street Pump Station	East End of 20th Street/Port	1993
Westside Pump Station	3000 Great Highway	1985
Wet-Weather Facilities	**Location**	**Constructed/Rebuilt**
Cesar Chavez Pump Station	Cesar Chavez/Army Street under James Lick Freeway	1975
Berry Street Pump Station	301 Berry Street and 5th Street	1997
Bruce Flynn Pump Station	1595 Davidson Avenue	1996
Davidson Wet-Weather Pump Station	1682 Davidson Street	1998
Geary Underpass Pump Station	Geary Expressway and Fillmore Street	1960
Harriet-Lucerne Wet-Weather Pump Station	Harriet Street and Brannan Street	2005
Merlin/Morris Pump Station	Morris Street off of Harrison Street	1988
North Point Wet-Weather Facility	111 Bay Street	1951
Palace of Fine Arts Pump Station (Wet Weather)	Marina Boulevard and Yacht Road	1967
Rankin Wet-Weather Pump Station	Transport/Storage Structure North of Rankin Street and Davidson Avenue	1998
Sea Cliff #3 Pump Station	25th Avenue, North	2006
Shotwell Wet-Weather Pump Station	Shotwell Street at 17th Street	2006
Sunnydale Pump Station	1 Harney Way, Brisbane	1991
Zoo Wet-Weather Pump Station	2995 Sloat Boulevard	1998

Table continued on next page.

Table 3-1. SFPUC Major Facilities – Year of Construction		
Transport/Storage Structures	**Figure 4-2 Location**	**Constructed/Rebuilt**
North Shore Facilities	Marina Transport/Storage, North Point Tunnel, Jackson Transport/Storage	1979/1981
Channel Facilities	Channel Transport/Storage	1979/1980
Islais Creek Facilities	Islais Creek Transport/Storage	1985/1996
Yosemite Facilities	Yosemite Transport/Storage	1989
Sunnydale Facilities	Sunnydale Transport/Storage	1991
Mariposa and 20th Street Facilities	Mariposa Transport/Storage	1992
Westside Facilities	Westside Transport/Storage, Lake Merced Tunnel, Richmond Tunnel	WST - 1980/1983; LMT - 1993; RTS - completed 1994, 1996
Outfalls	**Discharge Location**	**Constructed/Rebuilt**
Southwest Ocean Outfall	Pacific Ocean	1983
North Point Outfalls	Central San Francisco Bay	1950s
Southeast Bay Outfall	Lower San Francisco Bay	1967
Quint Street Outfall	Islais Creek	1967

Table continued from previous page.

Federal lands of Presidio Park and Hunters Point Shipyard, whose sanitary flows are transported to San Francisco treatment facilities.

The Westside Watershed is divided into three major drainage basins: Richmond, Sunset, and Lake Merced. The Bayside Watershed is divided into five major drainage basins: North Shore, Channel, Islais Creek, Sunnydale, and Yosemite (Figure 3-1 on the following page).

In addition to wastewater flows generated in the city, the WWE sewer system receives and treats flows from three other agencies, most of which discharge to the Bayside Watershed. Figure 3-1 illustrates the service area for each agency and a description of each agency follows.

North San Mateo County Municipal District — A small, northeastern section of Daly City drains by gravity into the Islais Creek Drainage Basin and, to a lesser extent, into the Sunnydale Drainage Basin and the Lake Merced Drainage Basin (which includes only a few city blocks of Daly City). The current average dry-weather flow is 0.79 mgd and is serviced by the San Francisco combined sewer system.

Bayshore Sanitary District — The Bayshore Sanitary District discharges wastewater flow to the Sunnydale Drainage Basin and currently averages 0.49 mgd in dry weather.

City of Brisbane — The City of Brisbane discharges, on average in dry weather, 0.37 mgd wastewater flow to the Sunnydale drainage area.

3.1.2 Collection System

The combined sewer system consists of a network of sewers spread across the majority of the city that collects wastewater and stormwater runoff and conveys flows to the T/S structures. Figure 3-2 on page 3-5 illustrates the main features of the SFPUC combined sewer system in which the T/S structures, combined with a system of pump stations and force mains, ultimately deliver this flow to the treatment facilities. The

Figure 3-1. San Francisco Major Drainage Basins

collection system is composed of more than 976 miles of sewers ranging from 8 inches in diameter to large multi-compartmental structures that are up to 44 feet by 25 feet (Table 3-2).

Over 90% of the city is served by the combined wastewater-stormwater sewer system. The remainder, along with the customers served in the City of Brisbane, Bayshore Sanitary District, and North San Mateo County Sanitation District, is served by separate sewer systems (i.e., sanitary sewer and storm drain systems). The separate sewer systems under the purview of the SFPUC includes Stow Lake, Middle Lake, and Elk Lake in Golden Gate Park, Pine Lake in Stern Grove, and Lake Merced. Separate sewer systems not currently under the purview of the SFPUC include Mission Bay, Treasure Island, Hunters Point Shipyard, and Port of San Francisco properties (San Francisco Public Utilities Commission, 2004).

Figure 3-2. Current SFPUC Major Facilities as a Result of the 1974 Master Plan

Table 3-2. Collection System Inventory	
Description	**Total Length** (miles)
Local Sewers (36 inches or less)	781
Major Collecting Sewers	
• Sewers (greater than 36 inches)	120
• Brick Sewers	51
• Transport/Storage Structures	24
Total	**976**

3.1.2.1 Transport/Storage Structures

As a result of the 1974 Master Plan, San Francisco built a series of large underground T/S structures (box sewers and tunnels) around the perimeter of the city to intercept, temporarily store, and transport the mixture of storm runoff and wastewater to new/upgraded treatment facilities (Figure 3-3 on the following page). The bayside T/S structures include the North Shore facilities (Marina T/S, North Point Tunnel, and Jackson T/S), Channel T/S, Islais Creek T/S, Yosemite T/S, Sunnydale T/S, and Mariposa T/S. The westside T/S structures include the

Richmond Tunnel, Westside T/S, and Lake Merced Tunnel. These major facilities are shown in **Figure** 3-2.

The primary purpose of this moat of T/S structures was to reduce the incidence and volume of overflows in wet weather. Prior to the construction of the T/S structures, untreated combined sewer overflows[1] (CSOs) occurred throughout the city whenever rainfall occurred at a rate of 0.02 inches per hour. By providing both storage volume and detention time, the T/S structures allow for delayed treatment of the stored combined wastewater and stormwater flows at the treatment plants after storms. In addition, the retention of the combined flows in the T/S structures allows solids to settle, and the weir and baffle structures retain floatable materials, providing the equivalent of wet-weather "primary treatment" (i.e., decant treatment).

The T/S structures were designed with sufficient storage to reduce CSOs and protect beneficial uses of receiving waters for the bay and ocean (Chapter 2, **Section** 2.12.3.3). Permitted nearshore discharge sites from the T/S structures exist around the perimeter of the city. Because discharges through these permitted sites receive decant treatment, they are considered treated combined sewer discharges (CSDs) rather than untreated CSOs. The performance of the T/S structures complies with the City's Long-Term Control Plan that fulfills requirements of the National Combined Sewer Overflow Control Policy.

When the three treatment facilities, pump stations, and T/S structures are fully operational, the entire San Francisco combined sewer infrastructure can provide 575 mgd of combined wastewater and stormwater treatment — 193 mgd of secondary treatment, 272 mgd of primary treatment, and 110 mgd of decant treatment. Deepwater outfalls can discharge 435 mgd. Another 140 mgd of secondary treated effluent can be discharged through a shallow water outfall to Islais Creek during peak wet-weather events.

Implementation of the 1974 Master Plan resulted in a reduction of citywide CSO frequency from 40 to 80 times per year to a CSD frequency that ranges from one to 10

1 A CSO is an untreated discharge of combined wastewater and stormwater to receiving waters as a result of wet-weather flow exceeding sewer system and treatment plant capacity.

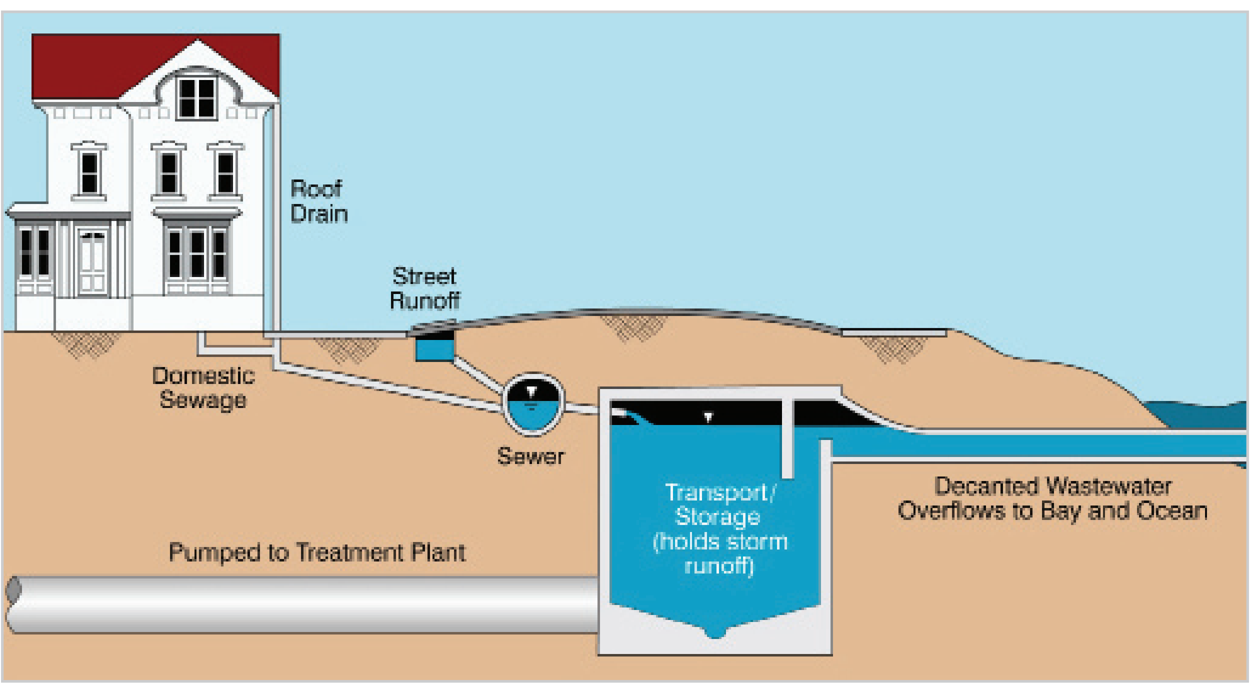


Figure 3-3. Features of the Combined Sewer System and Transport/Storage Box Sewer

times per year for each bayside 1974 stormwater model drainage basin, and eight times per year on the west side. With the completion of the 1974 Master Plan projects, the City achieved full compliance with all NPDES permits, in accordance with State and Federal laws.

System Overview

The storage capacities of the major T/S structures are summarized in **Table** 3-3. The individual features of the bayside and westside T/S structures are discussed in this section and in **Appendix** H. Details of the pump stations mentioned in Section 3.2.2.3 are found in **Appendix** I.

Bayside System

The bayside system, which comprises the northern and southern facilities, was brought into operation in 1982 to meet the dry-weather wastewater treatment requirements on the east side of the city. A significant reduction in CSO volumes during wet weather was achieved with the completion of all bayside improvements in 1997. The bayside wet-weather T/S structures provide storage and decant treatment for stormwater and wastewater during wet-weather conditions and have 29 discharge points (i.e., nearshore CSD structures). When capacities at the wastewater treatment plants, wet-weather facilities, and T/S structures are exceeded, the excess flow is discharged into the bay through the 29 nearshore CSD structures (see **Section** 3.1.2.2).

The northern bayside facilities include a 7-mile system of underground T/S sewers (the North Shore and Channel T/S structures), which follow the northern and central shoreline of the city. The large rectangular T/S structures are up to 20 feet in width and 45 feet in depth and feed two pumping stations – the North Shore Pump Station and the Channel Pump Station.

The southeast bayside facilities are distinct, but linked facilities that were designed to store and transport combined sewer flows

Table 3-3. Transport/Storage Structure Capacities

Bayside	Transport/Storage (MG)[1]	Transport/Storage and Sewers (MG)[2]
Marina, North Point, Jackson	18.8	24.0
Channel	28.0	38.0
Mariposa (and 20th Street)	0.8	0.9
Islais Creek	32.5	45.1
Yosemite	9.5	11.5
Sunnydale	5.7	6.2
Total	**95.3**	**125.7**
Westside	**Transport/Storage** (MG)[1]	**Transport/Storage and Sewers** (MG)[2]
Richmond	12.0	12.0
Westside	49.3	49.3
Lake Merced	10.0	10.0
Total	**71.3**	**71.3**

Notes:
1. Capacity to overflow point of T/S structure only
2. Capacity to overflow point of T/S structure including sewers feeding transports

to the SEP. These facilities are the Mariposa T/S, the Islais Creek T/S and Bruce Flynn Pump Station, the Hunters Point Outfall Consolidation facilities, the Yosemite/Egbert Sewer Enlargement Project, the Yosemite/Fitch T/S and Griffith Pump Station, and the Sunnydale T/S and Pump Station. A detailed description of the T/S facilities is presented in **Appendix** H.

Westside System

Prior to the construction of the 1974 Master Plan facilities, untreated CSOs in the westside system averaged 58 per year. The NPDES permit requirements mandated that facilities be designed and built to reduce these nearshore discharges to a long-term average of no more than eight per year through seven discharge points.

The westside system, whose construction was completed in 1994, consists of the Richmond Tunnel, Westside T/S, Lake Merced Tunnel, the Westside Pump Station, the OSP, the Southwest Ocean Outfall (SWO), and seven nearshore CSD points. The T/S structures provide storage and treatment for wet-weather flows so that any flows exceeding the capacity of the combined sewer system result in treated nearshore CSDs. A detailed description of the westside T/S facilities is presented in **Appendix** H.

3.1.2.2 Combined Sewer Discharge Structures

1974 Stormwater Model

In support of the development of the projects that resulted from the 1974 Master Plan, the City did extensive computer and physical modeling of the sewer system to estimate the impacts of the proposed collection system improvements. Based on existing development, proposed system improvements, and a 70 year rainfall record, a major result of the modeling effort was the estimation of the volume and frequency of combined CSD events (see **Figure** 3-4):

- Westside Watershed – 8
- Bayside Watershed
  - North Shore Drainage Basin – 4
  - Central Drainage Basin – 10
  - Southeastern Drainage Basin – 1

Inherent in the modeling assumptions were defined runoff factors and acreages of different types of development that together determined the volume of stormwater runoff and speed with which stormwater impacts the sewer system. Important to note is that certain industrial areas were excluded from these considerations, because at the time these areas did not contribute stormwater to the sewer system (Appendix J).

Current System

During wet-weather events, when flows exceed the capacities of the treatment plants, wet-weather facilities, and T/S structures, the combined stormwater and wastewater are discharged into either the San Francisco Bay or the Pacific Ocean. Discharges from the nearshore CSD structures occur only when the storm flow exceeds the combined storage capacity of the T/S structures, the capacity of the pumping facilities, and the treatment capacity of the wet-weather facilities.

The T/S structures were designed with the capacity to capture and hold wet-weather flows for later treatment to avoid shoreline overflows. The system capacity was designed using the previous 70-year rainfall history. Since the completion of this system of T/S structures, San Francisco has experienced no untreated overflow events; the wet-weather discharges that occur receive decant treatment within the T/S structures (Section 3.2.21). There are 36 nearshore CSD structures that remain active; 29 are located on the bay side. CSD structures 1 through 7 are located on the west side of the city. These CSD locations are shown in **Figure** 3-4 and descriptions are given in **Appendix** H.

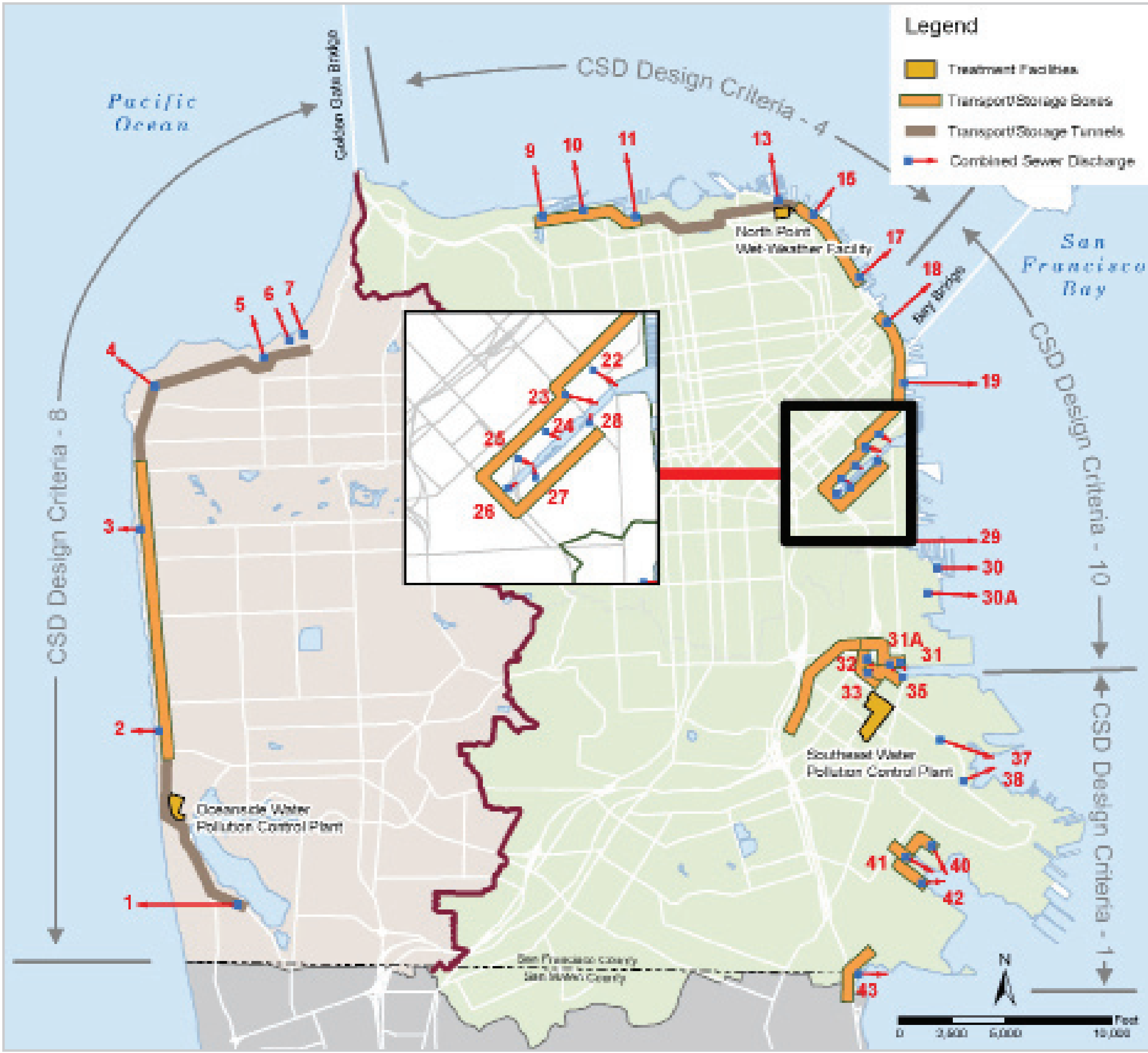


Figure 3-4. Location of the SFPUC Combined Sewer Discharge Structures

Notes: CSD Design Criteria are the allowable number of CSDs per year; red CSD numbers are described in Appendix G.

3.1.2.3 Pump Stations and Force Mains[2]

The sewer system has 27 pump stations. There are six major all-weather pump stations and two major wet-weather pump stations (summarized in Table 3-4 on page 3-11), 18 minor pump stations, and one major effluent pump station for bayside effluent discharge. Details of the major and minor pump stations are presented in Appendix I.

To ensure adequate dry-weather reliability and redundancy, consistent with recommended guidelines from the San Francisco Bay Regional Water Quality Control Board (RWQCB) and good operational practice, the major all-weather pump stations are equipped with auxiliary pumps to guarantee full pumping capacity with the largest unit out of service (Table 3-4). In addition to pump redundancy, all major pump stations have upstream storage in the T/S structures in the event of a power failure. Because of this built-in storage capacity, none of the pump stations include backup power facil-

2 Not included in this discussion are the six additional pump stations are planned for the Mission Bay Development.

ities of sufficient capacity to operate the pumps during a power outage. Some stations have backup power for auxiliary systems only, while others have no backup power at all. According to PG&E records, in the past five years, there have not been any power failures at any of the City's wastewater facilities that have lasted longer than 12 hours.

The major force mains that convey dry-weather and wet-weather flow from major all-weather pumps stations, North Shore, Channel, and Westside, are described below.

North Shore Force Main

The North Shore Force Main, which connects the discharge of the North Shore Pump Station to the Channel T/S, is 36 inches in diameter and ends at Steuart and Howard streets. There is no redundancy for this force main. The construction materials vary along its 7,700-foot length; the materials are primarily concrete-encased reinforced fiberglass pipe inside the T/S structure and steel pipe between the Jackson T/S and Channel T/S. There is also a small portion of ductile iron pipe.

Channel Force Main

The Channel Force Main, which connects the discharge of Channel Pump Station to the SEP, was constructed from 1976 through 1978. This 66-inch force main is 11,215 feet long and is primarily constructed of reinforced concrete pipe with several sections of steel pipe. The Channel Force Main runs from the Channel Pump Station to the SEP under Owens Street, Indiana Street, Cesar Chavez (Army) Street, Interstate 280, and Evans Avenue. It traverses a variety of soil types including artificial fill, bay mud, bay sands, Franciscan rock and serpentinite. The majority of the pipeline is buried; there are above-grade sections at the Channel Pump Station and under Interstate 280 near Islais Creek. The Channel Force Main varies in elevation from –16.6 feet near SEP to 21.1 feet (City Datum) at Indiana and 20th streets. The pipeline has the following facilities: nine access manholes, five drain manholes, three air/vacuum release valves, and one corrosion monitoring station. The profile of the Channel Force Main (see **Figure** 3-5 on page 3-12) is such that surge control is required. The Channel Force Main has failed three times since its construction. It is a serious point of vulnerability in the bayside sewer system since there is no redundant conveyance for this major artery of the system.

Westside Force Main

The Westside Pump Station dry- and wet-weather flows are conveyed to the pretreatment building at the OSP through a 48-inch-diameter reinforced concrete cylindrical force main (2,900 feet) that was constructed in 1989 and is located to the west of San Francisco Zoo and the Great Highway. Although there is no redundancy for the Westside Force Main, it is easy to access for repairs.

3.1.2.4 Tunnels

The existing sewer system has a number of tunnels that are 60-inch or more in diameter and are critical elements for coordinated collection system operation. The twelve active sewage tunnels[3] include North Point Main-Sansome Street, North Point Main-Moscone Center, Brannan Street, Hunters Point, Candlestick, Sunnydale, Mile Rock, Old Richmond, Locust Street-Presidio, College Hill, Lake Merced Overflow, and Park Merced. The Mile Rock Tunnel is inactive except for the discharge end. Concerns have been raised that most of the tunnels lack functional redundancy and are subject to failure both due to materials deterioration and seismic vulnerability.

A recent inspection showed that most were found to be in good condition, with the exception of the old Richmond Tunnel, which was considered in fair condition. Tunnel information is given in **Appendix** K.

3 Lake Merced, Richmond, and North Point tunnels are managed as part of the T/S system and discussed in **Section** 3.1.2.1.

Table 3-4. Major Pump Stations

Facility	Code	Description	Year Built[1]	Dry-Weather Average Flow[2]	Peak Wet-Weather Flow[3]	Peak Pumping Capacity and Percent Redundancy[4]		Major Drainage Basin Served and Acreages	Number of Pumps	
						Dry Weather[5]	Wet Weather[6]	Wet Weather	All Weather	Wet Weather
Major Pump Stations: All Weather										
Channel Pump Station[7]	CHS	All-weather pump station that pumps flows from the Channel T/S to the SEP via the Channel Force Main.	1979	40.8 mgd	103 mgd	88 mgd with 2 pumps (100% redundancy)	152 mgd with 3 pumps (33% redundancy)	Channel 5,618 acres	4	NA
Griffith Pump Station	GFS	All-weather pump station that pumps flows from the lower Yosemite and Sunnydale areas to the Islais Creek Drainage Basin.	1989	3.3 mgd[8]	120 mgd	10 mgd with 2 dry-weather pumps (100% redundancy)	120 mgd with 3 pumps (33% redundancy)	Yosemite 1,967 acres[9] [Sunnydale 1,045 acres] *Total 3,012 acres*[10]	4	4
Mariposa Pump Station	MPS	Separate dry-weather and wet-weather pump stations that pumps flows from Potrero Hill and 20th Street to the Islais Creek Drainage Basin.	1954/ 1993	0.4 mgd	10 mgd	1.5 mgd with 1 dry-weather pump (100% redundancy)	13 mgd with 2 wet-weather pumps (0% redundancy with wet-weather pumps; 23% redundancy with 2 dry-weather pumps if Wet-Weather pumps are inoperable)	Mariposa 257 acres	2	2
North Shore Pump Station	NSS	Dry-weather and wet-weather pump station that pumps dry-weather flows from the northeastern sector of the city to the Channel T/S and wet-weather flows to the NPF.	1982	13.9 mgd	150 mgd	33 mgd with 2 dry-weather pumps (100% redundancy)	150 mgd with 2 wet-weather pumps (0% redundancy)	North Shore 3,002 acres	4	2
Southeast Lift Station	SELS	All-weather pump station that pumps flow from the Islais Creek Drainage Basin to the SEP head-works.	1951/ 1981	20.6 mgd	70 mgd	70 mgd with 2 dry-weather pumps (100% redundancy)	140 with 4 pumps (0% redundancy)	Islais Creek 6,708 acres[11] [Yosemite/Sunnydale/Mariposa 3,270 acres] *Total 9,978 acres*[12]	4	NA
Westside Pump Station	WSS	All-weather pump station that pumps dry-weather and wet-weather flows to the OSP and decanted wet-weather flows to the SWO.	1985	16.1 mgd	65 mgd/110 mgd Total = 175 mgd	30 mgd with 2 dry-weather pumps (50% redundancy)	66 mgd to OSP with 3 pumps/120 mgd to SWO with 4 pumps (0% redundancy)	Richmond/Sunset/Lake Merced 11,176 acres	3	4
Major Pump Stations: Wet Weather										
Bruce Flynn Pump Station	BFS	Wet-weather pump station that pumps wet-weather flows from the Islais Creek T/S to the SEP.	1996	-[13]	110 mgd	-	120 mgd with 4 pumps (50% redundancy)	Islais Creek/Yosemite/Sunny-dale/Mariposa (supplements SELS pumping and serves same drainages and acreages)	NA	6
Sunnydale Pump Station	SDS	Wet-weather pump station that pumps wet-weather flows from the Sunnydale Drainage Ba-sin to the Yosemite T/S, which is then pumped by Griffith Pump Station to the Islais Creek Drainage Basin.	1991	-	50 mgd	-	63 mgd with 3 pumps (0% redundancy)	Sunnydale 1,045 acres	NA	3

Notes:
1. *Year station was built or major reconstruction.*
2. *Dry-weather flow: 2003 to 2007 average flow from June to September (6/1 to 9/30)*
3. *Actual maximum wet-weather flow, accounting for downstream restrictions/limitations; As peak flows do not occur simultaneously throughout the collection system, operational flexibility is provided.*
4. *Data from 2003 Baseline Facilities Report*
5. *Dry-weather pump redundancy based on dry-weather pumps.*
6. *Wet-weather pump redundancy based on wet-weather pumps.*
7. *The Channel Pump Station, Bruce Flynn Pump Station, and Southeast Lift Station all pump wastewater to the Southeast Water Pollution Control Plant and, as stated in the NPDES permit, their available wet-weather capacity must be 250 mgd to minimize Combined Sewer Discharges.*
8. *The Griffith Pump Station average dry-weather flow data is taken from 6/1/2005 to 9/30/2005 due to flow meter irregularities in other years.*
9. *Acreage for Yosemite Drainage Basin only*
10. *Griffith Pump Station serves the local Yosemite Drainage Basin, and also conveys the pumped flows from Sunnydale Drainage Basin. Total = combined acreage served.*
11. *Acreage for Islais Creek Drainage Basin only*
12. *Southeast Lift Station serves the local Islais Creek Drainage Basin, and also conveys the pumped flows from Sunnydale Pump Station, Griffith Pump Station, and Mariposa Pump Station to Southeast Water Pollution Control Plant. Total = combined acreage served.*
13. *BFS is currently being operated during dry weather (dry-weather average flow is 1.6 mgd) to provide a consistent influent flow regime at the Southeast Water Pollution Control Plant and in response to construction and maintenance demands.*

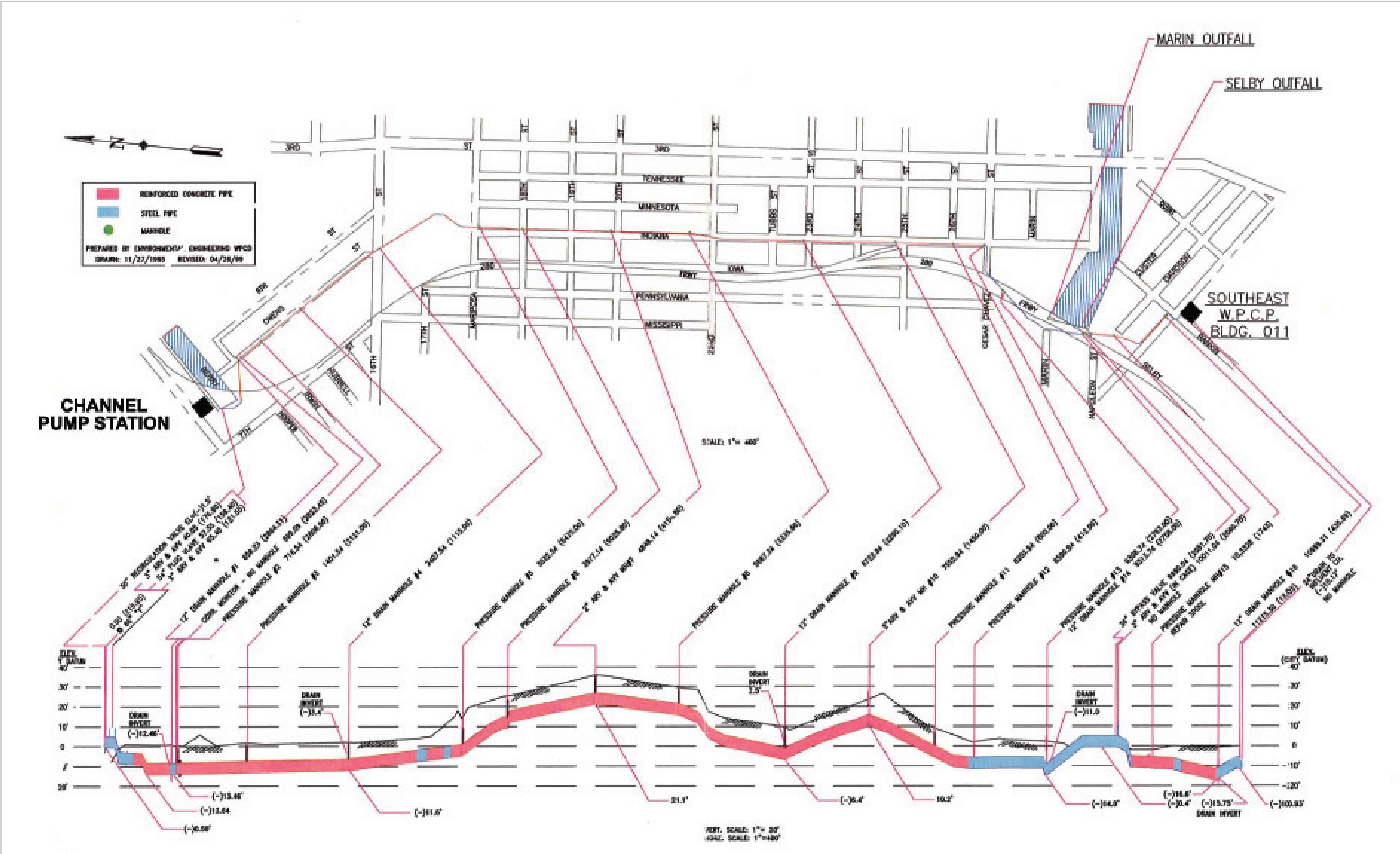


Figure 3-5. Alignment of Channel Force Main

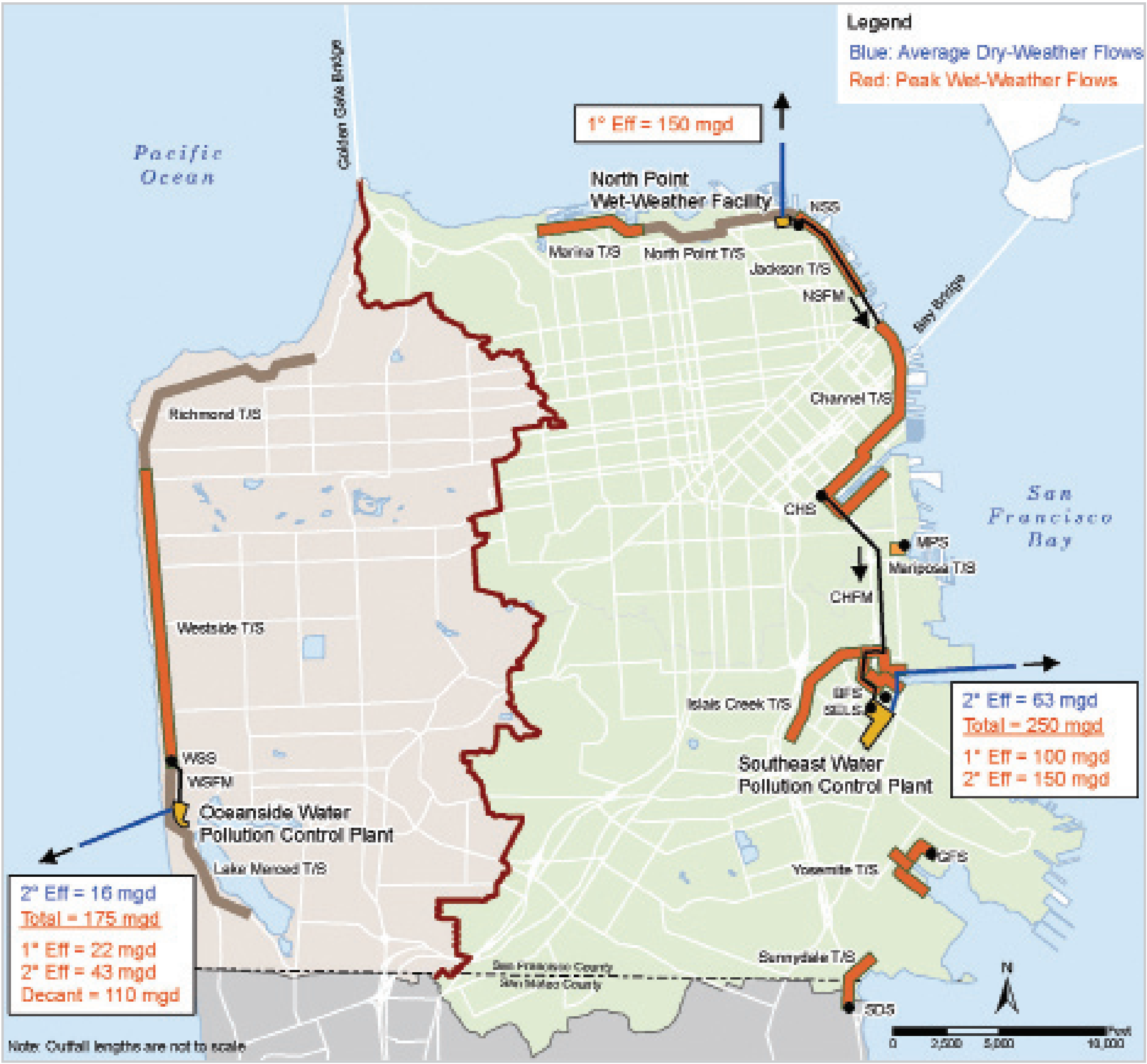


Figure 3-6. Current SFPUC Major Facilities and Treatment Capacities

Notes: Effluent - Eff

3.1.3 Bayside and Westside Treatment Facilities

3.1.3.1 Treatment Facilities Overview

Figure 3-6 illustrates the location of the three San Francisco treatment facilities. The bayside treatment facilities include the SEP and the NPF; the sole treatment facility on the west side is the OSP. During dry weather, the SEP and the OSP provide primary and secondary treatment on average for approximately 79 mgd of wastewater flow. The NPF can provide up to 150 mgd of primary treatment during wet weather.

3.1.3.2 Southeast Water Pollution Control Plant

The SEP, the only bayside dry-weather facility, occupies 39.9 acres bounded by Evans Avenue, Phelps Street, Quint Street, and Rankin Street, with Jerrold Avenue separating the north and south sides of the facility. It is a secondary wastewater treatment plant that serves the wastewater treat-

Figure 3-7. Southeast Water Pollution Control Plant

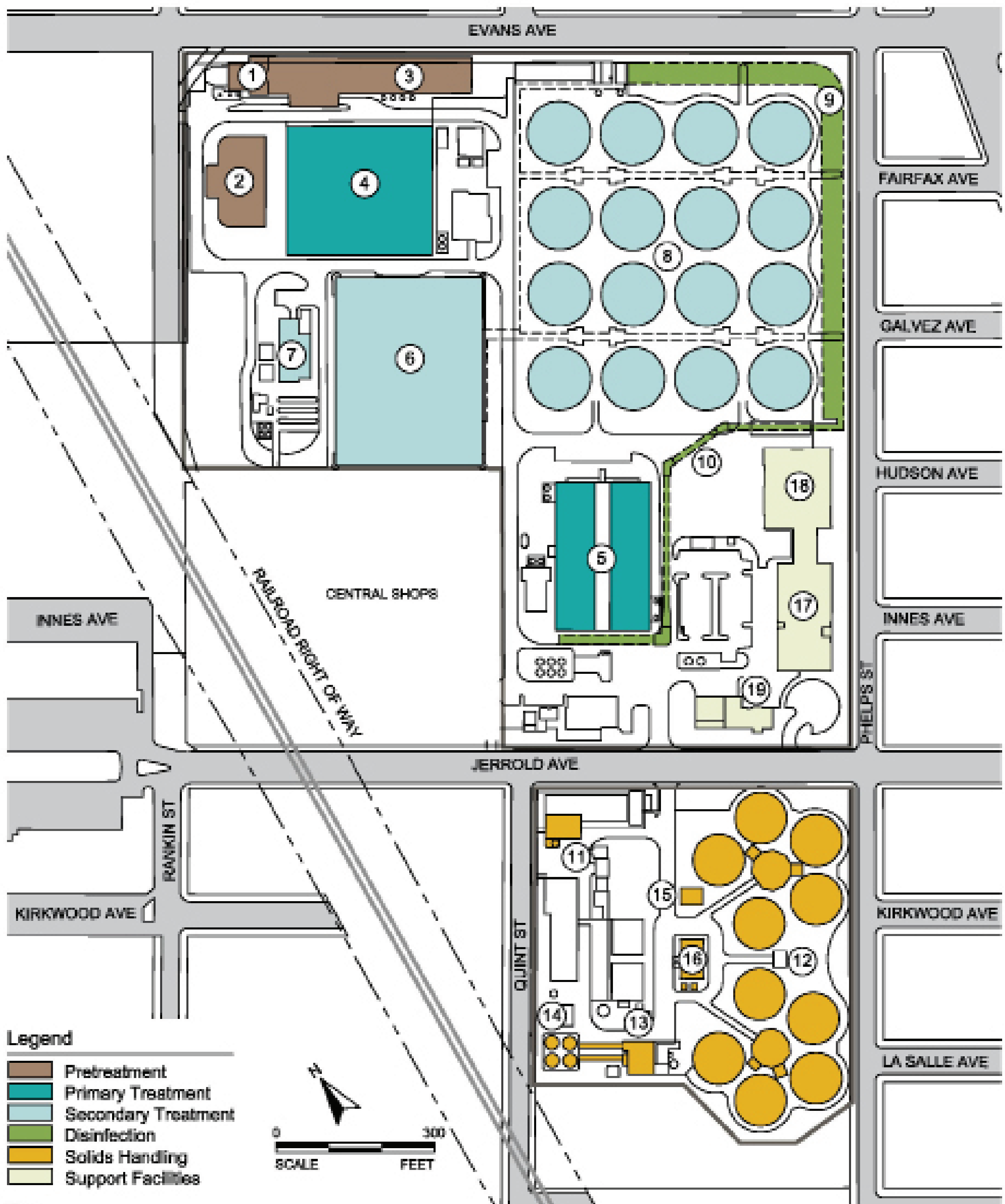
ment needs of the Bayside Watershed plus 1.65 mgd of flow from other agencies (see Section 3.1.1). During wet weather, the SEP wet-weather facilities are engaged to provide primary treatment to an additional 100 mgd of combined wastewater flow. Figure 3-7 is a recent photograph of the SEP and surrounding neighborhood.

Located in the Bayview District, among a mixture of industrial, commercial, and residential neighborhoods, the SEP serves about two-thirds of San Francisco citizens. The service areas include the Marina, Financial, South of Market area, Mission, Hunters Point, and Visitacion Valley, which generate 76% of the total annual flow from the city. The Bayside Watershed wastewater flow is collected by the combined sewer system and conveyed through gravity sewers, tunnels, T/S structures, pump stations and force mains to the SEP. A schematic of the facility layout is presented in Figure 3-8, and a process flow diagram is presented in Figure 3-9 on page 3-16.

Treatment Summary

The SEP was designed to treat all bayside dry-weather flows, with daily average design and peak-hour design flows of 85.4 and 142 mgd, respectively. Current dry-weather flow averages approximately 63 mgd (2003 to 2007 dry-weather average flow). In 1996, the plant wet-weather capacity was upgraded to 250 mgd, with flows greater than 150 mgd receiving primary treatment prior to disinfection and discharge.

The SEP treatment process consists of the following: pretreatment, primary, secondary, disinfection, and sludge stabilization and dewatering. Southeast Lift Station flows are directed through coarse bar screens and then combined with influent flows from the Channel Pump Station and the Bruce Flynn Pump Station in the influent control struc-



Key

1. Southeast Lift Station
2. Headworks
3. Wet-Weather Headworks
4. Primary Clarifiers
5. Wet-Weather Primary Clarifiers
6. Aeration Basins
7. Oxygen Plant
8. Secondary Clarifiers
9. Chlorination and Dechlorination
10. Wet-Weather Primary Effluent Chlorination
11. Gravity Belt Thickeners
12. Anaerobic Digesters
13. Centrifuges
14. Cake Loadout Facility
15. Cogeneration
16. Hot Water Boilers/Waste Gas Burners
17. Master Control/Laboratory/Administration
18. Maintenance Building
19. Engineering/Operations Building

Figure 3-8. Southeast Water Pollution Control Plant Layout

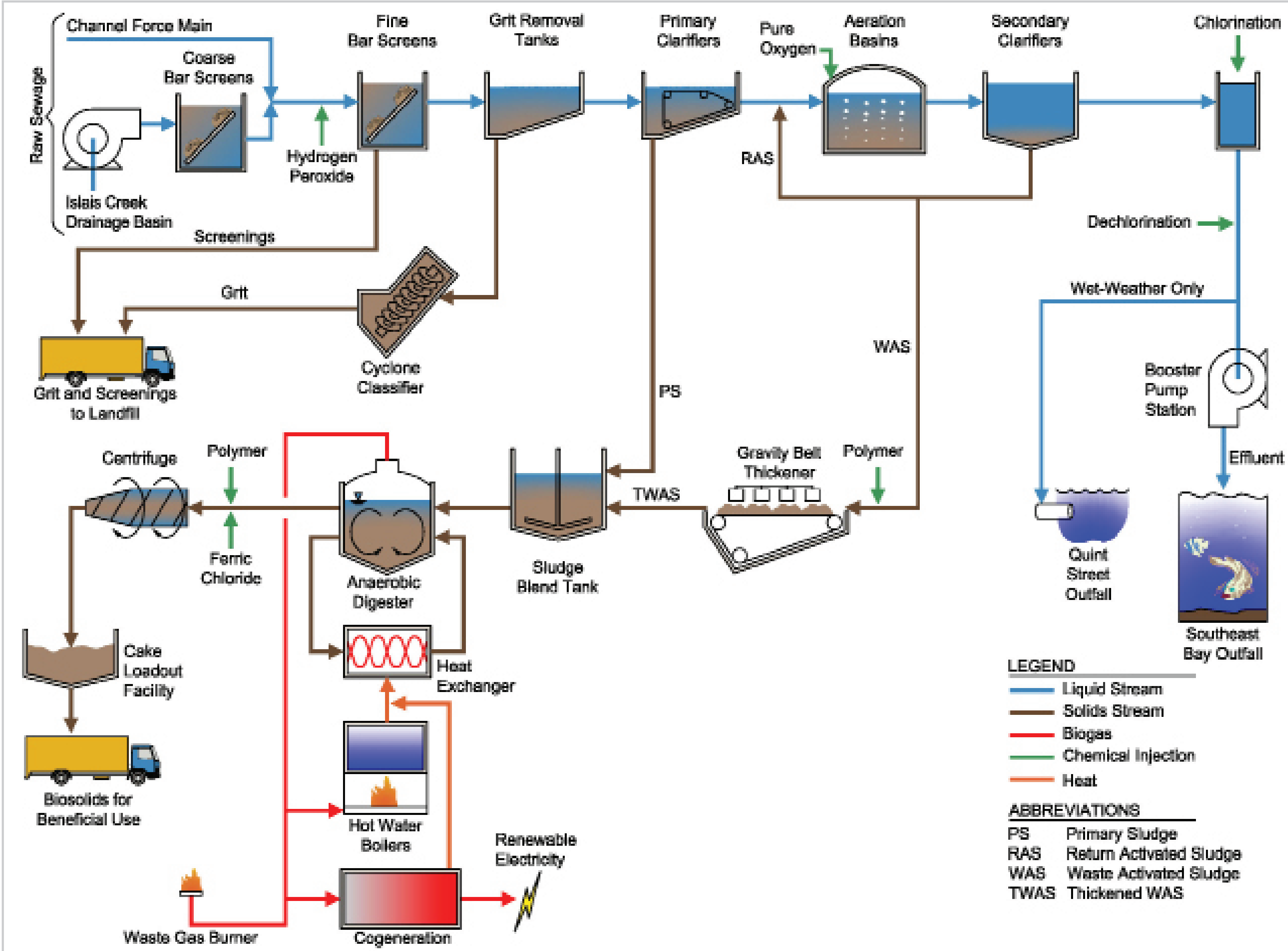


Figure 3-9. Southeast Water Pollution Control Plant Process Schematic

ture. From there flows are directed to the new or old headworks for pretreatment. In the new headworks, debris is removed with four fine bar screens and grit is removed with four vortex grit tanks. During wet weather, influent flow in excess of 150 mgd is directed to the old wet-weather headworks, where debris is removed with five fine bar screens and grit is removed with five unaerated grit tanks.

The screened and de-gritted flow is then directed to a set of rectangular sedimentation tanks (clarifiers) for primary treatment. Grease, oil, plastics, and other floatables are collected as primary scum with helical skimmers and scum troughs. In secondary treatment, primary effluent enters the aeration basins. The primary effluent combines with return activated sludge to become mixed liquor. Pure oxygen is introduced in the third stage of the six-stage aeration basins with the first and second stages functioning as an anaerobic selector. During the aeration step, the activated sludge removes the soluble and particulate organic matter from the wastewater. The mixed liquor then flows to 16 circular secondary clarifiers, where activated sludge solids settle by gravity. A portion of the settled sludge (waste activated sludge) is pumped to gravity belt thickeners, and the rest is pumped back to the first anaerobic stage of the aeration basins. A surface skimmer arm in the secondary clarifiers collects the scum/foam as secondary scum.

The overflow from the secondary clarifiers (secondary effluent) enters the chlorine contact channels where it is disinfected with sodium hypochlorite (NaOCl) and then treated with sodium bisulfite ($NaHSO_3$) to remove residual chlorine. The final effluent flows to the Booster Pump Station that pumps the treated effluent to the Southeast Bay Outfall (SEO). In addition to the SEO, during wet-weather, the SEP secondary effluent is also discharged through the Quint Street Outfall to Islais Creek. Off-shore effluent outfalls are discussed in more detail in **Section** 3.1.4.1.

During wet weather, the treatment process mirrors the dry-weather treatment process. Flows of up to 250 mgd receive primary treatment through the engagement of additional primary clarifiers. Of the 250 mgd, up to 150 mgd receives full secondary treatment. The primary and secondary streams have separate disinfection facilities. The primary effluent (100 mgd) and a small portion of the secondary effluent (up to 10 mgd) are discharged to the bay through the Booster Pump Station and the SEO. The remaining secondary effluent (140 mgd) is discharged through the Quint Street Outfall to Islais Creek.

Solids handling treatment processes consist of two gravity belt thickener units for waste activated sludge thickening, ten mesophilic anaerobic digesters (seven are heated and active, two are for storage, and one is inoperable), and six horizontal bowl centrifuges for dewatering. The thickened waste activated sludge is mixed with primary sludge and fed to the digesters for treatment at a minimum temperature of 95° F and a minimum 15-day hydraulic detention time. After digestion, the digested sludge is conditioned with ferric chloride ($FeCl_3$) and polymer, dewatered with centrifuges, and stored in four cake hoppers for hauling. The biosolids are either used for land application or landfill alternative daily cover. The SEP design details for dry- and wet-weather operations are provided in **Appendix** L

Power Generation Summary

The SEP has both a cogeneration facility and a photovoltaic installation that can supply up to 43% of the annual electrical demand of the facility, if fully functional.

A 2,000 kW Waukesha lean burn, turbocharged internal combustion engine uses digester gas to generate electricity for plant demand. Current operation can provide up to 14,892,000 kWh/year. Digester gas is also burned in boilers to provide heat and hot water for plant and digester facility requirements

Figure 3-10. North Point Wet-Weather Facility

Photovoltaic modules installed in October 2005 on the roofs of the wet-weather primary treatment facility are designed to generate 300,416 kWh/year of electricity with a peak output of 255 kW.

3.1.3.3 North Point Wet-Weather Facility

The NPF, a wet-weather-only facility, is located at 111 Bay Street (6.5 acres) and provides primary treatment to wet-weather flows from the northeast portion of the Bayside Watershed. **Figure** 3-10 is a photograph of the NPF.

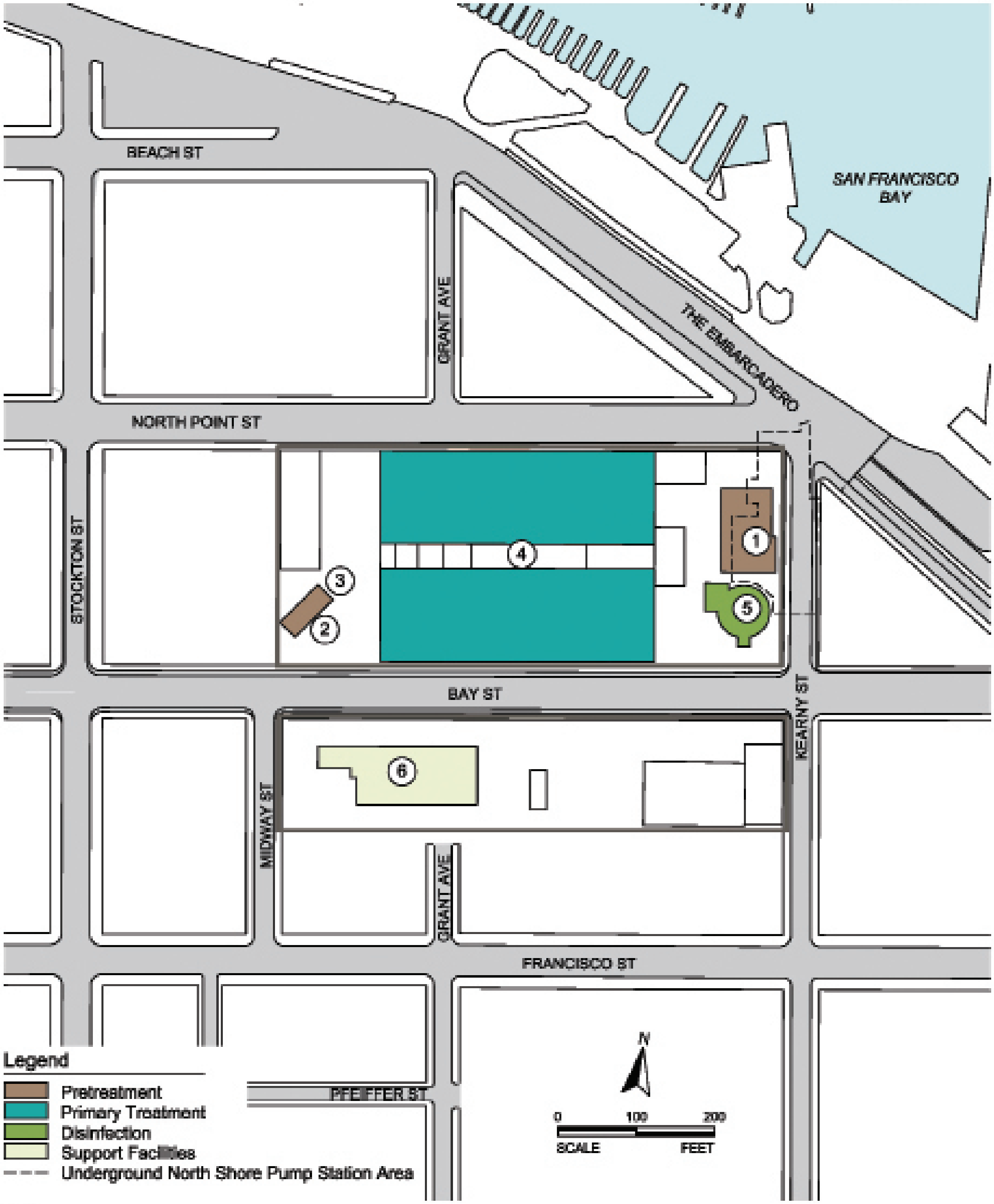
The NPF, located in a densely populated residential and business neighborhood, operates during, and shortly after, significant rainfall events. The peak hourly flow treatment capacity is 150 mgd. The facility operates, on average, 30 times per year (450 hours) and currently treats an annual average wet-weather flow of 0.7 billion gallons (4% of the average annual citywide wastewater flow) and is an integral part of the overall WWE wet-weather control system. A schematic of the facility layout is presented in **Figure** 3-11, and a process flow diagram is presented in **Figure** 3-12 on page 3-20.

Treatment Summary

The NPF has been in operation as a wet-weather facility since 1983. The plant operates episodically and is activated in response to rain-induced flow when the SEP secondary treatment system is approaching capacity (i.e., SEP flow approaches 150 mgd). The plant effluent has been in compliance with current wet-weather NPDES discharge requirements at least 99% of the time.

The NPF process consists of pretreatment and primary treatment with disinfection. Wet-weather flows from the North Shore Pump Station are pumped directly to the NPF headworks through a new force main, which begins with a diameter of 66 inches at North Shore Pump Station and expands to 72 inches at Bay Street[4]. The plant influent flow

4 Due to poor performance of the original grit removal facilities south of Bay Street during wet-weather events, these facilities were bypassed in 2006 and 2007 and are now deactivated.



Key

1. North Shore Pump Station
2. Fine Bar Screens
3. Chlorination
4. Primary Clarifiers
5. Dechlorination
6. Administration

Figure 3-11. North Point Wet-Weather Facility Layout

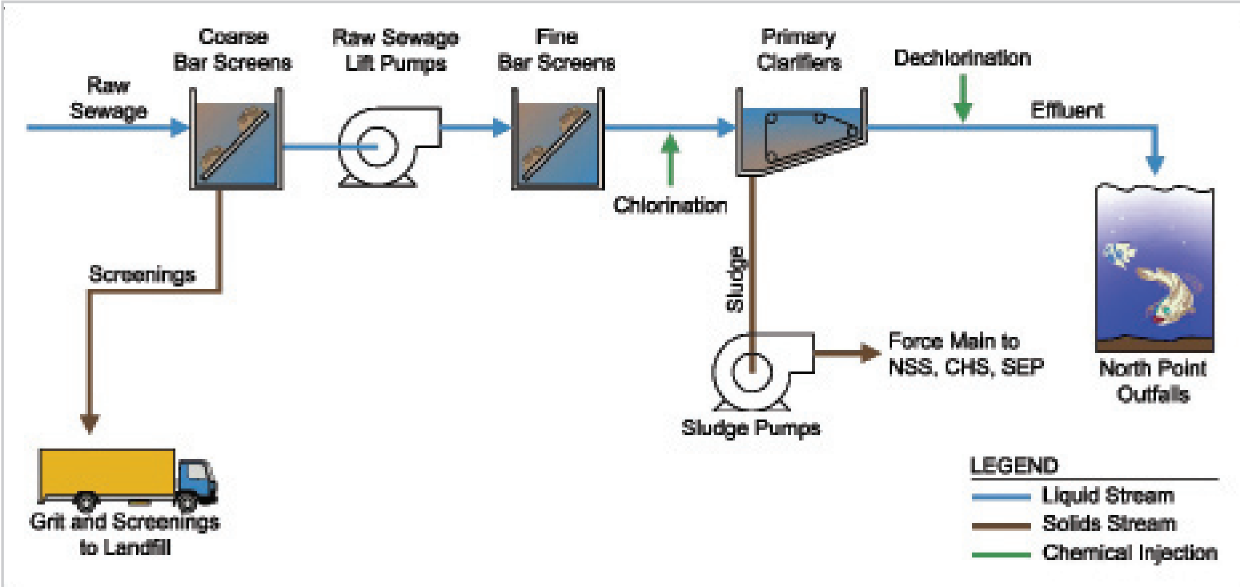


Figure 3-12. North Point Wet-Weather Facility Process Schematic

is discharged into the bar screen channels and screenings are removed by two fine bar screens. Screened primary influent is chlorinated with NaOCl and then distributed to six primary sedimentation tanks where both grit and sludge separate from the primary effluent. At the conclusion of each wet-weather event, grit and solids are flushed out of the sedimentation tanks and directed to the Channel Pump Station, which pumps them to the SEP for treatment.

Primary effluent flows to the "roundhouse" where $NaHSO_3$ is injected to remove residual chlorine from the effluent prior to gravity discharge through the North Point Outfalls. Process design features are detailed in **Appendix** L.

Power Generation Summary

Photovoltaic modules installed in December 2007 on the roofs of the primary treatment facility are designed to generate 251,498 kWh/year of electricity with a peak output of 241 kW.

3.1.3.4 Oceanside Water Pollution Control Plant

The OSP, located at 3500 Great Highway and adjacent to Lake Merced and the San Francisco Zoo, is a 12-acre secondary wastewater treatment plant that serves the Westside Watershed and the San Mateo County flows that drain to this basin (4,000 gpd). All dry-weather, secondary treated effluent flows by gravity to the ocean through the SWO. **Figure** 3-13 is a photograph of the OSP.

Located next to the Pacific Ocean in a residential neighborhood and bordering the San Francisco Zoo, the OSP serves about one-third of San Francisco citizens and treats 20% of the average annual wastewater flows. Dry- and wet-weather wastewater flow from the Westside Watershed is routed through the Richmond Tunnel, Westside T/S, and Lake Merced Tunnel (**Figure** 3-6) to the Westside Pump Station, where it is pumped to the OSP through a 48-inch force main for treatment. A schematic of the facility layout is presented in **Figure** 3-14 on page 3-22, and a process flow diagram is presented in **Figure** 3-15 on page 3-23.

Figure 3-13. Oceanside Water Pollution Control Plant

Treatment Summary

The OSP was designed for an average dry-weather flow of 21 mgd with a peak capacity of 43 mgd and currently treats 16.1 mgd average dry-weather flow (2003 to 2007 dry-weather average flow) with a daily peak flow of 30 mgd. The plant effluent has been in compliance with NPDES permit requirements for both dry- and wet-weather conditions since it was commissioned in 1993.

The OSP treatment process consists of preliminary, primary, and secondary treatment, and sludge stabilization. OSP disinfection facilities, although installed, are not currently in use.

Flows from Westside Pump Station through the 48-inch force main are directed to the headworks building for pretreatment. Mechanical front raked, front return bar screens collect debris, and grit is removed in vortex grit chambers. Screened and de-gritted flow from the pretreatment facility is directed to a series of primary clarifiers. Settled solids (primary sludge) are conveyed by submerged sludge collectors into primary sludge hoppers located at the west end of each clarifier.
Clarified wastewater exits the clarifier through four submerged, primary effluent launder pipes at the east end of each clarifier.

The primary effluent combines with return activated sludge to become mixed liquor and enters the six-stage pure oxygen activated sludge process. The first and second stages are anaerobic selectors, and the last four stages are aerated with pure oxygen. The mixed liquor then flows by gravity to a common inlet channel feeding the seven rectangular secondary clarifiers. Mixed liquor flows into each clarifier by passing through two submerged high-head loss inlet ports and over a weir. In the secondary clarifiers, the biological solids (secondary sludge) separate by gravity from the treated wastewater. Secondary effluent flows out of each clarifier by passing over V-notch weirs on surface launders, and then flows through one submerged port into a common effluent channel for discharge by gravity through the SWO.

Primary sludge, secondary sludge, and secondary scum are combined and pumped to the three gravity belt thickeners. The

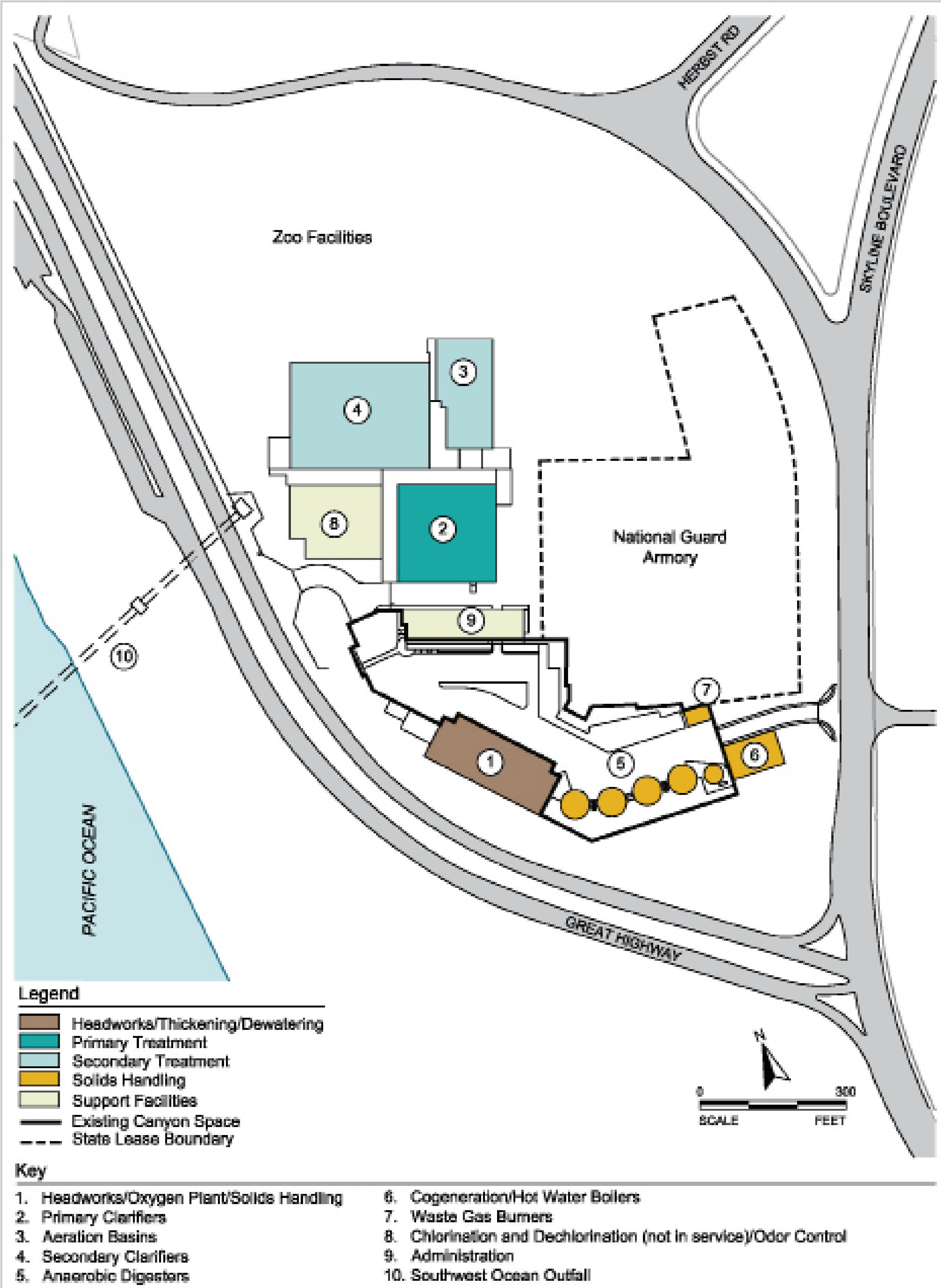


Figure 3-14. Oceanside Water Pollution Control Plant Layout

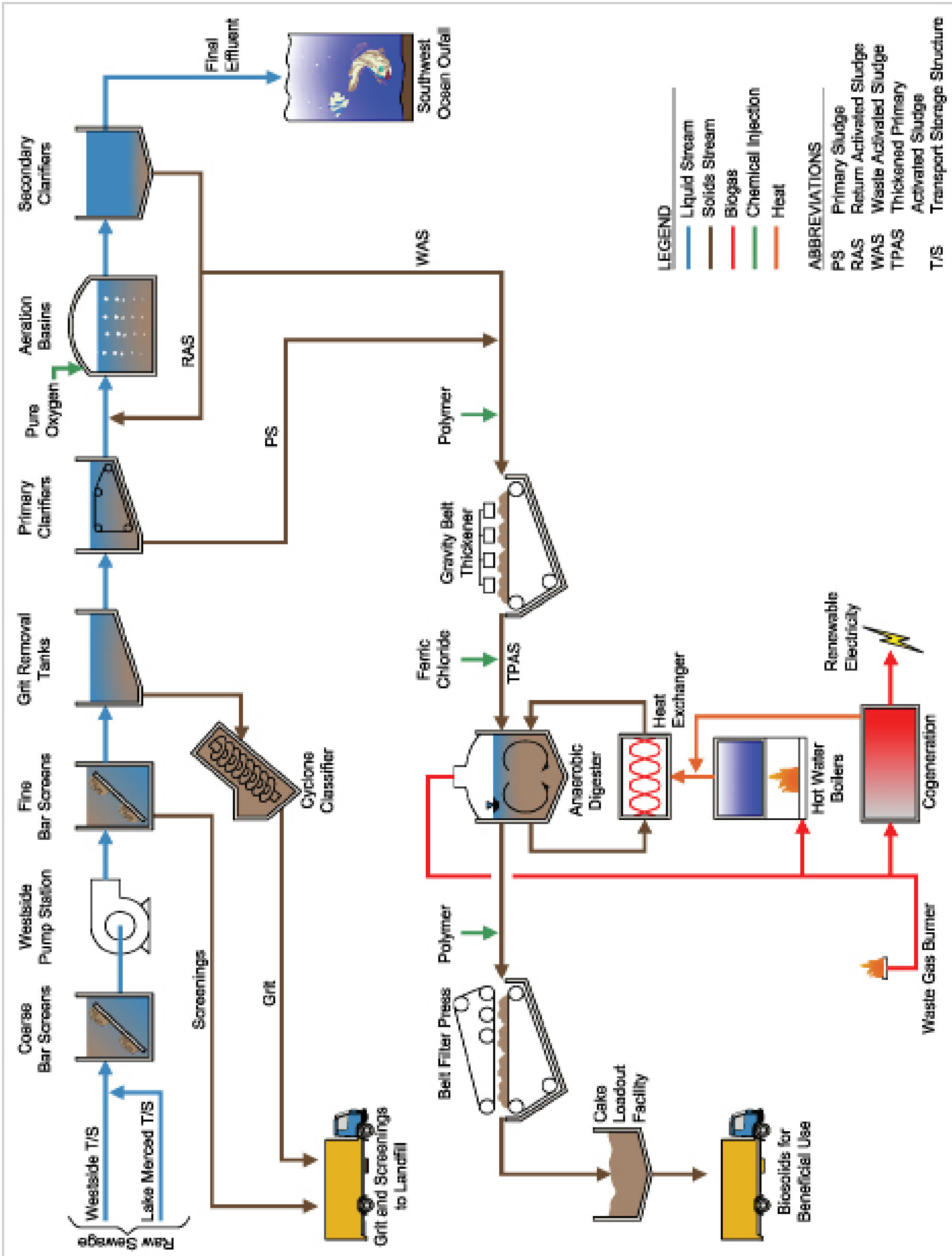


Figure 3-15. Oceanside Water Pollution Control Plant Process Schematic

thickened sludge is blended with primary scum and is pumped to four egg-shaped anaerobic digesters. The digesters are well mixed and maintained at a minimum temperature of 95° F and an average detention time of 23 days. After digestion, the sludge is conditioned with polymer and dewatered by the three belt press thickeners. Dewatered sludge cake from the belt presses is discharged to three sludge hoppers before being hauled for reuse in land application or landfill alternate daily cover.

During wet weather, the treatment process mirrors the dry-weather treatment process. Wet-weather flows up to 65 mgd receive primary treatment through the engagement of five rectangular primary clarifiers. Of the 65 mgd, up to 43 mgd receives full secondary treatment. Both process streams (22 mgd primary and 43 mgd secondary) are then blended prior to discharge. The OSP process design details for dry- and wet-weather operations are given in **Appendix** L.

Power Generation Summary

The OSP has a cogeneration facility that can supply up to 39% of the of the annual electrical demand of the facility, if fully functional.

Two 550 kW Wauksha lean burn, turbo-charged internal combustion engines use a combination of digester gas supplemented with natural gas to generate electricity for plant demand. Current operation can provide up to 6,263,000 kWh/year. Digester gas is also burned in boilers to provide heat and hot water for plant and digester facility requirements.

3.1.4 Off-Shore Effluent Outfalls

Table 3-5 provides a summary of the off-shore effluent outfalls for the combined sewer system. Three of the off-shore outfalls discharge to deep waters — Southeast Bay Outfall, North Point Outfalls, and Southwest Ocean Outfall — and one discharges to shallow waters (Quint Street Outfall). In addition to these outfalls, a series of CSD structures, or nearshore outfalls, serve as relief points of the combined sewer system. These CSD structures operate infrequently during large storm events and allow for discharge from the T/S structures to relieve the collection system and treatment plants (see **Section** 3.1.2.1).

3.1.4.1 Bayside Outfalls

Southeast Bay Outfall (Pier 80)

The SEO (**Figure** 3-16) is the main outfall for the SEP. Construction began on this outfall in 1967 and operation began in 1969. The outfall

Table 3-5. Major Off-shore Effluent Outfalls of the Sewer System

Name	Facility Served	Location	Discharge	RWQCB Dilution[2]	Modeling Dilution[3]	Receiving Water
Southeast Bay Outfall	SEP	Pier 80	810 feet from shore/ 42 feet below MLLW[1]	10:1	36:1	Lower San Francisco Bay
Quint Street Outfall	SEP	Quint Street	Shoreline Outfall	-	-	Islais Creek (flows into Lower San Francisco Bay)
North Point Outfalls	NPF	Pier 33 and Pier 35	Dual outfalls 800 feet from shore/ 18 feet below MLLW[1]	10:1	20:1	Central San Francisco Bay
Southwest Ocean Outfall	OSP	3500 Great Highway	4 miles from shore/ 80 feet below MLLW[1]	150:1	250:1	Pacific Ocean

Notes:
1. Mean Lower Low Water Tidal Level - MLLW
2. RWQCB Dilution: As designated by the Regional Water Quality Control Board (except for ammonia which is given a 36:1 dilution).
3. Modeling Dilution: As estimated from modeling.

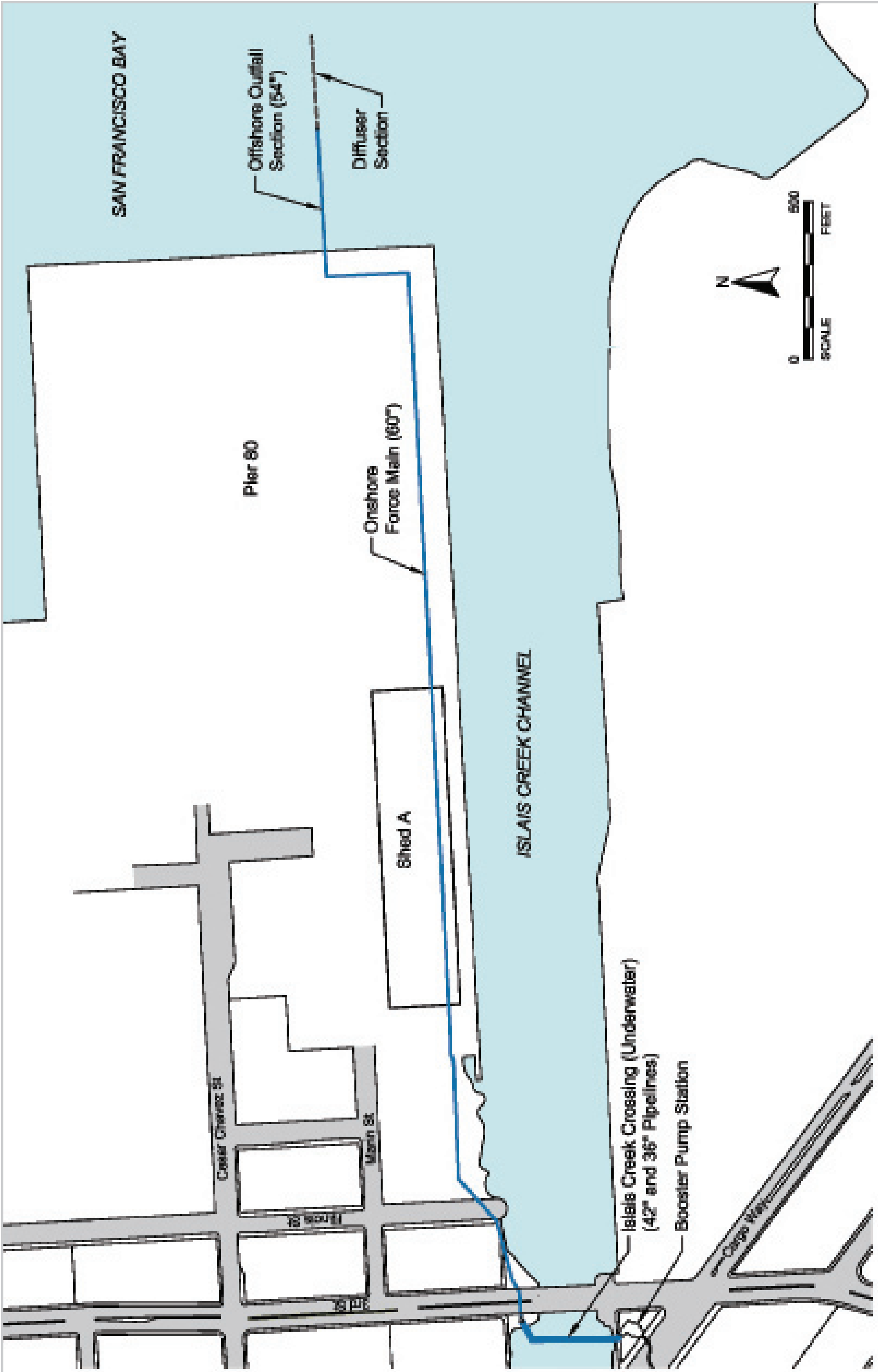


Figure 3-16. Southeast Bay Outfall

line extends 810 feet from Pier 80 into the San Francisco Bay. The off-shore discharge section of this outfall is 42 feet below the mean lower low water (MLLW). The outfall pipe is buried and protected by rocks and riprap. Only the diffuser ports of the eastern-most 300-foot section are exposed.

The treated effluent from the SEP is pumped through two inverted siphons that are 42 and 36 inches in diameter. These two pipes then cross Islais Creek and merge into a 60-inch-diameter pipe at the North Manhole Structure. The 60-inch pipe runs beneath Pier 80 and connects to the off-shore section of the SEO. The two inverted siphons, known as the Islais Creek Crossing, are made of ductile iron and are supported on timber piles along the inclined sections. The maximum flow from the Booster Pump Station is 110 mgd. The onshore main connects the Islais Creek Crossing with the off-shore section of the outfall. In dry weather, the SEO receives all of the SEP disinfected secondary effluent. The peak design discharge flow capacity of the outfall is 110 mgd, and the minimum initial dilution is approximately 36:1 (BCM Joint Venture, 2009a).

Quint Street Outfall

When the instantaneous SEP influent flow exceeds 110 mgd as a result of rain, disinfected secondary effluent is discharged through the shallow-water Quint Street Outfall into Islais Creek. The Quint Street Outfall, located on the south bank of Islais Creek, has a discharge capacity of 140 mgd. In August 1996, the San Francisco Bay RWQCB adopted Order 96-116, which allows "existing seasonal and intermittent discharge of the [secondary] treated effluent from the SEP to Islais Creek during wet weather" (BCM Joint Venture, 2009a).

North Point Outfalls

The North Point Outfalls (**Figure** 3-17) were constructed in the 1950s and diffusers were added in the 1970s. Disinfected NPF effluent flows over a 14-foot-wide weir into an 8-foot reinforced concrete outfall sewer, which subsequently branches into two 6-foot concrete pipes. Each 6-foot pipe in turn branches into two 48-inch cast iron outfalls; two are located under Pier 33 and two are located under Pier 35. Each outfall extends off shore into the San Francisco Bay about 800 feet at a depth of 17.8 feet below MLLW to an 80-foot diffuser section with 10-inch-diameter ports. The total hydraulic capacity is estimated to be 170 mgd. Minimum initial dilution has been estimated to be approximately 20:1, but as with the SEO, the RWQCB was conservative with respect to the NPDES permit and allows credit for only 10:1 dilution. The North Point Outfalls are normally used only during wet weather to discharge disinfected primary effluent into the San Francisco Bay.

3.1.4.2 Westside Outfall

Southwest Ocean Outfall

The construction of the SWO, shown in **Figure** 3-18 on page 3-28, was completed and began operation in 1986. The current flow rate through the SWO ranges from 4 to 175 mgd. The outfall extends in a southwesterly direction from the San Francisco western shoreline to approximately four miles off shore. The outfall pipeline is a 12-foot-diameter reinforced concrete pipe, buried 12 to 20 feet beneath the seabed, which terminates in a 3,250-foot-long angled diffuser section with 85 diffusers, situated at a depth of approximately 80 feet below MLLW. The diffuser section is located southwest of the OSP in open coastal waters, outside of designated shipping lanes. The historic permitted initial dilution for the SWO was 76:1 (BCM Joint Venture, 2009b), whereas the most recent Oceanside Permit allows 150:1. WWE modeling efforts indicate that actual initial dilution is closer to 250:1.

During a recent external inspection of the SWO, the outfall was found to be in good condition with no visible structural damage.

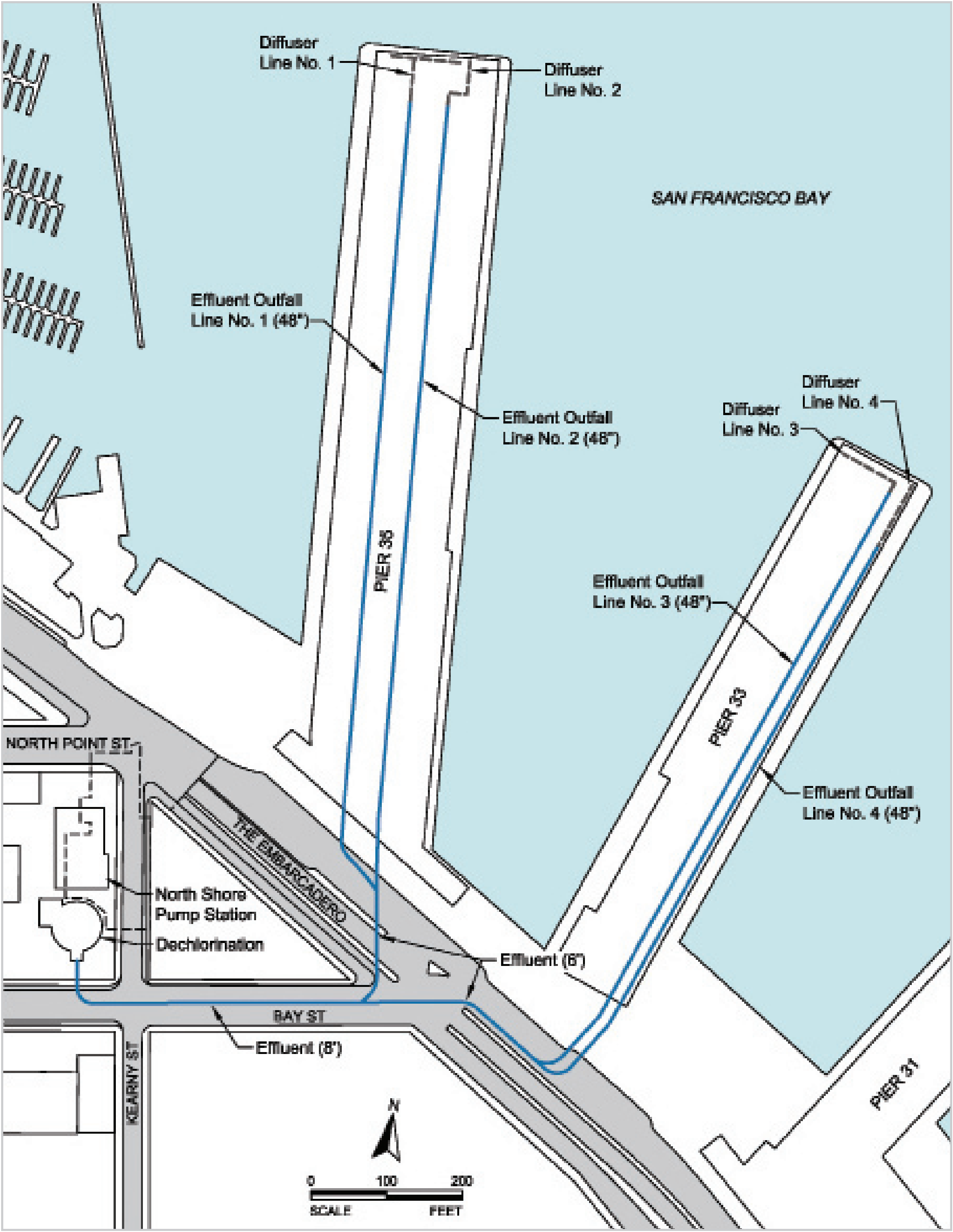


Figure 3-17. North Point Outfalls

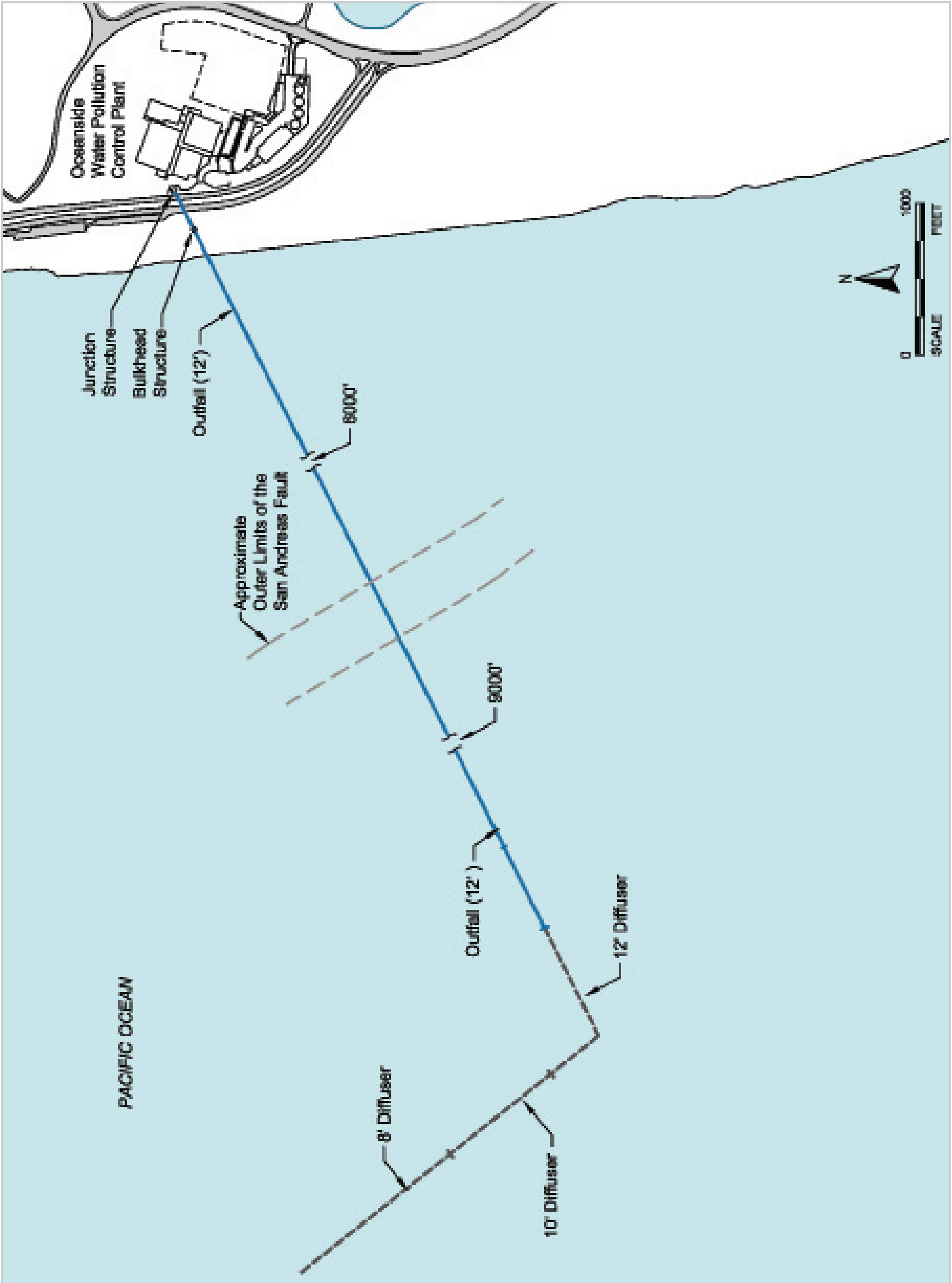


Figure 3-18. Southwest Ocean Outfall

3.2 Operating Strategies

3.2.1 Bayside

Dry Weather

All dry-weather flows from the five bayside drainage basins, as well as eastside municipal customers located outside the city limits, are treated at the SEP and the effluent is pumped by the Booster Pump Station to the SEO for discharge into the bay. See **Figure** 3-6 for an overview schematic of the existing system.

Dry-weather flow from the northeastern portion of the Bayside Watershed is pumped from the North Shore Pump Station through the North Shore Force Main to the Channel T/S structure. This flow, as well as the gravity flow from the Channel Drainage Basin sewers, is transported through the Channel Force Main directly to the SEP. Dry-weather flows from the Potrero Hill and 20th Street areas are pumped by the Mariposa Pump Station to a gravity sewer at 21st and Illinois streets that is part of the Islais Creek Drainage Basin. Dry-weather flow from the Islais Creek Drainage Basin is transported by gravity to the vicinity of the SEP and is lifted into the plant by the Southeast Lift Station.

Additionally, dry-weather flow from the upper Yosemite area gravitates to the SEP through the Hunters Point Tunnel. Dry-weather flow from the lower Yosemite areas combines with dry-weather flow from Sunnydale and is pumped to the Islais Creek Drainage Basin through the Hunters Point Tunnel by the Griffith Pump Station. The Bruce Flynn Pump Station is currently being operated during dry weather to provide a consistent influent flow regime at the SEP. See **Figure** 3-19 on page 3-30 for the Bayside Dry-Weather Operational Strategy for dry-weather operation.

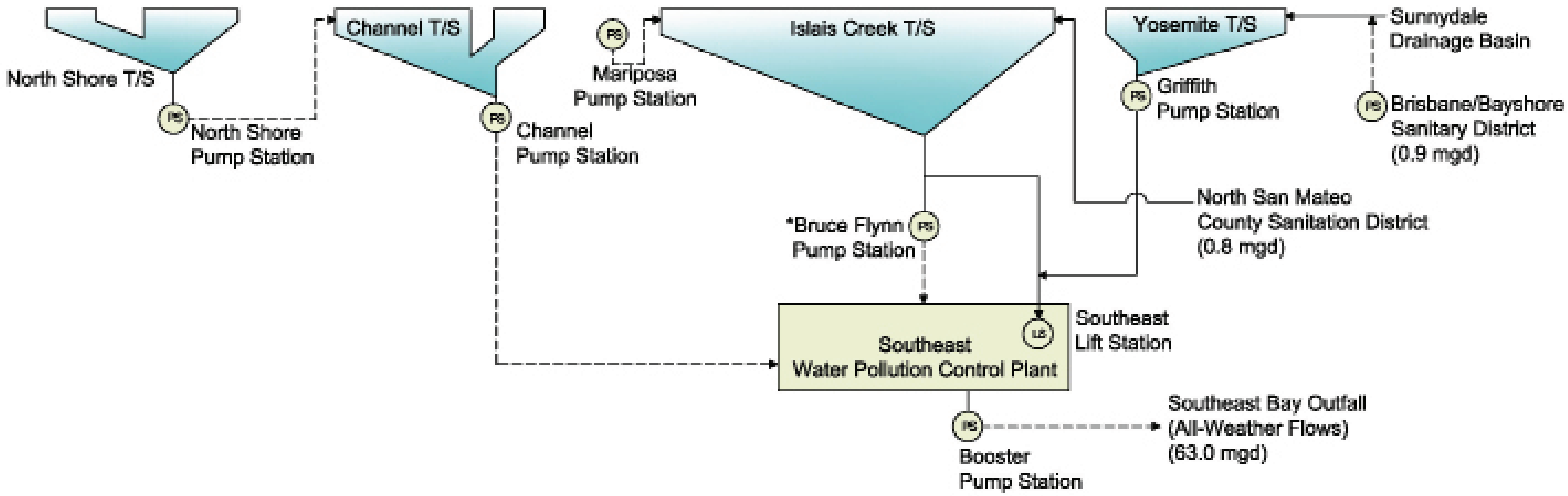
Wet Weather

In addition to the dry-weather pump stations and major force mains already identified, wet-weather combined wastewater and stormwater flows from the east side of San Francisco are also conveyed by two wet-weather pump stations — the Sunnydale and the Bruce Flynn Pump Stations. The Sunnydale Pump Station receives flow from the Sunnydale T/S structure and pumps it to the upstream end of the Candlestick Tunnel, which in turn flows by gravity to the Yosemite T/S structure. This flow is ultimately pumped again by the Griffith Pump Station to the vicinity of the SEP through the Hunters Point Tunnel. The Bruce Flynn Pump Station provides additional capacity to supplement the Southeast Lift Station during wet weather, lifting flow into the SEP from the Islais Creek T/S structure.

During wet weather, the SEP wet-weather facilities are engaged to provide primary treatment to an additional 100 mgd of combined wastewater and stormwater flow, beyond the dry-weather capacity. At full capacity, the SEP provides primary treatment to all flows up to 250 mgd and secondary treatment to a maximum flow rate of 150 mgd. Wet-weather effluent discharges are maximized through the deep-water SEO, which has a capacity of 110 mgd. Flows in excess of 110 mgd are discharged into Islais Creek through the shallow-water Quint Street Outfall (**Section** 3.1.4.1). All plant discharges into Islais Creek receives full secondary treatment; at full capacity, the 110-mgd discharge through the SEO receives primary treatment, with 10 mgd also receiving secondary treatment.

When the SEP approaches its secondary treatment capacity of 150 mgd and T/S box levels increase, a portion of the flow from the North Shore Drainage Basin is routed by way of the North Shore Pump Station to the NPF for primary treatment. Treated flow is then discharged through four gravity outfalls that extend to the end of Piers 33 and 35. The NPF transfers all wastewater solids to the SEP for treatment.

The bayside facilities (SEP and NPF) have a total treatment design capacities of 400 mgd. Once the capacities of the treatment facilities



Pump/Lift Stations	
Average Dry-Weather Flows (mgd)	
Name	Average[1]
North Shore	13.9
Channel	40.8
Mariposa & 20th	0.4
Griffith[2]	3.3
Bruce Flynn*	1.6
Southeast	20.6
Booster	63.0

* Special operation during dry weather

[1] 2003-2007 average flow (June-September)

[2] 2008 data only

Legend	
mgd	million gallons per day
T/S	Transport/Storage Structure
- - →	Force Main
——→	Gravity Flow Lines
(PS)	Pump Station
(LS)	Lift Station

Figure 3-19. Bayside Dry-Weather Operational Strategy

Notes: North Shore T/S structures consist of the Marina T/S, North Point Tunnel, and the Jackson T/S.

Table 3-6. Bayside Treatment and Outfall Capacities					
Facility	Treatment Level	Flow	Outfall Capacity		
			Southeast Bay	Quint Street	North Point
Dry Weather					
Southeast Water Pollution Control Plant	Secondary	63 mgd average	110 mgd	-	-
Wet Weather					
Southeast Water Pollution Control Plant	Secondary	150 mgd capacity	10 mgd	140 mgd	-
	Primary	100 mgd capacity	100 mgd	-	-
North Point Wet-Weather Facility	Primary	150 mgd capacity	-	-	170 mgd
Total Wet-Weather Treatment Capacity		**400 mgd capacity**	**-**	**-**	**-**

and the combined sewer system storage are maximized, the surplus flow discharges at permitted sites. These 29 bayside nearshore sites are the CSD structures. A summary of the bayside dry- and wet-weather treatment and outfall capacities is provided in **Table** 3-6. **Figure** 3-20 on page 3-32 illustrates the Bayside Wet-Weather Operational Strategy for wet-weather operation. Further details of the Bayside Operational Strategy are presented in **Appendix** M.

3.2.2 Westside

Dry Weather

All dry-weather flow collected from the Westside Watershed and some small flows from northern San Mateo County are treated at the OSP and discharged by gravity approximately four miles off shore in the Pacific Ocean through the SWO.

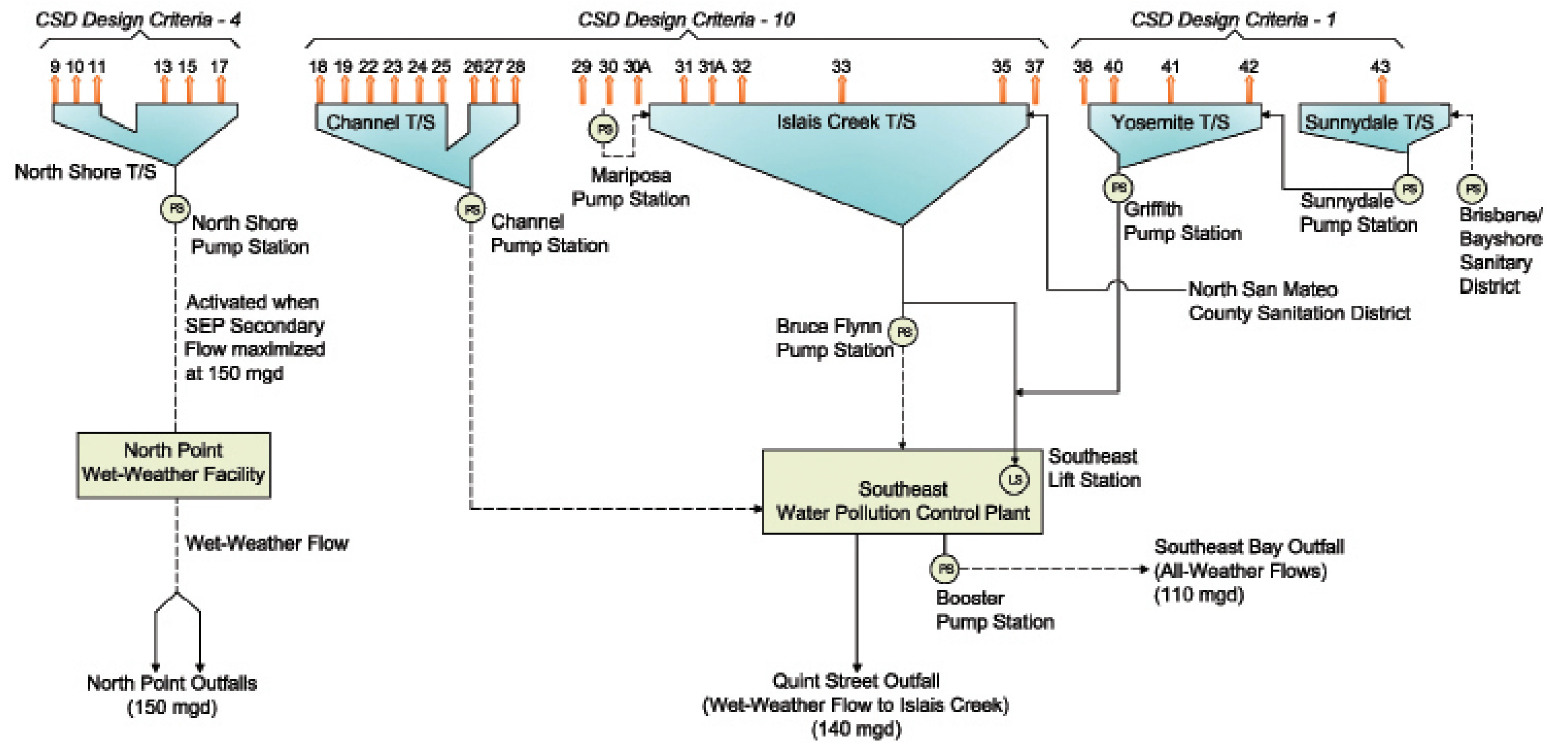
Dry-weather flows from the Richmond and Sunset drainage basins are transported by gravity[5], collected in the Westside T/S, and then pumped by the Westside Pump Station through the 48-inch force main to the OSP. Lake Merced Drainage Basin and minor Northern San Mateo County flows are served by the Lake Merced Tunnel that terminates in the southern end of the Westside T/S, commingles with the Westside T/S flow and is treated at the OSP. See **Figure** 3-21 on page 3-33 for the Westside Dry-Weather Operational Strategy for dry-weather operation.

Wet Weather

During wet weather, the OSP provides primary treatment for flows up to 65 mgd and secondary treatment to a maximum flow rate of 43 mgd. The blended primary and secondary treated wet-weather effluent is discharged directly to the SWO by gravity. As the secondary capacity of the OSP is exceeded, additional OSP wet-weather facilities are engaged. To achieve a 175 mgd SWO discharge capacity only 21 of the available diffusers are required. Up to 300 mgd can be discharged without having to pump OSP effluent. The maximum SWO discharge capacity of 590 mgd can only be obtained by pressurizing the system and utilizing all 85 diffusers.

Additional flows up to 110 mgd in the Westside T/S receive decant treatment (see **Section** 3.1.2.1) before being pumped out through the SWO. Once the storage capacity of the system is reached, flows exceeding 175 mgd discharge from the seven permitted westside CSD structures. A summary of

5 Except for some minor pump stations in the Sea Cliff area for localized flows.



Pump/Lift Stations	
Peak Wet-Weather Flows (mgd)[1]	
Name	Peak
North Shore	150
Channel	103
Mariposa	10
Sunnydale	50
Griffith	120
Bruce Flynn	110
Southeast	70
Booster	110

[1] As peak flows do not occur simultaneously throughout the collection system, operational flexibility is provided.

CSD Number and Name					
9	Baker Street	24	Fifth Street	32	Marin Street
10	Pierce Street	25	Sixth Street/North	33	Selby Street
11	Laguna Street	26	Division Street	35	Third Street/South
13	Beach Street	27	Sixth Street/South	37	Evans Street
15	Sansome Street	28	Fourth Street/South	38	Hudson Street
17	Jackson Street	29	Mariposa Street	40	Griffith Street/South
18	Howard Street	30	20th Street	41	Yosemite Avenue
19	Brannan Street	30A	22nd Street	42	Fitch Street
22	Third Street	31	Third Street/North	43	Sunnydale Avenue
23	Fourth Street	31A	Islais Creek/North		

Transport/Storage Structures	
Name	Usable Storage (MG)
North Shore	24.0
Channel	38.0
Mariposa & 20th	0.9
Islais Creek	45.1
Yosemite	11.5
Sunnydale	6.2

Legend	
CSD	Combined Sewer Discharge
MG	million gallons
mgd	million gallons per day
T/S	Transport/Storage Structure
- - →	Force Main
→	Gravity Flow Lines
# ←	Combined Sewer Discharge
PS	Pump Station
LS	Lift Station

Figure 3-20. Bayside Wet-Weather Operational Strategy

Notes: North Shore T/S structures consist of the Marina T/S, North Point Tunnel, and the Jackson T/S.

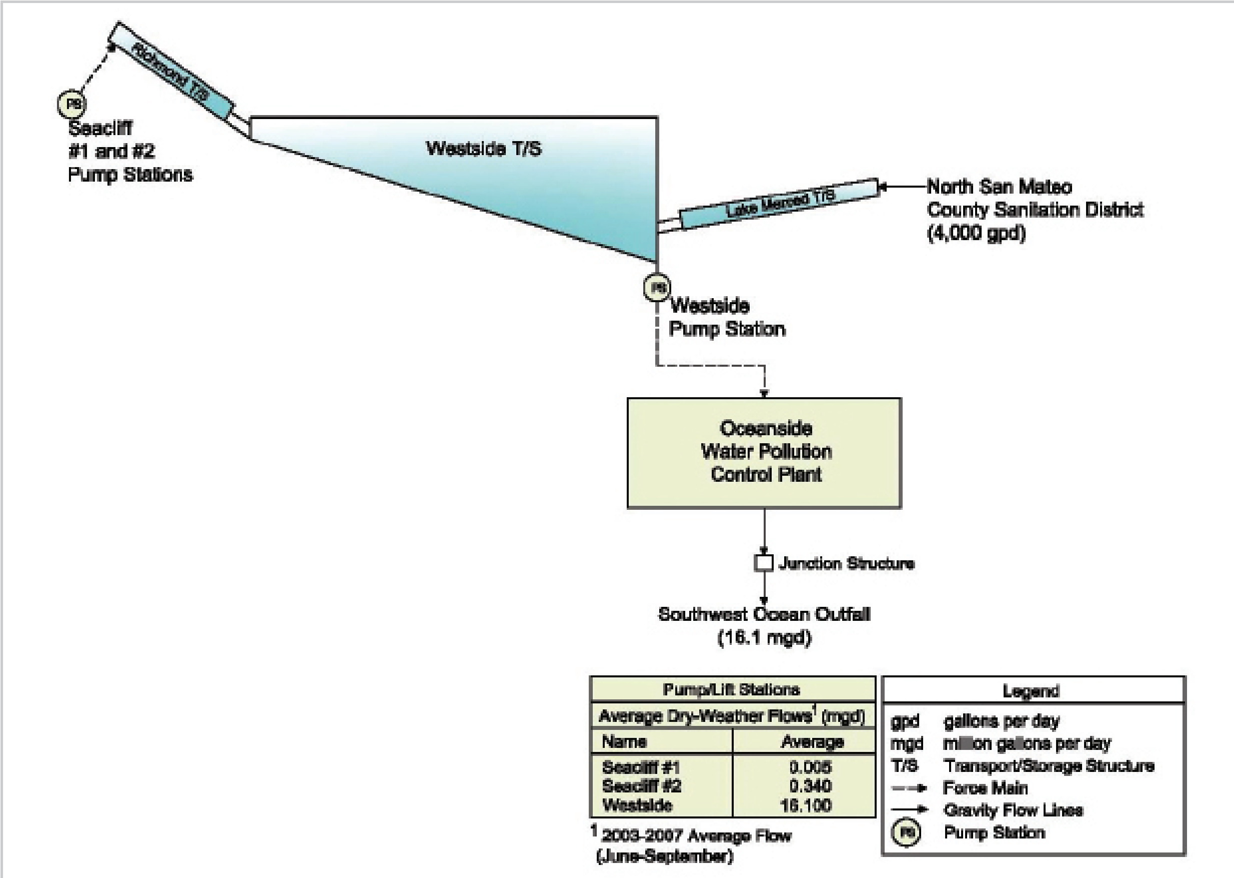


Figure 3-21. Westside Dry-Weather Operational Strategy

dry- and wet-weather treatment and outfall capacities is provided in Table 3-7 on page 3-34. Further details of the westside operational strategy are presented in Appendix M.

Figure 3-22 on page 3-35 illustrates the Westside Wet-Weather Operational Strategy for wet-weather operation.

3.3 Sewer System Performance

3.3.1 Influent Sources

During dry weather, the influent flow into the sewer system is essentially sanitary flow (residential and commercial wastewater with small contributions from industrial wastewater and urban runoff). During wet weather, stormwater runoff is also collected in the sewer system. The combined sewer system collects both the sanitary flow and stormwater where the volume and peak-flow values are governed by storm patterns and intensity. The separate sewer systems collect the sanitary flow and wet-weather stormwater in separate sewers; the sanitary flow sewers transport the wastewater to treatment plants. Details about influent sources are discussed in this section.

3.3.1.1 Industrial Wastewater

Industrial inputs into San Francisco sewer system account for 4% of the total dry-weather flow. In 2006, the bayside sewer system received industrial flows of greater than 25,000 gpd from each of 23 sources. Of the 23 sources, two are federal Categorical Industrial Users. Two other Categorical Industrial Users contribute to the flow from the Bayside Watershed, but they each average less than 25,000 gpd. These types of

Table 3-7. Westside Treatment and Outfall Capacities			
Facility	**Treatment Level**	**Flow**	**Southwest Ocean Outfall Capacity**
Dry Weather			
Oceanside Water Pollution Control Plant	Secondary	16 mgd average	590 mgd
Wet Weather			
Oceanside Water Pollution Control Plant	Secondary	43 mgd capacity	590 mgd
	Primary	22 mgd capacity	590 mgd
Westside Transport – West Box	Decant	110 mgd capacity	590 mgd
Total Wet-Weather Treatment Capacity		**175 mgd capacity**	**-**

industrial discharges are covered by 14 Standard Industrial Codes. In 2006, the westside sewer system received industrial flows greater than 25,000 gpd from seven sources. These discharges are covered by the five Standard Industrial Codes.

One facility, the University of California San Francisco Main Campus contributes to both the SEP and OSP influent. For flow and pollutant contribution purposes, half of the flow and pollutants are considered to go to each plant.

All industrial users are required to comply with the local wastewater limits, which are specified in the San Francisco Municipal Code Chapter X, Article 4.1 (Sewer Use Ordinance) and Department of Public Works Order Number 158170 (December 18, 1991). In addition, companies classified as Categorical Industrial Users are required to comply with effluent limits specified in the NPDES 40 CFR pertaining to their industry type, if the Federal categorical limits are more stringent than the City's local limit. The Sewer Use Ordinance Section 123(c) also specifies that, in addition to local limits, all dischargers must comply with all requirements set forth in Federal Categorical Pretreatment Standards and other applicable Federal and State standards. This means that for pollutants where no local limits are specified, State or Federal standards take effect.

Businesses that are consistently in noncompliance with local limits are required to address the issue either by installing a pretreatment system or by eliminating from the waste stream the waste chemical or material that could lead to noncompliance. The Collection System Division routinely collects samples from such facilities for metals and fee constituent analyses. The fee constituents from each sampling episode are used to routinely update sewer service charges to individual facilities; fee constituents for individual dischargers are listed in Appendix G. The average daily flow from these discharges is about 2.1 mgd to the bayside sewer system and 1.2 mgd to the westside sewer system.

University campuses and hospitals are among the major dischargers. The city has been gradually losing its traditional industries, while more biomedical and biotechnology facilities are being established. For the SSMP planning period (2005 to 2030), pollutant loadings from industrial wastewater sources are not expected to increase significantly above the current level.

Rainfall Runoff Volume

The volume of stormwater runoff that eventually enters the sewer system can be calculated by estimating the surface imperviousness of drainage basins. Table 3-8 provides an approximation of the total annual runoff volume by drainage basin.

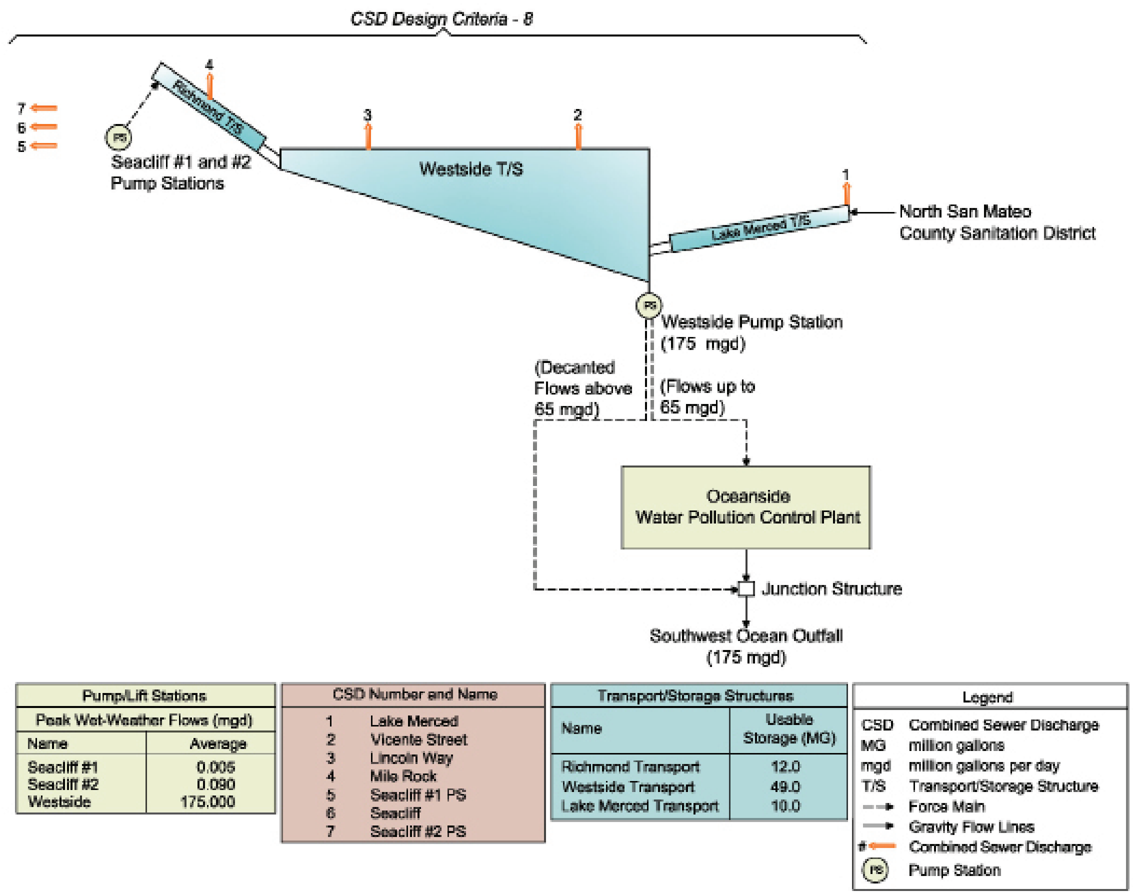


Figure 3-22. Westside Wet-Weather Operational Strategy

3.3.1.2 Groundwater Infiltration

Infiltration can occur when groundwater seeps into sewer conduits through various defects (leaky pipes, pipe joints, connections, or access port walls, including manholes) that develop over the lifespan of sewer pipes (Metcalf and Eddy, Inc., 2003). In addition to the usual problems of groundwater infiltration into an aging sewer system, several studies conducted by City staff have shown that portions of the bayside collection system that are constructed in artificial fill areas (Chapter 2, Figure 2.4) are subject to saltwater intrusion from the bay.

In 1974, City staff conducted two "desktop" studies on infiltration (San Francisco Department of Public Works, 1974a & 1974b). Based on the percentages of sewers located below tide and groundwater elevations, as well as

Table 3-8. Typical Annual Drainage Basin Runoff

Drainage Basin	Runoff (MG)
North Shore	458
Channel	1,796
Islais Creek	2,766
Yosemite	555
Sunnydale	285
Bayside Total	**5,860**
Richmond	475
Sunset	1,134
Lake Merced	533
Westside Total	**2,142**

Notes: As of May 2009

the age and material of the sewers, the rate of infiltration into the bayside sewer system was estimated to be 2 to 3 mgd. Based on current average SEP influent chloride levels, bay water intrusion is estimated at approximately 2 mgd.

Bay water intrusion degrades effluent quality, particularly for reuse applications, and can interfere with plant operations (e.g., activated sludge settleability). The WWE has set a quality control standard for chloride ion levels in the plant influent at 650 mg/L. The SEP can accept 2.4 mgd of bay water without exceeding this chloride concentration limit. The SEP effluent chloride ion concentration averages about 409 mg/L; the average TDS concentration is approximately 1,260 mg/L (RMC Water and Environment, 2006).

In contrast, the westside sewers are not subject to tidal influences, since most sewers are not in fill areas and are above the groundwater elevation; infiltration was estimated to be approximately 0.3 mgd on the west side. In addition, in the Westside Watershed, there is a strong westward groundwater flow that prevents the inflow of saltwater into the groundwater.

3.3.1.3 Saltwater Contributors

The biggest single saltwater contributor to the OSP is the California Academy of Sciences, which uses sea water for their Steinhart Aquarium and then discharges it into the collection system. The aquarium discharges an average of 60,000 to 100,000 gallons of saltwater per day. Since the average dry-weather flow of the OSP is about 16.1 mgd (2003 to 2007 dry-weather average), the saltwater discharged from the California Academy of Sciences represents 0.5% of the daily flow. According to the OSP data (May 2000 to December 2003), the average chloride concentration was 131 mg/L with an average TDS concentration of about 590 mg/L (RMC Water and Environment, 2006). At that point, Steinhart Aquarium exhibits and animals were moved to a temporary museum and, after demolition, the daily discharges to the sewer system were suspended. Since that time (August 2004 to December 2007), the chloride concentration has averaged about 52 mg/L. With the reopening of the aquarium, the OSP chloride levels have returned to their former averages.

In conclusion, the OSP effluent is considered “fair” water quality for landscaping needs, whereas the SEP effluent is considered “poor” unless advanced treatment (e.g., reverse osmosis) is applied (RMC Water and Environment, 2006).

3.3.1.4 Grit Loads

While higher grit levels are typical of a combined sewer system, the City’s wastewater system appears to experience exceptionally high grit loads, especially during wet-weather conditions. **Table** 3-9 provides the monthly SEP and OSP grit loads estimated from grit hauling records for each plant. Grit removed from the collection system during sewer cleaning is not included. The high grit loads can be attributed to the following possible factors:

- Surface geology (see Chapter 3)— the northern half of San Francisco is mostly covered by dune sand
- A long stretch of sandy beach on the Pacific Ocean coast, in combination with strong, persistent west winds
- Aging sewer cracks and separated joints
- Exfoliated roofing materials such as pea gravel and asphalt shingle grit
- Grit accumulation in T/S structures, which is flushed out during large wet-weather events

3.3.2 Bayside Influent Wastewater Characteristics

The characteristics of wastewater generated on the bay side are influenced by precipitation and show a general trend of decreasing volume due to the use of low-flow fixtures in homes and businesses. Customer behavioral changes in response to drought and cyclical economic trends also are evident.

Table 3-9. Grit Removal Data			
Hauled Grit	**Units**	**Dry Season**	**Wet Season**
Southeast Water Pollution Control Plant			
Average	1,000 wet lbs/day	99.1	105.9
	1,000 wet lbs/MG Influent flow	1.6	1.4
Maximum Month	1,000 wet lbs/day	133.8	156.7
	1,000 wet lbs/MG Influent flow	2.2	1.7
Oceanside Water Pollution Control Plant			
Average	1,000 wet lbs/day	45.2	56.0
	1,000 wet lbs/MG Influent flow	2.6	3.0
Maximum Month	1,000 wet lbs/day	96.4	114.2
	1,000 wet lbs/MG Influent flow	5.7	5.6

Notes: Dry season from June to September; Wet season from October to May

Dry Weather[6]

The annual average dry-weather flow, which ranged from 62.8 to 68.8 mgd (1995 to 2006), is shown in **Figure** 3-23 (on page 3-38). Review of the data for more recent summer months (June to September) shows that the current dry-weather flow averages approximately 63 mgd (2003 to 2007). These data indicate a continuation of the decreased influent flow trend.

Figure 3-24 (on page 3-38) shows the diurnal patterns of hourly dry-weather flows in 2004. The weekday diurnal pattern shows two flow peaks of similar magnitude — one in the morning and one in the evening. These peaks are less pronounced on weekends. Because partial flow equalization in the T/S structures is part of the current operating strategy, diurnal influent wastewater flow is attenuated. In addition, when mandated during the summer months, the SEP participates in a power curtailment program. Wastewater flow is stored at T/S structures during peak power usage periods (noon to 3:00 p.m.) then pumped and treated during off-peak hours.

Flow and conventional influent data also were compiled for 1991 to 1995 (**Table** 3-10 on page 3-39), prior to the startup of the new headworks (1996). It has been difficult to obtain representative influent samples since the plant modification. Recent SEP dry-weather influent metals data were also compiled and are summarized in **Appendix** L.

Wet Weather

Wet-weather influent flows and conventional influent data for the SEP and NPF are summarized in **Tables** 4-11 and 4-12 on page 3-39. SEP wet-weather influent metal concentrations were compiled and are also summarized in **Appendix** L.

3.3.3 Westside Influent Wastewater Characteristics

The characteristics of wastewater generated on the westside of San Francisco mirror those on the bayside, but show a less pronounced response to cyclical economic trends.

6 The bayside dry-weather wastewater is characterized by dry-weather influent at the SEP. Dry-weather days, for the purpose of plant process analysis, are defined as the days during which the total daily influent flow does not exceed 85 mgd. Data shown was analyzed in accordance with this definition. For compliance purposes, the NPDES permit definitions are used and followed.

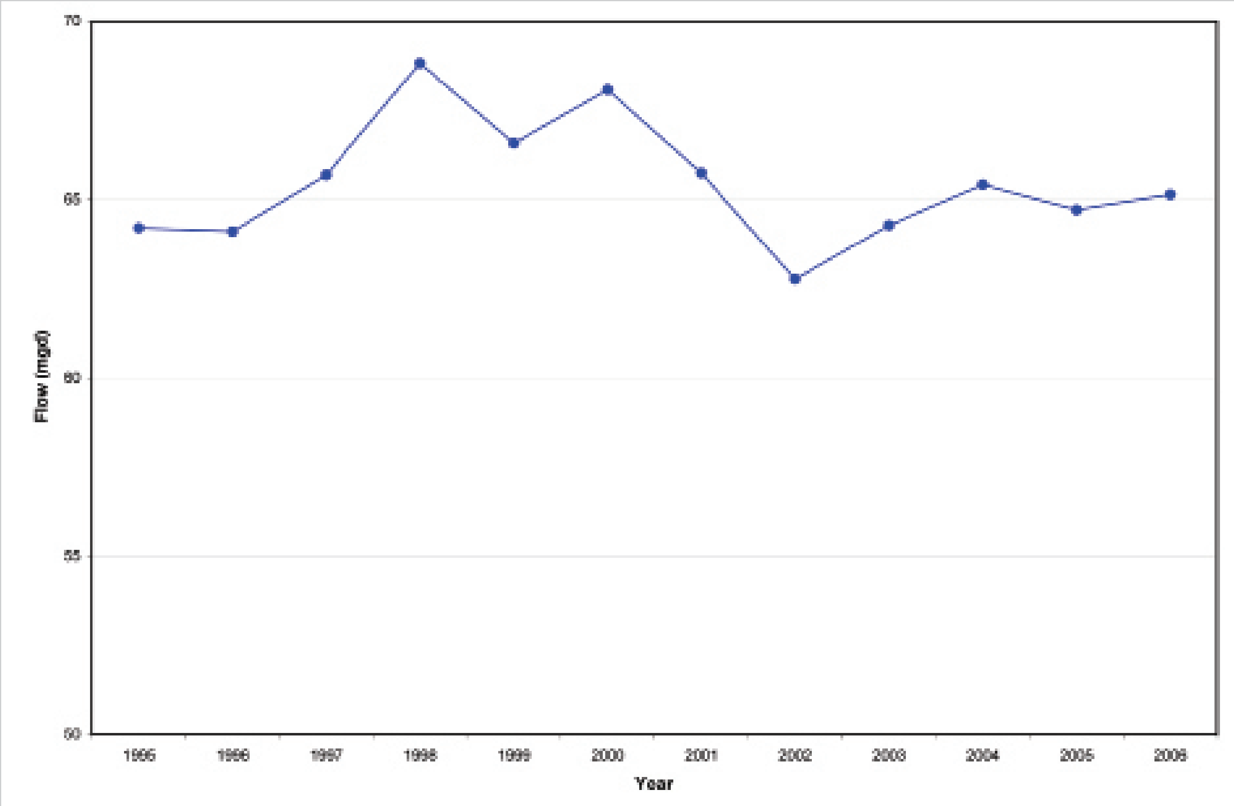


Figure 3-23. Southeast Water Pollution Control Plant Annual Average Dry-Weather Influent Flow Rate

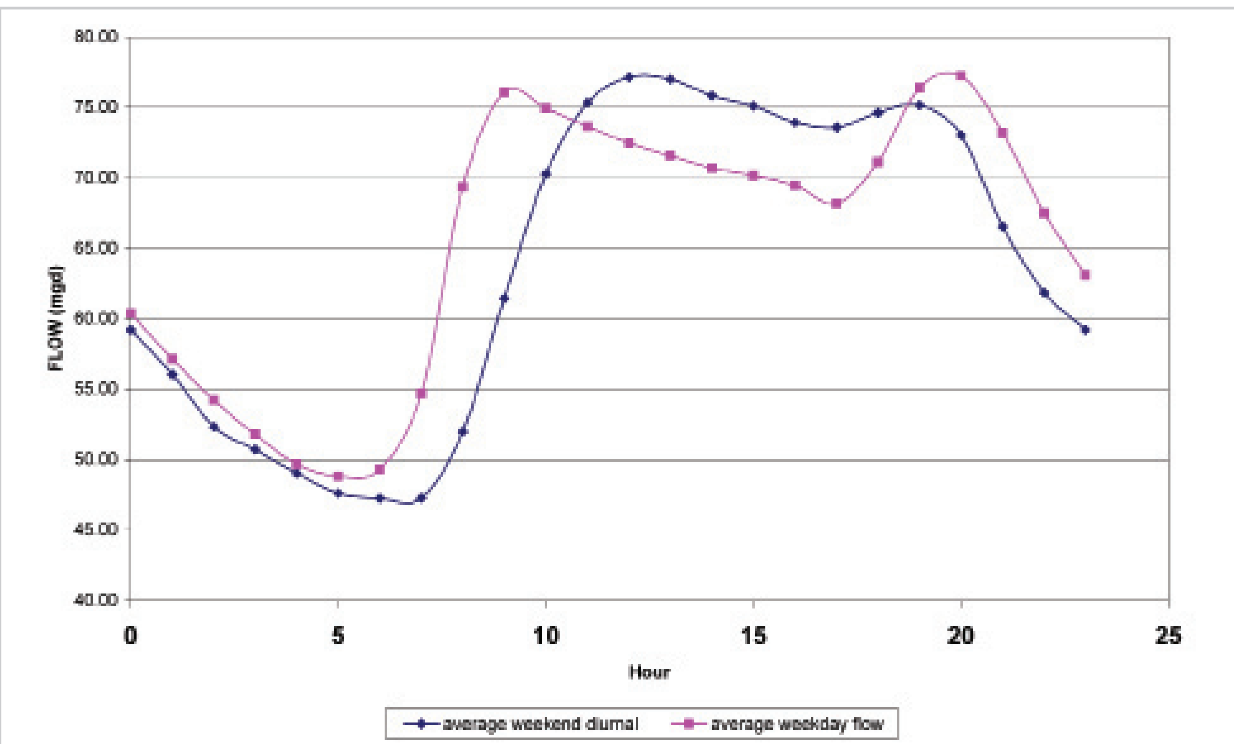


Figure 3-24. Southeast Water Pollution Control Plant Diurnal Flow Pattern for 2004

Table 3-10. SEP Dry-Weather Influent Data

Parameter	Average	Median	95th Percentile
Flow[1] (mgd)	65.3	64.9	77.2
BOD_5[2] (mg/L)	228	223	334
COD[2] (mg/L)	489	470	738
TSS[2] (mg/L)	248	233	396

Notes: 1. Data from 1995 to 2006; 2. Data from 1991 to1995

Table 3-11. SEP Wet-Weather Influent Data

Parameter	Average	Median	95th Percentile
Flow[1] (mgd)	119	102	220
BOD_5[2] (mg/L)	171	143	393
COD[2] (mg/L)	308	283	501
TSS[2] (mg/L)	147	141	328

Notes: 1. Data from 1997 to 2006; 2. Data from 1991 to1995

Dry Weather[7]

The annual average dry-weather flow, which ranged from 16.5 to 18.0 mgd (1995 to 2006), is shown in **Figure** 3-25. Review of the data for more recent summer months (June to September) shows that the current dry-

7 Dry-weather days, for the purpose of OSP process analysis, are defined as the days during which the total daily influent flow does not exceed 21 mgd. For compliance purposes, the NPDES permit definition is used.

Table 3-12. NPF Wet-Weather Influent Data

Parameter	Average	Median	95th Percentile
Flow[1] (mgd)	51.5	49.4	94.5
COD[2] (mg/L)	257	237	475
TSS[2] (mg/L)	116	86	322

Notes: 1. Data from 2001 to 2006; 2. Data from 1998 to 2006

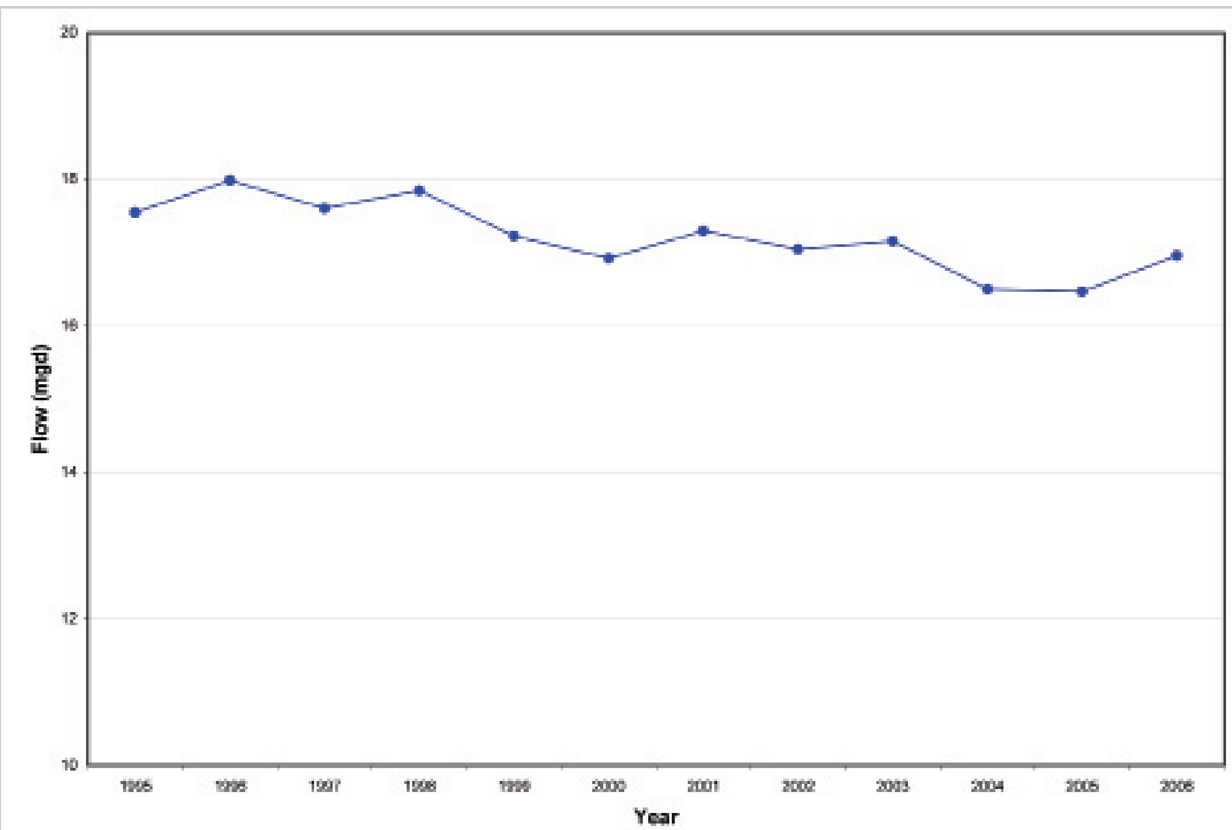


Figure 3-25. Oceanside Water Pollution Control Plant Average Annual Dry-Weather Influent Flow Rate

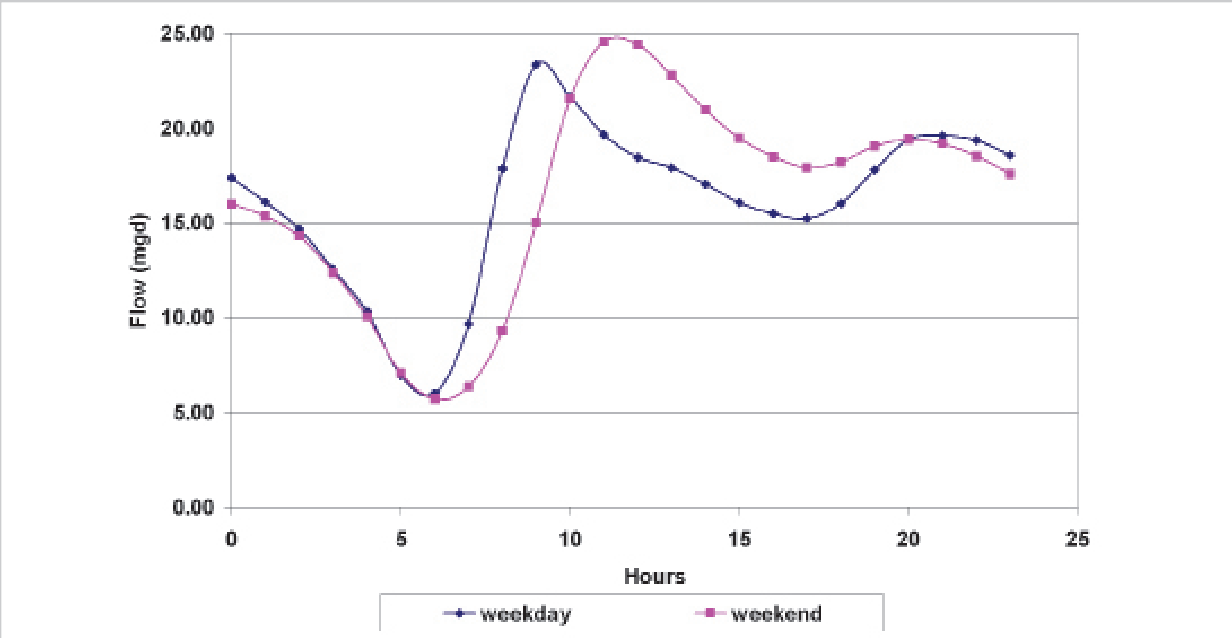


Figure 3-26. Oceanside Water Pollution Control Plant Diurnal Flow Pattern for 2004

Table 3-13. OSP Dry-Weather Influent Data			
Parameter	**Average**	**Median**	**95th Percentile**
Flow (mgd)	17.2	17.0	19.5
BOD_5 (mg/L)	236	234	335
COD (mg/L)	481	473	664
TSS (mg/L)	204	196	294

Notes: Data from 1995 to 2006

Table 3-14. OSP Wet-Weather Influent Data			
Parameter	**Average**	**Median**	**95th Percentile**
Flow (mgd)	32.2	30.1	56.0
BOD_5 (mg/L)	181	186	303
COD (mg/L)	340	332	578
TSS (mg/L)	165	160	300

Notes: Data from 1995 to 2006

weather flow averages approximately 16.1 mgd (2003 to 2007).

Figure 3-26 shows the diurnal patterns of hourly dry-weather flows in 2004. Similarly to the bay side, the weekday and weekend curves show a dual-peak pattern — one in the morning and one in the evening, however, the morning peak is about 25% higher than the evening peak. These peaks are attenuated by limited flow equalization and summer-months power curtailment.

Table 3-13 presents the conventional influent data for the OSP. The BOD_5 and COD values are within the typical range for municipal sanitary wastewater, but the TSS values appear somewhat low. These discrepancies indicate that there may be a sampling issue. Recent OSP dry-weather influent metals data are summarized in Appendix L.

Wet Weather

Wet-weather influent flows[8] and conventional influent data for the OSP are summarized in Table 3-14. OSP wet-weather influent

8 Daily OSP flows in excess of 21 mgd due to a rain event are considered wet weather in this analysis.

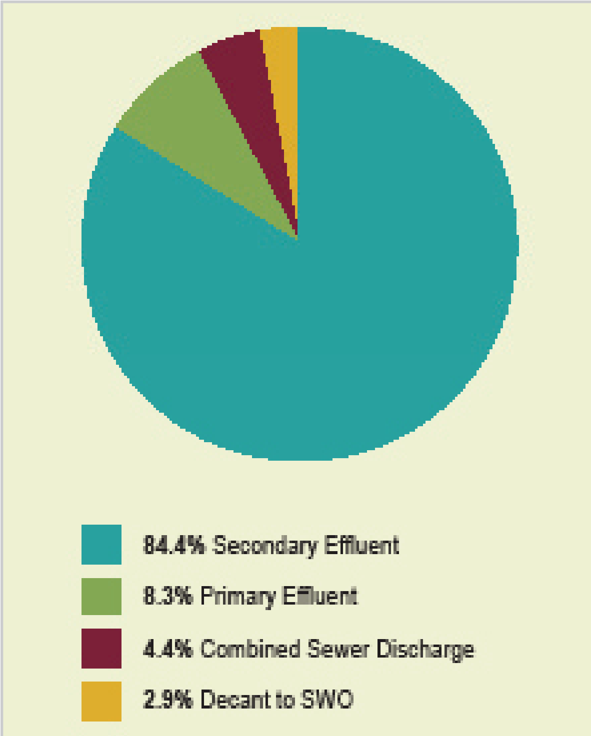


Figure 3-27. Annual System Performance for Level of Treatment

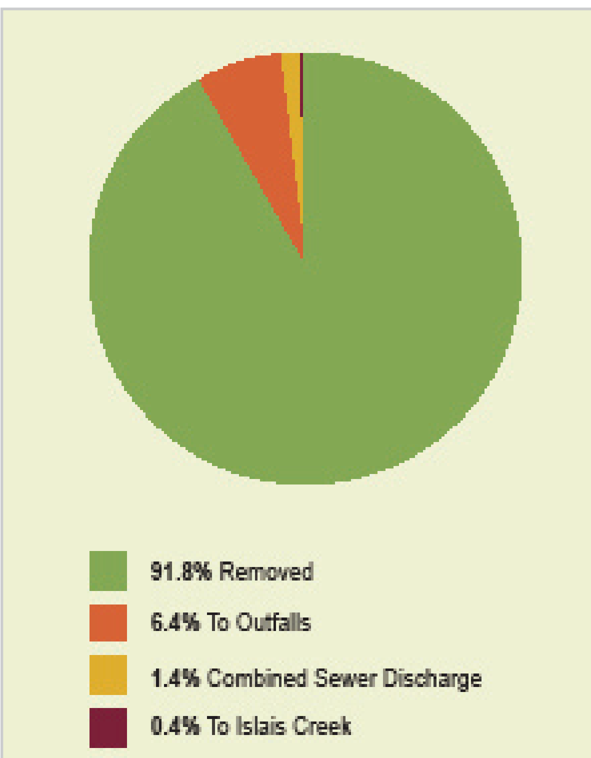


Figure 3-28. Annual System Performance for Effluent Total Suspended Solids

metals data were also compiled and are summarized in **Appendix** L.

3.3.4 Treatment Facility System Performance

Figure 3-27 shows the levels of treatment delivered by the sewer system between 1998 and 2006. Of an estimated total waste-water flow of over 40 billion gallons per year, approximately 34 billion gallons per year receives full secondary treatment, 4.5 billion gallons per year receives primary or decant treatment and is discharged to deepwater outfalls, and 1.8 billion per year receives primary or decant treatment and is discharged through nearshore outfalls. **Figure** 3-28 shows the fractions of TSS removal and discharge for the same time period. Of the total influent TSS load, nearly 92% is removed through the wastewater treatment system, 6.4% is discharged to deep ocean outfalls and 1.8% is discharged to the nearshore region.

3.3.4.1 Southeast Water Pollution Control Plant Performance

The SEP received National Association of Clean Water Act Gold[9] awards in 2003 and 2006. For seven of the past 11 years, the SEP has received National Association of Clean Water Act Silver[10] awards.

Performance Data

Table 3-15 on page 3-42 summarizes the 2007 average annual final effluent concentrations of TSS, BOD_5, pH, and oil and grease. With few exceptions, the SEP effluent has been in compliance with the secondary treatment discharge requirements during both dry and wet weather. **Table** 3-16 on page 3-42 summarizes the unit process performance data from 2005 and 2006.

9 100% compliance with the NPDES permit for an entire calendar year.
10 No more than five NPDES permit violations per calendar year.

Biosolids Characteristics

The SEP produces between 10,000 and 15,000 dry tons of mesophilically digested Class B biosolids each year. Pertinent biosolids characteristics, including solids concentrations, metals concentrations, pathogen densities, and vector attraction reduction data are reported to the U.S. Environmental Protection Agency (U.S. EPA) each year in the Biosolids Annual Report. Biosolids characteristics from the 2006 Biosolids Annual Report follow. Further details are in **Appendix** N.

The SEP biosolids total dry solids concentrations averaged 22.6% during 2006. In **Table** 3-17, the 2006 average metal concentrations are shown and compared with the most stringent limits outlined in NPDES 40 CFR 503.13 (U.S. Environmental Protection Agency, 2009). The biosolids produced at the SEP have metals concentrations well below these limits.

Table 3-15. SEP Final Effluent Data for 2007

Parameter	Average	High Weekly Average	Daily Maximum
TSS (mg/L)	<14	<19	38
BOD_5 (mg/L)	12	35	35
pH	7.0	6.0	8.0
Oil and Grease (mg/L)	<5	<5	<5

Table 3-16. SEP Average Biosolids Metal Concentrations for 2006

Metals	SEP 2006 Average (mg/kg)	Pollutant Concentration Limit (mg/kg)	Meets Compliance
Arsenic	<4.0	41	Yes
Cadmium	<2.6	39	Yes
Copper	620.2	1500	Yes
Lead	116.0	300	Yes
Mercury	1.4	17	Yes
Nickel	36.4	420	Yes
Selenium	6.1	100	Yes
Zinc	1,127.0	2,800	Yes

Notes: Milligrams per kilogram, dry weight basis - mg/kg

SEP biosolids consistently meets all U.S. EPA requirements to qualify as Class B. The pathogen density requirements (40 CFR 503.32(b)(3)) are met at the SEP by maintaining anaerobic digestion detention times of greater than 15 days and digestion temperatures above 95°F. The "time and temperature" methodology is used year round to demonstrate Class B compliance. During the land application season, cake samples are also analyzed twice per week for fecal coliform densities. The vector attraction reduction requirements (40 CFR 503.33(b)(1)) are met by demonstrating a reduction in volatile solids concentration of 38% or greater in the anaerobic digestion process (U.S. Environmental Protection Agency, 1999).

Biosolids Reuse

San Francisco produces 12,000 to 19,000 dry tons of mesophilically digested Class B biosolids each year. Approximately 70% of this total is produced at the SEP. San Francisco has beneficially reused all of the biosolids produced in recent years. The biosolids are transported to Alameda, Contra Costa, Merced, Solano, and Sonoma counties for agricultural land application, use as landfill alternate daily cover, or other landfill beneficial use. Agricultural land application occurs primarily during the months of April through October each year; application dates are legislated in Solano and Sonoma counties, and the ability to land apply is strictly weather-related in Merced County. Biosolids are primarily used for landfill beneficial reuse (as a substitute for soil on the landfill site) during the wet season, when land application is not permitted due to wet-field conditions. During the dry season, land application sites are used as much as possible, and any excess material is sent to landfills for use as alternate daily cover.

Table 3-17. SEP Process Performance for Dry- and Wet-Weather for 2005 and 2006				
Facility	Parameter	Unit	Average Values	
			Dry Weather	Wet Weather
Primary Effluent				
Overall Performance	TSS Removal	%	62	61
	COD Removal	%	40	41
	Primary Effluent TSS	mg/L	134	108
	Primary Effluent COD	mg/L	396	273
	Primary Sludge TS	%	5	5
	Primary Sludge Production	1,000 lb TS/ day	78	92
Secondary Effluent				
Overall Performance	Final Effluent TSS	mg/L	18	19
	Final Effluent COD	mg/L	56	52
	TSS Removal	%	94	91
	COD Removal	%	90	86
Disinfection				
Secondary Effluent Disinfection	Hypochlorite Dose	mg/L	5	4
	Bisulfite Dose	mg/L	3	4
Primary Effluent Disinfection	Hypochlorite Dose	mg/L	NA	5-7
	Bisulfite Dose	mg/L	NA	3-4
Bay Outfall Discharge	Fecal Coliform	CFU/100 mL	34	36
Islais Creek Discharge	Fecal Coliform	CFU/100 mL	NA	34
Anaerobic Digestion				
Overall Performance	Digested Sludge TS	%	2	2
	Digested Sludge VS/TS	%	67	68
	VS Reduction	%	53	54
	Biogas Production	1,000 ft^3/day	1316	1231
Dewatering				
Horizontal Bowl Centrifuges	Ferric Chloride Dose	lb/ton TS	126	128
	Polymer Dose	lb/ton TS	16	15
	Cake TS	%	22	23
	Solids Capture	%	94	95
	Cake Production (wet)	tons/day	163	167
	Cake Production (dry)	tons/day	41	46

Notes: Chemical Oxygen Demand - COD; Total Solids - TS; Total Suspended Solids - TSS; Volatile Solids - VS

Table 3-18. San Francisco Biosolids Management Summary for 2005 and 2006

County	Site	Beneficial Use	2005 Tons (wet weight)	2005 Percent of Total	2006 Tons (wet weight)	2006 Percent of Total
Alameda	Vasco Road Landfill	ADC	175	0.2	2,836	3.49
Contra Costa	Western Contra Costa County Landfill	ADC	9,668	11.6	2,725	3.35
Merced	Solid Solutions Land Application	Land application	0	0	581	0.72
	Synagro Central Valley Compost Facility	Class A compost	0	0	484	0.60
Solano	Hay Road Landfill	Beneficial landfill reuse	43,260	52.1	45,937	56.55
	Potrero Hills Landfill	ADC	4,243	5.1	4,546	5.60
	Synagro	Land application	19,204	23.1	15,473	19.05
Sonoma	Synagro	Land application	6,564	7.9	8,647	10.65
Totals			**83,114**	**100**	**81,228**	**100**

Table 3-18 provides a summary of biosolids management practices in 2005 and 2006. In addition, 2006 was the first year where, in an effort to diversify the biosolids reuse program, San Francisco began transporting small (pilot) quantities of biosolids to Merced County land application and composting sites. Current hauling and tipping fees for the different reuse locations are listed in Appendix N.

3.3.4.2 North Point Wet-Weather Facility Performance

Average wet-weather flows can vary significantly with the type of storm event. NPF wet-weather influent flows from 1998 to 2002 ranged from 54 to 63 mgd. The NPF process performance analysis was based on the 5-year daily average NPF data from July 2001 through June 2006 (Table 3-19). NPF effluent has been in compliance with NPDES discharge permit requirements at least 99% of the time.

3.3.4.3 Oceanside Water Pollution Control Plant Performance

The OSP has had a spectacular record in meeting dry- and wet-weather effluent discharge standards. The plant was recently awarded the NACWA Platinum 12 award for 12 straight years of fully complying with all NPDES requirements.

Performance Data

Table 3-20 summarizes the 2007 final average annual TSS, BOD_5, pH, and oil and grease concentrations. The 5-year average dry- and wet-weather unit process performance data (2000 to 2004) are summarized in Table 3-21 on page 3-46. Average removal rates for dry- and wet-weather secondary effluent TSS ranged from 85% to 94%, while BOD_5 removal ranged from 87% to 93%.

Biosolids Characteristics

The OSP produces between 2,000 and 4,000 dry tons of mesophilically digested Class B biosolids each year. Recent biosolids characteristics, as presented in the 2006 Biosolids Annual Report, follow. Further details are in Appendix N.

The OSP biosolids dry total solids concentrations averaged 15% during 2006. The biosolids produced at the OSP have low

Table 3-19. NPF Wet-Weather Primary Effluent Data for 2001 to 2006

Parameter	Average Value	Maximum Value
Total Hours in Service Per Year	448.8	623
Number of Events Per Year	36	56
TSS (mg/L)	31	63
COD (mg/L)	140	249
Oil and Grease (mg/L)	10	17

metals concentrations (Table 3-22 on page 3-47).

OSP biosolids consistently meet all U.S. EPA Class B requirements. The pathogen density requirements (40 CFR 503.32(b)(3)) are met at the OSP by maintaining anaerobic digestion detention times of greater than 15 days and digestion temperatures above 95°F. During the land application season, cake samples are analyzed for fecal coliform densities twice per week. The vector attraction reduction requirements (40 CFR 503.33(b)(1)) are met by demonstrating a reduction in volatile solids concentration of 38% or greater in the anaerobic digestion process (U.S. Environmental Protection Agency, 2009).

Biosolids Reuse

Approximately 30% of the total 12,000 to 19,000 dry tons Class B biosolids generated each year in the city is produced at the OSP. Reuse applications were described in detail in Section 3.3.4.1.

3.3.4.4 Odors

Southeast Water Pollution Control Plant

The current SEP odor control facilities (BCM Joint Venture, 2009c) reduce plant-generated odors using the following methods:

- Chemical addition to the influent flow and to the digester sludge feed to precipitate H_2S and other sulfur compounds

Table 3-20. OSP Final Effluent Data for 2007

Parameter	Average	Monthly Minimum	Monthly Maximum
TSS (mg/L)	14	4	73
BOD_5 (mg/L)	<16	<5	57
pH	5.7	-	7.3
Oil and Grease (mg/L)	<5	<5	<5

Notes: Biological Oxygen Demand - BOD_5; Total Suspended Solids - TSS

- "Cover, vent, and treat" methods for handling odorous air streams on various process units. Treatment methods are carbon adsorption units and wet scrubbers
- Covering process units and structures (e.g., mixed liquor channels, wet well, and digester overflow boxes) in order to contain odorous air streams
- Adherence to standard operating and maintenance procedures such as tank filling, draining, flushing, and routine digester gas handling equipment maintenance to eliminate sources of odor

Despite all of these efforts, odor is still released to the neighborhood (Chapter 4, Section 4.2.1.3). In some cases, such as the floating covers of the digesters, the odor problems can only be mitigated by the replacement of outdated technology. In other cases, additional funding is needed to implement odor control improvements.

Plant and surrounding perimeter odor surveys are conducted weekly. Subjective odor intensity is also recorded during monitoring (San Francisco Public Utilities Commission, 2003).

Oceanside Water Pollution Control Plant

Odor control at the OSP depends primarily on containment and adsorption of odorous compounds on activated carbon and potassium permanganate-impregnated aluminum oxide in specially designed vessels.

Table 3-21. OSP Process Performance for Dry- and Wet-Weather for 2000 to 2004				
Facility	Parameter	Unit	Average Values	
			Dry Weather	Wet Weather
Primary Effluent				
Overall Performance	TSS Removal	%	64	55
	COD Removal	%	35	31
	Primary Effluent TSS	mg/L	101	95
	Primary Effluent COD	mg/L	363	264
	Primary Sludge TS	%	2.9	3.1
	Primary Sludge Production	1000 lb TS/day	33.2	34.6
Secondary Effluent				
Overall Performance	Final Effluent TSS	mg/L	15	21
	Final Effluent COD	mg/L	59	55
	TSS Removal	%	94	85
	COD Removal	%	89	83
Anaerobic Digesters				
Overall Performance	Digested Sludge TS	%	2.3	2.4
	Digested Sludge VS	%	65	62
	VS Reduction	%	65	58
	Biogas Production	1,000 ft^3/day	270	268
Biogas Handling				
Biogas	Total Biogas Production	MBTU/day	278	275
	Natural Gas Usage	1,000 scf/day	67	87
	Biogas Usage	1,000 scf/day	197	211
	Biogas Flared	1,000 scf/day	83	52
Dewatering				
Belt Presses	Polymer Dose	lb/ton TS	16.7	15.8
	Cake TS	%	15.3	16.8
	Solids Capture	%	99	99
	Cake Production (wet)	tons/day	64	64
	Cake Production (dry)	tons/day	11	11
Total Chemical Consumption				
Polymer	-	lbs/day	168	173
Ferric Chloride	-	lbs/day	340	400
Hypochlorite (as Cl_2)	-	lbs/day	71	70

Notes: Chemical Oxygen Demand - COD; Total Solids - TS; Total Suspended Solids - TSS; Volatile Solids - VS

Table 3-22. OSP Average Biosolids Metal Concentrations for 2006			
Metals	**2006 Average Concentration** (mg/kg)	**Pollutant Concentration Limit** (mg/kg)	**Meets Compliance**
Arsenic	5.0	41	Yes
Cadmium	2.5	39	Yes
Copper	499	1,500	Yes
Lead	85	300	Yes
Mercury	1.7	17	Yes
Nickel	31	420	Yes
Selenium	6.3	100	Yes
Zinc	1,238	2,800	Yes

Notes: Milligrams per kilogram, dry weight basis - mg/kg

Plant and surrounding perimeter odor surveys are conducted weekly. Subjective odor intensity is also recorded during monitoring (San Francisco Public Utilities Commission, 2003). No odors have been detected beyond the perimeter of the plant during routine monitoring.

3.3.5 Collection System Performance

3.3.5.1 Combined Sewer Discharge Structures

Bayside Combined Sewer Discharge Data

Rainfall, CSD volume, and CSD events for the 10 wet-weather seasons from 1998 and 2008 are summarized in **Table** 3-23 on page 3-48. CSD durations were recorded at each discharge point, and discharge volumes were estimated using rainfall, runoff, and facility operating data. Volumes are not measured at individual discharge locations. For this 10-year period, the discharge frequencies in the Central and South basins slightly exceeded the system design targets, while the discharge frequencies in the North Shore area are significantly below the design target.

Westside Combined Sewer Discharge Data

Rainfall, CSD volume, and CSD event data for wet-weather seasons between 1998 to 2008 are summarized in **Table** 3-24 on page 3-48. The height of water above the CSD weirs are recorded for the duration of each event at the three discharge points, and the CSD volumes are estimated using hydraulic formulae. Estimates based on hydraulic formulae were used for the other discharge points. The average CSD frequency for this 10-year period met the design target of eight discharges per year.

3.3.5.2 Odors

Odor Control

Most sewer odors in the City's sewer system are caused by hydrogen sulfide gas (H_2S). Other compounds such as amines, ammonia, and mercaptans may also cause odors. Some areas of the existing sewer system have features that can lead to conditions that encourage production and release of odor. The transfer of the odor to the street level is due to natural displacement of the air from the sewer. Sewers have manhole covers and other vents, which prevent a buildup of odorous, corrosive, and potentially dangerous gases inside the sewer by venting them to the atmosphere.

Table 3-23. Bayside System Combined Sewer Discharges and Rainfall Data					
Wet-Weather Season	Rainfall (inches)	Estimated CSD Volume (MG)	Number of CSD Events		
			North Shore	Central Basin	South Basin
1998 – 1999	17.0	2,082	1	13	0
1999 – 2000	20.9	1,807	3	12	1
2000 – 2001	15.8	977	0	8	0
2001 – 2002	19.3	1,676	2	9	2
2002 – 2003	21.1	1,001	3	14	4
2003 – 2004	16.9	785	4	8	2
2004 – 2005	28.2	NA	4	15	1
2005 – 2006	28.9	431	3	16	2
2006 – 2007	15.1	275	1	5	1
2007 – 2008	17.4	805	3	7	2
Average	**18.8**	**1,093**	**2**	**11**	**2**
Design Target			**4**	**10**	**1**

Table 3-24. Westside System Combined Sewer Discharges and Rainfall Data				
Wet-Weather Season	Rainfall (inches)	Southwest Ocean Outfall Decant Volume (MG)	Estimated CSD Volume (MG)	Number of CSD Events
1998 – 1999	17.0	1,100	226	7
1999 – 2000	20.9	1,118	380	7
2000 – 2001	15.8	801	30.8	3
2001 – 2002	19.3	1,178	614	7
2002 – 2003	22.3	973	597	10
2003 – 2004	18.8	760	577	8
2004 – 2005	24.5	1,469	NA	12
2005 – 2006	31.8	1,550	265	12
2006 – 2007	14.8	563	89	3
2007 – 2008	18.4	718	276	4
Average	**20.8**	**1,023**	**367**	**7**
Design Target				**8**

Various methods of odor remediation are currently used. These include chemical addition to the sewers, preventative maintenance, operational procedures, and ventilation. The WWE maintains a number of chemical injection systems at problem areas to control odors. Sewer operations perform sewer system preventative maintenance including odor surveys, sewer inspections, routine cleaning of traps and catch basins, tree root removal, and grease control. Operational procedures that decrease odors include pumping down the collection system to lower detention times and flushing sewers with secondary effluent. The operational practice of flow equalization increases collection system odor potential (BCM Joint Venture, 2009d).

The City has established a special 24-hour odor complaint hotline to receive odor complaints concerning the collection system. Sewer operations crews respond to each call and investigate every complaint within 48 hours. Odor complaints may be resolved by cleaning catch basins, repairing odor traps, flushing sewer lines, replacing sewer lines, installing manhole vent inserts, and adding chemicals. These proactive odor control efforts have resulted in the reduction of collection system odor complaints from 365 in 2001 to 128 in 2006 (Chapter 4, **Section** 4.1.4.2) (BCM Joint Venture, 2009d).

Grease Control

When sewers clog with grease, odors can result from both the decomposing grease and from the fermentation of the backed-up stagnant wastewater. The WWE Collection System Division enforces a Fats, Oil, and Grease (FOG) Program with the objective of reducing or eliminating the discharge of FOG to the City's sewer system. This is accomplished through pollution prevention efforts, as well as through traditional control mechanisms (inspection, monitoring, permitting, and enforcement). The San Francisco FOG Program comprises four major integrated components designed to reduce grease impacts to the sewer system including:

- Public education and outreach
- FOG quantification (includes hot spot characterization, source characterization, food service establishment characterization, and database and GIS integration)
- Kitchen best management practices
- Monitoring and enforcement

Monitoring and inspection procedures screen approximately 2,800 licensed food service establishments. Inspections concentrate on kitchen best management practices, employee education, waste hauling, and record keeping. An assessment is performed after the inspections are complete to give priority to those businesses that are more likely to contribute to FOG problems. The criteria employed for the assessment include:

- Trap interceptor in place
- Cleaning frequency of traps/interceptors
- Customers served per day
- Water consumption
- Proximity of grease container to cooking area
- SFPUC sewer operations grease complaints over the last two years
- FOG best management practices awareness of managers and employees

Under the San Francisco FOG Program, all restaurants are required to either employ a set of FOG best management practices, or apply for an exemption from the FOG Program. All businesses, including food service establishments, must comply with the local discharge limit of 300 mg/L total oil and grease. Any business exceeding this concentration is referred to the Source Control Enforcement Section, where further enforcement steps are taken. Depending on the severity of the violation, enforcement may include: Notice of Warning, Notice of Violation, Cease and Desist Order, Show Cause Hearing, Clean-up and Abatement Order, Civil Administrative Penalties, or Termination of Discharge. Typically, a San Francisco business found to be in violation

Table 3-25. Current Chemical Injection Points throughout San Francisco

Location	Chemical
North Shore Pump Station	Hypochlorite
North Point Street and Columbus Avenue	Ferrous chloride
Green Street and Embarcadero	Ferrous chloride
Freelon and Fourth Streets	Hydrogen peroxide
Berry and Fourth Streets	Hypochlorite and hydrogen peroxide
Berry and Sixth Streets	Hypochlorite and hydrogen peroxide
Southeast Water Pollution Control Plant Headworks	Hypochlorite and hydrogen peroxide
Griffith Pump Station	Ferrous chloride
17th Avenue and Lake Street	Hypochlorite

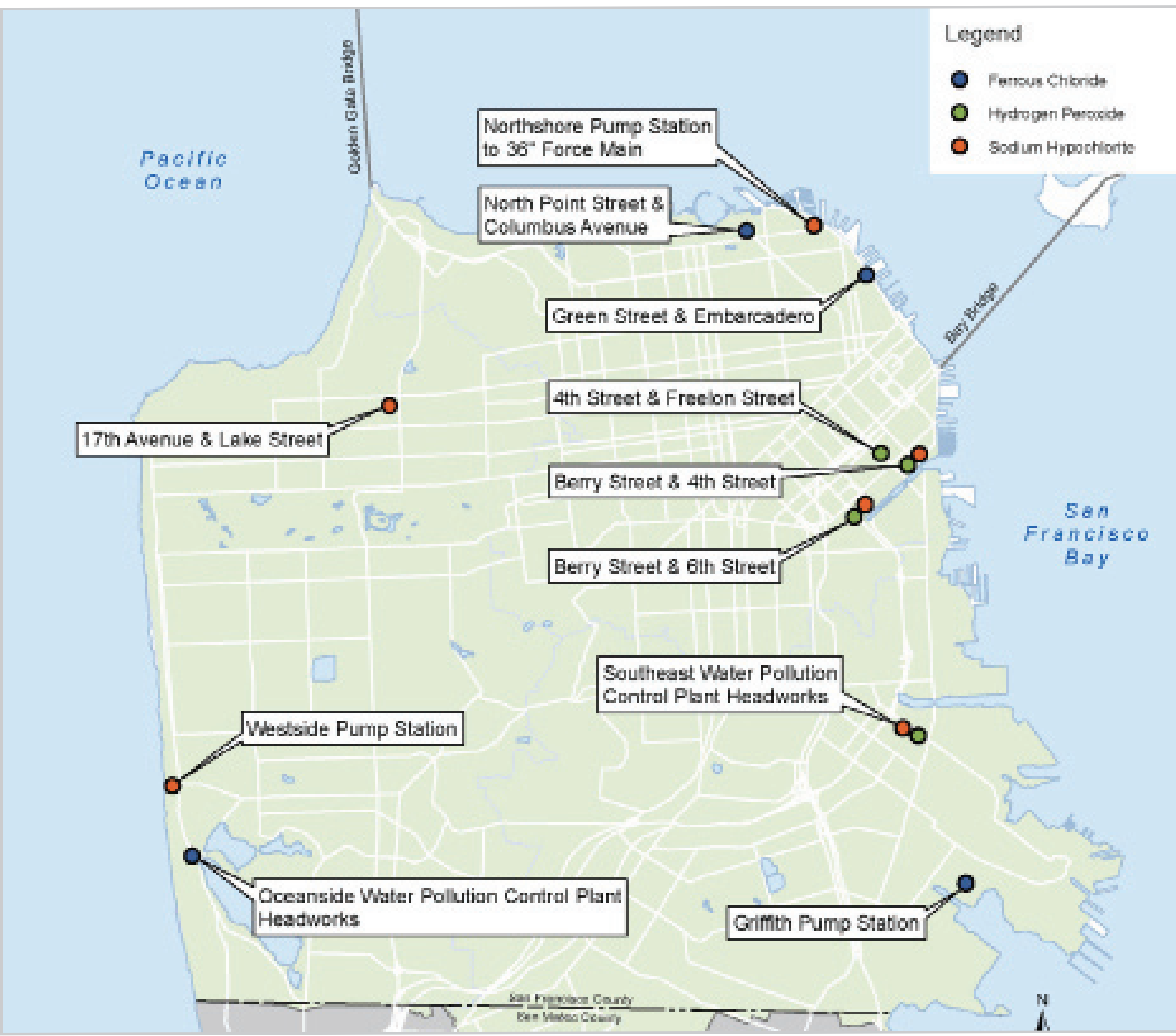


Figure 3-29. Chemical Injection Points for the Sewer System

of the Sewer Use Ordinance (including the FOG ordinance) will work closely with the WWE Collection System Division to seek the remedy that has the least adverse impact on both the business and the collection system.

Chemical Addition to Sewage

The City has an extensive chemical addition program for odor control. The chemicals injected include ferrous/ferric chloride ($FeCl_2$/$FeCl_3$), hydrogen peroxide (H_2O_2), and NaOCl. Selection of the most appropriate chemical is site specific. Although the City has relied on the use of NaOCl for sewer applications, in recent years the use of H_2O_2 and iron salts has increased. Extensive pilot studies performed in The Embarcadero sewers indicated that the combined use of H_2O_2 and iron salts provides more effective odor control than NaOCl in the collection system during the dry-weather season. Table 3-25 on page 3-50 provides the type of chemical that is used at each location. Figure 3-29 on page 3-50 illustrates the location of the chemical injection points.

Odor Traps and Manhole Inserts

Standard catch basin design includes an odor trap that retains foul air from the side sewers in the collection system to minimize localized nuisance odors. Manhole inserts are also an effective method of controlling odors and can be a rapid solution to localized odor complaints. While sixty inserts have been installed, their overall effectiveness for the odor control program is doubtful, because of the short media life and the requirement for frequent media replacement.

Vent Stacks

In 2007, tall vent stacks (15 feet) were installed over 10 Embarcadero manholes identified with odor problems (Figure 3-30). When wind blows across the top of the elevated vent stack, a negative pressure is created that dissipates sewer odors into the air from the top of the vent. Ground level odor is reduced significantly.

Figure 3-30. Vent Stack on The Embarcadero

Sewer Cleaning and Repair

Whenever wastewater velocities are reduced in sewers (e.g., flat slopes, low flow volumes, construction debris, or soil settlements), the sewers tend to accumulate debris and grit. This increases the potential for collection system odors. Many contracts have been awarded to private independent contractors for the removal of the accumulated grease, debris, and grit from sewers and completing minor structural modifications. A proactive street cleaning program removes debris from streets before it accumulates in either the collection system and is transported to the treatment plants or is discharged to the bay or ocean during CSD events.

References

BCM Joint Venture. SSMP Technical Memorandum, *Regulatory Considerations for Bayside Discharges*. 2009a.

BCM Joint Venture. SSMP Technical Memorandum, *Regulatory Considerations for Oceanside Discharges*. 2009b.

BCM Joint Venture. SSMP Technical Memorandum, *Odor Control for Treatment Facilities*. 2009c.

BCM Joint Venture. SSMP Technical Memorandum, *Odor Control for Collection System*. 2009d.

Metcalf and Eddy, Inc., Tchobonoglous, G., Burton, F., Stensel H. *Wastewater Engineering, Treatment and Use.* McGraw Hill. 2003.

RMC Water and Environment. *Draft Recycled Water Master Plan*. Prepared for the San Francisco Public Utilities Commission. 2006.

San Francisco Department of Public Works. S*ewer System Evaluation for Infiltration/Inflow, Phase I, North Point District.* 1974a.

San Francisco Department of Public Works. *Sewer System Evaluation for Infiltration/Inflow, Phase I, Richmond-Sunset District.* 1974b.

San Francisco Public Utilities Commission. *Baseline Facilities Report, Wastewater System Reliability Assessment*. Prepared by the Wastewater Enterprise. 2003.

San Francisco Public Utilities Commission. *Storm Water Management Plan, 2003-2004*. Prepared for the City and County of San Francisco. 2004.

U.S. Environmental Protection Agency. *Control of Pathogens and Vector Attraction in Sewage Sludge*. Office of Research and Development. EPA 625-R-92-013. 1999.

U.S. Environmental Protection Agency. *National Pollutant Discharge Elimination System Regulations*. http://epa.gov. 2009.