RECYCLED WATER SUPPLIES

This chapter presents a discussion of the West Basin Municipal Water District (West Basin) recycled water supplies. West Basin's historical overall supplies are presented first, followed by a discussion on the supplies of each type of recycled water usage. The projected recycled water supply requirements are described at the end of the chapter.

4.1 HISTORICAL AND EXISTING SUPPLIES

The City of Los Angeles' Hyperion Wastewater Treatment Plant (HWWTP), located at the southeast corner of Vista Del Mar and Imperial Highway, is currently the sole source of supply for the West Basin's treatment facilities and recycled water distribution systems.

4.1.1 Hyperion Wastewater Treatment Plant Supplies

The HWWTP treats sewage from approximately 4 million residents, serving about two-thirds of the City of Los Angeles (CLA 2009) and many other cities in Los Angeles County.

According to the Hyperion Secondary Effluent Pump Station Feasibility Study (CDM 2004), the HWWTP has the following design flows:

- Minimum flow of 160 million gallons per day (mgd)
- Maximum monthly flow of 550 mgd

According to flow records provided by the City of Los Angeles, secondary effluent flows from the HWWTP averaged 330 mgd for the year 2007, with a minimum monthly flow of 299 mgd and a maximum monthly flow of 471 mgd. The minimum hourly flow for the same time-period was about 95,800 gpm (equivalent to 138 mgd).

The HWWTP treats wastewater from two separate sources, with distinctive water quality characteristics:

- Coastal sewers having higher total dissolved solids (TDS)
- Inland sewers having lower TDS

While the feasibility study (CDM 2004) did not explicitly state the ranges of TDS concentrations in each source, it did conclude that the secondary effluent with higher TDS levels could not be used as a recycled water supply source for treatment by West Basin without additional treatment at the Edward C. Little Water Recycling Facility (ELWRF).

The treatment processes at the HWWTP have been designed to maintain independent treatment of the two distinct sources between the headworks to the clarifiers. In general, the south reactors and clarifiers receive the higher quality (lower TDS) water, constituting about 75 percent of the total plant flow. The average TDS in this water is approximately 900 mg/L.

To reduce treatment costs, the majority of water pumped into the West Basin system through the Hyperion Secondary Effluent Pumping Station (HSEPS) consists of this lower TDS water. However, as demands increase a greater proportion of higher TDS water could be conveyed to West Basin, which could have significant impacts to recycled water quality and costs. West Basin bears the costs associated with removing any excess TDS and other constituents from the pumped secondary effluent (SE) required to meet the water quality needs of their customers.

An effluent channel near the southeast corner of the HWWTP site collects the SE from the clarifiers that are a part of the lower TDS process train. This lower TDS effluent channel merges with another effluent channel that collects the SE from clarifiers that are a part of both the lower and higher TDS process trains, before reaching the HWWTP outfall. The slope of both of these effluent channels is flat, allowing for flow in two directions. The HSEPS currently pulls source water from the lower TDS effluent channel, but future growth in supply requirements may require flows from the higher TDS effluent channel. The Hyperion Secondary Effluent Pump Station Feasibility Study (CDM 2004) explored several alternatives for accessing flows in the second channel while maintaining supply only from Hyperion's lower TDS process train.

4.1.2 Historical Flows

In 2007, West Basin received on average of 32.4 mgd or 36,300 acre-feet per year (afy) of SE, with a maximum day supply of 40.5 mgd. During 2008, the average day SE supply was 32.7 mgd, with a maximum day supply of 41.8 mgd on September 6, 2008. This represents a seasonal supply variation of approximately 1.3, which is similar to the seasonal demand factor of 1.4 presented in Table 3.2. It should be noted that the historical supplies exceed the historical demands due to system losses during treatment and conveyance.

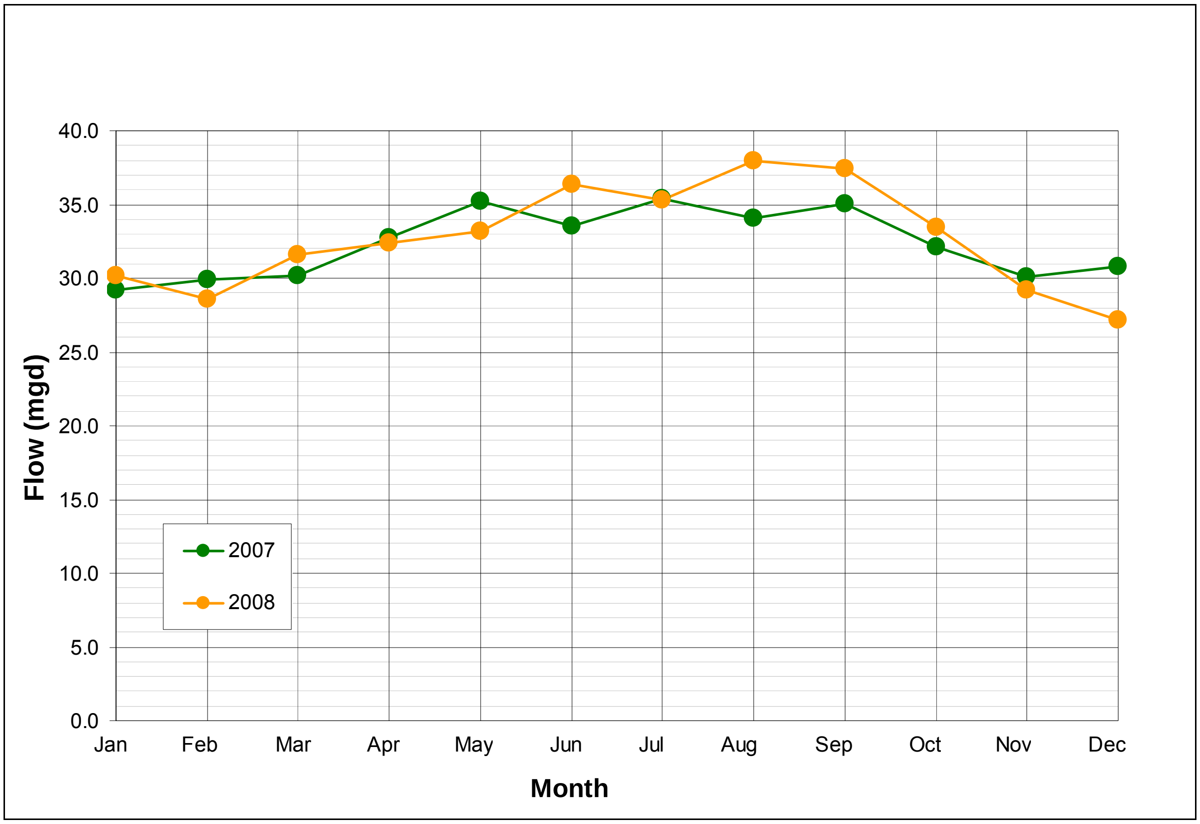
4.1.3 Monthly Peaking

The monthly variation in supplies observed between during 2007 and 2008 is presented on Figure 4.1. As expected due to the additional irrigation demand discussed in Chapter 3, supplies are higher during the summer months.

As shown on Figure 4.1, the maximum supply flows during 2007 occurred in July, averaging 35.4 mgd. The demand data for the same time period showed a customer demand of 28.6 mgd, resulting in an overall 81 percent recovery ratio. This ratio accounts for water loss in the distribution system as well as process waste and indicates that the required supply is equal to approximately 1.23 times the system demand.

An 81 percent recovery ratio may indicate that there is some unaccounted for water. This study identified some discrepancies in the flow measurement capacity in the Title 22 distribution system. However, for the supply planning in this study it is assumed that the future supply required equals 125 percent of the future demand to account for treatment and distribution system losses.

Figure 4.1
Seasonal Variation in Supplies



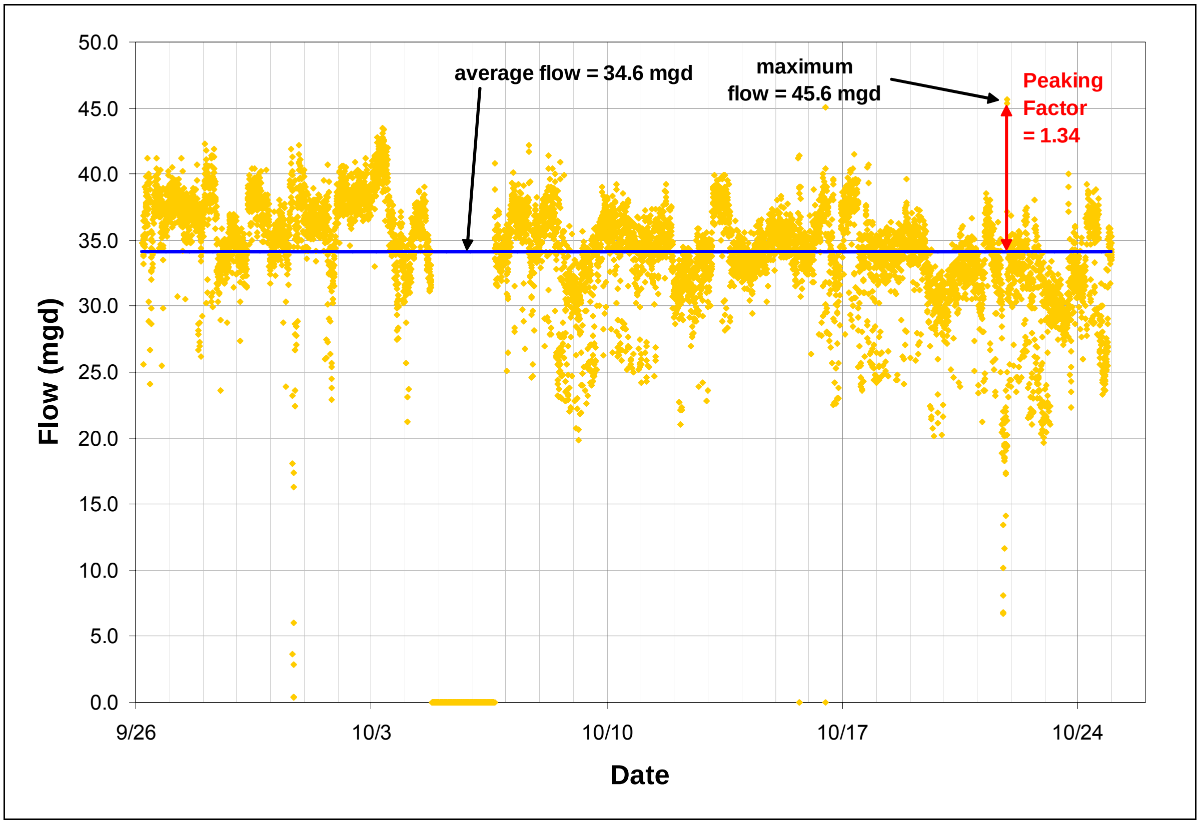
The actual maximum day demand (MDD) observed in supply flows during the calendar year 2007 occurred on May 9, 2007 with a total flow of 40.5 mgd, resulting in a daily supply seasonal peaking factor of 1.25.

4.1.4 Daily Peaking

Since detailed Distributed Control System (DCS) data (hourly time intervals or smaller) was not available for an entire year, daily peaking of supply sources was examined using the calibration data gathered in five-minute intervals between September 26, 2008, and October 24, 2008. Figure 4.2 presents the flow through the HSEPS over the calibration period in five-minute intervals.

The peak flow observed from HSEPS during the calibration period was 31,694 gpm (equivalent to 45.6 mgd) at 4:10 pm on October 21, 2008. Using the average flow for the entire calibration period, of 34.6 mgd, a peaking factor of 1.34 was calculated. However, using the average flow on October 21, 2008 (31.0 mgd or 21,540 gpm), a daily supply peaking factor of 1.47 was calculated.

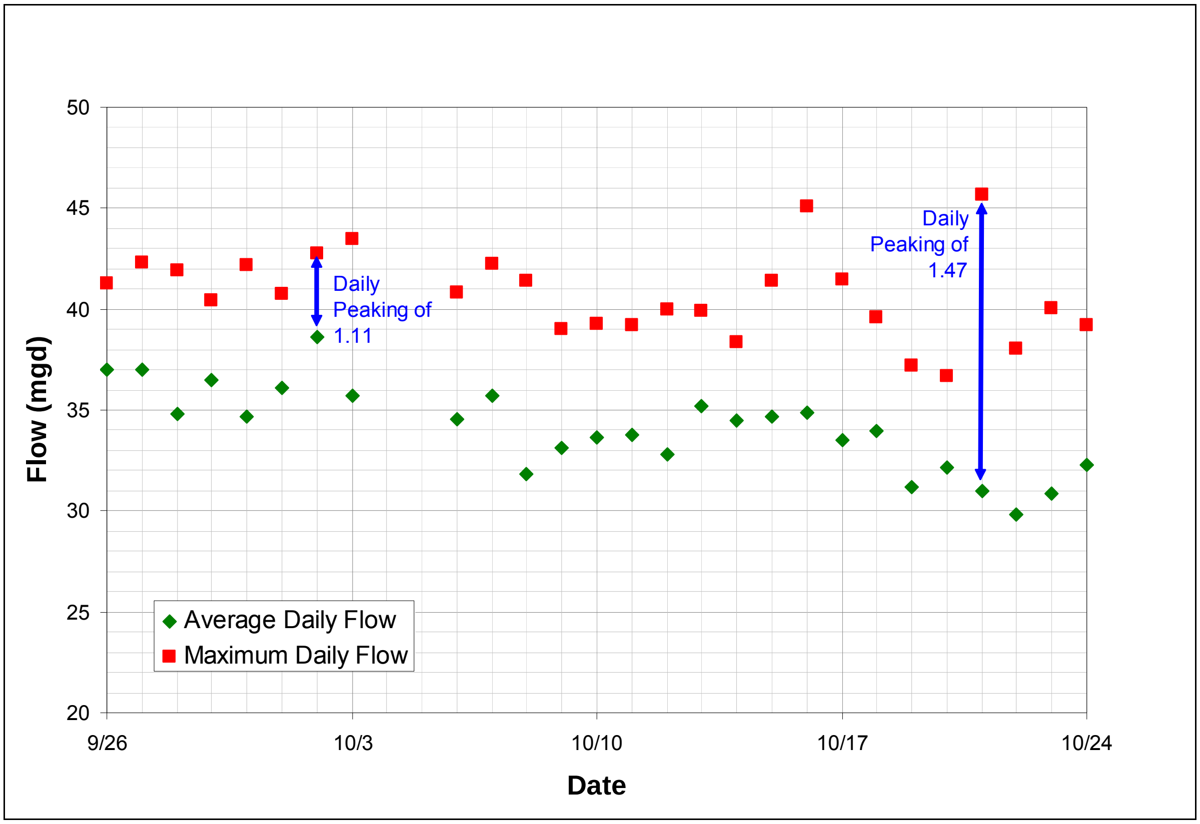
Figure 4.2
Variation in Hyperion Supplies



As shown on Figure 4.3, the ratio of peak daily flow to average daily flow varies significantly from day to day. During the calibration period, daily peaking was observed between 1.11 and 1.47.

West Basin does not currently operate any source equalization facilities to accommodate daily peaking in source supplies. Flow equalization storage is not currently necessary due to the significantly larger source of supply available at the HWWTP compared to the existing demands. Even the minimum flows observed in daily flow patterns at the HWWTP (138 mgd) currently exceed West Basin's firm pumping capacity of 51 mgd at the HSEPS. If demand for the Hyperion SE by West Basin and/or other agencies increases significantly in the future, flow equalization storage facilities may have to be considered to meet the future recycled water demands.

Figure 4.3
Peak Daily Flows in Hyperion Supplies



4.1.5 Source Water Quality

The supply from the HSEPS is continuously monitored for pH and turbidity and sampled daily for suspended solids, twice weekly for TOC, and weekly for carbonaceous biochemical oxygen demand (CBOD). Table 4.1 presents average, maximum, and minimum results for each of these constituents for calendar year 2007.

Ranges for suspended solids, pH, and CBOD shown in Table 4.1 all fall well within federal limits for SE. While the water quality data shown in Table 4.1 is from 2007, West Basin has monitored additional feedwater quality to ELWRF for several years. Figures 4.4 through 4.6 show the yearly average values for conductivity, hardness and alkalinity, and sodium, chloride and sulfate for the period 2001 through 2008.

Table 4.1 HWWTP Effluent Water Quality
Capital Implementation Master Plan
West Basin Municipal Water District

Constituent	Units	Average	Maximum	Minimum	National Standards for Secondary Effluent
Suspended Solids	mg/L	9.87	20.00	3.00	30
Turbidity	NTU	6.97	16.04	0.98	N/A
pH	PH	6.90	8.50	6.50	6.0 – 9.0
CBOD	mg/L	9.35	11.00	8.00	25
TOC	mg/L	12	13	11	N/A
Conductivity	µmho/cm	1,495	1,620	1,340	N/A
Alkalinity	mg/L (as $CaCO_3$)	235	287	169	N/A
Sulfate	mg/L	215	336	138	N/A
Chloride	mg/L	148	156	116	N/A
Calcium	mg/L	44	50	40	N/A
Magnesium	mg/L	25	28	22.5	N/A
Hardness	mg/L (as $CaCO_3$)	211	237	199	N/A
Sodium	mg/L	132	145	111	N/A
Silica	mg/L	21	23	19	N/A

From Figures 4.4 and 4.5, there appears to be an increasing trend in conductivity, as well as hardness and alkalinity. The implication of these trends is discussed in Chapter 8, Future System Analysis.

4.2 EXISTING TREATMENT FACILITIES

West Basin owns the following four treatment facilities:

- Edward C. Little Water Recycling Facility (ELWRF)
- Carson Regional Water Recycling Facility (CRWRF)
- Chevron Nitrification Facility (CNF)
- ExxonMobil Water Recycling Facility (EMWRF)

The locations of these facilities are shown on Figure 4.7.

Figure 4.4
Conductivity Trend 2001 - 2008

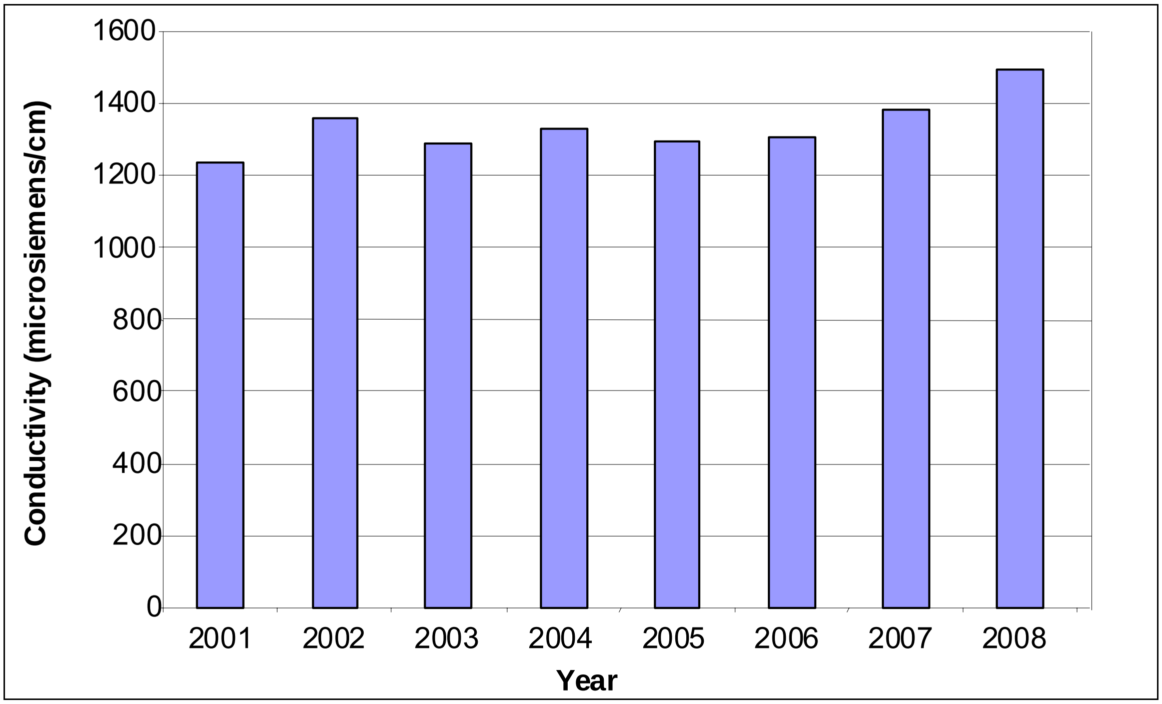


Figure 4.5
Hardness and Alkalinity Trends 2001 - 2008

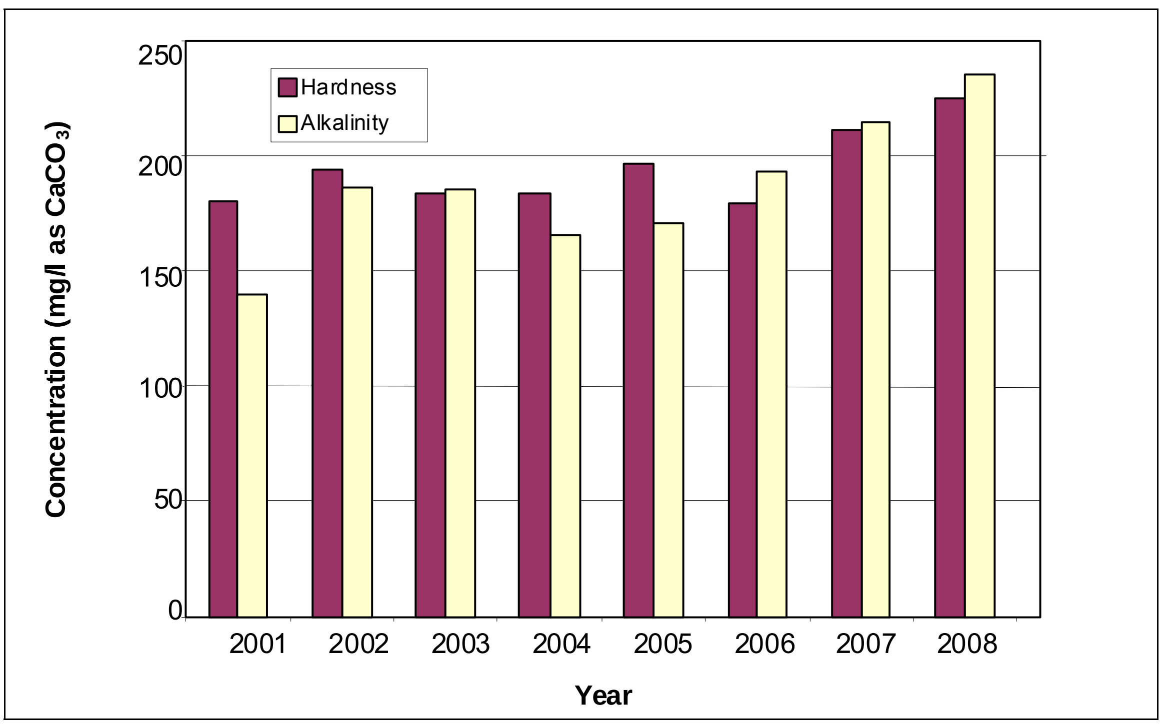
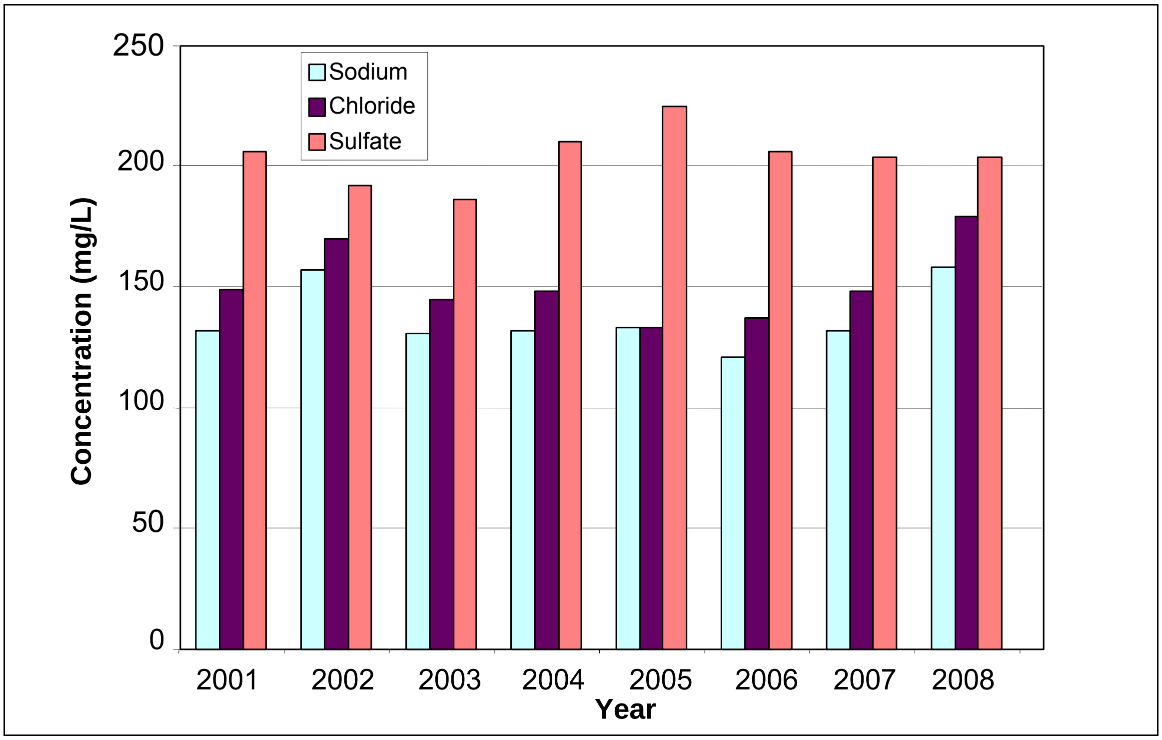


Figure 4.6
Trends in Sodium, Chloride and Sulfate 2001 – 2008



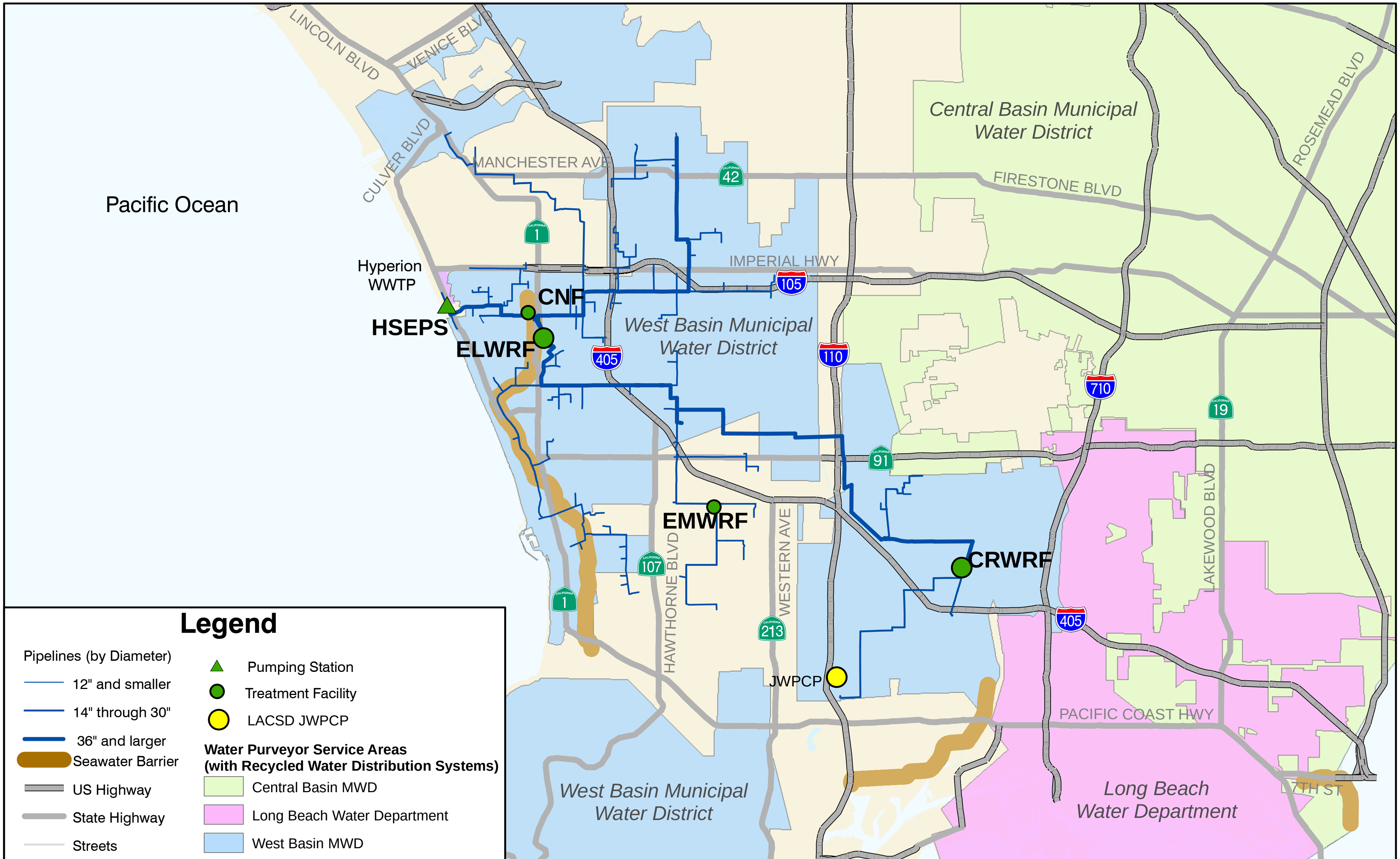
4.2.1 Existing Treatment Capacities

ELWRF is the only treatment plant that receives supply from the HWWTP. The remaining facilities rely on Title 22 recycled water from ELWRF as a supply source. The existing capacities of West Basin's treatment facilities are summarized in Table 4.2.

Table 4.2 Treatment Facility Capacities
Capital Implementation Master Plan
West Basin Municipal Water District

	Existing Capacity (mgd)	Expansion Capacity (mgd)	Near-Term Capacity (mgd)	Expansion Phase
ELWRF	56.8	6.5(1)	63.3	Phase V
CRWRF	6.0	17.0(2)	23.0	Phase II
CNF	4.9	1.5	6.4	-
EMF	8.1	-	8.1	-

Notes:
(1) Anticipated demand increase from feasibility study (HDR 2008). Does not include additional Title 22 demand to supply CNF facility or treatment process waste.
(2) Anticipated demand increase based on discussion with West Basin staff.



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AKM SPi

West Basin Municipal Water District
Capital Implementation Master Plan For Recycled Water Systems

N

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Miles

Figure 4.7
Recycled Water Supplies

It should be noted that the treatment capacities listed in Table 4.2 refer to all finished water qualities produced by each facility. For the Title 22 treatment processes at ELWRF, the current capacity is limited by the high rate clarifier to 30.0 mgd and the Title 22 filters to 40.0 mgd. Expansion of any of West Basin's systems requiring Title 22 water in excess of 30.0 mgd will require expansion of the Title 22 treatment processes.

4.2.2 Discharge and Process Wastes

Process discharges include reverse osmosis (RO) process concentrate, nitrification and microfiltration (MF) backwash, MF and RO clean in place, chemical clean in place, and plant drains. Waste and discharge flows are included in the facility schematics found in Chapter 2. The RO concentrates from ELWRF and CRWRF are discharged to dedicated brine lines. The brine flows from ELWRF are discharged into the Hyperion Outfall system located at the City of Los Angeles' HWWTP, and the brine flows from CRWRF are discharged into the Los Angeles County Sanitation District's (LACSD) Joint Water Pollution Control Plant (JWPCP) outfall system in the City of Carson. Discharge requirements for these brine lines are regulated by the California Regional Water Quality Control Board (RWQCB) and the United States Environmental Protection Agency (USEPA). Details of the discharge permits for each line are discussed below.

4.2.2.1 ELWRF Brine Line

Concentrate from the RO processes at ELWRF is discharged into the HWWTP 5-mile outfall via the ELWRF brine line system. The brine line consists of 18-inch diameter high-density polyethylene (HDPE) pipe that extends 3.0 miles west and north from ELWRF to the Hyperion outfall. Discharge from this system is regulated by NPDES CA0063401, which states that discharge is limited to a maximum flow of 4.5 mgd. The discharge permit contains effluent limitations on oil and grease, pH, temperature, TSS, ammonia, settleable solids, and turbidity. This discharge permit became effective on September 18, 2006, and is set to expire on September 17, 2011. During the calendar year 2007, an average flow of 2.5 mgd (2,800 afy) was observed in the ELWRF brine line, averaging 7.7 percent of the total influent to ELWRF.

4.2.2.2 CRWRF Brine Line

Concentrate from the RO process at the CRWRF is discharged into one of the four JWPCP outfalls via the CRWRF brine line system. The brine line consists of 14-inch diameter HDPE and PVC pipe that extends 5.4 miles south and west from CRWRF to the JWPCP outfall. Discharge from this system is regulated by NPDES CA0064246, which sets a maximum flow of 0.9 mgd. This discharge permit became effective on February 10, 2007, and is set to expire on December 10, 2011. During the calendar year 2007, an average flow of 0.54 mgd (606 afy) was observed in the CRWRF brine line, averaging 12.5 percent of the total influent to CRWRF.

4.2.2.3 EMWRF Concentrate

Concentrate from the RO process at the EMWRF is discharged into the ExxonMobil Torrance Refinery In-Plant Sewer System. Annual flow data for the concentrate stream was not available; however, the design flow for all four RO trains operating is 388 gpm, or about 0.6 mgd.

4.2.2.4 Solids Handling and Disposal of Solids

At ELWRF, solids streams from the various clarifiers are routed to two gravity thickeners, which feed a filter press. Dewatered sludge is directly loaded from the filter press to trucks for landfill disposal.

4.3 TREATMENT PLANT EXPANSION PROJECTS

West Basin has identified three near-term treatment plant expansion projects. These are:

- ELWRF Phase V
- CRWRF Phase II
- CNF

Each of these expansions is still in the preliminary phases of planning or design. Once completed, these projects will increase the existing treatment capabilities for expected growth in existing customer demand. The projected expansion capacities are listed in Table 4.2

4.3.1 ELWRF Phase V

To serve additional demand for both existing and future customers, the ELWRF Phase V Expansion Project will add MF and RO treatment capacity to increase production of Barrier water, Industrial RO water to the Chevron El Segundo Refinery and the El Segundo Power Plant, as well as Industrial RO Ultra water to Chevron. This expansion project is anticipated to be completed in 2011.

4.3.2 CRWRF Phase II

As part of the CRWRF Phase II Expansion Project, additional MF and RO units are anticipated to produce added Industrial RO product water for the bp Carson Refinery. Also, additional Nitrified water will be produced for the bp Carson Refinery cooling towers. This expansion is associated with the Amoco and Watson Cogeneration facilities.

4.3.3 CNF

Two additional Biofor units will be added to the CNF and facility improvements, such as pump station and electrical upgrades, will be performed to accommodate an additional 1.5 mgd of nitrified water demand. In addition to the facility improvements, the expansion of the CNF will also include implementation of an emergency backup potable water supply to the nitrification storage tank for reliability.

4.4 FUTURE SUPPLY REQUIREMENTS AND CONSIDERATIONS

As shown in Figure 4.9, the current HSEPS firm capacity limits the supply available from HWWTP to 51.0 mgd (57,100 afy). As discussed in Section 4.1.1, current utilization of this capacity is approximately 33 mgd, or about 65 percent of the total firm capacity available. To accommodate planned growth in potential customers discussed in Chapter 3, West Basin is considering expanding HSEPS for additional supply capacity.

4.4.1 Required Supply Projections

Projected supply requirements are presented in Table 4.3. Projected average annual supply requirements are shown on Figure 4.8, and projected maximum month supply requirements are shown on Figure 4.9. These projections assume a recovery ratio of 80 percent, and are based on the customer demand projections presented in Chapter 3.

Table 4.3 Phasing of Potential Supply
Capital Implementation Master Plan
West Basin Municipal Water District

Year	Projected Average Annual Demand(1) (afy)	Projected Maximum Month Demand(1) (mgd)	Projected Average Annual Supplies(2) (afy)			Projected Maximum Month Supplies(2) (mgd)		
			Inside Service Area	Outside Service Area	Total	Inside Service Area	Outside Service Area	Total
2008	31,860	38.4	31,295	8,530	39,825	37.5	10.5	48.0
2010	33,251	40.4	32,886	8,678	41,564	40.3	10.8	51.1
2020	67,573	82.0	63,578	20,889	84,466	76.2	27.0	103.1
2030	82,273	104.5	63,578	39,264	102,841	76.2	55.1	131.3

Notes:
(1) Demands from potential customer demand projections in Table 3.10.
(2) Supply projections assume 80% recovery ratio from aggregate of all processes (80% of supplies able to be delivered to customers, or 20% lost to processes, evaporation, overhead, and distribution water loss). Based on ratios of supplies to customer billing records in calendar year 2007 historical data.

As shown below in Figure 4.8 and Figure 4.9, West Basin's existing firm pumping capacity of 51.0 mgd is sufficient to meet both average annual demands and maximum month demands through the first two planning periods. However, an annual supply shortfall of approximately 27,500 afy is anticipated to occur by 2020. Moreover, a supply shortfall to meet the projected maximum demand is expected to occur much earlier as the maximum month demand is reaching the 51 mgd supply capacity in year 2010. The addition of new customers is therefore dependent upon West Basin's ability to increase the supply capacity from HWWTP and/or the development of a new supply source.

Figure 4.8
Projected Average Annual Supply Requirements

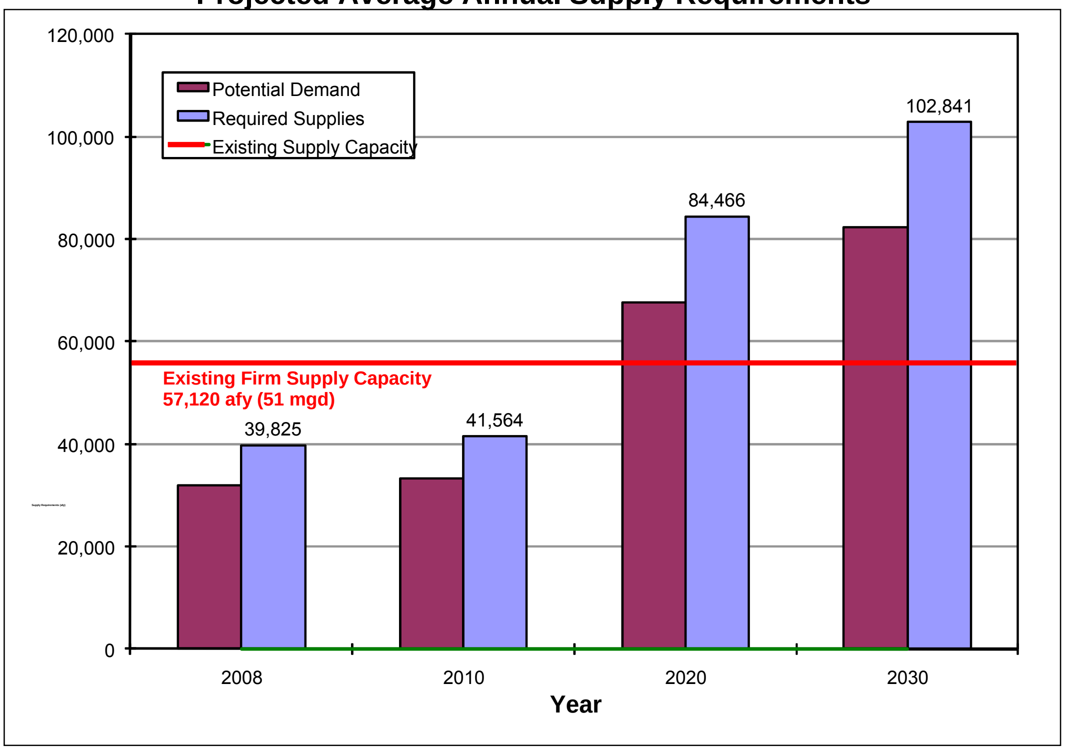
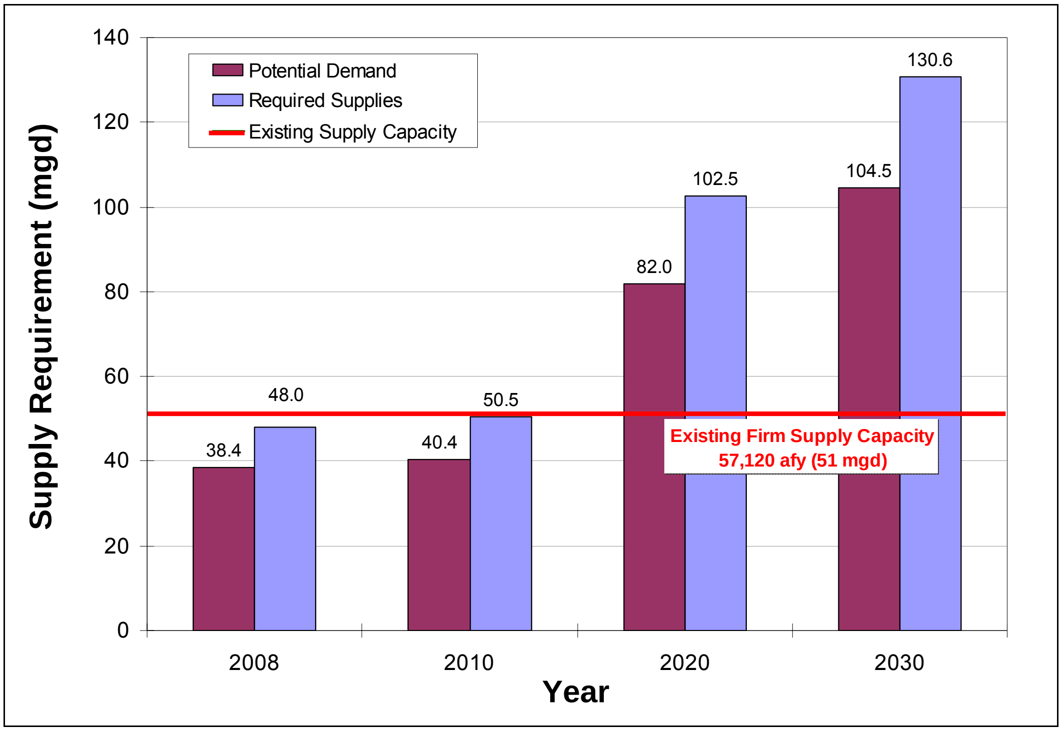


Figure 4.9
Projected Maximum Month Supply Requirements



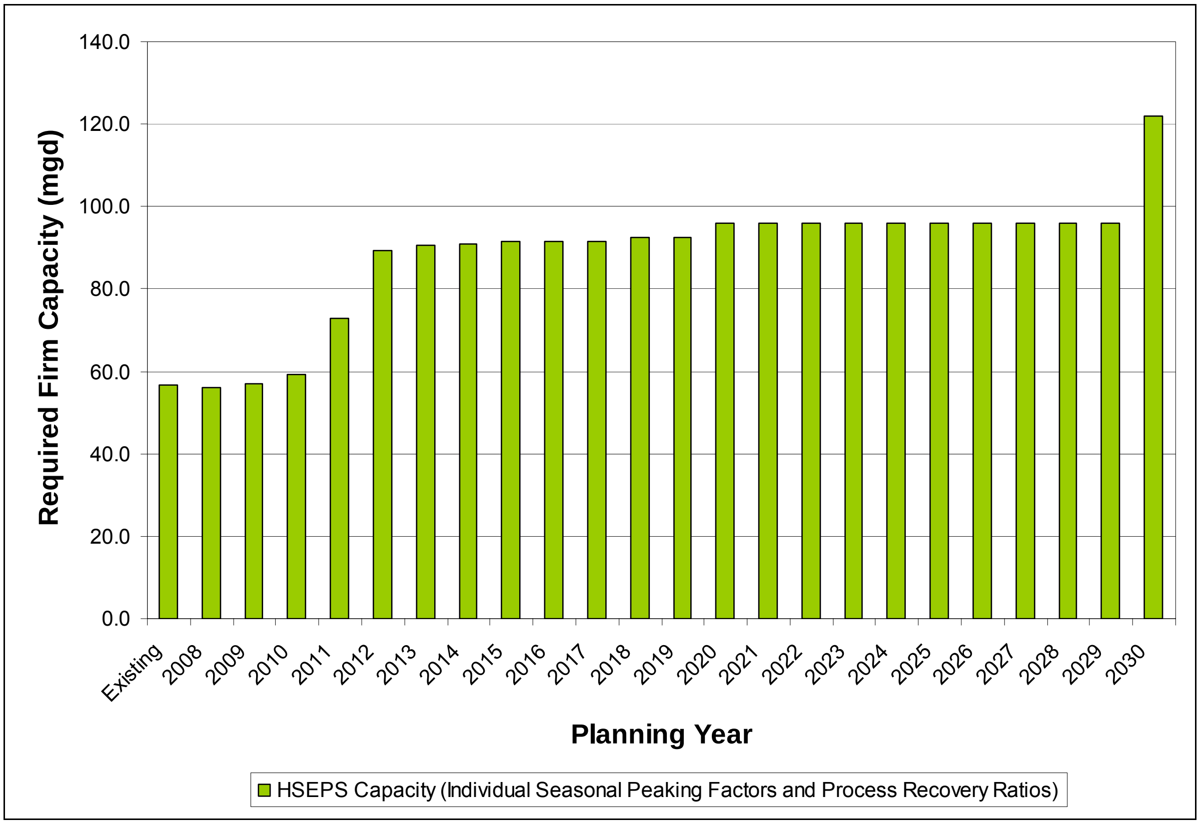
It should be noted that Figure 4.9 does not account for daily peaking. Actual firm capacity requirements of the HSEPS will be covered in greater detail in Chapter 8.

4.4.2 HSEPS Capacity Expansion

As Figure 4.9 indicated, the required capacity of the HSEPS will exceed the existing capacity during within the planning horizon.

Figure 4.10 presents the required firm capacity at HSEPS based on the customer phasing described in Chapter 3. The firm capacity was calculated based on applying individual seasonal peaking factors to each customer demand and including an additional fifteen percent for demands associated with advanced treatment (e.g., Chevron LPBF). The daily supply peaking factor was then applied to determine the total firm capacity requirement.

Figure 4.10
HSEPS Capacity Requirements



As shown on Figure 4.10, the most significant increase in capacity requirements at HSEPS is anticipated to occur between 2010 and 2012. This is due to several significant demands served by Hyperion becoming active in those years, including the LA Harbor Nitrified Water project and the ELWRF Phase V expansion (but not the bp expansion, as further discussed in Chapter 8). Hydraulic analysis and recommendations to accommodate projected demands will be discussed in further detail in Chapter 8.

It should be noted that Figure 4.10 includes the individual peaking factor as well as a daily peaking of 1.34 discussed in Section 4.1.4, while Figure 4.9 only includes the seasonal peaking factor (from individual customers). Firm capacity requirements shown in Figure 4.10 also assume simultaneous seasonal peaking of all demands, as discussed in Chapter 3.

4.4.3 Potential Additional Sources of Supply

To provide redundancy and reliability in supply of recycled water to existing and potential customers, West Basin has identified the LACSD as a potential additional source of supply. LACSD has 11 treatment facilities, including 10 water reclamation plants across Los Angeles County. LACSD's treatment plants produced a total annual average effluent of 486 mgd during Fiscal Year (FY) 2006-07, including 175 mgd of recycled water (LACSD 2008). LACSD's total reclamation capacity is currently 252 mgd.

LACSD's JWPCP is located about 4 miles southwest of the West Basin's CRWRF and treats a majority of the flow from the Joint Outfall System prior to discharge into the ocean. The location of the JWPCP in relation to West Basin's facilities is shown on Figure 4.7. In FY 2006/07, the JWPCP discharged 311 mgd of SE to the ocean. As the JWPCP treats only to SE levels, additional treatment and conveyance would be required.

The use of this supply source from JWPCP for West Basin's Title 22 system could be accomplished by adding tertiary treatment capabilities on the southeast side of the West Basin's recycled water system. This treatment capacity could be added to a plant located near the CRWRF, between the JWPCP and the CRWRF, or near the JWPCP. Based on discussions with West Basin staff, treatment of JWPCP's SE to Title 22 standards for irrigation would require more significant treatment than HWWTP's SE due to the higher TDS levels (approximately 1,300 mg/L at JWPCP versus 900 mg/L at HWWTP). The cost of these extra facilities, as well as the water quality of the SE from the JWPCP, is evaluated in more detail in Chapter 8 of this report.

4.4.4 Reliability and Redundancy

West Basin currently has only a single source of supply in the existing system; therefore, reliability is accomplished within the individual facilities and by backup potable water connections. The HSEPS and the Hyperion Secondary Effluent Force Main system represent critical elements whose failure would prevent operation of all West Basin facilities. Establishing additional water supplies across multiple points in the distribution system, along with backup power supply to each of the treatment facilities, or critical portions of each of the treatment facilities, would greatly increase reliability and redundancy in the system.

Current backup connections within the West Basin's treatment facilities and distribution systems consist of connections to potable water supplies. Based on the Los Angeles County Recycled Water Advisory Committee's *Recycled Water Use Manual*, connections to potable supplies are required to maintain separation between the potable water distribution system and the recycled water distribution system. Separation requirements are not satisfied by only a backflow prevention device. Devices satisfying this requirement include:

- **Air-gap Separation**: A physical separation between the systems usually accomplished through use of a floating reservoir. Such a connection prevents pressurization of the connection. Due to the lack of floating reservoirs in West Basin's distribution system, such a connection will often require downstream pumping to maintain pressure.
- **Swivel-ell Assembly**: Under "stringent requirements", an assembly is allowed to directly connect the two systems providing the assembly does not allow simultaneous connections. Such an assembly requires physical modifications to the facility in question during downtime. Assemblies of this type are located at West Basin's EMWRF and CRWRF. United Water staff estimated six to eight hours to switch connections under current configurations at West Basin facilities.

Potable water backup connections are intended to function as a supply source in an event of emergency such as brief recycled water supply interruptions.

Additional backup supply alternatives may include connections to neighboring recycled water systems. The closest neighboring recycled water systems to West Basin's distribution systems include the Central Basin Municipal Water District, the Long Beach Water Department, the City of Los Angeles distribution system served by Terminal Island Water Reclamation Plant (WRP), and the City of Santa Monica distribution systems served by Santa Monica WRP (LACRWAC 2008). Each of the service areas for neighboring recycled water systems is shown on Figure 4.7.

West Basin currently does not have backup power generators to operate any facilities. As a part of the most recent expansion of the HSEPS, an independent connection to electrical power was recommended as a backup power source (CDM 2004). Chapter 8 includes a discussion of options to establish redundancy using backup power sources.

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