Draft Environmental Impact Report

CANDLESTICK POINT–HUNTERS POINT SHIPYARD PHASE II

Volume VI: Draft EIR Appendix Q1 to Appendix V2

SAN FRANCISCO REDEVELOPMENT AGENCY
File No. ER06.05.07

CITY AND COUNTY OF SAN FRANCISCO PLANNING DEPARTMENT
File No. 2007.0946E

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DEIR Publication Date: November 12, 2009
San Francisco Redevelopment Agency Commission Public Hearing Date: December 15, 2009
San Francisco Planning Commission Public Hearing Date: December 17, 2009
DEIR Public Review Period: November 12, 2009–December 28, 2009

Written comments should be sent to:
Environmental Review Officer—San Francisco Redevelopment Agency
One South Van Ness Avenue, Fifth Floor, San Francisco, CA 94103
or
Environmental Review Officer—San Francisco Planning Department
1650 Mission Street, Suite 400, San Francisco, CA 94103

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Appendix Q1 PBS&J SFPUC Water Supply Assessment for the Proposed Candlestick Point–Hunters Point Shipyard Phase II Project, October 27, 2009

Final

Water Supply Assessment

for the

Proposed Candlestick Point - Hunters Point Shipyard Phase II Project

Adopted October 27, 2009

Prepared by:

PBS&J

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1.0 INTRODUCTION

The City of San Francisco (City or San Francisco), and San Francisco Redevelopment Agency are conducting an environmental review under the requirements of the California Environmental Quality Act (CEQA) for the proposed Candlestick Point-Hunters Point Shipyard Phase II Project (proposed project or CP-HPS II). This water supply assessment (WSA) will provide information for use in the CEQA analysis for this proposed project. The environmental review for the proposed project includes an assessment of the available water supply to serve the proposed project. The requirements for a WSA are set forth in the California Water Code (Water Code) Sections 10910 et seq.

A WSA connects water supply and land use planning with the environmental review process. The law also reflects the growing awareness of the need to incorporate water supply and demand analysis at the earliest possible stage in the land use planning process. The core of this law is an assessment of whether available water supplies are sufficient to serve the demand generated by a project, as well as the reasonably foreseeable cumulative demand in the region over the next 20 years under a range of hydrologic conditions.

This WSA provides information on the available water supply to serve the proposed project based on Water Code Sections 10631, and 10910 et seq.

This document is divided into six sections: Introduction, Water Supply Sources, Demand Analysis, Supply and Demand Comparison, Conclusion of Analysis and Findings. The Introduction describes the proposed project and water supply planning under Water Code 10910 et al.

1.1. Project Location, Land Use, Zoning and Characteristics

1.1.1. Project Location

Candlestick Point and Hunters Point Shipyard project sites comprise approximately 702 acres in the southeastern portion of San Francisco (see Figure 1-1 for the regional and local project location). Taken together, they are bordered by major features such as India Basin on the north, the Executive Park area and San Mateo County line on the south; Bayview Hill, the Bayview neighborhood, Yosemite Slough, and Hunters Point Hill on the west; and, San Francisco Bay on the north and the east.

1.1.2. Project Sites

1.1.2.1. Candlestick Point

The Candlestick Point area is immediately east of Executive Park, with the Bayview neighborhood to the north, the Hunters Point Shipyard to the northeast, and Candlestick Point State Recreation Area (SRA) along the Bay frontage generally on the east. The Candlestick Point site is generally bounded by Hawes Street to the northwest and Jamestown Avenue to the southwest, and the Candlestick Cove and South Basin areas of the Bay comprise the south and east boundaries, respectively.

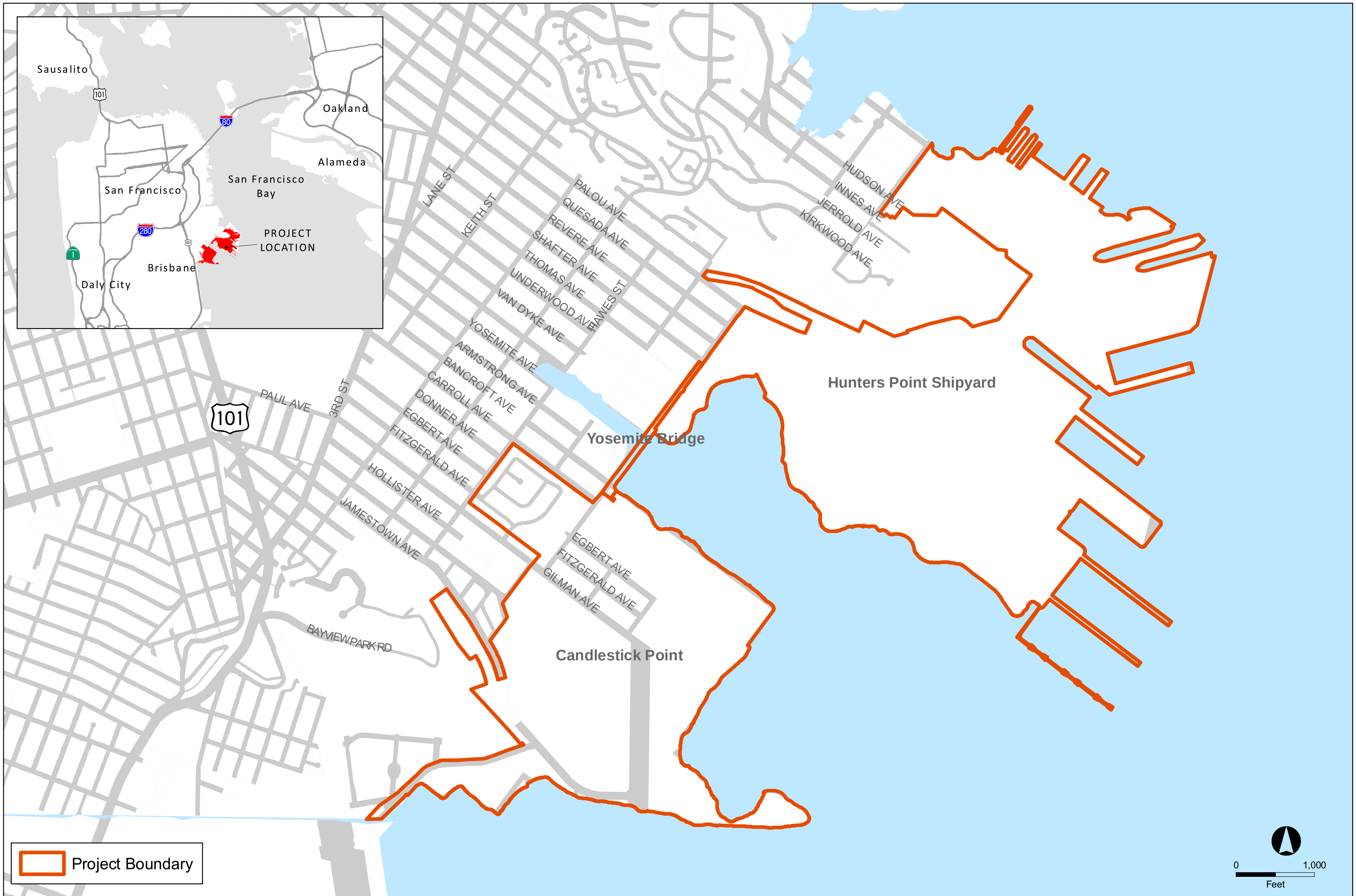

FIGURE 1-1

Regional and Project Location

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Bayview WSA

1.1.2.1. Hunters Point Shipyard Phase II

The Hunters Point Shipyard area is to the southeast of the Hunters Point neighborhood. The Hunters Point Shipyard site is generally bounded by San Francisco Bay to the north, east, and south. The south end of the western boundary extends from Yosemite Slough along Arelious Walker Drive north to approximately Crisp Road, excluding the University of California San Francisco (UCSF) property. The inland northern boundary generally extends along Crisp Road and Spear Avenue. The northernmost end of the HPS Phase II area is contiguous with Earl Street.

1.1.3. Proposed Project Land Use Information

The proposed project would consist of nine districts: five in Candlestick Point and four in Hunters Point Shipyard Phase II. Table 1-1 presents the overall land use distribution.

Table 1-1: Project Proposed Land Uses

Land Use	Candlestick Point	Hunters Point Shipyard Phase II	Total
Residential (DU)			
Residential Density Range I (15 to 75 units per acre)	1,325	680	2,005
Residential Density Range II (50 to 125 units per acre)	2,865	1,415	4,280
Residential Density Range III (100 to 175 units per acre)	2,000	265	2,265
Residential Density Range IV (175 to 285 units per acre)	1,660	290	1,950
Total	**7,850**	**2,650**	**10,500**
Commercial Uses			
Retail			
Regional Retail (gsf)	635,000	~	635,000
Neighborhood Retail (gsf)	125,000	125,000	250,000
Total	**760,000**	**125,000**	**885,000**
Hotel (150,000 gsf)	220 rooms		220 rooms
Office (gsf)	150,000	~	150,000
Community Uses/Services (gsf)	50,000	50,000	100,000
Research & Development (gsf)			
Office	~	835,000	835,000
Laboratory	~	835,000	835,000
Light Industrial	~	835,000	835,000
Total		**2,500,000**	**2,500,000**
Artist Center and Studios			
Artist's Studios		225,000	225,000
Artist Education Center		30,000	30,000
Total	**~**	**255,000**	**255,000**
Parks & Open Space (acres)			
New Parks	8.1	140.0	148.1
New Sports Fields and Waterfront Recreation	~	91.6	91.6
New and Improved State Parkland at CP	96.7 acres	~	96.7
Total	**104.8**	**231.6**	**336.4**
Ferry Terminal	~	1	1
Marina (slips)	~	300	300
Stadium (seats)		69,000	69,000
Performance Venue (75,000 gsf)	10,000 seats		10,000 seats

Notes:
gsf = gross square feet; DU = dwelling units
Source: Lennar Urban, 2009.

Figure 1-2 illustrates the land use plan.

- **Residential:** The proposed project would consist of 10,500 for-sale and rental residential units, including approximately 6,899 market-rate units and approximately 3,345 below market rate and 256 public housing replacement units. The units would range in size from studios to four bedrooms. Units include 2- and 3-story townhomes over parking, 3- to 5-story low-rise flats over podium parking, 8- to 14-story mid-rise flats, and 22- to 42-story high-rise towers. Depending on their location, lower floors of all residential building types (other than townhomes) could include commercial uses.
  - Residential Density Range I (15 to 75 units per net acre): Housing types would typically include townhomes, flats, and lofts
  - Residential Density Range II (50 to 125 units per net acre): Housing types would typically include low-rise flats and lofts
  - Residential Density Range III (100 to 175 units per net acre) Housing types would typically include low and mid-rise flats or low-rise flats and high-rise buildings
  - Residential Density Range IV (175 to 285 units per net acre): Housing types would typically include low-rise flats and high-rise buildings
- **Regional Retail.** A regional retail center of up to 635,000 gross square feet (gsf) is proposed on Candlestick Point. Retailers could include a variety of general merchandise, apparel, furniture and home furnishings, food service and restaurants, and entertainment related businesses to serve the regional market.
- **Neighborhood Retail.** Neighborhood retail sites are designated at both Candlestick Point and Hunters Point Shipyard, and in addition, small-scale neighborhood retail uses could be established throughout the project site depending on demand. Up to 250,000 gsf of neighborhood retail could include convenience goods (e.g. food, drugs and groceries) and personal services (e.g. laundry, dry cleaning, barbering, and shoe repair) for daily needs of the immediate neighborhood.
- **Community Services.** Up to 100,000 gsf of fire, police, healthcare, day-care, places of worship, senior centers, library, recreation center, community center, and performance center uses at sites designated for community serving use on both Candlestick Point and Hunters Point Shipyard.
- **Research and Development.** Hunters Point Shipyard Phase II would be the site of up to 2,500,000 gsf of a possible wide range of businesses including, but not limited to, emerging industries and technologies such as green technology and biotechnology.
- **Hotel.** A 220-room hotel is proposed at Candlestick Point Center.
- **Office.** Up to 150,000 gsf of office uses on Candlestick Point could include but not be limited to professional offices, real estate offices, and financial services.
- **Performance Venue/Arena.** A 10,000-seat venue for theatre productions, concerts, speaking engagements, educational events, or sporting events is proposed on Candlestick Point.
- **Artist's Studios/Artist Education Center.** Up to 255,000 gsf of artist's studios and an artist education center is proposed on Hunters Point Shipyard.
- **Parks and Open Space.** The Project would include an estimated 336 acres of new public parks and open space, sports fields, and improvements to the Candlestick Point Recreation Area.

Source: Lennar Urban, 2009.

PBS&J

FIGURE **1-2**

Candlestick Point - Hunters Point Shipyard Phase II Land Use Plan

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Bayview WSA

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- **Parking.** Parking would be provided as structured parking for residential uses, (as structured and on-street parking for commercial uses) for dedicated stadium use, and as general parking.
- **Marina.** A 300-slip marina is proposed at Hunters Point Shipyard. A marina could include utilities at each slip. Landside amenities could include a classroom facility for restrooms, showers and to sailing instruction.
- **Ferry Terminal.** A ferry terminal and dock to accommodate Water Emergency Transportation Authority (WETA) vessels is proposed at Hunters Point Shipyard. The terminal building could include ticketing kiosks, real-time transit information, and public restrooms.

1.1.4. Proposed Research and Development Variant Information

The Research and Development (R&D) Variant assumes that the Stadium would not be constructed at the HPS Phase II site; instead, additional R&D uses emphasizing emerging technologies would be developed. With the R&D Variant, the 69,000-seat Stadium proposed under the proposed project would not be constructed. Instead, the R&D Variant would result in construction of an additional 2,500,000 gross square feet of R&D uses above what is currently proposed in the HPS South neighborhood district. Table 1-2 lists the additional R&D space that would be constructed at the HPS South neighborhood district under the R&D Variant; all other proposed project land uses remain unchanged.

Table 1-2: Proposed R&D Variant

Land Use	Candlestick Point	Hunters Point Shipyard Phase II	Total
Research & Development (gsf)			
Office	~	1,665,000	1,665,000
Laboratory	~	1,665,000	1,665,000
Light Industrial	~	1,665,000	1,665,000
TOTAL		**5,000,000**	**5,000,000**

All other proposed project land uses remain unchanged.
Source: Lennar Urban, October 2009

1.2. Water Supply Planning

Senate Bill 610 was passed into law on January 1, 2002. This law reflects the need to incorporate water supply and demand analysis at the earliest possible stage in the planning process. SB 610 amended portions of the Water Code, including Section 10631, which contains the Urban Water Management Planning Act, as well as adding Sections 10910, 10911, 10912, 10913, and 10915, which describe the required elements of a WSA. Upon signing this bill and a related bill not applicable to the proposed project, Governor Gray Davis stated, “Most notably, these bills will coordinate local water supply and land use decisions to help provide California’s cities, farms, and rural communities with adequate water supplies. Additionally, these bills increase requirements and incentives for urban water suppliers to prepare and adopt comprehensive management plans on a timely basis.”[1]

Senate Bill 610 is designed to build on the information that is typically contained in an Urban Water Management Plan (UWMP). The amendments to Water Code Section 10631 were designed to make WSAs and UWMPs consistent. A key difference between the WSAs and UWMPs is that UWMPs are required to be revised every five years, in years ending with either zero or five, while WSAs are required as part of the environmental review process for each

1 Department of Water Resources. 2003. Guidebook for Implementation of SB 610 and SB 221 of 2001.

individually qualifying project. As a result, the 20-year planning horizons for each type of document may cover slightly different planning periods than other WSAs or the current UWMP. Additionally, not all water providers who must prepare a WSA are required to prepare an UWMP.

1.2.1. SB 610 Water Supply Assessment

The SB 610 water supply assessment process involves answering the following questions:

- Is the project subject to CEQA?
- Is it a project under SB 610?
- Is there a public water system?
- Is there a current UWMP that accounts for the project demand?
- Is groundwater a component of the supplies for the project?
- Are there sufficient supplies available to serve the project over the next 20 years?

1.2.1.1. "Is the Project Subject to CEQA?"

The first step in the SB 610 process is determining whether the project is subject to CEQA. SB 610 amended Public Resources Code Section 21151.9 to read: "Whenever a City or county determines that a project, as defined in Section 10912 of the Water Code, is subject to this division [i.e., CEQA], it shall comply with part 2.10 (commencing with Section 10910) of Division 6 of the Water Code." The City of San Francisco and the San Francisco Redevelopment Agency have determined that the proposed project is a project subject to CEQA. The information contained in this assessment will be used to inform and support the Environmental Impact Report (EIR) for the proposed project, and will be appended thereto.

1.2.1.2. "Is It a Project Under SB 610?"

The second step in the SB 610 process is to determine if a project meets the definition of a "Project" under Water Code Section 10912 (a). Under this section, a "Project" is defined as meeting any of the following criteria:

1. A proposed residential development of more than 500 dwelling units;
2. A proposed shopping center or business establishment employing more than 1,000 persons or having more than 500,000 square feet (ft^2) of floor space;
3. A commercial building employing more than 1,000 persons or having more than 250,000 ft^2 of floor space;
4. A hotel or motel with more than 500 rooms;
5. A proposed industrial, manufacturing, or processing plant, or industrial park, planned to house more than 1,000 persons, occupying more than 40 acres of land, or having more than 650,000 ft^2 of floor area;
6. A mixed-use project that includes one or more of these elements; or
7. A project creating the equivalent demand of 500 residential units.

Alternately, if a public water system has less than 5,000 service connections, the definition of a "Project" also includes any proposed residential, business, commercial, hotel or motel, or industrial development that would account for an increase of 10 percent or more in the number of service connections for the public water system. The proposed project is a mixed-use project that would include one or more of these elements listed above, specifically, "the proposed project exceeds residential development of more than 500 dwelling units" and for that reason, it meets the requirements as a "Project" under the Water Code.

1.2.1.3. "Is There a Public Water System?"

The third step in the SB 610 process is determining if there is a "public water system" to serve the project. Section 10912 (c) of the California Water Code states: "[A] public water system means a system for the provision of piped water to the public for human consumption that has 3,000 or more service connections." The San Francisco Public Utilities Commission (SFPUC) is a public water system that serves the City and County of San Francisco, including the proposed project area. The SFPUC's Retail service area is shown in Figure 1-3. The SFPUC provides water to both retail and wholesale water customers. A population of over 2.5 million people within the counties of San Francisco, San Mateo, Santa Clara, Alameda, and Tuolumne rely entirely or in part on the water supplied by the SFPUC.

Retail Customers: The SFPUC's retail water customers include the residents, business, and industries located within the corporate boundaries of the City and County of San Francisco (City). In addition to these customers, retail water service is also provided to other customers located outside of the City, such as Treasure Island, the Town of Sunol, San Francisco International Airport, Lawrence Livermore Laboratory, Castlewood, and Groveland Community Services District.

Wholesale Customers: The SFPUC sells water to wholesale customers under terms of the recently renegotiated Water Supply Agreement together with individual water sales contracts. Since 1970, the SFPUC has supplied approximately 65 percent of the total wholesale customer water demand. Some of the wholesale water customers are entirely reliant on the SFPUC for their water supply.

1.2.1.4. "Is There a Current UWMP That Accounts for the Project Demand?"

Step four in the SB 610 process involves determining if there is a current UWMP that considers the projected water demand for the project area. The Water Code requires that all public water systems providing water for municipal purposes to more than 3,000 customers or supplying more than 3,000 acre-feet annually must prepare an UWMP, and the plan must be updated at least every five years on or before December 31 in years ending in five and zero.

Water Code Section 10910 (c)(2) states: "If the projected water demand associated with the proposed project was accounted for in the most recently adopted urban water management plan, the public water system may incorporate the requested information from the urban water management plan in preparing the elements of the assessment required to comply with subdivisions (d),(e),(f), and (g) [i.e., the WSA]." The SFPUC 2005 UWMP is currently available online.[2]

2 SFPUC 2005 Urban Water Management Plan, http://sfwater.org/detail.cfm/MC_ID/13/MSC_ID/165/C_ID/2776.

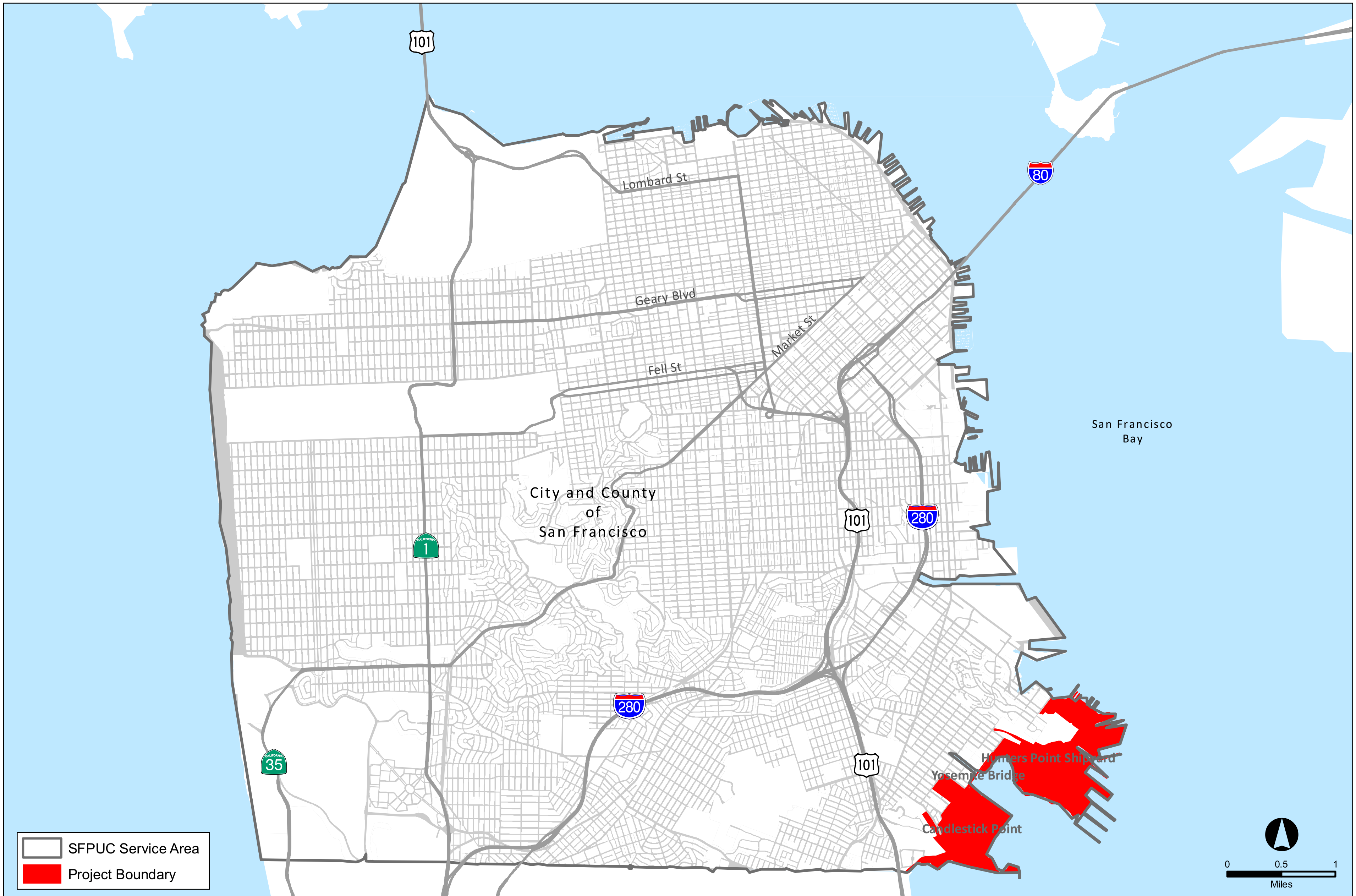

FIGURE 1-3

SFPUC Service Area within City and County of San Francisco

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Bayview WSA

As of late 2008, the SFPUC concluded that its 2005 UWMP no longer accounted for every qualifying project within San Francisco including the land use changes at the proposed project area. Therefore, any qualifying projects not accounted in the 2005 UWMP will require preparation of a WSA that documents the SFPUC's current and projected supplies when compared to projected demands associated with new growth not covered in the 2005 UWMP including agriculture and industrial uses. When the 2005 UWMP was prepared, the redevelopment plan at Candlestick Point and Hunters Point Shipyard did not encompass the entire development of the proposed project; therefore, this WSA analyzes the change in demand at the project site under the proposed project.

1.2.1.1. "Is Groundwater a Component of the Supplies for the Project?"

This section addresses the requirements of Water Code Section 10910 (f), paragraphs 1 through 5, which apply if groundwater is a source of supply for a proposed project. As required by Water Code Section 10910 (f) a description and status of the local groundwater basin is discussed below. Groundwater is a minor component of water supply for the SFPUC and for the proposed project. A discussion of the SFPUC's groundwater supply programs is included in Sections 2.6.2.1 and 3.4 of this WSA.

In April 2005, the SFPUC completed the Final Draft North Westside Basin Groundwater Management Plan (GWMP), which identified opportunities for increasing groundwater production in San Francisco. The GWMP included a Plan Element to regularly report on groundwater conditions in the North Westside Groundwater Basin. Since completion of the GWMP, the SFPUC prepared two annual reports on the condition, status and water supply programs involving the North Westside Groundwater Basin.

Groundwater Basin Descriptions

The City and County of San Francisco are located over seven groundwater basins: Westside, Lobos, Marina, Downtown, Islais Valley, South San Francisco, and Visitation Valley. The Lobos, Marina, Downtown, and South San Francisco Basins are located completely within City limits; the remaining basins extend into San Mateo County. The basins are part of the larger San Francisco Bay Hydrologic Region, as defined by the Department of Water Resources (DWR) in its Bulletin 118. DWR Bulletin 118 describes the groundwater resources of the state and provides individual basin descriptions. DWR has not identified any of the basins listed above as being in overdraft or as being adjudicated.[3]

The following information is from the SFPUC's *2008 Annual Groundwater Monitoring Report Westside Basin.* See Appendix A for the entire report.

> The Westside Basin is about 40 square miles in area and includes four major geologic units. These units are the Jurassic - Cretaceous Franciscan Complex, Pliocene Merced Formation, Pleistocene Colma Formation, and Pleistocene to recent Dune Sands. There are also minor, yet widespread, units of recent alluvium along stream channels. Groundwater development has primarily occurred in the Colma and Merced Formations. The Merced Formation is the primary water-producing aquifer in the basin; however, the Colma Formation is also of interest since Lake Merced is incised within this formation. As a result of the difficulty of differentiating the contacts between the Dune Sands, the Colma Formation, and the Merced Formation, the precise thickness of the Colma Formation and Dune Sands overlying the Merced Formation has not been determined. Groundwater in the vicinity of Lake Merced, and north to Stern Grove and Golden Gate Park, is encountered at relatively shallow depths (ranging from approximately 5 to

3 Department of Water Resources. Groundwater Management Technical Assistance – Adjudicated Basins. http://www.groundwater.water.ca.gov/technical_assistance/gw_management/#adbasins

60 feet). South of Lake Merced, the depth to groundwater can exceed 300 feet below ground surface (bgs).

Phillips, et al. (1993) defined each of the groundwater basins in San Francisco as a continuous body of unconsolidated sediments and the surrounding surface drainage area. All seven major groundwater basins identified in San Francisco are open to the Pacific Ocean or San Francisco Bay. The landward parts of the groundwater basins generally are bounded horizontally and vertically by bedrock, which is assumed to be relatively impermeable compared with unconsolidated marine and alluvial deposits. Groundwater flow may occur between basins where the bedrock ridge that constitutes the boundary is subterranean. The north-south topography and bedrock height defined by the Coast Ranges generally forms an east-west hydrologic boundary through San Francisco.

The western part of San Francisco is divided into the Westside and Lobos Basins on the basis of a northwest-trending bedrock ridge through the northeastern part of Golden Gate Park. The bedrock ridge has several small surface expressions, and bedrock altitude data indicate that the ridge is continuous, though subterranean. Some degree of hydraulic connection is possible between the two basins where the ridge is not exposed at the land surface, but the degree of connection probably is minimal. The Westside Basin extends south to Burlingame and Hillsborough. Well drillers' logs for the San Bruno area indicate a deep sandy unit overlain by about 200 feet of predominantly fine-grained clays. Correlation of the deeper sand deposits is unclear; however, surficial mapping may indicate a relationship to exposures of sand/gravel deposits in the Burlingame area, which are mapped as non-marine Santa Clara Formation (Brabb and Pampeyan, 1983). A southward-extending ridge of Franciscan bedrock appears to separate San Bruno from the San Francisco Bay to the east. The upper fine grained beds appear to be Holocene to Late Pleistocene estuarine deposits of the San Francisco Bay (LSCE, 2004).

The subsurface configuration of the various geologic units in the Westside Basin has been delineated in a series of geologic cross-sections based on a combination of lithologic logs; water well drillers' reports, and geophysical logs (LSCE, 2004 and 2006). Lithologic units and other significant features in the basin are illustrated in geological cross-section form. In the northern Westside Basin, in San Francisco, there are up to three aquifer units separated by two distinctive fine-grained units, the –100-foot clay and the W-Clay (LSCE, 2004). The aquifer units are generally designated as: 1) The "Shallow aquifer", which is present to an elevation of approximately –100 feet mean sea level (msl) (located above the –100-foot clay), in the vicinity of Lake Merced and the southern portion of the Sunset District of San Francisco; 2) The "Primary Production aquifer", which overlies the W-Clay; and 3) The "Deep aquifer" which underlies the W-Clay. In the Daly City area, the –100-foot clay is absent, and the aquifer system is primarily composed of the Primary Production aquifer and the Deep aquifer. Further to the south, in the South San Francisco area, the W-Clay is absent and the Primary Production aquifer is split into shallow and deep units, separated by a fine-grained unit at an elevation of approximately 300 feet below msl. The primary production aquifer in the San Bruno area is located at an elevation less than 200 feet below msl, and it underlies a thick, surficial fine-grained unit comprised of clay, sandy clay, and sand beds.

1.2.1.2. "Are There Sufficient Supplies to Serve the Project Over the Next 20 Years?"

Water Code Section 10910 (c)(4) states: "If the City or county is required to comply with this part pursuant to subdivision (b), the water assessment for the project shall include a discussion with regard to whether the total projected water supplies, determined to be available by the City or county for the project during normal, single dry and multiple dry water years during a 20-year projection, will meet the projected water demand associated with the proposed project, in addition to existing and planned future uses, including agricultural and manufacturing uses."

The SFPUC, based on the analysis in this WSA, concludes that are adequate supplies to serve the proposed project, including existing demand and planned future uses in the SFPUC's Retail service area through 2030. However, after 2030 in multiple dry-year events, the SFPUC would have to implement its demand management programs to reduce demand to meet projected supply curtailments.

As required, the next step in the SB 610 process is to prepare the assessment of the available water supplies, including the availability of these supplies in all water-year conditions over a 20-year planning horizon, and an assessment of how these supplies relate to project-specific and cumulative demands over that same 20-year period. In this case, the period is 20 years and covers the years 2010 to 2030.

There are three primary areas addressed in a water supply assessment:

- relevant water supply entitlements, water rights, and water contracts;
- a description of the available water supplies; and,
- an analysis of the demand placed on those supplies, both by the project and on a cumulative basis.

Water entitlements and contracts are addressed in Section 2 and demand analysis is discussed in Section 4. Section 6 contains conclusions and findings.

2.0 WATER SUPPLY

This section presents the local climate conditions and reviews the SFPUC's water supply sources, entitlements, water rights and contracts.

2.1. Climate

San Francisco has a Mediterranean climate. Summers are cool and winters are mild with infrequent rainfall. Temperatures in the San Francisco area average 58 degrees Fahrenheit annually ranging from the mid-40s in winter to the mid-70s in late summer. Strong onshore winds in summer keeps the air cool, generating fog through September. The warmest temperatures generally occur in September and October. Rainfall in the San Francisco area averages about 20 inches[4] per year and is generally confined to the "wet" season, from late October to early May. Except for occasional light drizzles from thick marine stratus clouds, summers are nearly completely dry. Coastal fog helps reduce summer irrigation requirements. A summary of temperature and rainfall data for the City of San Francisco is included in Table 2-1.

Table 2-1: City of San Francisco Climate Summary

	Maximum Average Temperature (°F)[a]	Minimum Average Temperature (°F)[a]	Average Monthly Rainfall (inches)[1]
January	55.8	42.5	4.38
February	59.1	44.9	3.63
March	61.2	46.1	2.81
April	63.9	47.6	1.37
May	66.8	50.2	0.39
June	70.0	52.7	0.11
July	71.5	54.1	0.02
August	72.1	55.0	0.05
September	73.4	54.8	0.18
October	70.2	51.9	0.96
November	62.9	47.4	2.36
December	56.4	43.2	3.76
Annual Average	**65.3**	**49.2**	**20.00**

Note:
1. Source: Western Regional Climate Center – San Francisco. Data from 1/1/1937 to 12/31/2008.

According to the Department of Water Resources, eleven droughts have occurred in California since 1850.[5] The year 1977 is recognized as the driest single year of California's measured hydrologic record. The most recent multi-year statewide drought took place between 1987 and 1992. Droughts exceeding three years are relatively rare in Northern California; however, even localized droughts in Northern California have extensive repercussions for water agencies dependent upon Sierra Nevada snowpack and spring runoff.

4 Hydrologic data from 1971 -2000: Western Regional Climate Center; Mission Delores/SF 047772 and Richmond/SF 047767.

5 Department of Water Resources. Background: Droughts in California. http://watersupplyconditions.water.ca.gov/background.cfm, accessed September 2007.

2.2. Water Supply Entitlements, Water Rights and Contracts

Water Code Section 10910 (d)(1) states: "The assessment required by this section shall include an identification of any existing water supply entitlements, water rights, or water service contracts relevant to the identified water supply for the proposed project, and a description of the quantities of water received in prior years by the public water system, or the City or county if either is required to comply with this part pursuant to subdivision (b), under the existing water supply entitlements, water rights or water service contracts."

2.3. Introduction to the SFPUC Water Supply Sources

The Regional Water System (RWS) currently delivers an annual average of approximately 265 million gallons of water per day (mgd), with approximately 85 percent of that water supply provided by the Hetch Hetchy system, which diverts water from the Tuolumne River. The balance (of approximately 15 percent) comes from runoff in the Alameda Creek watershed, which is stored in the Calaveras and San Antonio reservoirs, and runoff from the San Francisco Peninsula, which is stored in the Crystal Springs, San Andreas, and Pilarcitos reservoirs (which also provide storage for water delivered from the Hetch Hetchy Project). A small portion of retail demand is met through locally produced groundwater, used primarily for irrigation at local parks and on highway medians, and recycled water, which is used for wastewater treatment process water, sewer box flushing, and similar wash down operations. The SFPUC also retails groundwater (pumped from the Pleasanton well field) to the Castlewood development in Alameda County.

2.3.1. Surface Water Rights

The City and County hold pre-1914 appropriative water rights to store and deliver water from the Tuolumne River in the Sierra Nevada and locally from the Alameda and Peninsula watersheds. The City and County also divert and store water in the San Antonio Reservoir under an appropriative water right license granted by the State Water Resources Control Board (SWRCB) in 1959.

Appropriative water rights allow the holder to divert water from a source to a place of use not connected to the water source. These rights are based on seniority and use of water must be reasonable, beneficial, and not wasteful. In 1914, California established a formal water rights permit system, which is administered by the SWRCB. The SWRCB has sole authority to issue new appropriative water rights but cannot define property rights created under a pre-1914 appropriative water right.

The 1912 Freeman Report identified the ultimate diversion rate from the Tuolumne River to the Bay Area as 400 mgd and the City used this as the basis for designing the export capacity of the Hetch Hetchy project. The City has sufficient water rights for current diversions and the ultimate planned diversion rate of the Hetch Hetchy Project.

The federal Raker Act, enacted on December 19, 1913, grants to the City rights-of-way and public land use on federal property in the Sierra Nevada Mountains to construct, operate, and maintain reservoirs, dams, conduits, and other structures necessary or incidental to developing and using water and power. It also imposes restrictions on the City's use of the Hetch Hetchy Reservoir, including (among others) the requirement that the City recognize the senior water rights of the Turlock and Modesto Irrigation Districts (TID and MID) to divert water from the Tuolumne River. Specifically, the Raker Act requires the City to bypass certain flows through its Tuolumne River reservoirs to TID and MID for beneficial use. By agreement, the City, TID, and MID have supplemented these Raker Act obligations to increase the TID and MID entitlements to account for other senior Tuolumne River water rights and to allow the City to "pre-pay" TID and

MID their entitlement by storing water in the Don Pedro water bank. The City is required to bypass inflow to TID and MID sufficient to allow these districts to divert 2,416 cfs or natural daily flow, whichever is less, at all times (as measured at La Grange), except for April 15 to June 13, when the requirement is 4,066 cfs or natural daily flow as measured at La Grange, whichever is less.

2.4. Water Supply Considerations

The SFPUC prepared a Program Environmental Impact Report (PEIR) under CEQA for the Water System Improvement Program (WSIP). (A discussion of the WSIP follows in Section 2.7.1). At the request of the SFPUC, the San Francisco Planning Department studied the Phased WSIP Variant as part of the environmental analysis. The SFPUC identified this variant in order to consider a program scenario that involved full implementation of all proposed WSIP facility improvement projects to insure that the public health, seismic safety, and delivery reliability goals were achieved as soon possible, but phased implementation of a water supply program to meet projected water purchases through 2030. Deferring the 2030 water supply element of the WSIP until 2018 would allow the SFPUC and its wholesale customers to focus first on implementing additional local recycled water, groundwater, and demand management actions while minimizing additional diversions from the Tuolumne River.

The Phased WSIP Variant establishes a mid-term planning milestone in 2018 when the SFPUC would reevaluate water demands through 2030 in the context of then-current information, analysis, and available water resources. The SFPUC currently delivers on an annual average approximately 265 million gallons per day (mgd) from local watersheds (Peninsula and Alameda Creek) and the Tuolumne River Watershed. By 2030, demand on the SFPUC system is expected to increase to annual average of 300 mgd. The Phased WSIP Variant would meet the projected 2018 purchase requests of 285 mgd from the RWS by capping purchases at 265 mgd; the remaining 20 mgd would be met through water conservation, recycling, and groundwater use—10 mgd by Wholesale Customers and 10 mgd in the City. Before 2018, the SFPUC and the Wholesale Customers will engage in a new planning process to re-evaluate water system demands and supply options, including conducting additional studies and environmental reviews necessary to address water supply needs after 2018. Therefore, this WSA assumes the SFPUC will limit purchases to an annual average of 265 mgd from the RWS watersheds.

2.5. SFPUC Regional Water System

In 1934, San Francisco combined the Hetch Hetchy system and Spring Valley system to create the SFPUC RWS. The rights to local diversions were originally held by the Spring Valley Water Company, which was formed in 1862. The RWS is owned and operated by the City and County.

On average, the Hetch Hetchy Project provides over 85 percent of the water delivered and the balance approximately 15 percent is met through the Bay Area reservoirs. The RWS delivers an annual average of approximately 265 mgd – 81 mgd serves the Retail customers within the City and County of San Francisco and the other 184 mgd is delivered to the Wholesale customers. The RWS currently delivers water to 2.5 million users in Tuolumne, Alameda, Santa Clara, San Mateo, and San Francisco counties.

The RWS is a complex system, shown in Figure 2-1, and supplies water from two primary sources:

- Tuolumne River through the Hetch Hetchy Reservoir, and
- Local runoff into reservoirs in Bay Area reservoirs in the Alameda and Peninsula watersheds.

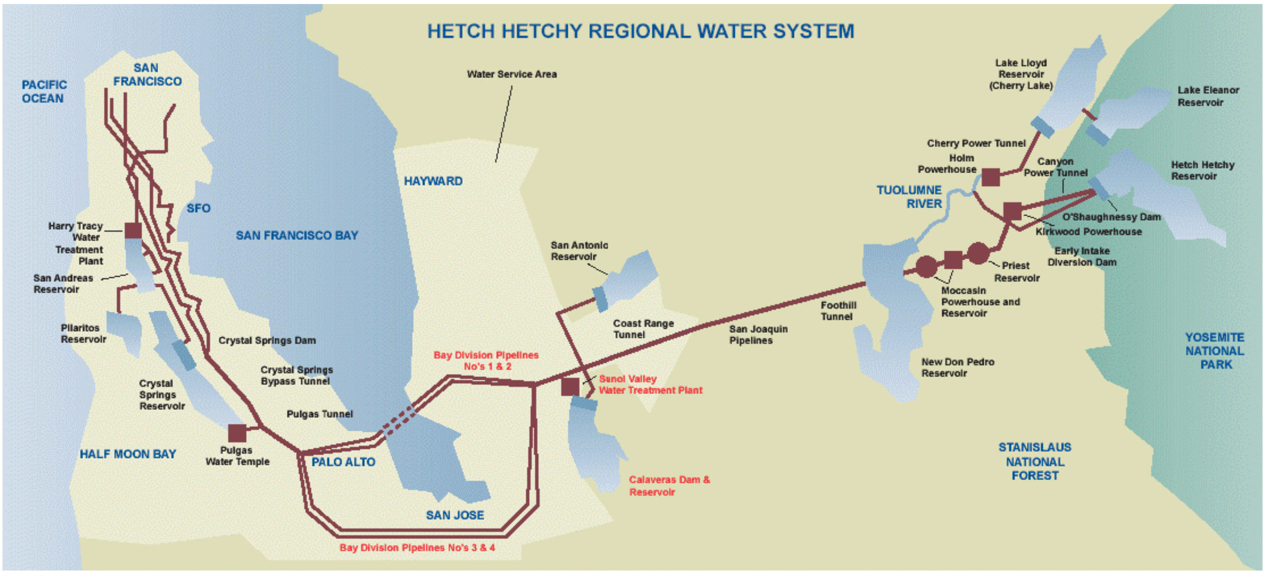

Figure 2-1: Regional Water Supply System

Water from Hetch Hetchy Reservoir, through the Hetch Hetchy facilities represents the majority of the water supply available to the SFPUC. On average, the Hetch Hetchy Project provides over 85 percent of the water delivered to the Bay Area. During droughts the water received from the Hetch Hetchy system can amount to over 93 percent of the total water delivered.

Bay Area reservoirs provide on average approximately 15 percent of the water delivered by the SFPUC RWS. The local watershed facilities are operated to conserve local runoff for delivery. On the San Francisco Peninsula, the SFPUC utilizes Crystal Springs Reservoir, San Andreas Reservoir, and Pilarcitos Reservoir to capture local watershed runoff. In the Alameda Creek watershed, the SFPUC constructed the Calaveras Reservoir and San Antonio Reservoir. In addition to capturing runoff, San Antonio, Crystal Springs, and San Andreas reservoirs also provide storage for Hetch Hetchy diversions. The local watershed facilities also serve as an emergency water supply in the event of an interruption to Hetch Hetchy diversions.

2.5.1. Local Groundwater

San Francisco overlies all or part of seven groundwater basins. These groundwater basins include the Westside, Lobos, Marina, Downtown, Islais Valley, South, and Visitation Valley basins. The Lobos, Marina, Downtown, and South basins are located wholly within the City limits, while the remaining three extend south into San Mateo County. The portion of the Westside Basin aquifer located within San Francisco is commonly referred to as the North Westside Basin. With the exception of the Westside and Lobos basins, all of the basins are generally inadequate to supply a significant amount of groundwater for municipal supply because of low yield.

Early in its history, San Francisco made significant use of local groundwater, springs, and spring-fed surface water. However, after the development of surface water supplies in the Peninsula and Alameda watersheds by Spring Valley Water Company and the subsequent completion of the Hetch Hetchy Reservoir and aqueduct in the 1930's, the municipal water supply system has relied almost exclusively on surface water from local runoff, the Alameda and Peninsula watersheds, and the Tuolumne River watershed. Local groundwater use, however, has continued in the City primarily for irrigation purposes. The San Francisco Zoo and Golden

Gate Park use groundwater for non-potable purposes. Current use accounts for annual average of approximately 2.5 mgd.

About one (1) mgd of groundwater is delivered to Castlewood Country Club from well fields operated by the SFPUC in Pleasanton and drawn from the Central Groundwater Sub Basin in the Livermore/Amador Valley. These wells are metered and have been in operation for several decades. For purposes of water accounting and billing, these deliveries to Castlewood are accounted for as part of San Francisco's Retail Customer base. Castlewood groundwater supplies are used entirely within Castlewood and not available for use in the City and County of San Francisco.

2.5.2. Local Recycled Water

From 1932 to 1981, the City's McQueen Treatment Plant provided recycled water to Golden Gate Park for irrigation purposes. Because of changes in regulations the City closed the McQueen plant and discontinued use of recycled water in Golden Gate Park. Currently, recycled water from the SFPUC's Southeast Water Pollution Control Plant is used on a limited basis for wash-down operations and is provided to construction contractors for dust control and other nonessential construction purposes. Current use of recycled water for these purposes in the City is less than one mgd.

2.5.3. Local Water Conservation

The SFPUC is committed to demand-side management programs and the City's per capita water use has dropped by about one-third since 1977 due, in part, to these programs. The first substantial decrease came following the 1976-77 drought in which gross per capita water use dropped from 160 to 130 gallons per capita per day (gpcd). Despite continuous growth in the City since then, water demands have remained lower than pre-drought levels.

A second substantial decrease in water use within the City occurred as a result of the 1987-92 drought when a new level of conservation activities resulted in further water use savings. It is anticipated that through the continuation and expansion of these programs, per capita water use will continue to decrease into the future. Current gross per capita water use within the City is 91.5 gpcd with residential water use calculated to be approximately 57 gpcd, the lowest use of any major urban area in the State.

The SFPUC's demand management programs range from financial incentives for plumbing devices to improvements in the distribution efficiency of the system. The conservation programs implemented by the SFPUC are based on the California Urban Water Conservation Council's list of fourteen Best Management Practices identified by signatories of the Memorandum of Understanding Regarding Urban Water Conservation in California executed in 1991.

2.6. Water Supply Reliability and Improvements

To improve dry-year supplies and ensure that the future water needs of its retail and wholesale customers will be met in a more reliable and sustainable manner, the SFPUC has undertaken water supply projects in the WSIP. In addition, the SFPUC is looking to diversify and enhance the City's water supply portfolio through the development of local water supplies, such as recycled water, groundwater, and water conservation.

2.6.1. Water System Improvement Program and the Phased WSIP Variant

The WSIP is a multi-billion dollar, multi-year, capital program to upgrade the RWS. The program will deliver improvements that enhance the SFPUC's ability to provide reliable, affordable, high quality drinking water to its 27 wholesale customers and regional Retail customers in Alameda, Santa Clara, and San Mateo counties, and to 800,000 Retail customers in San Francisco, in an environmentally sustainable manner.

As required under CEQA, the San Francisco Planning Department prepared a PEIR for the WSIP. The PEIR evaluated the potential environmental impacts of the proposed WSIP and identified potential mitigations to those impacts. The PEIR also evaluated several alternatives to meet the SFPUC service area's projected increase in water demand between now and 2030. The water supply improvement options investigated included 10 alternatives using various water supply combinations from the local watersheds; the Tuolumne and Lower Tuolumne; ocean desalination; and additional recycled water, groundwater, and conservation.

The PEIR was certified by the San Francisco Planning Commission on October 30, 2008. On the same day the SFPUC adopted the Phased WSIP Variant option. (Appendix B contains the SFPUC Commission Agenda Item for approval of the PEIR)

2.6.1.1. Phased WSIP Variant

At the request of the SFPUC, the San Francisco Planning Department studied the Phased WSIP Variant as part of the environmental analysis. The SFPUC identified this variant in order to consider a program scenario that involved full implementation of all proposed WSIP facility improvement projects to insure that the public health, seismic safety, and delivery reliability goals were achieved as soon possible, but phased implementation of a water supply program to meet projected water purchases through 2030. Deferring the 2030 water supply element of the WSIP until 2018 would allow the SFPUC and its wholesale customers to focus first on implementing additional local recycled water, groundwater, and demand management actions while minimizing additional diversions from the Tuolumne River.

The Phased WSIP Variant establishes a mid-term planning milestone in 2018 when the SFPUC would reevaluate water demands through 2030 in the context of then-current information, analysis and available water resources. The SFPUC currently delivers on an annual average approximately 265 million gallons of water per day from local watersheds (Peninsula and Alameda Creek) and the Tuolumne River Watershed. By 2030, demand on the SFPUC system is expected to increase to an annual average of 300 million gallons of water per day. The Phased WSIP Variant would meet the projected 2018 purchase requests of 285 mgd from the RWS by capping purchases from the watersheds at 265 mgd; the remaining 20 mgd would be met through water efficiencies and conservation, water recycling and local groundwater use—10 mgd by Wholesale Customers and 10 mgd in the City and County. Before 2018, the SFPUC and the Wholesale Customers will engage in a new planning process to reevaluate water system demands and supply options, including conducting additional studies and environmental reviews necessary to address water supply needs after 2018.

The Phased WSIP Variant includes the following key program elements:

- Full implementation of all WSIP facility improvement projects.
- Water supply delivery to RWS customers through 2018 only of 265 mgd average annual target delivery originating from the watersheds. This includes 184 mgd for the Wholesale Customers and 81 mgd for the Retail Customers.
- Water supply sources include: 265 mgd average annual from the Tuolumne River and local watersheds and 20 mgd of water conservation, recycled water and local groundwater developed within the SFPUC's service area (10 mgd Retail; 10 mgd wholesale).

- Dry-year water transfers of 2 mgd coupled with the Westside Groundwater Basin Conjunctive Use Project.
- Re-evaluation of 2030 demand projections, potential RWS purchase requests and water supply options by December 31, 2018 and a separate SFPUC decision in 2018 regarding RWS water deliveries after 2018.
- The ability to impose financial penalties is included in the new Water Supply Agreement to limit water sales to an average annual of 265 mgd from the watersheds.

The additional 10 mgd of supplies produced in San Francisco by implementation of the local WSIP programs have been included in this WSA. This WSA assumes WSIP local water supplies will be in place in the timeframes stated in the SFPUC WSIP, with this assumption total Retail supplies increase to 94.50 mgd in 2015 and remain constant over the 20-year planning horizon. Projects related to these efforts are detailed below. WSIP programs, financials and progress-to-date is presented in Appendix C.

2.6.2. Local Groundwater Projects

2.6.2.1. San Francisco Groundwater Supply Project

The San Francisco Groundwater Supply Project would provide up to 4 mgd of local groundwater water to improve reliability during drought or maintenance conditions, as well as ensure that a reliable, high-quality source of water is available in the case of an earthquake or other emergency. The project proposes the construction of up to six wells and associated facilities in the western part of San Francisco to extract up to 4 mgd of groundwater water from the Westside Groundwater Basin for distribution in the City. The extracted groundwater, which would be used both for regular and emergency water supply purposes, would be disinfected and blended in small quantities with imported surface water before entering the municipal drinking water system. The environmental review for this project begins in November 2009.

2.6.2.2. Lake Merced Water Level Restoration Project

The goal of the Lake Merced Water Level Restoration Project is to protect and balance the beneficial uses of Lake Merced by providing a more stable water level regime using groundwater and stormwater, rather than supplies provided through the RWS.

2.6.2.3. Local Recycled Water Projects

In March 2006, the SFPUC updated the Recycled Water Master Plan (RWMP) for the City. The 2006 RWMP identified where and how San Francisco could most feasibly develop recycled water in the City and provided strategies for implementing the recycled water projects that were identified.

The proposed Westside, Harding Park and Eastside Recycled Water Projects would provide up to 4 mgd of recycled water to a variety of users in San Francisco. Recycled water will primarily be used for landscape irrigation, toilet flushing and industrial purposes. The Harding Park Project has completed environmental review, and the Westside Project will begin environmental review in late 2009 or early 2010.

The proposed Westside Project would bring recycled water from the proposed recycled water treatment facility in Golden Gate Park to the San Francisco Zoo, Golden Gate Park, and Lincoln Park Golf Course. Recycled water would be used for irrigation at all three sites; additionally, it would be used for non-potable uses in Golden Gate Park at the California Academy of Sciences. The proposed Harding Park Recycled Water Project would use available recycled water from the North San Mateo County Sanitation District (NSMCSD) located in Daly City, to irrigate Harding Park and Fleming Park golf courses in San Francisco. The SFPUC has partnered with the NSMCSD for this proposed project.

Currently, the SFPUC is conducting a recycled water demand assessment on the Eastside of San Francisco. The assessment examines the potential uses of recycled water for irrigation, toilet flushing, and commercial applications. The WSIP contains funding for planning, design, and environmental review for the San Francisco Eastside Recycled Water Project.

2.6.3. Local Water Conservation

The SFPUC has also increased its water conservation programs in an effort to achieve new water savings by 2018. The SFPUC's conservation program is based on the Demand Study that identified water savings and implementation costs associated with a number of water conservation and efficiency measures. The Demand Study evaluated the costs and benefits of implementing 48 different conservation measures using an end-use model. The results indicated that local conservation programs implemented through 2030 could cumulatively reduce Retail purchases from the SFPUC RWS by 4.5 mgd in year 2030. These new conservation programs include high-efficiency toilet replacement in low-income communities, plumbing retrofits in compliance with the 1992 California plumbing code and water efficient irrigation systems in municipal parks. Through its expanded conservation program, the SFPUC anticipates reducing gross per capita consumption from 91.5 gpcd to 87.4 gpcd by 2018 for an average daily savings of approximately 4.0 mgd.

2.6.4. Summary of New Local Water Supply Programs

As previously stated, the SFPUC anticipates that the expanded groundwater and recycled water production, and increased conservation programs will provide the City with an additional 10 mgd of local WSIP water supplies. As quantified in Table 2-2 with implementation of the WSIP, the SFPUC expects to have in these local WSIP supplies in place by 2015. These programs and projects are reliable in all hydrologic conditions and are not subject to RWSAP reductions or curtailments. (Appendix C contains the Summary of the WSIP Projects, a Quarterly Progress Report [April – June 2009] and other progress-to-date information)

Table 2-2: WSIP Water Supply Sources (mgd)

WSIP Water Supplies	2010	2015	2020	2025	2030
Groundwater	0.0	2.0	2.0	2.0	2.0
Recycled Water	0.0	4.0	4.0	4.0	4.0
Conservation	0.0	4.0	4.0	4.0	4.0
Total New Supplies	**0.0**	**10.0**	**10.0**	**10.0**	**10.0**

Source: SFPUC Water System Improvement Program, October 2008.

2.7. Total SFPUC Retail Water Supplies

Table 2-2 summarizes the SFPUC's total water supplies now and over the 20-year planning period. In 2010, prior to the development of the 10 mgd of local supplies, the SFPUC can access an annual average 84.50 mgd from all sources discussed above. Beginning in 2015, when the WSIP water supply sources are readily available, the SFPUC's Retail water supplies increase to 94.5 mgd. These supplies are assumed to be available in the quantities listed in Table 2-2. The SFPUC intends to use these supplies to meet its Retail customer demands.

Figure 2-1 is a graphical representation of the SFPUC's current supply sources and the WSIP local supply sources. As shown in Figure 2-2, the supplies grow from 84.5 mgd in 2010 to 94.5 mgd as the WSIP local supplies are brought into the SFPUC Retail supply system. The figure shows the total supplies increasing in 2015 and holding constant over the 20-year planning horizon.

Table 2-2: SFPUC Water Supplies 2010 – 2030 (mgd)

Water Supply Sources	2010	2015	2020	2025	2030
Current Water Supply Sources					
SFPUC RWS (Surface water: Tuolumne River, Alameda & Peninsula)(1)	81.0	81.0	81.0	81.0	81.0
Groundwater Sources					
Groundwater (In-City Irrigation Purposes)	2.5(2)	0.5(3)	0.5(3)	0.5(3)	0.5(3)
Groundwater at Castlewood(4)	1.0(4)	1.0(4)	1.0(4)	1.0(4)	1.0(4)
Groundwater: Treated for Potable – Previously used for In-City Irrigation purposes(5)	0.0	2.0	2.0	2.0	2.0
Groundwater Subtotal	**3.5**	**3.5**	**3.5**	**3.5**	**3.5**
Current Water Supply Subtotal	**84.5**	**84.5**	**84.5**	**84.5**	**84.5**
WSIP Water Supply Sources					
Groundwater Development: Potable from SF GWSP (Westside Groundwater Basin)(6)	0.0	2.0	2.0	2.0	2.0
Recycled Water Expansion Irrigation(7)	0.0	4.0	4.0	4.0	4.0
Supply Conservation Program	0.0	4.0	4.0	4.0	4.0
WSIP Supply Subtotal	**0.0**	**10.0**	**10.0**	**10.0**	**10.0**
Total Retail Supply (Current and WSIP Supplies)	**84.5**	**94.5**	**94.5**	**94.5**	**94.5**

Notes:
1. RWS surface water supplies are subject to reductions due to below-normal precipitation. This may affect dry year supplies - model shows supply reduction occurs in year 2 of multiple dry year event. (Source: SFPUC 2008 WSIP Phase Variant Supply limitation)
2. Groundwater serves irrigation to Golden Gate Park, SF Zoo, and Great Highway Median. (Source: 2005 SFPUC UWMP Table 8B page 43)
3. A Groundwater reserve of 0.5 mgd for irrigation purposes will remain as part of SFPUC's non-potable groundwater supply. (Source: SFPUC 2008 WSIP Phase Variant)
4. Castlewood current and projected use remains unchanged over 20 year planning horizon. (Source: 2005 SFPUC UWMP Table 8B page 43)
5. 2.0 mgd of groundwater treated and blended for Potable water supply purposes. (Source: 2005 SFPUC UWMP Table 8B page 43)
6. 2.0 mgd of new groundwater developed as part of the new local supply target. (Source: SFPUC 2008 WSIP Phase Variant Supply Target)
7. 2.0 mgd of Recycled used for irrigation at Golden Gate Park, SF Zoo, Great Highway Median, and 2.0 mgd for other non-potable purposes. (Source: SFPUC 2008 WSIP Phase Variant Supply Target)

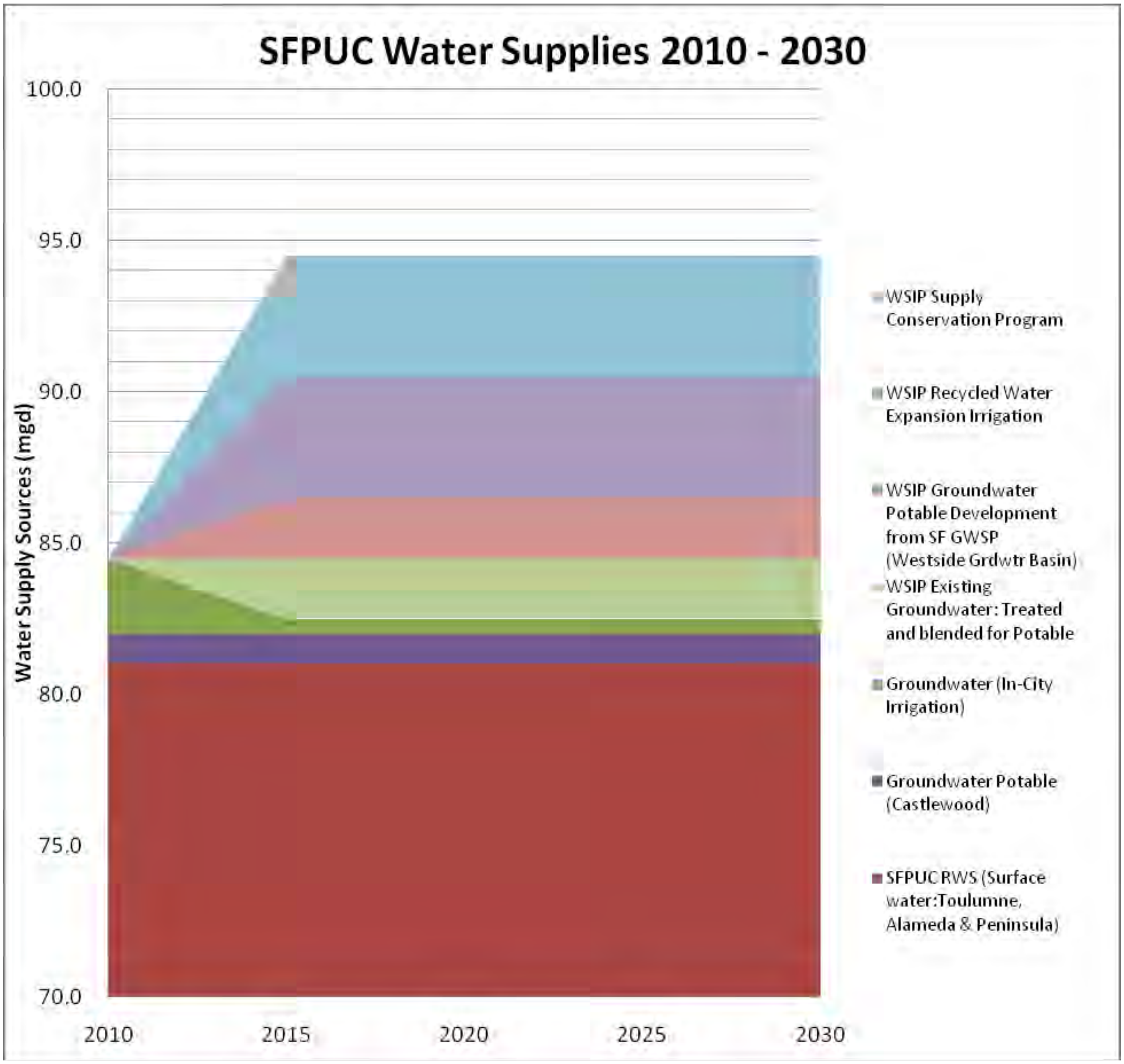

Figure 2-2: SFPUC Water Supplies

2.7.1. New Drought Supplies

As outlined above, the WSIP includes development of dry-year supplies for the RWS – these supplies would be readily available during dry years when the watershed supplies are cutback due to below-normal precipitation. The PEIR also included an analysis of dry-year water supply transfers from the senior water rights holders (MID and TID) on the Tuolumne River in 2018; a groundwater conjunctive use project; and, a regional desalination project. The latter two projects are described in greater detail in Section 3.4. The SFPUC is currently investigating the possibility of a dry-year water transfer with MID and TID in 2018.

3.0 DROUGHT SUPPLY PLANNING AND WATER SUPPLY RELIABILITY

3.1. Overview

The SFPUC water supply system reliability is expressed in terms of its ability to deliver water during droughts. Reliability is defined by the amount and frequency of water delivery reductions required to balance customer demands with available supplies in droughts. The SFPUC has a reliability goal of meeting dry-year delivery needs while limiting rationing to a maximum 20 percent system-wide reduction in water service during extended droughts.

The total amount of water the SFPUC has available to deliver to its retail and wholesale customers during a defined period of time is dependent on several factors. These include the amount of water that is available to the SFPUC from natural runoff, the amount of water in reservoir storage, and the amount of water that must be released from the SFPUC's system for commitments to purposes other than customer deliveries, such as releases below Hetch Hetchy reservoir to meet the Raker Act and fishery purposes.

The SFPUC operates its system to optimize the reliability and quality of its water deliveries. Hetch Hetchy Reservoir operations are guided by two principal objectives: collection of Tuolumne River water runoff for diversion to the Bay Area; and fulfillment of the SFPUC's downstream release obligations. To conserve runoff, Hetch Hetchy Project reservoirs are drawn down beginning in early winter, relying on the recurrence and forecast of snow melt to guide drawdown releases. Similarly, the RWS Bay Area reservoirs are operated to conserve watershed runoff. As such, reservoirs are drawn down during the winter period to capture storms and reduce the potential for spilling water out of the reservoirs. In the spring, excess Hetch Hetchy water supply (snowmelt) is transferred to three of the Bay Area reservoirs, capable of receiving the water, to fill any unused reservoir storage.

Prior to the late 1970's, droughts did not seriously affect the ability of the SFPUC to sustain full deliveries to its customers. However, as the 1987-1992 drought progressed and reservoir storage continued to decline, it became apparent that continued full deliveries could not be sustained without the risk of running out of water before the drought ended.

To provide some level of assurance that water could be delivered continuously throughout a drought (although at reduced levels), the SFPUC adopted a drought planning sequence and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in SFPUC's reservoirs. Each year, during the snowmelt period, the SFPUC evaluates the amount of total water storage expected to occur throughout the RWS. If this evaluation finds the projected total water storage to be less than an identified level sufficient to provide sustained deliveries during drought, the SFPUC may impose delivery reductions or rationing.

SFPUC's UWMP assumes "firm" delivery "as the amount the system can be expected to deliver during historically experienced drought periods."[6] The 1987 to 1992 drought is the basis for this plan, plus an additional period of limited water availability.[7] The SFPUC plans its water deliveries assuming that the worst drought experience is likely to recur and then adds an additional period of limited water availability. An 8.5-year drought scenario is referred to as the "design drought" and is ultimately the basis for SFPUC's water resource planning and modeling.

6 San Francisco Public Utilities Commission. December 2005. *Urban Water Management Plan*. p. 21.
7 San Francisco Public Utilities Commission. December 2005. *Urban Water Management Plan*. p. 21.

The "design drought" is based on the 1986-1992 drought plus 2.5 years of "prospective drought", which includes 6 months of recovery period.[8]

3.1.1. Water Shortage Allocation Plan

During a drought, it is expected that the retail and wholesale customers would experience a reduction in the amount of water received from the RWS. The amount of this reduction has been dictated by existing contractual agreements between the SFPUC and the Wholesale Customers, as detailed in the existing Water Shortage Allocation Plan (WSAP). The WSAP provides specific allocations of available water between the retail and wholesale customers collectively associated with different levels of system-wide shortages, as shown in Table 3-1.

Table 3-1: WSAP Allocation

Level of System-Wide Reduction in Water Use Required	Share of Available Water	
	SFPUC Share	Wholesale Customers Share (collectively)
5% or less	35.5%	64.5%
6% through 10%	36.0%	64.0%
11% through 15%	37.0%	63.0%
16% through 20%	37.5%	62.5%

In addition to providing an allocation method, the plan also includes provisions for transfers, banking and excess use charges.

Under the WSAP, SFPUC retail customers would experience no reduction in deliveries at a 10 percent shortage. However, during a 20 percent system-wide shortage, the retail customers would experience a 1.9 percent reduction in retail deliveries. This assumes the development of the additional 10 mgd of local supplies in the retail service area. These additional supplies are not subject to a reduction under the WSAP as the WSAP only allocates water from the RWS. Table 3-2 compares SFPUC RWS retail supplies during normal, single dry year, and multiple dry year periods.

Table 3-2: 2005 – 2030 SFPUC Retail Allocations in Normal, Dry and Multiple Dry Years

	Normal Year		Single Dry Year		Multiple Dry Year Event Year 1		Year 2		Year 3	
	mgd	%	mgd	%	mgd	%	mgd	%	mgd	%
2010	81.0	100%	81.0	100.0%	81.0	100.0%	79.5	98.1%	79.5	98.1%
2015	81.0	100%	81.0	100.0%	81.0	100.0%	79.5	98.1%	79.5	98.1%
2020	81.0	100%	81.0	100.0%	81.0	100.0%	79.5	98.1%	79.5	98.1%
2025	81.0	100%	81.0	100.0%	81.0	100.0%	79.5	98.1%	79.5	98.1%
2030	81.0	100%	81.0	100.0%	81.0	100.0%	79.5	98.1%	79.5	98.1%

Notes:
1. In 2010 the retail allocation of RWS supply is reduced to 81 mgd to reflect the retail allocation under the 2018 Phased WSIP Variant. 10 mgd of recycled water, groundwater, and conservation will be implemented by 2015 to make up for the loss in RWS supply. The 10 mgd of local supply is not subject to reduction under the WSAP.
2. Under the WSAP, the SFUPC retail allocations at a 10 percent shortage are 85.86 mgd. However, due to the Phased WSIP Variant, only 81 mgd of RWS supply is shown. The remaining supply can be transferred to the Wholesale Customers under the terms of the Water Supply Agreement.

Source: San Francisco Public Utilities Commission. 2005. Urban Water Management Plan for the City and County of San Francisco. p. 54-57 and discussions with SFPUC staff.

8 San Francisco Public Utilities Commission. April 2000. *Water Supply Master Plan*. p. 22.

The WSAP has been carried forward in the new Water Supply Agreement for system-wide shortages of up to 20 percent. For shortages in excess of this amount, the Water Sales Agreement provides that the SFPUC may allocate water in its discretion.

3.2. Retail Water Shortage Allocation Plan

San Francisco has established criteria that relate water deliveries to water supply and the SFPUC's objectives to manage water deliveries during extended drought. These criteria provide guidance to the SFPUC for the determination of the annual availability of water. The structure of the criteria was developed during the course of the 1987-92 drought period and incorporates procedures which were implemented during actual operations.

The established water delivery criteria incorporate a three-level staging of delivery reductions: the first stage is associated with voluntary actions by customers and the second and third stages are associated with mandatory rationing programs enforced by the SFPUC. Depending on the level of water demand and the desired maximum delivery reduction, one, two or all three of the stages are required. These criteria have been found to be viable through computer simulation of historical drought events and resultant SFPUC operations.

Based on past drought experience and the established criteria, San Francisco's Retail Water Shortage Allocation Plan (RWSAP) was adopted to formalize the three-stage program of action to be taken in San Francisco to reduce water use during a drought.

In accordance with the RWSAP, prior to the initiation of any water delivery reductions in San Francisco, whether it be initial implementation of reduction delivery or increasing the severity of water shortage, the SFPUC would outline a drought response plan that would address the following: the water supply situation; proposed water use reduction objectives; alternatives to water use reductions; methods to calculate water use allocations and adjustments; compliance methodology and enforcement measures; and, budget considerations. This drought response will be presented at a regularly scheduled SFPUC Commission meeting for public input. The meeting will be advertised in accordance with the requirements of Water Code Section 6066 of the Government Code, and the public will be invited to comment on the SFPUC's intent to reduce deliveries.

Depending on the level of water demand and the desired objective for water use reduction, one, two, or all three stages of the RWSAP may be required.

<u>Stage 1 (Voluntary)</u>

- System-wide demand reductions of 5-10 percent experienced
- Voluntary rationing request of customers
- Customers are alerted to water supply conditions
- Remind customers of existing water use prohibitions
- Education on, and possible acceleration of, incentive programs

<u>Stage 2 (Mandatory)</u>

- System-wide demand reductions of 11-20 percent experienced
- All Stage 1 actions implemented
- All customers receive an "allotment" of water based on the Inside/Outside allocation method (based on base year water usages for each account)

- Water use above the "allocation" level will be subject to excess use flow restrictor devices and shut-off of water

Stage 3 (Mandatory)

- System-wide demand reductions of 20 percent or greater experienced
- Same actions as in Stage 2 with further reduced allocations

3.3. Urban Water Management Planning Act (Water Code Section 10632)

Pursuant to the Urban Water Management Planning Act (Water Code Section 10632), water suppliers with an existing dry year shortage contingency plan can implement subsequent stages of demand reduction measures listed in its UWMP as a strategy to balance supply and demand. The WSAP and the RWSAP, contained in Section 9 of the SFPUC's 2005 UWMP is the SFPUC's dry year shortage contingency plan that allows the SFPUC to reduce water deliveries to customers and implement demand reductions during periods of water shortage. Therefore, when a supply deficit occurs, the SFPUC would follow its adopted water shortage contingency plans (WSAP and RWSAP) to implement drought-planning sequences and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in the SFPUC reservoirs. These delivery reductions allow the SFPUC to maintain water in storage over an extended period. In addition, under the RWSAP, the SFPUC would balance Retail supply curtailments by reducing demand.

3.4. Dry Year Water Supply Projects

As discussed in Section 2.7, the SFPUC, as part of the WSIP, has currently engaged the following projects or programs as methods to improve RWS dry-year supplies. Within the WSIP, the SFPUC addressed the development of supplies to be utilized during dry year events. These plans include the use of recycled water as component of a conjunctive use program and participation in the development of Bay Area desalination plant. Each of these plans is discussed below.

3.5. Development of Dry Year Supplies

3.5.1. Groundwater Storage and Recovery Project

The proposed Regional Groundwater Storage and Recovery Project would balance the use of both groundwater and surface water to increase water supply reliability during dry years or in emergencies. The proposed project is located in San Mateo County and is sponsored by the SFPUC in coordination with its partner agencies, the California Water Service Company, City of Daly City and City of San Bruno. The partner agencies currently purchase wholesale surface water from the SFPUC and also independently operate groundwater production wells for drinking water and irrigation.

The proposed Regional Groundwater Storage and Recovery Project would extract groundwater from the South Westside Basin groundwater aquifer in San Mateo County. The project would consist of installing up to 16 new recovery well facilities in northern San Mateo County to pump stored groundwater during a drought. During years of normal or heavy precipitation, the proposed project would provide surface water to the partner agencies in order to reduce the amount of groundwater pumped. Over time, the reduced pumping would result in the storage of approximately 61,000 acre-feet of water (more than the supply contained in the Crystal Springs Reservoir on the SFPUC Peninsula Watershed). This would allow recovery of this stored water at a rate of up to 7.2 mgd for a 7.5-year dry period. The water would be in compliance with the California Department of Public Health requirements for drinking water supplies. This project would include construction of well pump stations, disinfection units, and piping. This project is currently undergoing environmental review.

3.5.2. Desalination

The SFPUC's investigations of desalination as a water supply source have focused primarily on the potential for regional facilities. The proposed Bay Area Regional Desalination Project is a joint venture between the SFPUC, Contra Costa Water District, East Bay Municipal Utility District, and the Santa Clara Valley Water District. The regional desalination project would: provide an additional source of water during emergencies; provide a supplemental water supply source during extended droughts; allow other major water facilities to be taken out of service for maintenance or repairs; and increase supply reliability by providing water supply from a regional facility. The Bay Area Regional Desalination Project would have an ultimate total capacity of up to 65 mgd.[9]

9 EBMUD, "Desalination Project", www.ebmud.com/water_&_environment/water_supply/current_projects/desalination_project/default.htm, accessed July 30, 2009.

4.0 WATER DEMAND OVERVIEW

The SFPUC provides wholesale water service to 27 Bay Area water agencies located in Alameda, San Mateo and Santa Clara Counties (Wholesale Customers), and also serves as the retail water supplier for the City. This section shows the calculated water demand for the proposed project as well the calculated water demand projections for San Francisco based on recent housing and population forecasts within the entire system.

4.1. Overview

Over 2.5 million people in Bay Area counties currently rely on water supplied by the SFPUC RWS. The water supplied by the RWS comes from sources in the Bay Area (reservoirs with local runoff) and water from the Tuolumne River watershed. The water is of excellent quality and reasonable cost, and is a positive factor in attracting businesses, new residents, and industry to the Bay Area.

In addition to providing wholesale water supply, the SFPUC provides retail water service to residents, businesses, and institutions within the City limits, as well as to a number of residential and commercial accounts in the Bay Area and the Sierra Nevada foothills.

Wholesale Customers: The SFPUC provides wholesale water service to 27 Bay Area water agencies in Alameda, San Mateo, and Santa Clara Counties under the terms of a recently renegotiated Water Supply Agreement. The SFPUC supplies approximately 65 percent of the total wholesale customer water demand. Some of the wholesale water customers rely entirely on the SFPUC for their water supplies.

Retail Customers: The SFPUC's retail water customers include the residents, businesses, and industries within the municipal boundaries of the City and County. In addition to these customers, retail water service is also provided to other customers in the Bay Area and Sierra Nevada foothills. These accounts include the San Francisco International Airport and the San Francisco County Jail in San Mateo County, the unincorporated Town of Sunol and Lawrence Livermore Laboratory in Alameda County, and the Groveland Community Services District in Tuolumne County. In addition, the SFPUC retails groundwater (pumped from the Pleasanton well field) to the Castlewood development in Alameda County.

Historically, approximately 96 percent of the SFPUC's retail water demands have been met through deliveries from the SFPUC RWS. A small portion of San Francisco's demand is met through locally produced groundwater and secondary treated recycled water. The groundwater is used primarily for irrigation at local parks and on highway medians. The recycled water is used mostly at municipal facilities for wastewater treatment process water, sewer box flushing, and similar wash down operations.

4.2. Historical System Demand

Table 4-1 presents the historical water demands in the SFPUC Retail service area in fiscal years 2000-2008 and shows the changes in demands over this same year period. As shown in Table 4-1, over the last eight years, total demand in the Retail service area has decreased by 7.9 mgd.

Table 4-1: SFPUC Water Demands (mgd)

Fiscal Years[1]	2000	2001	2002	2003	2004	2005	2006	2007	2008
In City Retail Total	83.3	84.2	84.2	81.3	78.4	78.4	78.1	75.5	75.3
Outside Retail Customers[2]	8.4	8.4	8.6	8.2	9.1	9.1	7.7	8.4	8.5
Total Demand[3]	**91.7**	**92.6**	**92.8**	**89.5**	**87.5**	**87.1**	**85.8**	**83.9**	**83.8**

Notes:
1. Fiscal Years June to July
2. Other Retail Customers include: Groveland CSD, Lawrence Livermore Laboratory, City Irrigation, Castlewood.
3. Includes Unaccounted for water
Source: SFPUC 2005 UWMP and data from SFPUC staff August 2009.

4.3. Proposed Project Water Demand

The project sponsor's water resource consultants provided the expected water use of the proposed project under different development scenarios. An independent analysis was performed as a part of the Water Supply Availability Study (Appendix D) by analyzing similar land uses and assigning a demand factor for each use. The results of the independent analysis conclude that the demand estimates provided by the project sponsors are reliable. Proposed project implementation is expected by 2015 and build-out is expected by 2030.

Table 4-2 and Table 4-3 estimate the projected water demand at the project site with compliance to the California plumbing code and San Francisco's Green Building Ordinance. Each of the demand scenarios is described below.

Table 4-2: Water Demands for Proposed R&D Variant (mgd)(1)

Land and Facility Uses	Units/Area	Candlestick Point (mgd)	Hunters Point & Shipyard (mgd)	Total (mgd)
Residential	10,500 DU	0.61	0.22	0.83
Community Uses	100,000 gsf	0.01	0.01	0.02
Residential Uses Subtotal		**0.62**	**0.23**	**0.85**
Parks and Open Space Irrigation	336.4 acres	0.05	0.14	0.19
Residential and Irrigation Subtotal		**0.67**	**0.38**	**1.05**
Hotel	150,000 gsf	0.05	0.00	0.05
Office	150,000 gsf	0.04	0.02	0.06
R & D	5,000,000 gsf	0.00	0.71	0.71
Neighborhood Retail	250,000 gsf	0.02	0.02	0.03
Regional Retail	635,000 gsf	0.08	0.00	0.08
Football Stadium	~	0.00	0.00	0.00
Performance Venue	10,000 seats	0.01	0.00	0.01
Non-Residential Subtotal	~	**0.20**	**0.75**	**0.95**
Total Demand(1)		**0.88**	**1.13**	**1.99**
Existing Demand				0.30
Net Change in Demand				**1.69**

Note:
DU = dwelling unit; gsf = gross square footage
1. Average annual demands. Water demand for the proposed project were provided to the City by project developer. They were developed using an end use model on a per-unit or per-employee basis. The developer demands were independently reviewed by PBS&J and the SFPUC as part of this Study, and appear consistent with the SFPUC demand estimates. (Appendix D SFPUC Water Supply Availability Study [Appendix B]) Source: Lennar Urban, Water Demand Memorandum for Candlestick Point-Hunters Point Development, ARUP with Winzler & Kelly, September 25, 2009.
2. Includes local system losses, process water and miscellaneous uses of approximately 0.02 to 0.03 mgd.
Source: PBS&J October 2009.

Table 4-3: Water Demands with Proposed Stadium (mgd)[1]

Land and Facility Uses	Units/Area	Candlestick Point (mgd)	Hunters Point & Shipyard (mgd)	Total (mgd)
Residential	10,500 DU	0.61	0.22	0.83
Community Uses	100,000 gsf	0.01	0.01	0.02
Residential Uses Subtotal		**0.62**	**0.23**	0.85
Parks and Open Space Irrigation	336.4	0.06	0.15	0.21
Irrigation Subtotal		**0.67**	**0.38**	1.06
Hotel	150,000 gsf	0.05	0.00	0.05
Office	150,000 gsf	0.04	0.02	0.06
R & D	2,500,000 gsf	0.00	0.36	0.36
Neighborhood Retail	250,000 gsf	0.02	0.02	0.04
Regional Retail	635,000 gsf	0.08	0.00	0.08
Football Stadium	69,000 seats	0.00	0.02	0.02
Performance Venue	10,000 seats	0.01	0.00	0.01
Non-Residential Subtotal		**0.20**	**0.42**	**0.62**
Total Demand[a]		**0.88**	**0.79**	**1.67**
Existing Demand				0.30
Net Change in Demand				**1.37**

Note:
DU = dwelling unit; gsf = gross square footage
1. Average annual demands. Water demand for the proposed project were provided to the City by project developer. They were developed using an end use model on a per-unit or per-employee basis. The developer demands were independently reviewed by PBS&J and the SFPUC as part of this Study, and appear consistent with the SFPUC demand estimates. (Appendix D SFPUC Water Supply Availability Study [Appendix B]) Source: Lennar Urban, Water Demand Memorandum for Candlestick Point-Hunters Point Development, ARUP with Winzler & Kelly, September 25, 2009.
2. Includes local system losses, process water and miscellaneous uses of approximately 0.02 to 0.03 mgd.
Source: PBS&J October 2009.

Table 4-2 presents the proposed project demand under the R&D Variant, which estimates a conservative demand based on higher end-use of Research & Development (R&D) at the project site. Total demand at the project site is estimated at 1.99 mgd. Annual potable demand is estimated at 2,230.0 acre-feet per year.

Existing demand at the project site is reported at 0.3 mgd.[10] Therefore, the net change in daily demand at the project site under the R&D Variant is estimated at 1.69 mgd or an annual potable demand is 1,893.7 acre-feet per year.

Table 4-3 presents the proposed project demand with development of a new NFL stadium (Stadium) in place of an additional 2.5 million square feet of R&D space. Total demand at the project site is estimated at 1.67 mgd. Annual potable demand is estimated at 1,871.3 acre-feet per year.

Existing demand at the project site is reported at 0.3 mgd.[11] Therefore, the net change in daily demand at the project site under the Stadium development is estimated at 1.67 mgd or an annual potable demand is 1,893.7 acre-feet per year. The net change in demand is estimated at 1.37 mgd or 1,535.2 acre-feet per year.

4.4. Potential Recycled Water of Proposed Project

As described in the WSAS, on-site recycled water facilities developed at the project site could be used to offset the potable water demand. It is estimated that recycled water demand could be at least 0.89 mgd; however, this is contingent upon the level of development at the project site. At this time, on-site recycled water facilities are in the planning stages and have not been

10 SFPUC billing information from staff. July 2009.
11 SFPUC billing information from staff. July 2009.

fully evaluated; therefore, this WSA provides a conservative water supply analysis without on-site recycled water at the project site. It should be noted, that recycled water, generated on-site is considered additional water supply sources beyond the SFPUC's WSIP recycled water supplies.

4.5. City of San Francisco Retail Water Demand Analysis

To update the water supply and demand estimates provided in the 2005 UWMP, the SFPUC developed a Water Supply Availability Study (Appendix D) The WSAS incorporates new water supply information (per the Phased Variant WSIP) and generates new estimates of future water demand, which were based on new population and employment estimates, including several major development proposals not anticipated in the 2005 UWMP, including the proposed project (abbreviated as CP-HPS II), Treasure Island-Yerba Buena Island (TI-YBI) and Parkmerced.

To update future water demand, the WSAS compared the estimates of residential households and employees used in the 2005 UWMP with new population and employment forecasts provided by the San Francisco Planning Department,[12] which were designed to closely match the recently adopted Association of Bay Area Governments (ABAG) Projections 2009 target, but taken into account local knowledge of projects currently in various stages of the entitlement process. Updated water demand estimates were then generated, which included the incremental future growth that was not previously included in the 2005 UWMP estimates.

The new demand estimates also incorporate the results of the 2004 Demand Report, which analyzed water demands associated with each retail customer sector and included development of a water use model. The water use model accounts for demand at the end use level (such as individual toilets and showers), and established water use rates for specific units, including multiple family residential households and employees, the latter of which is used to estimate non-residential water demands. The WSAS used an average of these water use rates over the next 20 years (2010-2030) to establish a water use rate for multi-family residential households of 98.7 gpd, and a water use rate for employees of 42.42 gpd. With these unit rates, future water demand can be estimated from changes in the number of residential households and/or employees in San Francisco.

4.5.1. Water Demand of Major Development Projects and Incremental Growth

Upon buildout in 2030, the development at the CP-HPS II project site and two other large development projects represent the majority of new growth in San Francisco above the 2030 growth projected in the 2005 UWMP. Table 4-4 shows the total water demand of the proposed project, the R&D Variant and other proposed developments currently in the SF Planning development pipeline. The CP-HPS II project includes a number of different development scenarios, the estimated water demands of the two main proposed development scenarios are also shown in Table 4-4.

As stated previously, the Demand Report analyzed water demand associated with each Retail customer sector and established per unit-use rates. As such, between 2010 and 2030, the SFPUC used a per-unit use rate average of 98.7 gpd per household for multi-family residential demands. As shown in Table 4-4, the 98.7 gpd per household rate was applied to the incremental growth of 2,387 new dwelling units throughout the City resulting in a demand of 0.24 mgd in 2030.

12 San Francisco Planning Department, Projections of Growth by 2030, July 9, 2009 (included as Appendix A to the Water Supply Availability Study).

Table 4-4: 2030 Water Demand Increase within San Francisco (Proposed Project, R&D Variant, Other Development Projects and Incremental Growth) (mgd)

Development	Water Demand (mgd)[1]			
	Stadium		R&D Variant	
	Projected Demand	Demand with Non-Residential Adjustment (1.18)[7]	Projected Demand	Demand with Non-Residential Adjustment (1.40)[7]
CP-HPS II[2]	1.67	1.04	1.99	1.04
Treasure Island – Yerba Buena Island[3]	1.70	1.17	1.70	1.17
Parkmerced[4]	0.98	0.94	0.98	0.94
Development Subtotal	**4.38**	**3.16**	**4.67**	**3.16**
Existing Demand at Development Sites[5]	-1.51	-1.51	-1.51	-1.51
Net Development Subtotal	**2.87**	1.64	**3.17**	1.66
Incremental Growth in SF (City and County)[6]	0.24	0.24	0.24	0.24
Net Change in Water Demand with Non-Residential Adjustment[7]	~	**1.88**[7]	~	**1.89**[7]

Notes:
1. Average annual demands. Residential water demands for the proposed projects were provided to the City by project developer. They were also developed using an end use model on a per unit or per employee basis. The developer demands were independently reviewed by PBS&J and the SFPUC as part of this Study, and appear consistent with the SFPUC demand estimates. (Appendix D [WSAS Appendix B])
2. CP-HPS Phase II Arup – Winzler & Kelly Water Demand Memo September 25, 2009 (Appendix D [WSAS Appendix B])
3. Treasure Island Technical Memo Section 7 August 2009. (Appendix D [WSAS Appendix B])
4. Parkmerced Water Demand Spreadsheet from August 2009 (Appendix D [WSAS Appendix B])
5. Existing demand provided by SFPUC from current billing records (CP-HPS = 0.3 mgd) (TI-YPI = 0.25 mgd) (Parkmerced = 0.71 mgd) (Appendix D [WSAS Appendix B])
6. Derived by SFPUC staff based on approximately 2,387 dwelling units at 98.7 gpd. (Appendix D [WSAS Appendix B])
7. To avoid double-counting the water demand associated with the 2009 SF Planning Non-Residential Employment Projections and the non-residential demand calculated in the developer estimates at each of the Project sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This study assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections.

At the CP-HPS II project site in 2030, total potable demand is calculated at 1.67 mgd for the Stadium development and 1.99 mgd for the R&D Variant development. In that same year, under either development scenario, residential demand at the CP-HPS II project site is estimated to be 1.04 mgd. As shown in Table 4-4, in 2030 the total net change in demand of 1.89 mgd accounts for demand related to new development less existing demand, and includes a non-residential demand adjustment to avoid double-counting the SF Planning employment in 2030.[13]

4.5.2. Water Demand of Residential Projections

[In an effort to represent development implementation over the 20-year planning horizon (2010–2030), this WSA assumes that residential growth and demand would occur at a linear rate over the same 20-year period without accounting for market force influences or changes in local economics.

Table 4-5 presents the residential growth projections included the 2005 UWMP and the 2009 growth projections developed by the SF Planning department. As shown in Column A, residential growth in 2010 is estimated at 344,306 units, builds to 351,608 units in 2015 and then grows continually to 373,513 units by 2030. As shown in Column C, under the linear growth assumption, by 2015 new residential units are estimated to increase by 7,447 units, and

13 To avoid double-counting the water demand associated with the 2009 SF Planning Non-Residential Employment Projections and the non-residential demand calculated in the developer estimates at each of the proposed development sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This WSA assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections.

continue to increase proportionally over the next 15 years to 29,787 units in 2030. Of these 29,787 units, 27,400 are proposed in the large development projects and account for the majority of new residential growth in 2030. The balance of 2,387 is projected as Incremental Growth throughout the San Francisco. As presented in Column A+C, San Francisco can expect 359,055 units in 2015, and based on the 2009 SF Planning Projections estimate, total residential units would be 403,330 by 2030.

Table 4-5: Projections for Residential Growth and Residential Demand

Year	2005 UWMP Projections (DU)(1)	2005 UWMP Demand (mgd)(2)	2009 SF Planning Projections (DU)(3)	2009 SF Planning Demand (mgd)(4)	Total Residential (DU)(5)	Total Demand (mgd)(6)
	A	B	C	D	A+C	B+D
2010	344,306	44.7	0	0	344,306	44.70
2015	351,608	43.8	7,447	0.47	359,055	44.27
2020	358,910	43.2	14,894	0.95	373,804	44.15
2025	366,211	42.9	22,340	1.42	388,551	44.32
2030	373,513	42.9	29,787	1.89	403,300	44.79

Notes:
DU = Dwelling Units
1. Single and Multiple Family Residential Unit Projections from SFPUC 2005 UWMP(Table 2, page 7)
2. Estimated Demand generated by Residential Unit Projections from SFPUC 2005 UWMP (Table 8B, page 43)
3. Residential Units Projections from 2009 SF Planning (In 2030 - Projects (CP-HPS II (10,500 DU); TI-YBI (8,000 DU) and Parkmerced (total 8,900 DU) including Incremental Growth (2,387 DU) linear distribution over 20-year (2010-2030) planning period (Appendix D [WSAS Table 5-2])
4. Estimated Demand generated by Projects (from developer estimates) and Incremental Growth (98.7 gpd per household) linear distribution over 20-year (2010-2030) planning period (Appendix D [WSAS Tables 5-4 and 5-6])
5. Total Residential Unit Projections (2005 UWMP + 2006 SF Planning) residential units over the 20-year planning horizon. (Appendix D [WSAS Table 5-2])
6. Total Projected Water Demand generated by all new residential units over the 20-year planning horizon. (Appendix D [WSAS Table 5-6])
Source: Developed by PBS&J and SFPUC, October 2009.

Column B shows the residential water demand projected in the 2005 UWMP; demand deceases from 44.7 mgd in 2010 to 42.9 in 2030 because of plumbing fixture retrofits in existing residences and higher water efficiency fixtures at new developments, including the development at the project site. As shown in Column D, water demand Table 4-5, new residential water demand commences in 2015 at 0.47 mgd and progresses to 1.89 mgd in 2030. Column B+D shows the total residential demand, accounting for demand from the 2005 UWMP and 2009 SF Planning Projections over the 20 year planning period.]

[In 2030, total residential demand is estimated to be 44.79 mgd. In that same year, the proposed project's estimated residential demand of 1.04 mgd would increase average daily demand by 2.3 percent (1.04/44.79).]

4.5.3. Water Demand of Non-Residential Employment Projections

Between 2010 and 2030, SFPUC used an average of 42.42 gallons per day (gpd) per employee for non-residential water demands (Appendix D). As shown in Table 4-6, the 42.42 gpd per employee water demand rate was applied to the growth in jobs over the 20-year planning horizon. In 2015, demand is expected to be 30.52 mgd and by 2030, water demand generated through employment is expected to reach 31.73 mgd. To avoid double-counting the non-residential demand calculated in the developer estimates at each of the development sites, this WSA assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections.

[In 2030, total non-residential demand is estimated to be 31.73 mgd. In that same year, at buildout, the proposed project's estimated non-residential demand of 0.95 mgd would increase average daily demand by 2.9 percent (0.95/31.73).]

Table 4-6: Water Demand for Non-Residential Employment Projections

Employment Projections and Non-Residential Demand	2010	2015	2020	2025	2030
SF Planning Employment Total[1] (jobs)	712,145	719,447	726,749	734,050	748,100
Non-Residential - Business/Industrial Demand[2] (mgd)	30.21	30.52	30.83	31.14	31.73

Notes:
1. Table 5-1 2009 SF Planning Projections (Appendix D)
2. Average of 42.42 gallons per day (gpd) per employee for non-residential water demands. (Appendix D])

4.5.4. SFPUC Total Retail System Demand

The SFPUC incorporated the 2009 SF Planning projections for residential and non-residential growth in San Francisco into the WSAS to assess the results of the SF Planning projections and its effects on the City's water demand. The totals of the previous tables (Table 4-4 and Table 4-6) along with demand data from the 2005 UWMP is incorporated in the City's total Retail demand shown in Table 4-7. The table represents the anticipated growth in demand commencing in 2010 and extending over the 20-year planning horizon to 2030.

Table 4-7: SFPUC Retail Demand (mgd)

Users, Facilities and Entities	Projected Water Demand (mgd)				
	2010	2015	2020	2025	2030
Residential Demand (Single & Multiple Family)[1]	44.70	43.80	43.20	42.90	42.90
New Residential Demand generated by Projects and Incremental Growth[2][4]	-	0.47	0.95	1.42	1.89
Subtotal	44.70	44.27	44.15	44.32	44.79
Non-Residential - Business/Industrial Demands[3,4]	30.21	30.52	30.83	31.14	31.73
Subtotal	**74.91**	**74.79**	**74.97**	**75.46**	**76.52**
Unaccounted-for System Losses	7.30	7.30	7.30	7.30	7.30
Subtotal	**82.21**	**82.09**	**82.27**	**82.76**	**83.82**
Other Retail Demands[5]	4.90	4.90	4.90	4.90	4.90
Lawrence Livermore Laboratory; Groveland CSD[6]	1.20	1.20	1.20	1.20	1.20
City Irrigation Demand[7]	2.5	2.5	2.5	2.5	2.5
Castlewood Community Demand[8]	1.0	1.0	1.0	1.0	1.0
Total Retail Demand	**91.81**	**91.69**	**91.87**	**92.36**	**93.42**

Notes:
1. Residential Demands (Source: 2005 SFPUC UWMP Table 8B, page 43.)
2. See Table 4-4. Multiple Family – [In 2030 Incremental Growth of 0.24 mgd + (CP-HPS II 10,500 DU) 1.04 mgd + (TI-YBI 8,000 DU) 1.17 mgd + (Parkmerced 8,900 total DU) 0.94 mgd = 3.40 mgd] Existing Demand is 1.51 mgd at all sites. [3.40 mgd – 1.51 = 1.89 mgd] as shown in Table 4-2 (Sources: ARUP Water Demand Memo for CP-HPS Phase II September 25, 2009; Parkmerced Water Demand Spreadsheet June 30, 2009; Treasure Island Water Technical Report December 2008 Updated August 2009.)
3. See Table 4-6. Agriculture, Mining, Construction, Manufacturing, Transportation, Wholesale & Retail Trade, F.I.R.E., Services, Gov't including Builders – Contractors and Docks – Shipping. (Source: Adapted from 2009 ABAG Employment Projections in conjunction with SF Planning, July 2009) As developed in the Demand Study, SFPUC derived the employment water demands by taking the ABAG employment projections and multiplying by 42.42 gallons per employee per day and is consistent with SFPUC's demand projection methodology.
4. See Table 4-6. Non-residential (jobs/employment) demands at major project sites were assumed to be contained in the 2009 ABAG Employment projections. Growth in demand is incrementally increased to reflect the growth in jobs over the 20-year planning horizon. To avoid double-counting the water demand associated with the 2009 SF Planning Non-Residential Employment Projections and the non-residential demand calculated in the developer estimates at each of the Project sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This study assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections. Table 4-4 shows the net change in water demand at the Project sites and the adjusted change in water demand without non-residential demand. Adapted by PBS&J and SFPUC September 2009 from ARUP Water Demand Memo for CP-HPS Phase II September 25, 2009; Parkmerced Water Demand Spreadsheet June 30, 2009; Treasure Island Water Technical Report December 2008 Updated August 2009.
5. US Navy, SF International Airport, and other suburban/municipal accounts. (Source: 2005 SFPUC UWMP Table 8B, page 43.)
6. Lawrence Livermore Laboratories (0.8 mgd); Groveland CSD (0.4 mgd). (Source: 2005 SFPUC UWMP Table 8B, page 43.)
7. City Irrigation at Golden Gate Park, Great Highway Median and SF Zoo. (Source: 2005 SFPUC UWMP Table 8B, page 43.)
8. Castlewood Community demand served by wells in the Pleasanton well field.

Source: 2005 SFPUC UWMP Table 8B, page 43.

As shown in Table 4-7, incremental residential growth demand and demand at each of large development sites commences in 2015 at 0.47 mgd and progresses to 1.89 mgd in 2030. In

2015, demand drops slightly due to a reduction in total residential demand. The non-residential demand commences in 2010 at 30.21 mgd, increases to 30.83 mgd and culminates at 31.73 in 2030.

Table 4-7 shows total Retail demands for the SFPUC beginning in 2010 at 91.81, and then drops slightly in 2015 because of a drop in residential demand and then increases to 91.87 mgd in 2020. In 2030, total Retail demand is expected to be 93.42 mgd. In that same year, the proposed project's total demand of 1.67 mgd would increase average daily demand by 1.8 percent (1.67 mgd/ 93.42 mgd); alternatively, the R&D Variant's demand of 1.99 mgd would increase the average daily demand by 2.1 percent (1.99/94.42 mgd).

5.0 COMPARISON OF AVAILABLE WATER SUPPLIES VERSUS DEMAND

Section 10910 (c)(3) of the Water Code states, "the water supply assessment for the project shall include a discussion with regard to whether the public water system's total projected water supplies available for normal, dry and multiple dry water years during a 20-year projection will meet the projected water demand associated with the proposed project, in addition to the public water system's existing and planned future uses, including agricultural and manufacturing uses."

5.1. Supply and Demand Comparison

Table 5-1 compares the SFPUC Retail supplies and demand during normal, single dry year, and multiple dry year periods, as required by Water Code Section 10910 (c)(3). Section 2.7 discusses the SFPUC's total water supplies now and over the 20-year planning period. In 2010, prior to the development of the 10 mgd of local WSIP supplies, the SFPUC has access to annual average of 84.5 mgd from all water supply sources. Beginning in 2015, when the WSIP water supply sources are readily available, the SFPUC's Retail water supplies increase to 94.5 mgd. These supplies are assumed to be available in the quantities listed in Table 5-1. The SFPUC intends to use these supplies to meet its Retail customer demands.

The demand estimates in this Study show that the 2009 SF Planning projections result in an increase in City Retail demand. As stated previously, by 2030 Retail demand is estimated at 93.42 mgd. This increase, however, does not change the findings in the 2005 UWMP, which estimated demand at 93.4 mgd in 2030.[14] As shown in Table 5-1, the SFPUC can meet the current and future demands of its Retail customers in normal years, single dry-years and nearly all multiple dry-year events with the exception of years 2 and 3 after 2030. A discussion of an anomaly that occurs in 2010 follows Table 5-1 below.

As modeled in Table 5-1, the deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd as per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. It is expected that 10 mgd of local WSIP supply sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (Fiscal Year 2007-2008 use was 83.9 mgd). If Retail demand exceeds the available RWS supply of 81.0 mgd between 2010 and 2015, and total RWS deliveries exceed 265 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water with the payment of an Environmental Surcharge. Notably, total RWS deliveries in Fiscal Year 2007-2008 were 256.7 mgd, which is 8.3 mgd below the 265 mgd watershed delivery goal.

As discussed in Section 3, in time of system-wide shortages due to drought conditions, the WSAP provides a fair and reasonable method for allocating water between the SFPUC's Retail service area and its wholesale customers (collectively). As shown in Table 5-1, after 2030, pursuant to the SFPUC's WSAP, Retail customers would experience no reduction in deliveries at a 10 percent RWS Retail supply curtailment. However, during a 20 percent RWS shortage when Retail RWS supplies are reduced by 1.9 percent to 79.5 mgd, the Retail customers would experience a 1.5 mgd reduction in RWS Retail deliveries. The SFPUC, as part of the WSIP, adopted a water reliability objective of no greater than 20-percent rationing in any one year of a drought. The RWS rationing reduction of 1.9 percent is well within the SFPUC's 20-percent reliability objective.

14 SFPUC 2005 Urban Water Management Plan Table 8B, p. 43.

Table 5-1: Projected Supply and Demand Comparison - Normal, Dry, and Multiple Dry Years (mgd)

Retail Supply and Demand		Normal Year	Single Dry Year	Multiple Dry Year Event Year 1	Year 2	Year 3
2010	RWS Supply(1)	81.00	81.00	81.00	79.50	79.50
	Groundwater Supply(2)	3.50	3.50	3.50	3.50	3.50
	Total Retail Supply(3)	84.50	84.50	84.50	83.00	83.00
	Total Retail Demand(4)	91.81	91.81	91.81	91.81	91.81
	Surplus/(Deficit)(5)	**-7.31**	**-7.31**	**-7.31**	**-8.81**	**-8.81**
2015	RWS Supply(1)	81.00	81.00	81.00	79.50	79.50
	Groundwater(6)	3.50	3.50	3.50	3.50	3.50
	WSIP Supply Sources(7)	10.00	10.00	10.00	10.00	10.00
	Total City Supply(3)	94.50	94.50	94.50	93.00	93.00
	Total Retail Demand(4)	91.69	91.69	91.69	91.69	91.69
	Surplus/(Deficit)	**2.81**	**2.81**	**2.81**	**1.31**	**1.31**
2020	RWS Supply(1)	81.00	81.00	81.00	79.50	79.50
	Groundwater(6)	3.50	3.50	3.50	3.50	3.50
	WSIP Supply Sources(7)	10.00	10.00	10.00	10.00	10.00
	Total City Supply(3)	94.50	94.50	94.50	93.00	93.00
	Total Retail Demand(4)	91.87	91.87	91.87	91.87	91.87
	Surplus/(Deficit)	**2.63**	**2.63**	**2.63**	**1.13**	**1.13**
2025	RWS Supply(1)	81.00	81.00	81.00	79.50	79.50
	Groundwater(6)	3.50	3.50	3.50	3.50	3.50
	WSIP Supply Sources(7)	10.00	10.00	10.00	10.00	10.00
	Total City Supply(3)	94.50	94.50	94.50	93.00	93.00
	Total Retail Demand(4)	92.36	92.36	92.36	92.36	92.36
	Surplus/(Deficit)	**2.14**	**2.14**	**2.14**	**0.64**	**0.64**
2030	RWS Supply(1)	81.00	81.00	81.00	79.50	79.50
	Groundwater(6)	3.50	3.50	3.50	3.50	3.50
	WSIP Supply Sources(7)	10.00	10.00	10.00	10.00	10.00
	Total City Supply(3)	94.50	94.50	94.50	93.00	93.00
	Total Retail Demand(4)	93.42	93.42	93.42	93.42	93.42
	Surplus/(Deficit)	**1.08**	**1.08**	**1.08**	**-0.42(8)**	**-0.42(8)**

Notes:
1. RWS Supply SFPUC (Table 2-2)
2. Groundwater Uses for In-City Irrigation and Castlewood (Table 2-2).
3. Total Retail Supply from SFPUC Water Supplies Table 2-2.
4. SFPUC Retail Demand from Table 4-7.
5. The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).
6. Groundwater Supplies at Castlewood and In-City Irrigation (Table 2-2).
7. WSIP Supply Sources (Recycled Water (4.0 mgd; Groundwater (2.0 mgd Existing and 2.0 from NWGWP, and WSIP Water Efficiency and Conservation (4.0 mgd) (Table 2-2).
8. Deficit occurs in year 2 and 3 of multiple dry year event, SFPUC implements its Drought Year Water Shortage Contingency Plans - RWSAP and WSAP to balance supply and demand under this projected shortfall as described in Section 3.0.

As shown in Table 5-1, under this multiple dry-year event scenario,[15] it is possible that the SFPUC will not be able to meet 100 percent of its Retail demand. After 2030, as modeled in this WSA, a supply shortfall of 0.42 mgd is anticipated to occur in the second and third year of a multiple dry-year event due to RWS supply curtailments.

15 Multiple dry-year events are defined as a three-year event per UWMP requirements. SFPUC determined that a multiple dry-year event is years 2-4 of SFPUC's 8.5 year design drought. SFPUC can meet 100 percent of deliveries in the first year of such an event.

Pursuant to the Urban Water Management Planning Act (Water Code Section 10632), water suppliers with an existing dry year shortage contingency plan can implement subsequent stages of demand reduction measures listed in its UWMP as a strategy to balance supply and demand. The WSAP and the RWSAP, contained in Section 9 of the SFPUC's 2005 UWMP is SFPUC's dry year shortage contingency plan that allows the SFPUC to reduce water deliveries to customers and implement demand reductions during periods of water shortage. Therefore, to overcome the potential 0.42 mgd supply deficit expected after 2030, the SFPUC would follow its adopted water shortage contingency plans (WSAP and RWSAP) to implement drought-planning sequences and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in the SFPUC reservoirs. These delivery reductions allow the SFPUC to maintain water in storage over an extended period. In addition, under the RWSAP, the SFPUC would balance Retail supply curtailments by reducing demand.

Table 5-2 was extracted from Table 5-1 to demonstrate the additional conservation necessary to balance supply and demand under the RWSAP in 2030. When the SFPUC implements its RWSAP, as shown in Table 5-2, Retail customers would be required to reduce daily demand by approximately 0.44 percent to balance demand against the supply shortfall. Stage 1 of the RWSAP in Section 3.2 requests voluntary conservation of at least 5 percent up to 10 percent. The 0.44 percent needed falls within Stage 1 and as modeled no further conservation would be required.

Table 5-2: 2030 Supply and Demand with Implementation of WSAP and RWSAP (mgd)

Retail Supply and Demand[1]	Normal Year	Single Dry Year	Multiple Dry Year Event		
			Year 1	**Year 2**	**Year 3**
RWS Supply	81.00	81.00	81.00	79.50	79.50
Groundwater	3.50	3.50	3.50	3.50	3.50
WSIP Supply Sources	10.00	10.00	10.00	10.00	10.00
Total City Supply	94.50	94.50	94.50	93.00	93.00
Total Retail Demand	93.42	93.42	93.42	93.42	93.42
Surplus/(Deficit)	**1.08**	**1.08**	**1.08**	**-0.42**	**-0.42**
RWSAP Demand Reduction (Conservation Needed)					
Total City Supply	94.50	94.50	94.50	93.00	93.00
Total Retail Demand	93.42	93.42	93.42	93.42	93.42
Surplus/(Deficit)	None	None	None	-0.42	-0.42
Stage 1 Conservation Savings (0.44%)	*None*	*None*	*None*	*0.42*	*0.42*
Retail Demand Reduction with RWSAP	*Surplus*	*Surplus*	*Surplus*	*93.00*	*93.00*
Surplus/(Deficit)	**None**	**None**	**None**	**0.00**	**0.00**

Note:
1. Table 5-1 Projected Supply and Demand Comparison - Normal, Dry, and Multiple Dry Years.
Adapted by PBS&J October 2009.

6.0 CONCLUSION OF ANALYSIS AND FINDINGS

There is an anticipated increase in the SFPUC supply reliability over the next 20 years as a result of the SFPUC implementing the water supply improvements in the WSIP and local water supply projects. Over this same period, demand in SFPUC's Retail service area will continue to increase as well. This is the result of growth in housing developments, population increases and employment opportunities throughout San Francisco.

In 2030, the proposed project's demand of 1.67 mgd would increase average daily demand by 1.8 percent; alternatively, the R&D Variant's demand of 1.99 mgd would increase the average daily demand by 2.1 percent. This increase, however, does not affect the ability of the SFPUC to meet the demand of its Retail customers. Beginning in 2015, when the WSIP water supply sources are readily available, the SFPUC's Retail water supplies increase to 94.5 mgd. The SFPUC intends to use these supplies to meet its Retail customer demands. As shown in Table 5-1, the SFPUC has sufficient supplies to meet current and planned future uses in normal year, single dry and all multiple dry-year events with the exception of years 2 and 3 after 2030.

After 2030, as shown in Figure 6-1, under a multiple dry-year event the SFPUC will experience a 0.42 mgd supply deficit (demand exceeds supply) and would not be able to meet 100 percent of its Retail demand including the proposed project. The water supply deficit is related to increasing demand throughout the SFPUC's Retail service area and the policy decision to limit RWS deliveries from the watersheds until 2018. This WSA used a conservative assumption and extended the decision to limit deliveries to 2030 (Annual average RWS limit is 265 mgd [81 mgd in SFPUC's Retail service area and 184 mgd in the Wholesale service area]).

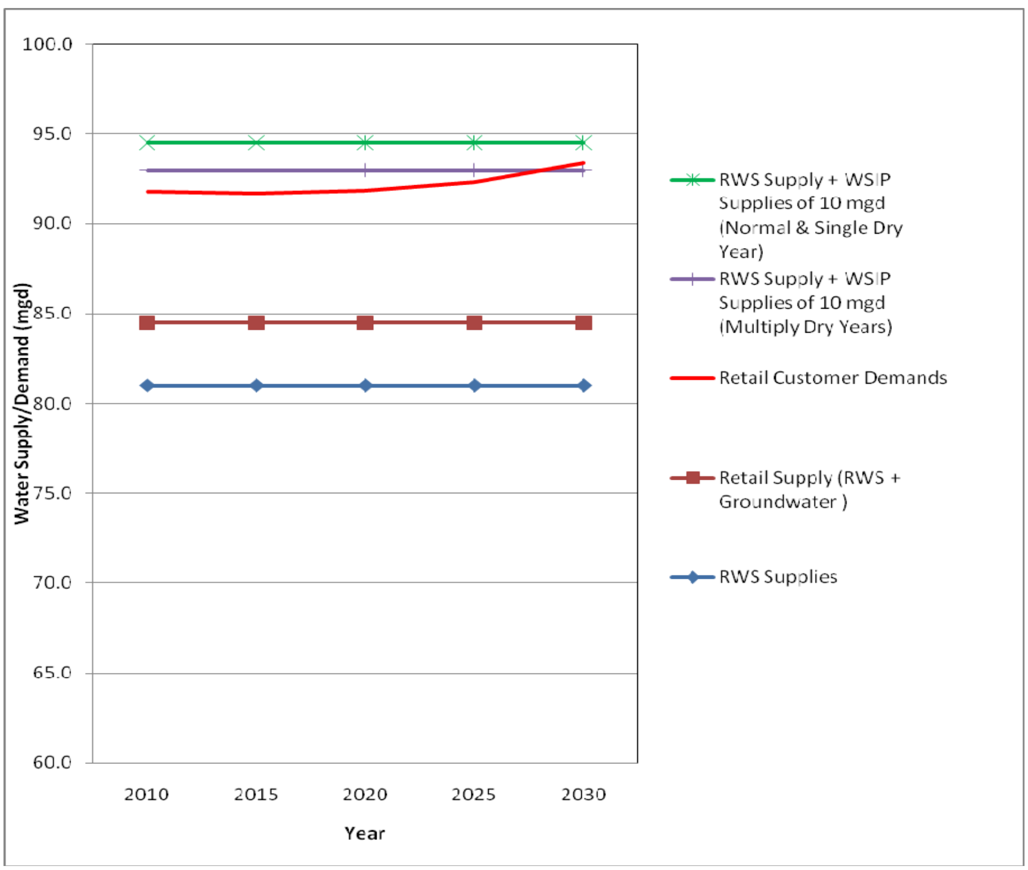

Figure 6-1: Comparison of Supply and Demand over 20 years

Pursuant to the Urban Water Management Planning Act (Water Code Section 10632), water suppliers with an existing dry year shortage contingency plan can implement subsequent stages of demand reduction measures listed in its UWMP as a strategy to balance supply and demand. The WSAP and the RWSAP, contained in Section 9 of the SFPUC's 2005 UWMP is the SFPUC's dry year shortage contingency plan that allows the SFPUC to reduce water deliveries to customers and implement demand reductions during periods of water shortage. Therefore, to overcome the potential 0.42 mgd supply deficit expected after 2030, the SFPUC would follow its adopted water shortage contingency plans (WSAP and RWSAP) to implement drought-planning sequences and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in the SFPUC reservoirs. These delivery reductions allow the SFPUC to maintain water in storage over an extended period. In addition, under the RWSAP, the SFPUC would balance Retail supply curtailments by reducing demand.

As discussed previously, the SFPUC has water rights and entitlements that are more than adequate to meet existing and projected future demand throughout the SFPUC's Retail service area. With completion of the WSIP projects, the SFPUC will have the capacity to reliably deliver potable water to meet customer purchases up to an annual average of 300 mgd. However, due to conditions of approval in the WSIP PEIR, the SFPUC is limiting deliveries from the watersheds until at least 2018. Prior to 2018, the SFPUC will engage in a new planning process to re-evaluate water system demand and water supply options. As a part of this process, San Francisco will conduct additional environmental studies and CEQA review as appropriate to address the SFPUC's recommendation regarding water supply and proposed water system deliveries after 2018.

This WSA concludes that the SFPUC has adequate supplies based on water rights and entitlements and adopted plans for local water supply projects to meet Retail demand in all years with the exception of a potential shortfall occurring after 2030 under a multiple dry-year event. In the event of a supply shortfall, the SFPUC, through its WSAP and RWSAP can impose supply curtailments and subsequent stages of demand reductions to balance demand against curtailed supplies.

6.1. WSA Findings

Regarding the availability of water supplies to serve the proposed project, beginning in 2015 the SFPUC finds as follows:

- In years of average and above-average precipitation, and including development of the SFPUC's local WSIP water supply sources, the SFPUC has adequate supplies to serve 100 percent of normal, single dry and multiple dry year demand up to 2030.[16]
- In multiple-dry-year events after 2030, when the SFPUC imposes reductions in its supply, the SFPUC has in place the WSAP and RWSAP to balance supply and demand.
- With the WSAP and RWSAP in place, and the addition of local WSIP supplies, the SFPUC finds it has sufficient water supplies available to serve its Retail customers including the demand of the proposed project, and existing and planned future uses.

16 The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).

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APPENDICES

APPENDIX A SFPUC 2008 ANNUAL GROUNDWATER MONITORING REPORT WESTSIDE BASIN

2008 ANNUAL GROUNDWATER MONITORING REPORT WESTSIDE BASIN SAN FRANCISCO AND SAN MATEO COUNTIES, CALIFORNIA

Prepared By:
San Francisco Public Utilities Commission

In Coordination with the City of Daly City, the City of San Bruno and the California Water Service Company (South San Francisco District)

April 2009

April 28, 2009

ACKNOWLEDGEMENTS

The Westside Basin Annual Groundwater Report for 2008 was prepared by the San Francisco Public Utilities Commission (SFPUC) in cooperation with the City of Daly City, California Water Services Company (South San Francisco District) and the City of San Bruno. This report summarizes the results of water level elevation monitoring, water quality sampling and analysis, and additional field activities conducted within the basin for 2008.

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1.0 INTRODUCTION

This report presents the results of the 2008 Annual Groundwater Monitoring for the Westside Basin. The Westside Groundwater Basin extends from Golden Gate Park in San Francisco to the City of Burlingame in San Mateo County, and is an important municipal and irrigation water supply for the respective communities and businesses that overlie the Basin (Figure 1).

As part of continuing agency coordination and public education, it is intended that the preparation of this annual report, along with future annual reporting and supplemental technical reports, will provide regular summaries of overall basin conditions. The annual report is intended to provide information summarizing basin-wide groundwater pumping in the basin, describe groundwater levels and quality in the different aquifer systems that are present in the basin, and describe surface water conditions, most notably in Lake Merced. In addition to reporting of hydrogeologic conditions, the data-gathering network will be modified as necessary to provide a comprehensive review of basin conditions. Additionally, monitoring activities will be coordinated with ongoing and future project-specific monitoring activities to ensure an efficient, comprehensive monitoring program.

1.1 Background

Over the last several years, there has been a significant increase in data collection efforts and cooperative management of groundwater and interrelated surface water resources in the Westside Basin among the San Francisco Public Utilities Commission (SFPUC), the City of Daly City (Daly City), California Water Service Company (Cal Water, municipal water purveyor to South San Francisco, the Town of Colma and a portion of unincorporated San Mateo County), and the City of San Bruno (San Bruno). The initial data collection efforts included increased monitoring of groundwater and lake level elevations in the northern Westside Basin and the initiation of a basin-wide, semi-annual monitoring program that has involved the cooperative efforts of the SFPUC, Daly City, Cal Water, and San Bruno beginning in spring 2000. Part of the increased management effort was the preparation of the 2005 Final Draft North Westside Groundwater Basin Management Plan, which included a Plan Element to regularly report on groundwater conditions in the Westside Basin (SFPUC, 2005).

In 2006, the SFPUC, in cooperation with Daly City, Cal Water, and San Bruno, prepared a report entitled “Hydrogeologic Conditions in the Westside Basin, 2005” (LSCE, 2006). That report provided an overview of historical, current and planned activities related to groundwater use within the Basin, and described the hydrogeologic conditions of the Westside Basin as of 2005. Since 2007, the SFPUC Water Resources Division has prepared the annual groundwater monitoring reports in cooperation with Daly City, San Bruno, and Cal Water.

The monitoring program has expanded to monitor changes in groundwater levels and quality resulting from the recycled water program and the pilot conjunctive use program and to assist the SFPUC in quantifying the change in groundwater storage resulting from the above projects.

The physical barriers to seawater intrusion that are evident west of Daly City (as a result of faulting and steeply dipping beds of the Merced Formation) are not as evident in the North Westside portion of the basin, where the beds do not exhibit pronounced dips, and faults are further offshore. In that light, the expansion of the monitoring program included the construction of monitoring wells along the coast from Daly City to Golden Gate Park to monitor for the potential occurrence of seawater intrusion resulting from ongoing groundwater use and planned groundwater development within the North Westside Basin. Monitoring for the potential occurrence of seawater intrusion on the San Francisco Bay-side (Bay Side) of the basin was implemented by the City of San Bruno in 2006. In the fall of 2006, two new well clusters were installed by San Bruno at locations in the San Francisco Airport and within Burlingame. These wells are monitored semi-annually by San Bruno.

For convenience, the portion of the Westside Groundwater Basin north of the San Francisco/ San Mateo County line is referred to as the North Westside Groundwater Basin. The portion of the Westside Basin located south of the County line is referred to as the South Westside Groundwater Basin.

1.1.1 Planned and Ongoing Projects

The purpose and scope of the monitoring program has evolved to monitor changes in the groundwater system resulting from the following planned and ongoing projects:

Proposed Westside Basin Recycled Water Project

The proposed Westside Recycled Water Project is part of the SFPUC's Water System Improvement Program. It would deliver highly treated recycled water to a variety of customers through a system of pipelines, pump stations, storage tanks, and reservoirs. The system would bring recycled water from the proposed water treatment facility in Golden Gate Park to the San Francisco Zoo, Golden Gate Park, and Lincoln Park and Golf Course. The recycled water would be used for irrigation at all three sites, as well as non-portable uses at the Zoo and at the California Academy of Sciences.

In 2004, the North San Mateo County Sanitation District (NSMCSD), a subsidiary of Daly City, constructed facilities at its wastewater treatment plant to produce recycled water. The plant currently provides recycled water that is used for irrigation purposes at the Lake Merced Golf Club, the Olympic Club Golf Course, and the San Francisco Golf Club, as well as other landscaped areas in Daly City. These recycled water customers use less than 1 million gallons of recycled water per day on average. The plant has the capacity to produce up to 2.8 million gallons of recycled water per day. As a result, the NSMCSD has recycled water available to irrigate the Harding Park and Fleming Golf Courses, while still meeting the needs for its current recycled water customers.

Daly City and the SFPUC are proposing to expand the NSMCSD's recycled water distribution system in order to provide recycled water for irrigation purposes to the Harding Park and Fleming Golf Courses. Recycled water would replace potable water from the SFPUC's Regional Water System currently being used for irrigation at these locations. The proposed project facilities would include:

- Distribution Facilities: The project would require a new pump station at the Harding Park Maintenance Yard, and approximately 4,800 feet of 18-inch distribution pipeline along Lake Merced Boulevard.
- Storage Reservoir: The project would require construction of a new 700,000 gallon underground recycled water storage tank at Harding Park Maintenance Yard.
- Back-up Connection: The project would require construction of a back-up connection to SFPUC potable water distribution system.

San Francisco Groundwater Supply Project

As part of the San Francisco Groundwater Supply Project, the SFPUC proposes the construction of up to six wells and associated facilities in the western part of San Francisco. The wells would extract up to 4 million gallons per day (mgd) of water from the Westside Basin. The extracted groundwater, which would be used both for regular and emergency water supply purposes, would be blended with imported surface water before entering the municipal drinking water system. The project would provide a new source of water and improve reliability during system maintenance and drought conditions.

South Westside Basin Conjunctive Use Project

The purpose of the project is to develop a groundwater supply in the South Westside Basin for use during drought conditions. In normal and wet years, the SFPUC will supply supplemental surface water to Daly City, Colma, San Bruno, and the California Water Service Company (South San Francisco District) to be used in place of groundwater pumping. The reduced pumping during the normal and wet years would thereby increase the volume of groundwater in storage that can be pumped in dry years.

The proposed project includes construction of 16 groundwater wells with a total capacity of 7.2 mgd. Five of the wells would be connected to the Daly City water system, six (or three each) will be connected to the water systems of Cal Water and San Bruno, and five would be connected to the SFPUC transmission system. Treatment may be required at some of the wells for the removal of manganese. Additionally, the project would include nearly 9,800 feet of water distribution piping to make the necessary connections.

In October 2008, five new monitoring well clusters were installed at the following locations as part of this project:

- CUP-10A located within SFPUC Right of Way in Daly City
- CUP-18 located within SFPUC Right of Way at Colma Blvd. in Colma;
- CUP-19 located within SFPUC Right of Way at Serramonte Blvd. in Colma;
- CUP-22A located within SFPUC Right of Way at Hickey Blvd. at Camaritas Road, in South San Francisco; and.
- CUP-36-1 located within SFPUC Right of Way at Southwood Drive in South San Francisco.

The well construction permits, as-built construction details, lithologic and geophysical logs, and summaries of groundwater quality are presented in Appendix D. Subsequent monitoring events will incorporate these wells into the monitoring network to enhance characterization of groundwater conditions in the southern portion of the basin.

1.2 Municipal Water Agencies

The SFPUC is responsible for providing a reliable, high quality water supply for the City and County of San Francisco (San Francisco). The SFPUC also provides water to a large network of wholesale customers that extend from Daly City, adjacent to San Francisco, south through the Peninsula to Santa Clara County, and up the southeast side of San Francisco Bay through Alameda County to Hayward. The SFPUC water supply system supplies all of the San Francisco municipal demand and about two-thirds of the total water demands of its wholesale customers (SFPUC, 2005). Total water demand of retail customers in San Francisco is nearly 94 million gallons per day (mgd), or about 105,000 acre-feet per year (afy), which represents a significant decrease in water demand from recent drought periods (SFPUC, 2005). The total water requirements of the Bay Area wholesale customers in 2005 were estimated to be about 282 mgd, or about 316,000 afy (SFPUC, 2005).

Since the 1990's the SFPUC, Daly City, Cal Water and San Bruno have worked cooperatively on Westside Basin investigations, monitoring and coordinated projects. Daly City, Cal Water, and San Bruno have typically included groundwater from the Westside Basin for municipal water supply in combination with SFPUC-imported surface water. The City of Daly City's Department of Water and Wastewater Resources is responsible for the management and operation of Daly City's drinking water supply system. The City of San Bruno's Water Division of the Public Works Department is responsible for the management and operation of San Bruno's drinking water supply system. Cal Water is an investor-owned utility that serves South San Francisco, Colma and a very small part of Daly City.

2.0 SITE DESCRIPTION AND HYDROGEOLOGICAL SETTING

2.1 Hydrogeologic Setting

The Westside Basin is about 40 square miles in area (Figure 1) and includes four major geologic units. These units are the Jurassic - Cretaceous Franciscan Complex, Pliocene Merced Formation, Pleistocene Colma Formation, and Pleistocene to recent Dune Sands. There are also minor, yet widespread, units of recent alluvium along stream channels. Groundwater development has primarily occurred in the Colma and Merced Formations. The Merced Formation is the primary water-producing aquifer in the basin; however, the Colma Formation is also of interest since Lake Merced is incised within this formation.

As a result of the difficulty of differentiating the contacts between the Dune Sands, the Colma Formation, and the Merced Formation, the precise thickness of the Colma Formation and Dune Sands overlying the Merced Formation has not been determined. Groundwater in the vicinity of Lake Merced, and north to Stern Grove and Golden Gate Park, is encountered at relatively shallow depths (ranging from approximately 5 to 60 feet). South of Lake Merced, the depth to groundwater can exceed 300 feet below ground surface (bgs).

Phillips, et al. (1993) defined each of the groundwater basins in San Francisco as a continuous body of unconsolidated sediments and the surrounding surface drainage area. All seven major groundwater basins identified in San Francisco are open to the Pacific Ocean or San Francisco Bay. The landward parts of the groundwater basins generally are bounded horizontally and vertically by bedrock, which is assumed to be relatively impermeable compared with unconsolidated marine and alluvial deposits. Groundwater flow may occur between basins where the bedrock ridge that constitutes the boundary is subterranean. The north-south topography and bedrock height defined by the Coast Ranges generally forms an east-west hydrologic boundary through San Francisco.

The western part of San Francisco is divided into the Westside and Lobos Basins on the basis of a northwest-trending bedrock ridge through the northeastern part of Golden Gate Park. The bedrock ridge has several small surface expressions, and bedrock altitude data indicate that the ridge is continuous, though subterranean. Some degree of hydraulic connection is possible between the two basins where the ridge is not exposed at the land surface, but the degree of connection probably is minimal. The Westside Basin extends south to Burlingame and Hillsborough. Well drillers' logs for the San Bruno area indicate a deep sandy unit overlain by about 200 feet of predominantly fine-grained clays. Correlation of the deeper sand deposits is unclear; however, surficial mapping may indicate a relationship to exposures of sand/gravel deposits in the Burlingame area, which are mapped as non-marine Santa Clara Formation (Brabb and Pampeyan, 1983). A southward-extending ridge of Franciscan bedrock appears to separate San Bruno from the San Francisco Bay to the east. The upper fine grained beds appear to be Holocene to Late Pleistocene estuarine deposits of the San Francisco Bay (LSCE, 2004).

The subsurface configuration of the various geologic units in the Westside Basin has been delineated in a series of geologic cross-sections based on a combination of lithologic logs, water well drillers' reports, and geophysical logs (LSCE, 2004 and 2006). Lithologic units and other significant features in the basin are illustrated in geological cross-section form in Figure 2.

In the northern Westside Basin, in San Francisco, there are up to three aquifer units separated by two distinctive fine-grained units, the –100-foot clay and the W-Clay (LSCE, 2004). The aquifer units are generally designated as:

1) The "Shallow aquifer", which is present to an elevation of approximately –100 feet mean sea level (msl) (located above the –100-foot clay), in the vicinity of Lake Merced and the southern portion of the Sunset District of San Francisco;

2) The "Primary Production aquifer", which overlies the W-Clay; and

3) The "Deep aquifer" which underlies the W-Clay.

In the Daly City area, the –100-foot clay is absent, and the aquifer system is primarily composed of the Primary Production aquifer and the Deep aquifer.

Further to the south, in the South San Francisco area, the W-Clay is absent and the Primary Production aquifer is split into shallow and deep units, separated by a fine-grained unit at an elevation of approximately 300 feet below msl. The primary production aquifer in the San Bruno area is located at an elevation less than 200 feet below msl, and it underlies a thick, surficial fine-grained unit comprised of clay, sandy clay, and sand beds.

2.2 Lake Merced

Lake Merced is incised in the Shallow aquifer and is composed of four lakes: North Lake, East Lake, South Lake, and Impound Lake. A narrow channel connects the North and East Lakes, thereby creating equal water elevations in both lakes. A conduit between North Lake and South Lake allows water to flow between the lakes when the elevation in either lake is approximately 3.35 feet, San Francisco City datum[1]. When lake levels are below that elevation, these two lakes are separated and typically exhibit different elevations. South Lake and Impound Lake are separated below an elevation of approximately 4.26 feet, San Francisco City datum, by a levee that contains the Ingleside combined sewer pipeline and the foundation of a pedestrian walkway. Soil has accumulated on the foundation to an elevation of approximately 5 feet, San

[1] City Datum = NAVD88-11.37ft.

Francisco City datum. When either lake level is above that 5-foot elevation, water flows freely underneath the pedestrian walkway to connect both lakes.

Until the early 1900's, Lake Merced was one continuous body of water fed by local runoff and springs, with an outflow to the ocean in the form of a stream located at the northwestern end of North Lake. The stream flowed westward toward the ocean through the present-day location of the San Francisco Zoo and Sloat Boulevard. The springs that fed the lake were primarily located on the eastern side and in the southern portion of Lake Merced, causing a primary flow direction through the lake from the south to the north. In contrast, the current flow direction through the lakes is reversed, largely as a result of urban growth in the vicinity of Lake Merced, which has resulted in reduced recharge from springs and increased pumpage in the Primary Production aquifer south of Lake Merced. The urbanization of the watershed has also resulted in the emplacement of large amounts of fill that now impede spring discharge in the lake, and the diversion of an increasing amount of storm water away from Lake Merced and into the ocean or wastewater treatment plant. These diversions began with the construction of the Vista Grande Canal and Tunnel by the Spring Valley Water Works in 1897, and have continued with successive urban development in San Francisco and northern San Mateo County. The development of the watershed has also affected groundwater recharge from precipitation, which previously infiltrated and recharged the Shallow aquifer to a greater extent. As a result of all the preceding, the amount of subsurface inflow into Lake Merced, which in the early 1900's was manifested as spring inflow, has been reduced. The reduction in subsurface recharge to Lake Merced results in short-term lake levels being more sensitive to fluctuations in precipitation, since direct precipitation, along with shallow groundwater inflow, are the primary lake recharge mechanisms.

2.3 Pine Lake

Pine Lake is located north/northeast of Lake Merced in the westernmost portion of the Stern Grove and Pine Lake Park. Pine Lake (also known as Laguna Puerca) is one of San Francisco's few natural lakes. It is a small, shallow lake approximately three (3) acres in size. The lake has historically been overgrown with aquatic plants, which have periodically been removed. The San Francisco Recreation and Park Department has recently implemented a park improvement program for the Stern Grove and Pine Lake Park area. In November 2004, the Recreation and Park Department augmented lake levels over a 15-day period using groundwater pumped from a nearby well located east of Pine Lake. The lake addition was part of a study to evaluate the rate of lake level decline following a water addition. Approximately 25 acre-feet were discharged to the lake, which would theoretically raise the lake by about 8 feet. Nearby groundwater monitoring showed a corresponding increase in groundwater levels of about 5 feet in the Shallow aquifer.

We understand that the San Francisco Recreation and Park Department intends to resume groundwater pumping at the newly rehabilitated Pine Lake well in the near future, to once again augment the water level in Pine Lake.

SFPUC will cooperate with the Recreation and Park Department to measure future groundwater pumping from the Pine Lake well.

3.0 HISTORICAL GROUNDWATER DEVELOPMENT

By the early 1900's, wells had been constructed north, east, and south of Lake Merced for farming and drinking water supply. During that time, Spring Valley Water Company had two wells located near the Lake Merced outlet. Spring Valley pumpage was only about 100 afy (Bartell, 1913). The total of Lake Merced, Sunset District, and Golden Gate Park pumpage averaged 400 to 500 afy. In the early 1930s, the San Francisco Board of Public Works installed production wells in the Sunset District with a pumping capacity of about 6 mgd (6,700 afy). Groundwater withdrawals for emergency (drought) purposes averaged about 5 mgd (5,600 afy) from October 1930 through October 1935, but were discontinued after the availability of Hetch Hetchy water in the mid-1930s.

Beginning in the early 1950's, post-World War II development of Daly City and farther south onto the Peninsula was met with an increase in groundwater pumping and imported water deliveries from the SFPUC. Groundwater pumping increased from about 1,000 afy to nearly 5,000 afy between 1950 and 1970 (Kirker, Chapman & Associates, 1972). Since then, Daly City's groundwater pumping has ranged between approximately 3,000 and 5,000 afy, where it remained until October 2002, when an increase in SFPUC system water replaced the majority of Daly City's groundwater supply in normal and wet years as part of a demonstration conjunctive use pilot program among San Francisco, Daly City, Cal Water in South San Francisco, and the City of San Bruno. The conjunctive use pilot program ended in 2004. However, a subsequent agreement extended the project with Daly City, which received supplemental surface water until May 2007 when deliveries were suspended due to dry year water conditions. SFPUC plans to continue this demonstration program in Daly City. Daly City groundwater pumping totaled about 3,600 acre-feet (af) for 2008.

Groundwater pumping by Cal Water in South San Francisco has progressively declined from about 2,200 afy in 1947, to about 1,600 afy in 1969, to about 1,200 afy in 2002, to zero in 2003 (Figure 3). The decreases in groundwater pumping have been offset by increases in SFPUC system water deliveries. In early 2003, groundwater pumping in South San Francisco was discontinued as part of the same conjunctive use pilot program described above, with local surface water supplies replacing pumped groundwater. Groundwater pumping for municipal supply in South San Francisco resumed once again in March 2008 and totaled 206 af during 2008.

Pumping in San Bruno ranged from approximately 1,700 to 3,100 afy from 1997 through 2001 (Figure 3). In 2002, San Bruno decreased groundwater pumping to approximately 1,240 acre feet (af) and further decreased groundwater production to about 550 af in 2003 and 2004 as part of the pilot conjunctive use program. San Bruno resumed pumping after cessation of the demonstration conjunctive use program in that part of the basin in early 2005. In 2008 San Bruno pumped approximately 2,100 af of groundwater.

Total municipal pumping in the Westside Basin, as shown in Figure 3, was about 7,500 afy from the mid-1970s to the mid-1980s, and then ranged generally between about 6,000 and 8,000 afy until 2001. From 2002 to 2007, municipal pumping was reduced as part of the conjunctive use pilot program. In spring 2007, due to the dry 2006/2007 winter conditions, the SFPUC discontinued supplemental water delivery to Daly City, and Daly City resumed pumping from its municipal wells. Major groundwater production areas and historical groundwater pumping in the Westside Basin are presented on Figure 1 and Figure 3, respectively. Recent municipal groundwater usage is shown on Figure 4.

In addition to municipal water supply pumping in the Westside Basin, groundwater has historically been developed for irrigation supply and other non-potable uses, most notably on golf courses around Lake Merced, on the cemeteries in Colma, in Golden Gate Park and at the San Francisco Zoo. All unmetered, groundwater pumping for irrigation supply has been estimated infrequently. Kirker Chapman (1972) estimated golf course and cemetery pumping to be about 5,000 afy in 1969, and Yates, et al. (1990) estimated Golden Gate Park pumping to be about 1,000 afy during the late 1970's and 1980's. Adding those estimates to metered municipal pumping, as illustrated in Figure 3, suggests that total pumping was almost 15,000 afy in the late 1960's [assuming that Golden Gate Park pumping was similar in the late 1960's to the late 1970's and 1980's, as reported by Yates, et al. (1990)]. Assuming irrigation pumping to not substantially have changed until 2005 as discussed below, total pumping could be considered to have been about 6,000 afy more than municipal pumping, or in the range of about 12,000 to 14,000 afy from the mid -1980's through 2001.

Between 2002 and 2004, municipal pumping significantly decreased as part of the conjunctive use pilot program, to around 2,000 afy. From 2005 to May 2007 supplemental SFPUC water continued to be delivered to Daly City. In 2005, initial deliveries of recycled water for golf course irrigation largely eliminated groundwater use at the courses around Lake Merced, leaving the cemeteries, the San Francisco Zoo, and Golden Gate Park as the notable pumpers for irrigation and other non-potable uses, using an estimated 3,000 afy. The combination of the conjunctive use demonstration project and recycled water deliveries for golf course irrigation resulted in the combination of metered and estimated pumping in the basin declining to about 6,000 af in 2005, and approximately 5,400 af in 2006. Following discontinuation of the conjunctive use pilot program with Daly City in May 2007, approximately 7,500 af of groundwater was pumped in 2007.

4.0 GROUNDWATER PUMPING, USAGE AND DEVELOPMENT - 2008

In 2008, groundwater pumping in the Westside Basin was primarily for municipal supply to Daly City, Cal Water (South San Francisco), and San Bruno, as well as for irrigation and other non-potable uses by the San Francisco Zoo, Golden Gate Park, golf courses, and cemeteries, as described below and summarized in Table 2.

The SFPUC is planning to develop 4 mgd of regular groundwater supply from the North Westside Basin. As part of this plan, a test well was constructed at the South Sunset Playground in June 2007 and a second test well was completed at the West Sunset Playground in 2008. The West Sunset Playground test well is 12-inches in diameter, with a total depth of about 370 feet bgs. The test well is screened from 160 to 200 feet bgs and from 210 to 360 feet bgs.. The well construction permit, as-built construction details, lithologic logs and geophysical logs, and a summary of groundwater quality are presented in Appendix D.

4.1 City of Daly City

From its highest historical pumping of around 5,000 afy through most of the 1960's, Daly City's pumping was near constant, around 4,500 afy, through the 1970's and 1980's. Slightly more variable in the 1990's, when it generally declined to around 4,000 afy, Daly City's pumping has been most notably reduced since 2001, when it initially decreased to about 2,700 afy in 2002, followed by further decreases to between 700 and 1,500 afy in 2003 through 2005. The decreases in 2003 through 2005 were associated with the conjunctive use pilot program, which continued in Daly City through May 2007. Groundwater pumping in Daly City during calendar year 2008 totaled about 3,600 af compared to about 2,600 af for 2007 (when Daly City only pumped for a portion of the year). The history of pumping in Daly City is illustrated in Figure 3 and Figure 4.

4.2 City of South San Francisco

Municipal groundwater pumping in South San Francisco is provided by Cal Water, which also serves Colma and small parts of Daly City. Historical pumping by Cal Water decreased from the late 1940's through 2002, from about 2,200 afy to about 1,200 afy. As part of the pilot conjunctive use project with the SFPUC, Cal Water discontinued groundwater pumping for water supply purposes in 2003 and 2004. The conjunctive use pilot program ended in South San Francisco in early 2005. Cal Water resumed groundwater pumping in March 2008. Groundwater pumping by Cal Water during calendar year 2008 totaled 206 af.

4.3 City of San Bruno

Over the long term, groundwater pumping in San Bruno has generally ranged between about 550 and 3,100 afy since the late 1940's. As part of the conjunctive use pilot program, San

Bruno reduced pumping to approximately 550 af in 2003 and 2004. After cessation of the conjunctive use pilot program in San Bruno in early 2005, groundwater pumping in San Bruno increased to about 1,700 af for that year. Groundwater pumping in San Bruno has amounted to approximately 1,950 af for 2006, 2,350 af for 2007, and 2,100 af for 2008.

4.4 San Francisco Zoo

The San Francisco Zoo uses groundwater for irrigation and Zoo operations. Landscape irrigation along part of the Great Highway is also supplied by groundwater. Since the mid-1990s, the water needs of the Zoo and the landscaping along the Great Highway have been met by Well No. 5, which is located at the Zoo and is operated and maintained by the San Francisco Recreation and Park Department. Groundwater meter data started being recorded in February 2005. In 2005 and 2006, annual groundwater pumping was reported at approximately 400 af and approximately 350 af, respectively. For 2008, metered groundwater pumping at the Zoo was approximately 260 af. This amount compares to about 620 af for 2007, and represents a decrease of about 42% compared to 2007 pumping (Table 2). The reason for the significant decrease in pumping at the SF Zoo is not readily apparent. SFPUC and Zoo staff are reviewing 2008 groundwater and surface water use in an attempt to understand these differences in 2008 groundwater use compared to 2007.

4.5 Golden Gate Park and Pine Lake

Groundwater is pumped in Golden Gate Park for irrigation and to maintain artificial lakes within the park. The Golden Gate Park wells are operated and maintained by the San Francisco Recreation and Park Department. Groundwater is pumped from three wells located at Elk Glen Lake, near North Lake, and near the South Windmill. Historically groundwater pumping data were not maintained for the Golden Gate Park wells. In 2005 meters were installed in all three production wells to quantify groundwater pumping in the park. Historical groundwater pumping in Golden Gate Park has previously been estimated to be approximately 1,100 afy (Yates, et al., 1990). For 2008, approximately 1,300 af of metered groundwater was pumped at the South Windmill Replacement well, the North Lake well, and the Elk Glen Lake well. This compares to about 830 af pumped from these wells in 2007 and represents an increase of about 57% over 2007 values. Total metered pumping in 2008 was calculated based on weekly flowmeter readings collected by the SFPUC from the three afore mentioned production wells. In accordance with recommendations made in the 2007 Annual Report, the SFPUC coordinated with Rec Park and retained Jensen Instruments (a licensed contractor) to service and calibrate the electronic flow totalizers at the North Lake and South Windmill Replacement wells. Service and calibration was conducted under the observation of SFPUC and Rec Park staff in November 2008.

In addition to Golden Gate Park, we understand that the Recreation and Park Department intends to resume groundwater pumping at the newly rehabilitated Pine Lake well sometime in the near future, to once again augment levels at the Pine Lake. SFPUC will cooperate with the Recreation and Park Department to measure future groundwater pumping from the Pine Lake well.

4.6 Golf Courses

There are six (6) golf courses in the Westside Basin that use groundwater for irrigation. These include the Lake Merced Golf Club, the Olympic Club Golf Course, the San Francisco Golf Club, the California Golf Club, the Golden Gate Park Golf Course and the Green Hills Country Club. In 2004, recycled water was made available to Lake Merced Golf Club, the Olympic Club Golf Course, and the San Francisco Golf Club by adding a tertiary level of treatment at the North San Mateo County Sanitation District (a subsidiary of the City of Daly City) Wastewater Treatment Plant and by installing a distribution system from the treatment plant to these respective golf courses.

In 2008, a total of 516 af of recycled water and 91 af of pumped groundwater were used by the Olympic Club Golf Course and the San Francisco Golf Club to meet irrigation needs. According to data provided by the City of Daly City, the Lake Merced Golf Club used about 78 af of recycled water in 2008. Annual pumping data for 2008 was not available from the Lake Merced Golf Club. A summary of golf course water use is presented in Table 1. Groundwater pumping data have not been requested from the California Golf Club for this report. However, based on the Recycled Water Feasibility Study (Carollo Engineers, September 2008), the pumping is estimated at 206 af per year. The Golden Gate Park Golf Course is irrigated with groundwater as part of the overall park irrigation. No pumping data have been requested from the Green Hills Country Club, located in Millbrae, within the southwestern portion of the basin.

4.7 Cemeteries

There are about 600 acres of cemeteries in Colma, most of which have historically been, and continue to be, irrigated with groundwater. Based on the Recycled Water Feasibility Study (Carollo Engineers, September 2008), the average annual groundwater pumping by cemeteries in Colma is estimated at 787 afy. Golden Gate National Cemetery has not been irrigated using groundwater for more than 20 years (personal communication on 9/7/07 between Greg Bartow (SFPUC) and Clifford Schem (US Dept. of Veterans Affairs, Nat'l Cemetery Administration)).

4.8 Summary

Total 2008 groundwater pumping in the Westside Basin is estimated at 8,500[2] af. Metered water use indicates that the cities of Daly City, South San Francisco, and San Bruno used approximately 5,900 af of groundwater in 2008, while the two metered golf courses in the Lake Merced area used approximately 91 af of groundwater and 516 af of recycled water during calendar year 2008.According to data provided by the City of Daly City, the Lake Merced Golf Course used approximately 78 af of recycled water in 2008. Annual pumping data for 2008 was not available from the Lake Merced Golf Club but is estimated at about 37 af based on 2007 metered groundwater use. A general comparison between the combinations of metered and estimated historical pumping, and more completely metered pumping in 2005, 2006, 2007 and 2008, is presented in Table 1 and 2.

Total 2008 reported metered pumping in the Westside Basin was approximately 8,550 af. This consists of metered pumping at the three wells in Golden Gate Park, the San Francisco Zoo well, Daly City, San Bruno, Olympic Club Golf Course, and San Francisco Golf Club, and estimated groundwater pumping at the Lake Merced Golf Club based on 2007 values. To date the SFPUC and cooperating municipal pumpers have not requested annual pumping information from the other irrigation pumpers in the Westside Basin. However, based on estimates compiled by Carollo Engineers (Carollo Engineers, September 2008), the other pumping in the South Westside Basin is estimated at about 1,000 afy. Pumping within the Westside Basin not described (e.g., private homeowner wells, groundwater remediation extraction wells, and construction dewatering wells) is assumed to be negligible compared to the municipal and large-scale irrigation uses.

5.0 GROUNDWATER MONITORING AND TESTING PROGRAM

Groundwater monitoring within the Westside Basin consists of groundwater elevation and water quality monitoring conducted on a semi-annual basis (conducted during the spring and fall each year). Monitoring of groundwater elevations and various water quality parameters is conducted throughout the Westside Basin to evaluate the potential for seawater intrusion, and define lake-aquifer interaction. The monitoring program is also conducted to assess general conditions in the basin resulting from ongoing pumping, the conjunctive use program pilot and the recycled water program. The groundwater elevation monitoring well network is listed in Table 3, and approximate well locations are shown on Figure 5. These include both dedicated monitoring wells and inactive production wells. Measurements are collected manually on a quarterly or semi-annual basis in some wells, and daily through the use of electronic pressure transducers in other wells. Groundwater elevation hydrographs of all the wells monitored in 2008 are presented in Appendix A. All groundwater elevations are presented relative to the North American Vertical Datum of 1988 (NAVD88).

In addition to monitoring groundwater elevation data, groundwater sampling and analysis were conducted from select wells to monitor concentrations of various analytes and physical parameters of groundwater within the Westside Basin. The groundwater quality testing network is shown on Figure 21. Results of these analyses are used to monitor and evaluate the potential for seawater intrusion and general groundwater quality. Groundwater samples collected by the SFPUC for the North Westside Basin were done so in accordance with the “Sampling and Testing Protocol” for the Westside Basin (Appendix C).

Select groundwater samples were tested for some or all of the following constituents:

- General Minerals including: total alkalinity, calcium, magnesium, sodium, potassium, bicarbonate as $CaCO_3$, chloride, and sulfate;
- Iron and manganese (total and dissolved fractions);
- Nitrate;
- General parameters including: specific conductance, pH, total dissolved solids (TDS), and hardness;
- Bromide;
- Orthophosphate, and
- Boron.

Select groundwater elevation data are summarized in hydrographs illustrated on Figures 6 to 15, and groundwater elevation contour maps are presented on Figures 16 to 19. Results of chemical analyses on select groundwater samples are summarized in Tables 6 to 9.

6.0 COASTAL AND BAY SIDE WATER LEVEL MONITORING

6.1 Coastal Water Level Monitoring

Groundwater level measurements are being collected from a coastal monitoring well network in the western part of the basin, along the Old Great Highway (near Kirkham, Ortega, and Taraval Streets), the north-western part of Golden Gate Park, at the Oceanside Wastewater Treatment Plant, at the San Francisco Zoo, at Fort Funston, and at Thornton Beach. Fieldwork was conducted in accordance with the "Sampling and Testing Protocol for the Westside Basin" presented in Appendix C.

Groundwater elevation hydrographs of the Kirkham, Ortega, Taraval, and Zoo monitoring wells are presented in Figures 6 through 9, respectively. These hydrographs also include chloride concentrations from the water quality monitoring conducted at these wells. The water quality data are further discussed in Section 7.1. Figures 6 through 9 show the history of groundwater levels in the coastal monitoring wells since installation of wells at those four sites.

Groundwater elevations within the Shallow aquifer at all four coastal wells increased slightly or remained virtually unchanged seasonally compared to observed 2007 levels, and continued to trend above sea level in all wells. Groundwater levels within the Primary Production aquifer and Deep aquifer at the following wells increased in 2008 from the observed seasonal low levels of 2007, as follows:

- Kirkham MW-255 (Figure 6b) increased from a seasonal low of 3.2 ft (September 2007) to 5.2 ft (July 22, 2008);
- Kirkham MW-385 (Figure 6c) increased from a seasonal low of 2.9 ft (September 2007) to 5.2 ft (September 22, 2008);
- Kirkham MW-435 (Figure 6d) increased from a seasonal low of -0.5 ft (September 2007) to 2.4 ft (June 2008);
- Groundwater levels in Ortega MW-475 (Figure 7d) increased from a seasonal low of -4.7 ft in September 2007 to 1.0 ft (May 2008).
- Taraval MW-530 (Figure 8d) increased from a seasonal low of -9.0 ft (September 2007) to -2.0 ft (May 2008); and
- Zoo Monitoring Well MW-565 (Figure 9c) increased from a seasonal low of -13.5 ft (September 2007) to -6.0 ft (May 2008);

At their lowest measured levels of 2008, groundwater elevations at Taraval MW-530 (-2.0 ft), and Zoo Monitoring Well MW-565 (-6.0 ft) were below sea level. In addition, observed groundwater levels at the South Windmill monitoring well MW-57 and MW-140 remained below sea level and were similar to the recorded 2007 levels (Appendix A). Groundwater levels in MW-57, located in close proximity to the South Windmill Replacement well, dropped below sea level for the first time in 2007 since water level measurement began in 1989.

The observed increase in water level elevations in the Primary Production and Deep aquifers at the Kirkham, Ortega, Taraval, and Zoo wells, are likely a result of the following factors:

- Decreased pumping of groundwater at the SF Zoo production well, from 616 af in 2007 to 260 af in 2008 (Table 2), resulting in reduced drawdown and impact on the nearby coastal monitoring wells screened in the Primary Production and Deep aquifer;

- Although total groundwater use at the Golden Gate Park increased from about 827 af in 2007 to 1,294 af in 2008 (Table 2), there was a slight shift in pumping patterns caused by the shutdown of the South Windmill Replacement production well to more inland locations at various times in 2008, and

- A corresponding increase in pumping at the North Lake production well in Golden Gate Park resulted in less observed drawdown of water levels in the coastal monitoring wells. Pumping at the North Lake production well increased from about 224 af in 2007 to 645 af in 2008, while pumping at the South Windmill Replacement production well decreased from 596 af in 2007 to 558 af in 2008. Pumping at the Elk Glenn production well located in the central portion of the Golden Gate Park, increased from 7 af in 2007 to 91 af in 2008.

With the exception of the South Windmill monitoring well MW-57 and MW-140, groundwater elevations measured at wells screened within the Shallow aquifer in 2008 were all above sea level. Groundwater elevation contours for the Shallow aquifer measured during the spring and fall 2008 monitoring events are presented on Figures 16 and 17, respectively.

Groundwater levels at coastal monitoring wells screened in the Primary Production aquifer increased in 2008 compared to observed 2007 levels. Groundwater elevation contours for the Primary Production aquifer measured during the spring and fall 2008 monitoring events are presented on Figures 18 and 19, respectively.

Groundwater levels at the two coastal wells screened in the Deep Aquifer (Taraval MW-530, and Zoo MW-565), increased compared to observed 2007 levels but remain below sea level.

In general, coastal groundwater levels in most of the wells on the Pacific Ocean side of the Westside Basin are sufficiently high (above sea level) to indicate a lack of potential for seawater intrusion. However groundwater levels in monitoring wells near the southwestern corner of Golden Gate Park were below sea level in the Shallow aquifer (South Windmill monitoring well MW-57 and MW-140). In the Shallow and Primary Production aquifers, the continued depression of groundwater levels appears to be the result of increased and concentrated pumping in the western part of Golden Gate Park. In addition, below-normal winter precipitation in 2006, 2007 and 2008 further reduced aquifer recharge, and increased the need for irrigation pumping. Continued concentrated pumping in Golden Gate Park and the resulting depression of groundwater levels below sea level indicates a potential for seawater intrusion.

Increased water level elevations observed in all monitoring wells screened in the Primary Production and Deep aquifer within the coastal monitoring system for 2008 reinforces the goal for more sustainable and decentralized pumping at the SF Zoo and Golden Gate Park. This would allow previously depressed water levels to continue to rise and reduce the potential for sea water intrusion, and create more sustainable groundwater conditions in the North Westside Basin.

The coastal monitoring wells located at Fort Funston and Thornton Beach have groundwater elevations above sea level. The aquifers at these locations appear to be hydraulically separated from the main portion of the Westside Basin by faults and resultant steeply dipping geologic units, which act as hydraulic barriers to flow (LSCE, 2004). Groundwater elevations in the Fort Funston monitoring wells (Fort Funston –S and Fort Funston –M) continue to exhibit a generally increasing trend in the Upper Merced Formation and a virtually constant water level elevation in the Middle Merced Formation. Groundwater elevation monitoring at the Thornton Beach well MW 225 (screened in the Primary Production aquifer) and MW 670 (screened in the Deep aquifer) indicates that groundwater levels in both aquifers continue to rise in this area and remain well above sea level. Groundwater hydrographs for all wells monitored in 2008 are presented in Appendix A.

6.2 Bay Side Water Level Monitoring

Additional monitoring on the Bay Side of the Westside Basin was implemented by the City of San Bruno in 2006. In the fall of 2006, two new well clusters were installed and monitored by the City of San Bruno at locations in the San Francisco Airport (SFO) and within Burlingame (Figure 5). These wells were positioned to enhance monitoring of groundwater levels and water quality parameters along the San Francisco Bay side of the basin. Details of field activities, well installation activities and resulting monitoring in November 2006 and April 2007, were presented in “San Bruno Groundwater Monitoring Wells: Installation and Monitoring, An AB 303 Project Report”, prepared for the City of San Bruno by WRIME, Inc. and dated April 2007.

In February 2008, groundwater elevations were measured in the two monitoring well clusters: SFO (S and D) and Burlingame (S, M, and D). Groundwater elevations measured during this event in wells SFO-S and SFO-D were 2.29 and -29.18 feet (NAVD88), respectively. Groundwater elevations measured during this event in wells Burlingame (S, M, and D) were 3.37, 1.52, and -3.95 ft (NAVD88), respectively. Groundwater elevations measured during the August 2008 monitoring event in wells SFO-S and SFO-D were 1.78 and -30.07 ft (NAVD88), respectively. Groundwater elevations measured at wells Burlingame –S, M, and D during the August event; were 1.64, -0.82, and -4.65 ft (NAVD88), respectively. Fieldwork was conducted by WRIME Inc in accordance with the "San Bruno Seawater Intrusion Monitoring Wells: Sampling Plan", prepared for the City of San Bruno by WRIME, Inc. dated April, 2007.

6.3 Lake Merced and Lake-Aquifer Monitoring

The water level elevations in Lake Merced in 2009 ranged from about 16.27 feet to 18.30 feet (NAVD88 datum). Lake levels are presented on Figure 20. Observed 2008 lake levels are fairly similar to observed levels in 2007, and continue to show a generally upward trend from seasonal low levels in 2002. These lake level elevations are above the 14 to 16 foot (NAVD88) interim lake level range established by the SFPUC.

Lake-aquifer monitoring around Lake Merced is accomplished by a combination of continuous and periodic monitoring of water levels in each of the three lake bodies, and by a combination of continuous and intermittent monitoring of groundwater levels in a network of dedicated monitoring wells around the lake complex, as illustrated in Figure 5.

Measured groundwater elevations in wells screened in the Shallow aquifer around the Lake. during the spring 2008 event, ranged from 13.34 feet (LMMW-9SS) to 29.31 ft above sea level (LMMW-7SS). For the fall 2008 event groundwater elevations ranged from 12.76 feet (LMMW-9SS) to 28.75 feet (LMMW-7SS). In the underlying Primary Production aquifer, groundwater elevations in the vicinity of Lake Merced ranged from -5.75 feet (LMMW-3D) to 14.63 feet (LMMW-2D) during the spring 2008 event. For the fall 2008 event, measured groundwater elevations in the Primary Production aquifer in the vicinity of Lake Merced ranged from -9.01 feet (LMMW-3D) to 13.48 feet (LMMW-2D).

For 2008, Shallow aquifer groundwater elevations around the Lake ranged from about 1.2 ft below to 12.7 ft above the interim Lake levels. Groundwater levels in the Primary Production aquifer around the lake ranged from about 23 ft below to 0.5 ft below the interim Lake levels. Groundwater elevations in the Primary Production aquifer were also in general lower than levels measured in the Shallow aquifer and the lake, indicative of a potential for flow from the Shallow aquifer-Lake system toward the underlying aquifer in which nearby production wells are primarily completed.

Hydrographs of two wells screened in the Shallow and Primary Production aquifers (LMMW-1S and LMMW-1D, respectively) that monitor groundwater elevations in the vicinity of Lake Merced are presented on Figure 12. Groundwater elevations in both aquifers continue to exhibit a generally upward trend from their 2002 levels. However groundwater levels in wells screened in the Primary Production and Deep Aquifer located near the southern portion of Lake Merced (e.g. LMMW-3D) decreased compared to 2007 values (Appendix A). This appears to be a result of increased and continued groundwater pumping by the City of Daly City.

6.4 South Westside Basin Water Level Monitoring

As part of the Westside Basin Monitoring Program, water levels in 9 wells screened in the Primary Production aquifer are typically monitored in the South Westside Basin. These wells were initially monitored by the San Mateo County Department of Environmental Health, starting in 2000. Since 2002 these wells have been monitored as part of the SFPUC's groundwater monitoring program. These wells consist of: LMMW-6D, DC 1 (Westlake), DC 8, and Park Plaza (MW-460) located in Daly City; SS1-02 and SS1-20 located in South San Francisco; SB-12 in San Bruno, and UAL 13C and UAL 13D located at the San Francisco International Airport. In 2006, two new well clusters (SFO and Burlingame) were installed by the City of San Bruno to fill data gaps in their own monitoring program. In the summer of 2007 SFPUC installed a monitoring well cluster consisting of 4 wells, at the South San Francisco Linear Park in South San Francisco.

In October 2008, SFPUC installed five new monitoring well clusters at the following locations:

- CUP-10A located within SFPUC Right of Way in Daly City;
- CUP-18 located within SFPUC Right of Way at Colma Blvd in Colma;
- CUP-19 located within SFPUC Right of Way at Serramonte Blvd in Colma;
- CUP-22A located within SFPUC Right of Way at Hickey Blvd at Camaritas Road, in South San Francisco; and
- CUP-36-1 located within SFPUC Right of Way at Southwood Drive in South San Francisco.

The five monitoring well clusters were completed at depths ranging from 151 to 710 feet bgs. These well clusters were installed as part of the Water System Improvement Program, Groundwater Conjunctive Use Project well installation and will be incorporated in the SFPUC's Westside Basin monitoring program. Permits, well construction details, lithologic logs and geophysical logs from these monitoring wells are presented in Appendix D.

Water level measurements for the wells screened within the Primary Production aquifer and monitored during the spring 2008 event [LMMW-6D, DC 1 (Westlake), Park Plaza MW-460, DC 8, SB-12, SS 1-02, and SSFLP MW-220] indicate that groundwater elevations were below sea level. Groundwater elevations ranged from -15.54 feet (LMMW-6D) to -185.23 feet (SB-12 Elm

Avenue) relative to mean sea level during the spring event. Groundwater elevation contours in the Primary Production aquifer for the spring 2008 event are presented on Figure 18. Groundwater elevations during the fall 2008 monitoring event indicate that elevations in these wells ranged from -19.84 feet (LMMW-6D) to –194.94 feet (SB-12 Elm Avenue). Groundwater elevation contours in the Primary Production aquifer for the fall 2008 event are presented on Figure 19. Groundwater elevation hydrographs for all the wells monitored during the spring and fall 2008 events are presented in Appendix A.

7.0 GROUNDWATER QUALITY MONITORING

Groundwater quality data for the Westside Basin are primarily from a combination of historical water quality analyses, mostly from municipal supply wells, and from the semi-annual monitoring program that was initiated throughout the basin in May 2000. The program has expanded to include additional wells as they have been constructed. Program wells are illustrated in Figure 21 and listed in Table 5, and they reflect the location of both production and dedicated monitoring wells. Results of groundwater quality monitoring in 2008 are presented below.

7.1 Coastal Groundwater Quality

Monitoring of groundwater levels and groundwater quality at the coastal monitoring wells located along the Great Highway near Kirkham, Ortega, and Taraval streets, and at the San Francisco Zoo, as well as in the southwestern portion of Golden Gate Park, is conducted to detect the potential for seawater intrusion. Groundwater samples from these wells were tested for specific conductance, total dissolved solids (TDS) and chloride in the spring and fall 2008. Results of groundwater quality testing for the coastal monitoring wells are presented in Table 6. Chloride concentrations and groundwater elevations in 2008, as well as records since the inception of coastal monitoring (2004), are plotted on hydrographs presented in Figures 6 through 9.

Chloride concentrations for 2008 ranged from 19 mg/l (SF#32-Ortega MW400) to 178 mg/l (SF#57-USGS South Windmill MW-57). Detected chloride concentrations in the coastal monitoring wells generally ranged from 19 mg/l to 69 mg/l, with the exception of the SF#57-USGS South Windmill MW-57, which had concentrations of 150 mg/l (spring 2008) and 178 mg/l (fall 2008). For the shallow coastal wells (screened between 50 to 150 feet), chloride concentrations ranged from 30 mg/l (SF#30-Grt Hyw/Ortega MW-125) to 178 mg/l (SF#57-USGS South Windmill MW-57) (Table 6).

The chloride concentrations measured in 2008 are within historical ranges at all the wells sampled, except for the USGS South Windmill MW-57 well. All chloride concentrations are below the state of California secondary drinking water standard of 250 mg/l and are also well below 500 mg/l, a commonly referenced concentration indicative of seawater intrusion. Although groundwater levels continue to be depressed below sea level in the deeper part of the aquifer system and chloride concentrations at the Zoo, and the USGS South Windmill MW-140 well located in the southwestern portion of Golden Gate Park are slightly higher than the other monitoring locations along the coast, none appear to be suggestive of seawater intrusion at the present time. The total dissolved solids (TDS) concentrations and specific conductance values in these wells are all within historical ranges and below established secondary drinking water standards.

The chloride, TDS and specific conductance values in the USGS South Windmill MW-57 well show an increase in concentration that may be an early indication of seawater intrusion. Efforts are underway between the SFPUC and the SF Recreation and Park Department to develop a recycled water supply for Golden Gate Park, and to distribute groundwater pumping further away from the coast.

7.2 General Basin Conditions

Groundwater quality is monitored in a network of production and monitoring wells as described above and illustrated in Figure 21. Groundwater samples were collected from wells used to assess general basin conditions in the spring (April, May, and June) 2008. The analytical results are summarized in Tables 7 and 8. With the exception of nitrate (as $N0_3$) concentrations detected in DC#01 - A St (Daly City) and one of the South San Francisco wells SS#08 - SS 1-19, groundwater quality generally meets the maximum contaminant levels (MCLs) of primary drinking water standards set by California Department of Public Health.

The South San Francisco Linear Park (SSFLP) wells (MW-120, 220, 440, and 520) were sampled and analyzed for iron and manganese in the spring and fall 2008. Detected total iron concentrations ranged from 0.013 mg/l (SSFLP MW-520) to 0.161 mg/l (SSFLP MW-120), while detected total manganese concentrations ranged from 0.147 mg/l (SSFLP MW-220) to 0.825 mg/l (SSFLP MW-120). In addition groundwater samples from the well cluster at the South San Francisco Linear Park were tested for dissolved iron and manganese. Detected dissolved iron concentrations ranged from 0.005 (SSFLP MW-520) to 0.063 mg/l (SSFLP MW-120). Detected dissolved manganese concentrations at these wells ranged from 0.139 mg/l (SSFLP MW-220) to 0.805 mg/l (SSFLP MW-120). Detected concentrations of total and dissolved manganese in these wells exceed the secondary MCL of 0.05 mg/l. Detected iron and manganese concentrations are summarized on Table 8.

The 2008 water quality results for specific conductance, TDS, and chloride for Daly City well (DC#11 – Westlake DC2), South San Francisco well SS#08 - SS 1-19 , and San Bruno well SB#06 - SB-17 Corporation Yard are combined with available historical data and illustrated in Figures 22 through 24, respectively. South San Francisco well SS#05 – SS 1-14, which is typically sampled as part of the monitoring program, was offline. Production well SS#08 – SS 1-19 located within the same well field was sampled instead. Results from this well have been appended to the historical data available from SS 1-14 and are presented in Figure 23 and 25. The 2008 and historical nitrate data for the above wells and the Vale well (Daly City) are illustrated in Figure 25.

7.2.1 City of Daly City

In Daly City, the available data extend back to the mid 1970's (Table 7 and Figures 22 and 25), but are too sporadic to derive any substantive conclusions about trends or changes. During the spring 2008 monitoring event, detected nitrate concentrations ranged from 10 mg/l in DC#06 - Jefferson to 131 mg/l in DC#01 - A St. Nitrate concentrations in DC#01 - A St exceeded the primary MCL of 45 mg/l. With the exception of well DC#06- Jefferson, which remained essentially unchanged (from 9.4 to 10 mg/l), detected nitrate concentrations decreased slightly with respect to the 2007 sampling results in three of the four wells sampled during this event. Specific conductance increased slightly in three of the four wells sampled compared to 2007 levels. Chloride concentrations ranged from 56 mg/l (DC#06-Jefferson) to 122 mg/l (DC#11 Westlake DC 2). Except for DC#06- Jefferson, which showed a decrease from 80 to 56 mg/l, detected chloride concentrations increased slightly in all of the Daly City wells sampled during this event. Ongoing monitoring will delineate whether the recent data are indicative of changing, temporary, or anomalous conditions in that area. The monitoring program will continue to examine these trends in subsequent events.

7.2.2 City of South San Francisco

For the South San Francisco area, records from Cal Water date back to the late 1950's (Table 7 and Figures 23 and 25). Chloride concentrations for the spring 2008 monitoring event ranged from 63 mg/l (SSFLP 440) to 176 mg/l (SSFLP 120). Chloride concentrations in the South San Francisco area, have consistently been higher than elsewhere in the basin. Historically specific conductance and TDS concentrations in well SS#05 SS 1-14 have fluctuated more than chloride and appeared to exhibit a generally upward trend since the 2000 monitoring event. During the 2008 spring monitoring event, wells SS#05-SS1-14, and SS#10-SS1-21 were undergoing repair and consequently were not sampled. Two other production wells SS #08-SS 1-19 and SS #09-SS 1-20 located in the same well field, were sampled in their place. The specific conductance at the two production wells sampled in South San Francisco during the spring 2008 monitoring event was 993 µmhos/cm (SS#08 – SS 1-19) and 863 µmhos/cm (SS#09 – SS 1-20). Analysis detected 47 mg/l (SS#08 – SS 1-19) and 35 mg/l (SS#09 – SS 1-20) of nitrate respectively. The detected nitrate concentration at well SS#08 – SS 1-19 is slightly above the primary MCL of 45 mg/l (Table 7). Ongoing monitoring will delineate whether the recent data are indicative of changing, temporary, or anomalous conditions in that area.

7.2.3 City of San Bruno

In San Bruno, available groundwater quality data extend back to 2000 (Table 7, Figures 24 and 25). Interpretation of the records since 2000 (Figure 24) suggests fairly constant conditions. For 2008, chloride concentrations were 57 mg/l and 84 mg/l at SB 17 Corporation Yard and SB 20

Lions Field Park, respectively. Reported chloride concentrations increased slightly at the SB-17 well and decreased at the Lions Field Park well, but remained within historical ranges. The nitrate concentrations were 6 mg/l and 1 mg/l in SB-17 and SB 20, respectively. Detected nitrate concentrations in the two wells sampled during the spring 2008 event are well below the primary MCL of 45 mg/l (Table 7 and Figure 25). At present, we understand that the City of San Bruno is treating groundwater pumped from well SB#08 - SB 20 for manganese.

As part of the City of San Bruno's Bay side monitoring program, the two well clusters installed in 2006 were sampled by WRIME, Inc in August 2008. A summary of chemical testing results was provided by WRIME Inc on behalf of the City of San Bruno (Figure 7). Chloride concentrations and groundwater elevations beginning in 2006 for the Burlingame and SFO wells are plotted on hydrographs presented in Figures 10 and 11 respectively.

7.3 Recycled Water

The initiation of recycled water deliveries in 2004 for golf course irrigation around Lake Merced, which resulted in meeting about most of irrigation demand at the private courses in 2008, had raised a question regarding potential impact of recycled water application on the underlying groundwater. Initial evaluation of this question in 2005 consisted of a comparison between recycled water quality and background (current) groundwater quality in monitoring wells near the golf courses. Groundwater monitoring of these four wells continued in 2008. Available data on recycled water quality collected in 2005, and nearby dedicated monitoring wells sampled at least annually between 2004 and 2008, are presented in Table 9. Based on comparison of those data, the water quality of recycled water and groundwater is sufficiently similar that no substantial change in groundwater quality would appear to be expected as a result of recycled water application. For the available data, constituent concentrations in the recycled water are within, or slightly higher than, those in the underlying groundwater (Table 9). Ongoing monitoring of recycled water quality and underlying groundwater will permit interpretation of changes that may occur in the future.

8.0 SUMMARY AND PROPOSED ACTIVITIES FOR 2009

This report is the annual report on groundwater conditions in the Westside Basin, prepared by the SFPUC in cooperation with Daly City, San Bruno, and Cal Water (cooperating agencies).

8.1 Groundwater Monitoring

The groundwater monitoring and reporting program will continue to be implemented in accordance with the recommendations presented in the 2005 annual report (LSCE, 2006). Semi annual sampling and various water level measurements will be conducted in 2009 to assess general groundwater conditions in the Westside Basin, as well as to continue to evaluate the adequacy of the entire program. In 2009, the cooperating agencies will assess the need for expanding the monitoring program within the southern part of the Basin, and continue to incorporate water level elevation and water quality data from any future wells installed within these jurisdictions (e.g. the five new well clusters installed in October 2008 in the southern portion of the basin as part of the Conjunctive Use Project). The scope and frequency of the groundwater monitoring program are presented on Tables 10 and 11.

8.2 Coastal Monitoring

Continued semi-annual monitoring of coastal water quality (primarily TDS, specific conductance, and chloride) conducted during the spring and fall (Table 11) will be coupled with quarterly-to-daily water level measurements from the existing coastal monitoring well locations (Table 10).

8.3 Lake Merced

For 2009 the existing monitoring program at Lake Merced will be continued, with collection of lake level data from South Lake and Impound Lake in accordance with recommendations of the 2005 annual report. Groundwater measurements will be recorded daily and quarterly in accordance with the current program (Table 10). More frequent measurements may be appropriate as part of any artificial water additions to the lake or aquifer hydraulic testing. Such changes will be implemented as necessary.

8.4 General Basin Conditions and In-Lieu Conjunctive Use Program

The SFPUC will continue to monitor daily water levels of key wells in the Daly City, South San Francisco, and San Bruno areas (Table 10), along with annual water quality monitoring (Table 11). In the southern portion of the Westside Basin, there remains a need for quantification of pumping at the cemeteries in Colma and at the California Country Club, to complete the current understanding of significant pumping in the Westside Basin.

8.5 Recycled Water Program

SFPUC will continue monitoring recycled water quality and groundwater quality in the areas of recycled water use on an annual basis (Table 11). Although initial data show recycled water quality and groundwater quality to be fairly similar, continued monitoring will provide data to evaluate whether any trends develop as a result of the use of recycled water for irrigation purposes. For 2009, we will add testing for nitrate as $N0_3$ to the monitoring of groundwater quality in areas of planned recycled water use (e.g. LMMW -2S and LMMW-2D located at the Harding Park Golf Course in San Francisco).

8.6 Bay Side Monitoring

The City of San Bruno will continue to monitor the Bay Side wells in the southeastern portion of the Westside Basin on a semi-annual basis, in general accordance with the Westside Basin monitoring program and transmit this data to the SFPUC for inclusion in the annual groundwater monitoring reports.

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APPENDIX B SFPUC AGENDA ITEM FOR APPROVAL OF THE WATER SYSTEM IMPROVEMENT PROJECT OCTOBER 31, 2008

AGENDA ITEM
Public Utilities Commission
City and County of San Francisco

DEPARTMENT Water Enterprise AGENDA NO.

MEETING DATE October 30, 2008

SUMMARY OF PROPOSED COMMISSION ACTION

Approve the Phased Water System Improvement Program (Phased WSIP) Goals and Objectives and **Adopt** California Environmental Quality Act (CEQA) Findings, including a statement of overriding considerations and the Mitigation Monitoring and Reporting Program (MMRP).

DESCRIPTION OF ACTION

Program Approval

The Phased WSIP is a variant of the originally proposed WSIP and includes full implementation of the WSIP facility projects to ensure that the public health, water quality, seismic safety, and delivery reliability goals are achieved, with phased implementation of the water supply portion of the program. Under the Phased WSIP, the SFPUC will establish an interim, mid-term implementation horizon of 2018. The Phased WSIP includes water supply delivery to wholesale and retail customers through 2018.

The Phased WSIP goals and objectives are founded on two fundamental principles pertaining to the existing regional water system: (1) maintain a clean, unfiltered water source from the Hetch Hetchy system and (2) maintain a gravity-driven system.

The overall goals of the Phased WSIP for the regional water system are to:

- Maintain high-quality water and a gravity-driven system
- Reduce vulnerability to earthquakes
- Increase delivery reliability
- Meet customer water supply needs
- Enhance sustainability
- Achieve a cost-effective, fully operational system

APPROVAL:

PERFORMING ORGANISATION		FINANCE	Todd Rydstrom
COMMISSION SECRETARY	Michael Housh	GENERAL MANAGER	Ed Harrington

A table presenting the Phased WSIP goals and objectives as they relate to the program goals is included in the Resolution for this action. The system performance objectives describe and, in some cases, more specifically quantify, what the regional water system proposes to achieve under the Phased WSIP. The performance objectives guide the water supply actions, facility improvements, operations, and maintenance requirements included in the Phased WSIP.

To meet the program goals and objectives the Phased WSIP includes the following program elements:

- Full implementation of WSIP facility improvement projects.

- Water supply delivery to regional water system customers through 2018 with an average annual target delivery of 265 mgd originating from the watersheds. This includes 81 mgd for the retail customers and 184 mgd for the wholesale customers.

- Water supply sources include: 265 mgd average annual delivery from the Tuolumne River watershed and the local watersheds plus 20 mgd of conservation, recycled water, and groundwater developed in the service area (10 mgd retail; 10 mgd wholesale).

- Implementation of delivery and drought reliability elements of the WSIP, including dry-year water transfers coupled with the Westside Groundwater Basin Conjunctive Use project, will meet the drought-year goal of limiting rationing to no more than 20 percent on a systemwide basis.

- Reevaluation of 2030 demand projections, potential regional system demand (purchase requests), and water supply options by 2018, and SFPUC decision in 2018 regarding regional water system deliveries after 2018.

- Financial incentives to limit water sales to an average annual amount of 265 mgd from the SFPUC watersheds.

Adoption of CEQA Findings

The City Planning Department prepared and the Planning Commission will be asked to certify on October 30, 2008, a Program Environmental Impact Report (PEIR) for the WSIP as required under CEQA, the CEQA Guidelines and Chapter 31 of the San Francisco Administrative Code. In order to comply with CEQA requirements, as part of the approval of the WSIP, the Commission must adopt the CEQA Findings, including a statement of overriding considerations, and the MMRP, attached to the Resolution as Attachments A and B, respectively.

The Final PEIR (consisting of the Draft PEIR and the Comments and Responses document) identified potentially significant impacts resulting from water supply and system operations and construction of WSIP facility improvement projects. The potentially significant impacts that would result from implementation of the recommended Program, or the "Phased WSIP" are described in Chapter 13 of the Final PEIR and are included in the Findings. The Final PEIR identified mitigation measures to substantially reduce or eliminate many of the significant impacts identified in the PEIR. The CEQA Findings provide for adoption of the mitigation measures by the SFPUC and the MMRP provides information and allocates responsibility for implementing all of the mitigation measures proposed in the Final PEIR for the Phased WSIP.

Significant and unavoidable impacts are described in Section IV of the CEQA Findings attached to the Commission Resolution as Attachment A. Therefore, this Commission will need to adopt a Statement of Overriding Considerations, included in the CEQA Findings Section VI, explaining why the Commission has decided to approve the Phased WSIP notwithstanding these significant and unavoidable environmental impacts.

RECOMENDATION

SFPUC staff recommends that the Commission approve the Phased WSIP Goals and Objectives and adopt the CEQA Findings, including the statement of overriding considerations, and the MMRP.

CONTEXT OF THIS ACTION

The SFPUC began development of the Water System Improvement Program (WSIP) in the late 1990’s through a series of studies, reports, and authorizations. In 1998, the SFPUC initiated a water supply planning effort, culminating in the Water Supply Master Plan (WSMP), issued in April 2000. The WSMP recommended a water resource strategy of demand management, facilities improvements, and development of additional supplies. Concurrent with the WSMP efforts, reliability studies of the water system facilities were performed to assess their vulnerability to earthquakes, landslides, fire, flood, and power outages.

These efforts led to the preparation of a Long-Term Strategic Plan for Capital Improvements, a Long-Range Financial Plan, and a Capital Improvement Program, approved and adopted by the San Francisco Public Utilities Commission on May 28, 2002 under Resolution No. 02-0101. The Capital Improvement Program identified 37 regional water system projects and 40 local (in-City) projects. The resolution authorized and directed the General Manager (GM) of the SFPUC to proceed with development and implementation of the strategic and financial plans, as well as the capital improvement program with such additions or changes as the GM and Commission deemed necessary or desirable.

Planning efforts for the Water System Improvement Program gained momentum in 2002 with the passage of Propositions A and E, San Francisco ballot measures that approved financing for water system improvements and long-term stewardship of the public utilities. Specifically, Proposition A was a revenue bond authorizing the City of San Francisco to borrow money to pay for improvements to its water system. The improvements cited in the bond measure included: upgrading and retrofitting the system's infrastructure against earthquake damage; upgrading the regional system's ability to store and convey water to the Bay Area; ensuring future water quality standards are met; and increasing water system capacity.

Proposition E was a charter amendment related to Proposition A that reinforced the SFPUC's charge to rehabilitate the aging water system in order to ensure reliable water delivery in the future and provided the agency the ability to finance the improvements. Proposition E's goals and objectives included clauses maintaining SFPUC's stewardship of the system as well as the requirements to provide reliable water, optimize the system's ability to withstand disasters, and improve drinking water quality. In addition, the charter amendment required the development of long-term capital, financial, and strategic plans to ensure accountability by the SFPUC, ensuring that the utility is being operated efficiently in accordance with best public utility practices. Prior to the ballot measures, the SFPUC prepared long-term capital, financial, and strategic plans, which were adopted on May 28, 2002. These initiatives provided the impetus to move the WSIP forward, founding the system performance objectives in the water system reliability requirements of Proposition E.

Also in 2002, the state legislature approved three bills reflecting wholesale customer concerns over risk of failure of the water system in a major earthquake. Governor Davis approved these bills in September of 2002, including Assembly Bill No. 1823, the Wholesale Regional Water System Security and Reliability Act.

Additional studies refined the scope and magnitude of the Water System Improvement Program since completion of the WSMP. A November 2004 technical report on wholesale customer water demand projections updated 2030 planning horizon demands. A 2004 analysis of system performance under various operating conditions also assessed the effectiveness of the proposed regional water projects to meet program objectives. Concurrently, development of a draft regional operational strategy/principles document delineated current and future system operating goals, constraints, and strategies.

From October 2004 to January 2005, the Commission held a series of public workshops to present these studies. At the final workshop the Commission provided direction on system performance objectives for the program. Based upon the system performance objectives the scope, schedule, and budget of the program were refined, allowing the San Francisco Public Utilities Commission (SFPUC) to provide a description of the Water System Improvement Program. On February 28, 2005, the SFPUC endorsed the WSIP.

Subsequently, the San Francisco Planning Department prepared the PEIR to evaluate the potential environmental effects of the WSIP pursuant to and in accordance with California Public Resources Code Sections 21000 et. Seq. (CEQA), Title 14 of the California Code of Regulations Sections 15000 et. seq. (CEQA Guidelines) and the provisions of Chapter 31 of the San Francisco Administrative Code. Attachment A to the Commission's Resolution approving the Program contains detailed information about the CEQA process and preparation of the PEIR.

During the environmental review process, the SFPUC and the Planning Department received many comments expressing strong concern about, and opposition to, a decision now to divert more water from the SFPUC watersheds. The SFPUC staff considered carefully those concerns and the long term needs of the water system, including the customers' needs as well as protection of natural resources. In order to accomplish urgently needed physical rehabilitation and maintenance of the system and to improve asset management and delivery reliability now, the SFPUC staff recommends immediate implementation of all of the WSIP facility improvement projects. In order to carefully consider the long term decision of whether to divert more water from the watersheds, the SFPUC staff believes that the water supply decision should now be a limited one for the next 10 years and then the SFPUC will reconsider the long term water supply decision by 2018. In the next 10 years, the SFPUC will explore and develop other water supply options, including conservation, recycling and groundwater programs.

The Phased WSIP Variant facility improvement projects remain the same irrespective of the water supply decision now and in 2018. To meet the system performance objectives for water quality, seismic reliability and delivery reliability, the SFPUC must implement the Phased WSIP Variant facility improvement projects that provide physical system capacities to meet the performance objectives. Design of WSIP project facilities is driven by all four of the program goals -- the need to improve system performance for seismic reliability and water delivery reliability as well as maintaining high water quality standards and meeting water supply goals. All four of these goals are factored in to the decision on how to size the WSIP's individual facilities. The SFPUC must move forward with the WSIP facilities as proposed, to meet average demand of up to 300 mgd, in order to improve seismic and water delivery reliability, meet current and future water quality regulations, provide for additional system conveyance for maintenance and meet water supply reliability goals for year 2030 and possibly beyond. The SFPUC must consider current needs as well as possible future changes and unplanned outages and design a system that achieves a balance among the numerous objectives, functions and risks a water supplier must face.

The Phased WSIP Variant also includes implementation of delivery and drought reliability elements of the WSIP, including dry-year water transfers coupled with the Westside Groundwater Basin Conjunctive Use project, to meet the drought-year goal of limiting rationing to no more than 20 percent on a systemwide basis. While average annual deliveries from the SFPUC watersheds would be limited to 265 mgd such that there would be no increase in diversions from the Tuolumne River to serve additional demand, there would be a small increase in average annual Tuolumne River diversions of about 2 mgd over existing conditions in order to meet the delivery and drought reliability elements through 2018.

ATTACHMENTS:

SFPUC Resolution
Attachment A – CEQA Findings
Attachment B – Mitigation and Monitoring Reporting Program

Contact: Michael Carlin, Assistant General Manager
Water Enterprise

PUBLIC UTILITIES COMMISSION

City and County of San Francisco

RESOLUTION NO. ___________________

WHEREAS, the San Francisco Public Utilities Commission approved and adopted a Long-Term Strategic Plan for Capital Improvements, a Long-Range Financial Plan, and a Capital Improvement Program on May 28, 2002 under Resolution No. 02-0101; and

WHEREAS, the San Francisco Public Utilities Commission determined the need for the Water System Improvement Program (WSIP) to address water system deficiencies including aging infrastructure, exposure to seismic and other hazards, maintaining water quality, improving asset management and delivery reliability, and meeting customer demands; and

WHEREAS, Propositions A and E passed in November 2002 by San Francisco voters and Assembly Bill No. 1823 was also approved in 2002 requiring the City and County of San Francisco to adopt a capital improvement program designed to restore and improve the regional water system; and

WHEREAS, the San Francisco Public Utilities Commission staff developed a variant to the WSIP referred to as the Phased WSIP; and

WHEREAS, the two fundamental principles of the program are 1) maintaining a clean, unfiltered water source from the Hetch Hetchy system, and 2) maintaining a gravity-driven system; and

WHEREAS, the overall goals of the Phased WSIP for the regional water system include 1) Maintaining high-quality water and a gravity-driven system, 2) Reducing vulnerability to earthquakes, 3) Increasing delivery reliability, 4) Meeting customer water supply needs, 5) Enhancing sustainability, and 6) Achieving a cost-effective, fully operational system; and

WHEREAS, on October 30, 2008, the Planning Commission reviewed and considered the Final Program Environmental Impact Report (PEIR) in Planning Department File No. 2005.0159E, consisting of the Draft PEIR and the Comments and Responses document, and found that the contents of said report and the procedures through which the Final PEIR was prepared, publicized and reviewed complied with the provisions of the California Environmental Quality Act (CEQA), the CEQA Guidelines and Chapter 31 of the San Francisco Administrative Code ("Chapter 31") and found further that the Final PEIR reflects the independent judgment and analysis of the City and County of San Francisco, is adequate, accurate and objective, and that the Comments and Responses document contains no significant revisions to the Draft PEIR, and certified the completion of said Final PEIR in compliance with CEQA, the CEQA Guidelines and Chapter 31 in its Motion No. _____; and

WHEREAS, this Commission has reviewed and considered the information contained in the Final PEIR, all written and oral information provided by the Planning

Department, the public, relevant public agencies, SFPUC and other experts and the administrative files for the WSIP and the PEIR; and

WHEREAS, the WSIP and Final PEIR files have been made available for review by the San Francisco Public Utilities Commission and the public, and those files are part of the record before this Commission; and

WHEREAS, San Francisco Public Utilities Commission staff prepared proposed findings, as required by CEQA, (CEQA Findings) and a proposed Mitigation, Monitoring and Reporting Program (MMRP), which material was made available to the public and the Commission for the Commission's review, consideration and action; and

WHEREAS, the Phased WSIP includes the following program elements: 1) full implementation of all WSIP facility improvement projects; 2) water supply delivery to regional water system customers through 2018; 3) water supply sources (265 million gallons per day (mgd) average annual from SFPUC watersheds, 10 mgd conservation, recycled water, groundwater in San Francisco, and 10 mgd conservation, recycled water, groundwater in the wholesale service area); 4) dry-year water transfers coupled with the Westside Groundwater Basin Conjunctive Use project to ensure drought reliability; 5) re-evaluation of 2030 demand projections, regional water system purchase requests, and water supply options by 2018 and a separate SFPUC decision by 2018 regarding water deliveries after 2018; and, 6) provision of financial incentives to limit water sales to an average annual 265 mgd from the SFPUC watersheds through 2018; and

WHEREAS, the SFPUC staff has recommended that this Commission make a water supply decision only through 2018, limiting water sales from the SFPUC watersheds to an average annual of 265 mgd; and

WHEREAS, before 2018, the SFPUC would engage in a new planning process to re-evaluate water system demands and water supply options. As part of the process, the City would conduct additional environmental studies and CEQA review as appropriate to address the SFPUC's recommendation regarding water supply and proposed water system deliveries after 2018; and

WHEREAS, by 2018, this Commission will consider and evaluate a long-term water supply decision that contemplates deliveries beyond 2018 through a public process; and

WHEREAS, the SFPUC must consider current needs as well as possible future changes, and design a system that achieves a balance among the numerous objectives, functions and risks a water supplier must face, including possible increased demand in the future; now, therefore, be it

RESOLVED, this Commission hereby adopts the CEQA Findings, including the Statement of Overriding Considerations, attached to this Resolution as Attachment A and incorporated herein as part of this Resolution by this reference thereto, and adopts the Mitigation Monitoring and Reporting Program attached to this Resolution as Attachment B and incorporated herein as part of this Resolution by this reference thereto; and, be it

FURTHER RESOLVED, this Commission hereby approves a water system improvement program that would limit sales to an average annual of 265 mgd from the watersheds through 2018, and the SFPUC and the wholesale customers would collectively develop 20 mgd in conservation, recycled water, and groundwater to meet demand in 2018, which includes 10 mgd of conservation, recycled water, and groundwater to be developed by the SFPUC in San Francisco, and 10 mgd to be developed by the wholesale customers in the wholesale service area; and, be it

FURTHER RESOLVED, As part of the Phased WSIP, this Commission hereby approves implementation of delivery and drought reliability elements of the WSIP, including dry-year water transfers coupled with the Westside Groundwater Basin Conjunctive Use project, which meets the drought-year goal of limiting rationing to no more than 20 percent on a system-wide basis; and, be it

FURTHER RESOLVED, This Commission hereby approves the Phased Water System Improvement Program, which includes seismic and delivery reliability goals that apply to the design of system components to improve seismic and water delivery reliability, meet current and future water quality regulations, provide for additional system conveyance for maintenance and meet water supply reliability goals for year 2018 and possibly beyond; and, be it

FURTHER RESOLVED, This Commission hereby approves the following goals and objectives for the Phased Water System Improvement Program:

Phased WSIP GOALS AND OBJECTIVES

Program Goal	System Performance Objective
Water Quality – *maintain high water quality*	• Design improvements to meet current and foreseeable future federal and state water quality requirements. • Provide clean, unfiltered water originating from Hetch Hetchy Reservoir and filtered water from local watersheds. • Continue to implement watershed protection measures.
Seismic Reliability – *reduce vulnerability to earthquakes*	• Design improvements to meet current seismic standards. • Deliver basic service to the three regions in the service area (East/ South Bay, Peninsula, and San Francisco) within 24 hours after a major earthquake. Basic service is defined as average winter-month usage, and the performance objective for design of the regional system is 229 mgd. The performance objective is to provide delivery to at least 70 percent of the turnouts in each region, with 104, 44, and 81 mgd delivered to the East/South Bay, Peninsula, and San Francisco, respectively. • Restore facilities to meet average-day demand of up to 300 mgd within 30 days after a major earthquake.

Program Goal	System Performance Objective
Delivery Reliability – *increase delivery reliability and improve ability to maintain the system*	• Provide operational flexibility to allow planned maintenance shutdown of individual facilities without interrupting customer service. • Provide operational flexibility to minimize the risk of service interruption due to unplanned facility upsets or outages. • Provide operational flexibility and system capacity to replenish local reservoirs as needed. • Meet the estimated average annual demand of up to 300 mgd under the conditions of one planned shutdown of a major facility for maintenance concurrent with one unplanned facility outage due to a natural disaster, emergency, or facility failure/upset.
Water Supply – *meet customer water needs in non-drought and drought periods*	• Meet average annual water demand of 265 mgd from the SFPUC watersheds for retail and wholesale customers during non -drought years for system demands through 2018. • Meet dry-year delivery needs through 2018 while limiting rationing to a maximum 20 percent system-wide reduction in water service during extended droughts. • Diversify water supply options during non-drought and drought periods. • Improve use of new water sources and drought management, including groundwater, recycled water, conservation, and transfers.
Sustainability – *enhance sustainability in all system activities*	• Manage natural resources and physical systems to protect watershed ecosystems. • Meet, at a minimum, all current and anticipated legal requirements for protection of fish and wildlife habitat. • Manage natural resources and physical systems to protect public health and safety
Cost-effectiveness – *achieve a cost-effective, fully operational system*	• Ensure cost-effective use of funds. • Maintain gravity-driven system. • Implement regular inspection and maintenance program for all facilities.

And, be it

FURTHER RESOLVED, This Commission authorizes and directs SFPUC staff to design and develop WSIP facility improvement projects consistent with the Phased WSIP Goals and Objectives.

I hereby certify that the foregoing resolution was adopted by the Public Utilities Commission at its meeting of October 30, 2008

Secretary, Public Utilities Commission

APPENDIX C SFPUC WATER SYSTEM IMPROVEMENT PROJECT INFORMATION (PEIR SUMMARY; APRIL TO JULY QUARTERLY REPORT AND WSIP PROGRESS TO DATE)

SUMMARY

S.1 Introduction and Purpose of the PEIR (Chapter 1)

The San Francisco Public Utilities Commission (SFPUC) proposes to adopt and implement the Water System Improvement Program (WSIP or proposed program) to increase the reliability of the regional water system that serves 2.4 million people in San Francisco and the San Francisco Bay Area. The WSIP would improve the regional system with respect to water quality, seismic response, water delivery, and water supply to meet water delivery needs in the service area through the year 2030 and would establish level of service goals and system performance objectives. The WSIP would implement a proposed water supply option, modify system operations, and construct a series of facility improvement projects. The proposed program area spans seven counties—Tuolumne, Stanislaus, San Joaquin, Alameda, Santa Clara, San Mateo, and San Francisco.

The San Francisco Planning Department, Major Environmental Analysis (MEA) Division, determined that implementation of the WSIP could have a significant effect on the environment and therefore required preparation of a Program Environmental Impact Report (PEIR) in compliance with the California Environmental Quality Act (CEQA). This PEIR is intended to provide the public and responsible and trustee agencies with information about the potentially significant environmental effects of the proposed program, to identify possible ways to minimize the potentially significant effects, and to describe and evaluate feasible alternatives to the proposed program.

S.2 Program Description (Chapter 3)

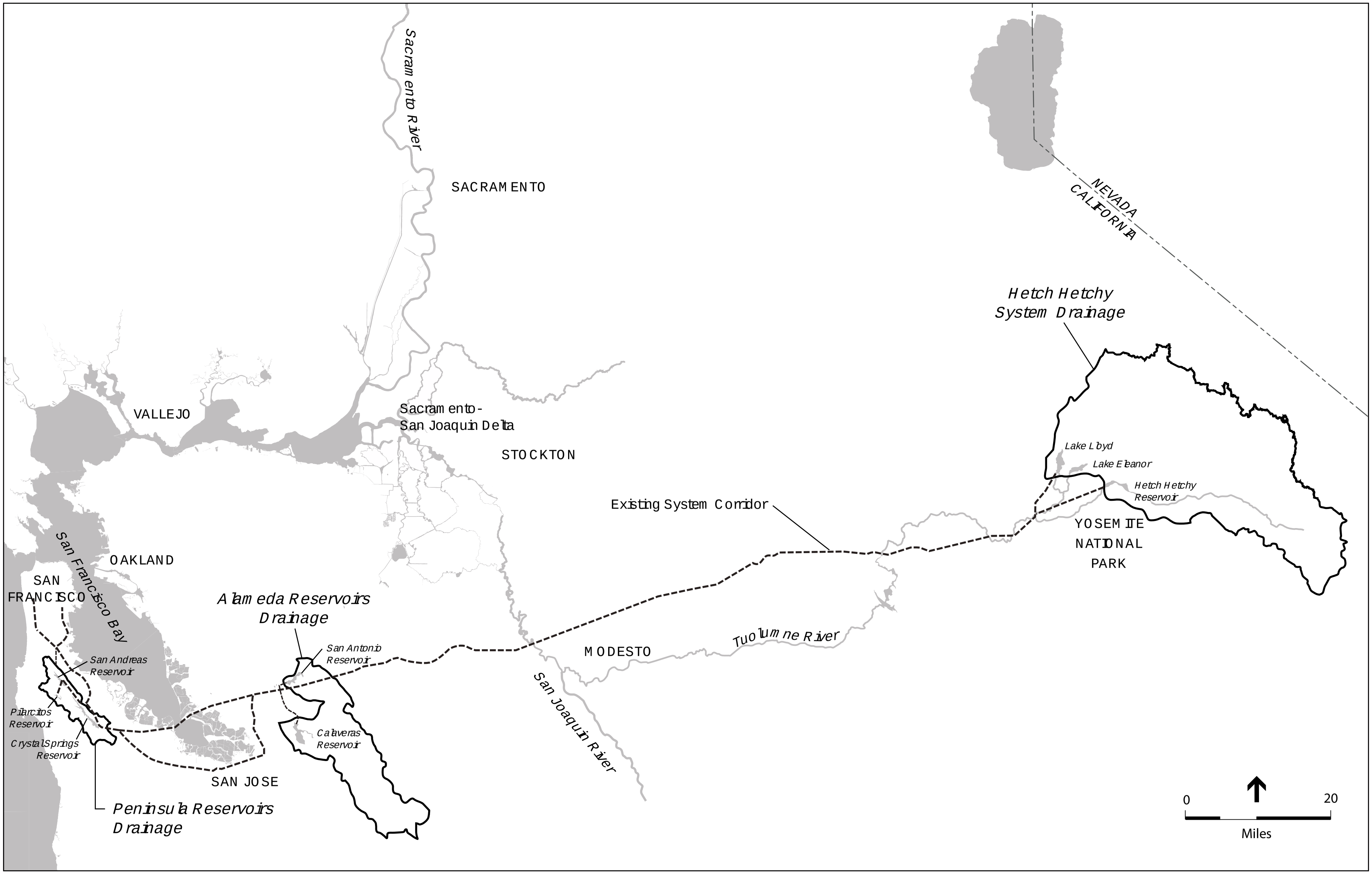
Need for and Objectives of the Program

The City and County of San Francisco (CCSF), through the SFPUC, owns and operates a regional water system that extends from the Sierra Nevada to San Francisco and serves retail and wholesale customers in San Francisco, San Mateo, Santa Clara, Alameda, and Tuolumne Counties. The existing regional system includes over 280 miles of pipelines, over 60 miles of tunnels, 11 reservoirs, 5 pump stations, and 2 water treatment plants. The SFPUC currently delivers an annual average of about 265 million gallons per day (mgd) of water to its customers. The source of the water supply is a combination of local supplies from streamflow and runoff in the Alameda Creek watershed and in the San Mateo and Pilarcitos Creeks watersheds (referred to together as the Peninsula watersheds), augmented with imported supplies from the Tuolumne River watershed. Local watersheds provide about 15 percent of total supplies and the Tuolumne River provides the remaining 85 percent. **Figure S.1** shows the general location of the SFPUC regional system and water supply watersheds.

The SFPUC serves about one-third of its water supplies directly to retail customers, primarily in San Francisco, and about two-thirds of its water supplies to wholesale customers by contractual agreement. The wholesale customers are largely represented by the Bay Area Water Supply and Conservation Agency (BAWSCA), which consists of 27 total customers, shown in **Figure S.2**. Some of these wholesale customers have other sources of water in addition to what they receive from the SFPUC regional system, while others rely completely on the SFPUC for supply.

While the SFPUC has historically met and is currently serving its customers' water demands, there are numerous factors contributing to the need for a comprehensive, systemwide program such as the WSIP. In order to continue to provide reliable water service to its customers, the SFPUC must plan for the future as well as address existing, known deficiencies, including the following:

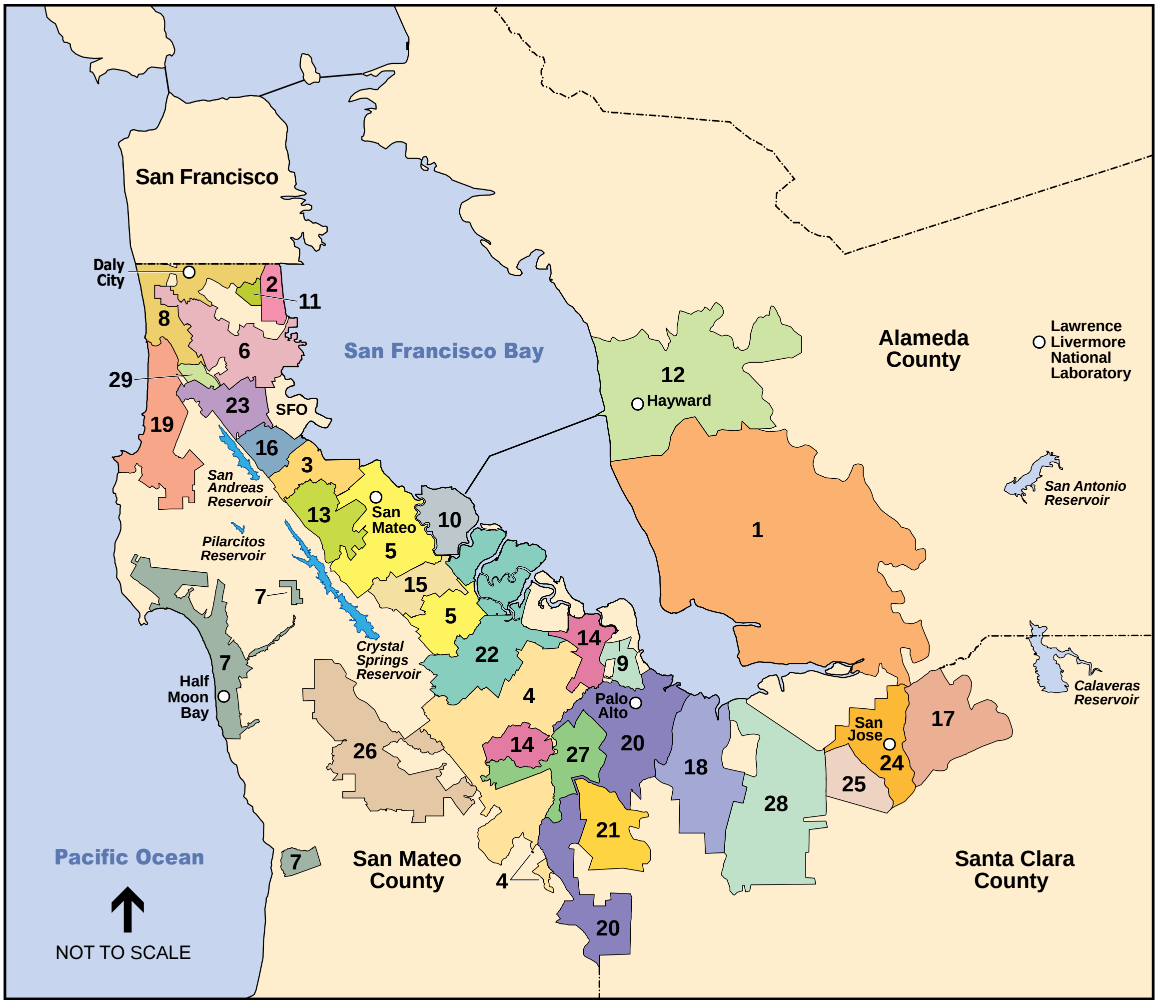
- *Aging Infrastructure*. Many of the components of the SFPUC regional water system were built in the 1800s and early 1900s. As the system ages, its reliability decreases and the risk of failure increases.



SOURCE: ESA + Orion

SFPUC Water System Improvement Program . 203287

Figure S.1
Overview of SFPUC Regional Water System and Water Supply Watersheds



Legend

(Wholesale customers and members of Bay Area Water Supply and Conservation Agency)

1 Alameda County Water District
2 City of Brisbane
3 City of Burlingame
4 CWS – Bear Gulch
5 CWS – Mid-Peninsula
6 CWS – South San Francisco
7 Coastside County Water District
8 City of Daly City
9 City of East Palo Alto
10 Estero Municipal Improvement District
11 Guadalupe Valley Municipal Improvement District
12 City of Hayward
13 Town of Hillsborough
14 City of Menlo Park
15 Mid-Peninsula Water District
16 City of Millbrae
17 City of Milpitas
18 City of Mountain View
19 North Coast County Water District
20 City of Palo Alto
21 Purissima Hills Water District
22 City of Redwood City
23 City of San Bruno
24 City of San Jose (North)
25 City of Santa Clara
26 Skyline County Water District
27 Stanford University
28 City of Sunnyvale
29 Westborough Water District

NOTE: For the purposes of this PEIR, the California Water Service (CWS) Company is a single wholesale customer with three different water service districts.

SOURCE: BAWSCA, 2006a

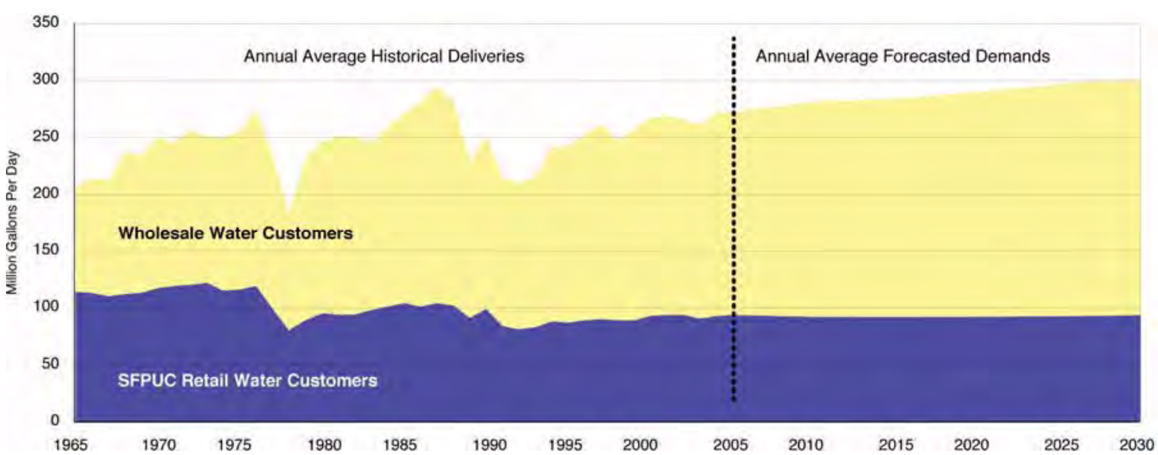
Figure S.2
SFPUC Water Service Area - San Francisco and SFPUC Wholesale Customers

- *Exposure to Seismic and Other Hazards.* The system crosses five active earthquake faults, and many of the existing facilities do not meet modern seismic standards. The California Division of Safety of Dams (DSOD) imposed operating restrictions on two of the system's reservoirs, Calaveras and Lower Crystal Springs Reservoirs, due to seismic and flood control safety hazards, respectively. The restricted operations at these reservoirs reduce local storage capacity and impair normal system operations.

- *Water Quality.* The regional system currently meets or exceeds existing water quality standards. However, system upgrades are needed to improve the SFPUC's ability to maintain compliance with current water quality standards and to meet anticipated future water quality standards.

- *Delivery Reliability.* The system requires additional redundancy (i.e., backup) of some critical facilities to ensure sufficient operational flexibility to carry out adequate system inspection and maintenance and to be adequately prepared in the event of an earthquake, system failure, or other emergency. These critical facilities are necessary to meeting day-to-day customer water supply needs, and increased operational flexibility is needed in order to maintain service to all customers during a full range of operating conditions.

- *Customer Water Demand.* The regional system currently has insufficient water supply to meet customer demand during a prolonged drought, and this situation will worsen in the future without the WSIP. Additional supplies are needed to satisfy current demand in drought years as well as to meet future demand. Water demand among SFPUC retail and wholesale customers is projected to increase over the next 25 years, from an average annual demand of about 366 mgd to 417 mgd in 2030. Of this total projected demand in the SFPUC service area, retail and wholesale customers would purchase an annual average of about 300 mgd from the SFPUC system in 2030, compared to 265 mgd in 2005, as shown in **Figure S.3**. Thus, the SFPUC would need to provide additional water supplies to serve a projected average annual increase in purchase requests of 35 mgd by 2030.



SOURCE: SFPUC, 2007b

SFPUC Water System Improvement Program ▪ 203287

Figure S.3
Annual Average Historical and
Projected Future Customer Purchase Requests

To address these challenges, the SFPUC must replace or upgrade numerous system facilities, add some new facilities, and expand its water supply portfolio—thus the need for the WSIP. In 2005, the SFPUC developed goals and objectives for the WSIP based on a planning horizon through 2030. The goals and objectives are founded on two fundamental principles pertaining to the existing regional water system: (1) maintaining a clean, unfiltered water source from the Hetch Hetchy system, and (2) maintaining a gravity-driven system. The overall goals of the WSIP are to:

- Maintain high-quality water
- Reduce vulnerability to earthquakes
- Increase delivery reliability and improve the ability to maintain the system
- Meet customer water supply purchase requests in nondrought and drought periods
- Enhance sustainability in all system activities
- Achieve a cost-effective, fully operational system

To further these program goals, the WSIP includes objectives that address system performance in the areas of water quality, seismic reliability, delivery reliability, and water supply through the year 2030. **Table S.1** presents the WSIP goals and objectives. The WSIP also includes proposed levels of service for the regional water system, which are intended to further define the system performance objectives through 2030 and provide design guidelines for the facility improvement projects. The levels of service (shown in Table 3.5, in Chapter 3, Program Description) address water quality, seismic response after a major earthquake, delivery during system maintenance, average annual water supply, regional system firm yield, and drought-year rationing.

Key program elements are summarized below and described in more detail in Chapter 3 (also see the SFPUC's 2006 *Water System Improvement Program* and 2007 *Water Supply Options* reports).

- *Water Supply*. Proposed water supply option to meet customer purchase requests during both nondrought and drought years.

- *System Operations*. Proposed system operations strategy to achieve water quality, seismic response, and delivery reliability performance objectives under a range of operating conditions, including the following scenarios: day-to-day, maintenance, unplanned outage, earthquake or other emergencies, and drought.

- *Facilities*. Proposed facility improvement projects to repair, upgrade, and, in some cases, expand the regional system facilities to reliably meet level of service goals and system performance objectives and to provide a cost-effective, fully operational water system.

Proposed Water Supply

Under the WSIP, the SFPUC proposes to meet the increased 35 mgd in purchase requests by continuing to maximize use of local watershed supplies, increasing diversions from the Tuolumne River under its existing water rights, and developing new local resources consisting of a combination of additional conservation, water recycling, and groundwater supply programs in

TABLE S.1
WSIP GOALS AND OBJECTIVES

Program Goal	System Performance Objective
Water Quality – *maintain high water quality*	• Design improvements to meet current and foreseeable future federal and state water quality requirements. • Provide clean, unfiltered water originating from Hetch Hetchy Reservoir and filter all other surface water sources. • Continue to implement watershed protection measures.
Seismic Reliability – *reduce vulnerability to earthquakes*	• Design improvements to meet current seismic standards. • Deliver basic service to the three regions in the service area (East/South Bay, Peninsula, and San Francisco) within 24 hours after a major earthquake. Basic service is defined as average winter-month usage, and the performance objective for the regional system is 229 million gallons per day (mgd). The performance objective is to provide delivery to at least 70 percent of the turnouts (i.e., water diversion connecting points from the regional system to customers) in each region, with 104, 44, and 81 mgd delivered to the East/South Bay, Peninsula, and San Francisco regions, respectively. • Restore facilities to meet average-day demand of 300 mgd within 30 days after a major earthquake.
Delivery Reliability – *increase delivery reliability and improve the ability to maintain the system*	• Provide operational flexibility to allow planned maintenance shutdown of individual facilities without interrupting customer service. • Provide operational flexibility to minimize the risk of service interruption due to unplanned facility upsets or outages. • Provide operational flexibility and system capacity to replenish local reservoirs as needed. • Meet the estimated average annual demand of 300 mgd for 2030 under the conditions of one planned shutdown of a major facility for maintenance concurrent with one unplanned facility outage.
Water Supply – *meet customer water needs in nondrought and drought periods*	• Meet average annual water purchase requests of 300 mgd from retail and wholesale customers during nondrought years for system demands through 2030. • Meet dry-year delivery needs through 2030 while limiting rationing to a maximum 20 percent systemwide reduction in water service during extended droughts. • Diversify water supply options during nondrought and drought periods. • Improve use of new water sources and drought management, including use of groundwater, recycled water, conservation, and transfers.
Sustainability – *enhance sustainability in all system activities*	• Manage natural resources and physical systems to protect watershed ecosystems. • Meet, at a minimum, all current and anticipated legal requirements for protection of fish and other wildlife habitat. • Manage natural resources and physical systems to protect public health and safety.
Cost-effectiveness – *achieve a cost-effective, fully operational system*	• Ensure cost-effective use of funds. • Maintain gravity-driven system. • Implement regular inspection and` maintenance program for all facilities.

SOURCE: SFPUC, 2005.

San Francisco, as shown in **Figure S.4**. The water recycling and groundwater supply programs would be developed as part of the proposed facility improvement projects. This combination of water supply sources is expected to fully meet customer purchase requests during nondrought years through 2030. However, based on recent experience, these water supply sources would not be adequate during drought periods. The WSIP level of service goals include a policy to limit customer rationing to a maximum of 20 percent systemwide in any one year of a drought.

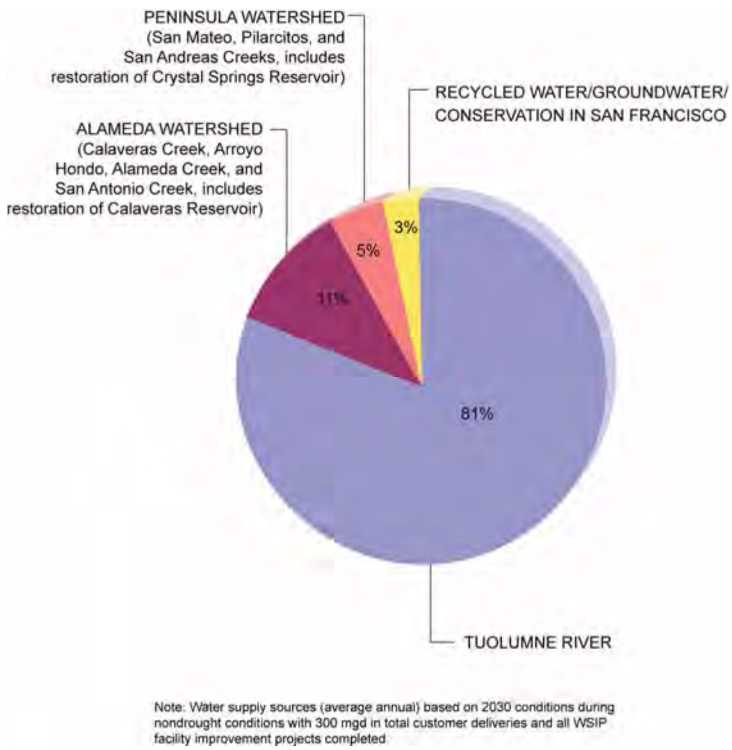


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Figure S.4

WSIP Water Supply Sources, Nondrought Years

To provide adequate water supply to customers during a prolonged drought, the WSIP includes supplemental sources to augment the nondrought-year water supplies described above. The SFPUC proposes to secure a water transfer with the Turlock Irrigation District (TID) and/or Modesto Irrigation District (MID) to provide supplemental dry-year water from the Tuolumne River. Further, the SFPUC proposes to implement a groundwater banking program in the Westside Groundwater Basin in San Mateo County. Under this program, SFPUC wholesale customers that utilize the Westside Groundwater Basin would use supplemental surface water supplies in nondrought years to reduce their groundwater pumping and allow for in-lieu groundwater banking; these wholesale customers could then increase their groundwater pumping in drought years and reduce their demand for surface water supply in those years. In addition, two of the WSIP facility improvement projects involve the restoration of historical operating capacities at two of the system reservoirs, Calaveras and Lower Crystal Springs Reservoirs, which would further augment drought supplies for the regional system. As shown in **Figure S.5**, during drought years under the WSIP, the SFPUC would also include up to 20 percent systemwide rationing.

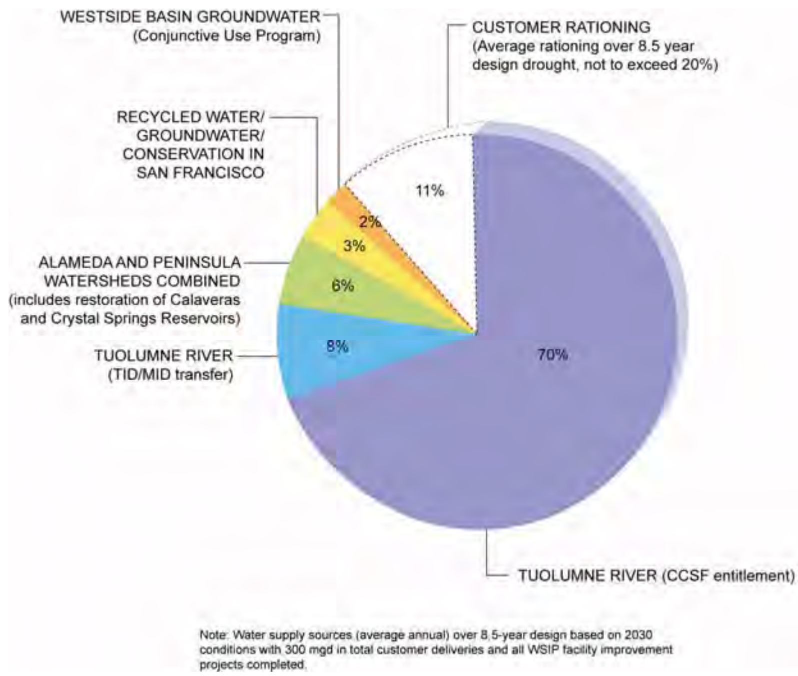

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Figure S.5
WSIP Water Supply Sources, Drought Years

Proposed System Operation Strategy

Operation of the regional water system is affected by numerous factors, including fluctuations in customer demand; meteorological and hydrologic conditions; physical facilities and infrastructure capacity and maintenance requirements; and multiple institutional parameters. The WSIP addresses the condition of the physical facilities and infrastructure while planning for and taking into account these various factors. The operating strategy addresses four components of system operation: water supply and storage, water quality, water delivery, and asset management.

Under the WSIP, general day-to-day operation of the regional water system would be similar to existing operations but would provide for additional facility maintenance activities and improved emergency preparedness. Implementation of the program would allow for a refinement of the operations strategy to meet the WSIP goals and objectives and would thereby increase system reliability and provide additional flexibility for scheduling repairs and maintenance. The proposed operations strategy would also include a multistage drought response program during an extended drought. Under the WSIP, regional system operations would continue to comply with all applicable institutional and planning requirements, including:

- Complying with all water quality, environmental, and public safety regulations
- Maximizing the use of water from local watersheds
- Assigning a higher priority to water delivery over hydropower generation
- Meeting all downstream flow requirements

Proposed Facility Improvement Projects

The WSIP includes 22 facility improvement projects along the regional system, from Oakdale Portal in Tuolumne County on the east end to San Francisco on the west. The projects, described in **Table S.2**, have been identified as necessary to achieve the level of service goals and system performance objectives of the WSIP. **Figure S.6** indicates the location of each facility improvement project.

Standard Construction Measures

The SFPUC has established standard construction measures that would be implemented as part of all WSIP projects. The main objective of these measures is to minimize potential disruption of surrounding neighborhoods during construction and to reduce impacts on environmental resources to the extent feasible. The construction measures would be implemented individually for the facility improvement projects; some measures might not be applicable to some projects, while some projects would require the development of more detailed construction measures and implementation steps as the individual projects are designed. The standard construction measures to be included in WSIP construction contracts address the following topics: neighborhood notice, seismic and geotechnical studies, onsite air and water quality measures during construction, groundwater, traffic, noise, hazardous materials, biological resources, cultural resources, and project site (i.e., the use of non-CCSF-owned land during construction).

Proposed Construction Schedule

Figure S.7 presents a preliminary master schedule of the construction phases for the facility improvement projects. The SFPUC developed the preliminary schedule to assure that water delivery service is maintained throughout construction of the numerous projects, but is preparing schedule refinements and adjustments as the projects are further developed and more information is known about construction requirements. All WSIP projects are scheduled to be completed by the end of 2014. The acquisition of supplemental water supplies during droughts would be implemented as needed to match the water supply needs of the retail and wholesale customers (see Chapter 5, Section 5.1) and is not included on the construction schedule.

TABLE S.2
WSIP FACILITY IMPROVEMENT PROJECTS

No.[a]	Project Title	Principal Type of Facility/ Objectives[b]	Location of Preferred Project[c]	Project Description
San Joaquin Region				
SJ-1	Advanced Disinfection	Treatment / Water Quality	Tesla Portal	This project would provide for the planning, design, and construction of a new advanced disinfection facility for the Hetch Hetchy water supply to comply with the new federal drinking water regulatory requirements contained in the Long Term 2 Enhanced Surface Water Treatment Rule. This regulation is designed to provide treatment for the parasite *Cryptosporidium*. The project is in the planning phase and the SFPUC is evaluating applicable technologies and possible locations to identify the most technologically sound and cost-effective alternative. In addition, the project includes planning and conceptual engineering for providing advanced disinfection facilities at the Sunol Valley and Harry Tracy Water Treatment Plants (WTPs). This project may be combined with the Tesla Portal Disinfection Station project along with portal modifications, and the need for the Lawrence Livermore Supply Improvements project may be affected by the location and technology selected for this project.
SJ-2	Lawrence Livermore Supply Improvements	Treatment / Water Quality	Thomas Shaft	This project includes design and construction of treatment upgrades for the water supplied to the Lawrence Livermore Laboratory. The project would construct water treatment facilities from the Thomas Shaft of the Coast Range Tunnel. An advanced disinfection facility planned at an upstream location under the Advanced Disinfection project could affect project design.
SJ-3	San Joaquin Pipeline System	Pipeline / Water Supply, Delivery Reliability	Isolated locations along the existing San Joaquin Pipeline corridor	The preferred project would generally be located within the existing San Joaquin Pipeline (SJPL) right-of-way and would include: • Construction of a new 6.4-mile-long, up to 86-inch-diameter fourth San Joaquin Pipeline parallel to the existing three pipelines at the east end of the pipelines, starting at Oakdale Portal, and associated portal modifications. • Construction of two additional crossover facilities between the San Joaquin Pipelines within the existing right-of-way, both located in Stanislaus County, with one about 20 miles east of Modesto and the other about 15 miles west of Modesto, and improvements at the existing Roselle Crossover. • Construction of a new 10-mile-long, up to 86-inch-diameter fourth San Joaquin Pipeline parallel to the existing three pipelines at the west end of the pipelines ending at Tesla Portal. This project would provide additional facilities to upgrade the hydraulic capacity of the San Joaquin Pipeline system to 314 mgd (and a 271-mgd average during system maintenance when a pipeline segment must be taken out of service) and to provide redundancy for prestressed concrete cylinder pipe for reliability. Note: While the current preferred alternative would construct 16 miles of pipeline, as much as 22 miles of pipeline could be constructed depending on the results of a conditions assessment of the existing pipelines.
SJ-4	Rehabilitation of Existing San Joaquin Pipelines	Pipeline / Water Supply, Delivery Reliability	Rehabilitation could occur anywhere along the pipeline corridor, which extends from Oakdale Portal to Tesla Portal	Reconditioning/rehabilitation of the existing San Joaquin Pipelines. There are three existing pipelines, each 47.7 miles long, extending from Oakdale Portal to Tesla Portal: • SJPL-1, riveted steel pipe, 56- to 72-inch internal diameter • SJPL-2, reinforced concrete pipe and welded steel pipe, 61- to 62-inch internal diameter • SJPL-3, prestressed concrete cylinder pipe and welded steel pipe, 78-inch internal diameter

TABLE S.2 (Continued)
WSIP FACILITY IMPROVEMENT PROJECTS

No.[a]	Project Title	Principal Type of Facility/ Objectives[b]	Location of Preferred Project[c]	Project Description
San Joaquin Region (cont.)				
SJ-5	Tesla Portal Disinfection Station	Treatment / Water Quality, Seismic Reliability	Tesla Portal	This project includes the planning, design, and construction of new disinfection facilities for the Hetch Hetchy water supply. The project would replace and upgrade the existing disinfection facilities at the Tesla Portal Disinfection Facility to meet current seismic, safety/fire, and building code standards. The preferred project would include construction of: • New control building and storage room • Pump houses • Chemical storage tanks and feed equipment and sampling systems • Emergency generator, including primary and standby power supplies • Access road It should be noted that the design and location of the Advanced Disinfection project would affect the design and location of this project.
Sunol Valley Region				
SV-1	Alameda Creek Fishery Enhancement	Other / Water Supply, Sustainability	Structural Alternatives: Alameda Creek in Sunol Valley, downstream of Calaveras Dam	This project would recapture the water released as part of the Calaveras Dam project and return it back to the regional system for use. A number of structural and non-structural recovery alternatives are under consideration for this project, including: a water recapture facility downstream of the Sunol Valley WTP, conjunctive groundwater use, horizontal collector wells, or other groundwater recovery systems yet to be defined. Other alternative designs for this project could be developed.
SV-2	Calaveras Dam Replacement	Storage / Water Supply, Delivery and Seismic Reliability	Sunol Valley, immediately downstream of existing dam	This project would provide for the planning, design, and construction of a replacement dam at Calaveras Reservoir to meet seismic safety requirements. The new dam would provide for a reservoir with the same storage capacity as the original reservoir (96,800 acre-feet), but the replacement dam would be designed to accommodate enlargement of the dam in the future. The preferred project would include construction of: • New earthfill dam • New intake tower and new outlet valve for water releases for instream flow requirements • New or rehabilitated outlet works for seismic safety and improved operations and maintenance As part of this project, Calaveras Reservoir would be operated to release up to 6,300 acre-feet per year (5.5 mgd) of water to Alameda Creek in support of fisheries.
SV-3	Additional 40-mgd Treated Water Supply	Treatment / Water Quality, Delivery Reliability	Sunol Valley WTP and pipeline to connect to the Alameda Siphons or Irvington Tunnel	This project would provide for the planning, design, and construction of an additional 40 mgd of treatment capacity at the Sunol Valley WTP. The project would increase the sustainable capacity of the Sunol Valley WTP to 160 mgd. The planning-level study would evaluate treatment operations protocol and an alternative treatment process. The project would include either retrofitting the existing facilities with a membrane treatment process or expanding the existing facilities with: • New flocculation and sedimentation system • Upgrade of existing filters or addition of three new filters and a new flow distribution chamber

TABLE S.2 (Continued)
WSIP FACILITY IMPROVEMENT PROJECTS

No.[a]	Project Title	Principal Type of Facility/ Objectives[b]	Location of Preferred Project[c]	Project Description
Sunol Valley Region (cont.)				
SV-3 (cont.)				• New filtered water and backwash piping Additionally, the project would include: • New chemical feed and piping system • Upgrade of the electrical supply system • Miscellaneous piping, valves, and mechanical and electrical work • Approximately two miles of 78-inch-diameter pipe to connect to the Alameda Siphons or Irvington Tunnel
SV-4	New Irvington Tunnel	Tunnel / Delivery and Seismic Reliability	Sunol Valley to Fremont, parallel to and just south of the existing Irvington Tunnel	This project would construct a new tunnel parallel to and just south of the existing Irvington Tunnel to convey water from the Hetch Hetchy system and the Sunol Valley WTP to the Bay Area. The new tunnel would be a redundant water transmission facility to the existing Irvington Tunnel. The preferred project would include construction of: • New 18,200-foot-long, 10-foot-diameter tunnel • New portal at the east end adjacent to the existing Alameda West Portal in the Sunol Valley with connections to the existing Alameda Siphons and proposed new siphon • New portal at the west end adjacent to the existing Irvington Portal in Fremont with connections to the existing Bay Division Pipelines and proposed new pipeline (Bay Division Pipeline Reliability Upgrade) • Valves and equipment to control and monitor flows • Modifications to the existing Alameda West and Irvington Portals
SV-5	SVWTP – Treated Water Reservoirs	Storage and Treatment / Delivery Reliability	North of the Sunol Valley WTP	This project would provide for the planning, design, and construction of new treated water storage reservoirs at the Sunol Valley WTP to comply with requirements of the California Department of Health Services. The preferred project would include construction of: • One 5-million-gallon chlorine contact basin • Two 8.75-million-gallon storage basins • New inlet and outlet piping and reservoir drainage system • Pipe bridge over Alameda Creek • Chemical (ammonia and chlorine) storage and feed system • Backup filter washwater supply and filter washwater supply system • Instrumentation and controls and miscellaneous pumping appurtenances to integrate the reservoirs into the existing treatment plant • Expansion of the existing Sunol Valley WTP electrical substation • Two 750-kilowatt diesel-powered emergency generators

**TABLE S.2 (Continued)
WSIP FACILITY IMPROVEMENT PROJECTS**

No.[a]	Project Title	Principal Type of Facility/ Objectives[b]	Location of Preferred Project[c]	Project Description
Sunol Valley Region (cont.)				
SV-6	San Antonio Backup Pipeline	Pipeline / Delivery and Seismic Reliability	Sunol Valley between San Antonio Reservoir and San Antonio Pump Station	This project would consist of three proposed facilities: (1) San Antonio Backup Pipeline, a new pipeline (size undetermined) from San Antonio Reservoir to San Antonio Pump Station, about two miles long; (2) San Antonio Creek discharge facilities (improvements allowing for the discharge of Hetch Hetchy water and associated road improvements); and (3) Alameda East Portal vent overflow pipeline and portal modifications.
Bay Division Region				
BD-1	Bay Division Pipeline Reliability Upgrade	Pipeline and Tunnel / Water Supply, Delivery and Seismic Reliability	Along existing Bay Division Pipelines Nos. 1 and 2 easement from Fremont to Redwood City	This project would construct a new Bay Division Pipeline No. 5 (BDPL No. 5) from Irvington Tunnel Portal in Fremont to Pulgas Tunnel Portal near Redwood City, consisting of 16 miles of new pipeline and 5 miles of tunnel under San Francisco Bay. Portions of the section of BDPL No. 1 between Edgewood Valve Lot and Pulgas Valve Lot would be removed (approximately 1.4 miles), and existing aboveground and submarine sections of BDPL Nos. 1 and 2 over the five-mile-long section from Newark Valve House to Ravenswood Valve House would be decommissioned (decommissioning is not part of this project). The redundancy provided by the project would increase the overall transmission capacity of the Bay Division Pipeline system. The preferred project would include construction of: • New welded-steel pipeline, approximately 72 inches in diameter, extending along the seven-mile reach from Irvington Portal to Newark Valve Lot, located within the existing SFPUC right-of-way of BDPL Nos. 1 and 2 • New “Bay Tunnel” segment of BDPL No. 5, approximately 120 inches in diameter, extending five miles from Newark Valve Lot to Ravenswood Valve Lot, crossing under San Francisco Bay and adjacent marshlands; BDPL Nos. 1 and 2 would tie into the tunnel at both ends and would be decommissioned between Newark and Ravenswood Valve Lots • New welded-steel pipeline, approximately 60 inches in diameter extending along the nine-mile reach from Ravenswood Valve Lot to Pulgas Portal, located within the existing SFPUC right-of-way of BDPL Nos. 1 and 2 • New facilities at eight valve vault lots along the alignment, containing new concrete vaults and control structures that house electrical control panels, isolation valves, mechanical equipment, and cross-connections between BDPL No. 5 and the existing Bay Division Pipelines • Two flow metering vaults at or near Mission Boulevard (in Fremont) and Pulgas Portal areas • New Isolation valves and piping for connecting BDPL No. 5 to Irvington and Pulgas Portals

TABLE S.2 (Continued)
WSIP FACILITY IMPROVEMENT PROJECTS

No.[a]	Project Title	Principal Type of Facility/ Objectives[b]	Location of Preferred Project[c]	Project Description
Bay Division Region (cont.)				
BD-2	BDPL Nos. 3 and 4 Crossovers	Valve House / Delivery and Seismic Reliability	Three locations adjacent to where BDPL Nos. 3 and 4 traverse Guadalupe River, Barron Creek, Bear Gulch Reservoir	This project would construct three additional crossover facilities along BDPL Nos. 3 and 4 to provide operational flexibility for maintenance or during emergencies. The new crossover facilities would reduce the length of pipe to be removed from service, either for maintenance or for emergencies, and would reduce the duration of outages. Each crossover facility would include construction of: • Four mainline valves and one cross-connect valve • Automatic controlled actuators • Discharge facilities to enable release of water that meets water quality discharge requirements within discrete pipeline segments to surface waters, either for maintenance or emergencies
BD-3	Seismic Upgrade of BDPL Nos. 3 and 4 at Hayward Fault	Pipeline / Seismic Reliability	Along existing BDPL Nos. 3 and 4 in Fremont	This project would provide for the planning, design, and construction of upgraded, seismically resistant sections of the BDPL Nos. 3 and 4 where they cross the Hayward fault. The replacement pipelines would be located between the two new crossover/isolation valves that would be built as part of BDPL Nos. 3 and 4 Crossover/Isolation Valve at Hayward Fault project (a WSIP project determined to be independent of the PEIR). In addition to the replacement pipelines, a new bypass pipeline between the two new crossover/isolation valve vaults could also be built as part of one of the several alternatives being considered for this project.
Peninsula Region				
PN-1	Baden and San Pedro Valve Lots Improvements	Valve House / Delivery and Seismic Reliability	Baden Valve Lot, South San Francisco, San Pedro Valve Lot, Daly City	This project would upgrade valve vaults, valves, and piping at the existing Baden and San Pedro Valve Lots to meet current seismic standards. Work could also be performed at the Pulgas Pump Station and Pulgas Valve Lot as part of transmission reliability. The project would include a new pressure-reducing valve at one of the locations to allow transfer of water between high and low pressure zones from the Harry Tracy WTP to the Peninsula under an emergency scenario.
PN-2	Crystal Springs/ San Andreas Transmission Upgrade	Pipeline / Delivery and Seismic Reliability	Lower Crystal Springs Reservoir to San Andreas Reservoir, including Crystal Springs Pump Station	This project would consist of seismic improvements of facilities that convey water from Crystal Springs Reservoir to the Harry Tracy WTP. This project would increase the transmission capacity of the existing raw water pipeline from Crystal Springs Reservoir to San Andreas Reservoir in order to reliably supply 140 mgd of raw water for treatment at the Harry Tracy WTP. The project would include: • Repair of Upper Crystal Springs Dam discharge culverts • Upgrade and repair of Lower Crystal Springs Dam outlet structures and tunnels conveying water to Crystal Springs Pump Station • Replacement or refurbishment of Crystal Springs Pump Station • Upgrade and repair of the chemical system and Crystal Springs chlorine emergency feed • Improvements to the Crystal Springs/San Andreas Pipeline, including replacement of approximately 1,350 feet of 66-inch-diameter pipeline, general renewal of the remaining pipeline, and addition of new manholes, blowoff valves, and isolation valves; or construction of a new redundant pipeline along a new alignment.

TABLE S.2 (Continued)
WSIP FACILITY IMPROVEMENT PROJECTS

No.[a]	Project Title	Principal Type of Facility/ Objectives[b]	Location of Preferred Project[c]	Project Description
Peninsula Region (cont.)				
PN-2 (cont.)				• Seismic and hydraulic upgrade and repair of San Andreas outlet facilities • Addition of fish screens on the outlet structures for both Crystal Springs and San Andreas Reservoirs • Repair of two pipelines that convey raw water from San Andreas Reservoir to the Harry Tracy WTP raw water pump station
PN-3	HTWTP Long-Term Improvements	Treatment / Water Quality, Delivery and Seismic Reliability	Harry Tracy WTP	This project would be a seismic retrofit and rehabilitation of the existing building and facility to provide long-term reliability and process improvements. The project would increase the sustained treatment capacity of the plant from 120 to 140 mgd for 60 days. The proposed improvements would include: • Replacement and upgrade of the ozone generation system for primary disinfection • Replacement or upgrade of the existing sedimentation basins at the same location • Improvements to sludge handling facilities • New, redundant pipeline from the treatment works to the finished water storage reservoir • Raw water pump station improvements • Upgrade and replacement of electrical and instrumentation components, including improvements to process and plant security facilities
PN-4	Lower Crystal Springs Dam Improvements	Storage / Water Supply and Delivery Reliability	Lower Crystal Springs Dam	This project would consist of major repairs and improvements to Lower Crystal Springs Dam to provide adequate protection of the dam and downstream areas from the probable maximum flood, as defined by the California Division of Safety of Dams (DSOD). The DSOD has placed operational restrictions on the dam, and the capacity of the reservoir is limited to 58,400 acre-feet. The project would restore the historical reservoir capacity of 69,300 acre-feet. The project would be coordinated with San Mateo County, which is concurrently planning the replacement of the existing county bridge built above the crest of the dam. Project elements would include: • Lowering the existing parapet wall on either side of the existing spillway to lengthen the overflow weir (central spillway) from the reservoir • Raising the remaining parapet walls and adding two new spillway bays, one on each side of the existing central spillway • Enlarging the spillway stilling basin to accommodated the probable maximum flood • Installing four gates (with control building) or installing a fixed weir within the spillway to restore the historical storage capacity

TABLE S.2 (Continued)
WSIP FACILITY IMPROVEMENT PROJECTS

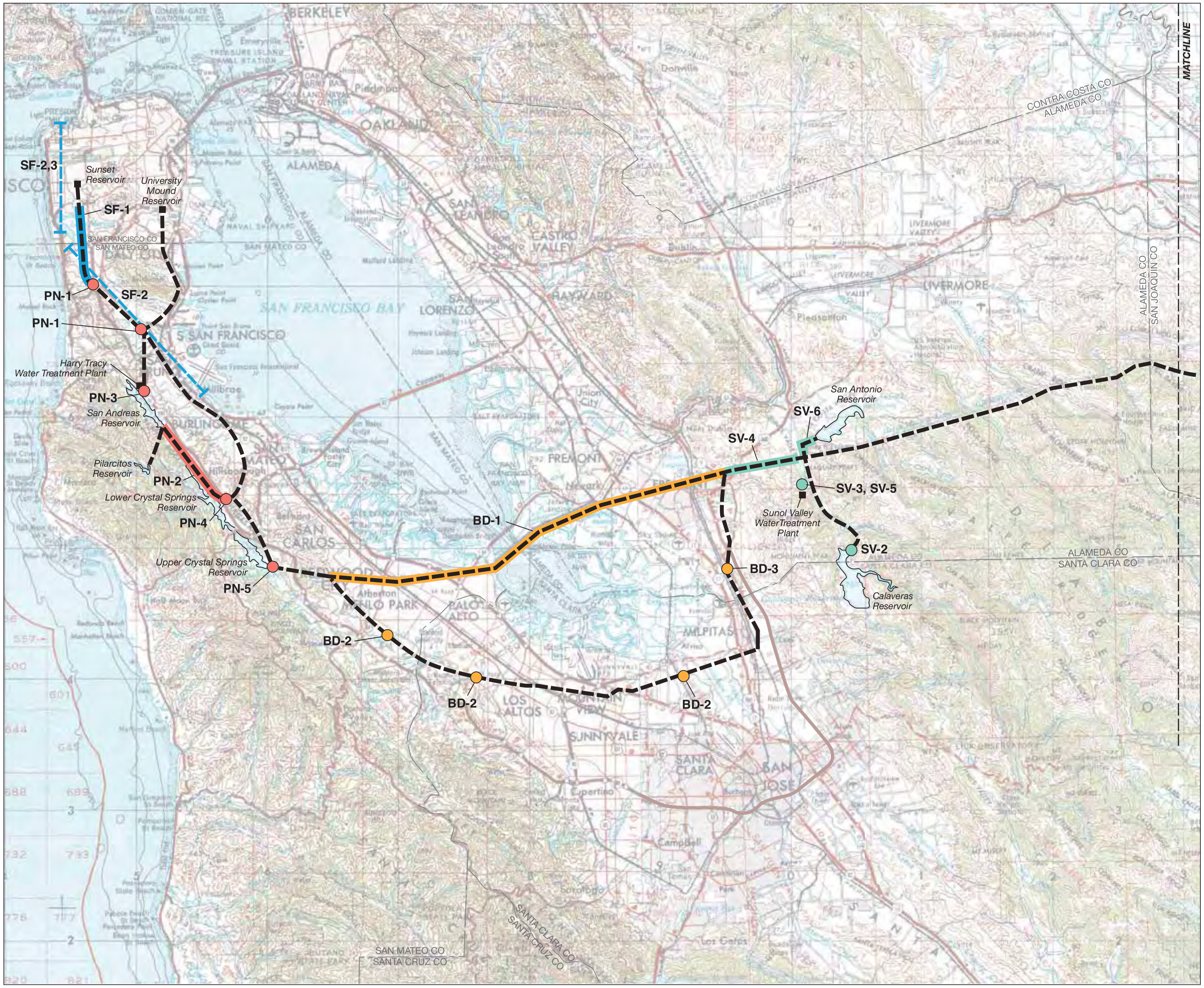
No.[a]	Project Title	Principal Type of Facility/ Objectives[b]	Location of Preferred Project[c]	Project Description
Peninsula Region (cont.)				
PN-5	Pulgas Balancing Reservoir Rehabilitation	Storage / Water Quality, Delivery and Seismic Reliability	Pulgas Balancing Reservoir and mouth of Laguna Creek at south end of Upper Crystal Springs Reservoir	This project would provide for the planning, design, and construction of improvements to the existing Pulgas Balancing Reservoir and associated facilities. The project would include: • Modifications to the inlet/outlet piping (Phase 1, currently under construction) • Design and construction to rehabilitate and/or expand the discharge channel to Crystal Springs Reservoir (or to install a parallel channel) (Phase 2) • Geotechnical investigations, design, and construction of recommended seismic improvements, including repair/replacement of the reservoir walls, floor, and roof (Phase 3) • Restoration of a six- to eight-acre sediment catchment basin in Laguna Creek to also serve as sustainable habitat for San Francisco garter snake and California red-legged frog, including culvert replacement, sediment removal, revegetation, and protective measures to avoid impacts on sensitive species (Phase 4) • Modification of the existing dechlorination process, including modifications to the chemical feed system to enable pH adjustment and dechlorination system to operate reliably (Phase 5)
San Francisco Region				
SF-1	San Andreas Pipeline No. 3 Installation	Pipeline / Delivery and Seismic Reliability	Daly City to San Francisco	This project would replace the out-of-service Baden-Merced Pipeline, which is beyond repair, and would construct a new pipeline extension of the existing San Andreas Pipeline No. 3 from San Pedro Valve Lot in Daly City to Merced Manor Reservoir in San Francisco. It would also connect the existing San Andreas Pipeline No. 2 at Sloat Boulevard in San Francisco and install an additional pipeline to serve the water turnouts along San Andreas Pipeline No. 2. The project would provide seismic reliability and system redundancy for Peninsula and San Francisco customers. The project would include: • New 3.8-mile-long, 36-inch-diameter pipeline • Approximately 0.27 mile of 36-inchdiameter pipeline for three connections between San Andreas Pipelines Nos. 2 and 3 • Removal of the Baden-Merced Pipeline where the new San Andreas Pipeline No. 3 alignment matches the Baden-Merced alignment • Less than 0.1 mile of 12- to 16-inch-diameter new pipeline for five branch connections to user turnouts (three turnouts to Daly City, two turnouts to San Francisco distribution lines) • Installation of line valves and vaults, manholes, cathodic protection and monitoring stations, sample taps, air valves, blowoffs, and other pipeline appurtenances
SF-2	Groundwater Projects	Other / Water Supply	West side of San Francisco and northern San Mateo County	This project includes three groundwater projects: Lake Merced, Local Groundwater, and Regional Groundwater. • The Lake Merced project would address raising the level of Lake Merced in San Francisco using a supplemental source of water, such as treated stormwater, recycled water, groundwater, or SFPUC system water.

TABLE S.2 (Continued)
WSIP FACILITY IMPROVEMENT PROJECTS

No.[a]	Project Title	Principal Type of Facility/ Objectives[b]	Location of Preferred Project[c]	Project Description
San Francisco Region (cont.)				
SF-2 (cont.)				• The Local Groundwater Projects would include development of 2 mgd of new local groundwater for blending with water in the potable water system in San Francisco. An estimated four wells and well stations would be constructed to develop this new local groundwater. This project would also include the use of an additional 2 mgd of groundwater through replacement of existing irrigation wells at the San Francisco Zoo, Golden Gate Park, and/or other locations, once recycled water were available for irrigation (to be developed under the Recycled Water Projects). Two existing wells would be modified to enable emergency supply to local residents in the event of a major earthquake or other disaster. This project would include the pipelines, water treatment equipment, and controls needed to add the groundwater to the municipal supply. The additional water supply developed under this project would be used during both nondrought and drought years. • As part of a regional conjunctive-use project, the SFPUC would construct about 10 new groundwater production wells in San Mateo County to develop about 6 mgd of potable groundwater for use as a supplemental drought-year supply. In nondrought years under this project, the SFPUC would provide potable water from the regional system to customers in Daly City, San Bruno, and South San Francisco to substitute for groundwater currently used for municipal purposes, thereby reducing groundwater pumping and allowing the groundwater basin to recharge naturally. In drought years, the groundwater would be available for local use to supplement the regional system water. This project would require agreements with the affected agencies see (Section 3.13).
SF-3	Recycled Water Projects	Other / Water Supply, Sustainability	Various locations on west side of San Francisco	This project includes recycled water projects in San Francisco and other locations. Projects include Westside Baseline and Harding Park/Lake Merced. This project would provide treatment, storage, and distribution facilities for about 4 mgd of recycled water to users on the west side of San Francisco. Primary users would include Golden Gate Park, Lincoln Park, Lincoln Park Golf Course, Harding Park Golf Course, San Francisco Zoo, Sunset Boulevard medians, and San Francisco State University. As described under Groundwater Projects, the SFPUC is also investigating appropriate sources of supply for increasing and maintaining Lake Merced lake levels, including recycled water that has undergone advanced treatment.

[a] The numbering system is consistent, to the extent possible, with that presented in the Notice of Preparation (NOP) regarding preparation of an environmental impact report on the WSIP issued in September 2005. However, due to a regrouping of the projects after publication of the NOP, some projects have been renumbered.
[b] General types of facilities. Objectives refer to the WSIP objectives met by each project; see Table S.1 for a complete description of WSIP goals and objectives.
[c] See Figure S.6 for the approximate locations of preferred projects; many of the projects are still in development, and the SFPUC may ultimately consider other design options.

SOURCE: SFPUC, 2006.



SFPUC WATER SYSTEM IMPROVEMENT PROGRAM, FACILITY IMPROVEMENT PROJECTS

SUNOL VALLEY REGION

SV-1 Alameda Creek Fishery Enhancement (not shown)
SV-2 Calaveras Dam Replacement
SV-3 Additional 40-mgd Treated Water Supply
SV-4 New Irvington Tunnel
SV-5 SVWTP – Treated Water Reservoirs
SV-6 San Antonio Backup Pipeline

BAY DIVISION REGION

BD-1 Bay Division Pipeline Reliability Upgrade
BD-2 BDPL Nos. 3 and 4 Crossovers (3 locations)
BD-3 Seismic Upgrade of BDPL Nos. 3 and 4 at Hayward Fault

PENINSULA REGION

PN-1 Baden and San Pedro Valve Lots Improvements (2 locations)
PN-2 Crystal Springs / San Andreas Transmission Upgrade
PN-3 HTWTP Long-Term Improvements
PN-4 Lower Crystal Springs Dam Improvements
PN-5 Pulgas Balancing Reservoir Rehabilitation

SAN FRANCISCO REGION

SF-1 San Andreas Pipeline No. 3 Installation
SF-2 Groundwater Projects (general geographic area indicated)
SF-3 Recycled Water Projects (general geographic area indicated)

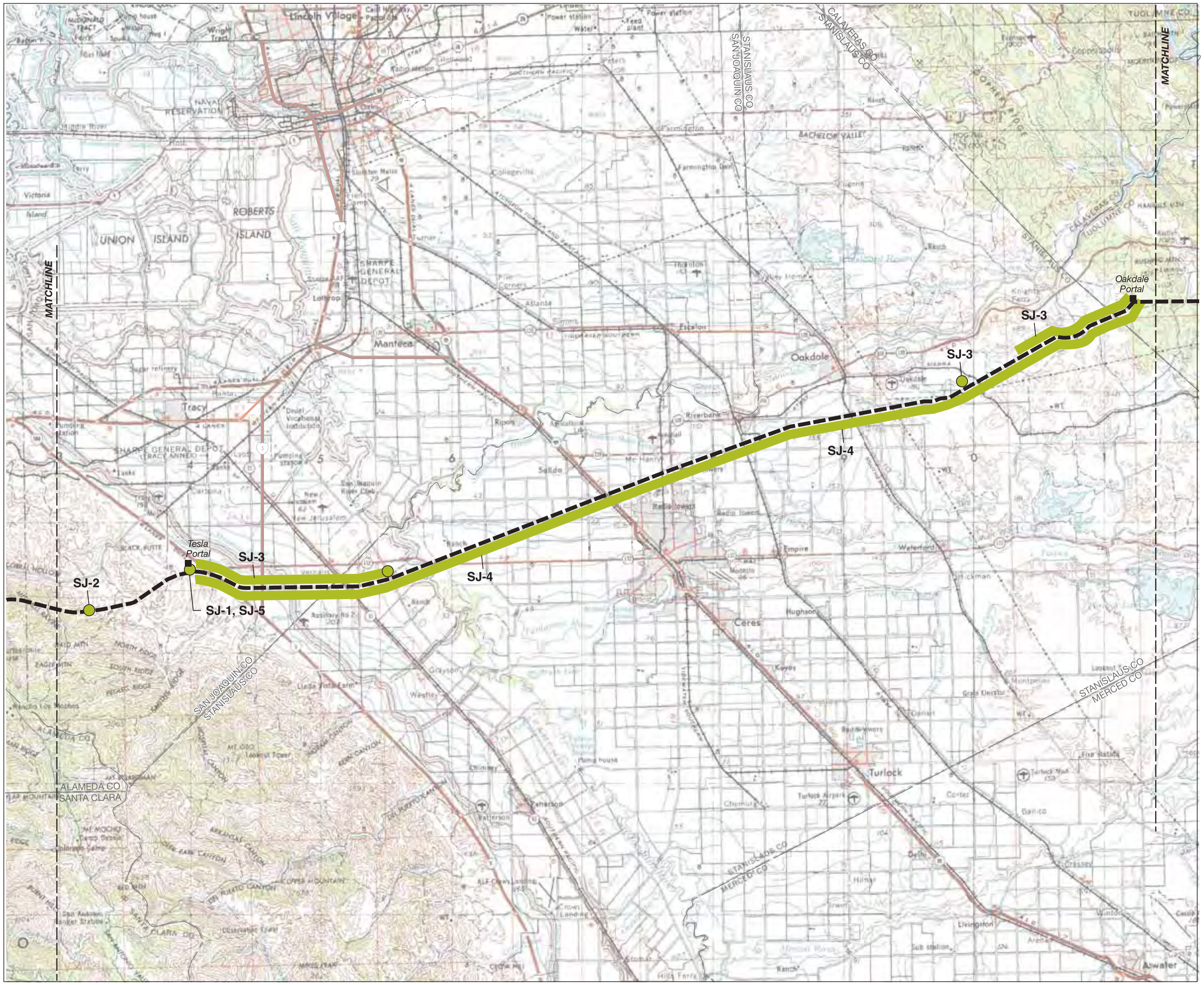
Existing System Corridor
Existing System Facility
Proposed Facility Corridor
Proposed Facility Site
Proposed Facility, General Location

0 5
Miles

SOURCE: ESA + Orion; SFPUC, 2006; USGS 1978

SFPUC Water System Improvement Program . 203287

Figure S.6a
Location of WSIP Facility Improvement Projects- Sunol Valley, Bay Division, Peninsula, and San Francisco Regions



SFPUC WATER SYSTEM IMPROVEMENT PROGRAM, FACILITY IMPROVEMENT PROJECTS

SAN JOAQUIN REGION

SJ-1 Advanced Disinfection
SJ-2 Lawrence Livermore Supply Improvements
SJ-3 San Joaquin Pipeline System
SJ-4 Rehabilitation of Existing San Joaquin Pipelines
SJ-5 Tesla Portal Disinfection Station

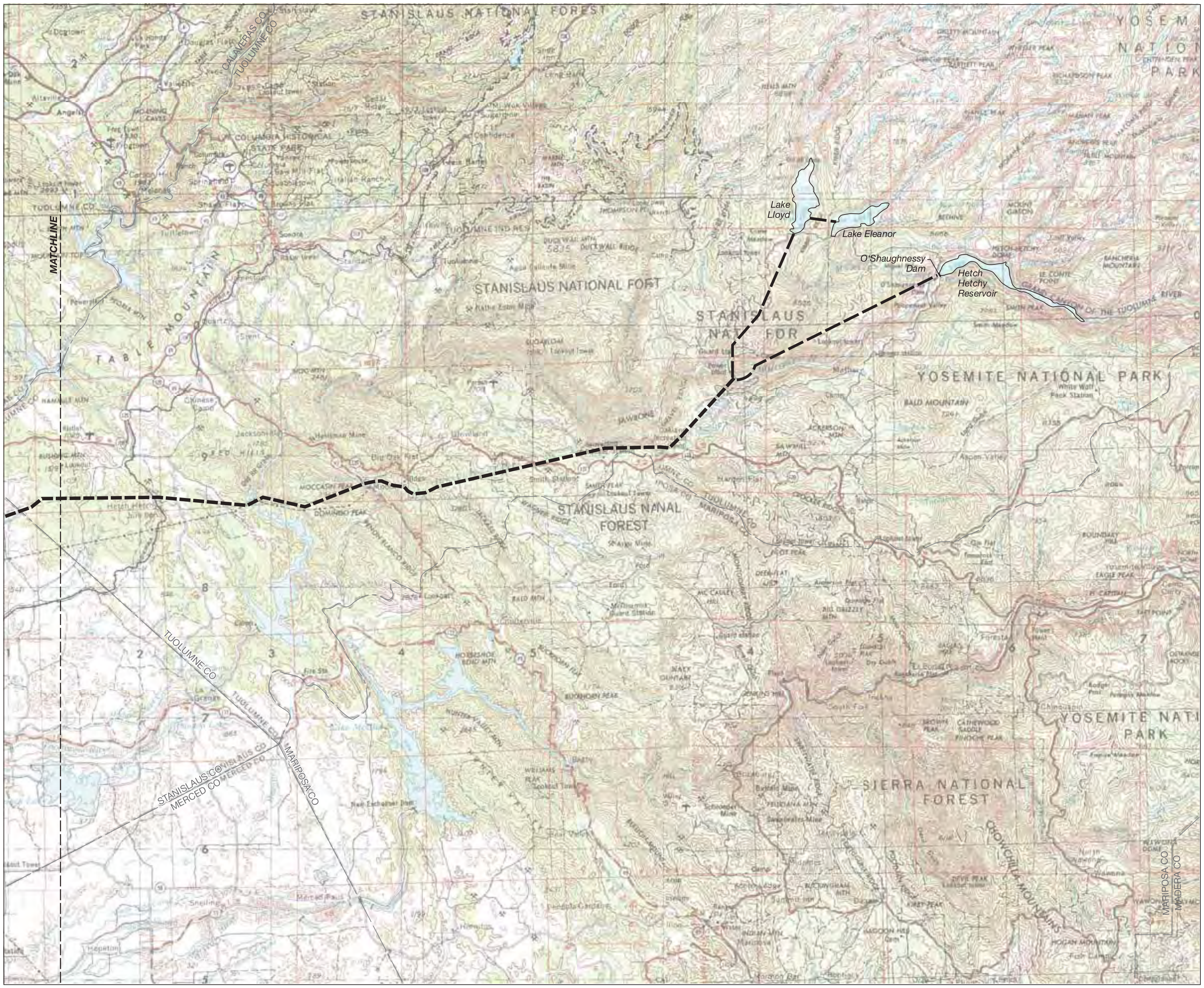
Existing System Corridor
Existing System Facility
Proposed Facility Corridor
Proposed Facility Site
Proposed Facility, General Location

0 5
Miles

SOURCE: ESA + Orion; SFPUC, 2006; USGS 1969

SFPUC Water System Improvement Program . 203287

Figure S.6b
Location of WSIP Facility Improvement Projects - San Joaquin Region



SFPUC WATER SYSTEM IMPROVEMENT PROGRAM, FACILITY IMPROVEMENT PROJECTS

- Existing System Corridor
- Existing System Facility
- Proposed Facility Corridor
- Proposed Facility Site
- Proposed Facility, General Location

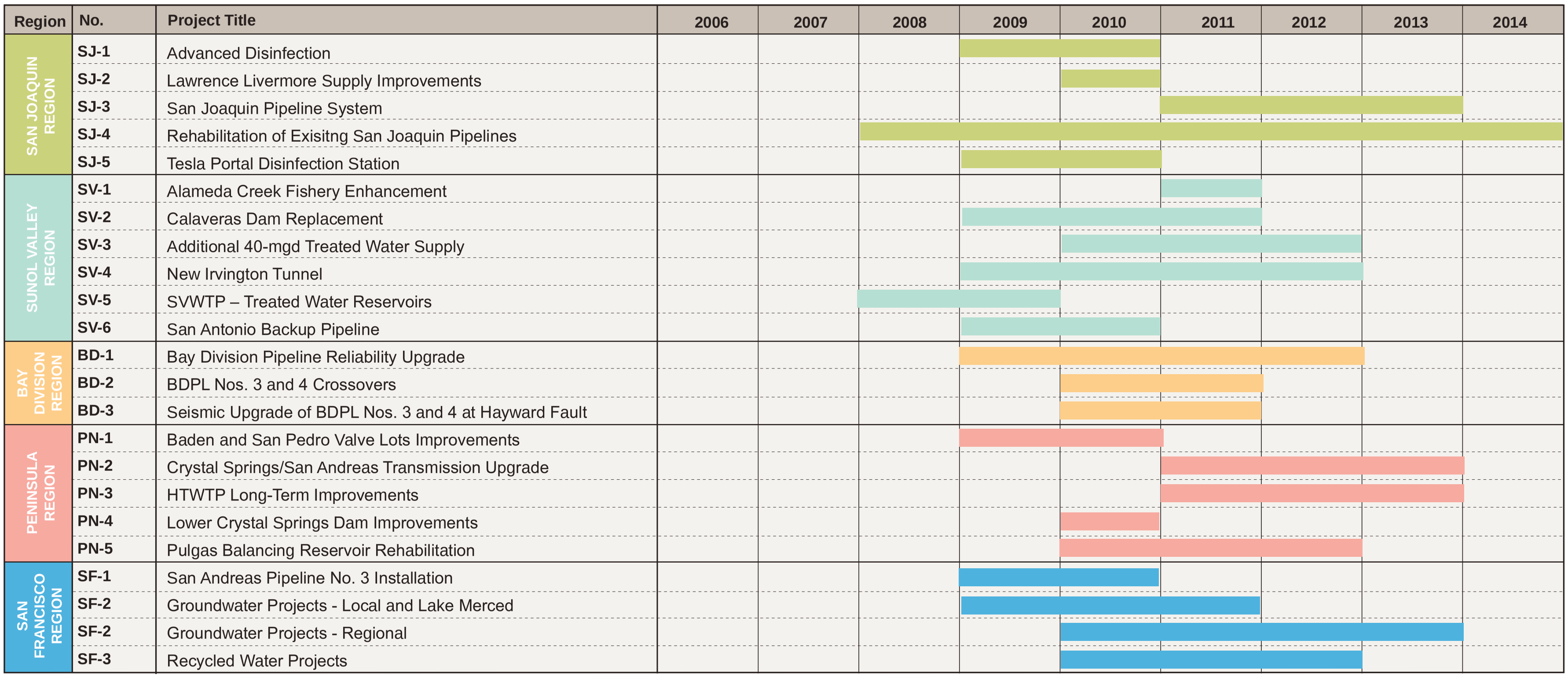
NOTE: No WSIP facilities are proposed in this region.

0 5 Miles

SOURCE: ESA + Orion; SFPUC, 2006; USGS 1970

SFPUC Water System Improvement Program . 203287

Figure S.6c
Location of WSIP Facility Improvement Projects - Hetch Hetchy Region



SOURCE: SFPUC, 2006

SFPUC Water System Improvement Program . 203287

Figure S.7
Preliminary WSIP Construction Schedule

SFPUC

WATER
WASTEWATER
POWER

SAN FRANCISCO PUBLIC UTILITIES COMMISSION

Julie Labonte, Director – Water System Improvement Program
1155 Market Street, 6th Floor, San Francisco, CA 94103 • Tel. (415) 554-1856 • Fax (415) 551-4515

DATE: August 20, 2009

TO: The Honorable Ann Moller Caen, President
The Honorable F.X. Crowley, Vice President
The Honorable Francesca Vietor
The Honorable Juliet Ellis
The Honorable Anson B. Moran

THROUGH: Ed Harrington, General Manager EH

FROM: Michael Carlin, Deputy General Manager MPC
Harlan L. Kelly, Jr., Assistant General Manager HK
Julie L. Labonte, WSIP Director JLL

RE: WSIP Regional Projects Quarterly Report
4th Quarter / Fiscal Year 2008-2009

Enclosed is the Water System Improvement Program (WSIP) Regional Projects Quarterly Report for the 4th Quarter of Fiscal Year 2008-2009. The primary intent of the report is to provide the Commission, stakeholders and the public with a status summary of the program's regional projects for the period of April 5, 2009 through July 1, 2009.

Report Organization

The report has three main sections. The *Program Summary* section includes a program overview and performance summary, and a program update on the following topics: program management, planning/design, environmental, right-of-way, construction and project achievements. The *Regional Summary* section provides a regional performance summary for each WSIP region, and an update on each region's planning, environmental, design and construction efforts. The *Project Status* section contains the Quarterly Project Status Reports (PSRs) for all regional projects.

June 2009 Revised WSIP

This Quarterly Report incorporates all changes to the WSIP Regional Program made in the June 2009 Revised WSIP and approved by the San Francisco Public Utilities Commission (SFPUC) on July 28, 2009, including project name changes, modification of the WSIP organizational structure, the addition of a new regional project, and revised budgets and schedules.

The names of two regional projects were changed as part of the adoption of the June 2009 Revised WSIP. The name changes are as follows:

- Project CUW30103: Groundwater Project C - South Westside Basin changed to Regional Groundwater Storage and Recovery
- Project CUW35201: Alameda Creek Fishery Enhancement changed to Upper Alameda Creek Filter Gallery

In the June 2009 Revised WSIP and as reflected in the enclosed report, all of the WSIP Water Supply Region Projects, except for Project CUW30103: Regional Groundwater Storage and Recovery Project, moved from the Regional Program to the Local Program. Project CUW30101: Regional Groundwater Storage and Recovery Project was moved to the San Francisco Regional Region.

One regional project was added as part of the adoption of the June 2009 Revised WSIP to ensure the program continues to meet the level of service (LOS) goals established for the program. Project CUW36702: Peninsula Pipelines Seismic Upgrade, which was included in the Peninsula Region, will provide the seismic reliability required for key transmission pipelines that transport water from the Harry Tracy Water Treatment Plant (HTWTP).

It should be noted that the approved June 2009 Revised WSIP does not include revisions to all project budgets and schedules. Projects with cost and schedule variances that can potentially be mitigated were not re-baselined (i.e., changes to the budget and schedule of these projects were not made). Therefore the Baseline (Approved) Budget and/or and Baseline (Approved) Schedule for those projects remain the same and cost and/or schedule variances are recorded in the enclosed report based on the latest project forecasts.

Major changes were made to the scope, schedule, and/or budget of four regional projects as part of the June 2009 Revised WSIP. These changes are summarized below.

Significant scope changes were made to the WSIP's two San Joaquin Pipelines (SJPLs) projects to maximize the reliability of the overall system, provide additional maintenance flexibility and facilitate construction.

Project CUW37301: San Joaquin Pipeline System – The revised project scope includes the addition of a 6.7-mile, 78-inch diameter pipeline (referred to as the Eastern Segment) from Oakdale Portal to a new connection point corresponding to the end of the pre-stressed concrete cylinder pipe (PCCP) segment of SJPL No. 3. This change allowed for the downsizing of the 10.3-mile Western Segment from a 96-inch to a 78-inch diameter pipeline. Also added to the project scope are new valve facilities on SJPL Nos. 3 & 4 along the Eastern Segment to allow for better control of system pressure. The project budget has been increased $7,708,570 to $278,055,413. The project approved completion date remains the same (March 25, 2014) and the first construction contract for this project will be advertised in November 2009.

Project CUW37302: Rehabilitation of Existing San Joaquin Pipelines – The benefits provided by the increased scope of the SJPL System Project allowed for a reduction of the scope of this project without compromising levels of service. The revised project scope includes the rehabilitation of the Roselle Crossover Facility, the repair of the system's cathodic protection system, and the upgrade of the system's SCADA system. It also includes more detailed development of the SJPL Condition Assessment and Maintenance Program to enhance system sustainability. Finally, project funding is also set aside for additional priority work on the existing pipelines, which will be identified upon conclusion of the conditions assessment in December 2009. This resulted in a reduction of the project budget of $58,147,236 to $31,852,309. The project approved completion date remains the same (June 30, 2014). Bids for the first construction package for the Roselle Crossover Facility were received in June 2009 and contract award is scheduled for July 2009.

Project CUW37401: Calaveras Dam Replacement – The scope has been revised to include a flow bypass tunnel at the Alameda Creek Diversion Dam to provide minimum bypass flow in Alameda Creek. This additional scope was one of the mitigation requirements adopted as part of the WSIP Programmatic Environmental Impact Report (EIR). Delivery of this project has been impacted significantly by the need to address the potential presence of steelhead trout in the Alameda Creek Watershed and the presence of high concentrations of Naturally Occurring Asbestos (NOA) at the project site. It should be noted that formal consultation with the National Marine Fisheries Service (NMFS) is now required for this project. These issues have a substantial cumulative effect on both ongoing pre-construction activities and upcoming construction work in the field that resulted in a 42-month delay in the project schedule (revised completion date of December 4, 2015), and a $101,688,640 increase in the project budget (revised project budget of $409,444,761). The project schedule calls for publication of the project Draft EIR in September 2009 and advertisement for construction in August 2010.

Project CUW36701: Harry Tracy Water Treatment Plant (HTWTP) Long-Term Improvements – The discovery of a new strand of the Serra Fault in the vicinity of the plant's two treated water reservoirs (TWRs) triggered the need for additional investigations which confirmed that additional improvements were required to address seismic risks and ensure compliance with the program's Levels of Service (LOS) goals. As a result, the following scope revisions were proposed and adopted: abandon two existing TWRs and build a new 11.0 mg TWR, seismically retrofit pipelines in the vicinity of the Serra Fault, and build interim improvements to address short-term seismic risks. The scope changes resulted in a $183,303,228 increase in the project budget (revised project budget of $359,063,409). The project approved completion date remains the same (June 12, 2014). The project EIR is being prepared and 35% design has been completed. Advertisement for construction is scheduled for April 2011.

It is important to underscore that the project scopes in the June 2009 Revised WSIP continue to meet all the LOS goals established for the system. No changes were made to the program's LOS goals to accommodate project scope revisions.

<u>Status and Performance Summary</u>

The program performance metrics for planned and actual performance had to be updated following approval of the June 2009 Revised WSIP. It should be noted that incorporation of the revised schedule and cost baselines resulted in a slight reduction of the planned and actual performance metrics from what was reported in the previous WSIP Quarterly Report. Overall, actual performance (16.6%) on the program is tracking very close to planned performance (16.7%). Planning activities are nearing completion at 96%, whereas environmental, design and construction efforts are 67%, 75% and 6% complete, respectively. As of July 1, 2009, there are two (2) regional projects in the Planning Phase, eleven (11) in the Design Phase, six (6) in the Bid & Award Phase, five (5) in the Construction Phase, two (2) in the Close-Out Phase, eight (8) regional projects have been completed, one (1) project has not been initiated, and eleven (11) are active in multiple phases.

The approved WSIP Regional Program completion date is December 4, 2015 and the current forecast completion date is the same. The approved WSIP Regional Program budget is $3,514,026,000 and the current forecast at completion is $3,532,336,000 ($18,310,000 over the approved budget). The total approved WSIP budget (Local and Regional Programs including Finance Cost) is $4,585,556,000 and the current total forecast at completion is $4,608,583,000 ($23,027,000 over the approved budget).

Major program milestones reached during this reporting quarter include:

Environmental Approvals:
- CUW36103: Pulgas Balancing - Structural Rehabilitation and Roof Replacement (Mitigated Negative Declaration)

Construction Contract Advertised:
- CUW36103: Pulgas Balancing - Structural Rehabilitation and Roof Replacement
- CUW36401: Lawrence Livermore Water Quality Improvement
- CUW38001: BDPL No. 3 and 4 - Crossovers
- CUW37901: San Andreas Pipeline No. 3 Installation
- CUW38601: San Antonio Pump Station Upgrade

Construction Contract Awarded:
- CUW35901: Alameda Siphon #4
- CUW37201: University Mound Reservoir - North Basin
- CUW37901: San Andreas Pipeline No. 3 Installation
- CUW38001: BDPL Nos. 3 and 4 Crossovers

Construction Notice to Proceed Issued
- CUW36102: Pulgas Balancing - Discharge Channel Modifications
- CUW39101: Baden & San Pedro Valve Lot Improvements

The WSIP Team continues to work collaboratively with other City Departments, the SFPUC Regional Wholesale customers, and all program stakeholders to ensure the successful delivery of the WSIP.

HETCH HETCHY
WATER SYSTEM IMPROVEMENT PROGRAM

Quarterly Report

Q4 FY 2008 | 2009

Regional Projects

4.5.09 - 7.1.09

Rebuilding Today
for a Better Tomorrow

Published: 8.20.09

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1.0 PROGRAM SUMMARY

1.1 PROGRAM OVERVIEW

The Water System Improvement Program (WSIP) is a multi-billion dollar, multi-year capital program to upgrade the City of San Francisco's regional and local drinking water systems. The program will deliver improvements that enhance the City's ability to provide reliable, affordable, high quality drinking water to its 27 wholesale customers and regional retail customers in Alameda, Santa Clara, and San Mateo Counties, and to 800,000 retail customers in San Francisco, in an environmentally sustainable manner. The proposed WSIP is structured to cost-effectively meet water quality requirements, improve seismic and delivery reliability, and achieve water supply goals.

This Fourth (4th) Quarterly Report for Fiscal Year (FY) 2008-2009 presents the progress made on the WSIP regional projects between April 5, 2009 and July 1, 2009. The program's schedule and budget were last approved by the San Francisco Public Utilities Commission (SFPUC or Commission) on July 28, 2009.

June 2009 Revised WSIP:
Consistent with other large and complex infrastructure programs, the WSIP needs to periodically go through a comprehensive review and revision. The process of formally approving new project scopes, schedules and budgets is referred to as re-baselining. Making periodic adjustments in the WSIP through a re-baselining process is required to:

- incorporate the latest available information, including new project scopes, risk mitigation measures and value engineering proposals;
- capture low construction bids in revised project budgets;
- provide more realistic project baselines for performance measurements;
- ensure that adequate funding is available in future supplemental appropriations; and
- ensure compliance with the California Water Code #73500 (Assembly Bills 1823 and 2437).

The adjustments to the program scope, schedule and budget reflected in the June 2009 Revised WSIP were based on an analysis of monthly forecasting and change management data over the past two quarters and a program re-alignment review undertaken by the WSIP Senior Management Team in April 2009. A Notice of Public Hearing describing proposed changes to regional project schedules and scopes was posted on June 26, 2009, in compliance with the notification requirements of the California Water Code. Additional material of proposed cost changes were subsequently posted on July 23, 2009. The June 2009 Revised WSIP was adopted by the SFPUC Commission on July 28, 2009. The approval included an endorsement of recommendations made by the Bay Area Water Supply and Conservation Agency

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(BAWSCA). For more information on the program changes adopted by the SFPUC Commission, refer to documents posted on the SFPUC Website under following headings:

Web Address: (http://sfwater.org/detail.cfm/MC_ID/35/MSC_ID/397/C_ID/4660)

- Notice of public Hearing 7/28/09: Proposed Revisions to the WSIP-2
- Notice of public Hearing 7/28/09: Proposed Revisions to the WSIP-1

This Quarterly Report incorporates all changes to the WSIP Regional Program approved as part of the June 2009 Revised WSIP, including project name changes, modification of the WSIP organizational structure, the addition of a new regional project, and revised budgets and schedules.

The name of two regional projects was changed as part of the adoption of the June 2009 Revised WSIP. The name changes are as follows:

- Project CUW30103: Groundwater Project C - South Westside Basin changed to Regional Groundwater Storage and Recovery
- Project CUW35201: Alameda Creek Fishery Enhancement changed to Upper Alameda Creek Filter Gallery

In the June 2009 Revised WSIP, all of the WSIP Water Supply Region Projects, except for CUW30103 – Regional Groundwater Storage and Recovery Project, moved from the Regional Program to the Local Program. The CUW30101 - Regional Groundwater Storage and Recovery Project was moved to the San Francisco Regional Region.

One regional project was added as part of the adoption of the June 2009 Revised WSIP to ensure the program continues to meet the (LOS) goals established for the program. CUW36702 - Peninsula Pipelines Seismic Upgrade, which was included in the Peninsula Region, will provide the seismic reliability required for key transmission pipelines that transport water from the Harry Tracy Water Treatment Plant (HTWTP).

It should be noted that the approved June 2009 Revised WSIP does not include revisions to all project budgets and schedules. Projects with cost and schedule variances that can potentially be mitigated were not re-baselined (i.e., changes to the budget and schedule of these projects were not made). Therefore the Baseline (Approved) Budget and/or and Baseline (Approved) Schedule for those projects remain the same and cost and/or schedule variances continue to be reported based on the latest project forecasts.

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1.2 PROGRAM PERFORMANCE

The overall performance of the WSIP at the program and regional level is assessed using the Earned Value Management (EVM) method. EVM has the unique ability to combine measurements of scope, schedule, and cost in a single integrated system. It allows the WSIP Management Team to (1) measure the amount of work actually performed on the program, (2) forecast the program's cost and completion date using historical and statistical projections, (3) determine how well the program is "performing" compared to its original plan, and (4) forecast how well the program will perform in the future. The Earned Value (or Budgeted Cost of Work Performed) is the cost originally budgeted to accomplish the work completed by the report date. In other words, it is the value of the work completed and it is defined as the percent of work accomplished multiplied by the Approved Budget for that work. Planned Value (or Budgeted Cost of Work Scheduled) is the budgeted cost for the work scheduled to be performed by the report date. The Actual Cost (or Actual Cost of Work Performed) is cost incurred to accomplish the work completed by the report date. EVM uses a number of calculations, indices and variances to assess performance. The Schedule Performance Index (SPI) reported herein is a measure of how well the program is doing in terms of following the WSIP approved schedule. It is calculated by dividing the Earned Value by the Planned Value.

At the project-level, WSIP performance is measured using both the EVM and the reporting of schedule and cost variances. These variances are not based on EVM calculations but instead on an overall progress assessment by Project Managers. Appendices D and E include a summary of schedule and cost variances for all WSIP Regional Projects. The "Schedule Variance of WSIP Regional Project" Table in Appendix D summarizes the schedule variance between the projects' Approved Finish Date and the Current Forecast at Completion (or Forecasted Completion Date). The "Cost Variance of WSIP Regional Projects" Table in Appendix E summarizes the cost variance between the projects' Approved Budget and Current Forecast at Completion (or Forecasted Cost at Completion).

Current Program Performance

WSIP activities during the reporting quarter continued to focus primarily on environmental review and design efforts. To date, planning of the WSIP Regional Program is approximately 96% complete, whereas environmental review/permitting, design and construction efforts are about 67%, 75% and 6% complete, respectively. The Schedule Performance Index (SPI) for the Regional Program is 0.99, indicating that 99% of the overall work planned was performed as of the end of this reporting quarter.

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Earned Value exceeds Actual Cost to date by $31.5 million. The Planned versus Actual % Completion of all phases of the WSIP Regional Program are summarized in Table 1.1.

Table 1.1 Program Performances (1, 2)

			July 1, 2009	
			% Planned	**% Actual**
Project Management			42.6%	42.8%
Planning			97.3%	96.4%
Environmental	Comparison with last quarter data not provided because program baseline was changed and such comparison would not be meaningful.		70.1%	66.5%
Right-of-Way			33.4%	30.4%
Design			75.8%	74.6%
Bid & Award			39.0%	39.9%
Construction Management			6.1%	6.1%
Construction			6.1%	6.2%
Close-Out			23.4%	21.8%
Program Management			36.0%	35.9%
Program Cumulative			**16.7%**	**16.6%**

Notes:

1. Includes performance from San Joaquin, Sunol Valley, Bay Division, Peninsula, and San Francisco Regional Regions.
2. See Appendix A.2 (Definition and How to Read PSR's) for explanation of percentage calculations.

Overall, the actual performance of the Project Management, Planning, Design, Bid & Award, Construction Management, Construction, and Program Management Phases is tracking planned performance relatively well. The Environmental, Right-of-Way, and Close-out Phases are slightly behind schedule.

The overall Environmental Phase delay is associated with the complex environmental issues to be thoroughly analyzed under the California Environmental Quality Act (CEQA). No delays have been experienced to date in the environmental permits to be issued by various Federal, State and Regional Resource Agencies prior to construction. The delay recorded for the Environmental Phase is due to the addition of a 3rd Admin

1.0 PROGRAM SUMMARY

Draft EIR, a screen check review, and extended review periods requested by Division of Major Environmental Analysis for CUW35901 - New Irvington Tunnel, CUW38101 - SVWTP Expansion & Treated Water Reservoir, and CUW35401 – Lower Crystal Springs Dam Improvements Projects. It should be noted that CUW35901 - New Irvington Tunnel and CUW38101 - SVWTP Expansion & Treated Water Reservoir projects were not re-baselined for schedule under the June 2009 Revised WSIP.

The delay recorded for the ROW Phase is to a great extent a carryover from the delay in the Environmental Phase since some land entitlement and encroachment removal actions cannot be initiated until after a project has formally been approved following CEQA certification. It should be noted that the ROW Phase has not delayed any project to date.

The delay recorded for the Close-Out Phase is attributed to 2 projects – CUW37001 – Pipeline Repair & Readiness Improvements, and CUW35801 – Sunset Reservoir – North Basin. In both cases, additional construction work had to be completed, which delayed the Close-Out Phase. It should be noted that both projects were not re-baselined for schedule under the June 2009 Revised WSIP.

The relative progress of the different regions is summarized in Table 1.2.

Table 1.2 Regional Performance (1)

			July 1, 2009	
			% Planned	**% Actual**
San Joaquin Region			17.1%	16.7%
Sunol Valley Region			12.3%	12.0%
Bay Division Region			14.6%	14.8%
Peninsula Region			14.8%	14.8%
San Francisco Regional Region			48.7%	48.5%
System-Wide			30.1%	29.0%
Regional Program Cumulative			**16.7%**	**16.6%**

Comparison with last quarter data not provided because program baseline was changed and such comparison would not be meaningful.

Notes:

1. See Appendix A.2 (Definition and How to Read PSR's) for explanation of percentage calculations

1.0 PROGRAM SUMMARY

All regions are tracking within +/_ 10% of early planned performance, which is considered acceptable. The delay recorded for San Joaquin Region is due to slippage in attainment of the Draft Environmental Impact Report (DEIR) certification for CUW37301 – San Joaquin Pipeline System Project, which was resulted from a couple of weeks delay in completion of response to public review comments. However, the San Francisco Planning Commission certified the EIR for the CUW37301 – San Joaquin Pipeline System Project on 07/14/09. The overall delay recorded for the Sunol Valley Region is due to delays in the Environmental Phase of the CUW35901 - New Irvington Tunnel and CUW38101 - SVWTP Expansion & Treated Water Reservoir Projects. The delay recorded for the San Francisco Regional is due to delay in completion of Close-out phase for CUW35801 – Sunset Reservoir – North Basin. However, the Sunset Reservoir was placed in active service on January 16, 2009. The delay recorded for the System-Wide Region is due to delay in the Planning Phase of CUW39401 – Watershed Environmental Improvement Program. It should be noted that in accordance with the June 2009 Revised WSIP adopted by the SFPUC Commission on July 28, 2009, the baseline (approved) schedules for all above mentioned projects were not changed.

Project Phase Status

As of July 1, 2009, there are two (2) projects in the Planning Phase, eleven (11) projects in the Design Phase, six (6) projects in the Bid and Award Phase, five (5) projects in the Construction Phase, two (2) projects in the Close-Out Phase, eight (8) projects are completed, one (1) project has not been initiated, and eleven (11) projects have multiple active phases. As of July 1, 2009, one (1) project has not initiated their Environmental Phase, twenty (20) are undergoing environmental review, and twenty-two (22) have completed their Environmental Phase.

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Table 1.3 Projects Status

CUW	Project	Active Phase	Environmental Phase
San Joaquin Region			
36401	Lawrence Livermore Water Quality Improvement	Bid & Award	Completed
37301	San Joaquin Pipeline System	Design	Active
37302	Rehabilitation of Existing San Joaquin Pipelines	Planning, Design, Bid & Award	Active
38401	Tesla Treatment Facility	Design, Construction	Completed
38701	Tesla Portal Disinfection Station (combined with 38401)	Combined with 38401	Not Applicable
Sunol Valley Region			
35201	Upper Alameda Creek Filter Gallery	Planning	Active
35501	Standby Power Facilities - Various Locations	Construction	Completed
35901	New Irvington Tunnel	Design	Active
35902	Alameda Siphon #4	Bid & Award	Active
37001	Pipeline Repair & Readiness Improvements	Completed	Completed
37401	Calaveras Dam Replacement	Design	Active
37402	Calaveras Reservoir Upgrades (Completed)	Completed	Completed
37403	San Antonio Backup Pipeline	Design	Active
38101	SVWTP Expansion & Treated Water Reservoir	Design	Active
38102	SVWTP Calaveras Road (Deleted)	Deleted	Not Applicable
38103	SVWTP New Pipeline	Combined with 38101	Not Applicable
38201	SVWTP Treated Water Reservoir (Combined with CUW38101)	Combined with 38101	Not Applicable
38601	San Antonio Pump Station Upgrade	Bid & Award	Completed
Bay Division Region			
35301	BDPL Nos. 3 & 4 Crossover/Isolation Valves	Close-Out	Completed
35302	Seismic Upgrade of BDPL Nos. 3 & 4	Design	Active

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CUW	Project	Active Phase	Environmental Phase
36301	SCADA System - Phase II	Design, Bid & Award, Construction	Active
36302	System Security Upgrades	Planning, Design, Bid & Award, Construction	Active
36801	BDPL Reliability Upgrade - Tunnel	Design, Bid & Award	Active
36802	BDPL Reliability Upgrade - Pipeline	Design, Bid & Award	Part of 36801
36803	BDPL Reliability Upgrade - Relocation of BDPL Nos. 1 & 2	Bid & Award	Completed
38001	BDPL Nos. 3 and 4 Crossovers	Bid & Award, Construction	Completed
38901	SFPUC/EBMUD Intertie	Close-Out	Completed
39301	BDPL No. 4 Condition Assessment PCCP Sections	Completed	Completed
Peninsula Region			
35401	Lower Crystal Springs Dam Improvements	Design	Active
35601	New Crystal Springs Bypass Tunnel	Construction	Completed
35701	Adit Leak Repair - Crystal Springs/Calaveras (Completed)	Completed	Completed
36101	Pulgas Balancing - Inlet/Outlet Work (Completed)	Completed	Completed
36102	Pulgas Balancing - Discharge Channel Modifications	Construction	Completed
36103	Pulgas Balancing - Structural Rehabilitation and Roof Replacement	Design, Bid & Award	Active
36104	Pulgas Balancing - Laguna Creek Sedimentation (Closed)	Closed	Completed
36105	Pulgas Balancing - Modifications of the Existing Dechlorination Facility	Design	Active
36501	Cross Connection Controls	Completed	Completed
36601	HTWTP Short-Term Improvements - Demo Filters (Completed)	Completed	Completed
36602	HTWTP Short-Term Improvements - Remaining Filters (Combined with CUW36603)	Combined with 36603	Not Applicable

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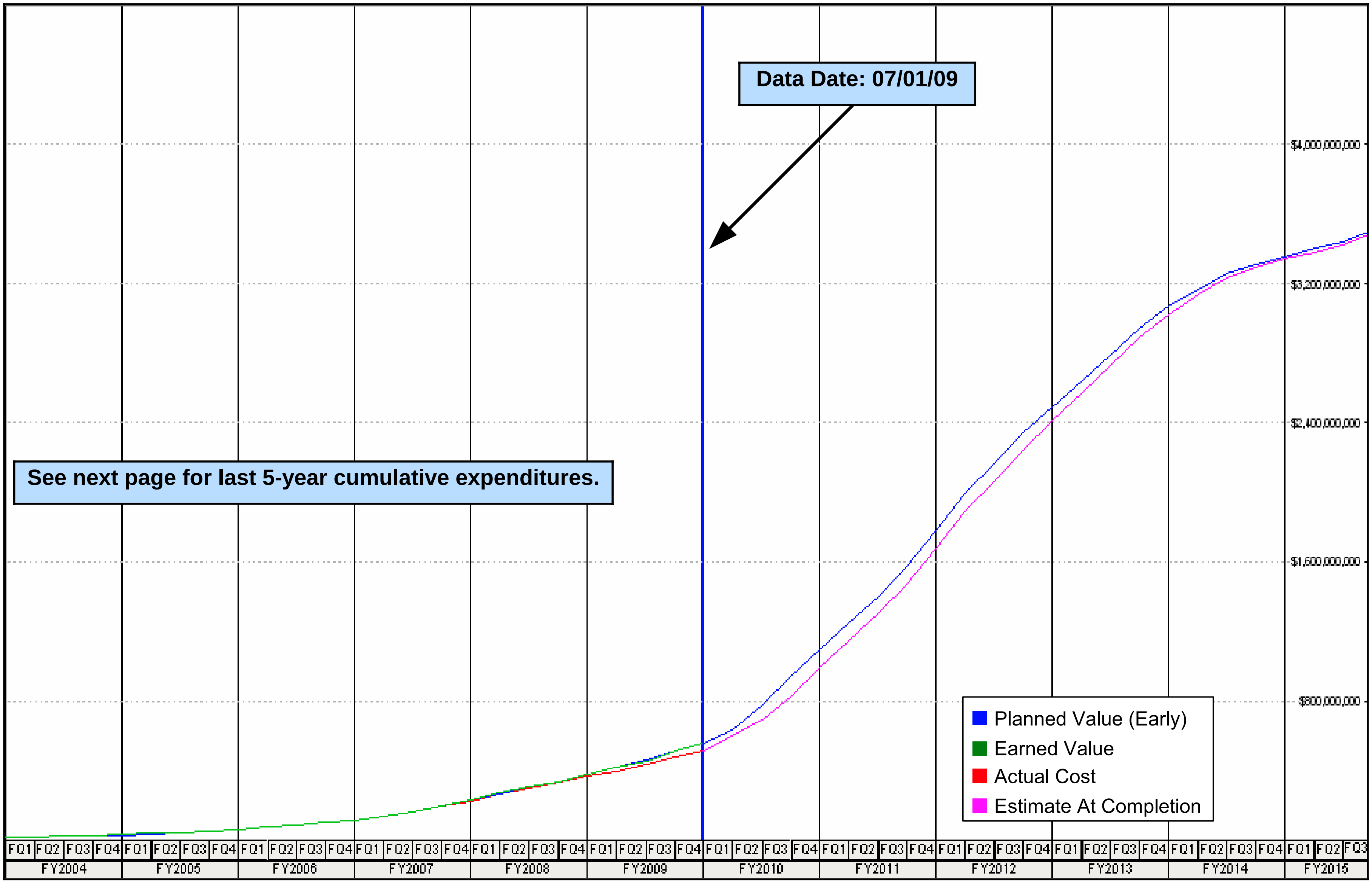
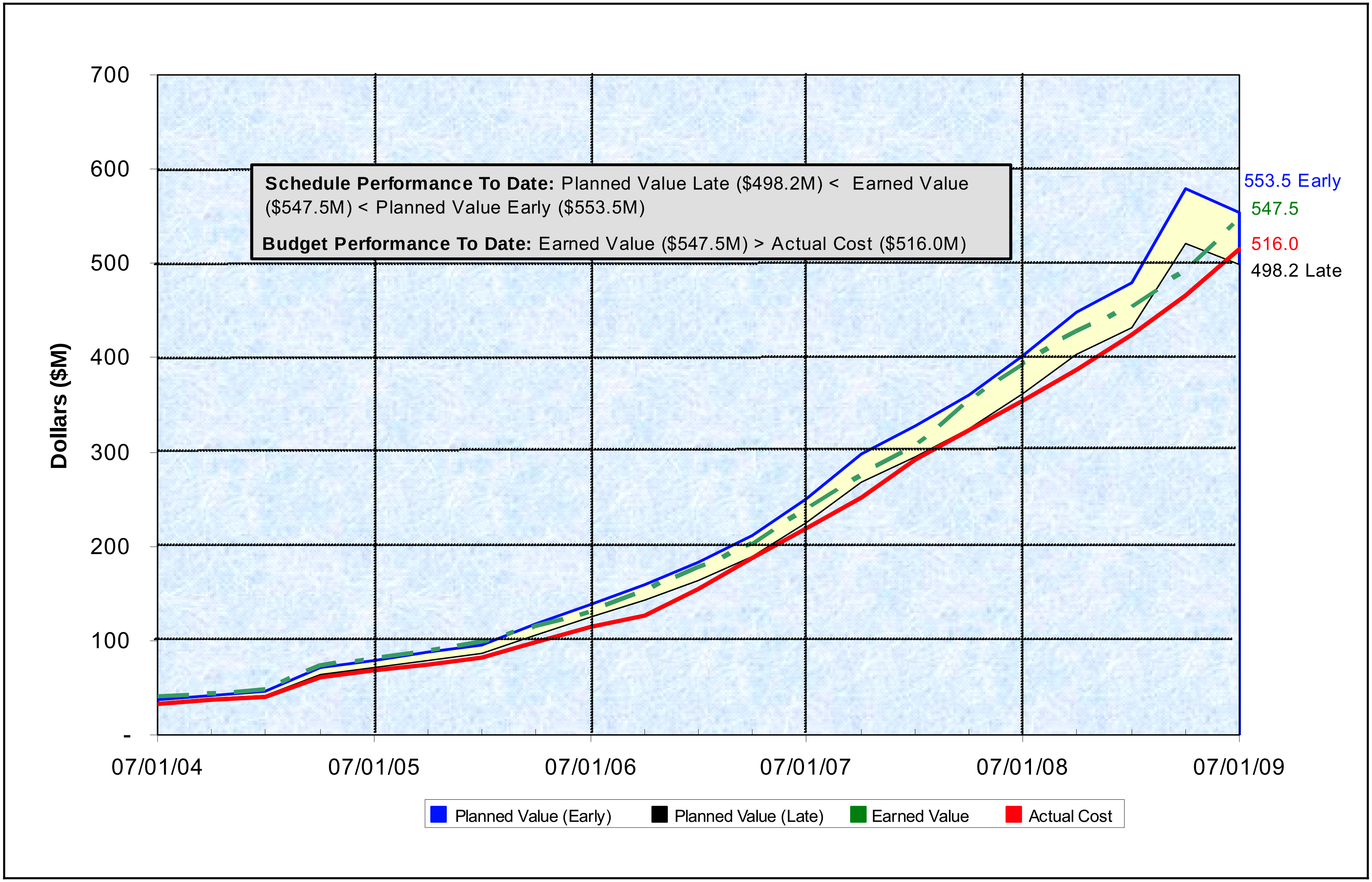
CUW	Project	Active Phase	Environmental Phase
36603	HTWTP Short-Term Improvements - Coagulation & Flocculation/ Remaining Filters	Construction	Completed
36701	HTWTP Long-Term Improvements	Design	Active
36702	Peninsula Pipelines Seismic Upgrade	Not Initiated	Not Initiated
36901	Capuchino Valve Lot Improvements (Completed)	Completed	Completed
37101	Crystal Springs/San Andreas Transmission Upgrade	Design	Active
37801	Crystal Springs Pipeline No. 2 Replacement	Design	Active
37901	San Andreas Pipeline No. 3 Installation	Bid & Award	Completed
39101	Baden and San Pedro Valve Lots Improvements	Construction	Completed
San Francisco Regional Region			
30103	Regional Groundwater Storage and Recovery	Design, Bid & Award, Construction	Active
35801	Sunset Reservoir - North Basin	Construction, Close-Out	Completed
37201	University Mound Reservoir - North Basin	Bid & Award	Completed
System-Wide Region			
38801	Programmatic EIR	Completed	Completed
38802	Habitat Reserve Program	Design, Construction	Active
39401	Watershed Environmental Improvement Program	Planning	Not Initiated



Data Date: 07/01/09
See next page for last 5-year cumulative expenditures.
$4,000,000,000
$3,200,000,000
$2,400,000,000
$1,600,000,000
$800,000,000
Planned Value (Early)
Earned Value
Actual Cost
Estimate At Completion
FQ1 FQ2 FQ3 FQ4
FY2004
FY2005
FY2006
FY2007
FY2008
FY2009
FY2010
FY2011
FY2012
FY2013
FY2014
FY2015

CUMULATIVE EXPENDITURES (LAST 5 YEARS)



Phase	Schedule				Budget							
	Approved Start	Current Start	Approved Finish	Current Finish	Planned Expenditure To Date	Planned % Complete	Expended To Date	Actual % Expended	Progress % Complete	Earned Value Cost	Approved Budget	Current Forecast
Project Management	03/31/00	03/31/00A	12/04/15	12/04/15	$57,870,000	42.6	$53,302,000	39.2	42.8	$58,107,000	$135,886,000	$135,323,000
Planning	03/31/00	03/31/00A	12/30/10	12/30/10	$62,756,000	97.3	$61,403,000	94.8	96.4	$62,183,000	$64,789,000	$65,053,000
Environmental	10/14/02	10/14/02A	12/31/12	12/31/12	$62,899,000	70.1	$52,394,000	57.3	66.5	$59,689,000	$91,473,000	$91,279,000
Right-of-Way	03/27/06	03/27/06A	09/13/12	09/13/12	$7,823,000	33.4	$6,329,000	27.0	30.4	$7,126,000	$23,406,000	$23,386,000
Design	10/01/01	10/01/01A	10/31/12	10/31/12	$155,172,000	75.8	$141,502,000	69.1	74.6	$152,655,000	$204,917,000	$204,854,000
Bid and Award	03/05/04	03/05/04A	04/30/13	04/30/13	$2,190,000	39.0	$1,654,000	29.3	39.9	$2,238,000	$5,644,000	$5,531,000
Construction Management	01/18/05	01/18/05A	06/03/15	06/03/15	$18,468,000	6.1	$16,306,000	5.4	6.1	$18,395,000	$302,875,000	$303,327,000
Construction	07/01/03	07/01/03A	06/03/15	06/03/15	$144,764,000	6.1	$146,030,000	5.7	6.2	$145,703,000	$2,566,573,000	$2,585,086,000
Close-Out	10/06/05	10/06/05A	12/04/15	12/04/15	$1,858,000	23.4	$783,000	9.9	21.8	$1,732,000	$7,937,000	$7,972,000
Program Management	08/01/05	08/01/05A	12/04/15	12/04/15	$39,747,000	36.0	$36,336,000	32.9	35.9	$39,688,000	$110,525,000	$110,525,000
Regional Total	**03/31/00**	**03/31/00A**	**12/04/15**	**12/04/15**	**$553,548,000**	**16.7**	**$516,039,000**	**14.7**	**16.6**	**$547,516,000**	**$3,514,026,000**	**$3,532,336,000**
Local Total	**01/02/01**	**01/02/01A**	**10/14/14**	**10/14/14**	**$231,105,000**	**40.5**	**$227,164,000**	**37.9**	**40.3**	**$230,106,000**	**$599,830,000**	**$604,547,000**
										Budgeted Finance Cost:	**$471,700,000**	**$471,700,000**
										WSIP Total Cost:	**$4,585,556,000**	**$4,608,583,000**

1.0 PROGRAM SUMMARY

1.3 PROGRAM UPDATE

Program Management

During the reporting quarter, WSIP Program Management efforts continued to focus on several key activities including program level contracts, various ongoing program control initiatives, and system shutdown planning and public and contractor outreach efforts. In addition, efforts were spent on addressing follow up comments provided by regulatory agencies and the Bay Area Water Supply & Conservation Agency (BAWSCA) on the WSIP proposed changes, as well as on a number of other activities related to the implementation of the program.

The 2nd Quarter - Fiscal Year 2008-2009 (Q2-FY08/09) Regional Projects Quarterly Report listed commitments that were made to the California Department of Public Health (CDPH) and the California Seismic Safety Commission (CSSC) in response to their concerns about the program changes approved in 2008. Progress was made during the last quarter on some of the commitments to CDPH that were included in a letter to them from the SFPUC on November 13, 2008, as reported below:

Conduct independent technical review for the CUW35902 - Alameda Siphon #4 project to assure seismic reliability; investigate potential additional capital and operational response improvements that may increase seismic reliability in the Sunol Valley; create and implement a seismic response strategy for the Sunol Valley, as well as update Operational Response Plans to address response procedures including operation of WSIP facilities following major seismic events. A review by seismic design experts was performed for the Alameda Siphon #4 project, focusing on the adequacy of the design to withstand a Calaveras design earthquake. In the draft report "Draft: Seismic Review of Alameda Siphon #4 Project" (URS, March 12, 2009), the Review Team concluded that an "acceptable standard of care" was applied to the design, and that the "project uses appropriate technology to achieve the WSIP goals." The report was finalized May 21, 2009. In addition to this review, the Sunol Valley Seismic Reliability Assessment final draft was completed May 2009. It presents the results of various reviews and evaluations that the SFPUC has conducted regarding the level of seismic reliability that will be provided in the Sunol Valley following completion of the WSIP. The intent is to:

- Verify the adequacy of the existing and proposed facilities and operational requirements to meet their intended purposes in satisfying the seismic reliability level of service (LOS) goals.
- Identify potential weaknesses.

- Identify additional improvements that might increase reliability beyond the requirements of the seismic reliability LOS goals.

There has been a significant amount of detailed evaluation and design performed to date on the individual facilities in the Sunol Valley so that these facilities comply with the seismic reliability LOS goals. However, in some cases, reliability may be further increased through a combination of synergistic improvements to multiple projects, including both capital and operational, that would not be achievable by a single project. Key recommendations from the document have been incorporated or are being considered for incorporation in several projects.

Progress was made during the last quarter on the SFPUC's commitments to the CSSC that were included in a letter to the CSSC dated November 13, 2008. During the past quarter, SFPUC facilitated URS Consultants' presentation on their approach to the design of a seismically reliable pipeline at the Bay Division Pipelines Nos. 3 and 4 Hayward Fault crossing to the independent Seismic Safety Task Force (SSTF), as well as AECOM's approach to seismic reliability modeling and analysis. The Seismic Safety Task Force will be following up with written recommendations regarding "Revised General Seismic Requirements for Design of New Facilities and Upgrade of Existing Facilities – Revision 1" (SFPUC, December 22, 2008) in the next quarter. In addition, they will also provide their written recommendations regarding the proposed reduction of redundant seismically reliable pipeline at the Bay Division Pipelines Nos. 3 and 4 Hayward Fault crossing.

SFPUC staffs are scheduling to meet with the SSTF again in the next quarter to follow up on two remaining items:

a) Magnitude of design earthquakes for WSIP projects impacted by the Calaveras Fault;
b) Size and consistency of design fault displacements at pipeline crossings. The SSTF confirmed in a meeting on May 11, 2009 that the size of design fault displacements used for WSIP projects is reasonable and consistency has been maintained among projects, and the SSTF indicated they will be providing written recommendations in the upcoming quarters.

During the CSSC meeting on October 28, 2008, the SFPUC concurred with the CSSC that two issues warranted evaluations by external experts/consultants:

a) **Redundancy of the Alameda Siphon Project and alternative connections between the Sunol Valley Water Treatment Plant and the Irvington Tunnel.** A draft report titled, "Sunol Valley Seismic Reliability Assessment" by CH2M Hill has been completed. The final draft report was completed in May 2009. As discussed above, key recommendations from the document have been incorporated or are being considered for incorporation in several projects.

b) **Faulting and slope stability issues at the Harry Tracy Water Treatment Plant (HTWTP): Status of the two reports for HTWTP is as follows:**
   - "Draft Seismic Risk Assessment for Treated Water Reservoirs" by Exponent Failure Analysis Associates (December 2008). Final draft report was submitted to SFPUC at the end of June 2009. The consultant will issue the final report this quarter.
   - "Supplemental Fault Rupture Hazard Assessment" by William Lettis & Associates, Inc. was finalized in March 2009.

The SFPUC continued to prepare a Preliminary Official Statement in anticipation of issuing the second round of WSIP bonds in August 2009. The expected total bond size is an estimated $375 million in one or more series and proceeds will be used to defease outstanding commercial paper as well as continue funding WSIP capital projects.

During this reporting period, ongoing efforts aimed at improving the WSIP Program Controls System and processes included the following accomplishments: (1) Performing a thorough and systematic analysis of program scope, cost and schedule to generate the proposed program changes; (2) establishing detailed project baselines for monitoring, controlling and reporting purposes; (3) providing online "dashboard" access to the Construction Management Consultants to view respective projects schedule at the program level; and (4) holding cost estimating training sessions.

Planning efforts associated with system shutdowns continued during the reporting quarter. The WSIP Management Team held multiple meetings with the SFPUC Water Enterprise to coordinate the planning, scheduling, staffing, and work-around plans for the WSIP system shutdowns required through 2014. A number of special shutdown meetings were also held to plan for the Coast Range Tunnel shutdown in January 2010. The WSIP Master System Shutdown schedule and a summary of the changes made to the schedule since it was last updated in October 2008 was issued and distributed to the BAWSCA on May 8, 2009.

WSIP Communications orchestrated two major groundbreaking events for regional projects in the Peninsula and San Joaquin Regions during the quarter. These events resulted in significant media coverage regarding WSIP. Additionally, Communications collaborated with the WSIP Construction Management team in the first of several orientation trainings for staff and consultant teams managing WSIP projects in construction. Communications also activated its program consultant to audit Communications planning and execution in all regions and implement new action plans and procedures for WSIP communications in the field.

The groundbreaking for the CUW35601- New Crystal Springs Bypass Tunnel coincided with the anniversary of the 1906 earthquake and was collaboration with US Geological Survey as well as San Mateo Board of Supervisors. The event received widespread media coverage. In May 2009, the USGS prominently displayed WSIP projects and efforts to seismic retrofit the regional water system as part of its annual open house that drew 10,000 guests. In San Joaquin, the Mayor of San Francisco and President of the San Joaquin Board of Supervisors along with representatives of the U.S. Environmental Protection Agency (EPA) broke ground for the CUW38401 - Tesla Treatment Facility Project near Tracy, CA. Again, this event brought significant media attention to WSIP around the state.

San Joaquin regional Communications Liaison coordinated briefings before the Stanislaus and San Joaquin Board of Supervisors, Riverbank City Council and respective Irrigation Districts' Commissions. In the Sunol region, briefings continue with key Alameda County representatives and the Sunol Citizens Advisory Committee. Additionally, Communications is planning an event with the Sunol School to kick-off the first WSIP project in the Sunol Valley: CUW35902 - Alameda Siphon #4. As the Bay Division region prepares for environmental certification hearings, Communications is taking the lead to arrange final meetings with all municipalities and counties on the Memorandums of Understanding (MOU) for CUW36801/36802 - BDPL Reliability Upgrade – Tunnel/Pipeline Projects. In the Peninsula region, Communications is onsite regularly at New Crystal Springs Tunnel site, as well as focusing on outreach around Daly City and Sawyer Camp Trail projects. With final approval of CUW 37901 - San Andreas Pipeline #3 Installation Project, Communications is refining outreach plans for 4.4 mile pipeline between Daly City and San Francisco's Stonestown neighborhood.

Coordination with the Arts Commission Civic Design Review Committee has produced a design charrette for water supply groundwater projects. This innovative solution will help streamline approvals for more than 20 ground well sites in northern San Mateo County and within San Francisco.

Social marketing continues to be an increasingly popular platform to promote the WSIP projects among neighbors and others. Upcoming refinements to the WSIP website will enable visitors to access blogs quicker for project updates. Additionally, WSIP will add an environmental section to highlight environmental management on projects throughout the regions.

Contracting Outreach staff held a successful Contractor's Fair on April 1 in San Mateo, coordinating with both the Peninsula Builder's Exchange and the WSIP Small Business Advisory Committee. More than 75 contractors and primes from the area attended as did San Mateo Supervisor Rose Jacobs Gibson. Throughout the quarter, this team certified 13 new local business enterprise (LBE) contractors and subcontractors in the regions. Since July 1, 2008, 103 LBE contractors have been certified.

Contracting Outreach also assisted with numerous pre-bid conferences for WSIP Projects. In June, the team hosted another successful Contractor's Breakfast with a film highlighting labor's successful involvement within WSIP and the strides SFPUC has made to improve the contracting process. WSIP's presence at Rapid Excavation and Tunneling Conference (RETC), also in June, provided national exposure to several upcoming WSIP projects that will be out for bid in the coming year.

Planning/Design

Planning and design efforts continue with most projects achieving their key scheduled milestones. All regional projects with the exception of two projects (CUW35201 – Upper Alameda Creek Filter Gallery and CUW39401 – Watershed Environmental Improvement Program) have now entered the Design Phase. During this reporting period, the Design Phase for the CUW37901 - San Andreas Pipeline No. 3 Installation, and CUW38601 - San Antonio Pump Station Upgrade Projects were completed. The 35% design package for the CUW35302 – Seismic Upgrade of BDPL Nos. 3 & 4 Project, and the 95% design package for the CUW38401 – Tesla Treatment Facility, CUW36301 – SCADA System – Phase II, CUW35401 – Lower Crystal Springs Dam Improvements, CUW38101 – SVWTP Expansion & Treated Water Reservoir, and CUW5901 – New Irvington Tunnel Projects were all completed.

In addition, the construction bid packages for the CUW36401 - Lawrence Livermore Water Quality Improvement, CUW37302 - Rehabilitation of Existing San Joaquin Pipelines (Roselle Crossover), CUW37901 - San Andreas Pipeline No. 3 Installation, CUW36103 -Pulgas Balancing – Structural Rehabilitation and Roof Replacement, and CUW38601 - San Antonio Pump Station Upgrade Projects were advertised.

A Cooperative Agreement with Caltrans District 4 for proposed improvements in connection with WSIP within the State Highway System ROW was executed on February 19, 2009, and will be effective through December 31, 2017. To date, WSIP has received sixteen (16) encroachment permits from Caltrans. As a part of this agreement, the SFPUC agreed to establish a Construction Zone Enhancement Enforcement Program (COZEEP), working with the California Highway Patrol (CHP) for traffic safety on State highways. This quarter, an agreement with the California Highway Patrol (CHP) to provide the COZEEP services during construction of the improvements has been drafted. This agreement will help facilitate construction around State highways by providing supplemental CHP officers to assist the SFPUC and its contractors in the management of traffic in order to enhance the safety of motorists, pedestrians, and construction workers.

To ensure all WSIP projects share a common contract basis, the Engineering Management Bureau (EMB) has completed work on the "baseline template" for the Division 0 (Procurement and Contracting Requirements) and Division 1 (General Requirements) Specifications.

Environmental

Keeping the environmental review process on track with scheduled performance has been one of the program's greatest challenges. This challenge encompasses the following factors: (1) the early decision to conduct the Pre-Construction Phases (planning, design, and environmental) for the WSIP in parallel. Although this approach saves time overall and is practiced on major infrastructure programs, it requires several iterations of environmental reviews as design progresses and projects scopes are modified. (2) Preparation of the Draft PEIR in parallel with individual project EIRs. Additional time was needed to accomplish the necessary level of consistency of individual documents with the PEIR. (3) New environmental resource issues surfaced during report preparation that was initially excluded from consideration. For example, Steelhead fisheries analyses, previously anticipated to be completed under a separate permitting process, are now required for completion of the environmental review for the CUW37401 - Calaveras Dam Replacement Project. (4) Inadequate consultant resources have resulted in prolonged document reviews by the Major Environmental Analysis Division of the San Francisco Planning Department (MEA) and termination of two consultant contracts. Having released two consulting firms, the transition to new consultants extended the schedule. (5) Several projects were delayed as a result of the decision by MEA to prepare EIRs instead of Mitigated Negative Declarations (MNDs) on some projects, thus prolonging the Environmental Phase.

The SFPUC Bureau of Environmental Management (BEM) continues to work closely with the SFPUC Water Enterprise, MEA, the Office of the City Attorney and the environmental consultants to mitigate delays in the environmental review process. In addition to hiring new consultants for some projects, additional consultants have been hired to supplement MEA's staff and to supplement some existing consulting contracts.

During the reporting quarter, significant progress was made in certification of several Environmental Impact Reports (EIRs), completion and publication of several Draft EIRs and receipt of other California Environmental Quality Act (CEQA) clearances. Specific CEQA review accomplishments include the following:

The San Francisco Planning Department approved the Mitigated Negative Declaration (MND) for the CUW36103 – Pulgas Balancing - Structural Rehabilitation and Roof Replacement Project on May 14, 2009.

The San Francisco Planning Commission certified the Environmental Impact Report for the CUW37901 – San Andreas Pipeline No. 3 Installation - Project on April 2, 2009

Response to Comments documents were published for the CUW37301 - San Joaquin Pipeline System and CUW36801/CUW36802 – BDPL Reliability Upgrade – Tunnel/ Pipeline Projects on May 14, 2009 and June 18, 2009 respectively.

The Notice of Preparation (NOP) document for the Environmental Impact Report for CUW30103 - Regional Groundwater Storage and Recovery Project was published on June 22, 2009.

Draft Environmental Impact Reports (EIR) were published for the CUW35901 – New Irvington Tunnel and CUW38101 – SVWTP Expansion & Treated Water Projects, both on June 1, 2009.

Resource agency permitting involves the environmental permits that must be obtained prior to construction from the following agencies: US Army Corps of Engineers (USACE), the US Fish and Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS), the State Historic Preservation Officer (SHPO), the California Department of Fish and Game (CDFG), and the Regional Water Quality Control Board (RWQCB).

Significant progress was made on environmental permitting activities. Specific permitting accomplishments during the reporting period are summarized below.

Permits Applications Submitted:

- CUW36801 – BDPL Reliability Upgrade - Tunnel:
    - USACE submitted Letter to SHPO for 106 concurrence

1.0 PROGRAM SUMMARY

- CUW 35901 - New Irvington Tunnel:
  - Submitted 404 Application to USACE
  - Submitted Biological Assessment to USFWS
- CUW37401 – Calaveras Dam Replacement:
  - Submitted Draft Biological Assessment to NMFS
  - Submitted Section 404 Individual Permit Application to the USACE
  - Submitted Biological Assessment to USFWS
- CUW 38101 – SVWTP Expansion & Treated Water Reservoir:
  - Submitted 404 Application to USACE
  - Submitted Biological Assessment to USFWS

Permits Received:

- CUW35902 – Alameda Siphon #4:
  - Completed 401 Water Quality Certification from the RWQCB
- CUW37401 – Calaveras Dam Replacement:
  - Received Approval on Second Supplemental Wetland Delineation Report for verification

Environmental Construction Compliance Management

During this reporting period, the WSIP Environmental Construction Compliance Manager (ECCM) coordinated completion of the Environmental Mitigation Section of the Contract Specifications for one (1) project (CUW36801 – BDPL Reliability Upgrade – Tunnel (East Bay Segment)) and four (4) others are in progress (CUW35901 – New Irvington Tunnel, CUW37301 - San Joaquin Pipeline System, CUW36801 – BDPL Reliability Upgrade – Tunnel (Peninsula Segment), and CUW38101 – SVWTP Expansion & Treated Water Reservoir Projects). Preconstruction planning efforts focused on finalizing environmental construction compliance contracts for Peninsula Region and performing other tasks supporting the environmental compliance program for this region. In addition, agency coordination/reporting and minor project modification approvals supported pre-construction and construction phases for the CUW35601 - New Crystal Springs Bypass Tunnel, CUW38401 - Tesla Treatment Facility, CUW36102-Pulgas Balancing - Discharge Channel Modifications, CUW39101 - Baden and San Pedro Valve Lots Improvements, and CUW38001 – BDPL No. 3 & 4 Crossovers Projects. A training manual for Environmental Inspectors was developed.

Right-of-Way

The ROW engineering, surveys and appraisals have been completed for the CUW36801 - BDPL Reliability Upgrade - Tunnel Project. The project passes through the lands of

USFWS, State Lands, Mid-Peninsula Open Space, Sam-Trans and Leslie Salt. Each of these ownerships will involve different and challenging land acquisition processes.

Encroachment removal activities continues for the CUW36802 - BDPL Reliability Upgrade - Pipeline Project. The Right-of-Way (ROW) Team is now focusing on the remaining difficult encroachments and is diligently working with the City Attorney's Office to find solutions for removal which may include litigation if absolutely necessary. The ROW Team is also mapping and appraising the Bay Road parcel and the City of Fremont Access Road.

The appraisal process was completed for the CUW38001 - BDPL No. 3 & 4 - Crossovers Project and the land acquisition process is underway. Negotiations resulted in a successful settlement on the Guadalupe site in Santa Clara. Discussions continue with Cal Water.

The ROW Team received the final alignment for the CUW35901 - New Irvington Tunnel Project and the ROW mapping has been completed. A significant portion of the appraisal work is underway on this project and the Project Team is meeting with the property owners to explain the ROW process. Initial relocation planning has also commenced.

A ROW Encroachment Team was set up for the CUW37301 - San Joaquin Pipeline System Project. Sixty-nine (69) encroachments have been identified and contact has been initiated via letter and personally. ROW engineering and surveys work have commenced and are ongoing. The appraisal process was also initiated on this project.

Overall, the ROW Team is making steady progress; however, delays in the environmental review of some projects have impacted the ROW Team's ability to initiate some tasks that require CEQA approval first.

Construction

Significant efforts continued on implementing the construction management (CM) approach, structure, processes, procedures and systems, and recruiting the consultants and staffing required managing all upcoming construction activities.

Pre-construction planning:

Pre-construction planning efforts focused on: (1) finalizing of CM Procedures based on the WSIP CM Plan: 46 out of 49 procedures are posted as final on the WSIP section of the SFPUC website (sfwater.org/WSIP) and the SFPUC network drives; (2) implementing the SFPUC revised construction specifications (Perfectus Version 3 for Division 0 and Division 1) on WSIP projects; (3) updating the CM Staffing Plan to manage consultant needs and internal hiring/re-assignment requirements based on schedule update of several WSIP projects and the transition of City staff to CMB; and (4) implementing the WSIP CM Management Information System (CMIS) to provide efficient and consistent management of various CM processes such as submittals, requests for information, written communications, and changes. Preparation of CM Construction Procedures is 98% complete as of the end of the reporting quarter. A thorough QA review has been completed and revisions to incorporate all comments are currently in progress for the WSIP Business Processes, CM Procedures, and the CM Plan.

Construction Management Information System (CMIS):
The WSIP CMIS continued to be transitioned into use on WSIP projects. The CMIS was implemented on the following projects:

- CUW35601 - New Crystal Springs Bypass Tunnel Project, which had its NTP in December 2008.

- CUW38401 - Tesla Treatment Facility Project, which had its construction NTP in March 2009.

- CUW39101 - Baden and San Pedro Valve Lot Improvements Project, which had its NTP in April 09.

- CUW36102 –Pulgas Balancing - Discharge Channel Modifications Project, which had its NTP in April 09.

As of this reporting quarter, a total of about 80 individuals consisting of construction contractors, CM Consultants and SFPUC WSIP employees had received CMIS training.

CM Contract Agreements and Progress:
Significant efforts were made continuing to select and put in place Construction Management Consultants for the WSIP. As of the end of the quarter, the following CM Contract Agreements were in effect:

- CS-910: Construction Management (CM) Services for WSIP - San Francisco Region/Local;
- CS-912: Construction Management (CM) Services for WSIP - New Crystal Springs Bypass Tunnel Project;
- CS-913: Construction Management (CM) Services for WSIP - Bay Tunnel Project;

- CS-914: Construction Management (CM) Services for WSIP – Bay Division Region;
- CS-917: Construction Management (CM) Services for WSIP - San Joaquin Region

Two other Contract Agreements for CM services were awarded and were in process of negotiations:
- CS-915R: Sunol Regional Construction Management (CM) Services and
- CS-918: Construction Management (CM) services for WSIP - New Irvington Tunnel Project.

An additional contract Agreement for CS-916: Peninsula Regional Construction Management (CM) Services has been advertised and is in the selection process for ranking and award to the most qualified proposer.

Three (3) other Construction Management (CM) services RFPs have yet to be advertised: CS-911R Calaveras Dam, HTWTP Long-term Improvement project and Seismic Upgrade of BDPL No. 3 & 4. (CS numbers have not been assigned to the last two projects).

Partnering/Disputes Review Advisors (DRA)/Disputes Review Boards (DRB):
Formal partnering and informal partnering is being conducted with Project CM teams including CM Consultants, City CM Staff and Construction Contractors. Additionally, alternative dispute resolution methods involving independent third party Disputes Review Advisors or Disputes Review Boards are being put into place on all medium to large WSIP construction contracts.

Supplier Quality Surveillance (SQS):
During this reporting period, Parsons as a part of their Pre-construction services has developed SQS Plans for scoping independent third party quality assurance in SFPUC and Construction Contractor vendor fabrication facilities which are providing permanent plant equipment and materials for WSIP construction projects. This is being done to assure that complex equipment and equipment critically needed as a prerequisite to major system shutdowns is delivered on time and to specified quality requirements. SQS Plans for the following projects were developed this reporting period:
- CUW38401 - Tesla Treatment Facility
- CUW37301 – San Joaquin Pipeline System (Contract 1)
- CUW35902 - Alameda Siphon #4
- CUW38001 - BDPL Nos. Crossovers
- CUW39101 – Baden and San Pedro Valve Lots Improvements

1.0 PROGRAM SUMMARY

Program Construction Management:
AECOM began work as Program Construction Management (PCM) team in March, 2009 providing management oversight of construction and implementation of the WSIP CM Plan and processes at the program level. As of June 30, 2009, the PCM team is fully mobilized.

WSIP Construction Management Training:
The first Construction Management (CM) Orientation and Training Session was conducted in June, 2009. The session provided a one-day hands-on workshop to provide a practical overview and working knowledge of the WSIP CM Plan and Procedures, key contractual and regulatory requirements, and the CM role in implementing these in a correct and consistent manner. These sessions will continue to be provided as Project CM teams are mobilized and put in place.

Project Achievements

Planning Phase Completed:

- None

Environmental Phase Completed:

- CUW37901 - San Andreas Pipeline No. 3 Installation
- CUW38801 - Programmatic EIR

Design Phase Started:

- None

Design Phase Completed:

- CUW37901 - San Andreas Pipeline No. 3 Installation
- CUW38601 - San Antonio Pump Station Upgrade

Construction Contract Advertised:

- CUW36103 - Pulgas Balancing - Structural Rehabilitation and Roof Replacement
- CUW36401 - Lawrence Livermore Water Quality Improvement
- CUW38001 – BDPL No. 3 and 4 – Crossovers
- CUW37901 - San Andreas Pipeline No. 3 Installation
- CUW38601 - San Antonio Pump Station Upgrade

Construction Contract Awarded:

1.0 PROGRAM SUMMARY

- CUW35901 – Alameda Siphon #4
- CUW37201 - University Mound Reservoir - North Basin
- CUW37901 - San Andreas Pipeline No. 3 Installation
- CUW38001 - BDPL Nos. 3 and 4 Crossovers

Construction Final Completion:
- None

1.0 PROGRAM SUMMARY

2.0 SUB PROGRAM SUMMARY

2.5 WATER SUPPLY

Overall, the Water Supply projects are on schedule with an actual completion of 8.0% as compared to a planned completion of 8.8%. The Schedule Performance Index (SPI) for the Region is 0.91. This indicates that 91% of the work planned was performed as of the end of the reporting quarter. Earned Value exceeds actual costs to date by $2.1 million. The table below summarizes the overall progress of the Water Supply Sub Program during the reporting quarter.

Table 2.5 Sub Program Performance – Water Supply

			July 1, 2009	
			% Planned	**% Actual**
Project Management			26.5%	24.6%
Planning			65.6%	63.7%
Environmental			27.3%	16.0%
Right-of-Way			3.0%	0.5%
Design			7.8%	7.2%
Bid & Award			0.0%	0.0%
Construction Management			2.3%	2.3%
Construction			2.2%	2.2%
Close-Out			0.0%	0.0%
Program Cumulative			**8.8%**	**8.0%**

Comparison with last quarter data not provided because program baseline was changed and such comparison would not be meaningful.

In accordance with the June 2009 Revised WSIP adopted by the SFPUC Commission on July 28, 2009, a Water Supply sub program comprising of seven (7) projects was added to the Local projects. The following changes were made to the Baseline (Approved) Budget and Schedule of the seven (7) projects in this sub program:

Projects with Changes to Baseline (Approved) Schedule and Budget

- CUW30201 – San Francisco Westside Recycled Water
- CUW30204 – Harding Park Recycled Water

Projects with Changes to Baseline (Approved) Schedule

2.0 SUB PROGRAM SUMMARY

- CUW30102 – San Francisco Groundwater Supply

Projects with Changes to Baseline (Approved) Budget

- CUW30101 – Lake Merced Water Levels Restoration
- CUW30202 – Recycled Water Project – Pacifica (Closed)

Projects with No Changes to Baseline (Approved) Budget and Schedule

- CUW39001 – SF Bay Area Desalination Plant (On Hold)

Additionally, one (1) new project, CUW30205 – San Francisco Eastside Recycled Water was added to this sub program.

Planning
Planning phase is slightly behind schedule with an actual completion of 63.7% versus 65.6% for planned. Planning Phase activities for the CUW30201 – San Francisco Westside Recycled Water–completed the Final Preliminary Project Scope Description. Planning activities for the CUW30101 –Lake Merced Water Levels Restoration involve revision to the Draft CER.

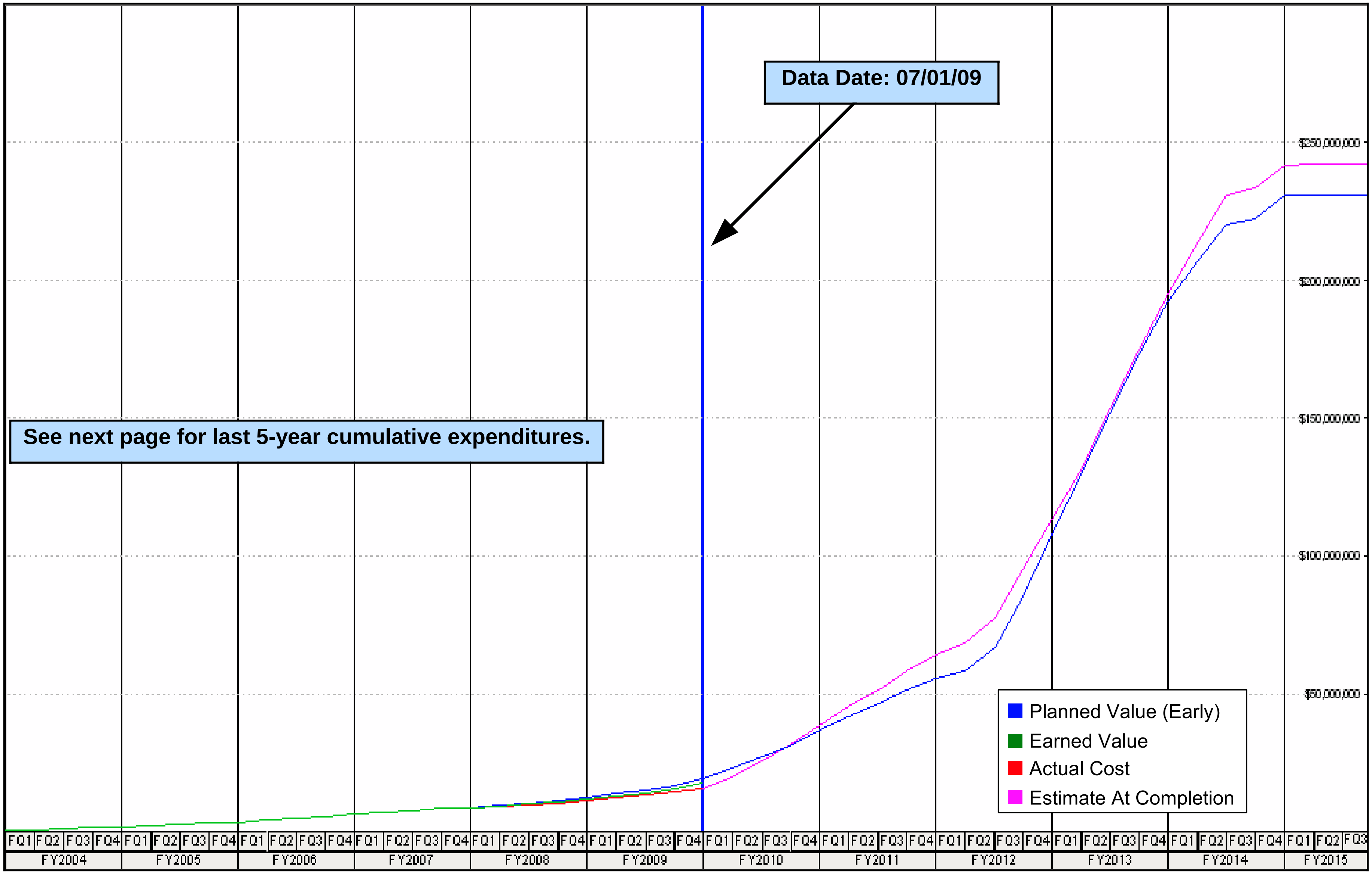
Environmental
Environmental phase is behind schedule with an actual completion of 16.0% versus 27.3% for planned. Environmental Phase activities for the CUW30201 –Recycled Water Project – San Francisco Project resumed this quarter after the scope revision. The Administrative Draft EIR was issued for internal review for CUW30204 – Harding Park Recycled Water.

Design
Design phase is behind schedule with an actual completion of 7.2% versus 7.8% for planned. CUW30102 – San Francisco Groundwater Supply project team completed the 35% design milestone this quarter. For CUW30204 – Harding Park Recycled Water, 95% design completion is anticipated by next quarter.

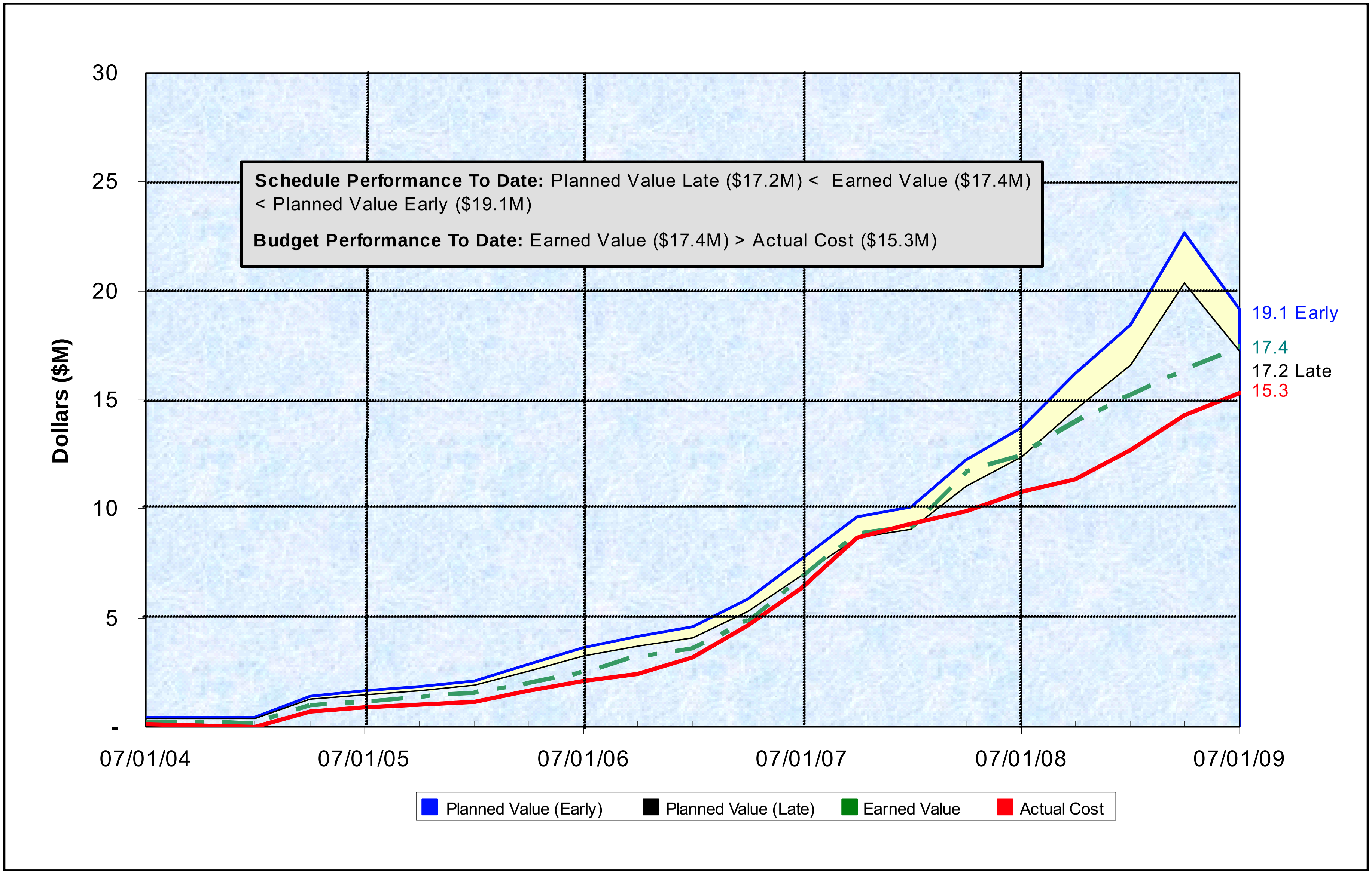
Construction
Construction phase is on schedule with an actual completion of 2.2% versus 2.2% for planned. There were no significant Construction Phase activities on any of the projects in the Water Supply Sub Program.

2.0 SUB PROGRAM SUMMARY

Figure 2.7 San Francisco Groundwater Supply Test Well Drilling



Data Date: 07/01/09
See next page for last 5-year cumulative expenditures.
$250,000,000
$200,000,000
$150,000,000
$100,000,000
$50,000,000
Planned Value (Early)
Earned Value
Actual Cost
Estimate At Completion
FQ1 FQ2 FQ3 FQ4
FY2004
FY2005
FY2006
FY2007
FY2008
FY2009
FY2010
FY2011
FY2012
FY2013
FY2014
FY2015



Schedule Performance To Date: Planned Value Late ($17.2M) < Earned Value ($17.4M) < Planned Value Early ($19.1M)
Budget Performance To Date: Earned Value ($17.4M) > Actual Cost ($15.3M)
Dollars ($M)
30
25
20
15
10
5
-
07/01/04
07/01/05
07/01/06
07/01/07
07/01/08
07/01/09
19.1 Early
17.4
17.2 Late
15.3
Planned Value (Early)
Planned Value (Late)
Earned Value
Actual Cost

SUB PROGRAM SUMMARY

Phase	Schedule				Budget							
	Approved Start	Current Start	Approved Finish	Current Finish	Planned Expenditure To Date	Planned % Complete	Expended To Date	Actual % Expended	Progress % Complete	Earned Value Cost	Approved Budget	Current Forecast
Project Management	01/06/03	01/06/03A	10/14/14	10/14/14	$3,982,000	26.5	$3,493,000	23.3	24.6	$3,689,000	$15,017,000	$15,017,000
Planning	01/06/03	01/06/03A	10/03/11	10/03/11	$6,944,000	65.6	$6,208,000	58.2	63.7	$6,738,000	$10,672,000	$10,672,000
Environmental	10/13/03	10/13/03A	04/08/13	04/08/13	$2,463,000	27.3	$1,351,000	14.4	16.0	$1,447,000	$9,375,000	$9,375,000
Right-of-Way	02/02/07	02/02/07A	05/20/13	05/20/13	$21,000	3.0	$0	0.0	0.5	$4,000	$697,000	$697,000
Design	05/12/04	05/12/04A	04/11/13	04/11/13	$2,387,000	7.8	$1,236,000	4.0	7.2	$2,205,000	$30,845,000	$30,845,000
Bid and Award	04/18/05	04/18/05A	09/24/13	09/24/13	$0	0.0	$0	0.0	0.0	$0	$450,000	$450,000
Construction Management	10/20/04	10/20/04A	04/15/14	04/15/14	$439,000	2.3	$439,000	2.3	2.3	$439,000	$18,802,000	$18,802,000
Construction	08/02/04	08/02/04A	04/15/14	04/15/14	$2,896,000	2.2	$2,561,000	1.8	2.2	$2,896,000	$144,501,000	$149,218,000
Close-Out	11/05/09	06/30/09A	10/14/14	10/14/14	$0	0.0	$0	0.0	0.0	$0	$730,000	$730,000
Water Supply Cumulative	**01/06/03**	**01/06/03A**	**10/14/14**	**10/14/14**	**$19,133,000**	**8.8**	**$15,289,000**	**6.6**	**8.0**	**$17,418,000**	**$231,088,000**	**$235,805,000**

3.5 WATER SUPPLY

Quarterly Project Status Report

As of July 1, 2009

Title: **CUW30101 - Lake Merced Water Level Restoration**	PE: Debra Temple, DPW
PM: Betsey Eagon	CM: Ben Leung
Phone: 415-554-1871	EPM: Yin Lan Zhang
AB1823: No	PCE: JP Torres

PROJECT STATUS:

Project Description:

The project consists of the development of a plan for operations and maintenance; construction of a stormwater treatment wetland, which will yield approximately 315 acre-feet (103 MG) per year for lake augmentation; and installation of up to two groundwater wells that will be used as the secondary water source to fill the lake.

Planning Status:

* The project is in the conceptual engineering phase. The Draft Conceptual Engineering Report (CER) is currently being revised, and the lake demand and a lake level response model were updated.
* The Final CER and the Planning Phase are expected to be completed by 10/01/09.

Environmental Status:

* The San Francisco Planning Department determined that this project requires an Environmental Impact Report (EIR).
* Environmental review is underway.

Right-of-Way Status:

* This project requires no land acquisitions and no encroachment removal actions.
* Discussions are being held with SFPUC Real Estate Services, City Attorney's office, and landowners to determine potential Right-of-Way and land acquisition/leasing issues.

Design Status:

* The Design Phase was initiated and procurement of the design consultant is underway.
* Bid Advertisement Date: Current Forecast: 04/23/12 / Approved: 10/17/11

Construction Status:

* Construction NTP Date: Current Forecast: 09/24/12 / Approved: 03/26/12
* The main Construction Phase has yet to be initiated. Construction costs to date reflect installation of an interim lake fill de-chlorination system completed in early 2005.

Major Issues/Potential Obstacles and Recommended Solutions:

* None at this time.

Schedule Variances:

In accordance with the June 2009 Revised WSIP adopted by the SFPUC Commission on July 28, 2009, the baseline (approved) schedule for this project was not changed.

The following variances are between the Current Forecast Date and Approved Finish Date:

* The 1-month variance for the Planning Phase is due to the additional work required for updating the design criteria and completing the conceptual design.
* The 6-month variance for the Project Management , Bid & Award , Construction Management , Construction and Closeout Phases is due to the inclusion of a Right-of-Way Phase.

Cost Variances:

* None at this time.

Quarterly Project Status Report

As of July 1, 2009

Title: **CUW30101 - Lake Merced Water Level Restoration**	PE: Debra Temple, DPW
PM: Betsey Eagon	CM: Ben Leung
Phone: 415-554-1871	EPM: Yin Lan Zhang
AB1823: No	PCE: JP Torres

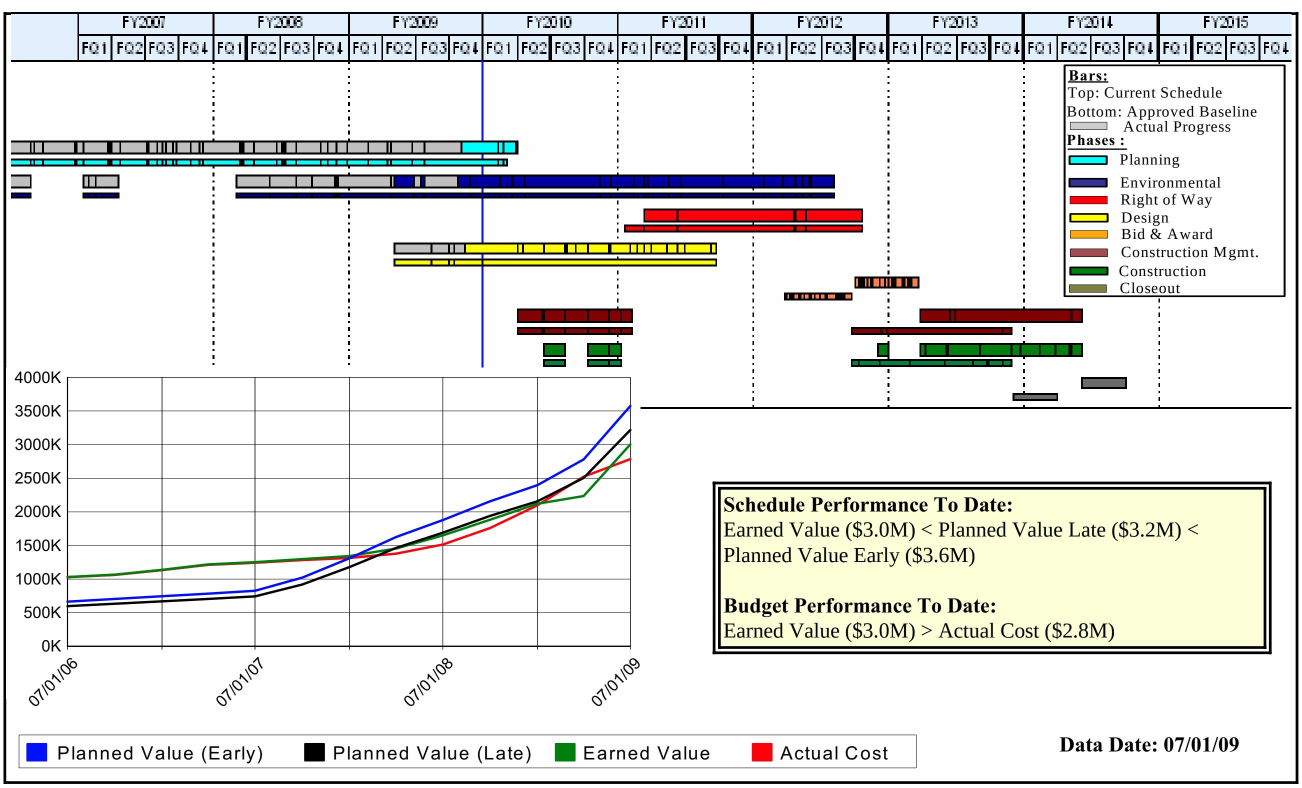
SCHEDULE:

Project Status-Schedule:	Original Start	Approved Start	Original Finish	Approved Finish	Last Forecast	Current Forecast
Project Management	06/16/03	06/16/03	07/19/11	09/27/13	04/04/14	04/04/14
Planning	06/16/03	06/16/03	08/31/07	09/01/09	09/01/09	10/01/09
Environmental	10/22/04	10/22/04	02/18/09	02/02/12	02/02/12	02/02/12
Right-of-Way		07/20/10		04/20/12	04/20/12	04/20/12
Design	05/12/04	05/12/04	09/04/09	03/24/11	03/24/11	03/24/11
Bid and Award	08/27/04	09/23/11	02/01/10	03/23/12	09/21/12	09/21/12
Construction Management	10/20/04	10/20/04	02/01/11	05/31/13	12/04/13	12/04/13
Construction	10/20/04	08/02/04	02/01/11	05/31/13	12/04/13	12/04/13
Close-Out	02/02/11	06/03/13	07/19/11	09/27/13	04/04/14	04/07/14

BUDGET:

Project Status - Budget & Expenditures:	Original Budget *	Planned Expenditure To Date	Planned % Complete	Expended to Date	Actual % Expended	Progress % Complete	Approved Budget *	Last Forecast	Current Forecast
Project Management	$723,000	$940,000	49.2	$843,000	44.1	47.6	$1,911,000	$1,911,000	$1,911,000
Planning	$903,000	$1,838,000	93.1	$1,493,000	75.6	90.7	$1,975,000	$2,005,000	$1,975,000
Environmental	$332,000	$667,000	30.2	$348,000	15.5	8.6	$2,250,000	$2,250,000	$2,250,000
Right-of-Way		$0	0.0	$0	0.0	0.0	$175,000	$175,000	$175,000
Design	$564,000	$38,000	1.7	$11,000	0.5	0.9	$2,418,000	$2,388,000	$2,418,000
Bid and Award	$190,000	$0	0.0	$0	0.0	0.0	$50,000	$50,000	$50,000
Construction Management	$610,000	$43,000	1.9	$43,000	1.9	1.9	$2,269,000	$2,269,000	$2,269,000
Construction	$1,903,000	$48,000	0.2	$48,000	0.2	0.2	$21,409,000	$21,409,000	$21,409,000
Close-Out	$38,000	$0	0.0	$0	0.0	0.0	$209,000	$209,000	$209,000
Total:	$5,264,000	$3,574,000	11.7	$2,786,000	8.5	9.8	$32,668,000	$32,668,000	$32,668,000

Note: * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).



Schedule Performance To Date:
Earned Value ($3.0M) < Planned Value Late ($3.2M) < Planned Value Early ($3.6M)

Budget Performance To Date:
Earned Value ($3.0M) > Actual Cost ($2.8M)

Data Date: 07/01/09

Title: **CUW30102 - San Francisco Groundwater Supply**	PE: Debra Temple, DPW
PM: Jeff Gilman	CM: Ben Leung
Phone: 415-551-2952	EPM: Yin Lan Zhang
AB1823: No	PCE: JP Torres

PROJECT STATUS:

Project Description:

This project consists of two phases, each delivering an annual average of 2 mgd. The first phase consists of building three or four new groundwater well stations in the San Francisco Sunset District or Golden Gate Park. All stations will include a building to house the well pump and electrical equipment, with two stations having an additional room for chemical disinfection. Buried piping will be installed to connect the well stations to the Sunset Reservoir. The second phase, consisting of improvements or replacement of two or more irrigation wells in Golden Gate Park, will be operational when the existing wells are no longer needed for irrigation (after implementation of the CUW30201 – San Francisco Westside Recycled Water Project). The facilities in Golden Gate Park will allow groundwater currently used for irrigation to be used as a potable water source. Improvements to the facilities at the existing San Francisco Zoo Well No. 5 have been completed, allowing this well to serve as an emergency potable water source.

Planning Status:

* The Planning Phase was completed on 12/12/06.

Environmental Status:

* The San Francisco Planning Department determined that this project requires an Environmental Impact Report (EIR).
* Environmental review is underway.

Right-of-Way Status:

* This project requires no land entitlement actions and no encroachment removal actions. However, funding is allocated for encroachment permits and other similar activities.
* Completed a Memorandum of Understanding with the San Francisco Recreation and Park Department (RPD) to address use of existing wells, selection of additional well station sites, pipeline routes and groundwater management in Golden Gate Park.

Design Status:

* Completed the 35% design of well stations and pipelines for the South Sunset Playground, West Sunset Playground, and Lake Merced Pump Station (first project phase). The 65% design for this phase is expected to be completed in the next reporting quarter.
* Began review of two existing irrigation wells and well stations in Golden Gate Park (second project phase) and the conceptual design for modifications to use these wells as a potable supply.
* Bid Advertisement Date: Current Forecast: 07/01/11 / Approved: 07/01/11

Construction Status:

* Construction NTP Date: Current Forecast: 12/19/11 / Approved: 12/19/11
* The main Construction Phase has yet to be initiated. Construction costs to date reflect installation of coastal groundwater monitoring wells, construction of Zoo Well No. 5 improvements, and construction of test wells at South Sunset Playground, West Sunset Playground and Lake Merced Pump Station.

Major Issues/Potential Obstacles and Recommended Solutions:

* Reaching concurrence with the RPD on a new well station site and pipeline routes in Golden Gate Park. Additional meetings with RPD staff and resolution of well site/pipeline routes are anticipated in the next reporting quarter.

Schedule Variances:

* None at this time.

Cost Variances:

In accordance with the June 2009 Revised WSIP adopted by the SFPUC Commission on July 28, 2009, the baseline (approved) construction budget for this project was not changed.

* The $4.7M variance between the Current Forecast Cost and the Approved Budget for the Construction Phase is due to revising the pipeline construction estimates based on increased lengths of pipeline routes and to the escalation associated with the extended environmental review period.

Quarterly Project Status Report

As of July 1, 2009

Title: **CUW30102 - San Francisco Groundwater Supply**	PE: Debra Temple, DPW
PM: Jeff Gilman	CM: Ben Leung
Phone: 415-551-2952	EPM: Yin Lan Zhang
AB1823: No	PCE: JP Torres

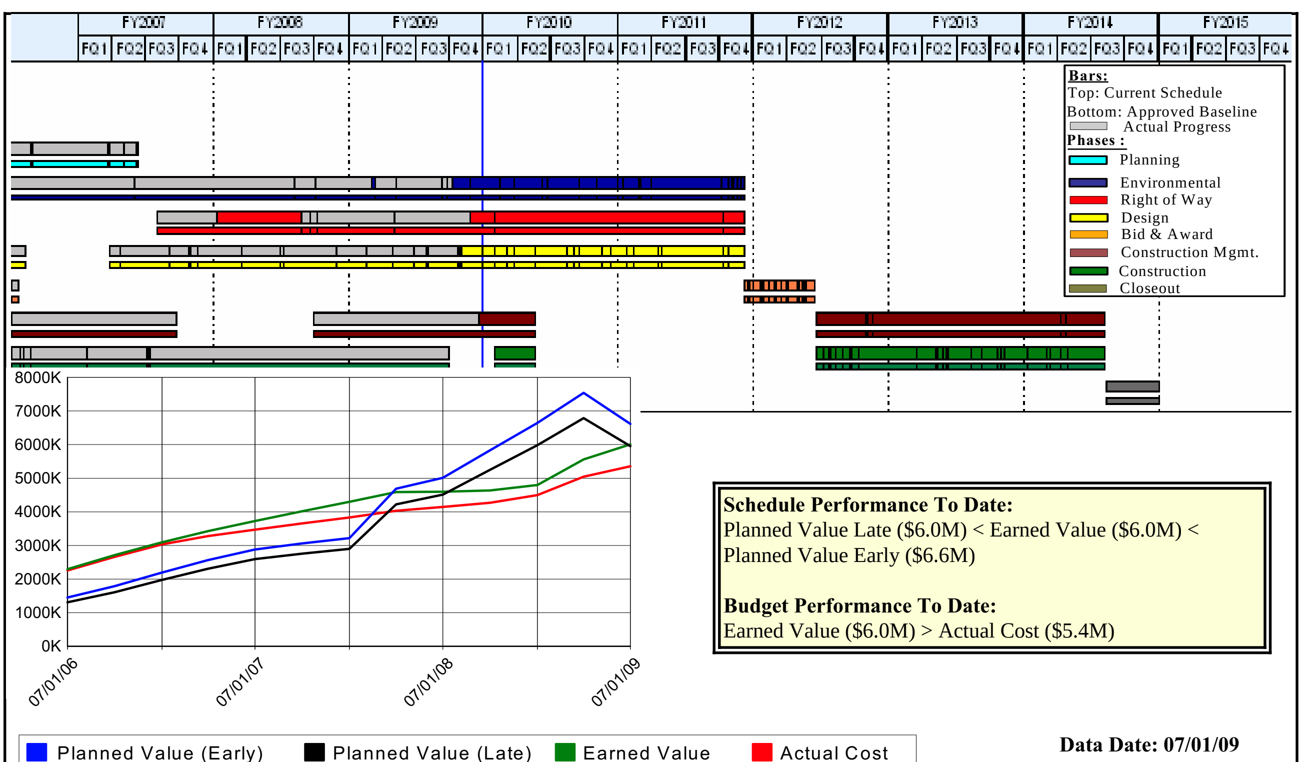
SCHEDULE:

Project Status-Schedule:	Original Start	Approved Start	Original Finish	Approved Finish	Last Forecast	Current Forecast
Project Management	07/01/05	06/16/03	04/30/13	07/01/14	07/01/14	07/01/14
Planning	07/01/05	06/16/03	06/01/06	12/12/06	12/12/06	12/12/06A
Environmental	07/01/05	07/01/05	05/05/09	06/07/11	06/07/11	06/07/11
Right-of-Way		02/02/07		06/09/11	06/10/11	06/09/11
Design	10/11/06	10/01/04	11/19/09	06/07/11	06/07/11	06/07/11
Bid and Award	11/20/09	04/18/05	05/18/10	12/16/11	12/16/11	12/16/11
Construction Management	05/19/10	08/15/05	11/13/12	02/06/14	02/06/14	02/06/14
Construction	05/19/10	08/15/05	11/13/12	02/06/14	02/06/14	02/06/14
Close-Out	11/15/12	02/07/14	04/30/13	07/01/14	07/01/14	07/01/14

BUDGET:

Project Status - Budget & Expenditures:	Original Budget *	Planned Expenditure To Date	Planned % Complete	Expended to Date	Actual % Expended	Progress % Complete	Approved Budget *	Last Forecast	Current Forecast
Project Management	$854,000	$942,000	43.4	$742,000	34.2	32.8	$2,170,000	$2,170,000	$2,170,000
Planning	$788,000	$910,000	100.0	$910,000	100.0	100.0	$910,000	$910,000	$910,000
Environmental	$599,000	$724,000	42.7	$393,000	22.2	31.2	$1,771,000	$1,771,000	$1,771,000
Right-of-Way	$0	$21,000	14.4	$0	0.0	2.6	$145,000	$145,000	$145,000
Design	$1,677,000	$886,000	25.7	$514,000	14.9	20.9	$3,448,000	$3,448,000	$3,448,000
Bid and Award	$88,000	$0	0.0	$0	0.0	0.0	$50,000	$50,000	$50,000
Construction Management	$1,707,000	$396,000	8.4	$396,000	8.4	8.4	$4,725,000	$4,725,000	$4,725,000
Construction	$18,760,000	$2,735,000	11.7	$2,399,000	9.5	11.7	$25,366,000	$30,082,000	$30,082,000
Close-Out	$42,000	$0	0.0	$0	0.0	0.0	$115,000	$115,000	$115,000
Total:	$24,513,000	$6,614,000	18.1	$5,355,000	13.8	16.4	$38,700,000	$43,417,000	$43,417,000

Note: * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).



Schedule Performance To Date:
Planned Value Late ($6.0M) < Earned Value ($6.0M) < Planned Value Early ($6.6M)

Budget Performance To Date:
Earned Value ($6.0M) > Actual Cost ($5.4M)

Data Date: 07/01/09

Publication Date: August 20, 2009

Quarterly Project Status Report

As of July 1, 2009

Title: **CUW30201 - San Francisco Westside Recycled Water**	PE: L. Wong
PM: Barbara Palacios	CM: Ben Leung
Phone: 415-554-0718	EPM: Scott MacPherson
AB1823: No	PCE: JP Torres

PROJECT STATUS:

Project Description:

This project consists of a new recycled water treatment facility at the western end of Golden Gate Park (the site of the former Richmond-Sunset Water Pollution Control Plant), along with the associated distribution system components to produce and deliver an annual average of approximately 2 mgd of recycled water to Golden Gate Park, Lincoln Park, and the SF Zoo. The proposed treatment scheme includes membrane filtration, reverse osmosis, and ultraviolet light disinfection. A 1.6 MG recycled water storage reservoir will be located underneath the treatment facility. Distribution pumping facilities will be located at the new facility, and will pump recycled water to the customers through approximately 5 to 6 miles of new pipelines. The project also includes the retrofitting of the existing irrigation systems to bring them in compliance with Title 22 regulations. The treatment facility includes additional capacity to serve potential future customers such as the Presidio Golf Course, although distribution system components to serve the Presidio are not part of the project scope.

Planning Status:

* SFPUC met with the Recreation & Park Department (RPD) in April 2009 to respond to their comments on the draft Project Scope Description. The Final Preliminary Project Scope Description was completed in June 2009.

Environmental Status:

* The San Francisco Planning Department determined that this project requires an Environmental Impact Report (EIR).

Right-of-Way Status:

* This project requires no land entitlement actions and no encroachment removal actions.

Design Status:

* Work on the 10% Design Report was initiated in May 2009.
* Bid Advertisement Date: Current Forecast: 06/09/11 / Approved: 06/09/11

Construction Status:

* Construction NTP Date: Current Forecast: 11/21/11 / Approved: 11/21/11
* The Construction Phase has yet to be initiated.

Major Issues/Potential Obstacles and Recommended Solutions:

* In June 2009, the RPD raised concerns regarding the exact placement of the treatment facility within the Richmond-Sunset site, noting potential visual impacts from nearby recreational areas. Uncertainties in the siting of the facility could delay aspects of the 10% Design effort, if not addressed immediately. The SFPUC will work with RPD to develop a comprehensive site plan that addresses space needs for the new recycled water facility, the existing South Windmill groundwater well facility (to be converted to potable supply as part of the CUW30102 - San Francisco Groundwater Supply Project), and future recreational uses for the site.

Schedule Variances:

* None at this time.

Cost Variances:

* None at this time.

Title: **CUW30201 - San Francisco Westside Recycled Water**	PE: L. Wong
PM: Barbara Palacios	CM: Ben Leung
Phone: 415-554-0718	EPM: Scott MacPherson
AB1823: No	PCE: JP Torres

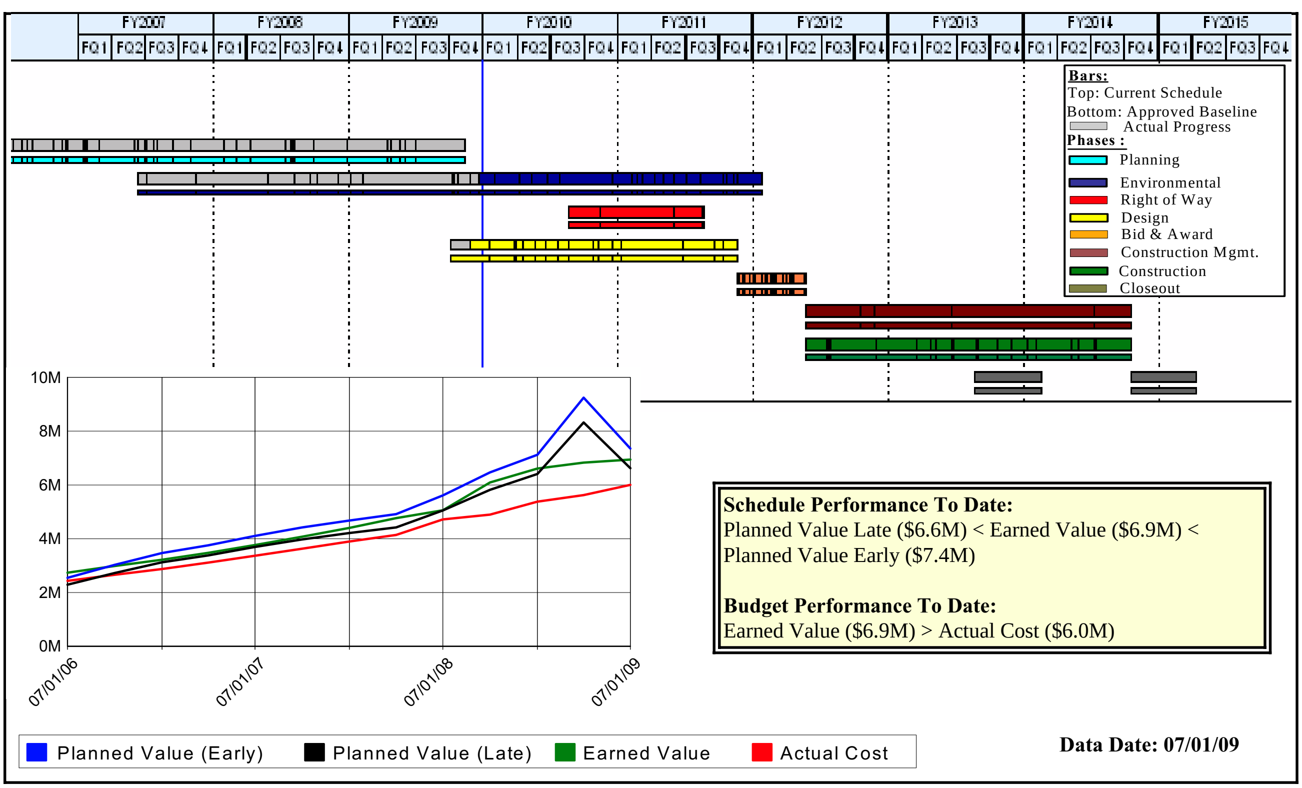
SCHEDULE:

Project Status-Schedule:	Original Start	Approved Start	Original Finish	Approved Finish	Last Forecast	Current Forecast
Project Management	03/03/03	03/03/03	09/04/12	10/14/14	10/14/14	10/14/14
Planning	07/01/03	03/03/03	04/18/08	05/15/09	05/15/09	05/15/09 A
Environmental	10/14/03	12/12/06	02/27/09	07/22/11	07/22/11	07/22/11
Right-of-Way		02/18/10		02/14/11	02/14/11	02/14/11
Design	04/21/08	04/06/09	08/20/09	05/17/11	05/17/11	05/17/11
Bid and Award	08/21/09	05/18/11	02/26/10	11/18/11	11/18/11	11/18/11
Construction Management	07/14/06	11/21/11	03/01/12	04/15/14	04/15/14	04/15/14
Construction	07/14/06	11/21/11	03/01/12	04/15/14	04/15/14	04/15/14
Close-Out	03/02/12	02/21/13	09/04/12	10/14/14	10/14/14	10/14/14

BUDGET:

Project Status - Budget & Expenditures:	Original Budget *	Planned Expenditure To Date	Planned % Complete	Expended to Date	Actual % Expended	Progress % Complete	Approved Budget *	Last Forecast	Current Forecast
Project Management	$5,889,000	$1,831,000	28.5	$1,750,000	27.2	28.4	$6,424,000	$6,424,000	$6,424,000
Planning	$3,682,000	$4,004,000	100.0	$3,774,000	94.3	100.0	$4,004,000	$4,004,000	$4,004,000
Environmental	$2,813,000	$747,000	42.4	$405,000	21.5	24.3	$1,880,000	$1,880,000	$1,880,000
Right-of-Way		$0	0.0	$0	0.0	0.0	$127,000	$127,000	$127,000
Design	$21,045,000	$774,000	6.7	$73,000	0.6	5.9	$11,562,000	$11,562,000	$11,562,000
Bid and Award	$328,000	$0	0.0	$0	0.0	0.0	$150,000	$150,000	$150,000
Construction Management	$16,474,000	$0	0.0	$0	0.0	0.0	$10,174,000	$10,174,000	$10,174,000
Construction	$150,595,000	$0	0.0	$0	0.0	0.0	$91,215,000	$91,215,000	$91,215,000
Close-Out	$510,000	$0	0.0	$0	0.0	0.0	$386,000	$386,000	$386,000
Total:	$201,334,000	$7,356,000	6.3	$6,002,000	4.8	5.9	$125,923,000	$125,923,000	$125,923,000

Note: * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).



Quarterly Project Status Report

As of July 1, 2009

Title: **CUW30202 - Recycled Water Project - Pacifica (Closed)**	PE: Sam Young
PM: Barbara Palacios	CM: Ben Leung
Phone: 415-554-0718	EPM: To Be Determined
AB1823: No	PCE: JP Torres

PROJECT STATUS:

Project Description:

The SFPUC, in partnership with North Coast County Water District, is implementing the Pacifica Recycled Water Project. The primary project elements will include a pump station at the recycling plant, a 400,000 gallon above-ground storage tank, and approximately 17,000 feet of pipe up to 18 inches in diameter. The project will also include site retrofits necessary for the use of the recycled water. North Coast County Water District is responsible for the design, environmental review and construction of this project. This project was closed in October 2008. The final project expenditures have been actualized in this Quarterly Report. The project will be completed using funds from the Water Enterprise capital budget instead of the WSIP budget. (No change from the last Quarterly Report)

CLOSED

Quarterly Project Status Report

As of July 1, 2009

Title: **CUW30202 - Recycled Water Project - Pacifica (Closed)**	PE: Sam Young
PM: Barbara Palacios	CM: Ben Leung
Phone: 415-554-0718	EPM: To Be Determined
AB1823: No	PCE: JP Torres

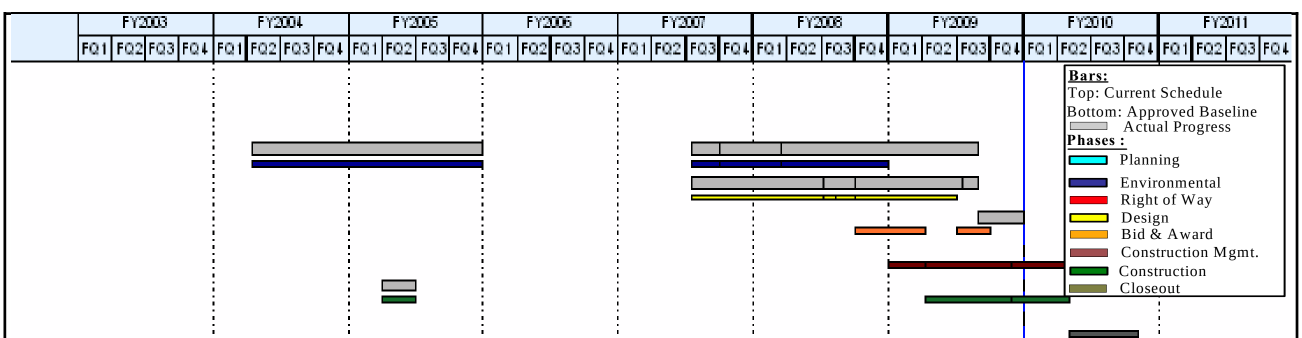
SCHEDULE:

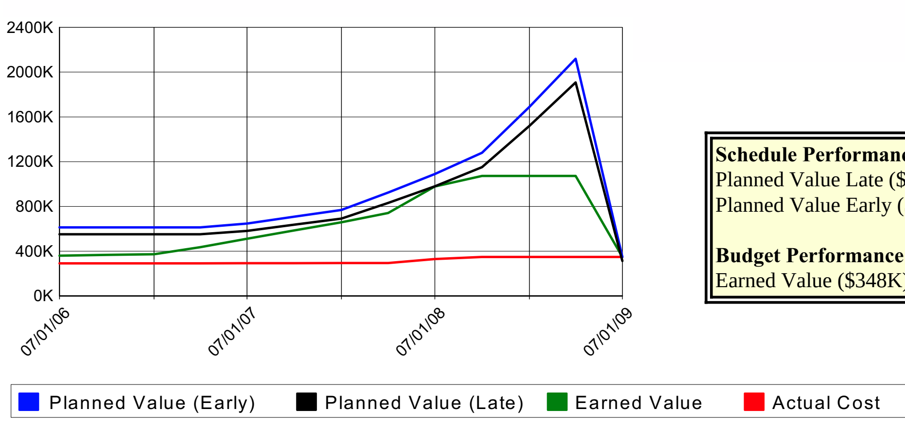
Project Status-Schedule:	Original Start	Approved Start	Original Finish	Approved Finish	Last Forecast	Current Forecast
Project Management	07/01/03	10/13/03	02/09/06	05/07/10	01/12/11	06/30/09 A
Planning	07/01/03		10/10/03			
Environmental	10/03/03	10/13/03	01/31/05	07/01/08	02/27/09	02/27/09 A
Right-of-Way						
Design	07/01/05	01/15/07	02/09/06	12/31/08	02/27/09	02/27/09 A
Bid and Award		04/02/08		04/01/09	01/06/10	06/30/09 A
Construction Management		07/02/08		11/04/09	07/12/10	06/30/09 A
Construction	10/01/04	10/01/04	12/30/04	11/04/09	07/12/10	06/30/09 A
Close-Out		11/05/09		05/07/10	01/12/11	06/30/09 A

BUDGET:

Project Status - Budget & Expenditures:	Original Budget *	Planned Expenditure To Date	Planned % Complete	Expended to Date	Actual % Expended	Progress % Complete	Approved Budget *	Last Forecast	Current Forecast
Project Management	$25,000	$58,000	100.0	$58,000	100.3	100.0	$58,000	$58,000	$58,000
Planning	$0								
Environmental	$153,000	$153,000	100.0	$153,000	100.0	100.0	$153,000	$153,000	$153,000
Right-of-Way									
Design	$0	$25,000	100.0	$25,000	100.2	100.0	$25,000	$25,000	$25,000
Bid and Award		$0	100.0	$0	100.0	100.0	$0	$0	$0
Construction Management		$0	0.0	$0	100.0	100.0	$0	$0	$0
Construction	$113,000	$113,000	100.0	$113,000	100.0	100.0	$113,000	$113,000	$113,000
Close-Out		$0	0.0	$0	100.0	100.0	$0	$0	$0
Total:	$292,000	$348,000	100.0	$348,000	100.1	100.0	$348,000	$348,000	$348,000

Note: * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).





Schedule Performance To Date:
Planned Value Late ($313K) < Earned Value ($348K) = Planned Value Early ($348K)

Budget Performance To Date:
Earned Value ($348K) = Actual Cost ($348K)

Data Date: 07/01/09

Quarterly Project Status Report

As of July 1, 2009

Title: **CUW30204 - Harding Park Recycled Water**	PE: Sam Young
PM: Barbara Palacios	CM: Ben Leung
Phone: 415-554-0718	EPM: Antonia Fairbanks
AB1823: No	PCE: Mike Elwin

PROJECT STATUS:

Project Description:

The SFPUC, in partnership with the City of Daly City, is implementing the Harding Park Recycled Water Project. This project consists of providing the infrastructure needed to convey water supplied from the existing recycled water facility in Daly City (that is operated by the North San Mateo Sanitation District) to Harding Park. The project consists of approximately 4,700 feet of 18-inch pipe, a 700,000-gallon buried storage reservoir at the park, and two irrigation pumps. The golf course has already been retrofitted to accommodate the use of recycled water; however, some additional retrofits may be required at the park to meet regulatory requirements. The City of Daly City is the agency responsible for the design, environmental review and construction of this project.

Planning Status:

* The Planning Phase was completed on 10/07/08.

Environmental Status:

* The City of Daly City has determined that this project requires an Environmental Impact Report (EIR).
* The Administrative Draft EIR was issued in June 2009 for internal review.

Right-of-Way Status:

* This project requires no land entitlement actions and no encroachment removal actions.

Design Status:

* The design team is currently working on the 95% design package, scheduled to be issued in August 2009.
* Bid Advertisement Date: Current Forecast: 11/10/09 / Approved: 11/10/09

Construction Status:

* Construction NTP Date: Current Forecast: 04/06/09 / Approved: 04/06/09
* The Construction Phase has yet to be initiated.

Major Issues/Potential Obstacles and Recommended Solutions:

* The SFPUC has not been able to secure Phase I/Phase II design approval from the Civic Design Review Committee of the Arts Commission; this could lead to a delay in the completion of the final bid package. The SFPUC will schedule a follow-up meeting with members of the Civic Design Review Committee to better understand their concerns with the architectural design concept, and identify features/concepts that will gain Phase I/II/III design approval in July 2009.

Schedule Variances:

* None at this time.

Cost Variances:

* None at this time.

Quarterly Project Status Report

As of July 1, 2009

Title: **CUW30204 - Harding Park Recycled Water**	PE: Sam Young
PM: Barbara Palacios	CM: Ben Leung
Phone: 415-554-0718	EPM: Antonia Fairbanks
AB1823: No	PCE: Mike Elwin

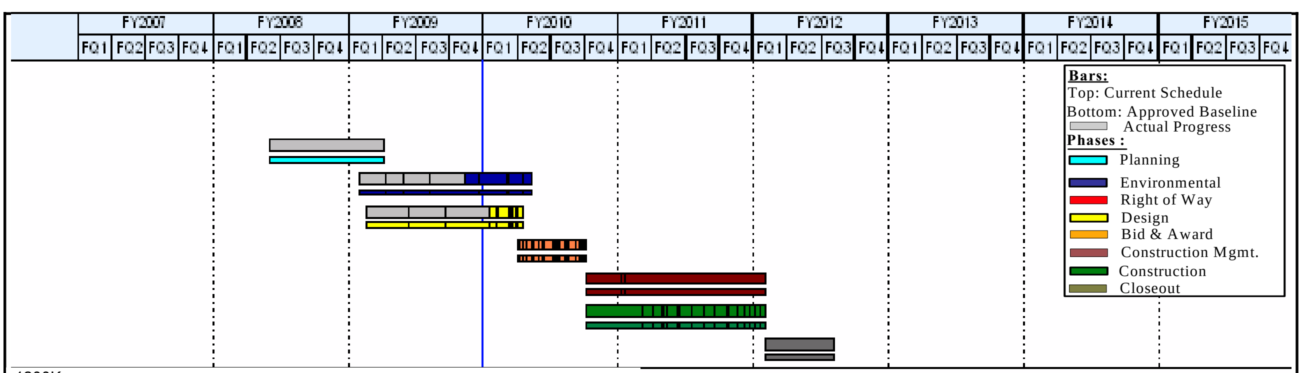
SCHEDULE:

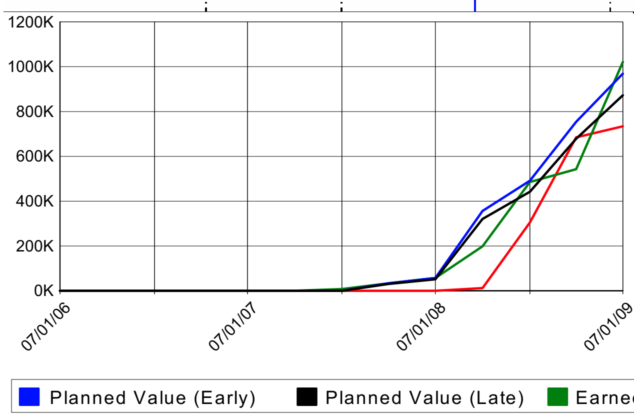
Project Status-Schedule:	Original Start	Approved Start	Original Finish	Approved Finish	Last Forecast	Current Forecast
Project Management		12/03/07		02/03/12	02/03/12	02/03/12
Planning		12/03/07		10/07/08	10/07/08	10/07/08 A
Environmental		08/01/08		11/10/09	11/10/09	11/10/09
Right-of-Way						
Design		08/18/08		10/16/09	10/16/09	10/16/09
Bid and Award		09/30/09		04/05/10	04/05/10	04/05/10
Construction Management		04/06/10		08/01/11	08/01/11	08/01/11
Construction		04/06/10		08/01/11	08/01/11	08/01/11
Close-Out		08/02/11		02/03/12	02/03/12	02/03/12

BUDGET:

Project Status - Budget & Expenditures:	Original Budget *	Planned Expenditure To Date	Planned % Complete	Expended to Date	Actual % Expended	Progress % Complete	Approved Budget *	Last Forecast	Current Forecast
Project Management		$132,000	35.2	$68,000	18.3	32.7	$374,000	$374,000	$374,000
Planning		$0	100.0	$0	100.0	100.0	$0	$0	$0
Environmental		$173,000	70.7	$52,000	21.4	60.0	$244,000	$244,000	$244,000
Right-of-Way									
Design		$665,000	74.6	$613,000	68.8	84.3	$891,000	$891,000	$891,000
Bid and Award		$0	0.0	$0	0.0	0.0	$50,000	$50,000	$50,000
Construction Management		$0	0.0	$0	0.0	0.0	$1,634,000	$1,634,000	$1,634,000
Construction		$0	0.0	$0	0.0	0.0	$6,398,000	$6,398,000	$6,398,000
Close-Out		$0	0.0	$0	0.0	0.0	$19,000	$19,000	$19,000
Total:		$969,000	10.7	$734,000	7.6	11.3	$9,612,000	$9,612,000	$9,612,000

Note: * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).





Schedule Performance To Date:
Planned Value Late ($0.9M) < Earned Value ($1.0M) =
Planned Value Early ($1.0M)

Budget Performance To Date:
Earned Value ($1.0M) > Actual Cost ($0.7M)

Data Date: 07/01/09

Quarterly Project Status Report

As of July 1, 2009

Title: **CUW30205 - San Francisco Eastside Recycled Water**	PE: To Be Determined
PM: Barbara Palacios	CM: Ben Leung
Phone: 415-554-0718	EPM: To Be Determined
AB1823: No	PCE: Mike Elwin

PROJECT STATUS:

Project Description:

This project will plan and design a recycled water treatment facility (or facilities) and distribution system to produce and distribute tertiary recycled water to proposed non-potable water customers on the eastern side of the City of San Francisco. The project is in early planning stages and its scope will be further defined as planning efforts progress.

Planning Status:

* The Planning Phase has yet to be initiated.

Environmental Status:

* The Environmental Phase has yet to be initiated.

Right-of-Way Status:

* This project requires no land entitlement actions and no encroachment removal actions.

Design Status:

* The Design Phase has yet to be initiated.
* Bid Advertisement Date: Current Forecast: 05/03/13 / Approved: 05/03/13

Construction Status:

* The Construction Phase has yet to be initiated.

Major Issues/Potential Obstacles and Recommended Solutions:

* None at this time.

Schedule Variances:

* None at this time.

Cost Variances:

* None at this time.

Quarterly Project Status Report

As of July 1, 2009

Title: **CUW30205 - San Francisco Eastside Recycled Water**	PE: To Be Determined
PM: Barbara Palacios	CM: Ben Leung
Phone: 415-554-0718	EPM: To Be Determined
AB1823: No	PCE: Mike Elwin

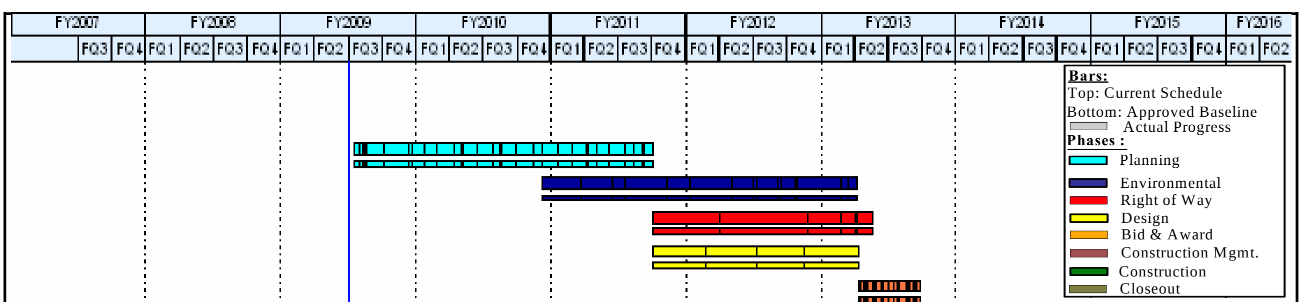
SCHEDULE:

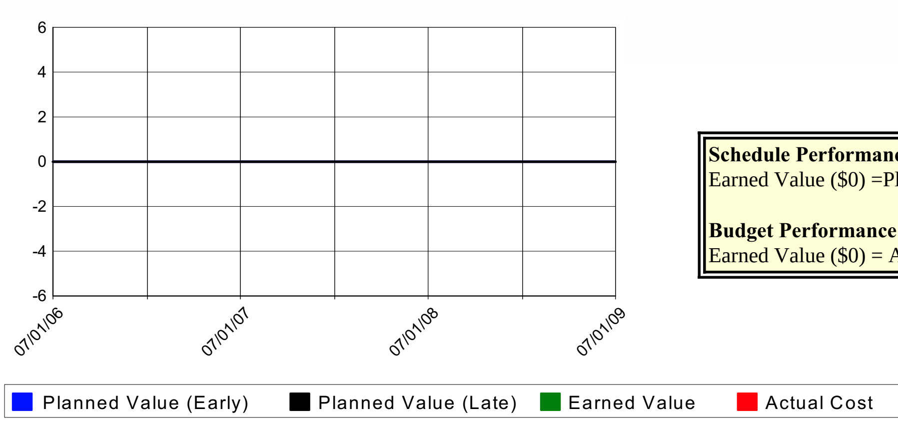
Project Status-Schedule:	Original Start	Approved Start	Original Finish	Approved Finish	Last Forecast	Current Forecast
Project Management		07/15/09		09/24/13		09/24/13
Planning		07/15/09		10/03/11		10/03/11
Environmental		12/08/10		04/08/13		04/08/13
Right-of-Way		10/04/11		05/20/13		05/20/13
Design		10/04/11		04/11/13		04/11/13
Bid and Award		04/12/13		09/24/13		09/24/13
Construction Management						
Construction						
Close-Out						

BUDGET:

Project Status - Budget & Expenditures:	Original Budget *	Planned Expenditure To Date	Planned % Complete	Expended to Date	Actual % Expended	Progress % Complete	Approved Budget *	Last Forecast	Current Forecast
Project Management		$0	0.0	$0	0.0	0.0	$4,000,000		$4,000,000
Planning		$0	0.0	$0	0.0	0.0	$3,500,000		$3,500,000
Environmental		$0	0.0	$0	0.0	0.0	$2,500,000		$2,500,000
Right-of-Way		$0	0.0	$0	0.0	0.0	$250,000		$250,000
Design		$0	0.0	$0	0.0	0.0	$12,500,000		$12,500,000
Bid and Award		$0	0.0	$0	0.0	0.0	$150,000		$150,000
Construction Management									
Construction									
Close-Out									
Total:		$0	0.0	$0	0.0	0.0	$22,900,000		$22,900,000

Note: * Original Budget and Approved Budget approved by the Commission at the project level (i.e. total of all phases).





Schedule Performance To Date:
Earned Value ($0) =Planned Value Early ($0)

Budget Performance To Date:
Earned Value ($0) = Actual Cost ($0)

Data Date: 07/01/09

Publication Date: August 20, 2009

Quarterly Project Status Report

As of July 1, 2009

Title: **CUW39001 - SF Bay Area Desalination Plant (Closed)**	PE: To Be Determined
PM: Manisha Kothari	CM: To Be Determined
Phone: 415-554-3256	EPM: To Be Determined
AB1823: No	PCE: Deepa Rasalkar

PROJECT STATUS:

Project Description:

SFPUC, in partnership with EBMUD, Santa Clara Valley Water District (SCVWD), and Contra Costa Water District (CCWD), are investigating the feasibility of developing a joint desalination plant to meet some of the water needs in the agencies' service areas.

This project is currently on hold pending resolution of funding issues.

ON HOLD

Title: **CUW39001 - SF Bay Area Desalination Plant (Closed)**	PE: To Be Determined
PM: Manisha Kothari	CM: To Be Determined
Phone: 415-554-3256	EPM: To Be Determined
AB1823: No	PCE: Deepa Rasalkar

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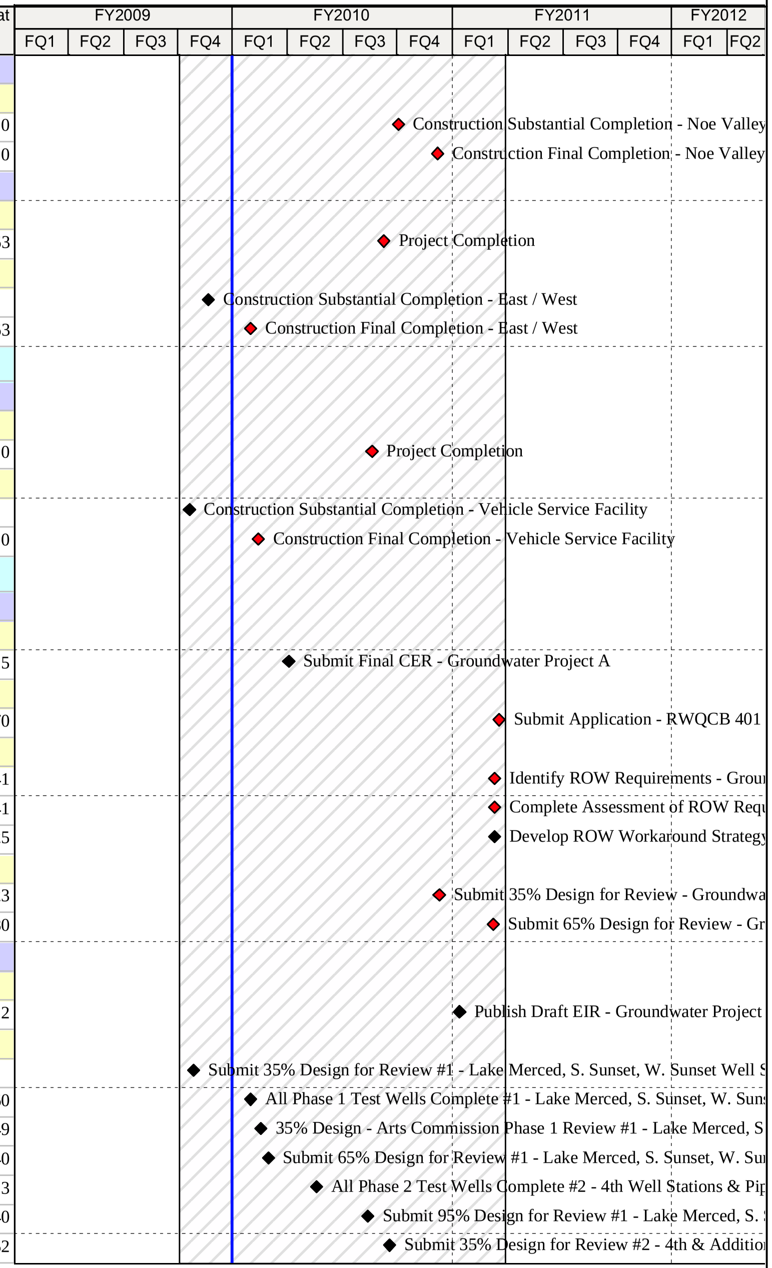
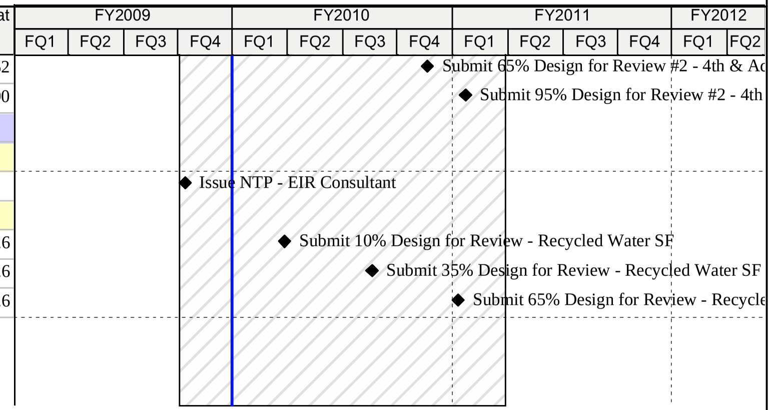
KEY MILESTONE REPORT - ROLLING SIX QUARTERS (04/05/09- 09/30/10)

Activity Name	Approved Date	Current Forecast	Variance	Current Late Date	Total Float
CUW31301 Noe Valley Transmission Main, Phase 2					
Construction					
Construction Substantial Completion - Noe Valley	02-Apr-10	02-Apr-10	0	02-Apr-10	0
Construction Final Completion - Noe Valley	07-Jun-10	07-Jun-10	0	07-Jun-10	0
CUW31501 East / West Transmission Main					
Project Milestones					
Project Completion	09-Mar-10	09-Mar-10	0	04-Dec-09	-63
Construction					
Construction Substantial Completion - East / West	22-May-09	22-May-09A	0	08-Apr-09	
Construction Final Completion - East / West	31-Jul-09	31-Jul-09	0	01-May-09	-63
Miscellaneous					
CUW30301 Vehicle Service Facility Equipment Safety Upgrade					
Project Milestones					
Project Completion	17-Feb-10	17-Feb-10	0	17-Feb-10	0
Construction					
Construction Substantial Completion - Vehicle Service Facility	21-Apr-09	21-Apr-09A	0	01-Jul-09	
Construction Final Completion - Vehicle Service Facility	12-Aug-09	12-Aug-09	0	12-Aug-09	0
Water Supply					
CUW30101 Lake Merced Water Level Restoration					
Project Planning					
Submit Final CER - Groundwater Project A	01-Sep-09	01-Oct-09	-21	08-Oct-09	5
Environmental Review					
Submit Application - RWQCB 401 Certification - Groundwat	17-Sep-10	17-Sep-10	0	15-Jan-10	-170
Right of Way					
Identify ROW Requirements - Groundwater Project A	08-Sep-10	08-Sep-10	0	18-Feb-10	-141
Complete Assessment of ROW Requirements - Groundwater l	08-Sep-10	08-Sep-10	0	18-Feb-10	-141
Develop ROW Workaround Strategy - Groundwater Project A	08-Sep-10	08-Sep-10	0	14-Mar-11	125
Design					
Submit 35% Design for Review - Groundwater Project A	09-Jun-10	09-Jun-10	0	17-Jul-09	-223
Submit 65% Design for Review - Groundwater Project A	07-Sep-10	07-Sep-10	0	18-Dec-09	-180
CUW30102 San Francisco Groundwater Supply					
Environmental Review					
Publish Draft EIR - Groundwater Project B	13-Jul-10	13-Jul-10	0	15-Jul-10	2
Design					
Submit 35% Design for Review #1 - Lake Merced, S. Sunset,	29-Apr-09	29-Apr-09A	0	17-Jun-10	
All Phase 1 Test Wells Complete #1 - Lake Merced, S. Sunset	31-Jul-09	31-Jul-09	0	16-Aug-10	260
35% Design - Arts Commission Phase 1 Review #1 - Lake Me	17-Aug-09	17-Aug-09	0	16-Aug-10	249
Submit 65% Design for Review #1 - Lake Merced, S. Sunset,	28-Aug-09	28-Aug-09	0	16-Aug-10	240
All Phase 2 Test Wells Complete #2 - 4th Well Stations & Pip	17-Nov-09	17-Nov-09	0	20-Nov-09	3
Submit 95% Design for Review #1 - Lake Merced, S. Sunset,	09-Feb-10	09-Feb-10	0	26-Jan-11	240
Submit 35% Design for Review #2 - 4th & Additional Well St	17-Mar-10	17-Mar-10	0	21-Oct-10	152



KEY MILESTONE REPORT - ROLLING SIX QUARTERS (04/05/09- 09/30/10)

Activity Name	Approved Date	Current Forecast	Variance	Current Late Date	Total Float
Submit 65% Design for Review #2 - 4th & Additional Well St	19-May-10	19-May-10	0	29-Dec-10	152
Submit 95% Design for Review #2 - 4th & Additional Well St	23-Jul-10	23-Jul-10	0	28-Apr-11	190
CUW30201 San Francisco Westside Recycled Water					
Environmental Review					
Issue NTP - EIR Consultant	13-Apr-09	13-Apr-09A	0	12-Aug-09	
Design					
Submit 10% Design for Review - Recycled Water SF	25-Sep-09	25-Sep-09	0	03-Nov-09	26
Submit 35% Design for Review - Recycled Water SF	17-Feb-10	17-Feb-10	0	25-Mar-10	26
Submit 65% Design for Review - Recycled Water SF	09-Jul-10	09-Jul-10	0	16-Aug-10	26



APPENDIX E   COST VARIANCE OF WSIP LOCAL PROJECTS

Projects	2009 Approved Budget	Current Forecast	Variance
CUW33301 - Mount Davidson Tank Seismic Upgrade	$2,894,000	$2,894,000	-
CUW33801 - La Grande Pump Station Upgrades	$7,205,000	$7,205,000	-
CUW33901 - Potrero Heights Pump Station Upgrades (Completed)	$606,000	$606,000	-
CUW34001 - Vista Francisco Pump Station Upgrades	$6,951,000	$6,951,000	-
Pipeline / Valves			
CUW30401 - North University Mound System Upgrade	$12,850,000	$12,850,000	-
CUW30801 - Key Motorized and Other Critical Valves (Completed)	$10,985,000	$10,985,000	-
CUW31101 - Sunset Circulation Improvements (Completed)	$6,984,000	$6,984,000	-
CUW31201 - Lincoln Way Transmission Line	$13,950,000	$13,950,000	-
CUW31301 - Noe Valley Transmission Main, Phase 2	$7,382,000	$7,382,000	-
CUW31501 - East / West Transmission Main	$28,600,000	$28,600,000	-
CUW31601 - Fulton @ Sixth Ave - 30" Main Replacement (Completed)	$4,708,000	$4,708,000	-
Miscellaneous			
CUW30301 - Vehicle Service Facility Equipment Safety Upgrade	$4,461,000	$4,461,000	-
CUW30501 - Fire Protection @ CDD (Completed)	$1,675,000	$1,675,000	-
Water Supply			
CUW30101 - Lake Merced Water Level Restoration	$32,668,000	$32,668,000	-
CUW30102 - San Francisco Groundwater Supply	$38,700,000	$43,417,000	$4,717,000
CUW30201 - San Francisco Westside Recycled Water	$125,923,000	$125,923,000	-
CUW30202 - Recycled Water Project - Pacifica (Closed)	$348,000	$348,000	-
CUW30204 - Harding Park Recycled Water	$9,612,000	$9,612,000	-
CUW30205 - San Francisco Eastside Recycled Water	$22,900,000	$22,900,000	-
CUW39001 - SF Bay Area Desalination Plant (Closed)	$938,000	$938,000	-

APPENDIX D SFPUC WATER SUPPLY AVAILABILITY STUDY (OCTOBER 2009)

FINAL

Water Supply Availability Study

for

City and County of San Francisco

Prepared for:

San Francisco Public Utilities Commission
Water Enterprise

October 2009

Prepared by:

PBS&J

1410 Rocky Ridge Drive, Suite 190
Roseville, CA 95661
916.782.7275

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SUMMARY AND FINDINGS

Summary

In an effort to streamline the water supply planning process within the City and County of San Francisco (San Francisco or City), the San Francisco Public Utilities Commission (SFPUC) adopted a resolution in 2002 and 2006 to allow for all development projects requiring a Water Supply Assessment (WSA) under Water Code Section 10910 et seq. to rely solely on the adopted Urban Water Management Plan (UWMP) without having to go through the process of preparing individual WSAs. SB 610 provides a nexus between the regional land use planning process and the environmental review process. The core of this law is an assessment of whether available water supplies are sufficient to serve the demand generated by a project, as well as the reasonably foreseeable cumulative demand in the region over the next 20 years under a range of hydrologic conditions.

The San Francisco Planning Department (SF Planning) and the San Francisco Redevelopment Agency are currently engaged in planning for various proposed land development projects throughout San Francisco that go beyond those future developments considered in the 2005 UWMP update. As a result of these new developments, the SFPUC concluded that its 2005 UWMP no longer accounted for every project requiring a WSA (qualifying project) within San Francisco. Therefore, during this interim period until the 2010 UWMP is prepared, any qualifying projects not accounted in the 2005 UWMP will require preparation of a WSA per Water Code Sections 10910 – 10915 that considers the SFPUC's current and projected supplies when compared to projected demands associated with new growth not covered in the 2005 UWMP.

This Water Supply Availability Study (Study) was developed as an interim period study and follows the format of a WSA. The Study captures the most current water supply planning and demand information, analyzes the various projected change in water demands associated with each qualifying project within San Francisco, evaluates overall supply and demand, assesses the sufficiency of supply, and prepares a conclusion based on the analysis. Upon completion of the Study, a WSA for each qualifying project can rely on the information and conclusions of this Study.

Findings

The 2009 SF Planning projections result in a Retail demand in 2030 of 93.42 mgd (Section 5.0), which is only slightly greater than the 2030 demand estimates projected in the 2005 UWMP. This increase, however, does not change the results of the 2005 UWMP. The SFPUC can still meet the current and future demand of its Retail customers in years of average or above-average precipitation. During a multiple dry year event;[1] however, it is possible that the SPFUC will not be able to meet 100 percent of the Retail demand in 2030. This Study shows the results of implementation of SFPUC's local supply reliability improvements under all hydrologic

1 Multiple dry-year event is defined as a three-year hydrologic condition of below-normal rainfall per the Urban Water Management Planning Act.

conditions beginning in 2010 and extending to 2030. The ability to meet the demand of the Retail customers is in large part due to the development of 10 mgd of local supplies in the City through implementation of the Water Supply Improvement Program (WSIP). These addition sources of groundwater, recycled water, and conservation supplies are essential to provide the City with adequate supply in dry year periods, as well as improving supply reliability during years with normal precipitation.

In years with normal or above-normal precipitation, the City has sufficient supplies to serve its Retail customers. As shown in Table 6-1 (Section 6.0), the supply shortfall shown in 2010 is the result of reducing the Regional Water System (RWS) supply to 81 mgd per the condition of the Phased WSIP Variant, without full development of the additional 10 mgd of additional local supplies available in 2015. However, Retail demand is currently lower than projected 2010 demand of 91.81 mgd – demand in Fiscal Year 2007-2008 was 83.9 mgd.

During a multiple dry-year event as shown in Table 6-1, it is possible that the SFPUC will not be able to meet the full demands of its Retail customers in 2030, and will therefore have to impose reductions on its Retail supply. Under the Water Supply Allocation Plan (WSAP), Retail customers would experience no reduction in RWS deliveries within a 10 percent RWS shortage. However, during a 20 percent system-wide shortage, the Retail customers would experience a 1.9 percent reduction in Retail deliveries. This difference is due to the development of the additional 10 mgd of local supplies in the Retail service area. These additional local supplies are not subject to a reduction under the WSAP, as the WSAP only allocates water from the RWS.

The qualifying projects (Candlestick Point-Hunters Point Shipyard Phase II (CP-HPS II), Treasure Island-Yerba Buena Island (TI-YBI), and Parkmerced) anticipate developing new recycled water projects to help offset potable demand. These new projects could produce up to 1.5 mgd of recycled water. By reducing potable water demand through the use of recycled water, these projects have the ability to eliminate the City's overall water shortage during multiple dry year periods.

Regarding the availability of water supplies to serve the City, beginning in 2015 the SFPUC finds as follows:

- In years of average and above-average precipitation and including development of SFPUC's local WSIP water supply sources the SFPUC has adequate supplies to serve 100 percent of normal, single dry and multiple dry year demand up to 2030.[2]
- In multiple-dry-year events after 2030, when the SFPUC imposes reductions in its supply, the SFPUC has in place the WSAP and RWSAP to balance supply and demand.

2 The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).

- If recycled water is implemented as proposed at each of the major development project sites, then it is assumed that potable water demands for the City can decrease by up to 1.5 mgd; thereby, eliminating potential multiple dry-year deficit after 2030.
- With the WSAP and Retail Water Supply Allocation Plan (Section 4)in place, and the addition of local WSIP supplies, the SFPUC finds it has sufficient water available to serve the Retail customers including the demand of its Retail existing customers and planned future uses.

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1.0 INTRODUCTION

1.1 Purpose

In an effort to streamline the water supply planning process within the City and County of San Francisco (San Francisco or City), the San Francisco Public Utilities Commission (SFPUC) adopted a resolution in 2002 and 2006 to allow for all development projects requiring a Water Supply Assessment (WSA) under SB 610 to rely solely on the adopted Urban Water Management Plan (UWMP)[3] without having to go through the process of preparing individual WSAs. SB 610 Water Code Section 10910 et seq. provides a nexus between the regional land use planning process and the environmental review process. The law also reflects the growing awareness of the need to incorporate water supply and demand analysis at the earliest possible stage in the land use planning process. The core of this law is an assessment of whether available water supplies are sufficient to serve the demand generated by a project, as well as the reasonably foreseeable cumulative demand in the region over the next 20 years under a range of hydrologic conditions.

The City of San Francisco Planning Department (SF Planning) and the San Francisco Redevelopment Agency are currently engaged in planning for various proposed land development projects that go beyond those future developments considered in the 2005 UWMP update. These developments, which include the Candlestick Point-Hunters Point Shipyard Phase II project (CP-HPS II), the Treasure Island-Yerba Island project (TI-TBI) and the Parkmerced project, hereinafter referred to as Projects, along with additional development throughout San Francisco account for 29,787 new dwelling units in 2030. As proposed, the Projects would contribute 27,400 new dwelling units to San Francisco's housing inventory. Additional development throughout the City accounts for the remaining 2,387 new dwelling units hereinafter referred to as Incremental Growth.

As a result of these new developments, the SFPUC concluded that its 2005 UWMP no longer accounted for every project requiring a WSA (qualifying project) within San Francisco. The SFPUC will not be preparing an updated UWMP until 2010. Therefore, during this interim period, any qualifying projects not accounted in the 2005 UWMP will require preparation of a WSA per Water Code Sections 10910 – 10915 that documents the SFPUC's current and projected supplies when compared to projected demands associated with new growth not covered in the 2005 UWMP.

The SFPUC determined that a WSA for the entire City and County service area, prepared pursuant to Water Code Sections 10910-10915, is the preferred method to evaluate supply and demands over a 20-year planning horizon. However, the Water Code Sections pertain to WSAs for qualifying projects, whereas the SFPUC needs a report to document its current and

3 California law requires that UWMPs be prepared and submitted in years ending with fives (5) and zeros (0). Pursuant to Water Code Section 10644(a), the SFPUC prepared and adopted its UWMP in 2005. The next UWMP is due prior to December 31, 2010.

projected supplies when compared to projected demands associated with new growth not covered in the 2005 UWMP. Therefore, this Water Supply Availability Study (Study) was developed and modeled on the format of a WSA. The Study captures the most current water supply planning and demand information, analyzes the various projected change in water demands associated with each qualifying project within San Francisco, evaluates overall supply and demand, assesses the sufficiency of supply, and prepares a conclusion based on the analysis. Upon completion of the Study, a WSA for each qualifying project can rely on the information and conclusions of this Study.

1.2 Previous SFPUC Water Resource Studies

In recent years, the SFPUC has been engaged in numerous water resource planning efforts focused on regional and local supplies options and demand management measures, which could potentially reduce the amount of water the SFPUC imports through the Regional Water System (RWS) to meet its Retail water demands. The current status of major local water supply planning efforts is summarized below:

- **San Francisco Retail Water Demands and Conservation Potential**: In November 2004, the SFPUC prepared the "City and County of San Francisco Retail Water Demands and Conservation Potential" study (Demand Report) to project SFPUC future Retail water demands through the year 2030. The study employed a disaggregated water use forecasting procedure, drawing from actual water use data, and reflects current and projected demographics and employment data, changes in use due to existing plumbing codes, and water use trends. The study also identified water savings and implementation costs associated with a number of water conservation measures. Much of the methodologies in the Demand Report became the backbone of the demand analysis used in the SFPUC's 2005 UWMP.

- **Groundwater Planning**: In April 2005, the SFPUC completed the Final Draft North Westside Basin Groundwater Management Plan (GWMP), which identified opportunities for increasing groundwater production in San Francisco.

- **Recycled Water Master Plan Update**: The SFPUC prepared the 2006 Recycled Water Master Plan for the City and County of San Francisco (RWMP). The plan provided guidance for San Francisco in the development of recycled water projects within the City and County. The 2006 RWMP included an assessment of potential recycled water users City-wide and focused on identifying future recycled water projects in the City.

- **Urban Water Management Plan**: The 2005 UWMP addressed SFPUC's Retail water needs and evaluated sources of water supply, described efficient uses of water, demand management measures, and implementation strategies. The projections in the UWMP employed the demand and conservation estimates contained in the Demand Report, and the potential for groundwater and recycled water developed in the aforementioned studies to help in meeting projected demands. For consistency with the UWMP demand analysis, this Study used some of the same demand methodologies as presented in Section 5.2 of this Study.

- **Sewer Master Plan**: The SFPUC is preparing a Sewer System Master Plan (SSMP). The SSMP will present a long-term strategy for the management of the City's wastewater and storm water and identify capital improvements to be implemented over the next 25 to 30 years. The development of the SSMP will also incorporate proposed recycled water projects in the area. The identification and evaluation of potential wastewater management alternatives include an assessment of opportunities to implement recycled water projects to supply potential recycled water users identified in the 2006 RWMP. Environmental review of the Draft SSMP is anticipated to be complete in 2011.

- **Diversifying Retail Water Supply Portfolios**: In May 2006, the SFPUC prepared the "Diversifying San Francisco's Retail Water Supply Portfolio: Technical Memorandum". The study brought together planning data from existing planning projects, such as the North Westside Basin Groundwater Management Plan and the Recycled Water Master Plan, and summarized the potential local water supply options for San Francisco (including recycled water, groundwater, conservation and desalination projects). The memo also presented the implications of implementing different combinations of these local supply options, in terms of costs, ratepayer impacts and drought impact.

- **Water System Improvement Program (WSIP)**: On October 30, 2008, SFPUC certified the Final PEIR for the WSIP, a multiple year, system-wide capital improvements program. Many aspects of the WSIP are rooted in the 2000 Water Supply Master Plan and various water system vulnerability studies. The WSIP investigated the potential options of developing local water resources such as water recycling, groundwater, desalination and improved conservation to meet SFPUC purchase requests or demands.

1.3 Study Outline

This Study is an assessment of whether available water supplies are sufficient to serve the SFPUC's existing and planned Retail water system future uses within San Francisco, including agricultural and manufacturing uses, over the next 20 years under a range of hydrologic conditions. This Study employs the same disaggregated water use forecasting procedures as the Demand Report but incorporates an update of the end-use numbers presented in the Demand Report based on updated housing and employment projections.

This document is divided into six sections as follows:

1. Introduction

2. Water Supply

3. Potential Impact of Climate Change on SFPUC Supply

4. Drought Planning and Water Supply Reliability

5. San Francisco Growth Projections and Water Demand Analysis

6. Supply and Demand Comparison and Conclusion

2.0 WATER SUPPLY

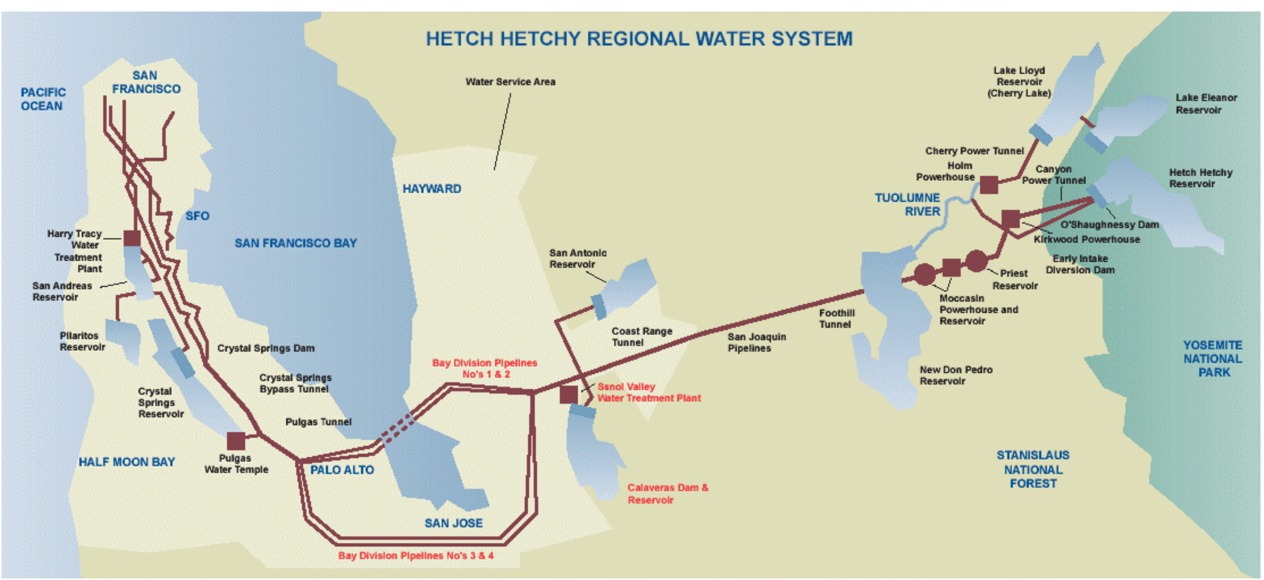
This section reviews San Francisco's existing and projected water supplies. The Regional Water System (RWS) is owned and operated by the City and County of San Francisco, under direction of the SFPUC. Historically, approximately 96 percent of the SFPUC's Retail water demands have been met through deliveries from the RWS. A small portion of San Francisco's water supply portfolio is produced through local groundwater and secondary treated recycled water. The groundwater is used primarily for irrigation at local parks and on highway medians. The recycled water is used mostly at municipal facilities for wastewater treatment process water, sewer box flushing and similar wash down operations.

In 1934, San Francisco combined the Hetch Hetchy system and Spring Valley system to create the SFPUC RWS. The rights to local diversions were originally held by the Spring Valley Water Company, which was formed in 1862.

The RWS currently delivers an annual average of approximately 265 mgd to 2.5 million users in Tuolumne, Alameda, Santa Clara, San Mateo, and San Francisco counties. The RWS is a complex system, shown in Figure 2-1, and supplies water from two primary sources:

- Tuolumne River through the Hetch Hetchy Reservoir, and
- Local runoff into reservoirs in Bay Area reservoirs in the Alameda and Peninsula watersheds.

Figure 2-1: Regional Water Supply System



Water from Hetch Hetchy Reservoir, through the Hetch Hetchy facilities represents the majority of the water supply available to the SFPUC. On average, the Hetch Hetchy Project provides over 85 percent of the water delivered to the Bay Area. During droughts the water received from the Hetch Hetchy system can amount to over 93 percent of the total water delivered.

Bay Area reservoirs provide on average approximately 15 percent of the water delivered by the SFPUC RWS. The local watershed facilities are operated to conserve local runoff for delivery. On the San Francisco Peninsula, the SFPUC utilizes Crystal Springs Reservoir, San Andreas Reservoir, and Pilarcitos Reservoir to capture local watershed runoff. In the Alameda Creek watershed, the SFPUC constructed the Calaveras Reservoir and San Antonio Reservoir. In addition to capturing runoff, San Antonio, Crystal Springs, and San Andreas reservoirs also provide storage for Hetch Hetchy diversions. The local watershed facilities also serve as an emergency water supply in the event of an interruption to Hetch Hetchy diversions.

2.1 Water Rights

The City and County hold pre-1914 appropriative water rights to store and deliver water from the Tuolumne River in the Sierra Nevada and locally from the Alameda and Peninsula watersheds. The City and County also divert and store water in the San Antonio Reservoir under an appropriative water right license granted by the State Water Resources Control Board (SWRCB) in 1959.

Appropriative water rights allow the holder to divert water from a source to a place of use not connected to the water source. These rights are based on seniority and use of water must be reasonable, beneficial, and not wasteful. In 1914, California established a formal water rights permit system, which is administered by the SWRCB. The SWRCB has sole authority to issue new appropriative water rights but cannot define property rights created under a pre-1914 appropriative water right.

The 1912 Freeman Report identified the ultimate diversion rate from the Tuolumne River to the Bay Area as 400 mgd and the City used this as the basis for designing the export capacity of the Hetch Hetchy project. The City has sufficient water rights for current diversions and the ultimate planned diversion rate of the Hetch Hetchy Project.

The federal Raker Act, enacted on December 19, 1913, grants to the City certain rights-of-way and public land use on federal property in the Sierra Nevada Mountains to construct, operate and maintain reservoirs, dams, conduits and other structures necessary or incidental to developing and using water and power. It also imposes restrictions on the City's use of the Hetch Hetchy Reservoir, including (among others) the requirement that the City recognize the senior water rights of the Turlock and Modesto Irrigation Districts (TID and MID) to divert water from the Tuolumne River. Specifically, the Raker Act requires the City to bypass certain flows through its Tuolumne River reservoirs to TID and MID for beneficial use. By agreement, the City, TID and MID have supplemented these Raker Act obligations to increase the TID and MID entitlements to account for other senior Tuolumne River water rights and allow the City to "pre-pay" TID and MID their entitlement by storing water in the Don Pedro water bank. The

City is required to bypass inflow to TID and MID sufficient to allow them to divert 2,416 cfs or natural daily flow, whichever is less, at all times (as measured at La Grange), except for April 15 to June 13, when the requirement is 4,066 cfs or natural daily flow as measured at La Grange, whichever is less.

2.2 Current Water Supply Sources

2.2.1 The Regional Water System

The RWS, as described above, provides nearly 96% of San Francisco's Retail water supplies from the Hetch Hetchy Reservoir and local Bay Area reservoirs in the Alameda and Peninsula watersheds. On average, the Hetch Hetchy Reservoir provides over 85 percent of the water delivered and Bay Area reservoirs provide approximately 15 percent of the water delivered. The RWS delivers an annual average of 265 mgd – 81 mgd serves the Retail customers within the City and County of San Francisco and the other 184 mgd is delivered to the Wholesale suburban customers on the San Francisco Bay Peninsula.

2.2.2 Local Groundwater

San Francisco overlies all or part of seven groundwater basins. These groundwater basins include the Westside, Lobos, Marina, Downtown, Islais Valley, South and Visitation Valley basins. The Lobos, Marina, Downtown and South basins are located wholly within the City limits, while the remaining three extend south into San Mateo County. The portion of the Westside Basin aquifer located within San Francisco is commonly referred to as the North Westside Basin. With the exception of the Westside and Lobos basins, all of the basins are generally inadequate to supply a significant amount of groundwater for municipal supply due to low yield.

Early in its history, San Francisco made significant use of local groundwater, springs, and spring-fed surface water. However, after the development of surface water supplies in the Peninsula and Alameda watersheds by Spring Valley Water Company and the subsequent completion of the Hetch Hetchy Reservoir and aqueduct in the 1930's, the municipal water supply system has relied almost exclusively on surface water from local runoff, the Alameda and Peninsula watersheds, and the Tuolumne River watershed. Local groundwater use, however, has continued in the City primarily for irrigation purposes. The San Francisco Zoo and Golden Gate Park use groundwater for non-potable purposes.

About one mgd of groundwater is delivered to Castlewood Country Club from well fields operated by the SFPUC in Pleasanton and drawn from the Central Groundwater Sub Basin in the Livermore/Amador Valley. These wells are metered and have been in operation for several decades. For purposes of water accounting and billing, these deliveries to Castlewood are accounted for as part of San Francisco's Retail Customer base.

2.2.3 Local Recycled Water

From 1932 to 1981, San Francisco's McQueen Treatment Plant provided recycled water to Golden Gate Park for irrigation purposes. Due to changes in regulations the City closed the

McQueen plant and discontinued use of recycled water in Golden Gate Park. Currently in San Francisco, disinfected secondary-treated recycled water from the SFPUC's Southeast Water Pollution Control Plant is used on a limited basis for wash-down operations and is provided to construction contractors for dust control and other nonessential construction purposes. Current use of recycled water for these purposes in San Francisco is less than one mgd.

2.2.4 Local Water Conservation

The SFPUC is committed to demand-side management programs and San Francisco's per capita water use has dropped by about one-third since 1977 in part due to these programs. The first substantial decrease came following the 1976-77 drought in which gross per capita water use dropped from 160 to 130 gpcd. Despite continuous growth in San Francisco since then, water demands have remained lower than pre-drought levels.

A second substantial decrease in water use within San Francisco occurred as a result of the 1987-1992 drought when a new level of conservation activities resulted in further water use savings. It is anticipated that through the continuation and expansion of these programs, per capita water use will continue to decrease into the future. Current gross per capita water use within San Francisco is 91.5 gallons per capita per day (gpcd) with residential water use calculated to be approximately 57 gpcd, the lowest use of any major urban area in California.

The SFPUC's demand management programs range from financial incentives for plumbing devices to improvements in the distribution efficiency of the system. The conservation programs implemented by the SFPUC are based on the California Urban Water Conservation Council's list of fourteen Best Management Practices identified by signatories of the Memorandum of Understanding Regarding Urban Water Conservation in California, executed in 1991.

2.3 Water System Improvements and New Supply Reliability

To ensure that the future water needs of its Retail and wholesale customers will be met in a more reliable and sustainable manner, the SFPUC has undertaken water supply projects in the Water System Improvement Program (WSIP) to improve dry-year supplies, and is diversifying San Francisco's water supply portfolio through the development of local water supplies such as increasing recycled water and groundwater production, and bolstering water conservation. Many of the water supply and reliability projects evaluated in the WSIP were originally put forth in SFPUC's Water Master Plan (2000), then summarized in the 2005 UWMP and then investigated further in a Technical Memorandum Diversifying San Francisco's Retail Water Supply Portfolio (May 2006). In addition, specific water resource reports were prepared and released as well. Specifically, in 2005, SFPUC prepared a Recycled Water Master Plan, which updated the 1996 Recycled Water Master Plan and also prepared the North Westside Basin Groundwater Management Plan. Water supply elements of the WSIP are summarized below. The WSIP and its Program Environmental Impact Report are available for review at www.sfwater.org and www.sfgov.org. Sections of the WSIP Phased Variant to support the summaries in this Study are appended hereto.

2.3.1 Water System Improvement Program and the Phased WSIP Variant

The WSIP is a multi-billion dollar, multi-year, capital program to upgrade the RWS. The program will deliver improvements that enhance the SFPUC's ability to provide reliable, affordable, high quality drinking water to its 27 wholesale customers and regional Retail customers in Alameda, Santa Clara, and San Mateo counties, and to 800,000 Retail customers in San Francisco, in an environmentally sustainable manner.

As required under CEQA, SF Planning prepared a Program Environmental Impact Report (PEIR) for the WSIP. The PEIR evaluated the potential environmental impacts of the proposed WSIP and identified potential mitigations to those impacts. The PEIR also evaluated several alternatives to meet the SFPUC service area's projected increase in water demand between now and 2030. The water supply improvement options investigated included 10 alternatives using various water supply combinations from the local watersheds; the Tuolumne and Lower Tuolumne; ocean desalination; and additional recycled water, groundwater, and conservation.

The PEIR was certified by the SF Planning Commission on October 30, 2008. On the same day the SFPUC adopted the Phased WSIP Variant option.

2.3.1.1. Phased WSIP Variant

At the request of the SFPUC, SF Planning studied the Phased WSIP Variant as part of the environmental analysis. The SFPUC identified this variant in order to consider a program scenario that involved full implementation of all proposed WSIP facility improvement projects to insure that the public health, seismic safety, and delivery reliability goals were achieved as soon possible, but phased implementation of a water supply program to meet projected water purchases through 2030. Deferring the 2030 water supply element of the WSIP until 2018 would allow the SFPUC and its wholesale customers to focus first on implementing additional local recycled water, groundwater, and demand management actions while minimizing additional diversions from the Tuolumne River.

The Phased WSIP Variant establishes a mid-term planning milestone in 2018 when the SFPUC would reevaluate water demands through 2030 in the context of then-current information, analysis and available water resources. The SFPUC currently delivers on an annual average approximately 265 million gallons of water per day from local watersheds (Peninsula and Alameda Creek) and the Tuolumne River Watershed. By 2030, demand on the SFPUC system is expected to increase to an annual average of 300 million gallons of water per day. The Phased WSIP Variant would meet the projected 2018 purchase requests of 285 mgd from the RWS by capping purchases from the watersheds at 265 mgd; the remaining 20 mgd would be met through water efficiencies and conservation, water recycling and local groundwater use—10 mgd by Wholesale Customers and 10 mgd in the City and County. Before 2018, the SFPUC and the Wholesale Customers will engage in a new planning process to reevaluate water system demands and supply options, including conducting additional studies and environmental reviews necessary to address water supply needs after 2018.

The Phased WSIP Variant includes the following key program elements:

- Full implementation of all WSIP facility improvement projects.
- Water supply delivery to RWS customers through 2018 only of 265 mgd average annual target delivery originating from the watersheds. This includes 184 mgd for the Wholesale Customers and 81 mgd for the Retail Customers.
- Water supply sources include: 265 mgd average annual from the Tuolumne River and local watersheds and 20 mgd of water conservation, recycled water and local groundwater developed within SFPUC's service area (10 mgd Retail; 10 mgd wholesale).
- Dry-year water transfers of 2 mgd coupled with the Westside Groundwater Basin Conjunctive Use Project.
- Re-evaluation of 2030 demand projections, potential RWS purchase requests and water supply options by December 31, 2018 and a separate SFPUC decision in 2018 regarding RWS water deliveries after 2018.
- The ability to impose financial penalties is included in the new Water Supply Agreement to limit water sales to an average annual of 265 mgd from the watersheds.

The additional 10 mgd of supplies produced in San Francisco by implementation of the WSIP are considered secure and have been included in this Study. This Study assumes the WSIP local supplies will be in place in the timeframes stated in the SFPUC WSIP, with this assumption total Retail supplies increase to 94.50 mgd in 2015 and remain constant over the 20-year planning horizon. Projects related to these efforts are detailed below.

2.3.2 Local Groundwater Projects

2.3.2.1. San Francisco Groundwater Supply Project

The San Francisco Groundwater Supply Project would provide up to 4 mgd of local groundwater water to improve reliability during drought or maintenance conditions, as well as ensure that a reliable, high-quality source of water is available in the case of an earthquake or other emergency. The project proposes the construction of up to six wells and associated facilities in the western part of San Francisco to extract up to 4 mgd of groundwater water from the Westside Groundwater Basin for distribution in the City. The extracted groundwater, which would be used both for regular and emergency water supply purposes, would be disinfected and blended in small quantities with imported surface water before entering the municipal drinking water system. The environmental review for this project will begin in November 2009.

2.3.2.2. Lake Merced Water Level Restoration Project

The goal of the Lake Merced Water Level Restoration Project is to protect and balance the beneficial uses of Lake Merced by providing a more stable water level regime using groundwater and stormwater, rather than supplies provided through the RWS.

2.3.3 Local Recycled Water Projects

The proposed Westside, Harding Park and Eastside Recycled Water Projects would provide up to 4 mgd of recycled water to a variety of users in San Francisco. Recycled water will primarily be used for landscape irrigation, toilet flushing and industrial purposes. The Harding Park Project has completed environmental review, and the Westside Project will begin environmental review in late 2009 or early 2010.

The proposed Westside Project would bring recycled water from the proposed recycled water treatment facility in Golden Gate Park to the San Francisco Zoo, Golden Gate Park, and Lincoln Park Golf Course. Recycled water would be used for irrigation at all three sites; additionally, it would be used for non-potable uses in Golden Gate Park at the California Academy of Sciences. The proposed Harding Park Recycled Water Project would use available recycled water from the North San Mateo County Sanitation District (NSMCSD) located in Daly City, to irrigate Harding Park and Fleming Park golf courses in San Francisco. The SFPUC has partnered with the NSMCSD for this proposed project.

Currently, the SFPUC is conducting a recycled water demand assessment on the Eastside of San Francisco. The assessment examines the potential uses of recycled water for irrigation, toilet flushing, and commercial applications. The WSIP contains funding for planning, design, and environmental review for the San Francisco Eastside Recycled Water Project.

2.3.4 Local Water Conservation

The SFPUC has also increased its water conservation programs in an effort to achieve new water savings by 2018. The SFPUC's conservation program is based on the Demand Study (Section 1.2) that identified water savings and implementation costs associated with a number of water conservation and efficiency measures. The Demand Study evaluated the costs and benefits of implementing 48 different conservation measures using an end-use model. The results indicated that local conservation programs implemented through 2030 could cumulatively reduce Retail purchases from the SFPUC RWS by 4.5 mgd in year 2030. These new conservation programs include high-efficiency toilet replacement in low-income communities, plumbing retrofits in compliance with the 1992 California plumbing code and water efficient irrigation systems in municipal parks. Through its conservation program, the SFPUC anticipates reducing gross per capita consumption from 91.5 gpcd to 87.4 gpcd by 2018 for an average daily savings of nearly 4.0 mgd.

2.3.5 Summary of Local WSIP Water Supply Programs

As previously discussed, SFPUC anticipates that the expanded groundwater and recycled water production, and increased conservation programs will provide the City with an additional 10 mgd of local water supplies. As quantified in Table 2-1 with implementation of the WSIP, SFPUC expects to have in these local supplies in place by 2015. These programs and projects are reliable in all hydrologic conditions and are not subject to RWSAP reductions or curtailments.

Table 2-1: WSIP Water Supply Sources (mgd)

WSIP Water Supplies	2010	2015	2020	2025	2030
Groundwater	0.0	2.0	2.0	2.0	2.0
Recycled Water	0.0	4.0	4.0	4.0	4.0
Conservation	0.0	4.0	4.0	4.0	4.0
Total WSIP Local Supplies	**0.0**	**10.0**	**10.0**	**10.0**	**10.0**

2.3.6 Total SFPUC Retail Water Supplies

Table 2-2 summarizes SFPUC's total water supplies now and over the 20-year planning period. In 2010, prior to the development of the 10 mgd of local supplies, SFPUC can access an annual average 84.50 mgd from all sources discussed above. Beginning in 2015, when the WSIP water supply sources are readily available, the SFPUC's Retail water supplies increase to 94.5 mgd. These supplies are assumed to be available in the quantities listed in Table 2-2. SFPUC intends to use these supplies to meet its Retail customer demands.

Table 2-2: SFPUC Water Supplies 2010 - 2030

Current Water Supply Sources	2010	2015	2020	2025	2030
SFPUC RWS (Surface water: Tuolumne River, Alameda & Peninsula) (1)	81.0	81.0	81.0	81.0	81.0
Groundwater Sources					
Groundwater (In-City Irrigation Purposes)	2.5(2)	0.5(3)	0.5(3)	0.5(3)	0.5(3)
Groundwater at Castlewood(4)	1.0(4)	1.0(4)	1.0(4)	1.0(4)	1.0(4)
Groundwater: Treated for Potable – Previously used for In-City Irrigation purposes(5)	0.0	2.0	2.0	2.0	2.0
Groundwater Subtotal	**3.5**	**3.5**	**3.5**	**3.5**	**3.5**
Current Water Supply Subtotal	**84.5**	**84.5**	**84.5**	**84.5**	**84.5**
WSIP Water Supply Sources					
Groundwater Development: Potable from SF GWSP (Westside Groundwater Basin)(6)	0.0	2.0	2.0	2.0	2.0
Recycled Water Expansion Irrigation(7)	0.0	4.0	4.0	4.0	4.0
Supply Conservation Program	0.0	4.0	4.0	4.0	4.0
WSIP Supply Subtotal	**0.0**	**10.0**	**10.0**	**10.0**	**10.0**
Total Retail Supply (Current and WSIP Supplies)	**84.5**	**94.5**	**94.5**	**94.5**	**94.5**

(1) RWS surface water supplies are subject to reductions due to below-normal precipitation. This may affect dry year supplies - model shows supply reduction occurs in year 2 of multiple dry year event. (Source: SFPUC 2008 WSIP Phase Variant Supply limitation)

(2) Groundwater serves irrigation to Golden Gate Park, SF Zoo, and Great Highway Median. (Source: 2005 SFPUC UWMP Table 8B page 43)

(3) A Groundwater reserve of 0.5 mgd for irrigation purposes will remain as part of SFPUC's non-potable groundwater supply. (Source: SFPUC 2008 WSIP Phase Variant)

(4) Castlewood current and projected use remains unchanged over 20 year planning horizon. (Source: 2005 SFPUC UWMP Table 8B page 43)

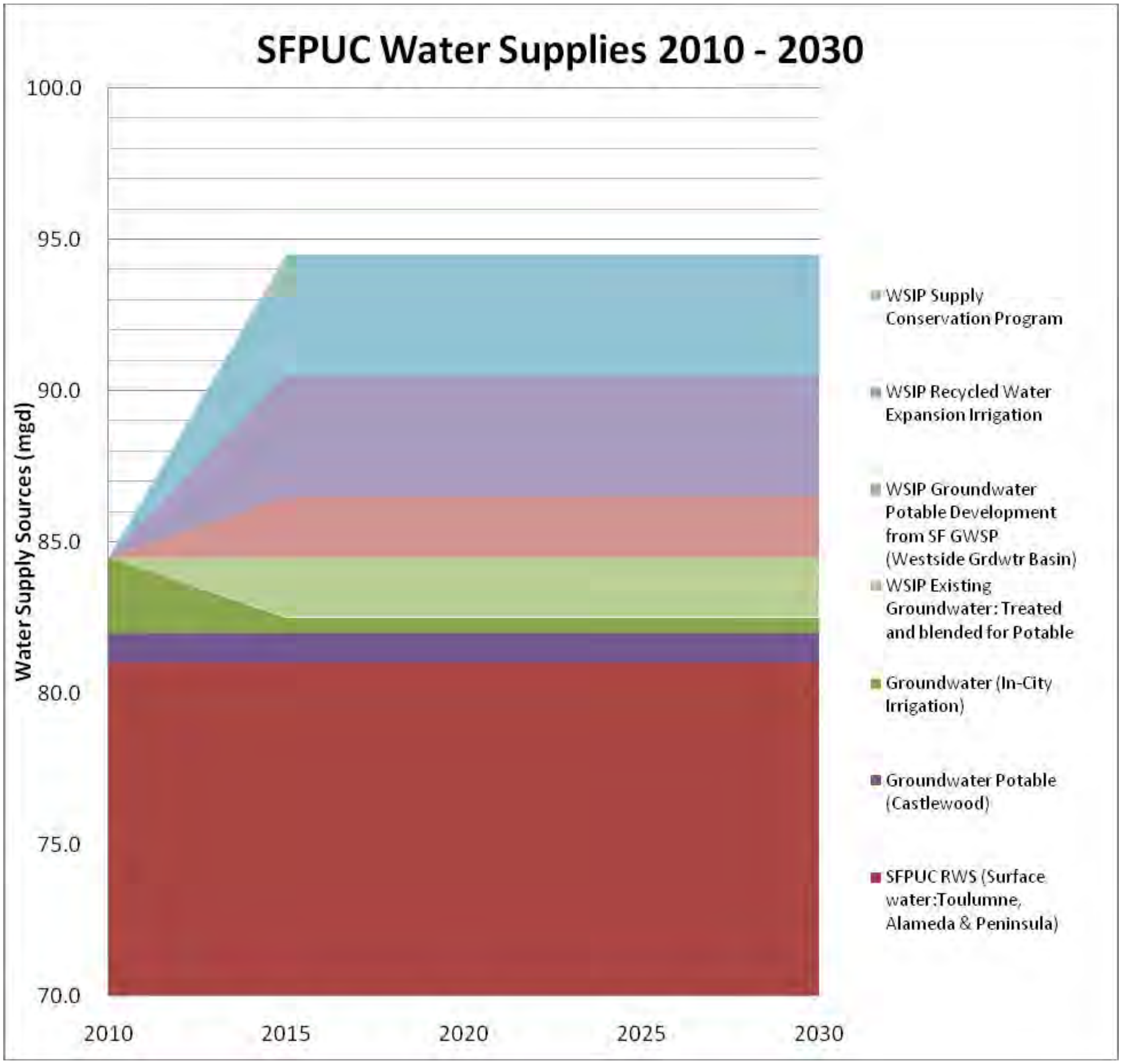
(5) 2.0 mgd of groundwater treated and blended for Potable water supply purposes. (Source: 2005 SFPUC UWMP Table 8B page 43)

(6) 2.0 mgd of new groundwater developed as part of the new local supply target. (Source: SFPUC 2008 WSIP Phase Variant Supply Target)

(7) 2.0 mgd of Recycled used for irrigation at Golden Gate Park, SF Zoo, Great Highway Median, and 2.0 mgd for other non-potable purposes. (Source: SFPUC 2008 WSIP Phase Variant Supply Target)

Figure 2-1 is a graphical representation of the SFPUC's current supply sources and the WSIP local supply sources. As shown in Figure 2-2, the supplies grow from 84.5 mgd in 2010 to 94.5 mgd as the WSIP local supplies are brought into the SFPUC Retail supply system. The figure shows the total supplies increasing in 2015 and holding constant over the 20-year planning horizon.

Figure 2-2: SFPUC Water Supplies



2.3.7 Dry Year Water Supply Projects

The WSIP water supply program includes development of dry-year supplies for the RWS. The PEIR included an analysis of dry-year water supply transfers from the senior water rights holders on the Tuolumne River (MID and TID); a groundwater conjunctive use project; and a regional desalination project. The latter two projects are described below. The SFPUC is investigating the possibility of a dry-year water transfer with MID and TID for 2 mgd in 2018. The WSIP provides funding for the Groundwater Storage and Recovery Project.

2.3.7.1. **Groundwater Storage and Recovery Project**

The proposed Regional Groundwater Storage and Recovery Project would balance the use of both groundwater and surface water to increase water supply reliability during dry years or in emergencies. The proposed project is located in San Mateo County and is sponsored by the SFPUC in coordination with its partner agencies, the California Water Service Company, City of Daly City and City of San Bruno. The partner agencies currently purchase wholesale surface water from the SFPUC and also independently operate groundwater production wells for drinking water and irrigation.

The proposed Regional Groundwater Storage and Recovery Project would extract groundwater from the South Westside Basin groundwater aquifer in San Mateo County. The project would consist of installing up to sixteen new recovery well facilities in northern San Mateo County to pump stored groundwater during a drought. During years of normal or heavy precipitation, the proposed project would provide surface water to the partner agencies in order to reduce the amount of groundwater pumped. Over time, the reduced pumping would result in the storage of approximately 61,000 acre-feet of water (more than the supply contained in the Crystal Springs Reservoir on the SFPUC Peninsula Watershed.) This would allow recovery of this stored water at a rate of up to 7.2 million gallons per day for a 7.5-year dry period. The water would be in compliance with the California Department of Public Health requirements for drinking water supplies. The proposed project would include construction of well pump stations, disinfection units, and piping. The proposed project is currently undergoing environmental review.

2.3.7.2. **Desalination**

The SFPUC's investigations of desalination as a water supply source have focused primarily on the potential for regional facilities. The proposed Bay Area Regional Desalination Project is a joint venture between the SFPUC, Contra Costa Water District, East Bay Municipal Utility District, and the Santa Clara Valley Water District.

The regional desalination project would provide an additional source of water during emergencies, provide a supplemental water supply source during extended droughts, allow other major water facilities to be taken out of service for maintenance or repairs, and increase supply reliability by providing water supply from a regional facility. The Bay Area Regional Desalination Project would have an ultimate total capacity of up to 65 mgd.[4]

4 EBMUD, "Desalination Project", http://www.ebmud.com/water_&_environment/water_supply/current_projects/desalination_project/default.htm, accessed July 30, 2009.

3.0 POTENTIAL IMPACT OF CLIMATE CHANGE ON SFPUC SUPPLY AVAILABILITY

The issue of climate change has become an important factor in water resources planning in the State, and it is being considered during planning for the RWS. There is evidence that increasing concentrations of greenhouse gases have caused and will continue to cause a rise in temperatures around the world, which will result in a wide range of changes in climate patterns. Moreover, there is evidence that a warming trend occurred during the latter part of the 20th century and will likely continue through the 21st century. These changes will have a direct effect on water resources in California, and numerous studies on climate change have been conducted to determine the potential impacts water resources. Based on these studies, climate change could result in the following types of water resource impacts, including impacts on the RWS and associated watersheds:

- Reductions in the average annual snowpack due to a rise in the snowline and a shallower snowpack in the low- and medium-elevation zones, such as in the Tuolumne River basin, and a shift in snowmelt runoff to earlier in the year,
- Changes in the timing, intensity, and variability of precipitation, and an increased amount of precipitation falling as rain instead of as snow,
- Long-term changes in watershed vegetation and increased incidence of wildfires that could affect water quality,
- Sea level rise and an increase in saltwater intrusion,
- Increased water temperatures with accompanying adverse effects on some fisheries,
- Increases in evaporation and concomitant increased irrigation need, and
- Changes in urban and agricultural water demand.

However, other than the general trends listed above, there is no clear scientific consensus on exactly how global warming will quantitatively affect State water supplies, and current models of State water systems generally do not reflect the potential effects of global warming.

The SFPUC staff performed an initial evaluation of the effect on the Regional Water System of a 1.5-degree Celsius (°C) temperature rise between 2000 and 2025. The temperature rise of 1.5°C is based on a consensus among many climatologists that current global climate modeling suggests a 3°C rise will occur between 2000 and 2050 and a rise of 6°C will occur by 2100. The evaluation predicts that an increase in temperature of 1.5°C will raise the snowline approximately 500 feet every twenty-five years. The elevation of the watershed draining into Hetch Hetchy Reservoir ranges from 3,800 to 12,000 feet above mean sea level, with about 87 percent of the watershed area above 6,000 feet. In 2000 (a normal hydrologic year in the 82-year period of historical record), the average snowline in this watershed was approximately 6,000 feet during the winter months. Therefore, the SFPUC evaluation indicates that a rise in temperature of 1.5°C between 2000 and 2025 will result in less or no snowpack between 6,000 and 6,500 feet and faster melting of the snowpack above 6,500 feet. Similarly, a temperature rise of 1.5°C between 2025 and 2050 will result in less or no snowpack between 6,500 and 7,000 feet and faster melting of the snowpack above 7,000 feet.

The SFPUC climate change modeling indicates that about 7 percent of the runoff currently draining into Hetch Hetchy Reservoir will shift from the spring and summer seasons to the fall and winter seasons in the Hetch Hetchy basin by 2025. This percentage is within the current interannual variation in runoff and is within the range accounted for during normal runoff forecasting and existing reservoir management practices. The additional change between 2025 and 2030 is not expected to be detectible. The predicted shift in runoff timing is similar to the results found by other researchers modeling water resource impacts in the Sierra Nevada due to warming trends associated with climate change.

Based on these preliminary studies and the results of literature reviews, the potential impacts of global warming on the RWS are not expected to affect the water system operations through 2030. SFPUC hydrologists are involved in ongoing monitoring and research regarding climate change trends and will continue to monitor the changes and predictions, particularly as these changes relate to water system operations and management of the RWS. The SFPUC has developed a workplan to further advance its research on the effects of climate change on the RWS.

4.0 DROUGHT PLANNING AND WATER SUPPLY RELIABILITY

The SFPUC water supply system reliability is expressed in terms of its ability to deliver water during droughts. Reliability is defined by the amount and frequency of water delivery reductions required to balance customer demands with available supplies in droughts. The SFPUC has a reliability goal of meeting dry-year delivery needs while limiting rationing to a maximum 20 percent system-wide reduction in water service during extended droughts.

The total amount of water the SFPUC has available to deliver to its Retail and wholesale customers during a defined period of time is dependent on several factors. These include the amount of water that is available to the SFPUC from natural runoff, the amount of water in reservoir storage, and the amount of water that must be released from the SFPUC's system for commitments to purposes other than customer deliveries, such as releases below Hetch Hetchy reservoir to meet the Raker Act and fishery purposes.

The SFPUC operates its system to optimize the reliability and quality of its water deliveries. Hetch Hetchy Reservoir operations are guided by two principal objectives: collection of Tuolumne River water runoff for diversion to the Bay Area; and fulfillment of the SFPUC's downstream release obligations. To conserve runoff, Hetch Hetchy Project reservoirs are drawn down beginning in early winter, relying on the recurrence and forecast of snow melt to guide drawdown releases. Similarly, the Regional Water System Bay Area reservoirs are operated to conserve watershed runoff. As such, reservoirs are drawn down during the winter period to capture storms and reduce the potential for spilling water out of the reservoirs. In the spring, excess Hetch Hetchy water supply (snowmelt) is transferred to three of the Bay Area reservoirs, capable of receiving the water, to fill any unused reservoir storage.

Prior to the late 1970's, droughts did not seriously affect the ability of the SFPUC to sustain full deliveries to its customers. However, as the 1987-1992 droughts progressed and reservoir storage continued to decline, it became apparent that continued full deliveries could not be sustained without the risk of running out of water before the drought ended.

To provide some level of assurance that water could be delivered continuously throughout a drought (although at reduced levels), the SFPUC adopted a drought planning sequence and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in SFPUC reservoirs. Each year, during the snowmelt period, the SFPUC evaluates the amount of total water storage expected to occur throughout the RWS. If this evaluation finds the projected total water storage to be less than an identified level sufficient to provide sustained deliveries during drought, the SFPUC may impose delivery reductions or rationing.

4.1 *Water Shortage Allocation Plan (WSAP)*

During a drought, it is expected that the Retail and wholesale customers would experience a reduction in the amount of water received from the RWS. The amount of this reduction has been dictated by existing contractual agreements between the SFPUC and the Wholesale Customers, as detailed in the existing WSAP. The WSAP provides specific allocations of available water between the Retail and wholesale customers collectively associated with different levels of system-wide shortages, as shown in Table 4-1.

Table 4-1: WSAP Allocation

Level of System-Wide Reduction in Water Use Required	Share of Available Water	
	SFPUC Share	Wholesale Customers Share (collectively)
5% or less	35.5%	64.5%
6% through 10%	36.0%	64.0%
11% through 15%	37.0%	63.0%
16% through 20%	37.5%	62.5%

In addition to providing an allocation method, the plan also includes provisions for transfers, banking and excess use charges.

Under the WSAP, SFPUC Retail customers would experience no reduction in deliveries at a 10 percent shortage. However, during a 20 percent system-wide shortage, the Retail customers would experience a 1.9 percent reduction in Retail deliveries. This assumes the full development of the additional 10 mgd of local WSIP supplies in the Retail service area. These 10 mgd of local supplies are not subject to reduction under the WSAP as the WSAP only allocates water supplies from the RWS. Table 4-2 shows SFPUC RWS Retail supply schedule during normal, single dry year, and multiple dry year periods.

The WSAP has been carried forward in the new Water Supply Agreement for system-wide shortages of up to 20 percent. For shortages in excess of this amount, the Water Supply Agreement provides that the SFPUC may allocate water in its discretion.

4.2 *Retail Water Shortage Allocation Plan*

San Francisco's Retail Water Shortage Allocation Plan (RWSAP) was adopted to formalize a three-stage program of action to be taken in San Francisco to reduce water use during a drought. In accordance with the RWSAP, prior to the initiation of any water delivery reductions in San Francisco, whether it be initial implementation of reduction delivery or increasing the severity of water shortage, the SFPUC would outline a drought response plan that would address the following: the water supply situation; proposed water use reduction objectives; alternatives to water use reductions; methods to calculate water use allocations and adjustments; compliance methodology and enforcement measures; and budget considerations.

Table 4-2: 2005 – 2030 SFPUC Retail Allocations in Normal, Dry and Multiple Dry Years

	Normal Year		Single Dry Year		Multiple Dry Year Event[2] Year 1		Year 2		Year 3	
	mgd	%	mgd	%	mgd	%	mgd	%	mgd	%
2010[1]	81.0	100	81.0	100.0	81.0	100.0	79.5	98.1	79.5	98.1
2015	81.0	100	81.0	100.0	81.0	100.0	79.5	98.1	79.5	98.1
2020	81.0	100	81.0	100.0	81.0	100.0	79.5	98.1	79.5	98.1
2025	81.0	100	81.0	100.0	81.0	100.0	79.5	98.1	79.5	98.1
2030	81.0	100	81.0	100.0	81.0	100.0	79.5	98.1	79.5	98.1

(1) In 2010 the Retail allocation of RWS supply is reduced to 81 mgd to reflect the Retail allocation under the 2018 Phased WSIP Variant. 10 mgd of recycled water, groundwater, and conservation will be implemented by 2015 to make up for the loss in RWS supply. The 10 mgd of local supply is not subject to reduction under the WSAP.

(2) Under the WSAP, the SFUPC Retail allocations at a 10 percent shortage are 85.86 mgd. However, due to the Phased WSIP Variant, only 81 mgd of RWS supply is shown. The remaining supply can be transferred from or to the Wholesale Customers under the terms of the Water Supply Agreement.

Source: San Francisco Public Utilities Commission. 2005. Urban Water Management Plan for the City and County of San Francisco. p. 54-57 and discussions with SFPUC staff.

This drought response will be presented at a regularly scheduled SFPUC Commission meeting for public input. The meeting will be advertised in accordance with the requirements of California Water Code Section 6066 of the Government Code, and the public will be invited to comment on the SFPUC's intent to reduce deliveries.

Depending on the level of water demand and the desired objective for water use reduction, one, two or all three stages of the RWSAP may be required.

<u>Stage 1 (Voluntary)</u>

- System-wide demand reductions of 5-10 percent experienced
- Voluntary rationing request of customers
- Customers are alerted to water supply conditions
- Remind customers of existing water use prohibitions
- Education on, and possible acceleration of, incentive programs

<u>Stage 2 (Mandatory)</u>

- System-wide demand reductions of 11-20 percent experienced
- All Stage 1 actions implemented
- All customers receive an "allotment" of water based on the Inside/Outside allocation method (based on base year water usages for each account)
- Water use above the "allocation" level will be subject to excess use of flow restrictor devices and shut-off of water

Stage 3 (Mandatory)

- System-wide demand reductions of 20 percent or greater experienced
- Same actions as in Stage 2 with further reduced allocations

5.0 SAN FRANCISCO GROWTH PROJECTIONS AND WATER DEMAND ANALYSIS

This section shows the calculated water demand projections for San Francisco based on recent housing and employment forecasts.

5.1 Revised City of San Francisco Growth Projections

The SFPUC has recently evaluated projected demands and incorporated the updated San Francisco Planning projections for residential and non-residential growth contained in a memorandum from SF Planning to SFPUC dated July 9, 2009 (Appendix A). This analysis results in a 2030 growth projection that differs from the 2005 UWMP. Table 5-1 compares 2030 growth projections between the 2005 UWMP and the 2009 growth projections developed by the SF Planning department. As shown in Table 5-1 new residential growth is expected to increase by 29,787 units. The 27,400 new residential units proposed in three Projects account for the majority of new residential growth in 2030. In contrast, the 2009 employment projections result in net loss of 47,300 new employment opportunities in 2030.

Table 5-1: 2030 SF Planning Projections for Households and Employment

Residential Units		**2030 Projection**
2005 UWMP[1]		373,513
2009 SF Planning Projections[2]		403,300
	Net Change	**29,787**[3]
Non-Residential Population		**2030 Projection**
2005 UWMP[4]		795,400
2009 SF Planning Projections[5]		748,100
	Net Change	**-47,300**

(1) 2005 Urban Water Management Plan residential projections were based on ABAG Projections 2002 and Citywide Policy Analysis and Planning, San Francisco Planning Department, Land Use Allocations 2002.

(2) 2009 Residential Projections were developed by the San Francisco Planning Department and designed to closely match the recently adopted ABAG Projections 2009 target, but taking into account local knowledge of projects currently in various stages of the entitlement process, commonly referred to as the Development Pipeline. (Appendix A)

(3) Of the new residential units the Projects account for 27,700 units and new incremental growth accounts for 2,387 units.

(4) 2005 Urban Water Management Plan non-residential projections were based on ABAG 2030 employment projections and linearly extrapolated for 2020 and 2030.

(5) Revised 2009 Non-Residential Projections were developed by the San Francisco Planning Department and based on ABAG 2009 Employment projections for 2030. (Appendix A)

5.1.1 2009 Residential Projections

As stated previously, the SF Planning and the San Francisco Redevelopment Agency are currently engaged in planning for various proposed land development projects. These Projects, as well as Incremental Growth throughout San Francisco, account for 29,787 new dwelling units in 2030. As proposed, the Projects would contribute 27,400 new dwelling units to San Francisco's housing inventory. The Incremental Growth throughout the City accounts for the remaining 2,387 new dwelling units (Appendix B).

The updated 2030 City growth projection shown in Table 5-1 reflects an increase in residential households from the 2005 UWMP forecast but an overall decrease in non-residential (employment) population. As shown in Table 5-2, the residential growth at the Projects commences in 2015 with 6,850 new dwelling units and continues to grow to 27,400 in 2030, essentially growing by 6,850 over each five-year period. In addition, this Study also assumes that the incremental growth throughout San Francisco would occur in the same manner. As shown in Table 5-2, the incremental growth commences in 2015 with 597 new dwelling units and continues to grow to 2,387 in 2030, essentially growing by 597 over each five-year period.

Table 5-2: Projects and Incremental Growth within San Francisco

Residential Units	2010	2015	2020	2025	2030
Residential Units [1]	344,306	351,608	358,910	366,211	373,513
Residential Units for Projects[2]	0	6,850	13,700	20,550	27,400
Residential Units for Incremental Growth[3]	0	597	1,194	1,790	2,387
Subtotal (Projects and Incremental Growth)		***7,447***	***14,894***	***22,340***	***29,787***
Total New Residential Units	**344,306**	**359,055**	**373,803**	**388,552**	**403,300**

(1) 2005 UWMP residential unit projections shown in Table 5-1. Source: 2005 SFPUC UWMP Table 2, page 7
(2) Residential Units of Projects (CP-HPS II 10,500 units); (TI-YBI 8,000 units); (Parkmerced 8,900 total units)
(3) Incremental Growth accounts for 2,387 new units.

5.1.2 2009 Employment Projections

The updated 2030 City growth projection shown in Table 5-1 reflects an increase in residential households from the 2005 UWMP forecast but an overall decrease in non-residential (employment) population. These changes mirror the changes in the Association of Bay Area Governments (ABAG) projections. ABAG projections are used for various planning purposes by many of the cities in the nine-county area covered by ABAG. ABAG publishes regional projections and employment and growth every two years. Projections developed after 2002 incorporate a fundamental shift in ABAG's projection methodology. Rather than taking existing local land use policy as a given (as had previously been the case), in the projections following the 2002 projections, ABAG assumes that local policy will be amended in the future to adopt "smart growth" principles. Specifically, the projections assume that higher density growth will be focused in urban core areas, and that more housing will be produced in those areas, compared to that previously assumed. The result of these assumptions is to increase the expected population in already developed areas. Another difference reflected in the later projections is a more current and accurate reflection of the internet industry (dot com era), as well as the effect of the current recession on employment projections.

Table 5-3 shows the progression of growth in employment opportunities forecasted in San Francisco based on SF Planning's 2009 Employment Projections (Appendix B). Beginning in 2015 employment is projected to increase to 719,145 jobs, and then by 2025 employment is expected to grow to 734,050 jobs. As projected, and shown in Table 5-3 employment in San Francisco is expected to reach 748,100 jobs.

Table 5-3: Non-Residential Employment Projections

Non-Residential Employment Projections	2010	2015	2020	2025	2030
SF Planning Employment Total(1) (jobs)	712,145	719,447	726,749	734,050	748,100

(1) Table 5-1 2009 SF Planning Projections based on ABAG 2030 Employment projections

5.2 City of San Francisco Retail Water Demand Analysis

Retail water demands in the 2005 UWMP were based on the findings of the Demand Report. The Demand Report analyzed water demand associated with each Retail customer sector and then forecasted demand over a 25-year planning horizon using data provided by the City, and the SFPUC. The demand projections were developed using a water use model, which initially established a base-year water demand at the end-use level (such as toilets, showerheads, other lavatory hardware and household fixtures), calibrated the model to initial conditions, and forecasted future water demand based on projected demand of existing water service accounts and future population growth.

This Study updates the 2005 UWMP water demand forecasts in 2010 through 2030 to reflect San Francisco's three major development Projects (CP-HPS II, TI-YBI, and Parkmerced) and incremental growth projected to occur throughout the City, and the 2009 San Francisco non-residential planning projections (based on ABAG 2009 Employment Projections) for 2030. Tables 5-4 and 5-5 show the results of the demand forecasts at the Project sites; anticipated incremental growth expected to occur throughout the City and growth in demand generated through employment opportunities (jobs).

5.2.1 Water Demand of Projects and Incremental Growth

The Projects are proposed as mixed-use residential redevelopment projects within San Francisco. Each project sponsor provided land use plans or reports to the City that include residential unit counts, commercial spaces, and public facilities. These same plans and reports estimated potable water demand along with other land use information. Residential water demands for the Projects were provided to the City by the Project developers, and were developed using an end use model on a per-unit or per-employee basis. The Project demands were independently reviewed by PBS&J and the SFPUC as part of this Study, and appear consistent with the SFPUC demand estimates. See Appendix B for the methodology used in the Project demand estimates.

Upon buildout in 2030, these Projects represent the majority of new growth in San Francisco above the 2030 growth projected in the 2005 UWMP. As shown in Table 5-4, overall water demand at each of the Project sites is estimated at 1.99 mgd (CP-HPS II); 1.70 mgd (TI-YBI) and 0.98 mgd at Parkmerced. The CP-HPS II includes a number of different development scenarios, the estimated water demands of the three main CP-HPS II development scenarios are also shown in Table 5-2.

The Demand Report (see Section 1.2) analyzed water demands associated with each Retail customer sector and established per unit-use rates. As such, between 2010 and 2030, SFPUC used a per-unit use rate average of 98.7 gpd per household for multi-family residential demands. As shown in Table 5-4, the 98.7 gpd per household rate was applied to the incremental growth of 2,387 new dwelling units throughout the City resulting in a demand of 0.24 mgd in 2030.

Table 5-4: 2030 Water Demand of the Projects and Incremental Growth within SF City and County (mgd)

Projects and Incremental Growth[1]	Water Demand (mgd)					
	Stadium		R&D Variant		Housing Variant	
	Project Water Demand	Non-Residential Adjustment (1.18)[7]	Project Water Demand	Non-Residential Adjustment (1.40)[7]	Project Water Demand	Non-Residential Adjustment (1.15)[7]
CP-HPS II[2]	1.67	1.04	1.99	1.05	1.66	1.04
TI – YBI[3]	1.70	1.17	1.70	1.17	1.70	1.17
Parkmerced[4]	0.98	0.94	0.98	0.94	0.98	0.94
Projects Subtotal	**4.38**	**3.16**	**4.67**	**3.16**	**4.34**	**3.16**
Existing Demand at Project Sites[5]	-1.51	-1.51	-1.51	-1.51	-1.51	-1.51
Net Development Subtotal	**2.87**	1.64	**3.16**	1.65	**2.83**	1.64
Other Growth in SF (City and County)[6]	0.24	0.24	0.24	0.24	0.24	0.24
Net Change in Water Demand with Non-Residential Adjustment[7]		**1.88**[7]		**1.89**[7]		**1.88**[7]

(1) Average annual demands. Residential water demands for the proposed projects were provided to the City by project developer. They were also developed using an end use model on a per unit or per employee basis. The developer demands were independently reviewed by PBS&J and the SFPUC as part of this Study, and appear consistent with the SFPUC demand estimates. (Appendix B)

(2) CP-HPS Phase II Arup – Winzler & Kelly Water Demand Memo September 25, 2009 Appendix B

(3) Treasure Island Technical Memo Section 7 August 2009. Appendix B

(4) Parkmerced Water Demand Spreadsheet from August 2009 Appendix B

(5) Existing demand provided by SFPUC from current billing records

(6) Derived by SFPUC staff based on approximately 2,387 dwelling units at 98.7 gpd. August 2009 Appendix X

(7) To avoid double-counting the water demand associated with the 2009 SF Planning Non-Residential Employment Projections and the non-residential demand calculated in the developer estimates at each of the Project sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This study assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections.

For conservative water supply planning purposes, this Study uses the highest total water demand adjusted for non-residential uses[5] of 1.89 mgd associated with the R&D Variant at CP-HPS II. The net change in demand accounts for existing uses at the project site and a non-residential demand adjustment.

5.2.2 Water Demand of Non-Residential Employment Projections

As shown above in Table 5-1, the SF Planning and ABAG projected new job growth in the San Francisco based on the employment changes in the San Francisco Bay Area as described in Section 5.1.1 above.

Demand projections for overall City growth were based on 2010-2030 average per-unit use factors of the Demand Report. The Demand Report analyzed water demands associated with each Retail customer sector and established per unit-use rates. As such, between 2010 and 2030, SFPUC used an average of 42.42 gallons per day (gpd) per employee for non-residential water demands. In an effort to represent the employment opportunities over the 20-year planning horizon this Study assumes that the non-residential employment sector would grow at a linear rate over the same planning period without accounting for market force influences and changes in local economics. As shown in Table 5-5, the 42.42 gpd per employee water demand rate was applied to the growth in jobs over the 20-year planning horizon. In 2015, demand is expected to be 30.52 mgd and by 2030, water demand generated through employment is expected to reach 31.73 mgd.

Table 5-5: Water Demand for Non-Residential Employment Projections

Employment Projections and Non-Residential Demand	2010	2015	2020	2025	2030
SF Planning Employment Total[(1)] (jobs)	712,145	719,447	726,749	734,050	748,100
Non-Residential - Business/Industrial Demand[(2)] (mgd)	30.21	30.52	30.83	31.14	31.73

(1) Table 5-1 2009 SF Planning Projections
(2) Average of 42.42 gallons per day (gpd) per employee for non-residential water demands.

5.2.3 SFPUC Total Retail System Demand

The SFPUC incorporated the 2009 SF Planning projections for residential and non-residential growth in San Francisco into this Study to assess the results of the SF Planning projections and its effects on the City's water demand. The previous tables (5-3 and 5-4) along with demand data from the 2005 UWMP is incorporated in the City's total Retail demand. The results of these 2009 demand forecasts are shown in Table 5-6. The table represents the anticipated growth in demand commencing in 2010 and extending over the 20-year planning horizon to 2030.

5 To avoid double-counting the water demand associated with the 2009 Non-Residential Planning Projections and the non-residential demand calculated in the developer estimates at each of the Project sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This study assumes all non-residential demand is accounted for in the 2009 Non-Residential SF Planning Projections. Table 5-2 shows the net change in water demand at the Project sites and the adjusted change in water demand without non-residential demand.

As shown in Table 5-6, incremental residential growth demand and demand at the Project sites commences in 2015 at 0.47 mgd and progresses to 1.89 mgd in 2030. In 2015, demand drops slightly due to a reduction in total residential demand. The non-residential demand commences in 2010 at 30.21 mgd, increases to 30.83 mgd and culminates at 31.73 in 2030.

Table 5-6 shows total Retail demands for SFPUC beginning in 2010 at 91.81, and then drops slightly in 2015 because of a drop in residential demand and then increases to 91.87 mgd in 2020. By 2030, Retail demand will be approximately 93.42 mgd.

Table 5-6: SFPUC Retail Demand (mgd)

Users, Facilities and Entities	Projected Water Demand (mgd)				
	2010	**2015**	**2020**	**2025**	**2030**
Residential Demand (Single & Multiple Family)(1)	44.70	43.80	43.20	42.90	42.90
New Residential Demand generated by Projects and Incremental Growth(2)(4)	-	0.47	0.95	1.42	1.89
Subtotal	44.70	44.27	44.15	44.32	44.79
Non-Residential - Business/Industrial Demands(3,4)	30.21	30.52	30.83	31.14	31.73
Subtotal	**74.91**	**74.79**	**74.97**	**75.46**	**76.52**
Unaccounted-for System Losses	7.30	7.30	7.30	7.30	7.30
Subtotal	**82.21**	**82.09**	**82.27**	**82.76**	**83.82**
Other Retail Demands(5)	4.90	4.90	4.90	4.90	4.90
Lawrence Livermore Laboratory; Groveland CSD(6)	1.20	1.20	1.20	1.20	1.20
City Irrigation Demand(7)	2.5	2.5	2.5	2.5	2.5
Castlewood Community Demand(8)	1.0	1.0	1.0	1.0	1.0
Total Retail Demand	**91.81**	**91.69**	**91.87**	**92.36**	**93.42**

(1) Residential Demands (Source: 2005 SFPUC UWMP Table 8B, page 43)

(2) See Table 5-4. Multiple Family – [In 2030 Incremental Growth of 0.24 mgd + (CP-HPS II 10,500 DU) 1.04 mgd + (TI-YBI 8,000 DU) 1.17 mgd + (Parkmerced 8,900 total DU) 0.94 mgd = 3.40 mgd] Existing Demand is 1.51 mgd at all sites. [3.40 mgd – 1.51 = 1.89 mgd] as shown in Table 4-2 (Sources: ARUP Water Demand Memo for CP-HPS Phase II September 25, 2009; Parkmerced Water Demand Spreadsheet June 30, 2009; Treasure Island Water Technical Report December 2008 Updated August 2009)

(3) See Table 5-5. Agriculture, Mining, Construction, Manufacturing, Transportation, Wholesale & Retail Trade, F.I.R.E., Services, Gov't including Builders – Contractors and Docks – Shipping. (Source: Adapted from 2009 ABAG Employment Projections in conjunction with SF Planning, July 2009) As developed in the Demand Study, SFPUC derived the employment water demands by taking the ABAG employment projections and multiplying by 42.42 gallons per employee per day and is consistent with SFPUC's demand projection methodology.

(4) See Table 5-5. Non-residential (jobs/employment) demands at major project sites were assumed to be contained in the 2009 ABAG Employment projections. Growth in demand is incrementally increased to reflect the growth in jobs over the 20-year planning horizon. To avoid double-counting the water demand associated with the 2009 SF Planning Non-Residential Employment Projections and the non-residential demand calculated in the developer estimates at each of the Project sites, the total water demand at each of the developments was adjusted to remove the non-residential demands. This study assumes all non-residential demand is accounted for in the 2009 SF Planning Non-Residential Employment Projections. Table 5-4 shows the net change in water demand at the Project sites and the adjusted change in water demand without non-residential demand. Adapted by PBS&J and SFPUC September 2009 from ARUP Water Demand Memo for CP-HPS Phase II September 25, 2009; Parkmerced Water Demand Spreadsheet June 30, 2009; Treasure Island Water Technical Report December 2008 Updated August 2009

(5) US Navy, SF International Airport, and other suburban/municipal accounts. (Source: 2005 SFPUC UWMP Table 8B, page 43)

(6) Lawrence Livermore Laboratories (0.8 mgd); Groveland CSD (0.4 mgd) (Source: 2005 SFPUC UWMP Table 8B, page 43)

(7) City Irrigation at Golden Gate Park, Great Highway Median and SF Zoo. (Source: 2005 SFPUC UWMP Table 8B, page 43)

(8) Castlewood Community demand served by wells in the Pleasanton well field. (Source: 2005 SFPUC UWMP Table 8B, page 43)

5.2.4 Potential Recycle Water Demand of the Projects

In addition to providing estimated potable water demands, each of the Projects also provided the City with estimated recycled water demands. Each of the Projects anticipates developing new recycled water projects to help offset potable demand. As shown in Table 5-7, the Projects may produce up to 1.49 or 1.5 mgd of recycled water.

Table 5-7: Potential Recycled Water Demand of the Projects (mgd)

Development	Recycled Water Demand(1) (mgd)
CP-HPS II	0.89
TI-YBI	0.38
Parkmerced	0.22
Total	**1.49**

Notes: Average annual recycled water demand.
(1) Sources: ARUP Water Demand Memo for CP-HPS Phase II September 25, 2009; Parkmerced Water Demand Spreadsheet June 30, 2009; Treasure Island Water Technical Report December 2008 Updated August 2009. Appendix B

The recycled water potential shown in Table 5-7 is considered additional recycled water sources and have not been included as part of SFPUC's local WSIP supplies. In the event that recycled water is produced at the Project sites, recycled water could offset as much as 1.5 mgd in total City potable demand. This Study provides a conservative analysis of SFPUC's Retail supplies and demands and, as such, evaluates the City's demands to include the proposed projects without recycled water.

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6.0 SUPPLY AND DEMAND COMPARISON

This section compares the SFPUC's Retail water supplies and demands through year 2030.

6.1 Supply and Demand Comparison

Table 6-1 compares SFPUC Retail supplies and demand during normal, single dry year, and multiple dry year periods. Section 2.3.6 discusses SFPUC's total water supplies now and over the 20-year planning period. In 2010, prior to the development of the 10 mgd of local supplies, SFPUC can access an annual average 84.50 mgd from all water supply sources. Beginning in 2015, when the WSIP water supply sources are readily available, the SFPUC's Retail water supplies increase to 94.5 mgd. These supplies are assumed to be available in the quantities listed in Table 6-1. SFPUC intends to use these supplies to meet its Retail customer demands.

The demand estimates in this Study show that the 2009 SF Planning projections result in an increase in City Retail demand. As stated previously, by 2030 Retail demand is estimated at 93.42 mgd. This increase, however, does not change the findings in the 2005 UWMP, which estimated demand at 93.4 mgd in 2030.[6] As shown in Table 6-1, the SFPUC can meet the current and future demands of its Retail customers in normal years, single dry-years and nearly all multiple dry-year events with the exception of years 2 and 3 in 2030.

As modeled in Table 6-1, the deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd as per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. It is expected that 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (Fiscal Year 2007-2008 use was 83.9 mgd). If Retail demand exceeds the available RWS supply of 81.0 mgd between 2010 and 2015, and total RWS deliveries exceed 265 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water with the payment of an Environmental Surcharge. Notably, total RWS deliveries in Fiscal Year 2007-2008 were 256.7 mgd, which is 8.3 mgd below the 265 mgd watershed delivery goal.

As shown in Table 6-1, during a multiple dry-year event[7] commencing in 2030, it is possible that the SFPUC will not be able to meet 100 percent of Retail demand in 2030. As modeled, a supply shortfall of 0.42 mgd is anticipated to occur in the second and third year of a multiple dry-year event. To overcome the potential 0.42 mgd supply deficit during multiple dry-years in 2030, the SFPUC will implement their adopted drought planning sequence and associated operating procedures that trigger different levels of water delivery reduction rationing relative to the volume of water actually stored in SFPUC reservoirs. If the SFPUC determines the projected total water storage to be less than an identified level sufficient to provide sustained deliveries during drought, the SFPUC may impose delivery reductions or rationing. The WSAP and RWSAP allow the SFPUC to reduce water deliveries to customers during periods of water shortage to

6 SFPUC 2005 Urban Water Management Plan Table 8B, page 43.

7 Multiple dry-year events are defined as a three-year event per UWMP requirements. SFPUC determined that a multiple dry-year event is years 2-4 of SFPUC's 8.5 year design drought. SFPUC can meet 100 percent of deliveries in the first year of such an event.

achieve a positive balance of supplies and demands. Under WSAP, the RWS supply curtailment in multiple dry years of 1.5 mgd to 79.5 mgd, results in a 1.9 percent reduction as shown in Table 4-2. The SFPUC, as part of the WSIP, adopted a water reliability objective of no greater than 20 percent rationing in any one year of a drought.

Table 6-1: Projected Supply and Demand Comparison - Normal, Dry, and Multiple Dry Years (mgd)

				Multiple Dry Year Event		
	Retail Supply and Demand	**Normal Year**	**Single Dry Year**	**Year 1**	**Year 2**	**Year 3**
2010	RWS Supply[1]	81.00	81.00	81.00	79.50	79.50
	Groundwater Supply[2]	3.50	3.50	3.50	3.50	3.50
	Total Retail Supply[3]	84.50	84.50	84.50	83.00	83.00
	Total Retail Demand[4]	91.81	91.81	91.81	91.81	91.81
	Surplus/(Deficit)[5]	-7.31	-7.31	-7.31	-8.81	-8.81
2015	RWS Supply[1]	81.00	81.00	81.00	79.50	79.50
	Groundwater[6]	3.50	3.50	3.50	3.50	3.50
	WSIP Supply Sources[7]	10.00	10.00	10.00	10.00	10.00
	Total City Supply[3]	94.50	94.50	94.50	93.00	93.00
	Total Retail Demand[4]	91.69	91.69	91.69	91.69	91.69
	Surplus/(Deficit)	2.81	2.81	2.81	1.31	1.31
2020	RWS Supply[1]	81.00	81.00	81.00	79.50	79.50
	Groundwater[6]	3.50	3.50	3.50	3.50	3.50
	WSIP Supply Sources[7]	10.00	10.00	10.00	10.00	10.00
	Total City Supply[3]	94.50	94.50	94.50	93.00	93.00
	Total Retail Demand[4]	91.87	91.87	91.87	91.87	91.87
	Surplus/(Deficit)	2.63	2.63	2.63	1.13	1.13
2025	RWS Supply[1]	81.00	81.00	81.00	79.50	79.50
	Groundwater[6]	3.50	3.50	3.50	3.50	3.50
	WSIP Supply Sources[7]	10.00	10.00	10.00	10.00	10.00
	Total City Supply[3]	94.50	94.50	94.50	93.00	93.00
	Total Retail Demand[4]	92.36	92.36	92.36	92.36	92.36
	Surplus/(Deficit)	2.14	2.14	2.14	0.64	0.64
2030	RWS Supply[1]	81.00	81.00	81.00	79.50	79.50
	Groundwater[6]	3.50	3.50	3.50	3.50	3.50
	WSIP Supply Sources[7]	10.00	10.00	10.00	10.00	10.00
	Total City Supply[3]	94.50	94.50	94.50	93.00	93.00
	Total Retail Demand[4]	93.42	93.42	93.42	93.42	93.42
	Surplus/(Deficit)	1.08	1.08	1.08	-0.42[8]	-0.42[8]

(1) RWS Supply (SFPUC Water Supplies Table 2-2)
(2) Groundwater Uses for In-City Irrigation and Castlewood (SFPUC Water Supplies - Table 2-2)
(3) Total Retail Supply (SFPUC Water Supplies Table 2-2)
(4) SFPUC Retail Demand (SFPUC Retail Demand Table 5-6)
(5) The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).
(6) Groundwater Supplies at Castlewood and In-City Irrigation (SFPUC Water Supplies Table 2-2)
(7) WSIP Supply Sources (Recycled Water (4.0 mgd; Groundwater (2.0 mgd Existing and 2.0 from NWGWP, and WSIP Water Efficiency and Conservation (4.0 mgd) (see SFPUC Water Supplies Table 2-2)
(8) Deficit occurs in year 2 and 3 of multiple dry year event, SFPUC implements its Drought Year Water Shortage Contingency Plans - RWSAP and WSAP to balance supply and demand under this projected shortfall as described in Section 4.0

6.2 Conclusion and Findings

The updated 2009 SF Planning projections results in a Retail demand in 2030 of 93.42 mgd, which is only slightly greater than the 2030 demand projections estimated in the 2005 UWMP. This increase, however, does not change the results of the 2005 UWMP. In years with normal or above-normal precipitation, the City has sufficient supplies to serve their Retail customers.[8] The ability to meet the demands of the Retail customers is in large part due to the development of 10 mgd of local WSIP supplies in the Retail service area. These new sources of groundwater, recycled water, and water conservation are essential to provide the City with adequate supply in dry year periods, as well as improving supply reliability during years with normal precipitation. Although the 2005 UWMP considered the 10 mgd of new WSIP sources in terms of system-wide drought-planning, the WSIP supplies were not assigned to either the Retail or Wholesale Customers directly as it was not known how the resources would be used. As presented in this Study, with the adoption of the Phased WSIP Variant, the WSIP supplies can now be applied to meet Retail demands. In addition, due to the nature and development of the local supplies, these WSIP supply sources are not subject to reduction under the WSAP.

During a multiple dry-year event, however, it is possible that the SFPUC will not be able to meet 100 percent of demand from its Retail customers in 2030, and will therefore have to impose reductions on its Retail supplies. Under the WSAP, SFPUC Retail customers would experience no reduction in deliveries at a 10 percent RWS shortage. However, during a 20 percent system-wide shortage, the Retail customers would experience a 1.9 percent reduction in Retail deliveries. Table 6-1 compared SFPUC Retail supplies during normal, single dry year, and multiple dry year periods. The main difference between 2010 and subsequent planning years (2015–2030) is due to the development of the additional 10 mgd of local WSIP supplies in the Retail service area. These WSIP local supplies are not subject to a reduction under the WSAP, as the WSAP only allocates water from the RWS, which is subject to reductions.

The Projects anticipate developing new recycled water projects to help offset potable demand. These new projects may produce up to 1.5 mgd of recycled water. By reducing their potable water demands through the use of recycled water, these projects have the ability to eliminate the City's overall water shortage during multiple dry year periods.

8 The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).

Regarding the availability of water supplies to serve the City, beginning in 2015 the SFPUC finds as follows:

- In years of average and above-average precipitation and including development of SFPUC's local WSIP water supply sources the SFPUC has adequate supplies to serve 100 percent of normal, single dry and multiple dry year demand up to 2030.[9]
- In multiple-dry-year events after 2030, when the SFPUC imposes reductions in its supply, the SFPUC has in place the WSAP and RWSAP to balance supply and demand.
- If recycled water is implemented as proposed at each of the major development project sites, then it is assumed that potable water demands for the City can decrease by up to 1.5 mgd; thereby, eliminating potential multiple dry-year deficit after 2030.
- With the WSAP and RWSAP in place, and the addition of local WSIP supplies, the SFPUC finds it has sufficient water supplies available to serve its existing Retail customers and planned future uses.

9 The deficit shown in 2010 is the result of reducing the RWS supply to 81 mgd per the Phased WSIP Variant, without full development of the additional 10 mgd of new WSIP supplies. 10 mgd of new sources will be developed and available for use in San Francisco by 2015. However, Retail demand is currently lower than the 2010 projected demand (FY 07/08 use was 83.9 mgd). If Retail demand exceeds the available supply of 84.5 mgd between 2010 and 2015, the Water Supply Agreement allows the SFPUC to purchase additional water from the RWS. If combined Retail and Wholesale RWS deliveries exceed 265 mgd, the SFPUC Retail customers would be required to pay an Environmental Surcharge for RWS deliveries over 81 mgd (Total RWS deliveries in FY07/08 were 256.7 mgd).

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APPENDICES

A Growth Projections Letter from San Francisco Planning Department
B Major Projects Water Demand Estimates from Project Sponsors

APPENDIX A

Growth Projections Letter from San Francisco Planning Department

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July 9, 2009

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Deputy General Manager, SFPUC
1155 Market St, 11th Floor
San Francisco, CA 94103

Subject: Projections of growth by 2030

Dear Michael:

Thank you for your letter dated March 11, 2009 requesting the Planning Department's projections of growth by 2030 in order to satisfy your mandates in connection with assessing water supply and demand in the years to come, and more specifically for preparing water supply assessments for individual projects moving forward.

The Planning Department routinely prepares projections for the purposes of analyzing impacts of plans and projects undergoing the environmental review process. While the assumptions of these sets may vary depending on the circumstances surrounding a specific project, the Department recently completed a citywide projection capturing citywide growth expectations by 2030 designed to closely match the recently adopted ABAG Projections 2009 target, but taking into account local knowledge of projects currently in various stages of the entitlement process, commonly referred to as the development pipeline. Table 1 shows the projections for 2030.

Table 1 Development Projections

	2000	2005	2030	Growth 2000-2030	Growth 2005-2030
Households	329,700	341,478	403,292	73,592	61,814
HH Population	756,976	783,441	916,800	159,824	133,359
Jobs	642,500	553,090	748,100	105,600	195,010

Source: ABAG, San Francisco Planning Department

As the question may arise whether particular projects were included, the Planning Department for the purposes of these numbers assumed full buildout over the course of the forecast period of three large development programs currently undergoing environmental review, namely Treasure Island, Bayview Waterfront, and Park Merced projects.

More generally, we included entitled pipeline projects, and projects larger than 500 units, or large commercial projects per criteria set forth in California Water Code §10912(a) as these are the projects for which individual water supply assessments would otherwise need to be made in the near future.

We are looking forward to continuing the larger regional growth dialogue with PUC and other regional stakeholders.

Sincerely,

John Rahaim
Director of Planning

CC: Aksel Olsen
Teresa Ojeda
File

APPENDIX B

Major Projects Water Demand Estimates from Project Sponsors

[Candlestick Point/Hunter's Point Shipyard; Parkmerced; Treasure Island-Yerba Buena Island]

To	Lennar -	Reference number	131878/RRJ
cc		File reference	
From	Rowan Roderick-Jones/Manish Dalia x 27222 (San Francisco)	Date	October 15, 2009
Subject	**Candlestick Point / Hunters Point Shipyard Phase II Water Demand Memorandum Revision # 16**		

1 Purpose

This Water Demand Memorandum (Memo) presents a summary approach, references, assumptions, and results of calculations undertaken by Arup to estimate a range of potential water demands and sanitary sewer flows for the Candlestick Point/Hunters Point Shipyard (CP/HPS) Development including the Proposed Project as well as the R&D and Housing Variants.

The Memo establishes a historical baseline condition and makes adjustments to account for current California building code requirements as well as the San Francisco Green Building Ordinance. The basis for these analyses and the results are presented herein.

Arup worked in conjunction with Winzler & Kelly to develop water demand and sanitary sewer flow values appropriate for use in engineering design.

2 Approach

To develop reasonable water demand estimates for the CP/HPS development the following steps were taken.

1) The Proposed Project was divided into land uses as identified in Table 1. Two project variants exclude the stadium. The R&D Variant also includes an additional 2,500,000 square feet of research and development space, as shown in Table 2. The Housing Variant does not include any additional program but shifts 1,350 housing units from Candlestick Point to Hunters Point, as shown in Table 4. The methodology for developing water demands was the same for the Proposed Project and Project Variants.
2) A **Historical Benchmark** demand was estimated for each land use based on a series of assumptions and references. Key references used were:
    a. The Urban Water Management Plan for the City of San Francisco
    b. The SFPUC Wholesale Customer Demand Projections Technical Report (URS, 2004)
    c. The City of Los Angeles CEQA Threshold Guide, 2006
    d. The EPA, Onsite Wastewater Treatment Systems Manual, 2002

A number of other references were also used and these are provided at the end of this memorandum. Arup collected information from a number of sources and selected a method of estimating demands that we believed to be appropriate and reasonable for the area. Assumptions and references are provided in Section 4.

3) The demands were then distributed between indoor and outdoor end uses which were estimated based on published data in the SFPUC Wholesale Customer Demand Projections Report (URS 2004). End use distributions for the stadium and performance venues were assumed rather than taken directly from the SFPUC's projections. The distribution ratios are provided in Table 23 and Table 25.

4) Next, the Historical Benchmark was adjusted to an **Adjusted to California Codes** scenario using new fixture flow rates from California and Federal Buildings standards as well as the International Plumbing Code.

5) The Adjusted to California Codes demand estimate does not include the requirements of the **San Francisco Green Building Ordinance (SFGBO)**. The SFGBO is based on LEED for New Construction (LEED NC) and requires a 50% reduction in landscape irrigation demands. The SFGBO does not specify what code is to be used as the baseline for irrigation demands. Therefore the current code was assumed to be equivalent to the irrigation amount allowed under the California Water Efficient Landscape Ordinance. This rule was assumed to be applicable to both private and public landscape irrigation. In addition, the SFGBO requires a 30% reduction in potable water demand. The SFGBO does not provide specific language as to which portions of demand are to be included in the 30% reduction. However, the intention of the similar LEED NC credit (Water Efficiency Credit 3) is to reduce building water demand by 30%. The total 30% reduction in building water efficiency may be achieved by any number of means including improved fixture efficiency, mechanical building efficiency, or by providing an alternative water supply. The demand estimates, when adjusted for the SFGBO represent the final demands for the Proposed Project and Project Variants.

   The SFGBO demand was developed by using the California code as a baseline and using a trajectory or possible means of water saving strategies and/or alternative water supplies to achieve the SFGBO. The assumptions and references used to make these adjustments are provided in Table 27.

6) Potential reclaimed water demands as well as sewage generation were determined based on end use distributions.

The results of the study are presented at the beginning of this report. References and Assumptions used for making the demand estimations are provided after the results in Section 3.

Table 1: CP/HPS Land Use Program (Proposed Project)

		Hunters Point Shipyard	Candlestick Point	Project Total
Land Use				
Residential				
	Density, 15-75 units per acre (units)	680	750	1,430
	Density, 50-125 units per acre (units)	1,415	3,215	4,630
	Density, 100-175 units per acre (units)	265	2,445	2,710
	Density, 175-285 units per acre (units)	290	1,440	1,730
	Total Project (units)	**2,650**	**7,850**	**10,500**
Retail				
	Regional Retail (sqft))	0	635,000	635,000
	Neighborhood Retail (sqft)	125,000	125,000	250,000
	Total (sqft)	**125,000**	**760,000**	**885,000**
Office (sqft)		0	150,000	150,000
Community Uses (sqft)		50,000	50,000	100,000
Research & Development (sqft)		2,500,000	0	2,500,000
Hotel (sqft)		0	150,000	150,000
Artist's Studios				
	1:1 Studio Renovation & Replacement (sqft)	225,000	0	225,000
	New Artist Center (sqft)	30,000	0	30,000
	Total (sqft)	**255,000**	**0**	**255,000**
Parks & Open Space				
	New City Parks (acres)	140	8.1	148.1
	New Sports Fields & Active Recreation (acres)	91.6	0	91.6
	New Open Space and Restored State Parkland (acres)	0	96.7	96.7
	Total (acres)	**231.6**	**104.8**	**336.4**
Football Stadium (seats)		69,000	0	69,000
Performance Venue (seats)		0	10,000	10,000
Source: Lennar, 2009				

Table 2: CP/HPS Land Use Program (R&D Variant)

		Hunters Point Shipyard	Candlestick Point	Project Total
Land Use				
Residential				
	Density, 15-75 units per acre (units)	680	750	1,430
	Density, 50-125 units per acre (units)	1,415	3,215	4,630
	Density, 100-175 units per acre (units)	265	2,445	2,710
	Density, 175-285 units per acre (units)	290	1,440	1,730
	Total Project (units)	**2,650**	**7,850**	**10,500**
Retail				
	Regional Retail (sqft))	0	635,000	635,000
	Neighborhood Retail (sqft)	125,000	125,000	250,000
	Total (sqft)	**125,000**	**760,000**	**885,000**
Office (sqft)		0	150,000	150,000
Community Uses (sqft)		50,000	50,000	100,000
Research & Development (sqft)		5,000,000	0	5,000,000
Hotel (sqft)		0	150,000	150,000
Artist's Studios				
	1:1 Studio Renovation & Replacement (sqft)	225,000	0	225,000
	New Artist Center (sqft)	30,000	0	30,000
	Total (sqft)	**255,000**	**0**	**255,000**
Parks & Open Space				
	New City Parks (acres)	152.4	8.1	160.5
	New Sports Fields & Active Recreation (acres)	69.8	0	69.8
	New Open Space and Restored State Parkland (acres)	0	96.7	96.7
	Total (acres)	**222.2**	**104.8**	**327**
Football Stadium (seats)		0	0	0
Performance Venue (seats)		0	10,000	10,000
Source: Lennar, 2009				

.

Table 4: CP/HPS Land Use Program (Housing Variant)

		Hunters Point Shipyard	Candlestick Point	Project Total
Land Use				
Residential				
	Density, 15-75 units per acre (units)	1,540	970	2,510
	Density, 50-125 units per acre (units)	1,905	3,670	5,575
	Density, 100-175 units per acre (units)	265	1,220	1,485
	Density, 175-285 units per acre (units)	290	640	930
	Total Project (units)	**4,000**	**6,500**	**10,500**
Retail				
	Regional Retail (sqft))	0	635,000	635,000
	Neighborhood Retail (sqft)	125,000	125,000	250,000
	Total (sqft)	**125,000**	**760,000**	**885,000**
Office (sqft)		0	150,000	150,000
Community Uses (sqft)		50,000	50,000	100,000
Research & Development (sqft)		2,500,000	0	2,500,000
Hotel (sqft)		0	150,000	150,000
Artist's Studios				
	1:1 Studio Renovation & Replacement (sqft)	225,000	0	225,000
	New Artist Center (sqft)	30,000	0	30,000
	Total (sqft)	**255,000**	**0**	**255,000**
Parks & Open Space				
	New City Parks (acres)	149.9	8.1	158
	New Sports Fields & Active Recreation (acres)	94.7	0	94.7
	New Open Space and Restored State Parkland (acres)	0	96.7	96.7
	Total (acres)	**244.6**	**104.8**	**349.4**
Football Stadium (seats)		69,000	0	69,000
Performance Venue (seats)		0	10,000	10,000
Source: Lennar, 2009				

3 Results

This section provides the results of the water demand assessment. The results are provided by land use as well as by end use (fixture type). The overall results for the proposed project are summarized by Figure 1. Similar summaries for the two project variants are provided in Figure 3and Figure 5.

Table 4: Potable water demands for Proposed Project and Project Variants.

	Proposed Project Demand (MGD)	R&D Variant Demand (MGD)	Housing Variant Demand (MGD)
Historical Baseline	2.95	3.47	2.92
Adjusted to California Codes	2.46	2.92	2.44
Adjusted to San Francisco Green Building Ordinance	1.67	1.99	1.66

The above table indicates that the R&D Variant will have the highest potable water demands under the requirements of the SFGBO of 1.99 MGD.

Figures 1 through 3 provide the Proposed Project and Project Variant demands for the Historical Benchmark, the Adjusted to California Codes and the San Francisco Green Building Ordinance cases. They also illustrate the Sustainable Case trajectory defined by the step down line. The first five steps in the "sustainable Case" step-down graph are demand reduction strategies while the later five steps are achieved by utilizing alternative water supplies. Additional demand breakdowns by land use and end use are provided in Table 5 through Table 14 for the Proposed Project and Project Variants. Reclaimed water demands and sanitary flows by end use for the Proposed Project are provided in Table 16 through Table 22.

Please note that in all reported annual water demand and sanitary flow data in Table 5 through Table 22 are in million gallons per day (MGD) and are rounded to the nearest 0.01 millionth gallon. When reporting the calculations within the tables slight rounding errors on the order of 0.01 MGD may occur.

Figure 1: Water demand results summary step down graph- Proposed Project

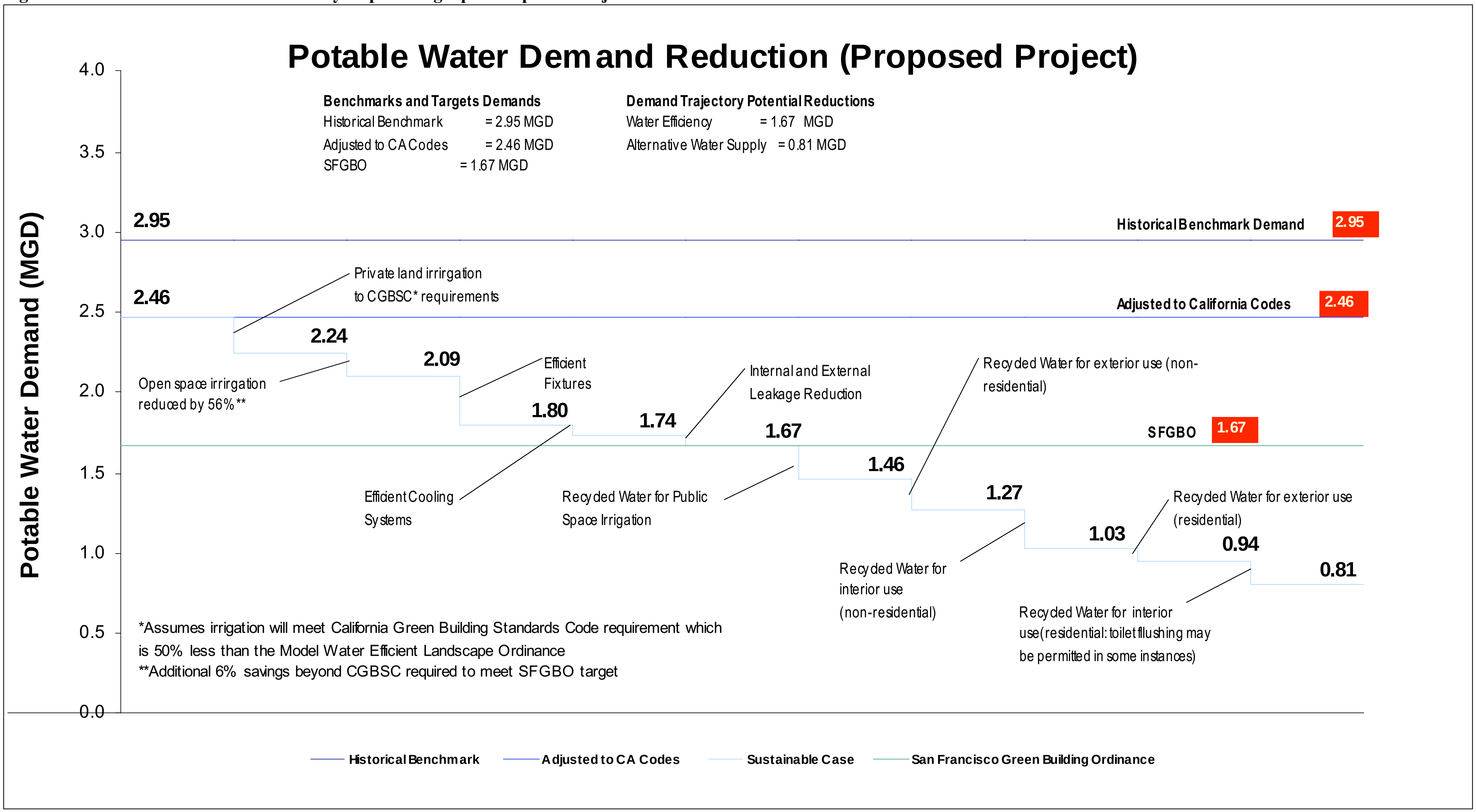

Figure 3: Water demand results summary (R&D Variant)

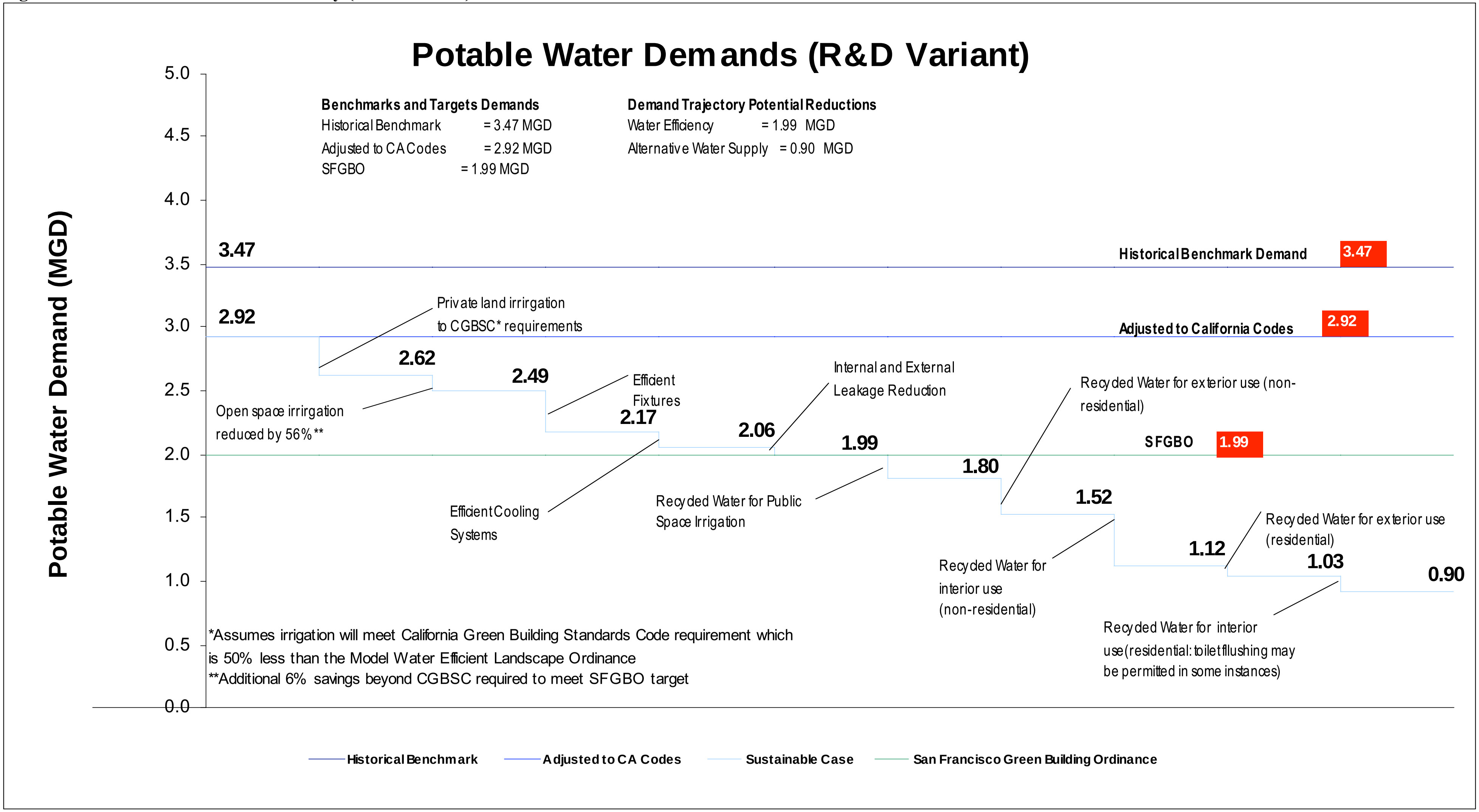

Figure 5: Water demand results summary (Housing Variant)

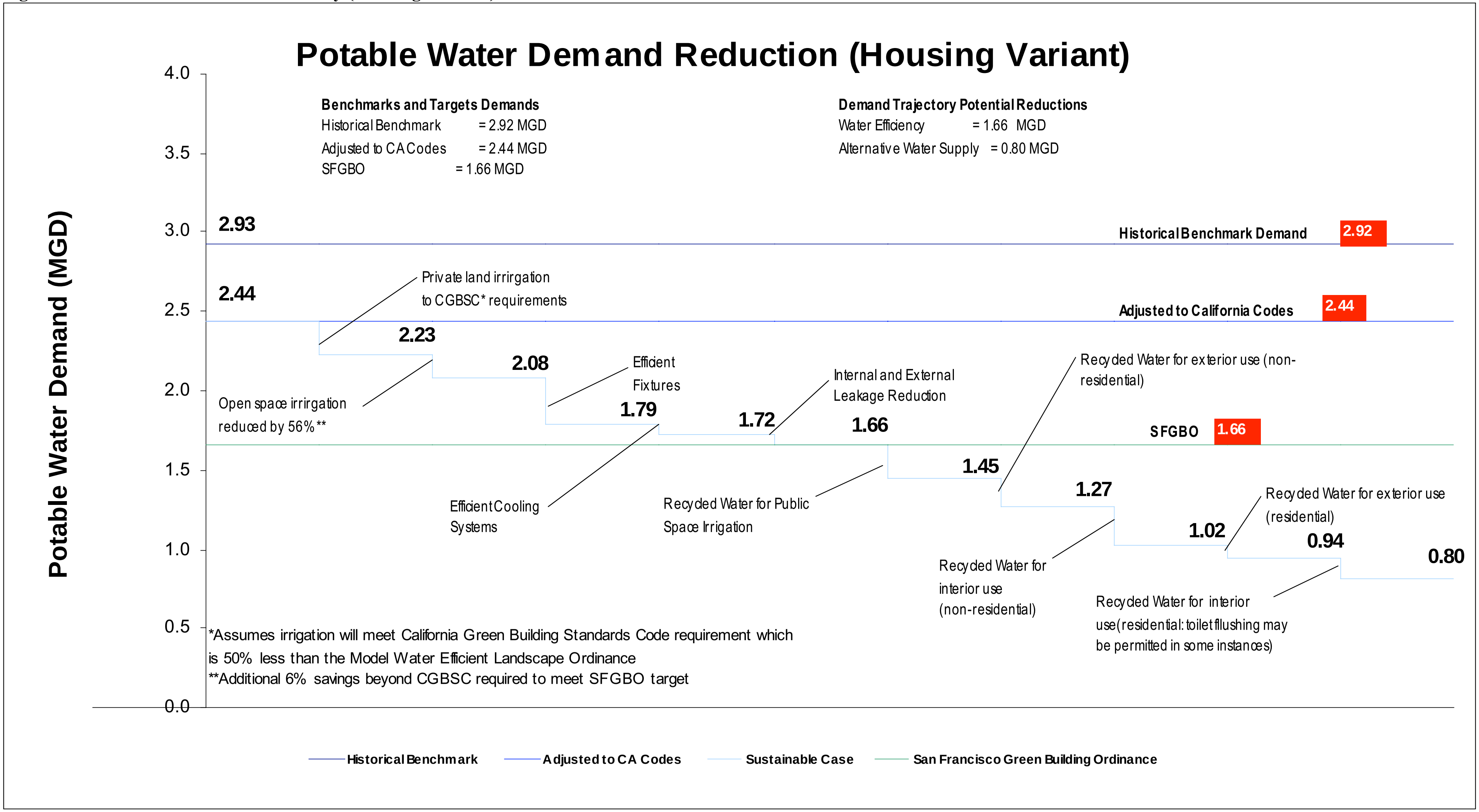

Table 5: Historical Benchmark demand by land use and end use – Proposed Project

Land Use	Historical Benchmark Demand (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	1.13	0.38	1.52
Hotel	0.08	0.00	0.08
Office	0.07	0.01	0.08
Artist Studios	0.00	0.03	0.03
Research and Development	0.00	0.61	0.61
Neighborhood Retail	0.03	0.03	0.06
Regional Retail	0.13	0.00	0.13
Community Uses	0.02	0.02	0.03
Football Stadium	0.00	0.05	0.05
Performance Venue	0.03	0.00	0.03
Total demand excluding Parks and Open Space	**1.49**	**1.11**	**2.60**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.59**	**1.36**	**2.95**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.03	0.01	0.04
Toilets (med-high density Residential)	0.25	0.08	0.32
Toilets (all other uses)	0.05	0.10	0.15
Urinals	0.01	0.02	0.02
Laundry (low density residential)	0.02	0.01	0.03
Laundry (medium and high density residential)	0.20	0.06	0.26
Laundry (all other uses)	0.02	0.03	0.04
Shower	0.19	0.08	0.27
Bath	0.02	0.01	0.02
Faucets	0.19	0.10	0.29
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.16	0.09	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**1.24**	**0.76**	**2.00**
Outdoor Uses			
Irrigation and landscaping	0.18	0.27	0.45
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.24**	**0.36**	**0.60**
Total excluding Parks and Open Space	**1.49**	**1.11**	**2.60**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.59**	**1.36**	**2.95**

*Note: Rounding errors may occur.

Table 6: Adjusted to CA Codes demand by land use and end use- Proposed Project

	Adjusted to CA Codes Demand (MGD)		
Land Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Residential	0.87	0.29	1.16
Hotel	0.07	0.00	0.07
Office	0.06	0.01	0.07
Artist Studios	0.00	0.02	0.02
Research and Development	0.00	0.54	0.54
Neighborhood Retail	0.02	0.02	0.05
Regional Retail	0.12	0.00	0.12
Community Uses	0.01	0.01	0.03
Football Stadium	0.00	0.04	0.04
Performance Venue	0.02	0.00	0.02
Total demand excluding Parks and Open Space	**1.18**	**0.94**	**2.11**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.28**	**1.19**	**2.46**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.11	0.04	0.15
Toilets (all other uses)	0.02	0.05	0.07
Urinals	0.00	0.01	0.01
Laundry (low density residential)	0.02	0.01	0.02
Laundry (medium and high density residential)	0.14	0.05	0.19
Laundry (all other uses)	0.01	0.02	0.03
Shower	0.15	0.06	0.21
Bath	0.02	0.01	0.02
Faucets	0.16	0.09	0.25
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.16	0.09	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**0.93**	**0.58**	**1.51**
Outdoor Uses			
Irrigation and landscaping	0.18	0.27	0.45
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.24**	**0.36**	**0.60**
Total excluding Parks and Open Space	**1.18**	**0.94**	**2.11**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.28**	**1.19**	**2.46**

*Note: Rounding errors may occur.

Table 7: SFGBO demands by land use and end use – Proposed Project

Land Use	SFGBO Demand (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.61	0.22	0.83
Hotel	0.05	0.00	0.05
Office	0.04	0.00	0.04
Artist Studios	0.00	0.01	0.01
Research and Development	0.00	0.36	0.36
Neighborhood Retail	0.02	0.02	0.03
Regional Retail	0.08	0.00	0.08
Community Uses	0.01	0.01	0.02
Football Stadium	0.00	0.02	0.02
Performance Venue	0.01	0.00	0.01
Total demand excluding Parks and Open Space	**0.82**	**0.64**	**1.47**
Parks and Open Space	0.06	0.15	0.21
Total Demand	**0.88**	**0.79**	**1.67**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.09	0.03	0.12
Toilets (all other uses)	0.02	0.04	0.06
Urinals	0.00	0.00	0.00
Laundry (low density residential)	0.01	0.01	0.02
Laundry (medium and high density residential)	0.10	0.03	0.13
Laundry (all other uses)	0.01	0.01	0.02
Shower	0.10	0.04	0.15
Bath	0.02	0.01	0.02
Faucets	0.11	0.06	0.18
Process Water	0.04	0.10	0.14
Dishwashers	0.02	0.02	0.04
Internal Leakage	0.12	0.07	0.19
Other domestic	0.02	0.01	0.03
Subtotal	**0.68**	**0.42**	**1.11**
Outdoor Uses			
Irrigation and landscaping	0.09	0.14	0.24
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.01	0.04	0.05
External Leakage	0.01	0.01	0.02
Subtotal	**0.14**	**0.22**	**0.36**
Total excluding Parks and Open Space	**0.82**	**0.64**	**1.47**
Parks and Open Space	0.06	0.15	0.21
Total Demand	**0.88**	**0.79**	**1.67**

*Note: Rounding errors may occur.

Table 8: Historical Benchmark demand by land use and end use – R&D Variant

Land Use	Historical Benchmark Demand (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	1.13	0.38	1.52
Hotel	0.08	0.00	0.08
Office	0.07	0.01	0.08
Artist Studios	0.00	0.03	0.03
Research and Development	0.00	1.21	1.21
Neighborhood Retail	0.03	0.03	0.06
Regional Retail	0.13	0.00	0.13
Community Uses	0.02	0.02	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.04	0.00	0.04
Total demand excluding Parks and Open Space	**1.49**	**1.67**	**3.16**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.58**	**1.89**	**3.47**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.03	0.01	0.04
Toilets (med-high density Residential)	0.25	0.08	0.32
Toilets (all other uses)	0.05	0.18	0.23
Urinals	0.01	0.02	0.03
Laundry (low density residential)	0.02	0.01	0.03
Laundry (medium and high density residential)	0.20	0.06	0.26
Laundry (all other uses)	0.02	0.05	0.07
Shower	0.19	0.09	0.28
Bath	0.02	0.01	0.02
Faucets	0.19	0.14	0.33
Process Water	0.05	0.24	0.29
Dishwashers	0.03	0.06	0.09
Internal Leakage	0.16	0.12	0.28
Other domestic	0.03	0.01	0.04
Subtotal	**1.25**	**1.08**	**2.33**
Outdoor Uses			
Irrigation and landscaping	0.18	0.43	0.61
Pools and Fountains	0.01	0.02	0.03
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.10	0.12
External Leakage	0.01	0.03	0.04
Subtotal	**0.24**	**0.59**	**0.83**
Total excluding Parks and Open Space	**1.49**	**1.67**	**3.16**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.58**	**1.89**	**3.47**

*Note: Rounding errors may occur.

Table 9: Adjusted to CA Codes demand by land use and end use- R&D Variant

Land Use	Adjusted to Codes BAU Demand (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.87	0.29	1.16
Hotel	0.07	0.00	0.07
Office	0.06	0.01	0.07
Artist Studios	0.00	0.02	0.02
Research and Development	0.00	1.08	1.08
Neighborhood Retail	0.02	0.02	0.05
Regional Retail	0.12	0.00	0.12
Community Uses	0.01	0.01	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.02	0.00	0.02
Total demand excluding Parks and Open Space	**1.18**	**1.43**	**2.61**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.27**	**1.66**	**2.92**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.11	0.04	0.15
Toilets (all other uses)	0.02	0.08	0.11
Urinals	0.01	0.01	0.01
Laundry (low density residential)	0.02	0.01	0.02
Laundry (medium and high density residential)	0.14	0.05	0.19
Laundry (all other uses)	0.01	0.04	0.05
Shower	0.15	0.08	0.23
Bath	0.02	0.01	0.02
Faucets	0.17	0.12	0.29
Process Water	0.05	0.24	0.29
Dishwashers	0.03	0.05	0.08
Internal Leakage	0.16	0.12	0.28
Other domestic	0.03	0.01	0.04
Subtotal	**0.93**	**0.84**	**1.78**
Outdoor Uses			
Irrigation and landscaping	0.18	0.43	0.61
Pools and Fountains	0.01	0.02	0.03
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.10	0.12
External Leakage	0.01	0.03	0.04
Subtotal	**0.24**	**0.59**	**0.83**
Total excluding Parks and Open Space	**1.18**	**1.43**	**2.61**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.27**	**1.66**	**2.92**

*Note: Rounding errors may occur.

Table 10: SFGBO demands by land use and end use – R&D Variant

Land Use	SFGBO (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.62	0.21	0.83
Hotel	0.05	0.00	0.05
Office	0.04	0.00	0.04
Artist Studios	0.00	0.01	0.01
Research and Development	0.00	0.71	0.71
Neighborhood Retail	0.02	0.02	0.03
Regional Retail	0.08	0.00	0.08
Community Uses	0.01	0.01	0.02
Football Stadium	0.00	0.00	0.00
Performance Venue	0.01	0.00	0.01
Total demand excluding Parks and Open Space	**0.83**	**0.96**	**1.80**
Parks and Open Space	0.05	0.14	0.19
Total Demand	**0.89**	**1.11**	**1.99**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
	Indoor Uses		
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.09	0.03	0.12
Toilets (all other uses)	0.02	0.07	0.09
Urinals	0.00	0.00	0.00
Laundry (low density residential)	0.01	0.01	0.02
Laundry (medium and high density residential)	0.10	0.03	0.13
Laundry (all other uses)	0.01	0.03	0.03
Shower	0.10	0.05	0.16
Bath	0.02	0.01	0.02
Faucets	0.11	0.08	0.20
Process Water	0.04	0.18	0.22
Dishwashers	0.02	0.03	0.05
Internal Leakage	0.12	0.09	0.21
Other domestic	0.02	0.01	0.03
Subtotal	**0.68**	**0.62**	**1.31**
	Outdoor Uses		
Irrigation and landscaping	0.09	0.22	0.32
Pools and Fountains	0.01	0.02	0.03
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.01	0.08	0.09
External Leakage	0.01	0.02	0.03
Subtotal	**0.14**	**0.36**	**0.50**
Total excluding Parks and Open Space	**0.83**	**0.96**	**1.80**
Parks and Open Space	0.05	0.14	0.19
Total Demand	**0.89**	**1.11**	**1.99**

*Note: Rounding errors may occur.

Table 11: Historical Benchmark demand by land use and end use – Housing Variant

Land Use	Historical Benchmark Demand (MGD) Candlestick Point	Hunters Point	Total Development
Residential	0.94	0.58	1.52
Hotel	0.08	0.00	0.08
Office	0.07	0.01	0.08
Artist Studios	0.00	0.03	0.03
Research and Development	0.00	0.61	0.61
Neighborhood Retail	0.03	0.03	0.06
Regional Retail	0.13	0.00	0.13
Community Uses	0.02	0.02	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.04	0.00	0.04
Total demand excluding Parks and Open Space	**1.29**	**1.26**	**2.56**
Parks and Open Space	0.11	0.25	0.36
Total Demand	**1.40**	**1.51**	**2.92**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.05	0.05	0.10
Toilets (med-high density Residential)	0.18	0.09	0.26
Toilets (all other uses)	0.05	0.10	0.15
Urinals	0.01	0.01	0.02
Laundry (low density residential)	0.04	0.04	0.08
Laundry (medium and high density residential)	0.14	0.07	0.21
Laundry (all other uses)	0.02	0.03	0.04
Shower	0.16	0.11	0.26
Bath	0.01	0.01	0.02
Faucets	0.16	0.13	0.29
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.14	0.11	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**1.07**	**0.91**	**1.98**
Outdoor Uses			
Irrigation and landscaping	0.17	0.26	0.43
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.00	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.22**	**0.35**	**0.57**
Total excluding Parks and Open Space	**1.29**	**1.26**	**2.56**
Parks and Open Space	0.11	0.25	0.36
Total Demand	**1.40**	**1.51**	**2.92**

*Note: Rounding errors may occur.

Table 12: Adjusted to CA Codes demand by land use and end use- Housing Variant

Land Use	Adjusted to Codes BAU Demand (MGD) Candlestick Point	Hunters Point	Total Development
Residential	0.72	0.44	1.16
Hotel	0.07	0.00	0.07
Office	0.06	0.01	0.07
Artist Studios	0.00	0.02	0.02
Research and Development	0.00	0.54	0.54
Neighborhood Retail	0.02	0.02	0.05
Regional Retail	0.12	0.00	0.12
Community Uses	0.01	0.01	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.02	0.00	0.02
Total demand excluding Parks and Open Space	**1.03**	**1.05**	**2.08**
Parks and Open Space	0.11	0.25	0.36
Total Demand	**1.14**	**1.30**	**2.44**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.02	0.02	0.05
Toilets (med-high density Residential)	0.08	0.04	0.12
Toilets (all other uses)	0.02	0.04	0.07
Urinals	0.01	0.00	0.01
Laundry (low density residential)	0.03	0.03	0.06
Laundry (medium and high density residential)	0.10	0.05	0.15
Laundry (all other uses)	0.01	0.02	0.03
Shower	0.13	0.09	0.21
Bath	0.01	0.01	0.02
Faucets	0.14	0.11	0.25
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.14	0.11	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**0.80**	**0.70**	**1.50**
Outdoor Uses			
Irrigation and landscaping	0.17	0.26	0.43
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.00	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.22**	**0.35**	**0.57**
Total excluding Parks and Open Space	**1.03**	**1.05**	**2.08**
Parks and Open Space	0.11	0.25	0.36
Total Demand	**1.14**	**1.31**	**2.44**

*Note: Rounding errors may occur.

Table 14: SFGBO demands by land use and end use – Housing Variant

Land Use	SFGBO (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.51	0.33	0.83
Hotel	0.05	0.00	0.05
Office	0.04	0.00	0.04
Artist Studios	0.00	0.01	0.01
Research and Development	0.00	0.36	0.36
Neighborhood Retail	0.02	0.02	0.03
Regional Retail	0.08	0.00	0.08
Community Uses	0.01	0.01	0.02
Football Stadium	0.00	0.00	0.00
Performance Venue	0.01	0.00	0.01
Total demand excluding Parks and Open Space	**0.72**	**0.73**	**1.45**
Parks and Open Space	0.06	0.15	0.22
Total Demand	**0.78**	**0.88**	**1.66**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.02	0.02	0.04
Toilets (med-high density Residential)	0.06	0.03	0.10
Toilets (all other uses)	0.02	0.03	0.05
Urinals	0.00	0.00	0.00
Laundry (low density residential)	0.02	0.02	0.04
Laundry (medium and high density residential)	0.07	0.03	0.11
Laundry (all other uses)	0.01	0.01	0.02
Shower	0.09	0.06	0.15
Bath	0.01	0.01	0.02
Faucets	0.10	0.08	0.18
Process Water	0.04	0.10	0.14
Dishwashers	0.02	0.02	0.04
Internal Leakage	0.10	0.08	0.19
Other domestic	0.02	0.01	0.03
Subtotal	**0.58**	**0.51**	**1.10**
Outdoor Uses			
Irrigation and landscaping	0.08	0.14	0.22
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.00	0.00	0.01
Cooling	0.01	0.04	0.05
External Leakage	0.01	0.01	0.02
Subtotal	**0.13**	**0.22**	**0.34**
Total excluding Parks and Open Space	**0.72**	**0.73**	**1.45**
Parks and Open Space	0.06	0.15	0.22
Total Demand	**0.78**	**0.88**	**1.66**

*Note: Rounding errors may occur.

Potential reclaimed water demands and sanitary flows by end use were estimated for the Proposed Project and Project Variants. These are provided below in Table 16 through Table 22.

Table 16: Reclaimed water demands by end use – Proposed Project

End Use	Reclaimed Water Demands by End Use (MGD)		
	Historical Benchmark	Adjusted to CA Codes	SFGBO
Toilets (residential)	0.36	0.17	0.14
Toilets (non-residential))	0.15	0.07	0.06
Urinals	0.02	0.01	0.00
Process Water (non-residential)	0.18	0.18	0.14
Irrigation and landscaping (residential)	0.12	0.12	0.06
Irrigation and Landscaping (non-residential)	0.33	0.33	0.16
Pools and Fountains (residential)	0.01	0.01	0.01
Pools and Fountains (non-residential)	0.01	0.01	0.01
Wash down (residential)	0.01	0.01	0.01
Wash down (non-residential)	0.01	0.01	0.01
Car Washing (residential)	0.01	0.01	0.01
Car Washing (non-residential)	0.00	0.00	0.00
Cooling (non-residential)	0.07	0.07	0.05
Total flow excluding Parks and Open Space	**1.30**	**1.00**	**0.66**
Parks and Open Space	0.35	0.35	0.21
Total Demand	**1.65**	**1.35**	**0.87**

*Note: Rounding errors may occur.

Table 15: Sanitary flows by end use – Proposed Project

End Use	Sanitary Flows by End Use (MGD)		
	Historical Benchmark	Adjusted to CA Codes	SFGBO
Toilets	0.52	0.24	0.19
Urinals	0.02	0.01	0.00
Laundry	0.34	0.24	0.17
Shower	0.27	0.21	0.15
Bath	0.02	0.02	0.02
Faucets	0.29	0.25	0.18
Process Water	0.18	0.18	0.14
Dishwashers	0.06	0.06	0.04
Other domestic	0.04	0.04	0.03
Cooling	0.07	0.07	0.05
Total	**1.82**	**1.33**	**0.98**

*Note: Rounding errors may occur.

Table 16: Reclaimed water demands by end use – R&D Variant

End Use	Reclaimed Water Demands by End Use (MGD)		
	Historical Benchmark	Adjusted to Codes BAU	SFGBO
Toilets (residential)	0.36	0.17	0.14
Toilets (non-residential))	0.23	0.11	0.09
Urinals	0.03	0.01	0.00
Process Water (non-residential)	0.29	0.29	0.22
Irrigation and landscaping (residential)	0.12	0.12	0.06
Irrigation and Landscaping (non-residential)	0.49	0.49	0.25
Pools and Fountains (residential)	0.01	0.01	0.01
Pools and Fountains (non-residential)	0.02	0.02	0.02
Wash down (residential)	0.01	0.01	0.01
Wash down (non-residential)	0.02	0.02	0.02
Car Washing (residential)	0.01	0.01	0.01
Car Washing (non-residential)	0.00	0.00	0.00
Cooling (non-residential)	0.12	0.12	0.09
Total flow excluding Parks and Open Space	**1.71**	**1.37**	**0.90**
Parks and Open Space	0.31	0.31	0.19
Total Demand	**2.02**	**1.69**	**1.09**

*Note: Rounding errors may occur.

Table 17: Sanitary flows by end use – R&D Variant

End Use	Sanitary Flows by End Use (MGD)		
	Historical Benchmark	Adjusted to CA Codes	SFGBO
Toilets	0.60	0.27	0.22
Urinals	0.03	0.01	0.00
Laundry	0.36	0.26	0.18
Shower	0.28	0.23	0.16
Bath	0.02	0.02	0.02
Faucets	0.33	0.29	0.20
Process Water	0.29	0.29	0.22
Dishwashers	0.09	0.08	0.05
Other domestic	0.04	0.04	0.03
Cooling	0.12	0.12	0.09
Total	**2.16**	**1.61**	**1.18**

*Note: Rounding errors may occur.

Table 18: Reclaimed water demands by end use – Housing Variant

End Use	Reclaimed Water Demands by End Use (MGD)		
	Historical Benchmark	Adjusted to Codes BAU	SFGBO
Toilets (residential)	0.36	0.17	0.14
Toilets (non-residential))	0.15	0.07	0.05
Urinals	0.02	0.01	0.00
Process Water (non-residential)	0.18	0.18	0.14
Irrigation and landscaping (residential)	0.12	0.12	0.06
Irrigation and Landscaping (non-residential)	0.30	0.30	0.15
Pools and Fountains (residential)	0.01	0.01	0.01
Pools and Fountains (non-residential)	0.01	0.01	0.01
Wash down (residential)	0.01	0.01	0.01
Wash down (non-residential)	0.01	0.01	0.01
Car Washing (residential)	0.01	0.01	0.01
Car Washing (non-residential)	0.00	0.00	0.00
Cooling (non-residential)	0.07	0.07	0.05
Total flow excluding Parks and Open Space	**1.26**	**0.97**	**0.64**
Parks and Open Space	0.37	0.37	0.22
Total Demand	**1.63**	**1.34**	**0.86**

*Note: Rounding errors may occur.

Table 22: Sanitary flows by end use – Housing Variant

End Use	Sanitary Flows by End Use (MGD)		
	Historical Benchmark	Adjusted to CA Codes	SFGBO
Toilets	0.51	0.23	0.19
Urinals	0.02	0.01	0.00
Laundry	0.34	0.24	0.17
Shower	0.26	0.21	0.15
Bath	0.02	0.02	0.02
Faucets	0.29	0.25	0.18
Process Water	0.18	0.18	0.14
Dishwashers	0.06	0.06	0.04
Other domestic	0.04	0.04	0.03
Cooling (50% flow to sewer)	0.07	0.07	0.05
Total	**1.80**	**1.32**	**0.97**

*Note: Rounding errors may occur.

4 Assumptions and References

This section describes assumptions used to:

1) Estimate historical baseline demands;
2) Distribute the historical baseline demands to specific end uses such as toilets, showers, irrigation etc…;
3) Adjust the historical baseline demands to current California code; and
4) Adjust the to-code demands to a sustainable case wherein efficiency measures such as efficient fixturesare applied. The efficiency measures applied in the Sustainable Case have been tailored to meet the demand reduction requirements of the SFGBO.

Table 20: Assumptions for estimating water demands by land use for the Historical Benchmark case .

Assumptions Summary for Historical Benchmark Demand Estimation						
Land use	**ID#**	**Description**	**Value**	**Unit**	**Reference or Assumption**	**Notes**
Residential						
	1	No. of residents per unit - low density	2.33	residents	Mundie & Associates, 2009	
	2	No. of residents per unit - medium density	2.33	residents	Mundie & Associates, 2009	
	3	No. of residents per unit - high density	2.33	residents	Mundie & Associates, 2009	
	4	Average consumption per capita	62	gallons per day (gp)	SFPUC, 2005	
	5	Average outdoor water use for single family residences	10	%	SFPUC, 2005	Note reference states that average demand is less than 10%
Regional Retail						
	1	Regional Retail jobs creation	350	Square feet (sqft)/job	Economic and Planning Systems, 2009.	
	2	Area of retail space per customer	22	sqft/customer	British Standards Institution. 2006	
	3	Sewage generation per employee	10	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	4	Sewage generation per visitor	2	gpd	EPA, 2002	EPA sites 2 gpd / parking spot. Sewage generation is only a fraction of overall consumption
	5	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	
	6	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer

Neighborhood Retail						
	1	Neighborhood retail jobs creation	270	sqft/job	Economic and Planning Systems, 2009.	
	2	Area of retail space per customer	22	sqft/customer	British Standards Institution. 2006	
	3	Sewage generation per employee	10	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	4	Water generation per visitor	2	gpd	EPA, 2002	EPA sites 2 gpd / parking spot. Sewage generation is only a fraction of overall consumption
	5	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	Sewage generation is only a fraction of overall consumption
	6	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Office						
	1	Office job creation	276	sqft/job	Economic and Planning Systems, 2009.	
	2	Residential jobs creation	25	Units/job	Economic and Planning Systems, 2009.	
	3	Water consumption per employee	85	gpd	URS, 2004.	
	4	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	
	5	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Community Uses						

	1	Community use job creation	276	sqft/job	Assumed similar to office	Actual Community uses are not finalized therefore community use water demands have been estimated in a similar manner as office land use.
	2	Water consumption per employee	85	gpd	Assumed similar to office	
	3	Average outdoor water use for non-residential customers	43	percent	Assumed similar to office	
	4	Ratio of sewage generation to total water consumed on site	57	percent	Assumed similar to office	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Research and Development						
	1	R&D jobs creation (office)	267	sqft/job	Economic and Planning Systems, 2009.	
	2	Sewage generation per employee for office R&D space	85	gpd	URS, 2004.	Sewage generation is only a fraction of overall consumption
	3	Average outdoor water use for non-residential customers for all R&D	43	percent	URS, 2004.	Sewage generation is only a fraction of overall consumption
	4	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Assumption is conservative in that some water consumed indoors would not go to sanitary sewer
	5	Type of R&D Spaces	1/3,1/3, and 1/3	Fraction	Email from Lennar	From email correspondence with Lennar it has been assumed that 1/3 of the R&D space will be office, 1/3 will be wet laboratory, and the remaining 1/3 will be light production which is similar to industrial.
	6	Water Usage for Wet Laboratory R&D Space	0.547	gpsfd	2020 UC Berkeley LRDP Draft EIR (http://www.cp.berkeley.edu/LRDP_2020 draft.htm) - Table 4.13-1	Source provided by Winzler & Kelly. The report states that 0.32 is for sustainable lab case with efficient fixtures built in, and calculations were worked backwards to calculate the BAU.
	7	Water usage profile for	Varies	%	URS, 2004	The water usage profile for wet lab

		Wet Lab Space				space has been assumed to be the average of the commercial and industrial usage profile.
	8	Water Usage for Light Projection R&D Space	0.1	gpsfd	City of Los Angeles, L.A. CEQA Threshold Guide, 2006, Exhibit M.2. - 12 Sewage Generation Factors	
Hotel						
	1	Hotel job creation	700	sqft/job	Economic and Planning Systems, 2009	
	2	Average guest room size	600	sqft	Assumed	This includes the space for reception, kitchens and conference facilities
	3	Average guests / room	1.9	guests	Assumed	
	4	Sewage generation per guest	50	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	5	Sewage generation per employee	10	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	6	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	Sewage generation is only a fraction of overall consumption
	7	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Artist Studios						
	1	# of artists	252	people	Lennar, 2009	
	2	Consumption per artist	85	gpd	URS, 2004.	
Parks and Open Space						
	1	Total irrigation demand from landscape architect	350,180	gpd	Per landscape irrigation prepared by RHAA 7/31/08	
Football Stadium						
	1	Football games / year	10	Home games	Economic and Planning Systems, 2009.	
	2	Attendance at football games	69000	people	Economic and Planning Systems, 2009.	

	3	Other venues per year	20	Other venues	Economic and Planning Systems, 2009.	
	4	Attendance at other venues	37500	people	Lennar, 2009	
	5	Employees (football day)	3625	people	Stadium Staffing Numbers from SF 49ers, (Lennar, 2009)	Includes 2900 employees and 725 media personnel
	6	Employees (event day)	1,922	people	Pro-rated using football day attendance and employees on football days	
	7	Employee (nonevent days)	48	people	Stadium Staffing Numbers from SF 49ers, (Lennar, 2009)	
	8	No. of players/performers (event day)	200	people	Assumed	100 people per team for players and staff. Assumed same number for other event days
	9	Stadium average daily irrigation	23979	gpd	Marty Laporte, 2009	
	10	Sewage generation per seat and employee on game days	4	gpd	EPA, 2002.	EPA value is for "auditorium" Sewage generation is only a fraction of overall consumption
	11	Ratio of sewage generation to indoor water consumption	95	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
	12	Water consumption per permanent employee per day	85	gpd	URS, 2004.	
Performance Venue						
	1	Performance venue job creation	40	seats/job	Economic and Planning Systems, 2009.	
	2	Performance events per year	250	events	Economic and Planning Systems, 2009.	
	3	Employees - typical day	7	people	Assumed	Prorated to be similar to stadium
	4	Visitors per performance	10,000	people	Per CP/HPS development program, 2009	

	6	Water consumption per permanent employee per day	85	gpd	URS, 2004.	
	7	Sewage generation per seat and employee on event days	4	gpd	EPA, 2002.	EPA value is for "auditorium". Sewage generation is only a fraction of overall consumption
	12	Ratio of sewage generation to indoor water consumption	95	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Sanitary Sewer						
	1	Percent of indoor consumption to sanitary sewer	100%	Percent	Assumed per URS 2004 and conversations with W&K	
	2	Cooling demands assumed to contribute to sanitary sewer. (Non Res)			Assumed per conversations with W&K	Though some losses may occur, 100% of cooling demand is assumed to go to sanitary sewer

Table 23: End use demand distributions by land use (URS 2004)

Table 3-3
End-Use Data - Initial Percentage Assumptions

End Use	Initial Percentages by Customer-Billing Category				
	Single-Family Residential	Multi-Family Residential	Commercial	Industrial	Institutional
Indoor Usage					
Toilets (indoor)	26.7%	26.7%	25%	23%	20%
Urinals (indoor)	NA	NA	0%	7%	0%
Laundry (indoor)	21.7%	21.7%	8%	5%	10%
Showers (indoor)	16.8%	16.8%	5%	5%	16%
Bath (indoor)	1.7%	1.7%	NA	NA	NA
Faucets (indoor)	15.7%	15.7%	10%	15%	19%
Process (indoor)	NA	NA	34%	30%	5%
Dishwashers (indoor)	1.4%	1.4%	8%	5%	15%
Internal Leakage (indoor)	13.7%	13.7%	10%	10%	15%
Other Domestic (indoor)	2.2%	2.2%	NA	NA	NA
Outdoor Usage					
Irrigation and Landscaping (outdoor)	80%	80%	75%	65%	70%
Pools and Fountains (outdoor)	5%	5%	2%	5%	5%
Wash-down of house/facilities (outdoor)	5%	5%	3%	0%	5%
Car Washing (outdoor)	5%	5%	0%	0%	0%
Cooling (outdoor)	0%	0%	15%	25%	15%
External Leakage (outdoor)	5%	5%	5%	5%	5%

NA – Not Applicable

Sources: AWWARF, Konen (1986), Behling et al. (1992)

Table 25: Assumed end use distributions for the stadium and performance venue

Indoor Usage	%	95%
Outdoor Usage	%	5%
Indoor Uses		
Toilets	%	30%
Urinals	%	30%
Laundry	%	0%
Shower	%	5%
Bath	%	0%
Faucets	%	15%
Process Water	%	10%
Dishwashers	%	0%
Internal Leakage	%	10%
Other domestic	%	0%
Outdoor Uses		
Irrigation and landscaping	%	20%
Pools and Fountains	%	0%
Wash down of houses and facilities	%	20%
Car Washing	%	0%
Cooling	%	50%
External Leakage	%	10%

Table 27: Assumptions used to adjust between water demand scenarios

	Historical Benchmark		Adjusted to CA Code		SFGBO		
	Max Flow or Quantity	Note / Reference	Max Flow or Quantity	Note / Reference	Max Flow or Quantity	Note/Reference	Unit
Plumbing Fixture							
Lavatory faucet, private	2.5		2.2	2007 California Plumbing Code	1.5	EPA WaterSense	gpm at 60 psi
Lavatory faucet, public, (metering)	0.25		0.25	2006 International Plumbing Code	0.2	CA Green Building Standard 2008	gallon per metering cycle
(not metering)	0.6		0.5	IPC	0.5	n.a.	gpm at 60 psi
Shower head	3.125	URS 2004*	2.5	2007 California Plumbing Code	1.75	EPA WaterSense	gpm at 80 psi
Sink faucet	2.5		2.2	Plumbing Code	1.5	EPA WaterSense	gpm at 60 psi
Urinal	2	URS 2004*	1	2007 California Plumbing Code	0.125	EPA Water Sense	gallon per flushing cycle
Water closet	3.5	URS 2004*	1.6	2007 California Plumbing Code	1.28	EPA Water Sense and CA Green Building Standard 2008	gallon per flushing cycle
Other Appliances							
Dishwasher (Residential)	7		6	US Department of Energy 2007	4	Energy Star	gallons/cy capacity
Dishwasher (Commercial)	1.75		1.46	Energy Star	0.92	Energy Star	gallons per rack
Laundry	36.4	URS 2004	26	(US Federal Standard by 2011)	18	n.a. (calc)	gal/load
Laundry	13.2		8.5	CA Green Building Standard 2008	6	EPA Water Sense	gal/load-cf (Water Factor)
Irrigation							
Private Lands		Based on water demand distribution		California Water Efficient Landscape Ordinance (CWELO)	50%	CA Green Building Standard 2008	Fractional reduction compared to CWELO
Public Open Space		Per Landscape Architect Estimates		Per Landscape Architect Estimates - Note that this is less than CWELO	50%	CA Green Building Standard 2008	Fractional reduction compared to CWELO

Table 24: Other assumptions used to adjust the CA code demand to the SFGBO

Improved Cooling Efficiency		
Total fraction demand reductiont due to building envelope improvement measures and improved cooling technologies	0.25	
Reduced Losses		
Fractional demand reduction due to new piping and metering	0.25	

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FUTURE DEMANDS

			Annual Demand (MG/yr)	Annual Demand (mgd)	Peak Month Demand (mgd)
Residential (Indoor) New Unit	# of persons per new unit	2.3			
	# of new units	7248			
	leaks	5%			
	gal/person/day	gal/unit/day			
Toilet Flushing	6.46	14.87	39.3	0.108	0.108
Laundry	6.29	14.47	38.3	0.105	0.105
Shower	10.13	23.29	61.6	0.169	0.169
Bathtub	4.0	9.20	24.3	0.067	0.067
Dishwashing	0.96	2.21	5.8	0.016	0.016
Bath Faucet	1.95	4.49	11.9	0.033	0.033
Kitchen Faucet	9.90	22.77	60.2	0.165	0.165
Leaks		4.56	12.1	0.033	0.033
Subtotal Residential New Tower	39.7	95.85	254	0.69	0.69
Residential (Indoor) Existing Tower Unit					
	# of persons per ex tower unit	2.3			
	# of ex tower units	1638			
	leaks	10%			
	gal/person/day	gal/unit/day			
Toilet Flushing	8.08	18.58	11.1	0.030	0.030
Laundry	5.85	13.46	8.0	0.022	0.022
Shower	8.00	18.39	11.0	0.030	0.030
Bathtub	4.0	9.20	5.5	0.015	0.015
Bath Faucet	1.95	4.49	2.7	0.007	0.007
Kitchen Faucet	11.30	25.98	15.5	0.043	0.043
Leaks		9.01	5.4	0.015	0.015
Subtotal Residential Ex. Tower	39.2	99.10	59	0.16	0.16
Non-Residential					
	square feet	g/sf/yr			
Retail	203,900	15	3.059	0.008	0.008
Office	120,100	8	0.961	0.003	0.003
Educational	21,600	10	0.216	0.001	0.001
Maintenance	15,000	20	0.300	0.001	0.001
Fitness Club	54,700	130	7.111	0.019	0.019
Structured Parking	2,917,400	0.1	0.292	0.001	0.001
		Subtotal Non-Residential	11.9	0.03	0.033
Irrigation					
		acres			
	Public Open Space	49	22.72	0.06	0.16
	Courtyards	12.3	5.70	0.02	0.04
	Farm	3	1.71	0.005	0.011
	Playing Fields	1.8	1.13	0.003	0.008
	Pond	0.8	0.12	0.0003	0.004
		Subtotal Irrigation	31.4	0.09	0.22
		TOTAL	297	0.98	1.11

Parkmerced Water Demands September 2009

EXISTING UNITS

Base Case (existing code)

	Shower	Bath Faucet	WC	Bathtub	Kitchen	Dishwasher	Laundry	Total Per Person
gpm/gpf/gpl	2.5	1.5	3.5	40	2.2		40.9	
uses/person/day	0.65	1.5	5.05	0.1	1.0		0.37	
minutes	8.2				7.5			
gallons/day	13.33	2.25	17.68	4.0	16.57		15.13	68.95

Efficient Fixtures

	Shower	Bath Faucet	WC	Bathtub	Kitchen	Dishwasher	Laundry	Total Per Person
gpm/gpf/gpl	1.5	1.3	1.6	40	1.5		15	
uses/person/day	0.65	1.5	5.05	0.1	1.0		0.39	
minutes	8.2				7.5			
gallons/day	8.0	2.0	8.08	4.0	11.30		5.9	39.17

Super Efficient Fixtures

	Shower	Bath Faucet	WC	Bathtub	Kitchen	Dishwasher	Laundry	Total Per Person
gpm/gpf/gpl	1.5	1.0	1.1	40	1.34		15	
uses/person/day	0.65	1.5	5.05	0.1	1.0		0.39	
minutes	8.2				7.5			
gallons/day	8.00	1.50	5.56	4.00	10.09		5.9	34.99

NEW UNITS

Base Case (existing code)

	Shower	Bath Faucet	WC	Bathtub	Kitchen	Dishwasher	Laundry	Total Per Person
gpm/gpf/gpl	1.9	1.5	1.6	40	2.2	12.5	26	
uses/person/day	0.65	1.5	5.05	0.1	1.0	0.10	0.37	
minutes	8.2				6.6			
gallons/day	10.13	2.25	8.08	4.00	14.52	1.25	9.62	49.85

Efficient Fixtures

	Shower	Bath Faucet	WC	Bathtub	Kitchen	Dishwasher	Laundry	Total Per Person
gpm/gpf/gpl	1.9	1.3	1.28	40	1.5	9.6	17	
uses/person/day	0.65	1.5	5.05	0.1	1.0	0.10	0.37	
minutes	8.2				6.6			
gallons/day	10.1	1.95	6.46	4.0	9.9	1.0	6.29	39.69

Super Efficient Fixtures

	Shower	Bath Faucet	WC	Bathtub	Kitchen	Dishwasher	Laundry	Total Per Person
gpm/gpf/gpl	1.5	0.5	1.1	40	1.3	4	9.9	
uses/person/day	0.65	1.5	5.05	0.1	1.0	0.13	0.39	
minutes	8.2				6.6			
gallons/day	8.00	0.75	5.56	4.00	8.6	0.52	3.9	31.26

current retrofit
find cut sheet or reference

model numbers for cut sheets:

bath faucet	2.2 gpm	
	1.5 gpm	EPA WaterSense
	1.3 gpm	SFPUC Conservation Model
	1.0 gpm	*Niagara_ **faucet** _aerator_N3210-SAW*
	0.5 gpm	Kohler K-15597-P-CP
toilets	1.6 gpf	
	1.28 gpf	Green Building Standard (2008)
	1.1 gpf	Kohler K-3519
kitchen faucet	2.2 gpm	
	1.5 gpm	1.5 *GPM* Niagara Dual-Spray *Kitchen* Aerator
	1.3 gpm	SFPUC Conservation Model
laundry (commercial)		
	40.9 gpl	SFPUC Conservation Model
	15 gpl	Maytag MAH21PD

laundry (private)		
	26 gpl	US Federal Standard (2011)
	17 gpl	SFPUC Conservation Model
	9.9 gpl	Asko
dishwasher		
	12.5 gpl	SFPUC Conservation Model
	9.6 gpl	
	4 gpl	
shower	2.5 gpm	CA Plumbing Code (2007)
	1.9 gpm	SFPUC Conservation Model
	1.75 gpm	EPA WaterSense
	1.5 gpm	

TOTALS BY UNIT

Existing Units to Remain

# of units	persons per unit	leaks
1638	2.3	10%

	gpcd	gal/unit/day	total (mgd)	total (MG/yr)
code	75.8	174.4	0.286	104.3
efficient	43.09	99.1	0.162	59.2
super efficient	38.49	88.5	0.145	52.9

New Units

# of units	persons per unit	leaks
7248	2.3	5%

	gpcd	gal/unit/day	total (mgd)	total (MG/yr)
code	52.3	120.4	0.873	318.5
efficient	41.68	95.9	0.695	253.6
super efficient	32.82	75.5	0.547	199.7

Weighted Average

	gpcd	gal/unit/day	total (mgd)	total (MG/yr)
code	56.7	130.3	0.945	344.8
efficient	41.9	96.5	0.699	255.2
super efficient	33.9	77.9	0.565	206.1

TOTALS BY SITE

TOTAL RESIDENTIAL

	MGD	MG/YR
code	1.158	422.8
efficient	0.857	312.8
super efficient	0.692	252.7

NON-POTABLE RESIDENTIAL toilet flushing new units, plus all laundry

	MGD	MG/YR
code	0.352	128.5
efficient	0.235	85.6
super efficient	0.179	65.3

POTABLE RESIDENTIAL

	MGD	MG/YR
code	0.806	294.3
efficient	0.622	227.2
super efficient	0.513	187.3

Parkmerced Existing Demand Backup documentation – June 25, 2009
Beth Goldstein, P.E. Hydroconsult Engineers, Inc.

EXISTING:

	POTABLE		NON-POTABLE		TOTAL	
	MG/yr	mgd	MG/yr	mgd	MG/yr	mgd
Residential (Indoor)	202	0.55	-	-	202	0.55
Non-Residential	-	-	-	-	-	-
Irrigation	58	0.16	-	-	0	0.16
	260	0.71	-	-	202	0.71

FULL BUILD-OUT: (previously reported)

	POTABLE		NON-POTABLE		TOTAL	
	MG/yr	mgd	MG/yr	mgd	MG/yr	mgd
Residential (Indoor)	272	0.74	50.1	0.14	322	0.88
Non-Residential	12	0.03	-	-	12	0.03
Irrigation	-	-	31	0.09	31	0.09
	284	0.78	82	0.22	365	1.00

FULL BUILD-OUT: (w/efficient fixtures)

	POTABLE		NON-POTABLE		TOTAL	
	MG/yr	mgd	MG/yr	mgd	MG/yr	mgd
Residential (Indoor)	227	0.62	85.6	0.23	313	0.86
Non-Residential	8	0.02	3.6	0.01	12	0.03
Irrigation	-	-	31	0.09	31	0.09
	236	0.65	121	0.33	356	0.98

Notes: Existing demands calculated from residential billing records 2006-7 and irrigation billing records 2005-2006.

Future non-potable demand includes toilet flushing in new units, all laundry, and all irrigation.

7. WATER SYSTEM

7.1 Existing System

7.1.1 Existing Water Supply

There are two existing sources of water supply serving Treasure Island. The primary supply is provided by the San Francisco Public Utilities Commission (SFPUC) through an existing 10-inch diameter steel pipe attached to the western span of the Bay Bridge. Water is pumped across the bridge by a pumping station located at 475 Spear Street in San Francisco. The station contains four pumps each rated at 900 gpm. The station can run a maximum of two pumps at a time for a maximum station output of 1,800 gpm.

The existing back up supply of water is provided by the East Bay Municipal Utility District (EBMUD) through a 12-inch diameter ductile iron main connected to an EBMUD water meter at Beach Street in Emeryville. From this location, water is delivered to a pump station located at Pier E23 of the existing Bay Bridge in Oakland. Water is then pumped through a 12-inch diameter steel pipe attached to the eastern span of the Bay Bridge. This water supply charges the fire hydrants on the Bridge and is connected to the existing water tanks on YBI for an emergency backup water supply. The maximum flow rate for this system is reported to be 1,500 gpm. There is currently an agreement in place between EBMUD and the Navy that limits the average annual flow 61 gallons per minute to maintain water quality in the line on the bridge. Actual average annual flows are well below that limit, at approximately 35 gpm.

7.1.2 Existing Water Storage

There are currently four existing concrete reservoirs on Yerba Buena Island that service both Yerba Buena Island and Treasure Island. Combined they have a total design capacity of approximately 6.5 million gallons to serve as both the potable and fire protection water supplies for Treasure Island and Yerba Buena Island. However, all of the tanks are in varying states of disrepair and cannot operate to their full design capacity. The actual operating storage capacity is approximately 1.9 million gallons with another 0.5 million gallons dedicated for fire protection. The design capacities, operating capacities, and operating elevations of the existing reservoirs are shown in Table 7.1.

Table 7.1 – Existing Reservoir Data

Reservoir Number	Design Capacity (million gallons)	Current Operating Capacity (million gallons)	Operating Elevation Range (NAVD88)	Primary Service
227	3.0	0.0	252.5 to 255.5	TI
162	2.0	1.3	322.0 to 327.0	YBI
168	0.5	0.5	356.0 to 359.0	Fire Reserve
242	1.0	0.6	247.0 to 251.0	TI/YBI

The elevations of the existing reservoirs provide an operating pressure of approximately 100-115 psi on TI and 80 psi on YBI (pressures at the higher areas of YBI are achieved with booster pumps).

The existing water storage tanks range in age from 60 to 85 years, and studies indicate that they are all in poor condition and will require either major rehabilitation or replacement.

7.1.3 Existing Water Distribution System

The original piping systems for a separate potable water and fire protection system for the Islands was constructed in 1939 out of copper, galvanized steel, and asbestos cement pipe. In 1990, the two systems were combined and the pipe material replaced with PVC pipe. Many of the individual building services and irrigation services originally constructed out of galvanized steel, however, have not been replaced. The relatively new PVC pipe system will be utilized on an interim basis during the initial phases of construction, but will eventually be replaced at the full build out of the project.

7.2 Proposed Domestic Water System

7.2.1 Proposed Water Demand

The estimated water demand for the proposed Land Use Plan is presented on Table 7.2. This estimate includes demand for the new development as well as the existing demand for the Department of Labor and the Coast Guard. The demand factors for the various facilities are indicated in the notes at the bottom of the table. The project will include the use of recycled water for irrigation and appropriate plumbing in the commercial use buildings. The potable demand factors included in Table 7.2 account for the use of water conserving fixtures in all buildings, the use of recycled water for toilet flushing and other non potable water uses in commercial buildings, and the use of recycled water for irrigation uses where appropriate. Recycled water demands are shown in Table 9.1 and 9.2A of Section 9, Recycled Water System.

As shown on Table 7.2, the average daily demand is estimated to be 1.08 millions gallons per day, or 753 gallons per minute (gpm). Because of the size of the proposed development, the relatively homogeneous use, and the use of recycled water for the irrigation needs, the project will use a maximum day demand factor of 1.2 times the average daily demand. Therefore, the maximum daily demand is 1.3 million gallons per day or 904 gpm.

The project will be designed to provide fire flow of 3,500 gallons per minute. This will be adequate to accommodate new construction. The existing Buildings 2 and 3 are designated to remain and will be retrofitted with appropriate supplemental fire protection systems when they are remodeled for commercial use. The fire protection systems designs for these structures will need to consider the building construction, use, and available fire flow.

7.2.2 Proposed Water Supply

7.2.2.1 Primary Water Supply

The existing SFPUC pump station in San Francisco and 10-inch line on the western span of the Bay Bridge is adequate to provide the required water supply to the project at full buildout and will continue to be the primary supply of water to Treasure Island. As with other water systems in the City, the SFPUC will need to monitor the condition of the pump station and supply line and perform routine maintenance and repairs to ensure reliable service to the islands.

7.2.2.2 Secondary Water Supply Source

The proposed secondary water supply to Treasure Island will continue to be from the EBMUD service in Oakland. Caltrans' construction of the new eastern span of the Bay Bridge, the Eastern Span Seismic Safety Project (ESSSP), is requiring modifications to the EBMUD service near the bridge abutment in Oakland and across the bridge. The new improvements will include:

- Relocation of the water main to the new Bay Bridge abutment.
- New pump station near the new bridge abutment in Oakland.
- New stub and shut off valve on YBI near column line XXX of the new bridge structure.

All of these items will be constructed as part of the ESSSP in cooperation with the SFPUC, and are not considered part of this project.

In addition to the secondary water source improvements associated with the new Bay Bridge project, the alignment of the secondary water source on YBI will be revised to as shown on Figure 7.1. The new alignment will follow North Gate Drive and Macalla Road to the new water tank locations.

The EBMUD back-up system will be capable of delivering approximately 1,800 gpm during emergency conditions. The system will continue to operate within the existing limit of 61 gallons per minute in average annual flow. This modest routine use is needed to maintain the water quality in the line across the Bay Bridge.

Table 7.2 Treasure Island Redevelopment Project Water Demand (8,000 Residential Units +100,000 sf office)

DESCRIPTION OF USE			POTABLE WATER DEMAND			RECYCLED WATER DEMAND	TOTAL WATER DEMAND	SEWER DEMAND	NOTES
Land Use	No.	Unit	Average Daily Demand (gpd)	Average Daily Demand (gpm)	Maximum Daily Demand (gpm) (Note 12)	Average Daily Demand (gpd)	Average Daily Demand (gpd)	Average Daily Demand (gpd)	
Residential	8,000	Units	932,000	647	777	30,000	962,000	885,400	1
Hotel	500	Rooms	132,500	92	110	3,500	136,000	129,375	2
Office	100,000	sf	7,000	5	6	3,500	10,500	10,150	3
Retail	140,000	sf	9,800	7	8	4,900	14,700	14,210	3
Adaptive Reuse, General	244,000	sf	17,080	12	14	8,540	25,620	24,766	3
Adaptive Reuse, Retail	67,000	sf	4,690	3	4	2,345	7,035	6,801	3
Open Space	300	ac	30,000	21	25	180,000	210,000	28,500	10
Miscellaneous Structures	75,000	sf	5,625	4	5	1,875	7,500	7,219	4
Marina	400	Slips	20,000	14	17	0	20,000	19,000	14
Treasure Island School	105,000	sf	21,000	15	18	0	21,000	19,950	7
Police/Fire	30,000	sf	4,000	3	3	2,000	6,000	5,800	6
Misc. Small Community Facilities	13,500	sf	945	1	1	473	1,418	1,370	3
Pier 1 Community Center	35,000	sf	2,450	2	2	1,225	3,675	3,553	3
TI Sailing Center	15,000	sf	1,050	1	1	525	1,575	1,523	3
Museum	75,000	sf	5,250	4	4	2,625	7,875	7,613	3
Department of Labor (DOL)	900	Rooms	111,542	77	93	0	111,542	105,965	8
Coast Guard Facility			17,000	12	14	0	17,000	16,150	9
Utility Facilities	14,000	sf	980	1	1	490	1,470	1,421	3
Urban Farm	20	ac	2,000	1	2	60,000	62,000	1,900	11
Totals			**1,324,912**	**920**	**1,104**	**301,998**	**1,626,910**	**1,290,664**	

Notes:

1 50 gallons per capita per day (gpcd), based on water conserving projections for 2030, based on 8000 units at 2.33 residents per dwelling unit. Population per dwelling unit based on City average from Demands Report Includes 30,000 gpd irrigation (CMG 8/7/09 spreadsheet)

2 Potable use based on 265 gpd/room; this includes all uses within the hotel. Recycled use based on 7 gallons recycled water per room per day (toilet flushing). Assumes no grounds for irrigation. Water demand based on AWWA standards.

3 Potable water demand based on 0.07 gpd/sf. Recycled water demand based on 0.375 gpd/sf. Reference : CCSF Retail Demands Rept Nov 2004

4 4 Allowance for misc. open space buildings not included elsewhere, including the YBI Historic Buildings, kiosks, warming hut, etc. Estimated potable use is based on 1 person per 200 SF, 20 gpcd total water use, minus 5 gpcd recycled water for toilets.

6 Potable use based on 400 persons per day at 15 gpcd total water use, minus recycled water use (toilets) at 5 gpcd

7 1 Student per 100 SF, 20 gpd per students

8 Value based on 2007 monthly demand provided by S. Larano, SFPUC.

9 Value provided by S. Larano, SFPUC.

10 Potable demand at 100 gpd/acre. Irrigation demand at 180,000 gpd for TI (CMG 8/7/09 spreadsheet).

11 Potable demand at 100 gpd/acre. Irrigation demand at 60,000 gpd (CMG 8/7/09 spreadsheet).

12 Maximum daily demand 120% of average daily demand

14 Based on 400 slips, day use only (no live aboard). 50 gpd per slip

7.2.3 Proposed Water Storage

The existing water tanks that serve YBI and TI are in poor condition and need major repair or replacement in order to serve the proposed project. To meet current SFPUC requirements, the Project will replace the existing water storage tanks in phases. The new water storage tanks will be sized to serve both the proposed new uses, as well as the existing uses that will remain.

The SFPUC water storage requirements for Treasure Island will be 2 days of maximum daily demand plus 4 hours of fire flow, or approximately 3.4 million gallons of storage.

The redundant water source from EBMUD provides an equal, compatible, and reliable back up water source to Treasure Island. If either SFPUC or EBMUD system is taken off line for maintenance, power interruptions, or damage due to earthquake, the other source will continue to supply 1,800 gpm, sufficient to meet the peak daily demands for the development. In the extremely unlikely event that both water supplies are taken down at the same time, then 2 days of maximum daily demand plus four 4 hours of fire storage should be sufficient to bridge the time for repairs or evacuation of the Island. It should also be noted that in such an event of extreme emergency, the consumption of potable water would likely be much lower than the calculated average demand shown in Table 7.2. Assuming reasonable reductions in retail, hotel, public and cultural uses that would naturally result following events of dire emergency the potable emergency demand would be significantly less than the average demand under normal conditions.

In addition to the normal operational storage requirements described above, the storage design will also need the ability to accommodate the maintenance of storage tanks. During maintenance, one tank, or portions of a tank, will need to taken out of service. During these regularly scheduled maintenance periods the SFPUC requires that the Treasure Island project maintain a minimum storage of 1 day maximum daily demand plus 4 hours of fire storage, or approximately 2.1 million gallons, at all times.

In order to meet the emergency and maintenance storage requirements, the water storage will be provided in two tanks. The existing 1.0 million gallon, circular, steel water storage tank adjacent to Macalla Road will be replaced with a new 1.0 million gallon, above grade, circular, steel water storage tank in the existing location. The remainder of the storage will be in a 2.4 million gallon water storage tank located at a higher elevation on YBI. Two locations are being considered for this tank as shown on Figure 7.2. The final location of this tank will be determined during the Master Planning phase of the project. The 2.4 million gallon tank will be divided into two 1.2 million gallon cells to accommodate maintenance and provide a minimum of 2.2 million gallons of storage at all times during maintenance. Together, the two tanks will provide 3.4 million gallons of storage. The final sizes, configuration and locations of the water storage tanks are described in more detail in the “Treasure Island and Yerba Buena Island Water Service Area Master Plan and Tank Siting Study” (Appendix E)

The upper storage tank (2.4 million gallons) will be supplied by water pumped directly from the 10-inch supply line from San Francisco, and the back up supply from EBMUD during emergencies. Supply to the lower, 1.0 million gallon tank will flow from the 2.4 million gallon tank by gravity. Because of the elevation of the 1.0 million gallon tank, it is likely that there will need to be a pressure reducing valve between the tank and the Treasure Island service area. The 2.4 million gallon tank is not high enough to provide service with adequate pressure to the upper portions of YBI. Fire flow and domestic demands to these YBI areas will be provided by an adjacent booster pump station with multiple pumps and emergency generator.

7.2.4 Proposed Domestic Water Distribution System

Through phased development of YBI and Treasure Island the existing PVC water distribution system will be replaced with a new ductile iron water system installed to SFPUC standards. Based on preliminary calculation, we anticipate that new water mains will range in size from 8 inches at minimum to a maximum size of 24 inches. A conceptual layout of the proposed domestic water distribution system is shown on Figure 7.1.

The California Code of Regulations, Title 22, requires that the water distribution system be capable of delivering the maximum daily demand coincident with the required fire flow. Based on the preliminary demand calculations described above, the proposed water system will be designed to deliver the maximum daily demand of 882 gpm along with the design fire flow of 3,500 gpm with a minimum residual pressure of 20 pounds per square inch to the fire hydrants on the Island.

7.3 Proposed Bay Water Auxiliary Water Supply System (AWSS)

Treasure Island and YBI do not currently have an AWSS system for fire protection. The project proposes to construct a new bay water AWSS system on TI as a backup fire protection system in the unlikely event of an extended total disruption of water supplies to Treasure Island. AWSS is not planned for Yerba Buena Island due to its steep topography, smaller size and development, and proximity to storage tanks and water supply lines on the Bay Bridge. The exact nature of the AWSS system is still being discussed with the San Francisco Fire Department (SFFD). It is expected that TI's AWSS may provide the following:

- A pump station with a salt-water intake pipe
- Two pipe manifolds for connection to fireboats
- Up to twenty-nine fire hydrants
- A main trunk pipe connecting the pump station, manifolds, and fire hydrants
- Three suction hydrants

The proposed bay water AWSS system discussed with TIDA, SFPUC and SFFD is shown on Figure 7.3. A brief description of the main elements of the AWSS system are as follows:

Pump Station and Intake Structure

The AWSS pump station and intake structure will be capable of continually charging the system and delivering 3,500 gpm of bay water at a maximum pressure of 125 psi. The pump station will include a diesel emergency power generator and additional pumps to provide redundancy during emergencies.

The water is drawn through a horizontal, large diameter draft tube (steel or concrete pipe) with a trash rack on the end to prevent uptake of debris. The draft tube connects to the vertical pump pit (precast concrete box or large diameter manhole), in which the pump intake pipe is located. A retractable fish screen may be included at the interface of the draft tube and the pump pit to prevent fish from entering into the pump system. Portions of the pump station will be contained in a pump house, for protection from weather and damage. See Figure 7.3.1.

Distribution Piping

A dedicated underground piping system will distribute the bay water within the developed areas of TI; dedicated bay water AWSS hydrants will be provided along the distribution route.

Fireboat Manifolds

The fireboat manifolds will be located near the ferry quay and near Pier 1. The manifolds will allow the fireboats to connect to the AWSS system and charge the lines in the unlikely event the pump station fails or additional flow/pressure is required in the system. When connected to the pipe manifold, the fireboat will draw salt water via its on-board pumps which may have a minor effect on the natural environment; this is assumed to be inherent to the operation of the fireboat and is beyond the scope of the AWSS.

Suction Hydrants

Three suction hydrants will be located around the perimeter of Treasure Island that will allow fire trucks to draft water directly from the Bay. Suction hydrants, also called Bay Suction connections, allow fire engines to draft water directly from the Bay. The hydrant is similar to typical fire hydrants, however there is no connection to a pressurized, piped water supply – the hydrant is connected to an intake pipe leading into the Bay. To prevent debris from entering the intake pipes, the end of the pipe may be fitted with a screen. See Figure 7.3.1.

Potential Bay Regulatory Issues

Construction and operation of the AWSS may potentially affect the Bay environment. Descriptions of the potential temporary and permanent effects on the environment, as well as ways in which those effects could possibly be reduced, are described below:

1. Temporary Construction Effects:
   Construction of the draft tube and suction hydrant pipes will require temporary shoreline excavation in the vicinity of the intakes, construction of temporary shoring,

and backfill/replacement of existing shoreline revetment. See Figure 7.3.2 – 4 for approximate areas of potential effect. Measures to reduce the possible temporary environmental effects of this work could include:

- Limit the amount of disturbed area below the mean high water mark as much as feasible.
- Prohibit the use of materials that may reduce water quality
- Follow erosion control plans to keep sediment from entering the Bay
- Follow site maintenance plans to eliminate construction debris from entering the Bay

2. Permanent Construction Effects
The pump station draft tube and suction hydrant intake pipes will permanently extend through the shoreline revetment into the bay (below low water). This will be similar to other pipe penetrations through the shoreline for storm drain outfalls. Measures to reduce the possible permanent effects on the environmental from this work, could include:
    - Limit the amount of permanent improvements below the mean high water mark as much as feasible.
    - Prohibit the use of materials that may reduce water quality

3. AWSS Operational Effects
The intake structures have the potential to create a vortex at the end of intakes (pump station draft tube and suction hydrant intake pipes) which could constitute a hazard at the water surface if not addressed. To prevent this, the end of the intakes could be enlarged or otherwise designed to prevent vortex formation.

a. There may be potential effects on fish during the regular testing of the AWSS system. The effect will depend largely on the anticipated usage of the AWSS, which will depend on the frequency and duration of scheduled tests of the system. For short-duration tests to verify the operational functionality of the system, measures – such as fish screens – to prevent fish uptake may not be necessary. If fish screens are required, the affect on fish in the Bay will depend on the design of the fish screen in accordance with the following parameters:
    - Size of openings (based on species and size of fish to be protected);
    - Porosity (percent open area of screen face);
    - Approach velocity (perpendicular to screen face);
    - Sweeping velocity (parallel to screen face).

    In the event that the AWSS is operated to suppress actual fires, the system will be used for a longer duration than that used for periodic testing; consequently, the effect on the environment could be greater. However, it is assumed that any effects that occur as a result of an actual emergency will be acceptable as a unique, singular event, and that the emergency needs will govern.

The final designs for the AWSS intake structures will be submitted to the appropriate agencies for review and approval prior to construction. The permitting agencies will include the Bay Conservation and Development Commission (BCDC), Army Corps of Engineers, Regional Water Quality Control Board, California Department of Fish and Game, and United States Fish and Wildlife Service.

7.4 Phases for Water System Construction

The new water infrastructure to support development of the project will be installed in phases to match development of the project. The existing land uses on Treasure Island will continue to utilize the existing water distribution system with temporary connections to the new system and temporary water infrastructure where required to maintain the existing uses until they are demolished or permanent connections can be made. Water storage will be brought on-line as required to support the water demands of the project as it develops.

7.5 Master Utility System Plans and Master Fire Protection Plan

A Water System Master Plan will be prepared in coordination with the SFPUC and the SFFD during the development of the DDA. The Water System Master Plan will include detailed calculation to size pipes, domestic water system layout, proposed water tank locations and project phasing. The Master Plan is not expected to substantially change the supply, storage and distribution of water described here.

7.6 Sustainability Goals

The construction of the secondary water source from EBMUD, combined with the reconstruction of the entire water storage and delivery system on Yerba Buena and Treasure Islands will provide a robust water supply to sustain and protect the island community. This new system combined with water conserving fixtures within the new buildings, and the maximum feasible use of recycled water for the landscape areas and commercial buildings within the core development area (see below) will meet, or exceed, the goals described in the Sustainability Plan.

Appendix Q2 ARUP Candlestick Point/Hunters Point Shipyard Phase II Water Demand Memorandum Revision #16, October 15, 2009

To	Lennar -	Reference number 131878/RRJ	
cc		File reference	
From	Rowan Roderick-Jones/Manish Dalia x 27222 (San Francisco)	Date October 15, 2009	
Subject	**Candlestick Point / Hunters Point Shipyard Phase II Water Demand Memorandum Revision # 16**		

1 Purpose

This Water Demand Memorandum (Memo) presents a summary approach, references, assumptions, and results of calculations undertaken by Arup to estimate a range of potential water demands and sanitary sewer flows for the Candlestick Point/Hunters Point Shipyard (CP/HPS) Development including the Proposed Project as well as the R&D and Housing Variants.

The Memo establishes a historical baseline condition and makes adjustments to account for current California building code requirements as well as the San Francisco Green Building Ordinance. The basis for these analyses and the results are presented herein.

Arup worked in conjunction with Winzler & Kelly to develop water demand and sanitary sewer flow values appropriate for use in engineering design.

2 Approach

To develop reasonable water demand estimates for the CP/HPS development the following steps were taken.

1) The Proposed Project was divided into land uses as identified in Table 1. Two project variants exclude the stadium. The R&D Variant also includes an additional 2,500,000 square feet of research and development space, as shown in Table 2. The Housing Variant does not include any additional program but shifts 1,350 housing units from Candlestick Point to Hunters Point, as shown in Table 4. The methodology for developing water demands was the same for the Proposed Project and Project Variants.

2) A **Historical Benchmark** demand was estimated for each land use based on a series of assumptions and references. Key references used were:

   a. The Urban Water Management Plan for the City of San Francisco

   b. The SFPUC Wholesale Customer Demand Projections Technical Report (URS, 2004)

   c. The City of Los Angeles CEQA Threshold Guide, 2006

   d. The EPA, Onsite Wastewater Treatment Systems Manual, 2002

A number of other references were also used and these are provided at the end of this memorandum. Arup collected information from a number of sources and selected a method of estimating demands that we believed to be appropriate and reasonable for the area. Assumptions and references are provided in Section 4.

3) The demands were then distributed between indoor and outdoor end uses which were estimated based on published data in the SFPUC Wholesale Customer Demand Projections Report (URS 2004). End use distributions for the stadium and performance venues were assumed rather than taken directly from the SFPUC's projections. The distribution ratios are provided in Table 23 and Table 25.

4) Next, the Historical Benchmark was adjusted to an **Adjusted to California Codes** scenario using new fixture flow rates from California and Federal Buildings standards as well as the International Plumbing Code.

5) The Adjusted to California Codes demand estimate does not include the requirements of the **San Francisco Green Building Ordinance (SFGBO)**. The SFGBO is based on LEED for New Construction (LEED NC) and requires a 50% reduction in landscape irrigation demands. The SFGBO does not specify what code is to be used as the baseline for irrigation demands. Therefore the current code was assumed to be equivalent to the irrigation amount allowed under the California Water Efficient Landscape Ordinance. This rule was assumed to be applicable to both private and public landscape irrigation. In addition, the SFGBO requires a 30% reduction in potable water demand. The SFGBO does not provide specific language as to which portions of demand are to be included in the 30% reduction. However, the intention of the similar LEED NC credit (Water Efficiency Credit 3) is to reduce building water demand by 30%. The total 30% reduction in building water efficiency may be achieved by any number of means including improved fixture efficiency, mechanical building efficiency, or by providing an alternative water supply. The demand estimates, when adjusted for the SFGBO represent the final demands for the Proposed Project and Project Variants.

   The SFGBO demand was developed by using the California code as a baseline and using a trajectory or possible means of water saving strategies and/or alternative water supplies to achieve the SFGBO. The assumptions and references used to make these adjustments are provided in Table 27.

6) Potential reclaimed water demands as well as sewage generation were determined based on end use distributions.

The results of the study are presented at the beginning of this report. References and Assumptions used for making the demand estimations are provided after the results in Section 3.

Table 1: CP/HPS Land Use Program (Proposed Project)

	Hunters Point Shipyard	Candlestick Point	Project Total
Land Use			
Residential			
Density, 15-75 units per acre (units)	680	750	1,430
Density, 50-125 units per acre (units)	1,415	3,215	4,630
Density, 100-175 units per acre (units)	265	2,445	2,710
Density, 175-285 units per acre (units)	290	1,440	1,730
Total Project (units)	**2,650**	**7,850**	**10,500**
Retail			
Regional Retail (sqft))	0	635,000	635,000
Neighborhood Retail (sqft)	125,000	125,000	250,000
Total (sqft)	**125,000**	**760,000**	**885,000**
Office (sqft)	0	150,000	150,000
Community Uses (sqft)	50,000	50,000	100,000
Research & Development (sqft)	2,500,000	0	2,500,000
Hotel (sqft)	0	150,000	150,000
Artist's Studios			
1:1 Studio Renovation & Replacement (sqft)	225,000	0	225,000
New Artist Center (sqft)	30,000	0	30,000
Total (sqft)	**255,000**	**0**	**255,000**
Parks & Open Space			
New City Parks (acres)	140	8.1	148.1
New Sports Fields & Active Recreation (acres)	91.6	0	91.6
New Open Space and Restored State Parkland (acres)	0	96.7	96.7
Total (acres)	**231.6**	**104.8**	**336.4**
Football Stadium (seats)	69,000	0	69,000
Performance Venue (seats)	0	10,000	10,000
Source: Lennar, 2009			

Table 2: CP/HPS Land Use Program (R&D Variant)

		Hunters Point Shipyard	Candlestick Point	Project Total
Land Use				
Residential				
	Density, 15-75 units per acre (units)	680	750	1,430
	Density, 50-125 units per acre (units)	1,415	3,215	4,630
	Density, 100-175 units per acre (units)	265	2,445	2,710
	Density, 175-285 units per acre (units)	290	1,440	1,730
	Total Project (units)	**2,650**	**7,850**	**10,500**
Retail				
	Regional Retail (sqft))	0	635,000	635,000
	Neighborhood Retail (sqft)	125,000	125,000	250,000
	Total (sqft)	**125,000**	**760,000**	**885,000**
Office (sqft)		0	150,000	150,000
Community Uses (sqft)		50,000	50,000	100,000
Research & Development (sqft)		5,000,000	0	5,000,000
Hotel (sqft)		0	150,000	150,000
Artist's Studios				
	1:1 Studio Renovation & Replacement (sqft)	225,000	0	225,000
	New Artist Center (sqft)	30,000	0	30,000
	Total (sqft)	**255,000**	**0**	**255,000**
Parks & Open Space				
	New City Parks (acres)	152.4	8.1	160.5
	New Sports Fields & Active Recreation (acres)	69.8	0	69.8
	New Open Space and Restored State Parkland (acres)	0	96.7	96.7
	Total (acres)	**222.2**	**104.8**	**327**
Football Stadium (seats)		0	0	0
Performance Venue (seats)		0	10,000	10,000
Source: Lennar, 2009				

.

Table 4: CP/HPS Land Use Program (Housing Variant)

		Hunters Point Shipyard	Candlestick Point	Project Total
Land Use				
Residential				
	Density, 15-75 units per acre (units)	1,540	970	2,510
	Density, 50-125 units per acre (units)	1,905	3,670	5,575
	Density, 100-175 units per acre (units)	265	1,220	1,485
	Density, 175-285 units per acre (units)	290	640	930
	Total Project (units)	**4,000**	**6,500**	**10,500**
Retail				
	Regional Retail (sqft))	0	635,000	635,000
	Neighborhood Retail (sqft)	125,000	125,000	250,000
	Total (sqft)	**125,000**	**760,000**	**885,000**
Office (sqft)		0	150,000	150,000
Community Uses (sqft)		50,000	50,000	100,000
Research & Development (sqft)		2,500,000	0	2,500,000
Hotel (sqft)		0	150,000	150,000
Artist's Studios				
	1:1 Studio Renovation & Replacement (sqft)	225,000	0	225,000
	New Artist Center (sqft)	30,000	0	30,000
	Total (sqft)	**255,000**	**0**	**255,000**
Parks & Open Space				
	New City Parks (acres)	149.9	8.1	158
	New Sports Fields & Active Recreation (acres)	94.7	0	94.7
	New Open Space and Restored State Parkland (acres)	0	96.7	96.7
	Total (acres)	**244.6**	**104.8**	**349.4**
Football Stadium (seats)		69,000	0	69,000
Performance Venue (seats)		0	10,000	10,000
Source: Lennar, 2009				

3 Results

This section provides the results of the water demand assessment. The results are provided by land use as well as by end use (fixture type). The overall results for the proposed project are summarized by Figure 1. Similar summaries for the two project variants are provided in Figure 3and Figure 5.

Table 4: Potable water demands for Proposed Project and Project Variants.

	Proposed Project Demand (MGD)	R&D Variant Demand (MGD)	Housing Variant Demand (MGD)
Historical Baseline	2.95	3.47	2.92
Adjusted to California Codes	2.46	2.92	2.44
Adjusted to San Francisco Green Building Ordinance	1.67	1.99	1.66

The above table indicates that the R&D Variant will have the highest potable water demands under the requirements of the SFGBO of 1.99 MGD.

Figures 1 through 3 provide the Proposed Project and Project Variant demands for the Historical Benchmark, the Adjusted to California Codes and the San Francisco Green Building Ordinance cases. They also illustrate the Sustainable Case trajectory defined by the step down line. The first five steps in the "sustainable Case" step-down graph are demand reduction strategies while the later five steps are achieved by utilizing alternative water supplies. Additional demand breakdowns by land use and end use are provided in Table 5 through Table 14 for the Proposed Project and Project Variants. Reclaimed water demands and sanitary flows by end use for the Proposed Project are provided in Table 16 through Table 22.

Please note that in all reported annual water demand and sanitary flow data in Table 5 through Table 22 are in million gallons per day (MGD) and are rounded to the nearest 0.01 millionth gallon. When reporting the calculations within the tables slight rounding errors on the order of 0.01 MGD may occur.

Figure 1: Water demand results summary step down graph- Proposed Project

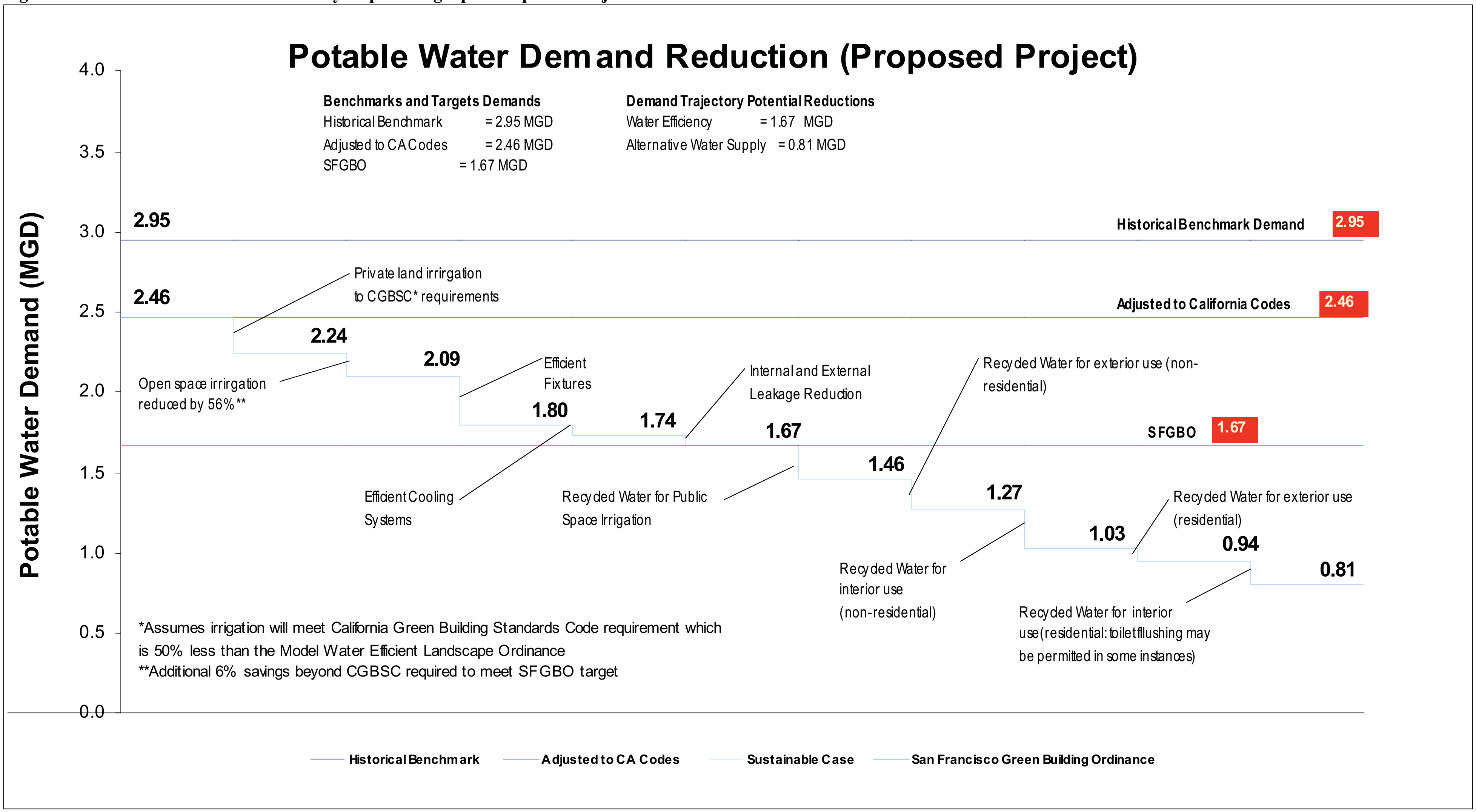

Figure 3: Water demand results summary (R&D Variant)

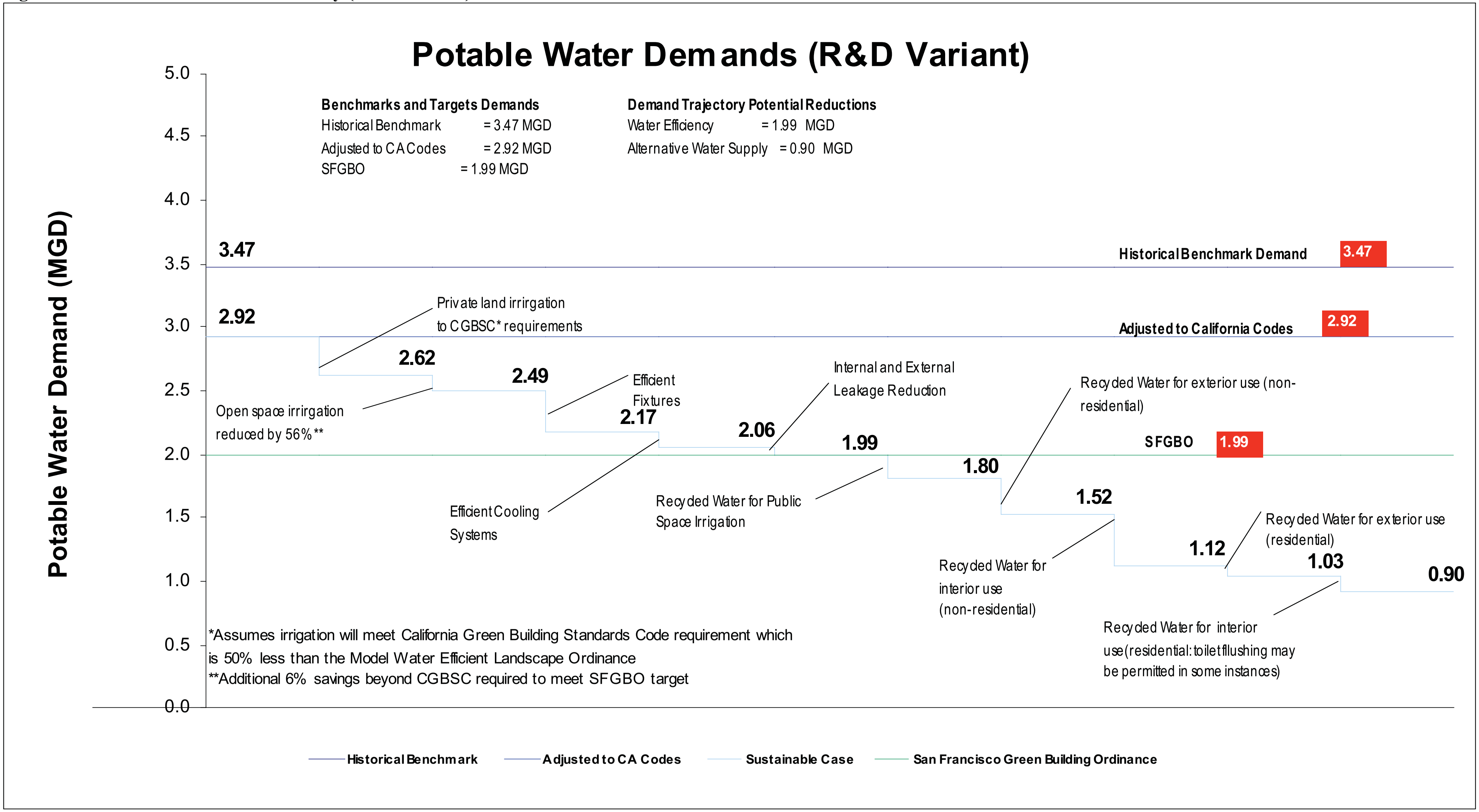

Figure 5: Water demand results summary (Housing Variant)

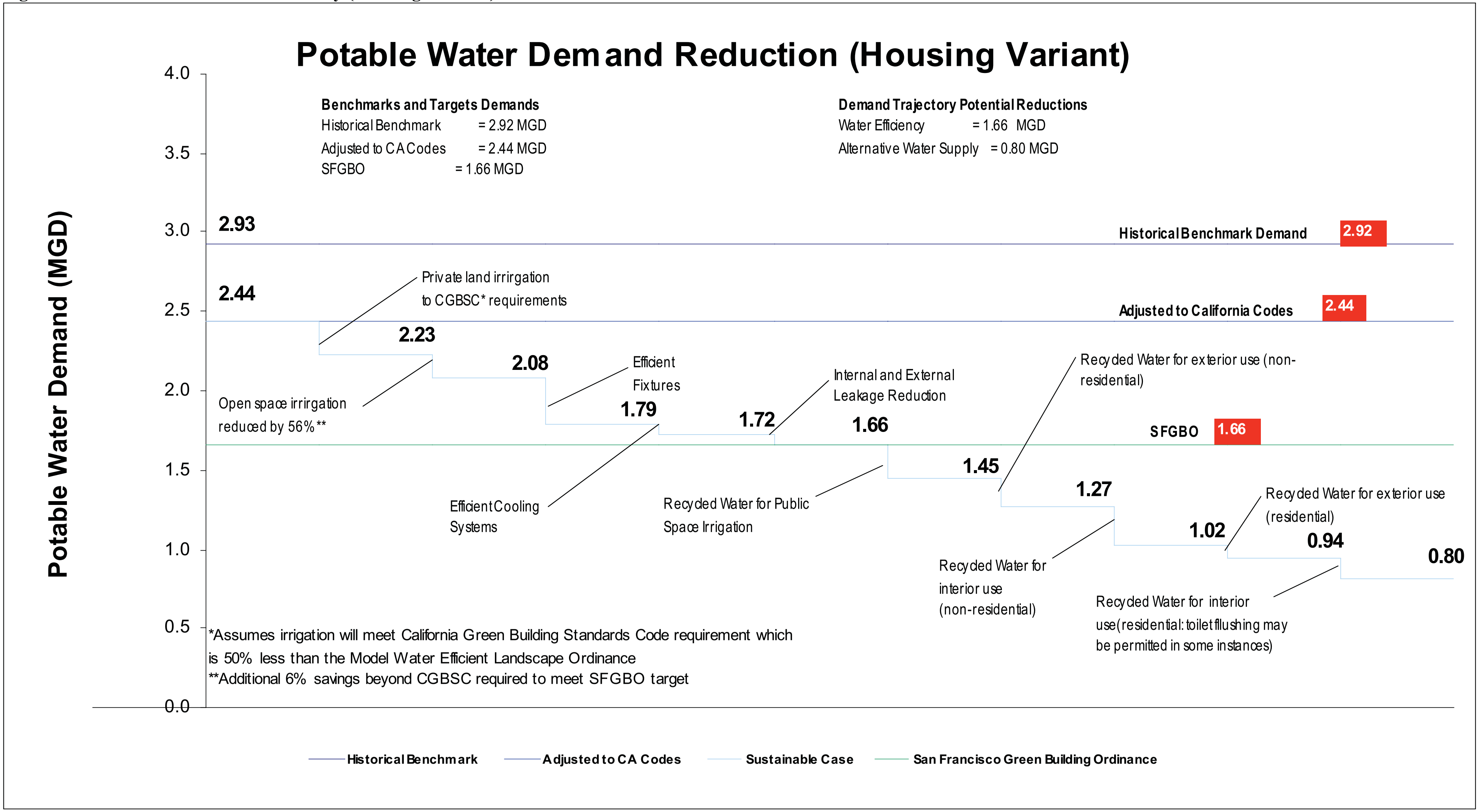

Table 5: Historical Benchmark demand by land use and end use – Proposed Project

Land Use	Historical Benchmark Demand (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	1.13	0.38	1.52
Hotel	0.08	0.00	0.08
Office	0.07	0.01	0.08
Artist Studios	0.00	0.03	0.03
Research and Development	0.00	0.61	0.61
Neighborhood Retail	0.03	0.03	0.06
Regional Retail	0.13	0.00	0.13
Community Uses	0.02	0.02	0.03
Football Stadium	0.00	0.05	0.05
Performance Venue	0.03	0.00	0.03
Total demand excluding Parks and Open Space	**1.49**	**1.11**	**2.60**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.59**	**1.36**	**2.95**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.03	0.01	0.04
Toilets (med-high density Residential)	0.25	0.08	0.32
Toilets (all other uses)	0.05	0.10	0.15
Urinals	0.01	0.02	0.02
Laundry (low density residential)	0.02	0.01	0.03
Laundry (medium and high density residential)	0.20	0.06	0.26
Laundry (all other uses)	0.02	0.03	0.04
Shower	0.19	0.08	0.27
Bath	0.02	0.01	0.02
Faucets	0.19	0.10	0.29
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.16	0.09	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**1.24**	**0.76**	**2.00**
Outdoor Uses			
Irrigation and landscaping	0.18	0.27	0.45
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.24**	**0.36**	**0.60**
Total excluding Parks and Open Space	**1.49**	**1.11**	**2.60**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.59**	**1.36**	**2.95**

*Note: Rounding errors may occur.

Table 6: Adjusted to CA Codes demand by land use and end use- Proposed Project

	Adjusted to CA Codes Demand (MGD)		
Land Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Residential	0.87	0.29	1.16
Hotel	0.07	0.00	0.07
Office	0.06	0.01	0.07
Artist Studios	0.00	0.02	0.02
Research and Development	0.00	0.54	0.54
Neighborhood Retail	0.02	0.02	0.05
Regional Retail	0.12	0.00	0.12
Community Uses	0.01	0.01	0.03
Football Stadium	0.00	0.04	0.04
Performance Venue	0.02	0.00	0.02
Total demand excluding Parks and Open Space	**1.18**	**0.94**	**2.11**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.28**	**1.19**	**2.46**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.11	0.04	0.15
Toilets (all other uses)	0.02	0.05	0.07
Urinals	0.00	0.01	0.01
Laundry (low density residential)	0.02	0.01	0.02
Laundry (medium and high density residential)	0.14	0.05	0.19
Laundry (all other uses)	0.01	0.02	0.03
Shower	0.15	0.06	0.21
Bath	0.02	0.01	0.02
Faucets	0.16	0.09	0.25
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.16	0.09	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**0.93**	**0.58**	**1.51**
Outdoor Uses			
Irrigation and landscaping	0.18	0.27	0.45
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.24**	**0.36**	**0.60**
Total excluding Parks and Open Space	**1.18**	**0.94**	**2.11**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.28**	**1.19**	**2.46**

*Note: Rounding errors may occur.

Table 7: SFGBO demands by land use and end use – Proposed Project

Land Use	SFGBO Demand (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.61	0.22	0.83
Hotel	0.05	0.00	0.05
Office	0.04	0.00	0.04
Artist Studios	0.00	0.01	0.01
Research and Development	0.00	0.36	0.36
Neighborhood Retail	0.02	0.02	0.03
Regional Retail	0.08	0.00	0.08
Community Uses	0.01	0.01	0.02
Football Stadium	0.00	0.02	0.02
Performance Venue	0.01	0.00	0.01
Total demand excluding Parks and Open Space	**0.82**	**0.64**	**1.47**
Parks and Open Space	0.06	0.15	0.21
Total Demand	**0.88**	**0.79**	**1.67**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.09	0.03	0.12
Toilets (all other uses)	0.02	0.04	0.06
Urinals	0.00	0.00	0.00
Laundry (low density residential)	0.01	0.01	0.02
Laundry (medium and high density residential)	0.10	0.03	0.13
Laundry (all other uses)	0.01	0.01	0.02
Shower	0.10	0.04	0.15
Bath	0.02	0.01	0.02
Faucets	0.11	0.06	0.18
Process Water	0.04	0.10	0.14
Dishwashers	0.02	0.02	0.04
Internal Leakage	0.12	0.07	0.19
Other domestic	0.02	0.01	0.03
Subtotal	**0.68**	**0.42**	**1.11**
Outdoor Uses			
Irrigation and landscaping	0.09	0.14	0.24
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.01	0.04	0.05
External Leakage	0.01	0.01	0.02
Subtotal	**0.14**	**0.22**	**0.36**
Total excluding Parks and Open Space	**0.82**	**0.64**	**1.47**
Parks and Open Space	0.06	0.15	0.21
Total Demand	**0.88**	**0.79**	**1.67**

*Note: Rounding errors may occur.

Table 8: Historical Benchmark demand by land use and end use – R&D Variant

Land Use	Historical Benchmark Demand (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	1.13	0.38	1.52
Hotel	0.08	0.00	0.08
Office	0.07	0.01	0.08
Artist Studios	0.00	0.03	0.03
Research and Development	0.00	1.21	1.21
Neighborhood Retail	0.03	0.03	0.06
Regional Retail	0.13	0.00	0.13
Community Uses	0.02	0.02	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.04	0.00	0.04
Total demand excluding Parks and Open Space	**1.49**	**1.67**	**3.16**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.58**	**1.89**	**3.47**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.03	0.01	0.04
Toilets (med-high density Residential)	0.25	0.08	0.32
Toilets (all other uses)	0.05	0.18	0.23
Urinals	0.01	0.02	0.03
Laundry (low density residential)	0.02	0.01	0.03
Laundry (medium and high density residential)	0.20	0.06	0.26
Laundry (all other uses)	0.02	0.05	0.07
Shower	0.19	0.09	0.28
Bath	0.02	0.01	0.02
Faucets	0.19	0.14	0.33
Process Water	0.05	0.24	0.29
Dishwashers	0.03	0.06	0.09
Internal Leakage	0.16	0.12	0.28
Other domestic	0.03	0.01	0.04
Subtotal	**1.25**	**1.08**	**2.33**
Outdoor Uses			
Irrigation and landscaping	0.18	0.43	0.61
Pools and Fountains	0.01	0.02	0.03
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.10	0.12
External Leakage	0.01	0.03	0.04
Subtotal	**0.24**	**0.59**	**0.83**
Total excluding Parks and Open Space	**1.49**	**1.67**	**3.16**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.58**	**1.89**	**3.47**

*Note: Rounding errors may occur.

Table 9: Adjusted to CA Codes demand by land use and end use- R&D Variant

	Adjusted to Codes BAU Demand (MGD)		
Land Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Residential	0.87	0.29	1.16
Hotel	0.07	0.00	0.07
Office	0.06	0.01	0.07
Artist Studios	0.00	0.02	0.02
Research and Development	0.00	1.08	1.08
Neighborhood Retail	0.02	0.02	0.05
Regional Retail	0.12	0.00	0.12
Community Uses	0.01	0.01	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.02	0.00	0.02
Total demand excluding Parks and Open Space	**1.18**	**1.43**	**2.61**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.27**	**1.66**	**2.92**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.11	0.04	0.15
Toilets (all other uses)	0.02	0.08	0.11
Urinals	0.01	0.01	0.01
Laundry (low density residential)	0.02	0.01	0.02
Laundry (medium and high density residential)	0.14	0.05	0.19
Laundry (all other uses)	0.01	0.04	0.05
Shower	0.15	0.08	0.23
Bath	0.02	0.01	0.02
Faucets	0.17	0.12	0.29
Process Water	0.05	0.24	0.29
Dishwashers	0.03	0.05	0.08
Internal Leakage	0.16	0.12	0.28
Other domestic	0.03	0.01	0.04
Subtotal	**0.93**	**0.84**	**1.78**
Outdoor Uses			
Irrigation and landscaping	0.18	0.43	0.61
Pools and Fountains	0.01	0.02	0.03
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.10	0.12
External Leakage	0.01	0.03	0.04
Subtotal	**0.24**	**0.59**	**0.83**
Total excluding Parks and Open Space	**1.18**	**1.43**	**2.61**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.27**	**1.66**	**2.92**

*Note: Rounding errors may occur.

Table 10: SFGBO demands by land use and end use – R&D Variant

Land Use	SFGBO (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.62	0.21	0.83
Hotel	0.05	0.00	0.05
Office	0.04	0.00	0.04
Artist Studios	0.00	0.01	0.01
Research and Development	0.00	0.71	0.71
Neighborhood Retail	0.02	0.02	0.03
Regional Retail	0.08	0.00	0.08
Community Uses	0.01	0.01	0.02
Football Stadium	0.00	0.00	0.00
Performance Venue	0.01	0.00	0.01
Total demand excluding Parks and Open Space	**0.83**	**0.96**	**1.80**
Parks and Open Space	0.05	0.14	0.19
Total Demand	**0.89**	**1.11**	**1.99**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
	Indoor Uses		
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.09	0.03	0.12
Toilets (all other uses)	0.02	0.07	0.09
Urinals	0.00	0.00	0.00
Laundry (low density residential)	0.01	0.01	0.02
Laundry (medium and high density residential)	0.10	0.03	0.13
Laundry (all other uses)	0.01	0.03	0.03
Shower	0.10	0.05	0.16
Bath	0.02	0.01	0.02
Faucets	0.11	0.08	0.20
Process Water	0.04	0.18	0.22
Dishwashers	0.02	0.03	0.05
Internal Leakage	0.12	0.09	0.21
Other domestic	0.02	0.01	0.03
Subtotal	**0.68**	**0.62**	**1.31**
	Outdoor Uses		
Irrigation and landscaping	0.09	0.22	0.32
Pools and Fountains	0.01	0.02	0.03
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.01	0.08	0.09
External Leakage	0.01	0.02	0.03
Subtotal	**0.14**	**0.36**	**0.50**
Total excluding Parks and Open Space	**0.83**	**0.96**	**1.80**
Parks and Open Space	0.05	0.14	0.19
Total Demand	**0.89**	**1.11**	**1.99**

*Note: Rounding errors may occur.

Table 11: Historical Benchmark demand by land use and end use – Housing Variant

	Historical Benchmark Demand (MGD)		
Land Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Residential	0.94	0.58	1.52
Hotel	0.08	0.00	0.08
Office	0.07	0.01	0.08
Artist Studios	0.00	0.03	0.03
Research and Development	0.00	0.61	0.61
Neighborhood Retail	0.03	0.03	0.06
Regional Retail	0.13	0.00	0.13
Community Uses	0.02	0.02	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.04	0.00	0.04
Total demand excluding Parks and Open Space	**1.29**	**1.26**	**2.56**
Parks and Open Space	0.11	0.25	0.36
Total Demand	**1.40**	**1.51**	**2.92**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.05	0.05	0.10
Toilets (med-high density Residential)	0.18	0.09	0.26
Toilets (all other uses)	0.05	0.10	0.15
Urinals	0.01	0.01	0.02
Laundry (low density residential)	0.04	0.04	0.08
Laundry (medium and high density residential)	0.14	0.07	0.21
Laundry (all other uses)	0.02	0.03	0.04
Shower	0.16	0.11	0.26
Bath	0.01	0.01	0.02
Faucets	0.16	0.13	0.29
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.14	0.11	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**1.07**	**0.91**	**1.98**
Outdoor Uses			
Irrigation and landscaping	0.17	0.26	0.43
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.00	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.22**	**0.35**	**0.57**
Total excluding Parks and Open Space	**1.29**	**1.26**	**2.56**
Parks and Open Space	0.11	0.25	0.36
Total Demand	**1.40**	**1.51**	**2.92**

*Note: Rounding errors may occur.

Table 12: Adjusted to CA Codes demand by land use and end use- Housing Variant

	Adjusted to Codes BAU Demand (MGD)		
Land Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Residential	0.72	0.44	1.16
Hotel	0.07	0.00	0.07
Office	0.06	0.01	0.07
Artist Studios	0.00	0.02	0.02
Research and Development	0.00	0.54	0.54
Neighborhood Retail	0.02	0.02	0.05
Regional Retail	0.12	0.00	0.12
Community Uses	0.01	0.01	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.02	0.00	0.02
Total demand excluding Parks and Open Space	**1.03**	**1.05**	**2.08**
Parks and Open Space	0.11	0.25	0.36
Total Demand	**1.14**	**1.30**	**2.44**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.02	0.02	0.05
Toilets (med-high density Residential)	0.08	0.04	0.12
Toilets (all other uses)	0.02	0.04	0.07
Urinals	0.01	0.00	0.01
Laundry (low density residential)	0.03	0.03	0.06
Laundry (medium and high density residential)	0.10	0.05	0.15
Laundry (all other uses)	0.01	0.02	0.03
Shower	0.13	0.09	0.21
Bath	0.01	0.01	0.02
Faucets	0.14	0.11	0.25
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.14	0.11	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**0.80**	**0.70**	**1.50**
Outdoor Uses			
Irrigation and landscaping	0.17	0.26	0.43
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.00	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.22**	**0.35**	**0.57**
Total excluding Parks and Open Space	**1.03**	**1.05**	**2.08**
Parks and Open Space	0.11	0.25	0.36
Total Demand	**1.14**	**1.31**	**2.44**

*Note: Rounding errors may occur.

Table 14: SFGBO demands by land use and end use – Housing Variant

Land Use	SFGBO (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.51	0.33	0.83
Hotel	0.05	0.00	0.05
Office	0.04	0.00	0.04
Artist Studios	0.00	0.01	0.01
Research and Development	0.00	0.36	0.36
Neighborhood Retail	0.02	0.02	0.03
Regional Retail	0.08	0.00	0.08
Community Uses	0.01	0.01	0.02
Football Stadium	0.00	0.00	0.00
Performance Venue	0.01	0.00	0.01
Total demand excluding Parks and Open Space	**0.72**	**0.73**	**1.45**
Parks and Open Space	0.06	0.15	0.22
Total Demand	**0.78**	**0.88**	**1.66**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.02	0.02	0.04
Toilets (med-high density Residential)	0.06	0.03	0.10
Toilets (all other uses)	0.02	0.03	0.05
Urinals	0.00	0.00	0.00
Laundry (low density residential)	0.02	0.02	0.04
Laundry (medium and high density residential)	0.07	0.03	0.11
Laundry (all other uses)	0.01	0.01	0.02
Shower	0.09	0.06	0.15
Bath	0.01	0.01	0.02
Faucets	0.10	0.08	0.18
Process Water	0.04	0.10	0.14
Dishwashers	0.02	0.02	0.04
Internal Leakage	0.10	0.08	0.19
Other domestic	0.02	0.01	0.03
Subtotal	**0.58**	**0.51**	**1.10**
Outdoor Uses			
Irrigation and landscaping	0.08	0.14	0.22
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.00	0.00	0.01
Cooling	0.01	0.04	0.05
External Leakage	0.01	0.01	0.02
Subtotal	**0.13**	**0.22**	**0.34**
Total excluding Parks and Open Space	**0.72**	**0.73**	**1.45**
Parks and Open Space	0.06	0.15	0.22
Total Demand	**0.78**	**0.88**	**1.66**

*Note: Rounding errors may occur.

Potential reclaimed water demands and sanitary flows by end use were estimated for the Proposed Project and Project Variants. These are provided below in Table 16 through Table 22.

Table 16: Reclaimed water demands by end use – Proposed Project

End Use	Reclaimed Water Demands by End Use (MGD)		
	Historical Benchmark	Adjusted to CA Codes	SFGBO
Toilets (residential)	0.36	0.17	0.14
Toilets (non-residential))	0.15	0.07	0.06
Urinals	0.02	0.01	0.00
Process Water (non-residential)	0.18	0.18	0.14
Irrigation and landscaping (residential)	0.12	0.12	0.06
Irrigation and Landscaping (non-residential)	0.33	0.33	0.16
Pools and Fountains (residential)	0.01	0.01	0.01
Pools and Fountains (non-residential)	0.01	0.01	0.01
Wash down (residential)	0.01	0.01	0.01
Wash down (non-residential)	0.01	0.01	0.01
Car Washing (residential)	0.01	0.01	0.01
Car Washing (non-residential)	0.00	0.00	0.00
Cooling (non-residential)	0.07	0.07	0.05
Total flow excluding Parks and Open Space	**1.30**	**1.00**	**0.66**
Parks and Open Space	0.35	0.35	0.21
Total Demand	**1.65**	**1.35**	**0.87**

*Note: Rounding errors may occur.

Table 15: Sanitary flows by end use – Proposed Project

End Use	Sanitary Flows by End Use (MGD)		
	Historical Benchmark	Adjusted to CA Codes	SFGBO
Toilets	0.52	0.24	0.19
Urinals	0.02	0.01	0.00
Laundry	0.34	0.24	0.17
Shower	0.27	0.21	0.15
Bath	0.02	0.02	0.02
Faucets	0.29	0.25	0.18
Process Water	0.18	0.18	0.14
Dishwashers	0.06	0.06	0.04
Other domestic	0.04	0.04	0.03
Cooling	0.07	0.07	0.05
Total	**1.82**	**1.33**	**0.98**

*Note: Rounding errors may occur.

Table 16: Reclaimed water demands by end use – R&D Variant

End Use	Reclaimed Water Demands by End Use (MGD) Historical Benchmark	Adjusted to Codes BAU	SFGBO
Toilets (residential)	0.36	0.17	0.14
Toilets (non-residential))	0.23	0.11	0.09
Urinals	0.03	0.01	0.00
Process Water (non-residential)	0.29	0.29	0.22
Irrigation and landscaping (residential)	0.12	0.12	0.06
Irrigation and Landscaping (non-residential)	0.49	0.49	0.25
Pools and Fountains (residential)	0.01	0.01	0.01
Pools and Fountains (non-residential)	0.02	0.02	0.02
Wash down (residential)	0.01	0.01	0.01
Wash down (non-residential)	0.02	0.02	0.02
Car Washing (residential)	0.01	0.01	0.01
Car Washing (non-residential)	0.00	0.00	0.00
Cooling (non-residential)	0.12	0.12	0.09
Total flow excluding Parks and Open Space	**1.71**	**1.37**	**0.90**
Parks and Open Space	0.31	0.31	0.19
Total Demand	**2.02**	**1.69**	**1.09**

*Note: Rounding errors may occur.

Table 17: Sanitary flows by end use – R&D Variant

End Use	Sanitary Flows by End Use (MGD) Historical Benchmark	Adjusted to CA Codes	SFGBO
Toilets	0.60	0.27	0.22
Urinals	0.03	0.01	0.00
Laundry	0.36	0.26	0.18
Shower	0.28	0.23	0.16
Bath	0.02	0.02	0.02
Faucets	0.33	0.29	0.20
Process Water	0.29	0.29	0.22
Dishwashers	0.09	0.08	0.05
Other domestic	0.04	0.04	0.03
Cooling	0.12	0.12	0.09
Total	**2.16**	**1.61**	**1.18**

*Note: Rounding errors may occur.

Table 18: Reclaimed water demands by end use – Housing Variant

End Use	Reclaimed Water Demands by End Use (MGD)		
	Historical Benchmark	Adjusted to Codes BAU	SFGBO
Toilets (residential)	0.36	0.17	0.14
Toilets (non-residential))	0.15	0.07	0.05
Urinals	0.02	0.01	0.00
Process Water (non-residential)	0.18	0.18	0.14
Irrigation and landscaping (residential)	0.12	0.12	0.06
Irrigation and Landscaping (non-residential)	0.30	0.30	0.15
Pools and Fountains (residential)	0.01	0.01	0.01
Pools and Fountains (non-residential)	0.01	0.01	0.01
Wash down (residential)	0.01	0.01	0.01
Wash down (non-residential)	0.01	0.01	0.01
Car Washing (residential)	0.01	0.01	0.01
Car Washing (non-residential)	0.00	0.00	0.00
Cooling (non-residential)	0.07	0.07	0.05
Total flow excluding Parks and Open Space	**1.26**	**0.97**	**0.64**
Parks and Open Space	0.37	0.37	0.22
Total Demand	**1.63**	**1.34**	**0.86**

*Note: Rounding errors may occur.

Table 22: Sanitary flows by end use – Housing Variant

End Use	Sanitary Flows by End Use (MGD)		
	Historical Benchmark	Adjusted to CA Codes	SFGBO
Toilets	0.51	0.23	0.19
Urinals	0.02	0.01	0.00
Laundry	0.34	0.24	0.17
Shower	0.26	0.21	0.15
Bath	0.02	0.02	0.02
Faucets	0.29	0.25	0.18
Process Water	0.18	0.18	0.14
Dishwashers	0.06	0.06	0.04
Other domestic	0.04	0.04	0.03
Cooling (50% flow to sewer)	0.07	0.07	0.05
Total	**1.80**	**1.32**	**0.97**

*Note: Rounding errors may occur.

4 Assumptions and References

This section describes assumptions used to:

1) Estimate historical baseline demands;
2) Distribute the historical baseline demands to specific end uses such as toilets, showers, irrigation etc…;
3) Adjust the historical baseline demands to current California code; and
4) Adjust the to-code demands to a sustainable case wherein efficiency measures such as efficient fixturesare applied. The efficiency measures applied in the Sustainable Case have been tailored to meet the demand reduction requirements of the SFGBO.

Table 20: Assumptions for estimating water demands by land use for the Historical Benchmark case .

Assumptions Summary for Historical Benchmark Demand Estimation						
Land use	**ID#**	**Description**	**Value**	**Unit**	**Reference or Assumption**	**Notes**
Residential						
	1	No. of residents per unit - low density	2.33	residents	Mundie & Associates, 2009	
	2	No. of residents per unit - medium density	2.33	residents	Mundie & Associates, 2009	
	3	No. of residents per unit - high density	2.33	residents	Mundie & Associates, 2009	
	4	Average consumption per capita	62	gallons per day (gp)	SFPUC, 2005	
	5	Average outdoor water use for single family residences	10	%	SFPUC, 2005	Note reference states that average demand is less than 10%
Regional Retail						
	1	Regional Retail jobs creation	350	Square feet (sqft)/job	Economic and Planning Systems, 2009.	
	2	Area of retail space per customer	22	sqft/customer	British Standards Institution. 2006	
	3	Sewage generation per employee	10	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	4	Sewage generation per visitor	2	gpd	EPA, 2002	EPA sites 2 gpd / parking spot. Sewage generation is only a fraction of overall consumption
	5	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	
	6	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer

Neighborhood Retail						
	1	Neighborhood retail jobs creation	270	sqft/job	Economic and Planning Systems, 2009.	
	2	Area of retail space per customer	22	sqft/customer	British Standards Institution. 2006	
	3	Sewage generation per employee	10	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	4	Water generation per visitor	2	gpd	EPA, 2002	EPA sites 2 gpd / parking spot. Sewage generation is only a fraction of overall consumption
	5	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	Sewage generation is only a fraction of overall consumption
	6	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Office						
	1	Office job creation	276	sqft/job	Economic and Planning Systems, 2009.	
	2	Residential jobs creation	25	Units/job	Economic and Planning Systems, 2009.	
	3	Water consumption per employee	85	gpd	URS, 2004.	
	4	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	
	5	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Community Uses						

	1	Community use job creation	276	sqft/job	Assumed similar to office	Actual Community uses are not finalized therefore community use water demands have been estimated in a similar manner as office land use.
	2	Water consumption per employee	85	gpd	Assumed similar to office	
	3	Average outdoor water use for non-residential customers	43	percent	Assumed similar to office	
	4	Ratio of sewage generation to total water consumed on site	57	percent	Assumed similar to office	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Research and Development						
	1	R&D jobs creation (office)	267	sqft/job	Economic and Planning Systems, 2009.	
	2	Sewage generation per employee for office R&D space	85	gpd	URS, 2004.	Sewage generation is only a fraction of overall consumption
	3	Average outdoor water use for non-residential customers for all R&D	43	percent	URS, 2004.	Sewage generation is only a fraction of overall consumption
	4	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Assumption is conservative in that some water consumed indoors would not go to sanitary sewer
	5	Type of R&D Spaces	1/3,1/3, and 1/3	Fraction	Email from Lennar	From email correspondence with Lennar it has been assumed that 1/3 of the R&D space will be office, 1/3 will be wet laboratory, and the remaining 1/3 will be light production which is similar to industrial.
	6	Water Usage for Wet Laboratory R&D Space	0.547	gpsfd	2020 UC Berkeley LRDP Draft EIR (http://www.cp.berkeley.edu/LRDP_2020 draft.htm) - Table 4.13-1	Source provided by Winzler & Kelly. The report states that 0.32 is for sustainable lab case with efficient fixtures built in, and calculations were worked backwards to calculate the BAU.
	7	Water usage profile for	Varies	%	URS, 2004	The water usage profile for wet lab

		Wet Lab Space				space has been assumed to be the average of the commercial and industrial usage profile.
	8	Water Usage for Light Projection R&D Space	0.1	gpsfd	City of Los Angeles, L.A. CEQA Threshold Guide, 2006, Exhibit M.2. - 12 Sewage Generation Factors	
Hotel						
	1	Hotel job creation	700	sqft/job	Economic and Planning Systems, 2009	
	2	Average guest room size	600	sqft	Assumed	This includes the space for reception, kitchens and conference facilities
	3	Average guests / room	1.9	guests	Assumed	
	4	Sewage generation per guest	50	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	5	Sewage generation per employee	10	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	6	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	Sewage generation is only a fraction of overall consumption
	7	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Artist Studios						
	1	# of artists	252	people	Lennar, 2009	
	2	Consumption per artist	85	gpd	URS, 2004.	
Parks and Open Space						
	1	Total irrigation demand from landscape architect	350,180	gpd	Per landscape irrigation prepared by RHAA 7/31/08	
Football Stadium						
	1	Football games / year	10	Home games	Economic and Planning Systems, 2009.	
	2	Attendance at football games	69000	people	Economic and Planning Systems, 2009.	

	3	Other venues per year	20	Other venues	Economic and Planning Systems, 2009.	
	4	Attendance at other venues	37500	people	Lennar, 2009	
	5	Employees (football day)	3625	people	Stadium Staffing Numbers from SF 49ers, (Lennar, 2009)	Includes 2900 employees and 725 media personnel
	6	Employees (event day)	1,922	people	Pro-rated using football day attendance and employees on football days	
	7	Employee (nonevent days)	48	people	Stadium Staffing Numbers from SF 49ers, (Lennar, 2009)	
	8	No. of players/performers (event day)	200	people	Assumed	100 people per team for players and staff. Assumed same number for other event days
	9	Stadium average daily irrigation	23979	gpd	Marty Laporte, 2009	
	10	Sewage generation per seat and employee on game days	4	gpd	EPA, 2002.	EPA value is for "auditorium" Sewage generation is only a fraction of overall consumption
	11	Ratio of sewage generation to indoor water consumption	95	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
	12	Water consumption per permanent employee per day	85	gpd	URS, 2004.	
Performance Venue						
	1	Performance venue job creation	40	seats/job	Economic and Planning Systems, 2009.	
	2	Performance events per year	250	events	Economic and Planning Systems, 2009.	
	3	Employees - typical day	7	people	Assumed	Prorated to be similar to stadium
	4	Visitors per performance	10,000	people	Per CP/HPS development program, 2009	

	6	Water consumption per permanent employee per day	85	gpd	URS, 2004.	
	7	Sewage generation per seat and employee on event days	4	gpd	EPA, 2002.	EPA value is for "auditorium". Sewage generation is only a fraction of overall consumption
	12	Ratio of sewage generation to indoor water consumption	95	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Sanitary Sewer						
	1	Percent of indoor consumption to sanitary sewer	100%	Percent	Assumed per URS 2004 and conversations with W&K	
	2	Cooling demands assumed to contribute to sanitary sewer. (Non Res)			Assumed per conversations with W&K	Though some losses may occur, 100% of cooling demand is assumed to go to sanitary sewer

Table 23: End use demand distributions by land use (URS 2004)

Table 3-3
End-Use Data - Initial Percentage Assumptions

End Use	Initial Percentages by Customer-Billing Category				
	Single-Family Residential	Multi-Family Residential	Commercial	Industrial	Institutional
Indoor Usage					
Toilets (indoor)	26.7%	26.7%	25%	23%	20%
Urinals (indoor)	NA	NA	0%	7%	0%
Laundry (indoor)	21.7%	21.7%	8%	5%	10%
Showers (indoor)	16.8%	16.8%	5%	5%	16%
Bath (indoor)	1.7%	1.7%	NA	NA	NA
Faucets (indoor)	15.7%	15.7%	10%	15%	19%
Process (indoor)	NA	NA	34%	30%	5%
Dishwashers (indoor)	1.4%	1.4%	8%	5%	15%
Internal Leakage (indoor)	13.7%	13.7%	10%	10%	15%
Other Domestic (indoor)	2.2%	2.2%	NA	NA	NA
Outdoor Usage					
Irrigation and Landscaping (outdoor)	80%	80%	75%	65%	70%
Pools and Fountains (outdoor)	5%	5%	2%	5%	5%
Wash-down of house/facilities (outdoor)	5%	5%	3%	0%	5%
Car Washing (outdoor)	5%	5%	0%	0%	0%
Cooling (outdoor)	0%	0%	15%	25%	15%
External Leakage (outdoor)	5%	5%	5%	5%	5%

NA – Not Applicable

Sources: AWWARF, Konen (1986), Behling et al. (1992)

Table 25: Assumed end use distributions for the stadium and performance venue

Indoor Usage	%	95%
Outdoor Usage	%	5%
Indoor Uses		
Toilets	%	30%
Urinals	%	30%
Laundry	%	0%
Shower	%	5%
Bath	%	0%
Faucets	%	15%
Process Water	%	10%
Dishwashers	%	0%
Internal Leakage	%	10%
Other domestic	%	0%
Outdoor Uses		
Irrigation and landscaping	%	20%
Pools and Fountains	%	0%
Wash down of houses and facilities	%	20%
Car Washing	%	0%
Cooling	%	50%
External Leakage	%	10%

Table 27: Assumptions used to adjust between water demand scenarios

	Historical Benchmark		Adjusted to CA Code		SFGBO		
	Max Flow or Quantity	Note / Reference	Max Flow or Quantity	Note / Reference	Max Flow or Quantity	Note/Reference	Unit
Plumbing Fixture							
Lavatory faucet, private	2.5		2.2	2007 California Plumbing Code	1.5	EPA WaterSense	gpm at 60 psi
Lavatory faucet, public, (metering)	0.25		0.25	2006 International Plumbing Code	0.2	CA Green Building Standard 2008	gallon per metering cycle
(not metering)	0.6		0.5	IPC	0.5	n.a.	gpm at 60 psi
Shower head	3.125	URS 2004*	2.5	2007 California Plumbing Code	1.75	EPA WaterSense	gpm at 80 psi
Sink faucet	2.5		2.2	Plumbing Code	1.5	EPA WaterSense	gpm at 60 psi
Urinal	2	URS 2004*	1	2007 California Plumbing Code	0.125	EPA Water Sense	gallon per flushing cycle
Water closet	3.5	URS 2004*	1.6	2007 California Plumbing Code	1.28	EPA Water Sense and CA Green Building Standard 2008	gallon per flushing cycle
Other Appliances							
Dishwasher (Residential)	7		6	US Department of Energy 2007	4	Energy Star	gallons/cy capacity
Dishwasher (Commercial)	1.75		1.46	Energy Star	0.92	Energy Star	gallons per rack
Laundry	36.4	URS 2004	26	(US Federal Standard by 2011)	18	n.a. (calc)	gal/load
Laundry	13.2		8.5	CA Green Building Standard 2008	6	EPA Water Sense	gal/load-cf (Water Factor)
Irrigation							
Private Lands		Based on water demand distribution		California Water Efficient Landscape Ordinance (CWELO)	50%	CA Green Building Standard 2008	Fractional reduction compared to CWELO
Public Open Space		Per Landscape Architect Estimates		Per Landscape Architect Estimates - Note that this is less than CWELO	50%	CA Green Building Standard 2008	Fractional reduction compared to CWELO

Table 24: Other assumptions used to adjust the CA code demand to the SFGBO

Improved Cooling Efficiency		
Total fraction demand reductiont due to building envelope improvement measures and improved cooling technologies	0.25	
Reduced Losses		
Fractional demand reduction due to new piping and metering	0.25	

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Appendix Q3 Hydroconsult Engineers Hydrologic Modeling to Determine Potential Water Quality Impacts, October 19, 2009

Subject:	**Hydrologic Modeling to Determine Potential Water Quality Impacts**
Phase:	Preliminary Results
Prepared By:	Chris Phanartzis, P.E., Beth Goldstein, P.E., LEED AP®
Reviewed By:	Brent Johnson, P.E., LEED AP®
Date:	October 19, 2009
Reference:	090014

1 Introduction

This report contains a brief description of potential water quality impacts resulting from changes in frequency, duration or volume of combined sewer overflows (CSOs) from the City's combined sewer system (CSS). Potential changes in CSOs were reviewed in response to predicted changes in the sanitary flow and storm runoff from the proposed redevelopment of Candlestick Point (CP) and Hunters Point Shipyard (HPS). This Technical Memorandum (TM) summarizes the results of a hydrologic modeling analysis and presents a comparison between the base case and with-project scenarios.

2 Base Case Scenario

The Base Case scenario for comparison represents the existing Bayside system including development at Hunters Point through Phase I, Mission Bay at full build-out, and construction of the Sunnydale Tunnel. It does not include additional reasonable foreseeable future developments.

3 With-Project Scenario

The hydrologic analysis was premised on a number of assumptions including type and extent of proposed uses, stormwater and sanitary flow discharge destinations and other pertinent information as outlined in Tables 1 and 2. Contributing areas were determined based on Figure 1—CP/HPS Project Area, and are organized into two main subareas as described below.

Figure 1. CP/HPS Project Area

Source: Lennar Urban

3.1 Candlestick Point Subarea

Currently, all of the Alice Griffith Housing Development, portions of the State Park, and portions of the Stadium site contribute storm runoff to the City's CSS. With the proposed project, these flows will be removed from the City system, and all future stormwater flows will be discharged to the Bay with a portion of the flow receiving treatment prior to discharge (Lennar Urban, "LID Stormwater Opportunities Study", June, 2009).

Currently, the CP site contributes sanitary sewage to the CSS via gravity sewers from three locations: the stadium, the Alice Griffith housing development, and the RV Park on State Park grounds. The existing sanitary flows from these three sources are as follows:

- The existing annual average sanitary flow from the stadium is assumed as 23,285 gpd (ARUP, "Candlestick Point/ Hunters Point Shipyard Phase II Water Demand Memorandum Revision # 15, September 25, 2009).
- The existing sanitary flow from the housing development is calculated based on 256 units at a rate of 101.9 gpd/unit (SFPUC Multi-Family Residential estimates for 2010, "householdcons.xls").

- The existing sanitary flow from the State Park RV Park is based on average monthly meter data for the period January, 2007 through September, 2009 provided by SFPUC (via email from Hayden Kam, September 30, 2009).

3.2 Hunters Point Shipyard Subarea

Currently, no stormwater flows (other than infiltration and inflow to the sanitary system) from HPS are directed to the City CSS. The proposed project and both variants maintain separation of stormwater flows from the City CSS. All sanitary flows from HPS are currently pumped to the City system via force main on Crisp Road discharging just upstream of the Hunters Point Tunnel. For the purpose of this analysis, the existing sanitary flows from HPS are assumed to be 0.154 mgd on average based on SFPUC meter data for the period July 1, 2001, through June 30, 2002 (SFPUC, "Annual Metered Sewage Discharge.xls").

Table 1. Hydrologic Model Dry Weather Inputs—Sanitary Flows to the City CSS

	Future[1] (mgd)	Base Case[2] (mgd)	Net increase (mgd)
Proposed Project			
Candlestick Park	0.57	0.0517	0.518
Hunters Point	0.39	0.154	0.236
R & D Variant			
Candlestick Park	0.57	0.0517	0.518
Hunters Point	0.61	0.154	0.456
Housing Variant			
Candlestick Park	0.49	0.0517	0.438
Hunters Point	0.48	0.154	0.326

Sources:

1. *Future sanitary flows from ARUP, "Candlestick Point/ Hunters Point Shipyard Phase II Water Demand Memorandum Revision # 15, September 25, 2009.*
2. *Existing sanitary flows from ARUP, 2009, data provided by SFPUC, and calculation.*

Table 2. Hydrologic Model Wet Weather Inputs--Area Contributing Runoff to the City CSS

Subarea	Total Area[1] (acres)	Base Case[2] (acres)	Future[3] (acres)
Candlestick Point	281	108	0
Hunters Point Shipyard	421	0	0

Sources:

1. *Total Area from Lennar Urban (see Figure 1)*
2. *Existing areas from SF Planning Department, "Preliminary Draft Candlestick Point Stadium and Retail/Entertainment Center Environmental Impact Report", February 17, 1998*
3. *Future areas from Lennar Urban, "LID Stormwater Opportunities Study", June, 2009*

4 Analysis and Results

The proposed redevelopment scenario described above was analyzed with the aid of the Bayside Planning computer model. Model results of primary importance to this project include the frequency, volume and duration of combined sewage overflow (CSO) from the Yosemite Basin, and the total CSO volume for the entire Bayside. Other Bayside basins are not impacted by the proposed redevelopment. The results of the computer analysis are summarized in Table 3.

Table 3. Hydrologic Model Results

	Yosemite CSO			Bayside CSO
	MG/yr	#/year	hours/yr	MG/yr
Base Case	5.3	1	2	890
Proposed Project	3.1	0.64	1.17	877
R & D Variant	3.1	0.64	1.18	878
Housing Variant	3.1	0.64	1.17	877

The model results indicate a predicted decrease in CSO volume, frequency, and duration of CSO in the Yosemite Basin, and a decrease in overall CSO volume for the entire Bayside, for the proposed project and both variants. While the total dry weather (sanitary) flows are expected to increase, the CSO frequency, duration, and volume are all expected to decrease. The proposed diversion of wet weather flows away from the combined system offset the increase in dry weather flows. This may not be the case during the construction period if enough new units are constructed (increasing the sanitary flows) before the separated stormwater management system is complete. Through the course of interim development, a balance will need to be kept between the increase in sanitary flows and the decrease in stormwater runoff.

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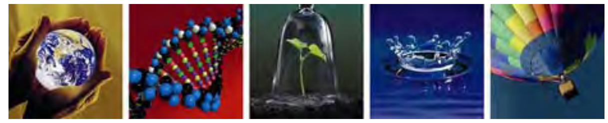
Appendix R There is no appendix associated with Section III.R

Appendix S ENVIRON Climate Change Technical Report Candlestick Point Hunters Point Shipyard Phase II, October 22, 2009



Climate Change Technical Report

Candlestick Point-Hunter's Point Shipyard Phase II Development Plan

Prepared for:
PBS&J
San Francisco, California

Prepared by:
ENVIRON International Corporation
San Francisco, California

Date:
October 22, 2009

Project Number:
03-22804A

ENVIRON

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Acronyms

AB 1493	Assembly Bill No. 1493
AB 32	California Global Warming Solutions Act of 2006
ACM	Alternative Compliance Method
AF	acre feet
ARB	California Air Resources Board
BAAQMD	Bay Area Air Quality Management District
C	carbon
CAFÉ	corporate average fuel economy
CAPCOA	California Air Pollution Control Officers Association
CAT	climate action team
CCAR	California Climate Action Registry
ccf/yr	hundred cubic feet per year
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CF_4	tetrafluoromethane
CFC	chlorinated fluorocarbons
CH_4	methane
CHP	combined heat and power
CO_2	carbon dioxide
CO_2e	CO_2 equivalents
CP	Candlestick Point
CP-HPS Plan	Candlestick Point-Hunter's Point Shipyard Phase II Development Plan
CPUC	California Public Utilities Commission
DHW	domestic hot water
DOT	Department of Transportation
EIA	United States Energy Information Administration
EIR	Environmental Impact Report
EMFAC	emissions estimation software programs
ENVIRON	ENVIRON International Corporation
GDP	gross domestic product
GHGs	greenhouse gases
GRP	General Reporting Protocol
GWP	global warming potential
H_2O	water
HFC	hydrofluorocarbons
HPS	Hunter's Point Shipyard
IPCC	Intergovernmental Panel on Climate Change
ISD	Climate Change Internal Services Department
kW	kilowatt
kW-hr/yr	kilowatt hours/year
lbs	pounds
LCA	Life Cycle Assessment
LDA	light-duty auto
LDT	light-duty truck
LEED	Leadership in Energy and Environmental Design
LEV	Low-Emission Vehicle
LID	Low Impact Development
MA	Massachusetts
MAC	Market Advisory Committee
$MMTCO_2e$	million metric tonnes of CO_2 equivalent
MN	Minnesota

MND	Mitigated Negative Declaration
MW	megawatts
NAT	No Action Taken
N_2O	nitrous oxide
O_2	oxygen
OPR	Office of Planning and Research
PC	passenger car
PFC	perfluorocarbon
PG&E	Pacific Gas and Electric Company
ppb	parts per billion
ppm	parts per million
RCx	Facility Retrocommissioning
RECS	Residential Energy Consumption Survey
SB 97	Senate Bill 97
SCAQMD	South Coast Air Quality Management District
SF_6	sulfur hexafluoride
sf	square feet
TBD	to be determined
TDV	Time Dependent Valuation
tonnes	Metric tonnes; 1,000 kilograms
UNEP	United Nations Environment Programme
URBEMIS	Urban Emissions Model
US	United States
USEPA	United States Environmental Protection Agency
VMT	vehicle miles traveled
WMO	World Meteorological Organization

Executive Summary

The Candlestick Point-Hunter's Point Shipyard Phase II Development Plan (CP-HPS Plan) is a proposed mixed use community to be built in the western area of San Francisco County. The CP-HPS Plan consists of two project areas: Candlestick Point (CP) and Hunter's Point Shipyard (HPS). The site is part of a redevelopment of the previous uses at the site. CP-HPS Plan will result in approximately 10,500 residences at full build out with 256 existing residences being replaced for a total of 10,244 net new residences. The development will also include commercial (i.e., office and retail uses) space. The CP-HPS Plan includes demolition of Candlestick Park. The Project includes having the Stadium rebuilt in the HPS project area. Two different project variants are considered if no Stadium is rebuilt. Project Variant 1 will place additional research and development space at HPS. Project Variant 2 will change the distribution of residences between CP and HPS but will keep the overall total number of residences the same as the Project. This development will result in both one-time and annual direct and indirect emissions of greenhouse gases (GHGs). The term, "direct emissions of GHGs" refers to GHGs that are emitted directly as a result of CP-HPS Plan and include land use change and construction emissions. Indirect emissions are those emissions that CP-HPS Plan entitlement will enable, but that are not controlled by CP-HPS Plan proponent. This report discusses the scientific developments surrounding global climate change and provides an inventory surveying the emissions that would result from approving CP-HPS Plan.

There is a general scientific consensus that most current global warming is the result of human activity on the planet. This man-made, or anthropogenic, warming is primarily caused by increased emissions of GHGs that keep the earth's surface warm. This is called "the greenhouse effect" and contributes to global climate change.

Residents and the employees and patrons of commercial and municipal buildings and services use electricity, heating, and are transported by motor vehicles. These activities directly or indirectly emit GHGs. The most significant GHG emissions resulting from such residential and commercial developments are emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). GHG emissions are typically measured in terms of tonnes of CO_2 equivalents (CO_2e), calculated as the product of the mass emitted of a given GHG and its specific global warming potential (GWP).

The emissions inventory presented in this report is consistent with the methodologies established by the California Climate Action Registry (CCAR), where possible. The CP-HPS Plan emissions inventory considers nine categories of direct and indirect GHG emissions: emissions due to vegetation changes, emissions from construction activities, residential building emissions, non-residential building emissions, mobile source emissions, municipal emissions, area sources, solid waste, and transit services. The emissions from construction and vegetation change are one-time emissions events. The other emissions occur annually throughout the life of CP-HPS Plan. The electrical power for the CP-HPS Plan development will be supplied by Pacific Gas and Electric Company (PG&E). Accordingly, indirect GHG emissions from electricity usage are calculated using the PG&E carbon-intensity factor.

A variety of methods are employed to develop a complete GHG emissions inventory. In addition to well-established emission factors for certain activities and emission estimates based on similar activities in other representative communities; several emissions estimation software programs are used. These include EMFAC, OFFROAD, and Urban Emissions Model (URBEMIS).

Emissions from the various aspects of CP-HPS Plan are presented in Table ES-1. Both the one-time emissions and emissions that are expected to occur each year after build-out of the CP-HPS Plan development are presented. There are 98,587 tonnes of CO_2e one-time emissions. The annual emissions from the use of the development amount to 154,639 tonnes CO_2e/year. Of the annual emissions, slightly more than 68% result from vehicular emissions associated with residential activities, and 29% result from the energy use associated with residential and non-residential buildings. If the one-time emissions are annualized assuming a 40-year development life (which is likely low), then the one-time emissions account for approximately 2,465 tonnes, or 2% of the annual emissions. Taking these annualized one-time emissions into account, the annual emissions are 157,104 tonnes/year.

Emissions from the various aspects of Variant 1 are presented in Table ES-2. Both the one-time emissions and emissions that are expected to occur each year after build-out of the CP-HPS Plan development are presented. There are 98,587 tonnes of CO_2e one-time emissions. This is the same for all project scenarios since there were not different estimates of construction equipment. The annual emissions from the use of the development amount to 178,651 tonnes CO_2e/year. Of the annual emissions, slightly more than 67% result from vehicular emissions associated with residential activities, and 29% result from the energy use associated with residential and non-residential buildings. If the one-time emissions are annualized assuming a 40-year development life (which is likely low), then the one-time emissions account for approximately 2,465 tonnes, or 2% of the annual emissions. Taking these annualized one-time emissions into account, the annual emissions are 181,115 tonnes/year.

Emissions from the various aspects of Variant 2 are presented in Table ES-3. Both the one-time emissions and emissions that are expected to occur each year after build-out of the CP-HPS Plan development are presented. There are 98,587 tonnes of CO_2e one-time emissions. This is the same for all project scenarios since there were not different estimates of construction equipment. The annual emissions from the use of the development amount to 157,509 tonnes CO_2e/year. Of the annual emissions, slightly more than 70% result from vehicular emissions associated with residential activities, and 26% result from the energy use associated with residential and non-residential buildings. If the one-time emissions are annualized assuming a 40-year development life (which is likely low), then the one-time emissions account for approximately 2,465 tonnes, or 2% of the annual emissions. Taking these annualized one-time emissions into account, the annual emissions are 159,974 tonnes/year.

This inventory was prepared as a worst-case analysis. For example, it assumes that all emissions from CP-HPS Plan are "new," in the sense that, absent the development of CP-HPS Plan, these emissions would not occur except for the 256 replacement residences and associated emissions and traffic associated with the stadium. Given the global nature of GHG emissions, “new” global GHG emissions are those caused by economic growth and population growth (births); local development projects accommodate such growth.

As an example of why these are worst-case emissions, these emissions are estimated assuming that the carbon intensity of the electricity supply system and transportation system do not change in the future beyond the changes anticipated from the 20% Renewable Portfolio Standard in 2010 and Pavley vehicle emission standards. This assumption is clearly an over-simplification, as the measures incorporated into California Global Warming Solutions Act of 2006 (AB 32) mandate change in both areas and would reduce future GHG emissions from the development.

Table ES-1
Summary of Greenhouse Gas Emissions for Candlestick Point-Hunters Point Shipyard Phase II Development Plan Project
San Francisco, California

Source	GHG Emissions				Percentage of Annual CO_2e Emissions (%)		
		HPS	CP	CP-HPS Plan	HP	CP	CP-HPS Plan
Vegetation[1]	tonnes CO_2e	-3,500	-3,500	-7,000	NA	NA	NA
Construction[2]		46,061	59,526	105,587	NA	NA	NA
Total (one time emissions)		**42,561**	**56,026**	**98,587**	NA	NA	NA
Residential[3]	tonnes CO_2e / year	6,642	19,035	25,677	13%	19%	17%
Non-Residential[4]		13,766	4,263	18,028	26%	4%	12%
Mobile[5]		30,371	75,149	105,520	57%	74%	68%
Municipal[6]		766	1,793	2,559	2%	2%	2%
Area		56	161	217	0%	0%	0%
Waste		375	532	907	1%	1%	1%
Transit Area		865	865	1,730	2%	1%	1%
Total (annual emissions)		**52,842**	**101,798**	**154,639**	NA	NA	NA
Annualized Total[8]	**tonnes CO_2e / year**	**53,906**	**103,198**	**157,104**	**NA**	**NA**	**NA**

Table ES-2
Summary of Greenhouse Gas Emissions for Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Variant 1
San Francisco, California

Source	**GHG Emissions**				**Percentage of Annual CO_2e Emissions (%)**		
		HPS	**CP**	**CP-HPS Plan**	**HP**	**CP**	**CP-HPS Plan**
Vegetation[1]	tonnes CO_2e total	-3,500	-3,500	-7,000	NA	NA	NA
Construction[2]		46,061	59,526	105,587	NA	NA	NA
Total (one time emissions)		**42,561**	**56,026**	**98,587**	NA	NA	NA
Residential[3]	tonnes CO_2e / year	6,642	19,035	25,677	9%	18%	14%
Non-Residential[4]		23,155	4,263	27,418	31%	4%	15%
Mobile[5]		42,332	77,586	119,918	57%	74%	67%
Municipal[6]		860	1,793	2,653	1%	2%	2%
Area		56	161	217	0%	0%	0%
Waste		506	532	1,038	1%	1%	1%
Transit Area		865	865	1,730	1%	1%	2%
Total (annual emissions)		**74,416**	**104,234**	**178,651**	NA	NA	NA
Annualized Total[8]	**tonnes CO_2e / year**	**75,480**	**105,635**	**181,115**	**NA**	**NA**	**NA**

Table ES-3
Summary of Greenhouse Gas Emissions for Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Variant 2
San Francisco, California

Source	**GHG Emissions**				**Percentage of Annual CO_2e Emissions (%)**		
		HPS	**CP**	**Variant 2**	**HP**	**CP**	**Variant 2**
Vegetation[1]	tonnes CO_2e total	-3,500	-3,500	-7,000	NA	NA	NA
Construction[2]		46,061	59,526	105,587	NA	NA	NA
Total (one time emissions)		**42,561**	**56,026**	**98,587**	NA	NA	NA
Residential[3]	tonnes CO_2e / year	10,026	15,651	25,677	17%	16%	16%
Non-Residential[4]		11,963	4,263	16,226	20%	4%	10%
Mobile[5]		34,888	75,180	110,068	58%	77%	70%
Municipal[6]		1,488	1,066	2,553	2%	1%	2%
Area		85	132	217	0%	0%	0%
Waste		587	451	1,038	1%	1%	2%
Transit Area		865	865	1,730	1%	1%	3%
Total (annual emissions)		**59,901**	**97,608**	**157,509**	NA	NA	NA
Annualized Total[8]	**tonnes CO_2e / year**	**60,965**	**99,009**	**159,974**	**NA**	**NA**	**NA**

1 Introduction

The Candlestick Point-Hunter's Point Shipyard Phase II Development Plan (CP-HPS Plan) will result in one-time and annual (direct and indirect) emissions of GHGs. Direct emissions of GHGs refers to GHGs that are emitted directly as a result of CP-HPS Plan and include land use change and construction emissions. Indirect emissions are those emissions that CP-HPS Plan entitlement will enable, but that are not controlled by CP-HPS Plan proponent. This report discusses the scientific developments surrounding global climate change and provides an estimate of an emissions inventory that would result from entitling CP-HPS Plan. This report also places the emissions inventory from CP-HPS Plan into context.

Residents, employees, and patrons of commercial and municipal buildings use electricity, heat their homes and water (typically with natural gas), and are transported in motor vehicles, all of which directly or indirectly emit GHGs. The principal green house gases resulting from such developments are emissions of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). CO_2 is considered the most important GHG, due primarily to the large emissions produced by fossil fuel combustion, especially for the generation of electricity and powering of motor vehicles. CH_4 and N_2O are also emitted by fossil fuel combustion, though their emissions are much less significant than CO_2. CH_4 is also emitted from the transmission, storage, and incomplete combustion of natural gas.

The effect that each of these gases can have on global warming is a combination of the mass of their emissions and their global warming potential (GWP). GWP indicates, on a pound for pound basis, how much a gas is predicted to contribute to global warming relative to how much warming would be predicted to be caused by the same mass of CO_2. CH_4 and N_2O are substantially more potent GHGs than CO_2, with GWPs of 21 and 310, respectively.[1] In emissions inventories, GHG emissions are typically reported in terms of pounds (lbs) or tonnes[2] of CO_2 equivalents (CO_2e). CO_2e are calculated as the product of the mass emitted of a given GHG and its specific GWP. While CH_4 and N_2O have much higher GWPs than CO_2, CO_2 is emitted in such vastly higher quantities that it accounts for the majority of GHG emissions in CO_2e, both from residential developments and human activity in general.

The CP-HPS Plan is located within the Bay Area Air Quality Management District (BAAQMD) jurisdiction. However, as BAAQMD guidelines for the preparation of GHG inventories have not yet been developed, this inventory has been developed consistent with the methodologies established by the California Climate Action Registry (CCAR) where possible[3]. When guidance from the CCAR is lacking, methodologies established by the Intergovernmental Panel on Climate Change (IPCC)[4] and best available science are used. Legislation and rules regarding

[1] GWP values from IPCC's Second Assessment Report (SAR, 1996) are still used by international convention and are used in this protocol, even though more recent (and slightly different) GWP values were developed in the IPCC's Third Assessment Report (TAR, 2001)

[2] In this report, "tonnes" will be used to refer to metric tonnes (1,000 kilograms). "Tons" will be used to refer to short tons (2,000 pounds).

[3] BAAQMD released Draft Air Quality Guidelines in September 2009 that includes some guidance for the preparation of GHG inventories. The methods described in the draft guidelines are similar to the methodologies used in the CP-HPS Plan GHG Inventory.

[4] The WMO and the UNEP established the IPCC in 1988; it is open to all members of the United Nations and WMO.

climate change, as well as scientific understanding of the extent to which different activities emit GHGs, continue to evolve; as such, the inventory in this report is a reflection of the guidance and knowledge currently available.

At the entitlement stage of a development, while the number of homes, the approximate size of commercial areas and the locations of both are known, the exact designs of the homes, businesses and facilities are not. Even so, the types of buildings and the types of facilities at the future CP-HPS Plan site can be used for developing an estimate of CP-HPS Plan's anticipated GHG emissions. Energy used in a building depends in part on the built environment; however, actual future emissions from the site will depend heavily upon the future homeowners' and business owners' habits. Because the actual future occupants and their habits are not yet known, average current behavior is assumed. Given the current regulatory environment and the media focus on global climate change, it is likely that the actual future occupants will be more sensitive to the GHG emissions caused by their activities and, therefore, their activities will result in lower GHG emissions than average current behavior shows.

1.1 Emissions Inventory

The CP-HPS Plan emissions inventory considers the following categories of GHG emissions:

- emissions due to land use (vegetation) changes,
- emissions from construction activities,
- residential building operations emissions,
- non-residential building operations emissions,
- mobile source operations emissions,
- municipal operations emissions,
- area sources (fireplaces and lawn maintenance) emissions,
- solid waste disposal, and
- transit services.

In addition, an estimate of “life-cycle” GHG emissions from building materials is presented. Life cycle emissions include all of the emissions caused by the existence of a product or project, for example, GHG emissions from the processes used to manufacture and transport materials used in the buildings and infrastructure. This estimate is to be used for comparison purposes only and is not included in the final inventory as these emissions would be accounted for under California Global Warming Solutions Act of 2006 (AB 32) in other industry sectors. In addition, life-cycle analyses inherently involve many uncertainties. For example, in a life-cycle analysis for building materials, somewhat arbitrary boundaries must be drawn to define the processes considered in the life-cycle analysis.[5] Although life-cycle emission estimates can provide a broader view of a project’s emissions, life cycle analyses often double count emissions that might be attributable to other sectors in a comprehensive analysis. The applicability of information to a specific

[5] For instance, in the case of building materials, the boundary could include the energy to make the materials, the energy used to make the machine that made the materials, and the energy used to make the machine that made the machine that made the materials.

geographic location, climatic zone and building type can influence the life-cycle GHG emissions. Further uncertainty of life-cycle analyses come from some basic choices, such as the useful life of a building or road which can substantially change the outcome of the life-cycle analysis.

The inventory does not consider whether the emissions from CP-HPS Plan are “new” in the sense that, absent the development of CP-HPS Plan, these emissions may not occur. However, emissions from electricity use and construction worker commuting are included.

The timeframe over which GHGs are emitted varies from category to category, which is taken into consideration in the emissions inventory. For most of the categories, GHGs will be emitted every year that the development is inhabited. For these categories (residential buildings, non-residential buildings, mobile sources, municipal services, area sources, solid waste disposal, and transit service), the inventory includes estimates of annual GHG emissions from ongoing development operations. GHG emissions from two of the categories, construction and changes in vegetation, are one-time events that will not be part of the development’s ongoing activity. These one-time emissions can be divided by the estimated lifetime of CP-HPS Plan to allow direct comparison of these two emissions classes. The inventory presents estimates of these one-time emissions, converts them to annualized estimates, and integrates them into an annual inventory.

It is worth noting that the GHG emissions estimates assume there are no reductions in GHG-generating activities over time. This is clearly unlikely, and presents a conservative analysis, given the expected reductions in GHG emissions from most activities that will take place over the years due to future regulations, greater public awareness and the likely increasing costs of energy. For example, the emissions estimated for electricity consumption assumes that there will not be an increase in energy production from renewables beyond the existing 20% Renewable Portfolio Standard (RPS) in 2010 or non-GHG producing sources; this is not realistic, given the mandates of AB 32, and other regulatory development, as discussed later in this report.

A variety of methods are employed to develop a complete GHG emissions inventory. In addition to well established emission factors for certain activities and emission estimates based on similar activities in other representative communities; several emissions estimation software programs are used. These include EMFAC, OFFROAD, and Urban Emissions Model (URBEMIS). Later sections of the report describe these models and other estimation methods. The major emissions sources that exist in residential developments are described later in this report.

1.2 Comparison of GHG Emissions

Because, to date, the BAAQMD and ARB has not established significance thresholds for GHG emissions under the California Environmental Quality Act (CEQA), the proposed GHG emissions from CP-HPS Plan are compared to other inventories to gain perspective on the impact these emissions may have[6]. To evaluate CP-HPS Plan’s GHG emissions, the CP-HPS

[6] Both BAAQMD and ARB have recently released proposed significance thresholds, but these have not been finalized at this time.

Plan inventory is compared with ARB Scoping Plan No Action Taken (NAT) scenario. The CP-HPS Plan inventory is also compared with emissions thresholds associated with regulations being developed by the California Air Resources Board (ARB) pursuant to AB 32 to determine if the development is likely to be consistent with rules propagated for California to meet its 2020 emissions reduction goal. In addition to absolute emissions, emissions per capita are compared with the current average per capita emissions of California residents. Finally, to understand the large-scale significance of CP-HPS Plan's GHG emissions, the inventory is compared to state, national and global inventories.

1.3 Report Description

This report contains six sections. Following this introduction, Sections 2 details the state of climate change science. Section 3 presents the results of the CP-HPS Plan GHG Inventory. Section 4 compares these results to various benchmarks to gain perspective on what impact the CP-HPS Plan development will have on overall GHG emissions. Section 5 analyzes the impact of regulatory developments on CP-HPS Plan's GHG emissions. Finally, the main findings from the report are summarized in the conclusion which is Section 6.

2 State of Science

This section summarizes the scientific issues surrounding climate change and global warming. It also provides a discussion of the actions and phenomena that contribute to climate change and puts into context global, national, and state emissions of GHGs.

2.1 Global Climate Change

Global warming and *global climate change* are both terms that describe changes in the earth's climate. *Global climate change* is a broad term used to describe any worldwide, long-term change in the earth's climate. This change could be, for example, an increase or decrease in temperatures, the start or end of an ice age, or a shift in precipitation patterns. The term *global warming* is more specific than *global climate change* and refers to a general increase in temperatures across the earth. Though global warming is characterized by rising temperatures, it can cause other climatic changes, such as a shift in the frequency and intensity of rainfall or hurricanes. Global warming does not necessarily imply that all locations will be warmer. Some specific, unique locations may be cooler even though the world, on average, is warmer. All of these changes fit under the umbrella of global climate change.[7]

While global warming can be caused by natural processes, there is a general scientific consensus that most current global warming is the result of human activity on the planet.[8] This man-made, or anthropogenic, warming is primarily caused by increased emissions of "GHGs" that keep the earth's surface warm. This is called "the greenhouse effect." The greenhouse effect and the role GHGs play in it are described below.

2.2 The Greenhouse Effect

Greenhouses allow sunlight to enter and then capture some of the heat generated by the sunlight's impact on the earth's surface. The earth's atmosphere acts like a greenhouse by allowing sunlight in, but trapping some of the heat that reaches the earth's surface. When solar radiation from the sun reaches the earth, much of it penetrates the atmosphere to ultimately reach the earth's surface; this solar radiation is absorbed by the earth's surface and then re-emitted as heat in the form of infrared radiation.[9] Whereas the GHGs in the atmosphere let solar radiation through, the infrared radiation is trapped by greenhouses gases, resulting in the warming of the earth's surface.[10] This phenomenon is referred to as the "greenhouse effect".

The earth's greenhouse effect has existed far longer than humans have and has played a key role in the development of life. Concentrations of major GHGs, such as CO_2, CH_4, N_2O, and water vapor have been naturally present for millennia at relatively stable levels in the

[7] Other definitions of "Greenhouse Effect" and "Global Warming" can be found on Merriam-Webster online: http://www.m-w.com/. A definition for "Climate Change" can be found on dictionary.com which uses Webster's New Millennium™ Dictionary of English, Preview Edition (v 0.9.6).

[8] From the IPCC "Climate Change 2007: The Physical Science Basis, Summary for Policymakers." Available online at: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf

[9] All light, be it visible, ultraviolet, or infrared, carries energy.

[10] Infrared radiation is characterized by longer wavelengths than solar radiation. Greenhouse gases reflect radiation with longer wavelengths. As a result, instead of escaping back into space, greenhouse gases reflect much infrared radiation (i.e., heat) back to Earth.

atmosphere, adequate to keep temperatures on Earth hospitable. Without these GHGs, the earth's temperature would be too cold for life to exist.

As human industrial activity has increased, atmospheric concentrations of certain GHGs have grown dramatically. Figure 2-1 shows the increase in concentrations of CO_2 and CH_4 over time. In the absence of major industrial human activity, natural processes have maintained atmospheric concentrations of GHGs, and, therefore, global temperatures at constant levels over the last several centuries.[11] As the concentrations of GHGs increase due to human activity, more infrared radiation is trapped, and the earth is heated to higher temperatures. This is the process that is described as human-induced global warming.

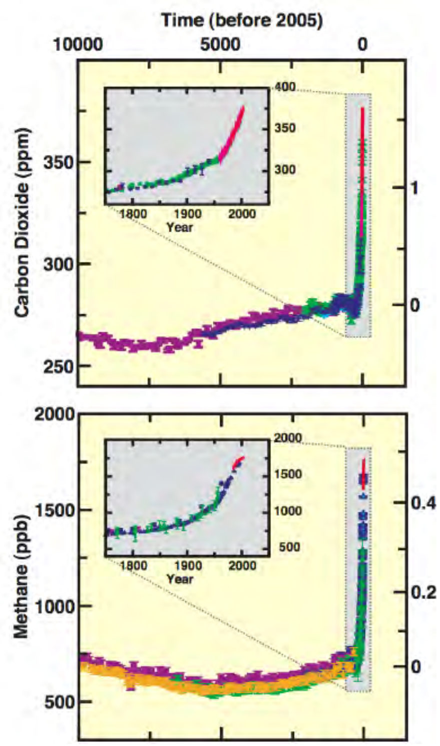

Figure 2-1. Carbon dioxide and methane concentrations have increased dramatically since the industrial revolution.[12]

In 2007, the IPCC began releasing components of its Fourth Assessment Report on climate change. In February 2007, the IPCC provided a comprehensive assessment of climate change science in its Working Group I Report.[13] It states that there is a scientific consensus that the global increases in GHGs since 1750 are mainly due to human activities such as fossil fuel use, land use change (e.g., deforestation), and agriculture. In addition, the report states that it is likely that these changes in greenhouse gas concentrations have contributed to global warming.

[11] Examples of natural processes include the addition of GHGs to the atmosphere from respiration, fires, and decomposition of organic matter. The removal of greenhouse gases is mainly from plant and algae growth and absorption by the ocean.

[12] Adapted from figure SPM-1 of the IPCC "Climate Change 2007: The Physical Science Basis, Summary for Policymakers." Available online at: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf

[13] Available online at: http://www.ipcc.ch/ipccreports/ar4-wg1.htm

Confidence levels of claims in this report have increased since 2001 due to the large number of simulations run and the broad range of available climate models.

2.3 Greenhouse Gases and Sources of Their Emissions

The term "GHGs" includes gases that contribute to the natural greenhouse effect, such as CO_2, CH_4, N_2O, and water, as well as gases that are only man-made and that are emitted through the use of modern industrial products, such as hydrofluorocarbons (HFCs), chlorinated fluorocarbons (CFCs), and sulfurhexafluoride (SF_6). These last three families of gases, while not naturally present in the atmosphere, have properties that also cause them to trap infrared radiation when they are present in the atmosphere, thus making them GHGs. These six gases comprise the major GHGs that are recognized by the Kyoto Accords (water is not included).[14] There are other GHGs that are not recognized by the Kyoto Accords, due either to the smaller role that they play in climate change or the uncertainties surrounding their effects. Atmospheric water vapor is not recognized by the Kyoto Accords because there is not an obvious correlation between water concentrations and specific human activities. Water appears to act in a positive feedback manner; higher temperatures lead to higher water concentrations, which in turn cause more global warming.[15]

The effect each of these gases has on global warming is a combination of the volume of their emissions and their GWP. GWP indicates, on a pound for pound basis, how much a gas will contribute to global warming relative to how much warming would be caused by the same mass of CO_2. CH_4 and N_2O are substantially more potent than CO_2, with GWPs of 21 and 310, respectively. However, these natural GHGs are nowhere near as potent as SF_6 and fluoromethane, which have GWPs of up to 23,900 and 6,500 respectively.[16] GHG emissions are typically measured in terms of mass of CO_2e. CO_2e are calculated as the product of the mass of a given GHG and its specific GWP.

The most important greenhouse gas in human-induced global warming is CO_2. While many gases have much higher GWPs than the naturally occurring GHGs, CO_2 is emitted in such vastly higher quantities that it accounts for 85% of the GWP of all GHGs emitted by the United States.[17] Fossil fuel combustion, especially for the generation of electricity and powering of motor vehicles, has led to substantial increases in CO_2 emissions and thus substantial increases in atmospheric CO_2 concentrations. In 2005, atmospheric CO_2 concentrations were about 379 parts per million (ppm), over 35 percent higher than the pre-industrial concentrations of about 280 ppm.[18] In addition to the sheer increase in the volume of its emissions, CO_2 is a major factor in human-induced global warming because of its lifespan in the atmosphere of 50 to 200 years.

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[14] This Kyoto Protocol sets legally binding targets and timetables for cutting the greenhouse-gas emissions of industrialized countries. The US has not approved the Kyoto treaty.

[15] From the IPCC Third Assessment Report: http://www.grida.no/climate/ipcc_tar/wg1/143.htm and http://www.grida.no/climate/ipcc_tar/wg1/268.htm

[16] California Climate Action Registry General Reporting Protocol - Reporting Entity-Wide Greenhouse Gas Emissions. Version 3.1 SAR values, Appendix B. Table C.1. http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

[17] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2006, U.S. Environmental Protection Agency. Available online at: http://epa.gov/climatechange/emissions/downloads/08_CR.pdf

[18] Page 2 of the IPCC "Climate Change 2007: The Physical Science Basis, Summary for Policymakers."

Concentrations of the second most prominent GHG, CH_4, have also increased due to human activities such as rice production, degradation of waste in landfills, cattle farming, and natural gas mining. In 2005, atmospheric levels of CH_4 were more than double pre-industrial levels, up to 1774 parts per billion (ppb) as compared to 715 ppb.[19] CH_4 has a relatively short atmospheric lifespan of only 12 years, but has a higher GWP than CO_2.

Nitrous oxide concentrations have increased from about 270 ppb in pre-industrial times to about 319 ppb by 2005.[20] Most of this increase can be attributed to agricultural practices (such as soil and manure management), as well as fossil-fuel combustion and the production of some acids. Nitrous oxide's 120-year atmospheric lifespan increases its role in global warming.

Besides CO_2, CH_4, and N_2O; there are several gases and categories of gases that were not present in the atmosphere in pre-industrial times but now exist and contribute to warming. These include CFCs, used often as refrigerants, and their more stratospheric-ozone-friendly replacements, HFCs. Fully fluorinated species, such as SF_6 and tetrafluoromethane (CF_4), are present in the atmosphere in relatively small concentrations, but have extremely long life spans of 50,000 and 3,200 years each, making them potent GHGs.

2.4 Current and Projected Climatic Impacts of Global Warming

A strong indication that global warming is currently taking place is the fact that the top seven warmest years since the 1890s occurred after 1997. Furthermore, a warming of about 0.2°C per decade is projected by currently accepted models.

There is a scientific consensus that global climate change will increase the frequency of heat extremes, heat waves, and heavy precipitation events. Other likely direct effects include an increase in the areas affected by drought and by floods, an increase in tropical cyclone activity, a rise in sea level, and recession of polar ice caps. The impacts of global warming have already been demonstrated by substantial ice loss in the Arctic.[21] Figure 2-2 shows the rise of global temperatures, the global rise of sea level, and the loss of snow cover from 1850 to the present.

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[19] Page 4 of the IPCC "Climate Change 2007: The Physical Science Basis, Summary for Policymakers."
[20] Page 4 of the IPCC "Climate Change 2007: The Physical Science Basis, Summary for Policymakers."
[21] Statistics from IPCC Working Group I and II Reports.

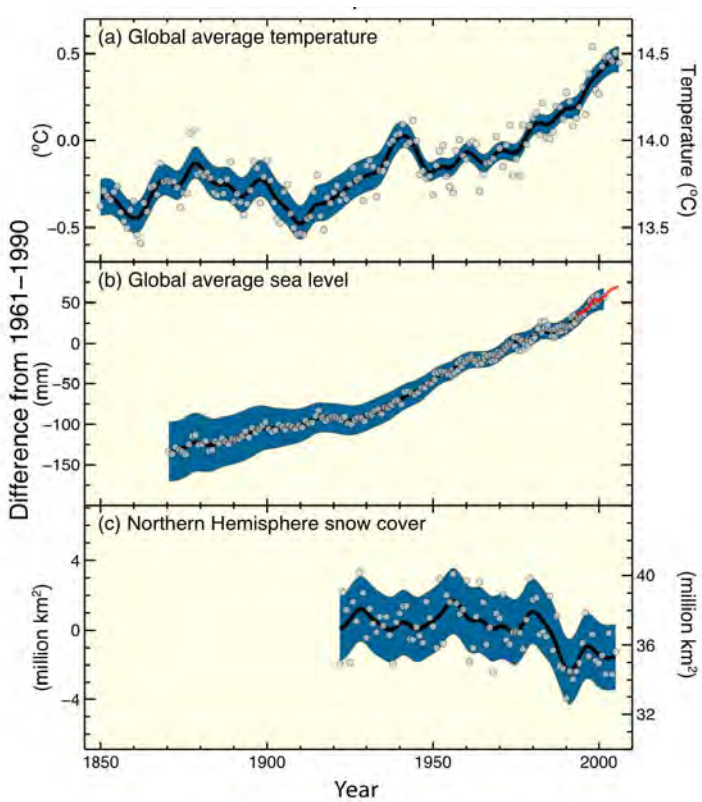

Figure 2-2. Global warming trends and associated sea level rise and snow cover decrease.[22]

2.5 Socioeconomic Impacts of Global Warming

Global temperature increases may have significant negative impacts on ecosystems, natural resources, and human health. Ecosystem structure and biodiversity will be compromised by temperature increases and associated climatic and hydrological disturbances.[23] The availability and quality of potable water resources may be compromised by increased salinisation of ground water due to sea-level rises, decreased supply in semi-arid and arid locations, and poorer water quality arising from increased water temperatures and more frequent floods and droughts.[24] These impacts on freshwater systems, in addition to the effects of increased drought and flood frequencies, can reduce crop productivity and food supply.

In addition to compromising food and water resources, there are other means through which climatic changes associated with global warming can affect human health and welfare. Warmer temperatures can cause more ground-level ozone, a pollutant that causes eye irritation and respiratory problems. Ranges of infectious diseases will likely increase and some areas will face greater incidences of illness and mortality associated with increased flooding and drought events.

[22] Figure SPM-3 of the IPCC "Climate Change 2007: The Physical Science Basis, Summary for Policymakers."
[23] From the IPCC Working Group II Report.
[24] From the IPCC Technical Paper VI: "Climate Change and Water". Available online at: http://www.ipcc.ch/pdf/technical-papers/climate-change-water-en.pdf

In its April 2007 Working Group II Report, the IPCC provided an assessment of the "current scientific understanding of impacts of climate change on natural, managed and human systems, the capacity of these systems to adapt and their vulnerability".[25] Here, the IPCC states that although some people will gain and some will lose because of global climate change, the overall change will be one of social and economic losses. California in particular is an area that could be negatively impacted by global warming. Global warming could alter the seasonal pattern of snow accumulation and snowmelt, which serve as primary sources for California's drinking water and irrigation water supplies. The scientific community projects extensions in the periods of high forest fire risk. Climatic changes would also affect agriculture, a major California industry, which could result in economic losses. For example, the heat wave in July 2006 is estimated to have cost the California dairy industry in excess of one billion dollars.[26]

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It is important to recognize that the climatic conditions experienced by the Project over its designed lifetime are likely to be substantially different from those observed over the past century. Consequently, it is useful to consider the implications of changing climatic conditions for Project performance. Scenarios[27] for 2100 modeled in the IPCC Fourth Assessment Report (FAR) include:

Temperature Increase

- Low Emissions Scenario: 1.8°C (best estimate), with a range of 1.1°C to 2.9°C
- High Emissions Scenario: 4.0°C (best estimate), with a range of 2.4°C to 6.4°C

Sea Level Rise

- Low Emissions Scenario: 0.18 to 0.38 meters (range)
- High Emissions Scenario: 0.26 to 0.59 meters (range)

Potential implications for the Project include:

Sea level: Rising sea levels could directly impact the proposed Project due to its close proximity to the coast and relative elevation.

Temperature: Rising temperatures could have a variety of impacts, including stress on sensitive populations (e.g., sick and elderly), additional burden on building systems (e.g., demand for

[25] Available online at: http://www.ipcc-wg2.org/index.html
[26] Office of the Governor.
[27] Future GHG emissions are the product of very complex dynamic systems, determined by driving forces such as demographic development, socio-economic development, and technological change. Their future evolution is highly uncertain. Scenarios are alternative images of how the future might unfold and are an appropriate tool with which to analyze how driving forces may influence future emission outcomes and to assess the associated uncertainties. They assist in climate change analysis, including climate modeling and the assessment of impacts, adaptation, and mitigation. The possibility that any single emissions path will occur as described in scenarios is highly uncertain. More information on the IPCC's selection of scenarios is available at http://www.ipcc.ch/ipccreports/sres/emission/index.htm.

conditioning), and, indirectly, increasing emissions of greenhouse gases and criteria pollutants associated with energy generation. It is not possible to reliably quantify these risks at this time.

Precipitation: Climate change is expected to alter seasonal and inter-annual patterns of precipitation. These changes continue to be one of the most uncertain aspects of future scenarios. For this Project, the most relevant direct impacts are likely to be changes in the timing and volume of stormwater runoff and changes in demand for irrigation. It is not possible to reliably quantify the implications of these changes at this time.

Wildfire: Changes in temperature and precipitation may combine to alter risks of wildfire. Changes in wildfire hazard have the potential to impact the Project; however, it is not possible to reliably quantify the implications of these changes at this time.

Water supply reliability: Changes in temperature and precipitation may also influence seasonal and inter-annual availability of water supplies. Consequently, it is reasonable to consider that climate change may affect water supply reliability. It is not possible to reliably quantify these risks for the Project at this time.

2.6 Impacts from Climate Change

The California Natural Resources Agency (CNRA)[28] recently prepared a document that discusses the impacts of climate change upon California, as well as California's climate adaptation strategy. The categories below are topics emphasized in the November 2008 Executive Order (S-13-08) which called on state agencies to develop California's first strategy to identify and prepare for these expected climate impacts. Adaptation strategies are addressed in the next section of this technical report.

2.6.1 Rising Temperatures

New projections by MIT modelers which predict a median probability of surface warming of 5.2 °C by 2100, which is much higher than previous modeling completed in 2003. [29] Researchers modeled temperature changes specifically related to California.[30] The model predicted greater temperature increases in summer than winter, and larger increases inland compared to the coast.

2.6.2 Tipping Elements

The CNRA emphasized "tipping elements", which bring about "abrupt changes that could push natural systems past thresholds beyond which they could not recover". According to the CNRA, there are four main events that could bring about abrupt environmental changes. Each of these four has a particular tipping temperature at which the event is likely to occur. The consequence

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[28] California Natural Resources Agency. 2009 California Climate Adaptation Strategy. Discussion Draft. .

[29] Sokolov A, Stone P, Forest C, Prinn R, Sarofim M, et al. (2009) Probabilistic forecast for 21st century climate based on uncertainties in emissions (without policy) and climate parameters. Journal of Climate: 2009 early online release, posted May 2009.

[30] Incorporated by reference. Moser, Susanne, Guido Franco, Sarah Pittiglio, Wendy Chou and Dan Cayan (2008). The Future is Now: An Update on Climate Change Science Impacts and Response Options for California. 2008 Climate Change Impacts Assessment Project - Second Biennial Science Report to the California Climate Action Team, CEC-500-2008-071, Sacramento, CA.

of crossing each threshold could cause a 7-12 m rise in sea level over the course of several centuries as shown in the table below.

Tipping elements that could trigger abrupt environmental changes.

Additional Warming (ºF)	Environmental Change	Length of Time
1-3	Rapid Arctic sea ice melt	10 years
2-4	Irreversible melting of the Greenland Ice Sheet	300+ years
5-9	Irreversible melting of the West Antarctic Ice Sheet	300+ years
5-7	Amazon forest die-back	None given
6-11	Intensification of ENSO cycles	None given

2.6.3 Extreme Natural Events

In addition, CNRA reports that extreme natural events are likely to occur, including higher nighttime temperatures and longer, more frequent heat waves overall; 12-35% decrease in precipitation levels by mid- to late-21st century; increased evaporation and faster incidences of snowmelt that will increase drought conditions, and more precipitation in the form of rain as compared to snow that will decrease water storage in California during the dry season and increase flood events during the wet season.[31]

2.6.4 Precipitation Changes and Rivers

CNRA also states that climate change will intensify California's "Mediterranean climate pattern", with the majority of annual precipitation occurring between November and March and drier conditions during the summer.[32] This will increase droughts and floods and will affect river systems. One of the ways to quantify potential impacts related to river system was through calculating a rise in water temperature and its effects on fisheries resources.[33]

2.6.5 Sea Level Rise

CNRA states that sea level rise can cause damage to coastal communities and loss of land, which could reach tens of billions of dollars per year in direct costs and trillions of dollars of assets in collateral risk.[34] Current calculations of sea level rise from 1900 to 2000 estimate

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[31] Cayan, Dan, Mary Tyree, Mike Dettinger, Hugo Hidalgo, Tapash Das, Ed Maurer, Peter Bromirski, Nicholas Graham, and Reinhard Flick (2009). Climate Change Scenarios and Sea Level Rise Estimates for the California 2008 Climate Change Scenarios Assessment. PIER Research Report, CEC-500-2009-014, Sacramento, CA: California Energy Commission.

[32] Cayan et al. 2009

[33] Crossin, G.T., S.G. Hinch, S.J. Cooke, D.W. Welch, D.A. Patterson, S.R.M. Jones, A.G. Lotto, R.A. Leggatt, M.T. Mathes, J.M. Shrimpton, G. Van Der Kraak and A.P. Farrell. 2008. Exposure to high temperature influences the behavior, physiology, and survival of sockeye salmon during spawning migration. Canadian Journal of Zoology. 86(2): 127-140.

[34] Kahrl, F. and D. Roland-Holst (2008). California Climate Risk and Response. Berkeley, CA: University of California-Berkeley, Department of Agricultural and Resource Economics.

approximately 7 inches along the California coast. [35] Further, up to 55 inches of sea-level rise globally by the end of the 21st century is predicted under the continued higher emission assumption models.

2.6.6 Low Sea Ice Levels

The CNRA states says that substantial sea ice melting from Greenland and the West Antarctic Ice Sheet has the potential to further raise sea levels. The sea ice extent in the Western Nordic Seas (i.e., Greenland, Norway, and Iceland Seas) is at the lowest level observed in the last 800 years. The implication being that a substantial reduction in sea ice in the Arctic sea promotes alterations in atmospheric circulation and precipitation patterns that extend to the mid-latitudes (e.g., the California coast). Additionally, it was reported that the variations in sea ice extent are correlated with changes in sea surface temperatures and atmospheric and ocean heat transport from the North Atlantic. [36]

The West Antarctic Ice Sheet is a marine-based ice sheet with edges that flow into floating ice shelves. Both the main sheet and the surrounding shelves have been showing signs of shrinking and collapsing due to global warming. Researchers have tracked the fate of at least nine shelves that have receded or collapsed around the Antarctic peninsula in the past 50 years. [37]

2.6.7 Ocean Chemistry

The CNRA also notes that an emerging effect from climate change may be acidification of the ocean. In turn, acidification will affect the ability of hard-shelled invertebrates to create their skeletal structures. [38] The implications of this change being major losses to shellfish industries, and shifts in food resources for ocean fisheries. The primary contributing factors were cited as increasing levels of CO_2 and weather pattern shifts. Increases in CO_2 results in increased uptake by the oceans, which result in decreased pH (acidification). Weather pattern shifts change the amount of calcium carbonate being delivered by rivers from sources stored in rocks, which further exacerbates the ability of invertebrates to form calcified shells. [39]

2.6.8 Permafrost Thaws

One of the main contributing factors to CO_2, outside of human influences, is melting permafrost. When permafrost thaws, it releases carbon into soil or beneath lakes and releases CO_2 and methane into the atmosphere. Scientists are now estimating that there is more than twice the

[35] Cayan et al. 2009

[36] Fauria, M.M., A. Grinsted, S. Helama, J. Moore, M. Timonen, T. Martma, E. Isaksson, and E. Eronen. 2009. Unprecedented low twentieth century winter sea ice extent in the Western Nordic Seas since A.D. 1200. Climate Dynamics. Published online: 12 June 2009.

[37] Doyle, A. 2009. Antarctic ice shelf set to collapse due to warming. Roche, A. (ed) In Reuters UK. Thomas Reuters. January 19, 2009. Website: http://uk.reuters.com/articlePrint?articleId=UKTRE50I4G520090119

[38] Risien, J. (ed.). 2009. West Coast Regional Marine Research and Information Needs. Corvallis, Oregon: Oregon Sea Grant. ORESU-Q-09-001.

[39] Griffith, E.M., A. Paytan, K. Caldeira, T. D. Bullen and E. Thomas. 2008. A dynamic marine calcium cycle during the past 28 million years. Science. December 12, 2008.

total amount of carbon stored in permafrost as there is in atmospheric carbon dioxide, and “could amount to roughly half those resulting from global land-use change during this century”.[40]

2.7 California-specific Adaptation Strategies

The CNRA[41] discusses California’s climate adaptation strategy. General themes from the report regarding adaptation strategies are summarized below although the report also includes many specific examples of how California may adapt to a changing climate.

Because climate change is already affecting California and current emissions will continue to drive climate change in the coming decades, regardless of any mitigation measured that may be adopted, the necessity of adaptation to the impacts of climate change is recognized by the state of California. The *2009 California Climate Adaptation Strategy Discussion Draft* begins what will be an on-going process of adaptation, as directed by Gov. Schwarzenegger's Executive Order S-13-08. The goals of the strategy are to analyze risks and vulnerabilities and identify strategies to reduce the risks. Once the strategies are identified and prioritized, government resources would be identified. Finally, the strategy includes identifying research needs and educating the public.

Climate change risks are evaluated using two distinct approaches: (1) projecting the amount of climate change that may occur using computer-based global climate models and (2) assessing the natural or human system's ability to cope with and adapt to change by examining past experience with climate variability and extrapolating this to understand how the systems may respond to the additional impact of climate change. The major anticipated climate changes expected in the State of California include increases in temperature, decreases in precipitation, particularly as snowfall, and increases in sea level, as discussed above. These gradual changes will also lead to an increasing number of extreme events, such as heat waves, wildfires, droughts, and floods. This would impact public health, ocean and coast resources, water supply, agriculture, biodiversity and the transportation and energy infrastructure.

Key preliminary adaptation recommendations included in the *Strategy* are as follows:

- Appointment of a Climate Adaptation Advisory Panel;
- Improved water management in anticipation of reduced water supplies, including a 20% reduction in per capita water use by 2020;
- Consideration of project alternatives that avoid significant new development in areas that cannot be adequately protected from flooding due to climate change;
- Preparation of agency-specific adaptation plans, guidance or criteria by September 2010;
- Consideration of climate change impacts for all significant state projects;
- Assessment of climate change impacts on emergency preparedness;

[40] Schuur, E.A.G. et al. 2008. Vulnerability of Permafrost Carbon to Climate Change: Implications for the Global Carbon Cycle. BioScience. 58(8): 701-714.
[41] California Natural Resources Agency. 2009 California Climate Adaptation Strategy. Discussion Draft.

- Identification of key habitats and development of plans to minimize adverse effects from climate change;
- Development of guidance by the California Department of Public Health by September 2010 for use by local health departments to assess adaptation strategies;
- Amendment of Plans to assess climate change impacts and develop local risk reduction strategies by communities with General Plans and Local Coastal Plans; and
- Inclusion of climate change impact information into fire program planning by state fire fighting agencies.

2.8 Global, National, and California-wide GHG Emissions Inventories

Worldwide emissions of GHGs in 2004 were 26.8 billion tonnes of CO_2e.[42] In 2004, the US emitted about 7 billion tonnes of CO_2e or about 24 tonnes of CO_2e per year per person.[43] Over 80% of the GHG emissions in the US are comprised of CO_2 emissions from energy related fossil fuel combustion. In 2004, California emitted 0.492 billion tonnes of CO_2e, or about 7% of the US emissions.[44] If California were a country, it would be the 16th largest emitter of GHGs in the world.[45] This large number is due primarily to the sheer size of California. Compared to other states, California has one of the lowest per capita GHG emission rates in the country. This is due to California's higher energy efficiency standards, its temperate climate, and the fact that it relies on substantial out-of-state energy generation.

In 2004, 81% of greenhouse gas emissions (in CO_2e) from California were comprised of CO_2 emissions from fossil fuel combustion, with 4% comprised of CO_2 from process emissions. CH_4 and N_2O accounted for 5.7% and 6.8% of total CO_2e respectively, and high GWP gases[46] accounted for 2.9% of the CO_2e emissions. Transportation is by far the largest end-use category of GHG emissions. Transportation includes that used for industry (i.e., shipping) as well as residential use.

2.9 Potential for Reduction of GHG Emissions

In May 2007, the IPCC produced its Working Group III Report on the "scientific, technological, environmental, economic and social aspects" of reducing GHG emissions to alleviate climate change.[47] The report concluded that, even with current policies for sustainable development and mitigation of climate change, global GHG emissions will continue to grow over the next several decades.

[42] Sum of Annex I and Annex II countries without counting Land-Use, Land-Use Change and Forestry (LULUCF) http://unfccc.int/ghg_emissions_data/predefined_queries/items/3814.php For countries for which 2004 data was unavailable, the most recent year was used.
[43] 2006 Inventory of U.S. Greenhouse Gas Emissions and Sinks. Available online at: http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBLP4/$File/06ES.pdf
[44] California Air Resources Board. Note that 2004 is typically the most recent inventory year presented by the ARB; as such, USA- and world-wide emissions from 2004 are presented here to keep the comparison years the same.
[45] Anywhere between the 12th and 16th depending upon methodology. Inventory of California Greenhouse Gas Emissions and Sinks: 1990 to 2004. California Energy Commission.
[46] Such as HFCs and PFCs.
[47] Available online at: http://www.ipcc.ch/ipccreports/ar4-wg3.htm

3 Greenhouse Gas Inventory

This section describes the methods that ENVIRON International Corporation (ENVIRON) used to estimate GHG emissions from CP-HPS Plan after development and full build out for the Project, Variant 1, and Variant 2. It includes some aspects that are fully within the control of Lennar Urban, such as grading and the placement of utilities; some aspects that are in control of the individuals building the houses and commercial buildings, such as construction emissions; and some aspects for which control over emissions is shared by the developers and the residents, such as energy use in the built environment and emissions from traffic by the development's future residents and employees in the commercial areas. In addition, an estimate of "life-cycle" GHG emissions (i.e., GHG emissions from the processes used to manufacture and transport materials used in the buildings and infrastructure) is presented. This estimate is to be used for comparison purposes only and is not included in the final inventory as these emissions would be attributable to other industry sectors under AB 32. The inventory does not consider whether the emissions from the development are "new" in the sense that, absent the development, the emissions may not occur. Each aspect of the GHG inventory is described in this section. Actual GHG emissions at full build-out at CP-HPS Plan are expected to be substantially lower due to regulatory developments; therefore, the GHG emissions reported in this section are a conservative estimate.

3.1 Evaluation of "New" Emissions

Given the global nature of GHG impacts, it is difficult to determine which emissions from a given project are "new" on a global scale. As described in this section, there are methods of estimating emissions from certain aspects of projects, such as that from the additional vehicle travel associated with CP-HPS Plan. However, it is not clear how to determine what proportion of those emissions are truly additional, or new, in the global sense, or what proportion of those emissions would have occurred globally without CP-HPS Plan.

Analyses for evaluating the airborne criteria pollutant impacts of new projects for inclusion in environmental documents have already, in a sense, addressed the issue of what is "new". However, the impacts of GHG emissions differ from those of criteria pollutants in that they are a function of global concentrations rather than local concentrations and, therefore, specific locations of where emissions occur is less important than for criteria pollutants. The calculation of "project" criteria pollutants (oxides of nitrogen, sulfur oxides, carbon monoxide, volatile organic compounds, lead, and particulate matter) in air quality emissions inventories for use in EIRs has a long history. The South Coast Air Quality Management District (SCAQMD) first published a comprehensive manual on the analysis of air quality impacts in 1993, and the Bay Area Air Quality Management District (BAAQMD) followed in 1999. Other smaller districts have prepared detailed guidance documents that describe the methods that should be used to calculate emissions inventories for EIRs from projects, including residential and commercial projects.

The goal of estimating emissions of criteria pollutants from projects is to understand whether there are significant new emissions in California's air basins, which have a limited ability to absorb additional criteria pollutant emissions without adverse air quality impacts. A review of how air quality analyses typically address the issue of whether emissions are "new" is instructive as to how to address the emissions of GHGs. However, unlike with criteria pollutants, the impacts of GHG emissions are a function of their global concentrations, rather than local concentrations. Thus, the question of whether or not a project's GHG impacts are significant, both on a project basis and on a cumulative basis, must be asked based on global, rather than basin-wide, considerations.

When evaluating the air quality impacts for a new project, such as a residential development, the vehicular emissions associated with the residents as they work and shop within the basin are counted as new emissions in traditional air quality analyses, even if those new residents would have moved from another house in the same air basin. The typical rationale for this approach is that the new residential development represents growth in the basin. As a result, all emissions associated with its residents' vehicle travel should be counted as new emissions, even if this might lead to some over-counting of criteria pollutant emissions from CP-HPS Plan.

World rankings of nations' GHG emissions generally depend on which gases are accounted for, and whether land use changes are considered. Without considering land use changes, in recent years, the US has been the top GHG-emitting country in the world. When all of the developing countries are grouped together, they contribute approximately 52% of the world-wide GHG emissions.[48]

To understand the global scale impact of GHGs, it is useful to understand that the increase of new GHG emissions globally is caused by economic and population growth. Emission growth rates are the highest among developing countries. While GHG emissions in developed countries were unchanged over the 1990-2002 period, emissions increased by 47% in developing countries during that same time period. Emissions in China grew about 50% during that time period -- preliminary estimates show that China's GHG emissions increased 35% in 2003 and 2004 alone. This increase in developing country GHG emissions is due to the increasing demand for higher standards of living as a result of GDP growth, requiring more vehicles and greater electricity demand. Also, developing countries often lack the technology or capital to utilize energy efficient products or to construct cleaner burning power plants. GHG emissions in China are growing slightly faster than primary energy use as the fuel mix increasingly favors coal, a high-carbon fuel. China accounts for 39% of projected increase between 2004 and 2030, and will overtake the United States as the world's biggest emitter before 2010.[49]

In the developed world, GHG increases are directly tied to population growth. Therefore, it makes sense to consider operational emissions (including vehicular emissions) from new residences as growth, as residences are rarely removed from the housing supply once constructed. There are exceptions, such as when one housing development replaces another, and, in those cases, the replacement residential development need not be considered growth. There are 256 existing residential dwelling units that are directly being replaced in the CP-HPS Plan. These replacement dwelling units and associated GHG emissions are therefore not considered in the net new GHG emission inventory. Due to the fact that older buildings are less

48 Baumert, K.A., T. Herzog, J. Pershing. 2005. Navigating the Numbers: Greenhouse Gas Data and International Climate Policy. (http://www.wri.org/climate/pubs_description.cfm?pid=4093)

49 http://www.iea.org/textbase/weo/fact_sheets/fs_GlobalEnergyTrends.pdf (accessed June 12, 2007) *World Energy Outlook 2006: Fact Sheet- Global Energy Trends The World's Energy Future: Where Are We Headed?*

energy efficient than newer buildings, this will result in an overestimate of CP-HPS Plan emissions.

However, it is not clear that non-residential (i.e. office space, retail space, and industrial buildings) development should be considered new growth for vehicular travel purposes. To the extent that non-residential development serves existing residential development, its vehicular travel may not be new. For instance, if the new non-residential area serves an area with a high residential/ non-residential balance, then this new non-residential growth will reduce shopping and work trip lengths and will reduce GHG emissions associated with mobile sources. If, however, the new non-residential area results in longer trips for its workers and shoppers than they would have previously made, then it adds GHGs emissions. Non-residential development that could potentially increase VMT would be facilities that draw trips from far away that otherwise would not be made. A theme park, for example, may be viewed as such a development.

In this report, it is assumed that the new non-residential area serves an area with a high residential/ non-residential balance. Therefore, this new non-residential growth likely will reduce shopping and work trip lengths from existing residences, and can reduce GHG emissions associated with mobile sources. Since the stadium is a replacement of an already existing stadium it would not considered to be a new facility that would draw trips from far away that otherwise would not be made since these trips are already being made. Therefore, there is not expected to be an increase in VMT associated with the construction of the new stadium. However, if the stadium is not built, as in Variants 1 and 2, there would be a reduction in trips drawn from afar. These reductions are not considered in the estimation of emissions from Variants 1 and 2. The music venue in CP is considered new non-residential facility that could draw trips that otherwise would not be made. The trips associated with customers and employees of the music venue are considered in the inventory.

The approach described above is different than that for criteria emissions. For criteria pollutants, if new emissions move into the basin, although there is a reduction in criteria emissions elsewhere, these emissions are new to the basin and therefore counted. For GHGs, if the emissions simply moved from one basin to another, the emissions would not be new on a global scale. To evaluate the sustainability of new non-residential developments, one must ask if the shoppers' and workers' travel distances to the new non-residential development are longer or shorter than the distances those same individuals currently travel to their non-residential areas. Since the CP-HPS Plan is an infill development, it is likely that its establishment will not lengthen shopping trips.

To the extent that new non-residential development serves new residential development, much of the non-residential vehicle travel would already be counted in the evaluation of the new residential development. Although the vehicle trips would be already counted elsewhere, the operational emissions from heating and cooling the non-residential areas would be considered to be new, as there are new non-residential buildings that goes along with growth in residential areas.

This report presents two methods for analyzing the GHG emissions from VMT. The first method includes all residential and non-residential land use categories except for the stadium trips since these already exist and will only be displaced. The alternative analysis which is an assessment of the “new” emissions associated with growth assumes GHG emissions from VMT serving non-residential areas will only be counted if the non-residential areas contribute to greater VMT as a result of their locations. If the non-residential development lowers VMT, then it will be considered to have a zero or negative GHG contribution as a result of the fact that it has generated shorter operational vehicle trip lengths than would have otherwise occurred. It should be noted that as CP-HPS Plan is a mixed use community, this issue does not directly affect CP-HPS Plan VMT calculations; all VMT from net new CP-HPS Plan residents are calculated regardless of internal or external destinations or purpose of trip.

3.2 Units of measurement: Tonnes of CO_2 and CO_2e

The term “GHGs” includes gases that contribute to the natural greenhouse effect, such as CO_2, CH_4, N_2O, and water, as well as gases that are only man-made and that are emitted through the use of modern industrial products, such as hydrofluorocarbons (HFCs) and CFCs. The most important greenhouse gas in human-induced global warming is CO_2. While many gases have much higher GWPs than CO_2, CO_2 is emitted in such vastly higher quantities that it accounts for 85% of the GWP of all GHGs emitted by the United States.[50]

The effect each of these gases has on global warming is a combination of the volume of their emissions and their GWP. GWP indicates, on a pound for pound basis, how much a gas will contribute to global warming relative to how much warming would be caused by the same mass of CO_2. CH_4 and N_2O are substantially more potent than CO_2, with GWPs of 21 and 310, respectively. GHG emissions are typically measured in terms of mass of CO_2e. CO_2e are calculated as the product of the mass of a given GHG and its specific GWP.

In many sections of this report, including the final summary sections, emissions are presented in units of CO_2e either because the GWPs of CH_4 and N_2O were accounted for explicitly, or the CH_4 and N_2O are assumed to contribute a negligible amount of GWP when compared to the CO_2 emissions from that particular emissions category.

In this report, "tonnes" will be used to refer to metric tonnes (1,000 kilograms). "Tons" will be used to refer to short tons (2,000 lbs).

Additionally, exact totals presented in all tables and report sections may not equal the sum of components due to independent rounding of numbers.

3.3 Resources

To estimate GHG emissions from CP-HPS Plan, ENVIRON directly or indirectly relied primarily on four different types of resources: emissions estimation guidance from government-sponsored organizations, government-commissioned studies of energy use patterns, energy surveys by other consulting firms, and emissions estimation software. These sources are described below.

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[50] Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2004, U.S. Environmental Protection Agency. Available online at: http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBSC3/$File/06_Complete_Report.pdf

3.3.1 Emissions Estimation Guidance

This inventory was developed using guidance from two government-sponsored organizations to assist in the estimation of GHG emissions. The first is the CCAR, which was established by the California Legislature to assist willing parties in estimating and recording their GHG emissions to use as a baseline for meeting future emissions reduction requirements. Publications by the CCAR include not only recommendations on how to compile a GHG emissions inventory, but also relevant data on energy use and emissions that are utilized in this protocol. The second organization is the IPCC, which was established in 1988 by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO). The IPCC's main role is to assess information on climate change which is synthesized in IPCC reports, including methodology reports. These reports also include relevant emission factors and specific scientific data that can be used to estimate GHG activities from various activities.

3.3.2 Emissions and Energy Use Studies

For estimating emissions based on electrical and natural gas energy use, literature information on patterns of energy use must often be employed. Studies commissioned by the CEC provide data on energy use patterns associated with municipal activities, natural resource distribution, and other activities that will take place in CP-HPS Plan. These data were used to estimate energy use patterns which were applied to the specific characteristics of CP-HPS Plan to estimate GHG emissions. In addition to CEC studies, studies performed by individual municipalities or scientific organizations are also used in this report.

3.3.3 Emissions Estimation Software

The ARB, the SCAQMD, and other public and private organizations have developed several software programs to facilitate the calculation of emissions from construction, motor vehicles, and urban developments by streamlining emissions estimation from these sources. This inventory was developed using several models to estimate GHG emissions from the CP-HPS Plan development. These are the OFFROAD2007 model, the EMFAC model, and the URBEMIS model. The features of each of these models are described below.

> OFFROAD – OFFROAD2007 is the most recent version of a model developed by the ARB to estimate the activity and emissions of off-road mobile emissions sources, such as construction equipment. OFFROAD contains a database of default values for horsepower, load factor, and hours per day of operation and can calculate emission factors based on the type of equipment and year of use.
>
> EMFAC – EMFAC, also developed by ARB, compiles real fleet data on the county-level for the state of California, including vehicle model year distributions, vehicle class (e.g., light-duty auto (LDA), medium-duty truck, heavy-heavy-duty truck) distributions, and emission rate information to generate fleet-average emission factors for most criteria pollutants and CO_2. EMFAC2007 is the newest version of the program. Emission factors from EMFAC depend on the vehicle class, vehicle technology, speed, year of operation, average ambient air temperature, and relative humidity.
>
> URBEMIS – The URBEMIS software was created by SCAQMD, although it is used by other air districts as well. It estimates emissions associated with different aspects of

urban development. The Operational Data module in URBEMIS calculates emissions from mobile sources operating during the use of a development based on emission factors from EMFAC and traffic use information specific to a development. Mobile source emissions during the construction phase are calculated separately in the construction module of URBEMIS. URBEMIS provides county, air district / air basin, or state wide averages for number of daily trips per housing unit and per student at an elementary school in the absence of more specific information from traffic engineers. URBEMIS also provides air district-specific default values for vehicle fleet characteristics (vehicle class distribution and technology categories) and travel conditions (average trip length, trip speed, and relative frequency of each type of trip). URBEMIS (Version 9.2.2), uses EMFAC2007 emission factors and calculates CO_2 emissions using District-specific default parameters for various inputs including vehicle fleet characteristics and travel conditions.

In addition to mobile source emissions, URBEMIS can also calculate emissions associated with the construction phase of a development and emissions from area sources, such as fireplaces, once the development is operational. The URBEMIS construction module enables separate emissions calculations from each of the three typical stages of any construction project: demolition, site grading, and building construction. Based on the timing of construction and size of the development, URBEMIS defaults can be used to estimate emissions. Alternatively, the user can override these defaults by entering specific information about the construction project, such as what types and numbers of equipment are going to be used. In terms of area sources, URBEMIS is equipped to estimate GHG emissions from three types of GHG-emitting area sources based either on program defaults or more specific project information inputted by the user. These uses are natural gas fuel combustion, hearth fuel combustion, and landscaping equipment.

3.4 Indirect GHG Emissions from Electricity Use

As noted above, indirect GHG emissions are created as a result of electricity use. When electricity is used in a building, the electricity generation typically takes place offsite at the power plant; electricity use in a building generally causes emissions in an indirect manner. The CP-HPS Plan development is supplied power by Pacific Gas and Electric Company (PG&E). Accordingly, indirect GHG emissions from electricity usage are calculated using the PG&E carbon-intensity factor of 574 lb CO_2e per MW-hr which is an adjustment of PG&E's 2007 carbon-intensity factor of 636 to account for the 20% Renewable Portfolio Standard required by 2010.[51] This emission factor takes into account the current mix of energy sources used to generate electricity for PG&E and the relative carbon intensities of these sources.[52] Table 5-1 details the calculations for the carbon-intensity factor used.

[51] California Climate Action Registry (CCAR) Database. Pacific Gas and Electric Company 2007 PUP Report. 2008.
[52] When calculating indirect emissions due to electricity usage, it is important to consider that indirect emissions from using a given amount of electricity will vary with the fuel-mix used to produce electricity. For example, CO_2 emissions per kW-hr from a coal-fired power plant are significantly higher than CO_2 emissions per kW-hr from a natural gas-fired power plant. Therefore, to most accurately estimate GHG emissions from the CP-HPS Plan development, the carbon intensity of the specific mix of energy sources PG&E uses to generate electricity was used to calculate emissions since PG&E is the most likely source of electricity for CP-HPS Plan.

3.5 Vegetation Change

This section presents the calculation of the positive GHG emissions associated with planting new trees at the CP-HPS Plan development. The CP-HPS Plan is on land classified as settlement as classified by the IPCC publication Guidelines for National Greenhouse Gas Inventories (IPCC Guidelines).[53] There will be no changes in the land use classification. The overall CO_2 emissions due to vegetation change will result from the amount that can be expected to be sequestered by new plantings. The amount of CO_2 emissions sequestered by new plantings is discussed in this section.

In this section of this report, the units CO_2 and CO_2e are used interchangeably. CH_4 and N_2O are assumed to contribute a negligible amount of GWP when compared to the CO_2 emissions from vegetation change.

3.5.1 Calculating CO_2 Sequestration by Trees

Planting individual trees on residential property and elsewhere in the CP-HPS Plan will sequester CO_2. Changing vegetation as described above results in a one-time carbon-stock change. Planting trees is also considered to result in a one-time carbon-stock change. Table 3-1 presents default annual CO_2 sequestration rates on a per tree basis, based on values provided by the IPCC. An average of 0.035 tonne CO_2 per year per tree can be assumed for trees planted, if the tree type is not known.

Urban trees are only net carbon sinks when they are actively growing. The IPCC assumes an active growing period of 20 years. Thereafter, the accumulation of carbon in biomass slows with age, and will be completely offset by losses from clipping, pruning, and occasional death. Actual active growing periods are subject to, among other things, species, climate regime, and planting density. In this report, the IPCC default value of 20 years will be assumed. Note that trees may also be replaced at the end of the 20-year cycle, which would result in additional years of carbon sequestration. However, this would be offset by the potential net release of carbon from the removal of the replaced tree.

Approximately 10,000 new net trees will be planted in CP-HPS Plan community.[54] Planting these trees in the community will sequester approximately 7,000 tonnes CO_2. This was calculated by using the average tree sequestration rate of 0.035 tonne CO_2 per year per tree and assuming 20 years of growth. This sequestration brings the net CO_2 emissions from vegetation to -7,000 tonnes (or a net decrease in the amount of CO_2 released). The net CO_2 emissions from vegetation changes are presented in Table 3-1.

3.6 Construction Activities

This section describes the estimation of GHG emissions from construction activities at CP-HPS Plan. GHG emissions from construction phases are largely attributable to fuel use from construction equipment and worker commuting.

[53] Available online at http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.htm
[54] Site-specific planting data provided by Lennar Urban.

CO_2 emissions associated with different aspects of urban development can be estimated using a combination of software programs. The OFFROAD2007[55] and the EMFAC2007[56] models are used to generate emission factor data for construction equipment and motor vehicles, respectively. These values serve as inputs for the URBEMIS[57] model, which estimates emissions from several different aspects of urban development including from construction sources based on emission factors and information specific to the development.

In this section of this report, the units CO_2 and CO_2e are used interchangeably for diesel construction equipment because CH_4 and N_2O are assumed to contribute a negligible amount of GWP when compared to the CO_2 emissions from construction equipment. For worker commuting, CH_4 and N_2O are explicitly calculated and therefore CO_2 and CO_2e for worker commuting are not equal.

3.6.1 Estimating GHG Emissions from Construction Equipment

This section describes how emissions from off-road equipment used during grading, building construction, and paving are calculated. It is important to note that GHG calculations are intended to estimate long-term emissions, while air quality emission calculations are intended to estimate worst-case daily scenarios. As such, the methodology presented in this section of the report will be different than the approach listed in the corresponding air quality section.

ENVIRON calculated emissions from construction equipment using the URBEMIS methodology. ENVIRON was provided with the number and type of equipment that will be used in the construction of CP-HPS Plan, as well as the duration of the different construction phases.[58] ENVIRON assumed that each piece of equipment will operate for 8 hours a day, five days a week during a given phase duration. An equipment hour is defined as one hour of a piece of equipment being used. Table 3-2 contains specifications for each type of construction equipment (horsepower, load factor, and GHG emission factor) provided by OFFROAD2007 and describes the detailed GHG calculations. CO_2 emissions for each type of construction equipment were calculated as follows:

> *Equipment Emissions [grams] = Total equipment-hours * emission factor [grams per brake horsepower-hour] * equipment horsepower * load factor*[59]

The contributions of CH_4 and N_2O to overall GHG emissions is likely small (< 1% of total CO_2e) from diesel construction equipment,[60] and were therefore not included in this calculation.

The total GHG emissions from all construction equipment are 56,403 tonnes CO_2 at CP and 42,895 tonnes CO_2 at HPS for a total of 99,298 tonnes CO_2.

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[55] California Air Resources Board Mobile Source Emissions Inventory Program. December 2006. http://www.arb.ca.gov/msei/offroad/offroad.htm
[56] Emission Factors (EMFAC2007) model (Version 2.3). November 2006. California Air Resources Board. http://www.arb.ca.gov/msei/onroad/latest_version.htm
[57] Urban Emissions Model (URBEMIS) (Version 8.7 – 2002 / Version 9.2.4 – 2008). Jones & Stokes Associates. Prepared for: South Coast Air Quality Management District. http://www.urbemis.com
[58] Received from MacTech.
[59] Load factor is the percentage of the maximum horsepower rating at which the equipment normally operates.
[60] California Climate Action Registry (CCAR). 2009. *General Reporting Protocol*. Version 3.1. ENVIRON estimates these emissions to be less than 1% of total GHG contributions for diesel fueled equipment.

3.6.2 GHG Emissions from Worker Commuting

Emissions from worker commuting are associated with workers involved in all construction subphases. GHGs are emitted from worker vehicles in two ways: running emissions, produced by driving the vehicle, and startup emissions, produced by turning the vehicle on. The majority of worker commute emissions are running emissions. Table 3-3 details emission calculations for worker commutes.

Total running emissions from worker commuting during each phase were calculated by estimating the total Vehicle Miles Traveled (VMT) by construction workers, and then multiplying this value by the representative GHG emission factors for the vehicles they are expected to drive. The total VMT by construction workers for a given phase is calculated as follows:

VMT = Number of worker trips x average one-way commute length x 2 commutes/day

The number of workers and duration of each subphase was provided to ENVIRON by MacTech. The length of the average one-way commute was assumed to be 14.9 miles[61].

After total VMT for CP-HPS Plan is calculated, GHG emissions for this development can be calculated from the following equation:

CO_2 emissions = VMT * [0.5 * EF_{LDA} + 0.5 * EF_{LDT2}]

Where:

VMT = vehicle miles traveled
EF_{LDA} = emission factor of light duty autos
EF_{LDT2} = emission factor of light duty trucks: up to 8500 GVW

The CO_2 calculation involves the following assumptions:

a. URBEMIS defaults assume that half of the workers commute with light duty trucks (LDTs) and half commute in light duty autos (LDAs).[62]

b. The emission factor depends upon the speed of the vehicle. The URBEMIS default value of 30 miles per hour was used.

c. EMFAC emission factors from the year 2011 were used for EF_{LDA} and EF_{LDT2}.

Startup emissions are CO_2 emitted from starting a vehicle. GHG emissions from startup for this development can be calculated from the following equation:

CO_2 emissions = Number of Work trips * [0.5 * EF_{LDA} + 0.5 * EF_{LDT2}] * 2 commutes/day

For construction workers during all phases, the startup emissions were calculated using the following assumptions:

[61] This represents the home-based work trip length provided by Fehr and Peers for San Francisco.
[62] Page A-9 of the URBEMIS user manual.

a. The number of round trips were equal to the number of worker days,

b. The breakdown in vehicles was 50% light duty autos and 50% light duty trucks,

c. Two engine startups per day with a 12 hour wait before each startup.[63]

The USEPA recommends assuming that CH_4, N_2O, and HFCs account for 5% of GHG emissions from on-road vehicles, taking into account their GWPs.[64] To incorporate these additional GHGs into the calculations, the total GHG footprint was calculated by dividing the CO_2 emissions by 0.95.

Table 3-3 summarizes the emission calculations for worker commutes. The total amount of GHG emissions from worker commuting during all phases is a one-time emission of 1,807 tonnes at CP and 2,265 tonnes at HPS for a total of 4,073 tonnes.

3.6.3 Hauling

Hauling involves removing material from the site during construction phases. Based on information provided to ENVIRON by MacTech, it is estimated that there will be 44,060 hauling trips for CP-HPS Plan. The number of trips is multiplied by the roundtrip length to determine total VMT. After total VMT for the hauling at CP-HPS Plan is calculated, CO_2 emissions from mobile running for this development can be calculated from the following equation:

CO_2 emissions from mobile running = VMT * EF_{HHD}

Where:

VMT = vehicle miles traveled (based on 14.6 miles round trip distance)
EF_{HHD} = emission factor of heavy heavy-duty trucks

The CO_2 calculation involves the following assumptions:

a. URBEMIS defaults assume that hauling trips use heavy heavy-duty trucks (HHDs).[65]

b. The emission factor depends upon the speed of the vehicle. The URBEMIS default value of 30 miles per hour was used.

c. EMFAC emission factors from the year 2011 were used for EF_{HHD}.

Startup emissions are CO_2 emitted from starting a vehicle. Startup emissions for hauling trips were calculated using the following assumptions:

[63] The emission factor grows with the length of time the engine is off before each ignition.
[64] USEPA. 2005. *Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle.* Office of Transportation and Air Quality. February.
[65] Page A-12 of the URBEMIS user manual.

a. The breakdown in vehicles was all heavy heavy-duty trucks,

b. Two engine startups per day with a 12 hour wait before each startup.[66]

The USEPA recommends assuming that CH_4, N_2O, and HFCs account for 5% of GHG emissions from on-road vehicles, taking into account their GWPs.[67] To incorporate these additional GHGs into the calculations, the total GHG footprint was calculated by dividing the CO_2 emissions by 0.95. The total amount of GHG emissions from hauling is a one-time emission of 1,316 tonnes of CO_2e at CP and 901 tonnes of CO_2e at HPS for a total of 2,216 tonnes of CO_2e as shown in Table 3-4.

Table 3-5 shows total one-time GHG emissions for construction, including off-road equipment, worker commuting, and hauling to be 59,526 tonnes CO_2e at CP and 46,061 tonnes CO_2e at HPS for a total of 105,587 tonnes CO_2e for the CP-HPS Plan development.

3.6.4 Uncertainties in Construction GHG Emissions Calculations

ENVIRON was provided with the phase length and number of each type of construction equipment during construction of buildings.[68] The number of construction equipment, worker and haul trips represent MacTech's estimates at time of this report. The calculations also used default values and settings from URBEMIS. This includes no consideration for reductions in GHG emissions due to new regulations and changes in off-road construction equipment and vehicles used for worker commuting and haul trips. As such, these values are somewhat uncertain.

3.7 GHG Emissions Associated with Residential Buildings

This section describes the methods used to estimate the GHGs associated with activities in residential buildings.

The amount of energy—and, therefore, the amount of associated GHG emissions emitted per dwelling unit— will vary with the type of residential building. Accordingly, information on the type of residential buildings that are planned for CP-HPS Plan is required to estimate GHG emissions. The main residential buildings at CP-HPS Plan provided by Lennar Urban are condos, townhomes, and other multi-family homes.

GHGs are emitted as a result of activities in residential buildings when electricity and natural gas are used as energy sources. Combustion of any type of fuel emits CO_2 and other GHGs directly into the atmosphere; when this occurs in a residential building, it is a direct emission source[69] associated with that building. GHGs are also emitted during the generation of electricity from fossil fuels. When electricity is used in a residential building, the electricity generation typically takes place offsite at the power plant; electricity use in a residential building generally causes emissions in an indirect manner.

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[66] The emission factor grows with the length of time the engine is off before each ignition.

[67] USEPA. 2005. *Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle.* Office of Transportation and Air Quality. February.

[68] Provided by MacTech.

[69] California Climate Action Registry (CCAR) General Reporting Protocol (GRP), Version 3.1 (April). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf, Chapter 8

While fuel combustion generates CH_4 and N_2O, the emissions of these GHGs typically comprise less than 1% of CO_2e emissions from electricity generation and natural gas consumption.[70] Fuel oil, kerosene, liquefied petroleum gas, and wood can also be used as fuels, but will likely contribute only in small amounts as combustion sources within residential buildings. Wood burning hearths are addressed in the area sources section of this report.

Energy use in residential buildings is divided into (1) energy consumed by the built environment, and (2) energy consumed by uses that are independent of the construction of the building, such as plug-in appliances. In California, Title 24 governs energy consumed by the built environment, including the HVAC system, water heating, and some fixed lighting. Non-building or 'plug-in' energy use can be further subdivided by specific end-uses (refrigeration, cooking, lighting, etc.). Energy use for each was calculated separately, as described in the following sections. The resulting energy use quantities were then converted to GHG emissions by multiplying by the appropriate emission factors, incorporating information on local electricity production and adjusted to account for the 20% Renewable Portfolio Standard required by 2010.[71]

In this section, the units CO_2 and CO_2e are used interchangeably for residential buildings because CH_4 and N_2O are assumed to contribute a negligible amount of GWP when compared to the CO_2 emissions from residential buildings.

3.7.1 Estimate of Residential Energy Use Intensity

ENVIRON developed CO_2 intensity values (i.e., CO_2 emissions per Dwelling Unit per year) for the residential building types found in CP-HPS Plan using the California Energy Commission Consultant Report entitled 'California Statewide Residential Appliance Saturation Study (RASS)'.[72] The methods that were used and the assumptions that were made in estimating energy use are described below.

3.7.2 Energy Use in the Built Environment

New Californian homes must be designed to meet building energy efficiency standards (Title 24). Compliance with Title 24 is determined from the total daily valuation (TDV) of energy use in the built-environment (on a per square foot per year basis). The regulated energy uses include space heating and cooling, domestic hot water heating, and hard-wired lighting. TDV energy use is a parameter that reflects the burden that a building imposes on an electricity supply system. In general, there is a larger electricity demand and, hence, stress on the supply system during the day (peak times) than at night (off peak). To account for this variation, the calculation of TDV assigns different weights for energy used at different times. For example, a building that uses a given amount of electricity during the peak mid-day period will have a higher TDV value

[70] Ibid. Tables C1 and C2. The methane and nitrous oxide emission factors are negligible compared to the total CO_2 emission factor for electricity generation in California.

[71] The PG&E specific emission factor for electricity deliveries is 636 lbs CO_2/MWh. From the California Climate Action Registry Database: Pacific Gas and Electric Company 2007 PUP Report. 2008. Although this emission factor accounts for only CO_2, the emissions associated with N_2O and CH_4 contribute to less than 1% of the electricity generation CO_2e emissions. Available at: https://www.climateregistry.org/CARROT/public/Reports.aspx This emission factor has been adjusted to 574 lbs CO_2/MWh to account for the 20% RPS required by 2010.

[72] Kema-Xenergy, Itron, RoperASW. California Statewide Residential Appliance Saturation Study (RASS) Volume 2, Study Results, Final Report. June 2004. 300-00-004.

than a building using an equivalent amount of electricity during off-peak hours. Title 24 determines compliance by comparing the energy use of a modeled (or 'proposed') home to a minimally Title 24 compliant 'standard home' of equal dimensions. Title 24 focuses on building energy efficiency per square foot; it places no limits upon the size of the house or the actual energy used per dwelling unit.

To determine Title 24 compliance for space heating, space cooling, and domestic hot water systems, data from RASS was used to calculate the total energy use per dwelling unit. Estimates for hard-wired lighting will be discussed later in this section. The study estimates the unit energy consumption (UEC) values for individual households surveyed and also provides the saturation number for each type of end-use. The saturation number indicates the proportion of households that have a demand for each type of end-use category.

The most applicable data provided in RASS was used to estimate the UEC values for dwelling units at CP-HPS Plan. Where available, data for multifamily, 5+ unit apartment types in climate zone 5, which is the climate zone in which San Francisco is located, was used. If multifamily or climate zone 5 data was not available, then all household or statewide data was used, respectively. The RASS dataset is comprised of older buildings, which are typically less energy efficient (on a per square foot basis) than newer buildings constructed to meet increasingly stricter efficiency standards. Although the homes used for RASS are likely less energy efficient than Title 24-compliant buildings, the energy use estimates were used to represent 2001 Title-24 compliant homes. The Title 24 standards have been updated twice (in 2005 and 2008) since RASS, and CEC has published reports estimating the percentage deductions in energy use resulting from these new standards[73,74]. Because buildings at CP-HPS Plan would conform to the most updated (and most stringent) standards, ENVIRON accounted for the impact of the Title 24 updates by deducting the estimated percentage savings from the RASS energy use estimates.

RASS provides the annual electricity use per dwelling unit for various heating, cooling, and domestic hot water subcategories. ENVIRON calculated the total electricity demand for each category by multiplying the UEC and saturation values and summing the products for each end-use subcategory within each category. End-use subcategories used to calculate the electrical heating UEC value include conventional electric heating, electrical heat pump space heating, auxiliary heating, and furnace fan. Subcategories included in the cooling category include central air, room air, and evaporative cooling. RASS also provides the UEC values for natural gas usage used for heating and domestic hot water. The same method was used to calculate natural gas usage for each Title 24 category as described above. Natural gas subcategories used to estimate natural gas UEC heating values include primary heat and auxiliary heat; domestic hot water natural gas includes conventional gas water heat.

[73] California Energy Commission. 2003. Impact Analysis: 2005 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2005standards/archive/rulemaking/documents/2003-07-11_400-03-014.PDF

[74] California Energy Commission. 2007. Impact Analysis: 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF

Title 24 compliant electricity use on a per dwelling unit basis is 542 kWh per dwelling unit per year. Natural gas use in Title 24 compliant residences on a per dwelling unit basis is 39 MBtu per dwelling unit per year.

Lennar Urban has committed to making all new homes 15% more energy efficient than Title 24 requirements, i.e., 15% more energy efficient on a TDV basis. ENVIRON assumed that all households would uniformly use 15% less annual energy. These calculations are shown in Table 3-6. Title 24 compliant energy use was calculated using the UEC values and saturation values from RASS as described above. These calculations include energy use for heating, air conditioning, DHW. These energy use numbers were then each multiplied by 0.85 to account for Lennar Urban's commitment to a 15% energy efficiency improvement over Title 24. This improvement over Title 24 reduces the electricity use to 286 kWh per year per dwelling unit. For natural gas, this improvement over Title 24 reduces usage on a per dwelling unit basis to 28 MBTU per year per dwelling unit. The calculations for major appliances and plug-in energy use are discussed in the next sections.

3.7.3 Energy Use for Major Appliances and Plug-Ins

Typical major household appliances provided in new residential units include refrigerator, clothes washer and dryer, dishwasher, and cooking range. These are typical appliances provided with a new residential unit that the developer has some control over. Energy demand from using these major appliances is based on UEC and saturations values from RASS.

Table 3-7 summarizes the estimated major appliance energy use for dwelling units at CP-HPS Plan. The annual electricity use of major appliances, taking into account the various types of housing proposed for the CP-HPS Plan, is 971 kWh per year per dwelling unit. In addition the annual natural gas use of major appliances is 3.1 MBtu per dwelling unit.

Lennar Urban has committed to requiring Energy Star appliances for all major appliances rated by Energy Star in newly built residences when the builder supplies appliances with the new home. This includes refrigerators, dishwashers, and clothes washers. There is no Energy Star rating for dryers at this time since there is no significant difference in energy use between different dryer models. Energy Star ratings also are not available for cooking ranges. The average energy improvement for Energy Star rated appliances over standard appliances as reported in Energy Star Annual Report was used to determine the percent reduction in energy use from major appliances.

In addition to major appliances, additional loads such as lighting, office equipment, plug-in cooking equipment and electronics other plug-in electricity loads, such as lighting in a miscellaneous category are also part of the anticipated energy use for a residential development. Similar to the major appliances above, energy use values for plug-in appliances are based on the UEC and saturation values for the miscellaneous category in RASS. The annual electricity use for plug-in appliances (miscellaneous) and lighting is 1,783 kWh for per dwelling unit.

Table 3-8 summarizes the combined energy use including the Title 24 systems, major appliances, and plug-ins. It should be noted that the estimates for residential plug-in energy-use presented here are likely overestimates. The estimates are based upon technologies that were available during the RASS survey, which was conducted in 2003. Future equipment models are likely to be more energy-efficient than current models. If future CP-HPS Plan residents install Energy Star appliances, use more energy efficient equipment, and replace incandescent lights with fluorescent lights, the actual electricity use for plug-ins will be lower than is estimated here. Conversely, future residents may have more small plug-ins (e.g. MP3 player, cell phone, miscellaneous equipment) that could somewhat offset the savings from more energy efficient equipment. However, because refrigerators, lighting, and large appliances contribute to the bulk of the electricity load, and these types of equipment will likely improve in energy efficiency in the future, the estimates presented here are still likely overestimates.

Table 3-8 shows the calculations for the improvement in energy use from Lennar Urban's commitment to a 15% improvement over Title 24 and their commitment to requiring Energy Star major appliances where available. This results in a 12% reduction in electricity use from Energy Star and a combined electricity savings of 9% when compared to a 2005 Title 24 compliant building with current carbon intensity values for electricity use.

3.7.4 Estimation of Annual Greenhouse Gas Emissions from Residential Buildings

Energy use data from Tables 3-8 were multiplied by the emission factors presented in Table 3-9 to generate CO_2 intensity values (i.e., CO_2 emissions per dwelling unit) for each building type. The builder has control over a portion of the estimated energy use for a residential building, the built environment and the initial major appliances. As shown in Table 3-10, the homes that are 15% more energy efficient than Title 24 have lower CO_2 emissions. When combined with Energy Star appliances, as shown in Table 3-10 the dwelling units emit 23% less CO_2 per year than current standard homes for the built environment and major appliances. As shown in Table 3-10, when plug-in loads are considered, dwelling units emit 20% less CO_2 per year, than the current Title 24 compliant homes without energy star appliances.

Table 3-11 shows the yearly CO_2 emissions from CP-HPS Plan by incorporating the aforementioned emission factors and the number of dwelling units for each building type for Title 24 systems and all plug-in energy. The number of dwelling units reflects only the net new units and does not consider the 256 replacement dwelling units. With15% improvements over Title 24, Energy Star appliances annual CO_2 emissions would be reduced to 19,035 tonnes (2.5 tonnes per unit) for CP, 6,642 tonnes (2.5 tonnes per unit) for HPS. The total emissions in this scenario would be 25,677 tonnes per year.

Variant 1 will be the same as the Project with a total of 25,677 tonnes per year. Variant 2 shifts 1,350 dwelling units from CP to HPS. The total net new units at CP will be 6,244 dwelling units with annual CO_2 emissions of 15,651 tonnes per year. HPS will have 4,000 dwelling units with annual CO_2 emissions of 10,026 tonnes per year. The total residential GHG emissions for Variant 2 is 25,677 tonnes CO_2e. This is shown in Table 3-12.

3.7.5 Uncertainties in Residential Building GHG Calculations

Several factors lead to uncertainties in the above analysis. These are described below. As described below, it is believed that these uncertainties result in conservative estimates of the GHG emissions for the residential buildings at CP-HPS Plan.

- Although all buildings in the development will be Title 24 compliant, Title 24 does not specify building dimensions (e.g. size, height, or orientation). Title 24 also provides significant flexibility for window types, window amounts, insulation choice, and other parameters. This uncertainty is not expected to either overestimate or underestimate emissions. Title 24 grants enough flexibility that if a designer puts in more windows than is 'allowed' under the prescriptive measures, the energy efficiency losses can be offset by improving the window quality, or installing a more efficient HVAC system. Although the designs of each residence are not yet known, each home will be Title 24 compliant, and thereby all design features of the home that make it less energy efficient will be offset by design features that make it more energy efficient.
- This analysis did not account for TDV of energy use. As such the reductions in GHG emissions may or may not be quantitatively reflective of the reductions if TDV is accounted for.
- Energy use will vary considerably depending upon the design of the home. The residential units to be built in CP-HPS Plan will vary considerably in size, layout, and overall design. The parameters used here are intended to represent the anticipated energy use of the homes. As such, energy use from the homes that will actually be built in CP-HPS Plan could be different.
- Built environment energy use will vary considerably depending upon the home owners' habits regarding energy use. For instance, homeowners determine the set point of thermostats, the duration of showers, and the usage of air conditioning, among other things. Lennar Urban will have little, if any, influence over these choices made by the homeowner. Current median behavior attributes were assumed for this report. To the extent that individuals are becoming more energy conscious, this will tend to overestimate energy use in the future.
- Plug-in energy use will also vary considerably depending upon the appliances, lights, and other plug-ins installed by the homeowner. Lennar Urban will have little, if any, influence over these choices made by the homeowner. As above, the current median behavior attributes are represented here. To the extent that individuals are becoming more energy conscious, or appliances are becoming more energy efficient, the estimates provided here will tend to overestimate energy use in the future.
- The energy use of the replacement dwelling units will likely be lower than the energy use of the new buildings. This reduction in energy use for the replacement dwelling units has not been accounted for and thus the estimate of energy use is conservative.

3.8 GHG Emissions Associated with Non-Residential Buildings

Non-residential buildings include all structures except residences that may exist in a development such as government, municipal, commercial, retail, and office space. This section describes the methods used to estimate the GHGs associated with activities in non-residential buildings.

The amount of energy used and the associated GHG emissions emitted per square foot of available space vary with the type of non-residential building. For example, food stores are far more energy intensive than warehouses, which have little climate-conditioned space. The CP-HPS Plan description provided data[75] summarizing the general non-residential building categories planned for CP-HPS Plan and the area of floor space planned for each building type. For new developments, the exact types of buildings are typically unknown. As such, not all building categories that may actually exist in CP-HPS Plan are represented below. However, all of the non-residential building area is accounted for, and the tables provided in this section present the differences in energy intensities from building type to building type. The types of non-residential buildings as provided to ENVIRON are:

a. Office

b. Retail

c. Research and Development

d. Artist Studios

e. Community Services

f. Hotel

g. Stadium

h. Performance Venue

Similar to the case for residential buildings, GHGs are emitted as a result of activities in non-residential buildings for which electricity and natural gas are used as energy sources. Combustion of any type of fuel emits CO_2 and other GHGs directly into the atmosphere; when this occurs in a non-residential building this is a direct emission source[76] associated with that building. GHGs are also emitted during the generation of electricity from fossil fuels. When electricity is used in a non-residential building, the electricity generation typically takes place offsite at the power plant; electricity use in a non-residential building generally causes emissions in an indirect manner.

While fuel combustion generates CH_4 and N_2O, the emissions of these GHGs typically comprise less than 1% of CO_2e emissions from electricity generation and natural gas consumption.[77]

[75] The CP-HPS Plan description was used to estimate total square footage of buildings.
[76] California Climate Action Registry (CCAR) General Reporting Protocol (GRP), Version 3.1 (January 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf , Chapter 8
[77] Ibid., Tables C1 and C2. The methane and nitrous oxide emission factors are negligible compared to the total CO_2 emission factor for electricity generation in California.

Fuel oil, kerosene, liquefied petroleum gas, and wood can also be used as fuels, but generally contribute only in small amounts as combustion sources within non-residential buildings. As such, these minor emissions are not accounted for here.

Similar to energy use in residential buildings, energy use in non-residential buildings is divided into energy consumed by the built environment and energy consumed by uses that are independent of the construction of the building such as plug-in appliances. In California, Title 24 governs energy consumed by the built environment, mechanical systems, and some fixed lighting. Non-building energy use, or "plug-in" energy use can be further subdivided by specific end-use (refrigeration, cooking, office equipment, etc.). The following two steps were performed to quantify the energy use due to non-residential buildings:

1. Calculate energy use from systems covered by Title 24[78] (HVAC system, water heating system, and the lighting system).
2. Calculate energy use from office equipment, plug-in lighting, and other sources not covered by Title 24.

The resulting energy use quantities were then converted to GHG emissions by multiplying by the appropriate emission factors obtained by incorporating information on local electricity production.[79] The total GHG emissions for non-residential buildings in CP-HPS Plan is estimated to be 18,028 tonnes CO_2 per year. Variant 1 is estimated to be 27,418 tonnes CO_2 per year. Variant 2 is estimated to be 16,226 CO_2 per year. The following sections describe the methodologies employed to estimate GHG emissions.

In this section of this report, the units CO_2 and CO_2e are used interchangeably for non-residential buildings because CH_4 and N_2O are assumed to contribute a negligible amount of GWP when compared to the CO_2 emissions from non-residential buildings.

3.8.1 Estimate of Non-residential Energy Use Intensity

ENVIRON developed CO_2 intensity values (CO_2 emissions per sqft per year) for building types found in CP-HPS Plan using data from the California Commercial End-Use Survey (CEUS) except for the Stadium.[80] The methods that were used to estimate these emissions for CP-HPS Plan are described below.

3.8.1.1 CEUS Database

The overall electricity use for the building types except for the Stadium was calculated based on data provided by the CEC.[81] The CEUS data is based on a survey conducted in 2002 of

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[78] Title 24, Part 6, of the California Code of Regulations: California's Energy Efficiency Standards for Residential and Nonresidential Buildings. http://www.energy.ca.gov/title24/

[79] The PG&E specific emission factor for electricity deliveries is 636 lbs CO_2/MWh. From the California Climate Action Registry Database: Pacific Gas and Electric Company 2007 PUP Report. 2008. Although this emission factor accounts for only CO_2, the emissions associated with N_2O and CH_4 contribute to less than 1% of the electricity generation CO_2e emissions. Available at: https://www.climateregistry.org/CARROT/public/Reports.aspx This emission factor has been adjusted to 574 lbs CO_2/MWh to account for the 20% RPS required by 2010.

[80] California Energy Commission (CEC). California Commercial End-Use Survey Results. Data available from Itron Inc. at http://capabilities.itron.com/CeusWeb/Chart.aspx

[81] Workbooks for "PGE – FCZ5" downloaded from http://capabilities.itron.com/CeusWeb/Chart.aspx for all building categories. Access 7/15/2009.

existing buildings. Each building type has a characteristic electricity and natural gas use per square foot of building space. Electricity use per square foot (electricity intensity) for each building sample was extracted from the CEUS data. Similarly, the natural gas use per square foot (natural gas intensity) for each building sample was also extracted.

For this analysis, energy use was based upon buildings in California climate zone 5. Table 3-13 lists the breakdown of electricity use among several end uses for electricity in various non-residential building types. Table 3-14 lists the percentage breakdown of end uses for natural gas in various non-residential building types. The end use data provide an estimate of the percent of the total energy use comprised by Title 24 regulated (built environment) and plug-in electricity in each building type. The Title 24-regulated electricity use (cooling, space heating, water heating, lighting, ventilation) and the non-built electricity use (office equipment, refrigeration, cooking, etc.) are presented in Table 3-16. The Title 24-regulated natural gas use and the non-built natural gas use (primarily from cooking) are presented in Table 3-16.

3.8.1.2 Stadium

The Stadium energy use estimates are based on San Francisco Climate Action Plan which lists 1990 energy use for the Stadium. The Stadium electricity use in 1990 was 5.1 million kWhr per year and natural gas use was 9 million kBtu per year[82]. The new Stadium will likely be more energy efficient than the old Stadium built in 1960. It was assumed that the new Stadium would use 20% less electricity than the old Stadium based on estimates from other new football stadiums[83]. Although the Stadium in 1990 housed both football and baseball, and the new Stadium is anticipated to house only football, no reduction in energy use has been assumed. Accordingly, this is likely an overestimate of Stadium energy use.

The electricity and natural gas use per square foot for each building type are converted to GHG emissions as shown in the next section.

3.8.2 Estimation of Annual Greenhouse Gas Emissions from Non-Residential Buildings

Lennar Urban has committed to making all new non-residential buildings 15% more energy efficient than Title 24 2008 standards, or 15% more energy efficient on a TDV basis. Although ENVIRON is aware that annual energy use and TDV energy do not necessarily scale linearly with each other, as discussed in the residential section, ENVIRON assumed that all sources covered by Title 24 would uniformly use 15% less annual energy. These calculations are shown in Table 3-16. Non-Title 24 regulated energy use is assumed to still use the same amount of energy as a minimally Title 24 compliant building. There is no credit taken for any Energy Star appliances in the non-residential building category since it is difficult to determine which appliances may be present in the various non-residential building categories. In addition, these are generally not supplied with the building. Baseline Title 24 usage rates shown in this table have been adjusted to reflect improvements in Title 24 building codes since their introduction in

[82] San Francisco Department of the Environment and San Francisco Public Utilities Commission. 2004. Climate Action Plan for San Francisco.

[83] The new stadium to be used by the New York Jets and Giants is expected to reduce energy consumption by 30%. The new stadium to be used by the Dallas Cowboys is expected to reduce energy use by 20%.

2002. CEC discusses average savings for improvements from 2002 to 2005 ("Impact Analysis for 2005 Energy Efficiency Standards") as well as from 2005 to 2008 ("Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings"). ENVIRON used these CEC average savings percentages to account for reductions in energy use due to Title 24. The average savings percentages are: for electricity: 8.5% reduction in 2005 and 4.9% reduction in 2008; for natural gas: 5.8% reduction in 2005 and 9.4% reduction in 2008. This methodology results in a reduction of energy use for all building types. Because plug-ins are not covered under Title 24, the decrease in energy use is typically less than 15%, yet still substantial.

Energy use data from Table 3-16 were multiplied by the emission factors presented in Table 3-15 to generate CO_2 intensity values (CO_2 emissions per sqft building area). The results are shown in Table 3-16. The CO_2 intensity values presented in Table 3-15 represent the non-residential building types in CP-HPS Plan described earlier.

Table 3-17 also shows the yearly CO_2 emissions from CP-HPS Plan by incorporating the emission factors developed as discussed above and the square footage of each of the main building categories. The total annual GHG emissions for CP will be 4,263 tonnes CO_2 per year. The total annual GHG emissions for HPS will be 13,766 tonnes CO_2 per year. This is a total of 18,028 tonnes CO_2 per year for CP-HPS Plan.

Variant 1 replaces the Stadium with an additional 2.5 million square feet of R&D space for a total of 5 million square feet of R&D space at HPS. CO_2 emissions are shown in Table 3-18. The CO_2 emissions at HPS for Variant 1 are 23,155 tonnes CO_2 per year for a total of 27,418 tonnes CO_2 per year for Variant 1.

Variant 2 replaces the Stadium with housing units. CO_2 emissions are shown in Table 3-19. The CO_2 emissions at HPS for Variant 2 are 11,963 tonnes CO_2 per year for a total of 16,226 tonnes CO_2 per year for Variant 2.

3.8.3 Uncertainties in Non-residential Building GHG Calculations

Several factors lead to uncertainties in the above analysis. These are described below.

- For new developments, the exact types of buildings are typically unknown. As such, not all building categories that may actually exist in CP-HPS are represented in this analysis. However, all of the commercial building area is accounted for and the best available assessment of the building type composition of CP-HPS Plan was used. The tables provided in this section present the differences in energy intensities from building type to building type.
- Although it is unknown exactly how the buildings will be designed, each building will be Title 24 compliant. Therefore all design features of the building that make it less energy efficient will be offset by design features that make it more energy efficient.
- The exact energy use for the new Stadium is only an estimate based on past energy use of the old Stadium and estimates in typical energy improvements claimed for other new football stadiums. In addition, the uses in the old Stadium included baseball, whereas the new Stadium uses will not include baseball.

3.9 Mobile Sources

This section estimates GHG emissions from mobile sources in CP-HPS Plan. The mobile source emissions considered for this project will be from the typical daily operation of motor vehicles by CP-HPS Plan residents and non-residents.

ENVIRON estimated GHG emissions based upon all miles traveled associated with net new CP-HPS Plan residential and non-residential trips regardless of internal or external destinations or purpose of trip. Traffic patterns, trip rates, and trip lengths are based upon information from the Candlestick Point-Hunter's Point Shipyard Phase II Development Transportation Study.[84]

ENVIRON estimated alternative GHG emissions which only accounts for the "new" emissions associated with growth. These GHG emissions are based upon all miles traveled by net new CP-HPS Plan residents regardless of internal or external destinations or purpose of trip.

For this alternative GHG emissions, it is assumed that new non-residential (i.e. office space, retail space, and industrial buildings) area serves an area with a high residential/ non-residential balance. Therefore, this new non-residential growth will not, independent of the new residential areas, result in new shopping and work trips. Since the Stadium is replacing Candlestick Park, this is not considered to cause new trips from far away. If the Stadium is not built at HPS, it is assumed that a new Stadium will be built elsewhere in the Bay Area and it is unknown if the trips will be shorter or longer for attendees. The music venue in CP is considered to be a new non-residential facility that could draw trips that otherwise would not be made. The trips associated with customers of the music venue are considered in the inventory. Accordingly, new non-residential space in the CP-HPS Plan development area will not contribute to mobile GHG emissions except for the music venue. However, the emissions from heating and cooling the non-residential areas would be considered to be new, as that would reflect growth in non-residential areas that goes along with growth in residential areas. Accordingly, GHG emissions from VMT serving non-residential areas will only be counted if the non-residential areas contribute to greater VMT as a result of its location such as the music venue. It should be noted that as CP-HPS Plan is a mixed use community, this issue does not directly affect CP-HPS Plan VMT calculations; all VMT from net new CP-HPS Plan residents is calculated regardless of internal or external destinations or purpose of trip.

The CCAR GRP[85] recommends estimating GHG emissions from mobile sources at an individual vehicle level, assuming knowledge of the fuel consumption rate for each vehicle as well as the miles traveled per car. Since these parameters are not known for a future development, the CCAR guidance can not be used as recommended.

For mobile sources, CH_4 and N_2O are explicitly calculated, multiplied by their respective GWP, and added to the CO_2 emissions, to result in total CO_2e emissions from mobile sources.

[84] CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunter's Point Shipyard Phase II Development Transportation Study.

[85] California Climate Action Registry (CCAR). 2009. *General Reporting Protocol*. Version 3.1. January.

3.9.1 Estimating VMT from Mobile Sources

This section explains the general approach used to estimate VMT made by the residents of CP-HPS Plan. Underlying data for the calculations were taken from the Candlestick Point-Hunter's Point Shipyard Phase II Development Transportation Study provided to ENVIRON.[86]

Traditional traffic models focus upon designing roads and planning a development such that traffic delays will be avoided during peak travel hours. Traditional traffic analyses also provide the total number of daily vehicles on a road which can then be used to calculate toxic or criteria emissions that may have localized health effects. Several steps must be taken to go from a traditional traffic model to a set of calculations that describe VMT made by CP-HPS Plan residents and non-residents.

The first step is to adjust the traffic report trips to account for project design features that reduce trips. As the traditional traffic analysis only predicts weekday driving patterns, this step is to account for differences in weekend and weekday driving patterns. The third step accounts for how many of these trips may be taken using modes of transportation other than cars. The final step is to take all of these parameters into account and calculate the final VMT from CP-HPS Plan residents. These four steps are summarized below:

1. Determine trip rates based on reductions for project design features.
2. Determine the difference in weekend and weekday driving patterns.
3. Determine how many trips are taken by modes other than cars.
4. Calculate final VMT based upon the above scenarios.

The following section describes, in more detail, how these four steps were carried out. An additional step is necessary for the alternative analysis which only considers the "new" GHG emissions associated with growth. This step is to disaggregate the traffic information that is contained in the original traffic report into trips made by CP-HPS Plan residents and into trips made by non-CP-HPS Plan residents as well as the number of trips for attendees of the music venue.

3.9.1.1 Determine trip rates based on reductions for project design features

The Candlestick Point-Hunter's Point Shipyard Phase II Development Transportation Study provided to ENVIRON included an estimate of the trip rates incorporating the project design features at CP-HPS. The trips and VMT calculated includes all trips and VMT generated by net new CP-HPS Plan residential and non-residential land uses. Once the number of trips is determined, the trip type is important. For example, a home based work (HBW) trip is a trip directly from home to work with no stops in-between, or directly from work to home. A home based shopping trip (HBS) is a trip directly from home to shopping or from shopping to home. A home based other trip (HBO) is a trip directly from home to another destination such as school. Non-home based (NHB) trips are trips between work and other types of destinations such as going to the bank during one's lunch hour. For all trip types, directionality is unimportant. The

[86] CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunter's Point Shipyard Phase II Development Transportation Study.

distribution of residential trip types follow the MTC 2030 model defaults where HBW trips account for 32% of trips, HBO are 47% of trips, and NHB are 21% of trips. Non-residential trip types are HBW account for 26% of trips, HBO accounts for 28% of trips, and NHB are 27% of trips.

3.9.1.2 Determine the difference in weekend and weekday driving patterns

Since the trip rates are based on weekday conditions, ENVIRON calculated weekend traffic by applying differences between the weekend and the weekday traffic based upon a report by Sonoma Technologies.[87] Weekend traffic on major highways was assumed to be 80% of the weekly capacity, and weekend traffic on small streets was assumed to be 80% of weekly capacity[88]. No adjustment to driving patterns was done for the music venue since this is on a per event basis.

3.9.1.3 Determine how many trips are taken by modes other than cars

It is likely that a portion of the CP-HPS Plan residents would take public transportation when travelling out of CP-HPS Plan. Lennar Urban has committed to enhancements of the public transportation in the region. The Candlestick Point-Hunter's Point Shipyard Phase II Development Transportation Study made an estimate of the total number of vehicle trips taking into account use of several alternative modes including public transit, bicycles, and carpooling.

3.9.1.4 Alternative GHG Emissions Analysis: Dis-aggregate the trips made by CP-HPS Plan residents from trips made by people that do not live in CP-HPS Plan.

As discussed above, the trips generated by the net new residents of CP-HPS Plan represent growth. However, new non-residential areas do not necessarily represent growth since people would already be taking these trips. The new non-residential areas will only serve to displace the location of trips with the exception of the music venue. The music venue will create trips that would otherwise not occur. The trips by attendees of the music venue are therefore counted. The total number of trips of attendees to the music venue was provided by Fehr and Peers and assumes 150 events per year. Therefore we will only account for trips generated from the residential land uses to determine the GHG emissions from CP-HPS Plan. To the extent that those trips visit commercial areas, both inside and outside of the CP-HPS Plan, they will be counted.

3.9.1.5 Calculate final VMT based upon the above scenarios

Each type of trip is associated with an average trip length as estimated by Fehr and Peers based on the Caltrans Household Travel Survey for San Francisco County. Total vehicle miles traveled (VMT) were calculated by multiplying the number of trips by the average trip length for each type of trip.

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[87] Sonoma Technologies, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

[88] A conservative adjustment for weekend travel was assumed for all the trips since information was not available to distinguish between trips on major highways and trips on small streets. The Sonoma Technologies report gives a range of values, but does not present a weighted value, thus a conservative percent reduction in the number of trips was selected.

VMT = Number of Trips * Average Trip Length

The average trip length for HBW is 14.9 miles, HBO is 9.1 and NHB is 9.5. Vehicle trips that are internal to the project area were assumed to be 1 mile. The music venue attendees were assumed to have a trip length of 9.1 miles, the same as the HBO trip length. The value calculated here includes all VMT generated by net new CP-HPS Plan residential and non-residential land use commuting within CP-HPS Plan and all VMT generated by CP-HPS Plan residents and nonresidents commuting to and from CP-HPS Plan as well as attendees of the music venue. The total VMT for CP-HPS Plan residents and non-residents is 309,166,932 as shown in Table 3-20. Using an alternative method, each CP-HPS Plan dwelling unit generates 13,467 VMT per year. The total VMT for CP-HPS Plan residents is 137,958,003 as shown in Table 3-21. For Variant 1, the total VMT for CP-HPS Plan residents and non residents is 351,783,194 VMT per year as shown in Table 3-22. Using the alternative method to estimate trips from residents only for Variant 1, the net new dwelling units would generate 13,720 VMT per year per dwelling unit for a total of 140,548,884 VMT as shown in Table 3-23. For Variant 2, there would be a total of 322,690,366 VMT from residents and nonresidents as shown in Table 3-24. Using the alternative approach for Variant 2, the net new dwelling units would generate 13,557 VMT per year for a total of 138,880,220 VMT as shown in Table 3-25. This VMT was multiplied by the appropriate emission factors in the next section to calculate GHG emissions from mobile sources at CP-HPS Plan.

3.9.2 Estimating GHG Emissions from Mobile Sources

The CO_2 emissions from mobile sources were calculated with the trip rates, trip lengths and emission factors for running and starting emissions from EMFAC2007 as follows:

CO_2 emissions = VMT * $EF_{running}$

Where:

VMT = vehicle miles traveled
$EF_{running}$ = emission factor for running emissions

The CO_2 calculation involves the following assumptions:

- The emission factor depends upon the speed of the vehicle. Here, it was assumed that trips were 30 miles per hour.
- EMFAC emission factors from the year 2020 were used for $EF_{running}$ based on San Francisco County fleet mix and adjusted to account for Pavley Vehicle Standards (see Appendix B for details).

Startup emissions are CO_2 emitted from starting a vehicle. Startup emissions were calculated using the following assumptions:

- The number of starts is equal to the number of trips made annually.
- The breakdown in vehicles was EMFAC fleet mix for San Francisco County in 2020.

- The emission factor for startup was calculated based on a conservative assumption of long waits between starts.

Fleet distribution types are from EMFAC2007 from the year 2020, a year selected to represent full build out. Tables 3-20, 3-22, and 3-24 shows the CO_2 emissions from vehicles associated with residents and nonresidents of CP-HPS Plan, Variant 1, and Variant 2 as calculated according to the methodology described above. Table 3-21, 3-23, and 3-25 shows the alternative analysis of the CO_2 emissions from vehicles associated with residents and music venue only of CP-HPS Plan, Variant 1, and Variant 2 as calculated according to the alternative methodology described above.

Nitrous oxide, CH_4, and HFCs[89] are also emitted from mobile sources. The USEPA recommends assuming that CH_4, N_2O, and HFCs account for 5% of mobile source GHG emissions, taking into account their GWPs.[90] Therefore, CO_2 emissions in Table 3-20 through 3-25 were divided by 0.95 to account for non-CO_2 GHGs. Vehicles associated with the CP-HPS Plan development will emit approximately 105,520 tonnes CO_2e per year. Vehicles associated with the Variant 1 will emit approximately 119,918 tonnes CO_2e per year. Vehicles associated with the Variant 2 will emit approximately 110,068 tonnes CO_2e per year. The alternative analysis estimates that vehicles associated with the CP-HPS Plan will emit approximately 47,049 tonnes CO_2e per year, Variant 1 will emit approximately 47,886 CO_2e per year, and Variant 2 will emit approximately 47,347 CO_2e per year. A sample EMFAC run for San Francisco County is given in Appendix B.

3.9.3 Uncertainty Analysis

In an effort to evaluate the assumptions described in the section it should be noted that changes in estimated fleet distribution and emission factors will likely improve based on anticipated regulations, over and above those currently enacted in law.

3.9.4 Transit Area

Emissions from the transit area are associated with increased public transport needed to service the CP-HPS Plan development. GHGs are emitted from public buses when the vehicles are in transit and when the vehicles are idling at the curbside. Table 3-26 details the emission calculation for transit area. This is based on the net new miles and trips made by transit servicing the CP-HPS Plan. The details of the net new transit service are described in Table 3-27 as provided by Fehr and Peers. Since San Francisco uses carbon free electricity to power its electric buses and trolleys, the mileage and idling time from these vehicles is not quantified.

Total running emissions from transit buses were calculated by multiplying the net new miles and idling time from the CP-HPS Plan by the GHG emission factors for urban buses.

$$CO_2 \text{ emissions} = VMT * EF_{BUS,running} + Idling * EF_{UBUS,idling}$$

Where:

[89] HFCs can be emissted from air conditioning systems.

[90] USEPA. 2005. *Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle.* Office of Transportation and Air Quality. February. (http://www.epa.gov/otaq/climate/420f05004.pdf)

VMT = net new vehicle miles traveled (from Fehr and Peers)

$EF_{BUS,running}$ = running emission factor for urban buses

Idling = net new idling time (from Fehr and Peers)

$EF_{BUS,idling}$ = idling emission factor for buses

The CO_2 calculations involve the following assumptions:

- $EF_{BUS,running}$ and $EF_{BUS,idling}$ are based on EMFAC emission factors from the year 2020
- The diesel buses servicing CP-HPS will be diesel-hybrid buses that reduce fuel usage by 25%[91]
- San Francisco transit buses use B20 (20% biodiesel, 80% petroleum diesel).[92]
- Startup emissions are expected to be minimal because transit buses are expected to operate the full day.

The idling emission factor for EMFAC's school bus was used for $EF_{BUS,idling}$ because the idling emission factor is not available for urban buses.

The USEPA recommends assuming that CH_4, N_2O, and HFCs account for 5% of GHG emissions from on-road vehicles, taking into account their GWPs.[93] To incorporate these additional GHGs into the calculations, the total GHG footprint was calculated by dividing the CO_2 emissions by 0.95.

The total amount of GHG emissions from the transit area is estimated to be 1,730 tonnes of CO_2 per year.

3.10 Municipal Sources

This section explains estimates for emissions stemming from municipal sources such as drinking water and wastewater supply and treatment, lighting in public areas, and municipal vehicles.

3.10.1 Water and wastewater supply and treatment systems

In general, the majority of municipal sector GHG emissions are related to the energy used to convey, treat and distribute water and wastewater. Thus, these emissions are generally indirect emissions from the production of electricity to power these systems. Additional emissions from wastewater treatment include CH_4 and N_2O, which are emitted directly from the wastewater.

The amount of electricity required to treat and supply water depends on the volume of water involved. According to Lennar Urban, the development would generate a total water demand of 0.90 and 0.77 million gallons per day (mgd) for CP and HPS, respectively. Three processes are

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[91] SFMTA Climate Action Plan. Draft for Public Review, December 19, 2008.

[92] Based on CCAR recommendations, emissions from burning biodiesel are not included in emissions estimation. EMFAC emission factors are further reduced by 20% to account for the use of B20.

[93] USEPA. 2005. *Emission Facts: Greenhouse Gas Emissions from a Typical Passenger Vehicle.* Office of Transportation and Air Quality. February.

necessary to supply potable water to residential and commercial users: (1) supply and conveyance of the water from the source; (2) treatment of the water to potable standards; and (3) distribution of the water to individual users. After use, the wastewater is treated and reused as reclaimed water. Any reclaimed water produced is generally redistributed to users via pumping.

Indirect emissions resulting from electricity use were determined by multiplying electricity use by the CO_2 emission factor provided by the local electricity supplier, Pacific Gas and Electric Company, (PG&E). Energy use for different aspects of water treatment (e.g. source water pumping and conveyance, water treatment, distribution to users) was determined using the stated volumes of water and energy intensities values (i.e., energy use per unit volume of water) provided by reports from the California Energy Commission (CEC). The emission factors and GHG emissions for all these processes are shown in Table 3-28. The annual emissions from water treatment and distribution, and wastewater treatment are approximately 257 and 230 tonnes CO_2e per year for CP and HPS, respectively. Variant 1 will have the same emissions for CP and 324 tonnes CO_2e per year for HPS. Variant 2 will have 225 and 257 tonnes CO_2e for CP and HPS, respectively. Details on the emissions generated by specific aspects of water treatment and supply systems are provided in the following sections.

3.10.2 Potable Water Source Supply and Conveyance

Most of the water supply in San Francisco is supplied by the Hetch Hetchy system. Supply and conveyance of water from the Hetch Hetchy system has minimal energy usage because it is delivered by gravity. Supplying and conveying water in CP-HPS Plan is estimated to have 0 tonnes of CO_2e emissions per year (see Tables 3-28 through 3-30).

3.10.3 Potable Water Treatment and Distribution

Treating and distributing potable water in CP-HPS Plan are estimated to account for 115 tonnes[94] and 103 tonnes[95] of CO_2e emissions per year, respectively. Variant 1 will be 115 and 146 tonnes of CO_2e emissions per year for treating and distributing potable water. Variant 2 will be 101 and 115 tonnes of CO_2e emissions per year for treating and distributing potable water. Based on the estimated potable water demand, these energy intensity factors, and the PG&E-carbon intensity factor adjusted for the Renewable Portfolio Standard, GHG emissions from potable water treatment and distribution were calculated as shown in Tables 3-28 through 3-30.

3.10.4 Wastewater Treatment

Emissions associated with wastewater treatment include indirect emissions necessary to power the treatment process and direct emissions from degradation of organic material in the

[94] Emission factor for water treatment is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand. California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.

[95] Emission factor for water distribution is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand. California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.

wastewater. Wastewater treatment indirect emissions in CP-HPS Plan are estimated to account for 268 tonnes of CO_2e emissions per year. Specifically, emissions are estimated to be 141 and 127[96] tonnes of CO_2e emissions per year for CP and HPS, respectively. Variant 1 wastewater treatment indirect emissions are estimated to account for 319 tonnes of CO_2e per year. Variant 2 wastewater treatment indirect emissions are estimated to account for 264 tonnes CO_2e emissions per year. Wastewater treatment direct emissions in CP-HPS Plan are estimated to account for zero tonnes of CO_2e emissions per year since all methane emissions from the wastewater at the Southeast Wastewater Treatment Plant is burned at the flare station or cogeneration plant and non methane emissions are directly emitted from the wastewater as directed by the plant's air permit.

Indirect GHG emissions from the electricity necessary to power the wastewater treatment process were calculated for CP-HPS Plan. Wastewater in San Francisco is handled by the Southeast Pollution Control Plant. The electricity required to operate wastewater treatment plant is estimated to be 1,688 kW-hr per AF[96]. Based on the expected amount of wastewater requiring treatment[97], this energy intensity factor and the PG&E carbon-intensity factor adjusted to account for the Renewable Portfolio Standard, indirect emissions due to wastewater treatment were calculated as shown in Tables 3-28 through 3-30.

Direct emissions from wastewater treatment include emissions of CH_4 and N_2O. All direct methane emissions from the Southeast Pollution Control Plant are burned either at the flare station or cogeneration plant. Therefore, there will be no direct emissions from the wastewater treatment plant.

Variant 1 is expected to have a water demand of 1.11 mgd at HPS. Table 3-29 shows the CO_2 emissions associated with Variant 1. Variant 2 is expected to have a water demand of 0.77 mgd at CP and 0.88 mgd at HPS. Table 3-30 shows the CO_2 emissions associated with Variant 2.

3.10.5 Public Lighting

Lighting sources contribute to GHG emissions indirectly, via the production of the electricity that powers these lights. Lighting sources considered in this source category include streetlights, traffic signals, area lighting for parks and lots, and lighting in public buildings. The emission factor for public lighting is shown in Tables 3-28 through 3-30. Data from a report by the City of Duluth shows that the amount of electricity demanded for all types of public lighting is 149 kW-hr per capita per year.[98] Lennar Urban has committed to using energy efficient street lighting in

[96] Emission factor for wastewater treatment are from the energy requirements for the Southeast Pollution Control Center provided in a Request for Proposals. This information was provided in "SFPUC Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101". All of the direct methane emissions from the wastewater treatment plant are burned at the flare station or cogenerations plant.

[97] Assumed 91% of the water treated is to be reclaimed.

[98] Skoog., C. 2001. This factor was calculated by summing the total electricity needs for municipal uses and dividing by the Duluth population. The Duluth population was calculated by dividing the city's reported GHG emissions by its reported per capita emissions.

CP-HPS Plan. This will reduce street lighting electricity demand by 16%[99]. Using this study, the PG&E-specific carbon-intensity emission factor adjusted for 20% RPS and the expected CP-HPS Plan population of 23,869, emissions from public lighting were calculated.[100] Thus, the CP-HPS Plan-specific emission factor for public lighting would be 0.037 tonnes CO_2e per capita per year. Public lighting emissions in CP-HPS Plan are estimated to account for 878 tonnes CO_2 per year. This is the same for Variant 1 and Variant 2 since the total population will be the same. This number is likely a conservative estimate since CP-HPS Plan is a master-planned compact community may require a lower number of lights than the City of Duluth.

3.10.6 Municipal Vehicles

GHG emissions from municipal vehicles are due to direct emissions from the burning of fossil fuels. Municipal vehicles considered in this source category include vehicles such as police cars, fire trucks, and garbage trucks. The emission factor for municipal vehicles is shown in Tables 3-28 through 3-30. Data from reports by Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, California[101] show that the CO_2 emissions from municipal vehicles would be approximately[102] 0.05 tonnes per capita per year. Using these studies and the expected CP-HPS Plan population of 23,869, emissions from municipal vehicles in CP-HPS Plan were calculated. Municipal vehicle emissions in CP-HPS Plan are estimated to account for 1,194 tonnes CO_2e per year. This is the same for Variant 1 and Variant 2 since the total population will be the same.

In total, all municipal sources including water, wastewater, public lighting and municipal vehicles for CP-HPS Plan is expected to produce 2,559 tonnes of CO_2e annually. Variant 1 is expected to produce 2,653 tonnes of CO_2e annually. Variant 2 is expected to produce 2,553 tonnes of CO_2e annually.

3.11 Area Sources

Area sources emissions stem from hearths (including gas fireplaces, wood-burning fireplaces, and wood-burning stoves) and small mobile fuel combustion sources such as lawnmowers. Fuel combustion associated with these sources produce direct GHG emissions. Since all of the housing units are multi-family, URBEMIS does not estimate a significant amount of emissions from lawn maintenance equipment and these have not been quantified. Since emissions from natural gas-fired stoves and natural gas heating are already included in the residential

[99] The resultant energy savings is calculated from the annual energy costs found on page 4 of NYSERDA's 2002 How-to Guide to Effective Energy-Efficient Street Lighting.

[100] Population estimate provided by Lennar Urban.

[101] City of Medford. 2001. Climate Action Plan. October. http://www.massclimateaction.org/pdf/MedfordPlan2001.pdf
City of Northampton. 2006. Greenhouse Gas Emissions Inventory. Cities for Climate Protection Campaign. June. http://www.northamptonma.gov/uploads/listWidget/3208/NorthamptonInventoryClimateProtection.pdf
City of Santa Rosa. Cities for Climate Protection: Santa Rosa. http://ci.santa-rosa.ca.us/City_Hall/City_Manager/CCPFinalReport.pdf
Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives. October.http://www.ci.duluth.mn.us/city/information/ccp/GHGEmissions.pdf

[102] In an effort to be conservative, the largest per capita number from these four reports was used.

sources[103], calculations based on the URBEMIS method for the remaining types of area sources, natural gas fireplaces was performed.

CP-HPS Plan will have natural gas fireplaces in 10% of its net new residential units based on estimates from Lennar Urban. Wood-burning stoves or fireplaces are prohibited. Direct GHG emissions from these sources were estimated by multiplying the energy use per year by the CO_2 emission factor for natural gas combustion. Annual energy use was determined by the number of fireplaces, the average energy use of each fireplace, and the URBEMIS default fireplace usage rate value of 200 hours/year. In the absence of site-specific energy use values for fireplaces at CP-HPS Plan, the URBEMIS default values of 20,000 BTU/hour/fireplace for multi-family residences was used. Table 3-31 shows an estimated 217 tonnes CO_2 will be generated annually by fuel combustion in natural-gas fireplaces. Variant 2 will have the same total emissions as CP-HPS Plan, but will be distributed in CP and HPS differently as shown in Table 3-32.

3.12 Emissions from Solid Waste Disposal

The residents and non-residential uses at the development will generate waste. A large percentage of this waste will be diverted from landfills either by waste generation reduction, recycling, and composting. San Francisco currently diverts a large portion of its waste generated and has goals to even further reduce the amount of waste sent to a landfill. The remainder of the waste not diverted will be disposed of at a landfill. Landfills emit GHG emissions associated with the anaerobic breakdown of material. The waste disposal rates for the various land uses at the development were estimated based on values reported by the Center for Integrated Waste Management Board (CIWMB)[104]. If no waste disposal rates could be found, waste generation rates for that land use were used. These are likely over-estimates since they do not account for the waste that would be diverted from a landfill. The waste disposal rates were multiplied by the non-biogenic emissions associated with the Altamount Landfill in 2005 which is 0.00674 tonnes of CO_2e emissions per metric ton of waste per year[105]. Tables 3-33 through 3-35 detail the calculation of GHG emissions associated with the waste disposal for CP-HPS Plan, Variant 1 and Variant 2 respectively. The total GHG emissions are anticipated to be 907, 1,038, and 1,038 tonnes CO_2e per year for CP-HPS Plan, Variant 1, and Variant 2 respectively. These estimates are likely conservative given the fact that future residents will be more conscious of waste and the aggressive goals for waste reduction in San Francisco. In addition, this estimate does not account for the carbon sequestration that will occur as a result of disposal of carbon in the landfill that will not degrade.

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[104] CIWMB. 1999 Statewide Waste Characterization Study: Results and Final Report. 340-00-009. Available at http://www.ciwmb.ca.gov/wastechar/Redisp.htm

CIWMB. 2007. Estimated Solid Waste Generation Rates for Industrial Establishments. Available at http://www.ciwmb.ca.gov/WasteChar/wasteGenRates/Industrial.htm

CIWMB. 2006. Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups. 341-06-006. Available at http://www.ciwmb.ca.gov/WasteChar/WasteStudies.htm#2006Industry

[105] Based on information provided by BAAQMD.

3.13 Emissions Sources Not Quantified in Inventory

Several emissions sources were not quantified in this inventory, due to their estimated relatively small[106] contribution to GHG emissions. These sources include emissions from recreational sources and refrigeration leaks which are described in more detail below[107].

3.13.1 Pools and Recreation Centers

The CP-HPS Plan Specific Plan includes neighborhood community areas and parks which may also include pools and recreation centers. At the entitlement stage of development, the degree of uncertainty in the potential end-uses of these recreational areas make a meaningful quantification of GHG emissions difficult. As a result of this uncertainty, ENVIRON did not quantify these emissions at this time.

3.13.2 Refrigeration Leaks

Emissions associated with leaks of high global warming potential gases such as from refrigeration leaks were not quantified. At the entitlement stage of development, the degree of uncertainty in the potential facilities with sources that may have refrigeration leaks make a meaningful quantification of GHG emissions difficult. In addition, since refrigeration systems will be new, they are likely efficient and should be designed to reduce the amount of leaks of high global warming potential gases. As a result of this uncertainty and likely small level of emissions, ENVIRON did not quantify these emissions at this time.

3.14 Project Design Features that Reduce GHG Emissions

The CP-HPS Plan development incorporates many design features to reduce GHG emissions. This section describes the design features that were incorporated into this analysis either directly or indirectly. This section also lists those features that were not quantified in this analysis, but would likely yield further GHG emissions reductions.

3.14.1 Project Design Features whose Emissions Reductions were Incorporated into the Analysis

3.14.1.1 Reductions in emissions from mobile sources

- Provide neighborhood serving retail.
- Provide automobile, public transportation, and pedestrian connections between the Shipyard, Candlestick Point and the larger Bayview neighborhood.
- The Urban Design Plan used at CP-HPS Plan will reduce its footprint and allow for transportation and open space corridors.
- Integrating land use patterns with multimodal street networks that would facilitate walking and cycling for internal trips and transit for trips of greater distance.
- Extend existing Muni routes to better serve the CP-HPS Plan area; increase frequencies on existing routes to provide more capacity; and complement those existing routes with

[106] Typically less than 1% of the overall inventory based upon previous studies.
[107] Black carbon was also not considered. Major sources of black carbon emissions are not present at CP-HPS Plan.

new transit facilities and routes that would serve the CP-HPS Plan's proposed land use program and transit demand.

3.14.1.2 Vegetation preservation

- The project is a redevelopment project and will not result in the conversion of any new land to settlement.
- Up to 10,000 trees new trees will be planted at CP-HPS Plan.

3.14.1.3 Energy Savings

- Homes and businesses will exceed the 2008 Standards for Title 24 Part 6 energy efficiency standards by at least 15%.
- Where appliances are offered by homebuilders, Energy Star appliances will be installed.
- Energy efficient street lighting will be used.

3.14.2 Project Design Features whose Emissions Reductions were not Incorporated into the Analysis but would yield further GHG emissions savings

While these project design features have not been quantified as part of this GHG emissions inventory, they are part of CP-HPS Plan and will likely result in further GHG emission reductions.

3.14.2.1 Reductions in emissions from mobile sources

- Transportation Demand Management Plan to reduce the auto use and encourage residents, employees and visitors to use alternative modes of travel, such as transit, walking, and bicycling.

3.14.2.2 Energy Savings

- The energy savings resulting from the replacement of 256 older homes with new more energy efficient homes.

3.14.2.3 Water Conservation

- The CP-HPS Plan would provide a network of reclaimed-water mains for dual plumbing in commercial buildings and for irrigation of landscaped areas. Reclaimed water mains would distribute reclaimed water with a source expected to be developed by the City.

3.15 Summary of Emissions from CP-HPS Plan

Emissions from the various aspects of CP-HPS Plan are presented in Table 3-36. One-time vegetation emissions are estimated to be -7,000 tonnes CO_2. One-time construction emissions are estimated to be 105,587 tonnes CO_2e. Emissions from residential buildings are estimated to be 25,677 tonnes CO_2e per year, or 17% of the annual project emissions. Emissions from non-residential buildings are estimated to be 18,028 tonnes CO_2e per year, or 12% of the annual project emissions. Emissions from mobile sources are estimated to be 105,520 tonnes CO_2e per year, or 69% of the annual project emissions. Emissions from municipal sources (water distribution, public lighting, and municipal vehicles) are estimated to be 2,559 tonnes CO_2e per year, or 2% of the annual project emissions. Emissions from area sources (fireplaces) are estimated to be 217 tonnes CO_2e per year, or less than 0.2% of the annual project emissions. Emissions from the additional transit services are estimated to be 1,730 tonnes CO_2e per year, or less than 1% of the annual project emissions. Emissions from waste disposal at landfills are estimated to be 907 tonnes CO_2e per year, or 1% of the annual project emissions.

Also noted in Table 3-36 is whether the emissions are attributable to a one-time action or are anticipated to occur on an annual basis, during each year after the full build-out of the development. The only one-time emissions are associated with construction and land use change emissions. There are 98,587 tonnes of CO_2e one-time emissions. The annual emissions from the use of the development amount to 154,639 tonnes. Of this, 68% result from vehicular emissions associated with residential activities. Approximately 29% result from the energy use associated with residential and non-residential buildings. If the one-time emissions are annualized assuming a 40-year development life (which is likely low) then the one-time emissions account for approximately 2,465 tonnes, or 2% of the annual emissions. Taking these one-time emissions into account, the annual emissions are 157,104 tonnes per year.

Emissions from the CP-HPS Plan using the alternative method for estimating mobile source is shown in Table 3-37. The annual emissions from the use of the development amount to 96,168 tonnes. Taking one-time emissions into account, the annual emissions are 98,633 tonnes per year.

Emissions from the various aspects of Variant 1 are presented in Table 3-38. Both the one-time emissions and emissions that are expected to occur each year after build-out of the CP-HPS Plan development are presented. There are 98,587 tonnes of CO_2e one-time emissions. The annual emissions from the use of the development amount to 178,651 tonnes CO_2e/year. Of the annual emissions, slightly more than 67% result from vehicular emissions associated with residential activities, and 29% result from the energy use associated with residential and non-residential buildings. If the one-time emissions are annualized assuming a 40-year development life (which is likely low), then the one-time emissions account for approximately 2,465 tonnes, or 2% of the annual emissions. Taking these annualized one-time emissions into account, the annual emissions are 181,115 tonnes/year.

Emissions from Variant 1 using the alternative method for estimating mobile source is shown in Table 3-39. The annual emissions from the use of the development amount to 106,619 tonnes. Taking one-time emissions into account, the annual emissions are 109,084 tonnes per year.

Emissions from the various aspects of Variant 2 are presented in Table 3-40. Both the one-time emissions and emissions that are expected to occur each year after build-out of the CP-HPS Plan development are presented. There are 98,587 tonnes of CO_2e one-time emissions. The annual emissions from the use of the development amount to 157,509 tonnes CO_2e/year. Of the annual emissions, slightly less than 70% result from vehicular emissions associated with residential activities, and 26% result from the energy use associated with residential and non-residential buildings. If the one-time emissions are annualized assuming a 40-year development life (which is likely low), then the one-time emissions account for approximately

2,465 tonnes, or 2% of the annual emissions. Taking these annualized one-time emissions into account, the annual emissions are 159,974 tonnes/year.

Emissions from Variant 1 using the alternative method for estimating mobile source is shown in Table 3-41. The annual emissions from the use of the development amount to 94,789 tonnes. Taking one-time emissions into account, the annual emissions are 97,254 tonnes per year.

It is important to note that these emissions are estimated assuming that the carbon intensity of the electricity supply system and transportation system do not in the future change beyond that which is required by enacted legislation. This assumption is clearly incorrect, as AB 32 and other legislative and regulatory mandates will result in GHG emission reductions in both areas.

AB 32 requires that GHG emissions from California be reduced to 1990 levels by 2020. This represents a reduction of approximately 28.5% from projected 2020 growth. The goals of AB 32 are likely to be reached by increasing renewable or non-carbon producing electricity production, and changing the transportation system to rely on a set of increasingly lower carbon fuels. As most of the carbon footprint of CP-HPS Plan results from either transportation or electricity use, these carbon emissions are likely overestimated as a result of the implementation measures of AB 32. Section 4 puts CP-HPS Plan emissions in context and includes an analysis of the CP-HPS Plan compared to a ARB Scoping Plan No Action Taken (NAT) scenario following the regulations considered by ARB in adopting the 2020 No Action Taken scenario as part of the Scoping Plan for AB32.

Furthermore, Governor Schwarzenegger's Executive Order S-3-05 set a target to reduce GHG emissions by 2050 to levels 80% less than the 1990 levels. It is likely that future measures will be implemented to reach this goal that similarly may result in reductions of GHG emissions for sources in CP-HPS Plan beyond those stated in this report. This is further discussed in Section 5 of this report.

3.16 Life Cycle Emissions of Building Materials

An estimate of "life-cycle" GHG emissions (i.e., GHG emissions from the processes used to manufacture and transport materials used in the buildings and infrastructure) is presented in this section and attached as Appendix C. This estimate is to be used for comparison purposes only and is not included in the final inventory as these emissions would be attributable to other industry sectors under AB 32. For instance, the concrete industry is required by law to report emissions and undergo certain early action emission reduction measures under AB 32. Furthermore, for a life-cycle analysis for building materials, somewhat arbitrary boundaries must be drawn to define the processes considered in the life-cycle analysis.[108] Recognizing the uncertainties associated with a life-cycle analysis, the California Air Pollution Control Officers Association (CAPCOA) released a white paper which states: "The full life-cycle of GHG emissions from construction activities is not accounted for in the modeling tools available, and

[108] For instance, in the case of building materials, the boundary could include the energy to make the materials, the energy used to make the machine that made the materials, and the energy used to make the machine that made the machine that made the materials.

the information needed to characterize GHG emissions from manufacture, transport, and end-of-life of construction materials would be speculative at the CEQA analysis level.[109]"

The calculations and results discussed here and presented more fully in Appendix C are estimates and should be used only for a general comparison to the overall GHG emissions estimated in the Climate Change Technical Report. Life Cycle Assessment (LCA) emissions vary based on input assumptions and assessment boundaries (e.g., how far back to trace the origin of a material). Assumptions made in this report are generally conservative. However, due to the open-ended nature of LCAs, the analysis is highly uncertain.

Appendix C is an ENVIRON report that evaluates the life cycle GHG emissions associated with the building materials for this project. The life cycle GHG emissions include the embodied energy from the materials manufacture and the energy used to transport those materials to the site. The report then compares the life cycle GHG emissions to the overall annual operational emissions. The materials analyzed in the report include materials for 1) residential and non-residential buildings, and 2) site infrastructure. This report calculates the overall life cycle emissions from construction materials to be approximately 3,068 to 16,285 tonnes CO_2 / year. This represents 2 to 10% of the annualized GHG emissions from the CP-HPS Plan area.

The report estimated the life cycle GHG emissions for buildings by conducting an analysis of available literature on LCAs for buildings. According to these studies, approximately 75 - 97% of GHG emissions from buildings are associated with energy usage during the operational phase; the other 3 - 25% of the GHG emissions are due to material manufacture and transport. Using the GHG emissions from the operation of buildings, 3% to 25% of building emissions corresponds to approximately 0.9 - 9% of the project emissions.

The report calculated the life cycle GHG emissions for certain components of infrastructure (roads, storm drains, utilities, gas, electricity, and cable). This analysis considered the manufacture and transport of concrete only, as ENVIRON assumed that other construction materials such as steel would be present in much smaller quantities. The majority of the emissions for infrastructure result from the manufacture of concrete. If a 40 year lifespan of the infrastructure is assumed, the total annualized emissions from embodied energy in infrastructure materials are approximately 1.1% of the project emissions.

The overall life cycle emissions, annualized by 40 years, are 3,068 to 16,285 tonnes CO_2 / year, or 2 – 10% of the annualized GHG emissions from the CP-HPS project. The bulk of these emissions (0.9 - 10%) are from general life cycle analysis studies and do not reflect specific information from CP-HPS.

Again, note that the calculations and results presented in this life cycle report are estimates and should be used only for a general comparison to the overall GHG emissions estimated in the Climate Change Technical Report. LCA emissions vary based on input assumptions and assessment boundaries (e.g., how far back to trace the origin of a material). Assumptions made

[109] CAPCOA. 2008. CEQA & Climate Change: Evaluating and Addressing Greenhouse Gas Emissions from Projects Subject to the California Environmental Quality Act. Available online at: http://www.capcoa.org/ceqa/?docID=ceqa&PHPSESSID=df1348d6f7eff0fc2a8263d19f6d10dd

in this report are generally conservative. However, due to the open-ended nature of LCAs, and the fact that literature evaluation, not site specific studies were used to analyze the embodied energy, the analysis should be considered to yield highly uncertain results. Additionally, these estimates likely double count emissions from other industry sectors.

4 Inventory in Context

4.1 CP-HPS Plan Greenhouse Gas inventory in Context

The BAAQMD has published draft significance thresholds for GHG emissions applicable to development projects. However, at this time these standards and screening thresholds for residential/commercial projects are still under consideration. Accordingly, this section is intended to place the GHG emissions from the proposed residential development in context with respect to intensity, consistency with AB 32 goals, and magnitude. For the intensity comparison, we compare the built environment emissions with that from ARB Scoping Plan No Action Taken scenario comparison of standard energy use for buildings in California in the same climate zone. In addition, we compare anticipated mobile emissions to current San Francisco County mobile emissions and emissions savings from water usage in the development. For comparison with AB 32 goals, we compare the GHG emissions with the overall reductions levels mandated under AB 32. Finally, the emissions from CP-HPS Plan at build-out are compared to California and global GHG emissions in order to put CP-HPS Plan emissions in a global context.

4.2 Characterization of Emissions

In 2004, 81% of greenhouse gas emissions (in CO_2e) from California were comprised of CO_2 emissions from fossil fuel combustion, with 4% comprised of CO_2 from process emissions. CH_4 and N_2O accounted for 5.6% and 6.8% of total CO_2e respectively, and high GWP gases[110] accounted for 2.9% of the CO_2e emissions. Transportation is by far the largest end-use category of GHGs. Transportation includes that used for industry (i.e., shipping) as well as residential use.

4.3 Comparison with AB 32-mandated Emissions Limits

AB 32 requires that statewide GHG emission in 2020 be equal to 1990 levels. California-wide GHG emissions in 1990 were 0.427 billion tonnes.[111] It is projected that emissions in 2020 under a No Action Taken scenario accounting for growth will be 0.596 billion tonnes[112]. This would require a 28.5% decrease in emissions by 2020 to achieve AB 32 goals. The population in California is projected to be 42,210,000 in 2020. In order to achieve AB 32 mandated goals, the per capita emissions would have to be 10.1 tonnes CO_2e (see Table 4-1 for calculation details). This includes emissions from the agricultural and manufacturing sector, as well as industrial transportation, allocated on a per capita basis.

CP-HPS Plan has estimated emissions of 154,639 tonnes per year, or 6.5 tonnes per capita per year, 4.5 tonnes per service population per year, or 15.1 tonnes per dwelling unit.[113] Variant 1 has estimated emissions of 178,651 tonnes per year, or 7.5 tonnes per capita per year, 4.4 tonnes per service population per year, or 17.4 tonnes per dwelling unit. Variant 2 has estimated emissions of 157,509 tonnes per year, or 6.6 tonnes per capita per year, 4.6 tonnes per service population per year, or 15.3 tonnes per dwelling unit per year. The California per

[110] Such as HFCs and PFCs.
[111] http://www.arb.ca.gov/cc/inventory/1990level/1990level.htm. California Air Resources Board.
[112] http://www.arb.ca.gov/cc/inventory/data/forecast.htm#summary_forescast
[113] Based upon 23,869 residents and 10,373 jobs (this excludes the 357 jobs associated with the stadium since these are existing jobs). Variant 1 will have 16,638 jobs and Variant 2 will have 10,379 jobs.

capita CO_2 emissions includes industries such as heavy industry, refining, and transportation of materials while the CP-HPS Plan per capita CO_2 emissions do not include these emissions. AB 32 will be reducing emissions in a variety of different ways, including increasing energy efficiency and introducing more renewable energy sources. It is difficult to compare CP-HPS Plan per capita emissions to the AB 32 goals as it is not clear what fraction of the reduction will be achieved in which sectors, and what portion will be achieved from energy efficiency and what fraction will be achieved by renewable resources. This is discussed more fully below.

4.4 ARB Scoping Plan No Action Taken Comparison

In order to put the GHG emission inventory into context and justify an improvement heading towards meeting the reduction goals set for 2020, it is necessary to compare the GHG emission inventory expected for CP-HPS Plan to the GHG emissions that would occur from a community that would be built today without CP-HPS Plan design features and energy reduction commitments made by Lennar Urban. This baseline comparison is referred to as No Action Taken (NAT) which follows the regulations considered by ARB in developing its 2020 No Action Taken estimate as part of the Scoping Plan. This represents the GHG emission inventory if things were continued to be built according to current standards. The major categories of the GHG emission inventory are considered separately. These include residential and non-residential buildings, mobile sources, municipal lighting, and water sources. The remaining categories include municipal vehicles and area sources. These categories represent a small fraction of the total inventory and do not have appropriate emission factors to quantify the reductions that are likely to occur at CP-HPS Plan compared to NAT.

4.4.1 Vegetation

Lennar Urban has committed to planting 10,000 new trees. The NAT analysis for vegetation assumes that this commitment is not taken.

4.4.2 The Built Environment

The energy use and GHG emissions from the modeled homes for CP-HPS Plan were compared to the energy use and GHG emissions from minimally Title 24 compliant 2005 buildings using the current carbon intensity factor for electricity (no Renewable Portfolio Standard adjustment)[114]. It was also assumed that the comparison homes had standard appliances instead of Energy Star appliances. The same assumptions used to evaluate the energy use from the RASS survey is used for the NAT analysis. CP-HPS Plan is 24% better than the NAT home for energy use covered by Title 24. In addition, when major appliances are considered, the homes of CP-HPS Plan are 23% better than the NAT homes. When the rest of plug-in energy use is considered, CP-HPS Plan homes are 20% better than the NAT homes. These comparisons are summarized in Tables 3-11 and 3-12. It is important to recognize that areas in which the developer has control over the energy use, building envelope and major appliances, show an improvement over NAT. This comparison does not take into account that the energy use of occupants is expected to change as people become more conscious of energy use and climate change issues, and more sensitive to the cost of energy, and use less energy.

[114] The 2005 version of Title 24 is what was in effect at the time that ARB developed the Scoping Plan 2020 No Action Taken.

CO_2 emissions per dwelling unit for CP-HPS Plan homes are approximately 2.5 tonnes per dwelling unit per year. For the NAT housing, emissions are approximately 3.2 tonnes per dwelling unit per year. CP-HPS Plan homes, per dwelling unit, emit approximately 0.64 tonnes less CO_2 per year than the NAT housing.

Homes in CP-HPS Plan are 20% more energy efficient than the current NAT. As such, CP-HPS Plan residential units are heading toward meeting AB 32 goals on a per dwelling unit basis, without any decrease in GHG intensity from energy production beyond the 20% Renewable Portfolio Standard for 2010, which is likely to occur. It also does not account for changes in occupant behavior.

A similar comparison for non-residential buildings compares CP-HPS Plan non-residential buildings energy use and GHG emissions from a minimally 2005 Title 24 compliant building using the current carbon intensity factor for electricity (no Renewable Portfolio Standard adjustment). Unlike residential homes, the developer has little control over the appliances and plug-in energy use that will occur in the buildings.   When typical plug-in energy use is considered for the non-residential buildings, CP-HPS Plan is 18% better than NAT, Variant 1 is 17% better than NAT and Variant 2 is 17% better than NAT. This does not account for non-residential occupants using energy efficient appliances.

There are some uncertainties and limitations that need to be pointed out for the residential and non-residential building NAT comparison. ENVIRON used survey data of existing buildings to represent future building energy use. ENVIRON made an attempt to adjust the baseline energy use value for residential and non-residential buildings based upon CEC reports indicating improvements in Title 24 building codes. The existing building stock is likely less efficient than the requirements for new buildings under Title 24. To the extent that CP-HPS Plan's mix changes the calculated savings may differ.

4.4.3 Transportation

Consistent with one of the options in the OPR Guidance, this section discusses a comparison of project emissions with the goals of AB 32. Since the Stadium is replacing Candlestick Park, this is not considered to cause new trips from far away. If the Stadium is not built at HPS, it is assumed that a new Stadium will be built elsewhere in the Bay Area and it is unknown if the trips will be shorter or longer for attendees.

Vehicle emissions will be reduced in the future regardless of the development location, as the implementation of AB 32 will require improvements in vehicle mileage, increased use of public transit, and the incorporation of low-carbon fuels into the transportation fuel supply[115]. Transportation emissions presented here are based upon EMFAC2007 values, which are based upon past vehicle emission trends and do not incorporate the known regulatory actions as described above. In fact, on a VMT basis, EMFAC2007 assumes that CO_2 emissions in 2030 are slightly higher than they are currently. This is clearly unlikely, given the mandates of AB 32 and the likelihood of federal regulation.

[115] The Low Carbon Fuel Standard (LCFS) mandated under Governor Schwarzenegger's Executive Order S-01-07 and currently being developed by the California Air Resources Board (ARB) requires a reduction in carbon intensity of California's transportation fuels by at least 10% by 2020.

ENVIRON estimated the trip rate for a NAT scenario assuming that the number of trips made assuming none of the trips use alternative transportation or internal to the project site development due to the transit, pedestrian and bicycle pathways and mixed of uses. These modified trip rates were applied to the same methodology outlined for the traffic calculations including the weekend trip rate adjustment. The same number of trips to the music venue was assumed for the NAT scenario. Table 4-2 shows a total VMT for the NAT scenario as 516,667,601 miles per year. The emission factor uses the EMFAC2007 value for 2020 with no adjustments. The NAT scenario would release 258,330 tonnes of CO_2e per year. CP-HPS Plan represents a 59% reduction in VMT and CO_2e emissions per year compared to NAT. Table 4-3 shows the calculations for Variant 1 which estimates a release of 277,459 tonnes of CO_2e per year. Table 4-4 shows the calculations for Variant 2 which estimates a release of 257,568 tonnes per CO_2e per year.

4.4.4 Water and Wastewater

The NAT comparison for water and wastewater treatment and distribution was based on a the same water usage as the CP-HPS Plan due to the incorporation of San Francisco Green Building Ordinance. Tables 4-5 through 4-7 show the calculations for the NAT scenario. A report by the Consortium for Energy Efficiency (CEE) estimates that 15 to 30% of water energy use savings will come as a result of water use efficiency improvements.

4.4.5 Public Lighting

The NAt comparison for public lighting assumes that energy efficient street lights will not be used. Tables 4-5 through 4-7 shows the CO_2e emissions for public lighting for the NAT scenario as 1,023 tonnes CO_2e per year. Table 4-5 through 4-7 shows CP-HPS Plan's public lighting is 14% less than NAT.

Overall for the municipal category CP-HPS Plan is 7% better than NAT. Variant 1 is 7% and Variant 2 is 7%.

4.4.6 Transit Service

The NAT comparison of transit service assumes that the project will use regular diesel buses and diesel fuel. The estimate of emissions for the NAT scenario is shown in Table 3-23. The NAT transit service emissions are 2,884 tonnes CO_2e per year. CP-HPS Plan is 40% better than NAT transit service emissions.

Tables 4-8 through 4-10 summarize the comparisons between CP-HPS Plan, Variant 1, Variant 2 and the NAT scenarios discussed in this section. When all emissions, including those where a NAT analysis was not able to be performed are considered, CP-HPS Plan shows a 51% improvement over NAT. Variant 1 shows a 49% improvement over NAT. Variant 2 shows a 50% improvement over NAT. Further discussions on how these emissions will be reduced based on current and future regulations not considered under the NAT scenario are discussed in Section 5. These regulations are likely to allow CP-HPS Plan to achieve its share in meeting AB 32 goals and head to the further emission reduction goals of Executive Order S-03-05.

4.5 Comparison with State, Global, and Worldwide GHG Emissions

The emissions from CP-HPS Plan at build-out are compared to California and global GHG emissions to put the emissions from CP-HPS Plan in context. CP-HPS Plan's annual emissions are approximately 154,639 metric tonnes CO_2e per year, and 98,587 tonnes of one-time emissions. If the one-time emissions are annualized by a development lifetime of 40 years (2,465 tonnes CO_2e per year), the overall yearly emissions are approximately 157,104 tonnes CO_2e per year. This is equivalent to approximately 6.5 tonnes per capita per year.[116]

Worldwide emissions of GHGs in 2004 were 26.8 billion tonnes of CO_2e per year.[117] In 2004, the US emitted about 7 billion tonnes of CO_2e.[118] Over 80% of the GHG emissions in the US are comprised of CO_2 emissions from energy related fossil fuel combustion. In 2004, California emitted 0.480 billion tonnes of CO_2e, or about 7% of the US emissions. 157,104 tonnes of CO_2e per year from CP-HPS Plan would be approximately 0.00058% of the world wide emissions, 0.0022% of the United State's emissions, or 0.032% of California's annual GHG emissions.

[116] Assuming a CP-HPS Plan population of 23,869.
[117] Sum of Annex I and Annex II countries without counting Land-Use, Land-Use Change and Forestry (LULUCF) http://unfccc.int/ghg_emissions_data/predefined_queries/items/3814.php For countries that 2004 data was unavailable, the most recent year was used.
[118] 2006 Inventory of U.S. Greenhouse Gas Emissions and Sinks. Available online at: http://yosemite.epa.gov/oar/globalwarming.nsf/UniqueKeyLookup/RAMR6MBLP4/$File/06ES.pdf

5 Impact of Regulatory Developments on CP-HPS Plan's GHG Inventory

There are a number of regulatory developments on both the federal and state level that will impact GHG emissions at CP-HPS Plan. For example, the Pavley Standards, and the Energy Independence and Security Act of 2007 all affect vehicle emissions, and because this is enacted legislation, these were incorporated into the estimated emissions from the CP-HPS Plan.

Executive order S-03-05 mandates that California emit 80% less GHGs in 2050 than it emitted in 1990. As of 2004, California was emitting 12% more GHG emissions than in 1990. For California to emit 80% less than it emitted in 1990, the emissions would be only 18% of the 2004 emissions. Accounting for a population growth from 35,840,000 people in 2004 to approximately 55,000,000 people in 2050, the emissions per capita would have to be only 12% of what they were in 2004. This means 88% reductions in per capita GHG emissions from today's emissions intensities must be realized in order to achieve California's 2050 GHG goals. Clearly, energy efficiency and reduced vehicle miles traveled will play important roles in achieving this aggressive goal, but the decarbonization of fuel will also be necessary.

The extent to which GHG emissions from traffic at CP-HPS Plan will change in the future depends on the quantity (e.g. number of vehicles, average daily mileage) and quality (i.e. carbon content) of fuel that will be available and required to meet both regulatory standards and residents' needs. As discussed above, renewable power requirements, the low carbon fuel standard, and vehicle emissions standards will all decrease GHG emissions per unit of energy delivered or per vehicle mile traveled. In this section we discuss the impact that future regulated fuel decarbonization may have on vehicular emissions at CP-HPS Plan.

The California Energy Commission (CEC) published "State Alternative Fuels Plan"[119] in which it noted the existence of "challenging but plausible ways to meet 2050 [transportation] goals." The main finding from this analysis is that reducing today's average per capita driving miles by about 5 percent (or back to 1990 levels), in addition to the decarbonization strategies listed below, would achieve S-03-05 goals of 80% below 1990 levels. The approach described below is directly[120] from the CEC report.

An 80 percent reduction in GHG emissions associated with personal transportation can be achieved even though population grows to 55 million, an increase of 50 percent. The following set of measures could be combined to produce this result:

1. Lowering the energy needed for personal transportation by tripling the energy efficiency of on-road vehicles in 2050 with:

    a. Conventional gas, diesel, and flexible fuel vehicles (FFVs) averaging more than 40 miles per gallon (mpg).

[119] State Alternative Fuels Plan. December 2007 CEC-600-2007-011-CMF. Available online at: http://www.energy.ca.gov/2007publications/CEC-600-2007-011/CEC-600-2007-011-CMF.PDF
[120] Ibid. Page 67 and 68.

b. Hybrid gas, diesel, and FFVs averaging almost 60 mpg.

c. All electric and plug-in hybrid electric vehicles (PHEVs) averaging well over 100 mpg (on a greenhouse gas equivalents (GGE) basis) on the electricity cycle.

d. Fuel cell vehicles (FCVs) averaging over 80 mpg (on a GGE basis).

2. Moderating growth in per capita driving, reducing today's average per capita driving miles by about 5 percent or back to 1990 levels.

3. Changing the energy sources for transportation fuels from the current 96 percent petroleum-based to approximately:

   a. 30 percent from gasoline and diesel from traditional petroleum sources or lower GHG emission fossil fuels such as natural gas.

   b. 30 percent from transportation biofuels.

   c. 40 percent from a mix of electricity and hydrogen.

4. Producing transportation biofuels, electricity, and hydrogen from renewable or very low carbon-emitting technologies that result in, on average, at least 80 percent lower life cycle GHG emissions than conventional fuels.

5. Encouraging more efficient land uses and greater use of mass transit, public transportation, and other means of moving goods and people.

The measures described above are the types of measures that will yield required reductions. Although these types of measures are expected to occur and are consistent with the CP-HPS Plan development plan, CP-HPS Plan is not claiming any credit for these measures.

5.1 Renewable Power Requirements

A major component of California's Renewable Energy Program is the Renewables Portfolio Standard (RPS) established under Senate Bills 1078 (Sher) and 107 (Simitian). Under the RPS, certain retail sellers of electricity are required to increase the amount of renewable energy each year by at least 1% until 20% by December 31, 2010. Executive Order S-14-08 sets an even higher goal of 33% by 2020. Renewable sources of electricity include wind, small hydropower, solar, geothermal, biomass, and biogas. The increase in renewable sources for electricity production will decrease indirect GHG emissions from CP-HPS Plan because electricity production from renewable sources is generally considered "carbon neutral."[121] For purposes of this semi-quantitative analysis, ENVIRON assumes that the production of electricity from these renewable sources does not produce any net emissions of CO_2.

[121] There is some debate on the carbon neutrality of using biomass and biogas for electricity production. While some may argue that the carbon released as CO_2 from biomass or biogas combustion originated from the atmosphere and thus does not contribute any net additional carbon to the atmosphere, others argue that the combustion still releases CO_2 into the atmosphere and thus cannot be ignored. For sake of the semi-quantitative analysis presented here, we assume that electricity production from renewable sources is carbon neutral. However, this should not be interpreted as a policy judgment for either argument.

The utility provider for the CP-HPS Plan development is assumed to be PG&E as the CP-HPS Plan Specific Plan is situated largely in San Francisco County. As shown in Table 5-1, 11% of the energy delivered by PG&E was procured from renewable sources in 2007.[122] Total electricity delivery for that year was 79,450,904 megawatt-hours (MWh). Based on PG&E's 2007 Power/Utility Protocol (PUP) Report to the CCAR[123], their CO_2 emissions per total power delivered was 636 lbs CO_2/MWh. Considering the total amount of energy delivered and the percentage of energy from renewables, ENVIRON estimated that once the 20% renewables target for 2010 was achieved, that CO_2 emission factor would decrease to 574 lbs CO_2/MWh. In addition, if the proposed 33% renewables target for 2020 was achieved, the CO_2 emission factor would decrease even further to 481 lbs CO_2/MWh. These represent indirect GHG emissions reductions by approximately 10% and 24%, respectively.

5.2 Low Carbon Fuel Standard (LCFS)

As mentioned previously, the LCFS requires a reduction in carbon intensity of transportation fuels by at least 10% by 2020. The LCFS encompasses the life cycle emissions for fuels (i.e., "well-to-wheel"). Thus, not only does it include the vehicle tailpipe emissions from the use of the fuel, it also includes all the energy used to produce, process, and transport the fuel. By design, the implementation of the LCFS would decrease the overall GHG emissions for California. However, its impact on vehicle tailpipe emissions is not obvious. As the CP-HPS Plan GHG inventory only considers the vehicle tailpipe emissions, and not the life cycle emissions for transportation, it is difficult to quantitatively assess the impacts of the LCFS on the inventory. The LCFS will directly affect the emission factor and the fuel economy since alternate fuels will have various energy/carbon content. Fuels identified as possible alternatives to conventional gasoline and diesel include biodiesel, ethanol E85, and compressed natural gas (CNG). According to a study by TIAX, LLC, well-to-wheel GHG emissions for E85 derived from Midwest corn feedstock and CNG from North America would be expected to be roughly 22% and 30% lower relative to reformulated gasoline.[124]

Table 5-2 presents a few scenarios to illustrate the impact of LCFS on tailpipe emissions at CP-HPS Plan. The baseline scenario represents the current vehicle miles traveled at CP-HPS Plan. Total annual vehicle miles travelled (VMT) is 309,166,932 miles per year for this scenario we will assume a fleet distribution of 95% gasoline vehicles and 5% diesel vehicles and a fleet average emission factor. The GHG inventory for vehicle tailpipe emissions in this scenario is approximately 56,881 metric tonnes CO_2 per year.[125] The GHG emissions depend on the emission factors for each fuel (kg CO_2/gallon of fuel), average fuel economy (miles per gallon), and the VMT.[126]

[122] The renewable energy distribution is based on 2007 data available at: http://www.pgecorp.com/corp_responsibility/reports/2007/environment/energy-future.html
[123] Available at: http://www.climateregistry.org./CarrotDocs/
[124] California Energy Commission (CEC) and California Air Resources Board (ARB). 2007. State Alternative Fuels Plan. Commission Report. CEC-600-2007-011-CMF. December.
[125] This figure only includes CO_2 and not CO_2e and does not include start-up emissions for purposes of comparison to this analysis.
[126] The emissions estimated in Table 5-2 here are derived differently compared to emissions calculated from the EMFAC model runs for the CP-HPS Plan inventory; the estimated emissions for the baseline scenario are roughly within 10% of the vehicle emissions developed using EMFAC. This difference is likely due to improvements in vehicle technology estimated for 2011. However, for purposes of this semi-quantitative analysis, this should be

Scenario A represents a replacement of conventional California diesel with biodiesel. While the emission factor for biodiesel is lower (9.52 kg CO_2/gal) compared to conventional California diesel (9.96 kg CO_2/gal), the average fuel economy of vehicles running on California diesel is higher (7.9 mpg) than for vehicles running on biodiesel (7.1 mpg).[127,128] The result is that the overall tailpipe vehicle emissions at CP-HPS Plan would increase slightly if California diesel were replaced by biodiesel. This is a case where the overall life cycle analysis GHG emissions for biodiesel are lower than that for conventional California diesel, but the actual tailpipe emissions would be slightly higher.

Scenario B represents a replacement of conventional California gasoline with an 85% ethanol blend (E85). Compared to conventional California gasoline, E85 has a lower emission factor on a per gallon basis (6.10 kg CO_2/gal)[129] but also a lower fuel economy (15.2 mpg)[130] due to the lower energy content of E85. The resulting tailpipe emissions at CP-HPS Plan in this scenario would be roughly 7.2% lower than the baseline scenario. In this case the decreased fuel economy for E85 vehicles was more than offset by the lower emission factor, resulting in lower tailpipe emissions.

Scenario C represents a replacement of conventional California gasoline with compressed natural gas (CNG). Compared to conventional California gasoline, CNG has a lower emission factor on a per equivalent gallon basis (6.86 kg CO_2/equivalent gallon).[131] The current commercially available car running on CNG has a higher fuel economy (28 mpg)[132] than that for the average gasoline vehicle. The resulting tailpipe emissions at CP-HPS Plan in this scenario would be over 53% lower than the baseline scenario. In this case, the increased fuel economy for CNG and the lower emission factor both contribute to the lower tailpipe emissions.

These scenarios illustrate that the alternative fuels available in the future can have different effects on vehicle tailpipe emissions which is accounted for in the CP-HPS Plan GHG inventory. The degree of impact on the CP-HPS Plan's GHG inventory can be slight to moderate depending on the fuel mix available. The semi-quantitative analysis presented here is only speculative. As a first-order assumption, this analysis does not account for improvements in vehicle technology (i.e., emission factors and fuel economy are constant) or changes in VMT for CP-HPS Plan's population. In reality, vehicle technologies are likely to improve and VMT will

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acceptable since the emissions presented in this table are only for comparative purposes and are not meant to represent actual emissions at CP-HPS Plan.

127 Emission factors for fuels were from the California Climate Action Registry (CCAR) General Reporting Protocol (GRP) Version 3.1 (2009)

128 Average fuel economy data for biodiesel from the Department of Energy website: http://www.fueleconomy.gov/feg/biodiesel.shtml
Average fuel economy data for diesel-fueled vehicles obtained from fuel usage and VMT projections for 2008 from the California Department of Transportation report "California Motor Vehicle Stock, Travel, and Fuel Forecast" available at: http://www.dot.ca.gov/hq/tsip/smb/documents/mvstaff/mvstaff05.pdf

129 Emission factors for fuels were from the California Climate Action Registry (CCAR) General Reporting Protocol (GRP) Version 3.1 (2009)

130 Average fuel economy data for E85 from the Department of Energy website: http://www.fueleconomy.gov/feg/ethanol.shtml

131 Emission factors for fuels were from the California Climate Action Registry (CCAR) General Reporting Protocol (GRP) Version 3.1 (2009)

132 Fuel economy for a 2008 Honda Civic fueled by CNG available at: http://www.fueleconomy.gov/feg/byfueltype.htm

increase as CP-HPS Plan's population increases. Nevertheless, the LCFS, by definition, should result in lower overall GHG emissions in California. However, these emission reductions are not reflected in CP-HPS Plan's GHG inventory.

6 Conclusion

ENVIRON prepared an emissions inventory for the CP-HPS Plan development and the two project Variants. This emissions inventory was prepared consistent with the methodologies established by the CCAR where possible. The CP-HPS Plan emissions inventory considers nine categories of GHG emissions: emissions due to vegetation changes, emissions from construction activities, residential emissions, commercial building emissions, mobile source emissions, municipal emissions, area source emissions, transit service emissions, and waste disposal emissions. Emission from recreation centers were not calculated since they are a small fraction of the overall inventory. The emissions from construction and land use change would be one-time emissions events, while the other emissions would occur annually, throughout the life of CP-HPS Plan. An assessment of the impact of rules to reduce GHG intensity in electricity production and vehicle use was also included.

A variety of methods were employed to develop the GHG emissions inventory. In addition to well established emission factors for certain activities and emission estimates based on similar activities in other representative communities, several different estimation software were used. These included EMFAC, OFFROAD, and URBEMIS.

Emissions from the various components of the CP-HPS Plan development are presented in Tables 3-36. There are 98,587 tonnes of CO_2e one-time emissions. The annual emissions from the use of the development amount to 154,639 tonnes CO_2e/year. Of the annual emissions, slightly more than 68% result from vehicular emissions associated with residential activities, and 29% result from the energy use associated with residential and non-residential buildings. If the one-time emissions are annualized assuming a 40-year development life (which is likely low), then the one-time emissions account for approximately 2,465 tonnes, or 2% of the annual emissions. Taking these annualized one-time emissions into account, the annual emissions are 157,104 tonnes/year. As discussed below, these figures reflect conservative assumptions that likely overstate the GHG emissions that would result from this project.

Emissions from the various aspects of Variant 1 are presented in Table 3-38. Both the one-time emissions and emissions that are expected to occur each year after build-out of the CP-HPS Plan development are presented. There are 98,587 tonnes of CO_2e one-time emissions. The annual emissions from the use of the development amount to 178,651 tonnes CO_2e/year. Of the annual emissions, slightly more than 67% result from vehicular emissions associated with residential activities, and 29% result from the energy use associated with residential and non-residential buildings. If the one-time emissions are annualized assuming a 40-year development life (which is likely low), then the one-time emissions account for approximately 2,465 tonnes, or 2% of the annual emissions. Taking these annualized one-time emissions into account, the annual emissions are 181,115 tonnes/year. As discussed below, these figures reflect conservative assumptions that likely overstate the GHG emissions that would result from this project.

Emissions from the various aspects of Variant 2 are presented in Table 3-40. Both the one-time emissions and emissions that are expected to occur each year after build-out of the CP-HPS Plan development are presented. There are 98,587 tonnes of CO_2e one-time emissions. The annual emissions from the use of the development amount to 157,509 tonnes CO_2e/year. Of the annual emissions, slightly more than 70% result from vehicular emissions associated with residential activities, and 26% result from the energy use associated with residential and non-residential buildings. If the one-time emissions are annualized assuming a 40-year development life (which is likely low), then the one-time emissions account for approximately 2,465 tonnes, or 2% of the annual emissions. Taking these annualized one-time emissions into account, the annual emissions are 159,974 tonnes/year. As discussed below, these figures reflect conservative assumptions that likely overstate the GHG emissions that would result from this project.

Compared to California's 2020 NAT per capita emissions, 14.1 tonnes CO_2e per capita, a 28.5% decrease in emissions by 2020 is required to achieve AB 32 goals. In order to achieve AB 32 mandated goals, the per capita emissions would have to be 10.1 tonnes CO_2e. CP-HPS Plan has estimated emissions of 154,639 tonnes per year, or 6.5 tonnes per capita per year.[133] This estimate does not include emissions from heavy industry, refining, or commercial transportation that are included in the California figure of 10.1 tonnes CO_2e per capita.

As a result of the various design elements incorporated into the CP-HPS Plan project, the development approaches AB 32's goal of 28.5% below NAT in several areas. For example, as designed, homes in CP-HPS Plan are expected to be 20% more energy efficient than the current housing stock in California, as shown in Tables 4-8 through 4-10. The non-residential units are 17-18% more energy efficient than the average California non-residential buildings stock. Vehicular emissions from CP-HPS Plan residents are 57-59% less per dwelling unit than NAT. Additionally, CP-HPS Plan's municipal sources are 16-18% better than NAT which does not include water efficiency measures and energy efficient street lighting. Transit services are 40% better than NAT. The emission savings combined for CP-HPS Plan represent a 51% for CP-HPS, 49% for Variant 1 and 50% for Variant 2 reduction from a NAT situation without taking into consideration changes in emission factors, occupant energy use reductions, and categories that do not permit a NAT comparison for at this time. It should be noted that each estimate was developed using a different methodology; any conclusions based upon a comparison of these numbers should note the difference in methodologies. It is yet unclear as to how to compare construction, waste disposal, and area emissions to AB 32 mandated goals.

The GHG emission inventory for CP-HPS Plan was based on several conservative assumptions. In addition, anticipated state and federal regulatory developments are expected to result in lower GHG emissions from CP-HPS Plan than are represented in this analysis. California's Renewables Portfolio Standard (RPS) anticipated 33% target for 2020 will also decrease CP-HPS Plan's GHG inventory from electricity use. Reaching the anticipated 2020 target would result in a decrease of roughly 24%.

Thus, while the CP-HPS Plan project already comes close to achieving the GHG levels necessary to achieve AB 32's mandates, upon implementation of existing and anticipated legislative and regulatory mandates, actual emissions associated with CP-HPS Plan will likely be considerably lower.

[133] Assuming a population of 23,869 residents in CP-HPS Plan.

Table 3-1
CO_2 Sequestration Capacity of New Vegetation Plantings
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, CA

Vegetation Species[1]	IPCC Species Class Designation	Sequestered CO_2 / Unit[2]	Unit	Total Quantity of New Vegetation[1]	Unit	CO_2 Sequestration Capacity of New Vegetation[3]
		[tonne/unit/year]				[tonne]
Miscellaneous	Miscellaneous Trees	0.035	trees	10,000	trees	7,000
Total	-	-		**10,000**	**trees**	**7,000**

Notes:
1. Lennar Urban has committed to planting 10,000 net new trees in the development.
2. Species class-specific sequestration values are provided in Table 8.2 of "2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 4". For species that do not appear in Table 8.2, the species was classifed as "miscellaneous" and the average value of all listed data was used.
3. An active growing period of 20 years was assumed for the new trees planted.

Sources:
1. IPCC. 2006. Guidelines for National Greenhouse Gas Inventories Volume 4. Available online at http://www.ipcc-nggip.iges.or.jp/public/2006gl/vol4.htm

Table 3-2
GHG Emissions from Construction Equipment[1]
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Location	Equipment	Horsepower	Load Factor	Total Equipment Hours	Emission Factor[3]	CO_2e Emission[4,5]
					(g/bhp-hr)	(tonne)
Candlestick Point	Asphalt Layer	100	0.62	21,900	568.3	772
	Barge	1000	0.51	2,607	568.3	756
	Bobcat	44	0.55	21,900	568.3	301
	Compactor	8	0.43	22,769	568.3	45
	Crane	399	0.43	18,250	568.3	1,779
	Cement Truck	479	0.57	11,298	568.3	1,753
	Dozer	357	0.59	26,245	568.3	3,142
	Offroad Dump Truck	479	0.57	28,505	568.3	4,423
	Excavator	168	0.57	41,019	568.3	2,232
	Rough Terrain Fork Lift	93	0.6	28,852	568.3	915
	Grader	174	0.61	21,900	568.3	1,321
	Haul Trucks	479	0.57	37,543	568.3	5,825
	Loader	164	0.54	105,155	568.3	5,292
	Man Lift	60	0.46	82,386	568.3	1,292
	Onsite Field Truck	479	0.57	37,543	568.3	5,825
	Pile Driver	291	0.75	7,821	568.3	970
	Pump Truck	479	0.57	11,298	568.3	1,753
	Roller	104	0.53	22,248	568.3	697
	Scraper	313	0.72	29,026	568.3	3,717
	Soil Stabilizer	238	0.51	21,900	568.3	1,511
	Water Truck	479	0.57	77,867	568.3	12,082
	Total					**56,403**
Hunter's Point Shipyard	Asphalt Layer	100	0.62	17,033	568.3	600
	Barge	1000	0.51	26,767	568.3	7,758
	Bobcat	44	0.55	33,024	568.3	454
	Compactor	8	0.43	18,424	568.3	36
	Crane	399	0.43	26,940	568.3	2,627
	Dozer	357	0.59	32,502	568.3	3,891
	Drill Rig	291	0.75	3,129	568.3	388
	Offroad Dump Truck	479	0.57	28,157	568.3	4,369
	Excavator	168	0.57	40,845	568.3	2,223
	Rough Terrain Fork Lift	93	0.6	25,898	568.3	821
	Grader	174	0.61	17,033	568.3	1,027
	Haul Trucks	479	0.57	16,686	568.3	2,589
	Loader	164	0.54	61,529	568.3	3,097
	Man Lift	60	0.46	21,900	568.3	344
	Onsite Field Truck	479	0.57	18,076	568.3	2,805
	Pile Driver	291	0.75	4,867	568.3	604
	Pump Truck	479	0.57	3,129	568.3	485
	Roller	104	0.53	17,033	568.3	534
	Scraper	313	0.72	11,819	568.3	1,514
	Soil Stabilizer	238	0.51	17,033	568.3	1,175
	Water Truck	479	0.57	35,805	568.3	5,556
	Total					**42,895**
Overall Emissions from Construction Equipment						**99,298**

Notes:
1. The list of equipment during each construction phase was provided by Mactech.
2. The equipment-hour of individual equipment is calculated based on the phase duration.
3. The values of Horsepower, Load Factor, and Emission Factor of each type of equipment are from OFFROAD2007 defaults.
4. The CO_2 Emission calculation formula for each piece of equipment is:
   CO_2 Emission = Equipment Hours x HP x Load Factor x Emission Factor x Unit Conversion Factor
5. Assume CO_2 = CO_2e because the contribution of CH_4 and N_2O to overall GHG emissions is likely small (< 1% of total CO_2e) from diesel construction equipment.

Abbreviations:
bhp - brake horsepower
CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
GHG - Greenhouse Gas
hr - hour

Table 3-3
GHG Emissions from Worker Commutes
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Location	Worker Round Trips[1]	Trip Length [2]	EF^3_{LDA}		EF_{LDT2}		CO_2 Emissions[4]		Total CO_2 Emissions	Total CO_2e Emissions[5,6]
			Running	Startup	Running	Startup	Running	Startup		
		(miles)	(g/mile)	(g/trip)	(g/mile)	(g/trip)	(tonne)			
Candlestick Point	144,870	29.8	340	209	424	259	1,649	68	1,717	1,807
Hunter's Point Shipyard	181,588	29.8	340	209	424	259	2,067	85	2,152	2,265
Total									**3,869**	**4,073**

Notes:
1. Worker trips were calculated based on the average number of workers and duration of each project phase as provided by Mactech.
2. The roundtrip length is 29.8 miles based on the Home-Work trip lenth for San Francisco provided by Fehr and Peers.
3. The running emission factor depends on the speed of the vehicle. The emission factor used in this calculation refers to the URBEMIS 9.2.4 default vehicle speed: 30 MPH.
The startup emission factor depends on the settling period before driving. The startup emissions were conservatively calculated based on a 12 hour wait before each engine startup.
4. GHG Running Emission calculation formula: GHG Emission = Roundtrips x Trip Length x $(0.5 \times EF_{LDA} + 0.5 \times EF_{LDT2})_{Running}$
GHG Startup Emission calculation formula: GHG Emission = Worker Trips x $(0.5 \times EF_{LDA} + 0.5 \times EF_{LDT2})_{Startup}$
URBEMIS 9.2.4 assumes that LDA and LDT have a 50:50 mixing ratio.
5. $CO_2e = CO_2 / 0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs account for 5% of GHG emissions from on-road vehicles, taking into account their global warming potentials.
6. The emission factor values of calendar year 2011, the anticipated start date of the project, were used for all calculations.

Abbreviations:
CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
GHG - Greenhouse Gas
EF - Emission Factor
HFC - hydro fluorocarbons
hr - hour
LDA - Light Duty Auto
LDT - Light Duty Truck
MPH - Miles per hour
URBEMIS - Urban Emissions Model

Table 3-4
GHG Emissions from Hauling Trips
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Location	Hauling Round Trips[1]	Trip Length[2]	EF^3_{HHD}		CO_2 Emissions[4]		Total CO_2 Emissions	Total CO_2e Emissions[5,6]
			Running	Startup	Running	Startup		
		(miles)	(g/mile)	(g/trip)	(tonne)			
Candlestick Point	26,158	14.6	1,610	389	1,230	20	1,250	1,316
Hunter's Point Shipyard	17,902	14.6	1,610	389	842	14	855.6	901

Notes:
1. Hauling trips are calculated based on information provided by Mactech.
2. Trip length is based on URBEMIS default for San Francisco consumer non-work of 7.3 miles one way.
3. The running emission factor depends on the speed of the vehicle. The emission factor used in this calculation refers to the URBEMIS 9.2.4 default vehicle speed: 30 MPH.
   The startup emission factor depends on the settling period before driving. The startup emissions are conservatively calculated based on a 12 hour wait before each engine startup.
4. URBEMIS 9.2.4 assumes that all haulers drive heavy-heavy-duty trucks.
   CO_2 Running Emission calculation formula: CO_2 Emission = trips x trip length x $EF_{HHD\text{-}Running}$
   CO_2 Startup Emission calculation formula: CO_2 Emission = Hauler Trips x $EF_{HHD\text{-}Startup}$
5. $CO_2e = CO_2 / 0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs account for 5% of GHG emissions from on-road vehicles, taking into account their global warming potentials.
6. The emission factor values of calendar year 2011, the anticipated start date of the project, are used for all calculations.

Abbreviations:
CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
g - gram
GHG - Greenhouse Gas
EF - Emission Factor
GVW - Gross Vehicle Weight
HFC - Hydro Fluorocarbons
HHD - Heavy-Heavy Duty
hr - hour
MPH - Miles per hour
URBEMIS - Urban Emissions model

Table 3-5
Overall Construction GHG Emissions
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Location	Construction Equipment	Worker Commuting	Hauling	Total GHG Emissions
	(tonnes CO_2e)			
Candlestick Point	56,403	1,807	1,316	**59,526**
Hunter's Point Shipyard	42,895	2,265	901	**46,061**
Total	**99,298**	**4,073**	**2,216**	**105,587**

Notes:
1. See previous tables for calculation detail. The table includes emissions from construction equipment, worker commuting and hauling.

Abbreviations:
CO_2e - carbon dioxide equivalent
GHG - Greenhouse Gas

Table 3-6
Energy Use per Residential Dwelling Unit: Title-24 Regulated Heating and Cooling
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Dwelling Type[1]	Electricity Delivered (kW-hr/DU/year)									Natural Gas Delivered (MBTU/DU/yr)							
	Heating[2,3]	Cooling[2]	Domestic Hot Water[2,3]	RASS Total	% reduction due to 2005 standards relative to 2001[4,5]	2005 Estimated Total	% reduction due to 2008 vs. 2005 standards[6]	2008 Estimated Total	2008 Estimated Total (with 15% improvement over Title 24)[7]	Heating[2,3]	Domestic Hot Water[2,3]	RASS total	% reduction due to 2005 standards relative to 2001[4]	2005 Estimated Total	% reduction due to 2008 vs. 2005 standards[6]	2008 Estimated Total	2008 Estimated Total (with 15% improvement over Title 24)[7]
Multifamily CP	422	5	115	542	19.8%	435	22.7%	336	286	22.2	17.1	39.3	6.7%	36.7	10%	33.0	28.1
Multifamily HPS	422	5	115	542	19.8%	435	22.7%	336	286	22.2	17.1	39.3	6.7%	36.7	10%	33.0	28.1

Notes:

1. Based on information provided by Lennar Urban.
2. Based on the California Residential Appliance Saturation Survey (RASS), which collected data from over 21,100 households statewide. When available, RASS data tabulated for multifamily homes in the climate zone in which the CP-HPS Plan would be located (Climate Zone 5) were considered in this analysis. Otherwise, the average of all household types or statewide values were used.
3. Homes can be heated using electricity and/or natural gas. Homes can also use water heaters that use electricity and/or natural gas. The mix of types is based on the RASS report saturation percentage.
4. Reductions are taken with the assumption that the RASS estimate reflects heating/cooling/hot water electricity use for homes that are minimally compliant with 2001 Title 24 Standards (this version was the most current at the time of the RASS study). More than 90% of the homes that participated in the survey were constructed before 1997. Because older homes tend to use more energy, the numbers shown here may overestimate actual energy use at a new development such as Bayview Waterfront.
5. Based on report by California Energy Commission on estimated first-year electricity savings due to 2005 standards for single-family and multi-family homes, relative to 2001 standards.
6. Based on California Energy Commission report on estimated first-year electricity savings due to 2008 standards for single-family and multi-family homes, relative to 2005 standards.
7. There is an additional 15% improvement over Title 24 for the Candlestick Pointand Hunter's Point Shipyard.

Abbreviations:

CP - Candlestick Point
DU - Dwelling
HPS -Hunter's Point Shipyard
IB - India Basin
kW-hr - kilowatt-hour
MBTU - million british thermal units
RASS - Residential Appliance Saturation Survey

Source:

California Energy Commission. 2003. Impact Analysis: 2005 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2005standards/archive/rulemaking/documents/2003-07-11_400-03-014.PDF

California Energy Commission. 2007. Impact Analysis: 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF

Kema-Xenergy, Itron, RoperASW. 2004. California Statewide Residential Appliance Saturation Study (RASS) Volume 2, Study Results, Final Report. June. 300-00-004. Available at: http://www.energy.ca.gov/reports/400-04-009/2004-08-17_400-04-009VOL2B.PDF

Table 3-7
Energy Use per Residential Dwelling Unit: Appliances and Plug-ins
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

		Electricity Delivered (kW-hr/DU/year)[2]								Natural Gas Delivered (MBTU/DU/yr)[2]		
Type	**Dwelling Type[1]**	**Refrigerator**	**Clothes Washer**	**Clothes Dryer[3]**	**Dishwasher**	**Cooking Range (Electric)[4]**	**Total Major Appliances**	**MELs**	**Total**	**Clothes Dryer (Gas)[3]**	**Gas Cooking Range[4]**	**Total**
Standard Appliances	**Multifamily CP**	744	4	93	28	101	971	1,783	2,753	0.7	2.3	3.1
	Multifamily HPS	744	4	93	28	101	971	1,783	2,753	0.7	2.3	3.1
Energy Star Appliances[5]	**Multifamily CP**	633	3	93	23	101	853	1,783	2,635	0.7	2.3	3.1
	Multifamily HPS	633	3	93	23	101	853	1,783	2,635	0.7	2.3	3.1

Notes:
1. Information provided by Lennar Urban.
2. Energy use per residential dwelling unit is based on information in RASS report.
either electric or
4. Cooking ranges can be either gas or electric. The mix of types is based on the RASS report saturation percentage.
5. Average energy savings above standard products are applied to refrigeration (15%), clothes washer (30%), dishwasher (20%) as reported in Energy Star and Other Climate Protection Partnerships 2007 Annual Report Table 9.

Abbreviations:
CP - Candlestick Point
DU - Dwelling Unit
HPS -Hunter's Point Shipyard
kW-hr - kilowatt-hour
MBTU - million british thermal units
MEL - Miscellaneous electric load
RASS - Residential Appliance Saturation Survey

Source:
Environmental Protection Agency (USEPA). 2007 Annual Report. Energy Star and Other Climate Protection Partnerships. Available at: http://www.energystar.gov/ia/partners/publications/pubdocs/2007%20Annual%20Report%20-%20Final%20 11-10-08.pdf
Kema-Xenergy, Itron, RoperASW. California Statewide Residential Appliance Saturation Study (RASS) Volume 2, Study Results, Final Report. June 2004. 300-00-004.

Table 3-8
Energy Use per Residential Dwelling Unit
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Title 24 Compliance	Dwelling Type	Electricity Delivered[1,2]					Natural Gas Delivered[1,2]		
		Heating, Cooling, and Domestic Hot Water	Hard Wired Lighting[3]	Major Appliances	Plug-ins[3,4]	Total	Heating and Domestic Hot Water	Gas Dryers and Oven Ranges	Total
		[kW-hr / DU / year]					(MBTU natural gas / DU / year)		
Minimally Title 24 Compliant (2005)	Multifamily CP	435	429	971	1,783	3,617	37	3	40
	Multifamily HPS	435	429	971	1,783	3,617	37	3	40
Minimally Title 24 Compliant (2008)	Multifamily CP	336	429	971	1,783	3,518	33	3	36
	Multifamily HPS	336	429	971	1,783	3,518	33	3	36
15% Better Than Title 24 and Energy Star Appliances[5]	Multifamily CP	286	364	853	1,783	3,285	28	3	31
	Multifamily HPS	286	364	853	1,783	3,285	28	3	31
Percentage Improvement over Title 24 (2005)	Multifamily CP	34%	15%	12%	0%	9%	15%	--	14%
	Multifamily HPS	34%	15%	12%	0%	9%	15%	--	14%

Notes:

1. Energy use shown is based on the California Residential Appliance Saturation Survey (RASS), which collected data from over 21,100 households statewide. Only RASS data tabulated for the multifamily homes in the climate zone in which Bayview Waterfront would be located (Climate Zone 5) were considered in this analysis.
2. For energy uses that can be electric or natural gas the mix of types is based on the RASS report saturation percentage.
3. Hard wired lighting is assumed to be all outdoor lighting and half of the energy for indoor lighting listed under miscellaneous electricity load in the RASS report. The other indoor lighting is assumed to be plug-ins. Lighting is 60% of the miscellaneous electricity load according to the RASS report.

4. "Plug-ins" refers to electricity use associated with plug-in lighting, plug-in appliances, and miscellaneous electric loads. This energy use is calculated based on the RASS report.
5. Lennar Urban has committed to a 15% improvement in energy use in the building envelope over 2008 Title 24 standards and inclusion of energy star appliances for Candlestick Point and Hunter's Point Shipyard.

Abbreviations:
CP - Candlestick Point
DU - Dwelling Unit
HPS -Hunter's Point Shipyard
IB - India Basin
kW-hr - kilowatt-hour
MBTU - million british thermal units
RASS - Residential Appliance Saturation Survey

Source:
Kema-Xenergy, Itron, RoperASW. California Statewide Residential Appliance Saturation Study (RASS) Volume 2, Study Results, Final Report. June 2004. 300-00-004.

Table 3-9
Emission Factors for Different Energy Sources for Buildings with Renewable Portfolio Standards
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Energy Source	Source Units	lb CO_2/source unit
Electricity[1]	(kW-hr)	0.636
Electricity RPS[2]	(kW-hr)	0.574
Natural Gas[3]	(MBTU)	117.0

Notes:
1. Emission factor for electricity provided by Pacific Gas and Electric, obtained from the California Climate Action Registry Database.
2. Emission factor for electricity has been adjusted to account for the 20% Renewable Portfolio Standard Required of electricity providers by 2010.
2. Emission factor for natural gas was obtained from California Climate Action Registry Reporting Protocol, Table C6.

Abbreviations:
kW-hr - kilowatt-hour
lb - pound
MBTU - million British thermal units
RPS - Renewable Portfolio Standards

Sources:
California Climate Action Registry General Reporting Protocol, Version 3.1 (January 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

California Climate Action Registry Database: PG&E 2007 PUP Report. 2008. Available at: https://www.climateregistry.org/CARROT/public/Reports.aspx

Table 3-10
CO_2e Emissions per Dwelling Unit with Renewable Portfolio Standard
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Title 24[1] Compliance	Type[2]	Title-24 Systems[1]		Title-24 Systems and Major Appliances		Title-24 Systems and All MELs		Title-24 Systems	Title-24 Systems and Major Appliances	Title-24 Systems and All MELs
		CO_2 Electricity[3]	CO_2 Natural Gas[4]	CO_2 Electricity[3]	CO_2 Natural Gas[4]	CO_2 Electricity[3]	CO_2 Natural Gas[4]	CO_2 Total	CO_2 Total	CO_2 Total
		(lbs / DU / year)						(tonnes / DU / year)		
Minimally Title 24 Compliant (2005)	Multifamily CP	549	4291	1166	4649	2299	4649	2.2	2.6	3.2
	Multifamily HPS	549	4291	1166	4649	2299	4649	2.2	2.6	3.2
Minimally Title 24 Compliant (2008)	Multifamily CP	439	3862	996	4220	2019	4220	2.0	2.4	2.8
	Multifamily HPS	439	3862	996	4220	2019	4220	2.0	2.4	2.8
15% Better Than Title 24 and Energy Star Appliances[5]	Multifamily CP	373	3283	862	3641	1885	3641	1.7	2.0	2.5
	Multifamily HPS	373	3283	862	3641	1885	3641	1.7	2.0	2.5
Percentage Improvement over Title 24 (2005)	Multifamily CP	32%	24%	26%	22%	18%	22%	24%	23%	20%
	Multifamily HPS	32%	24%	26%	22%	18%	22%	24%	23%	20%

Notes:
1. Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.
2. Information provided by Lennar Urban.
3. The minimally Title 24 Complaint (2005) scenario converted from kW-hr to lb CO_2 using emission factor from the California Climate Action Registry Database: PG&E 2007 PUP Report. 2008. All other scenarios converted from kW-hr to lb CO_2 using emission factor adjusted for the RPS.
4. Converted from MBTU to lb CO_2 using emission factor from California Climate Action Registry General Reporting Protocol (CCAR GRP).
5. Lennar Urban has committed to a 15% improvement in energy use in the building envelope over Title 24 standards and inclusion of energy star appliances at Candlestick Point and Hunter's Point Shipyard.

Abbreviations:
CO_2 - carbon dioxide
CP - Candlestick Point
DU - Dwelling Unit
HPS -Hunter's Point Shipyard
IB - India Basin
kW-hr - kilowatt-hour
lb - pound
SF - Square Feet
RPS - Renewable Portfolio Standards

Sources:

California Climate Action Registry General Reporting Protocol, Version 3.1 (June 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

California Climate Action Registry Database: PG&E 2007 PUP Report. 2008. Available at: Available at: https://www.climateregistry.org/CARROT/public/Reports.aspx

Table 3-11
CO_2 Emissions from Electricity and Natural Gas Usage in Residential Dwelling Units with Renewable Portfolio Standard
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Title 24[1] Compliance	Housing Type	# Dwelling Units[2]	Title-24 Systems			Title-24 Systems and Major Appliances			Title-24 Systems and All MELs		
			CO_2 Emission Factor	Total CO_2 Emissions		CO_2 Emission Factor	Total CO_2 Emissions		CO_2 Emission Factor	Total CO_2 Emissions	
			(tonne CO_2 / DU / year)	(tonne CO_2 / year)		(tonne CO_2 / DU / year)	(tonne CO_2 / year)		(tonne CO_2 / DU / year)	(tonne CO_2 / year)	
Minimally Title 24 Compliant (2005)	Multifamily CP	7,594	2.2	16,672	**16,672**	2.6	20,031	**20,031**	3.2	23,934	**23,934**
	Multifamily HPS	2,650	2.2	5,818	**5,818**	2.6	6,990	**6,990**	3.2	8,352	**8,352**
Minimally Title 24 Compliant (2008)	Multifamily CP	7,594	2.0	14,815	**14,815**	2.4	17,967	**17,967**	2.8	21,491	**21,491**
	Multifamily HPS	2,650	2.0	5,170	**5,170**	2.4	6,270	**6,270**	2.8	7,499	**7,499**
15% Better Than Title 24 and Energy Star Appliances	Multifamily CP	7,594	1.7	12,593	**12,593**	2.0	15,511	**15,511**	2.5	19,035	**19,035**
	Multifamily HPS	2,650	1.7	4,394	**4,394**	2.0	5,413	**5,413**	2.5	6,642	**6,642**
Percentage Improvement over Title 24 (2005)	Multifamily CP	7,594	24%	24%	**24%**	23%	23%	**23%**	20%	20%	**20%**
	Multifamily HPS	2,650	24%	24%	**24%**	23%	23%	**23%**	20%	20%	**20%**

Notes:
1. Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.
2. Information provided by Lennar Urban.

Abbreviations:
CP - Candlestick Point
CO_2 - carbon dioxide
HPS -Hunter's Point Shipyard
DU - Dwelling Units
MEL - Miscellaneous electric loads
RPS - Renewable Portfolio Standards

Sources:
California Climate Action Registry General Reporting Protocol, Version 3.1 (January 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

Table 3-12
CO_2 Emissions from Electricity and Natural Gas Usage in Residential Dwelling Units with Renewable Portfolio Standard
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Variant 2
San Francisco, California

Title 24[1] Compliance	Housing Type	# Dwelling Units[2]	Title-24 Systems			Title-24 Systems and Major Appliances			Title-24 Systems and All MELs		
			CO_2 Emission Factor	Total CO_2 Emissions		CO_2 Emission Factor	Total CO_2 Emissions		CO_2 Emission Factor	Total CO_2 Emissions	
			(tonne CO_2 / DU / year)	(tonne CO_2 / year)		(tonne CO_2 / DU / year)	(tonne CO_2 / year)		(tonne CO_2 / DU / year)	(tonne CO_2 / year)	
Minimally Title 24 Compliant (2005)	Multifamily CP	6,244	2.2	13,708	**13,708**	2.6	16,470	**16,470**	3.2	19,679	**19,679**
	Multifamily HPS	4,000	2.2	8,782	**8,782**	2.6	10,551	**10,551**	3.2	12,607	**12,607**
Minimally Title 24 Compliant (2008)	Multifamily CP	6,244	2.0	12,182	**12,182**	2.4	14,773	**14,773**	2.8	17,670	**17,670**
	Multifamily HPS	4,000	2.0	7,804	**7,804**	2.4	9,464	**9,464**	2.8	11,320	**11,320**
15% Better Than Title 24 and Energy Star Appliances	Multifamily CP	6,244	1.7	10,354	**10,354**	2.0	12,753	**12,753**	2.5	15,651	**15,651**
	Multifamily HPS	4,000	1.7	6,633	**6,633**	2.0	8,170	**8,170**	2.5	10,026	**10,026**
Percentage Improvement over Title 24 (2005)	Multifamily CP	6,244	24%	24%	**24%**	23%	23%	**23%**	20%	20%	**20%**
	Multifamily HPS	4,000	24%	24%	**24%**	23%	23%	**23%**	20%	20%	**20%**

Notes:
1. Title 24 - California Code of Regulations (CCR), Title 24, also known as the California Building Standards Code.
2. Information provided by Lennar Urban.

Abbreviations:
CP - Candlestick Point
CO_2 - carbon dioxide
HPS -Hunter's Point Shipyard
DU - Dwelling Units
MEL - Miscellaneous electric loads
RPS - Renewable Portfolio Standards

Sources:
California Climate Action Registry General Reporting Protocol, Version 3.1 (January 2009). Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

Table 3-13
Electricity End-Use Distribution for Non-Residential Building Types
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

CEUS Building Type	Heating	Cooling	Ventilation	Water Heating	Cooking	Refrigeration	Exterior Lighting	Interior Lighting	Office Equipment	Miscellaneous	Process	Motors	Air Compressors
Large Office	3.50%	17.56%	17.53%	0.72%	0.80%	1.98%	1.38%	27.76%	20.80%	2.09%	0.01%	5.37%	0.50%
Lodging	4.61%	13.31%	12.34%	0.97%	7.82%	5.11%	3.69%	36.62%	1.03%	8.40%	---	5.89%	0.22%
Retail	1.00%	9.77%	12.53%	1.01%	1.48%	10.12%	3.50%	45.57%	3.57%	7.22%	0.54%	3.21%	0.49%
Miscellaneous	1.53%	6.45%	8.04%	2.61%	3.21%	8.52%	11.13%	32.79%	3.77%	10.92%	1.10%	7.62%	2.31%
Included in Title 24 Building Envelope Energy Budget?[1]	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No	No

Notes:
1. Only end uses regulated by Title 24 are included in the Title 24 building envelope energy budget. Hard-wired lighting (exterior lighting and some interior lighting) are part of Title 24, but are not considered part of the building envelope energy budget.

Abbreviations:
CEUS - California Commercial End-Use Survey

Source:
Itron, Incorporated. 2006. California Commercial End-Use Survey Results. CEC-400-2006-005. Available at http://www.energy.ca.gov/ceus/

Table 3-14
Natural Gas End-Use Distribution for Non-Residential Building Types
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Candlestick Point

CEUS Building Type	Heating	Cooling	Water Heating	Cooking	Miscellaneous	Process
Large Office	87.32%	---	7.65%	0.35%	0.00%	4.68%
Lodging	14.09%	0.85%	66.82%	12.75%	5.48%	---
Retail	68.29%	---	18.87%	10.91%	1.94%	---
Miscellaneous	30.50%	---	44.13%	4.82%	1.14%	19.41%
Included in Title 24 Building Envelope Energy Budget?[1]	Yes	Yes	Yes	No	No	No

Notes:
1. Only end uses regulated by Title 24 are included in the Title 24 building envelope energy budget.

Abbreviations:
CEUS - California Commercial End-Use Survey

Source:
Itron, Incorporated. 2006. California Commercial End-Use Survey Results. CEC-400-2006-005. Available at http://www.energy.ca.gov/ceus/

Table 3-15
Emission Factors by Energy Source
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Energy Source	Unit	Conversion Factor [lb CO_2e/Unit]	Conversion Factor [tonne CO_2e/Unit]
Electricity[1]	kWh	0.636	2.88E-04
Electricity-RPS[2]	kWh	0.574	2.60E-04
Natural Gas[3]	kBTU	0.117	5.31E-05

Notes:

1. Emission factor for electricity provided by PG&E for the year 2007, obtained from the California Climate Action Registry Database.
2. Emission factor for electricity has been adjusted to account for the 20% Renewable Portfolio Standard Required of electricity providers by 2010.
3. Emission factor for natural gas obtained from California Climate Action Registry Reporting Protocol, Table C6.

Abbreviations:

CO_2e - carbon dioxide equivalent
kBTU - 1000 British thermal units
kWh - kilowatt-hour
lb - pound
PG&E - Pacific Gas & Electric Company
RPS - Renewable Portfolio Standard

Sources:

California Climate Action Registry 2009. General Reporting Protocol, Version 3.1. Available at: http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf
California Climate Action Registry. 2008. Database: Pacific Gas and Electric Company 2007 PUP Report. Available at: https://www.climateregistry.org/CARROT/public/Reports.aspx

Table 3-16
Energy and GHG Emissions Intensity for Non-Residential Building Types
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Candlestick Point

Building Type	CEUS Building Type	Energy Source	Unit	Usage Rate[1] [Unit/SF-yr]																	CO$_2$e EF[5] [tonnes/SF-yr]		
				Total Energy Intensity (kWh/Segment FS/Year)	2002 Title 24[3]	2005 Title 24 Reduction[2]	2005 Title 24[3]		Non-Title 24[4]		Overall based on 2005 Title 24		Non-Title 24[4]		Overall based on 2008 Title 24	15% Improvement over Title 24[6]		Non-Title 24[4]		Overall Project[6]	Overall based on 2005 Title 24	Overall based on 2008 Title 24	Overall Project[6]
Hotel	Lodging	Electricity	kWh	10.03	3.13	8.5%	2.87	+	6.90	=	9.76	+	6.90	=	9.62	2.32	+	6.90	=	9.22	2.82E-03	2.51E-03	2.40E-03
		Natural Gas	kBTU	39.15	32.01	5.8%	30.15	+	7.14	=	37.29	+	7.14	=	34.46	23.22	+	7.14	=	30.36	1.98E-03	1.83E-03	1.61E-03
Office	Large Office	Electricity	kWh	15.25	6.00	8.5%	5.49	+	9.25	=	14.74	+	9.25	=	14.47	4.43	+	9.25	=	13.69	4.25E-03	3.77E-03	3.56E-03
		Natural Gas	kBTU	23.28	22.11	5.8%	20.83	+	1.17	=	22.00	+	1.17	=	20.04	16.04	+	1.17	=	17.21	1.17E-03	1.06E-03	9.13E-04
Community Space	Large Office	Electricity	kWh	15.25	6.00	8.5%	5.49	+	9.25	=	14.74	+	9.25	=	14.47	4.43	+	9.25	=	13.69	4.25E-03	3.77E-03	3.56E-03
		Natural Gas	kBTU	23.28	22.11	5.8%	20.83	+	1.17	=	22.00	+	1.17	=	20.04	16.04	+	1.17	=	17.21	1.17E-03	1.06E-03	9.13E-04
Retail	Retail	Electricity	kWh	12.65	3.07	8.5%	2.81	+	9.57	=	12.39	+	9.57	=	12.25	2.27	+	9.57	=	11.85	3.57E-03	3.19E-03	3.08E-03
		Natural Gas	kBTU	5.51	4.80	5.8%	4.53	+	0.71	=	5.23	+	0.71	=	4.81	3.49	+	0.71	=	4.19	2.78E-04	2.55E-04	2.23E-04
Performance Venue	Miscellaneous	Electricity	kWh	8.98	1.67	8.5%	1.53	+	7.30	=	8.83	+	7.30	=	8.76	1.24	+	7.30	=	8.54	4.69E-04	2.28E-03	2.22E-03
		Natural Gas	kBTU	27.24	20.33	5.8%	19.15	+	6.91	=	26.06	+	6.91	=	24.26	14.74	+	6.91	=	21.65	1.38E-03	1.29E-03	1.15E-03

Hunter's Point Shipyard

Building Type	CEUS Building Type	Energy Source	Unit	Usage Rate[1] [Unit/SF-yr]																	CO$_2$e EF[5] [tonnes/SF-yr]		
				Total Energy Intensity (kWh/Segment FS/Year)	2002 Title 24[3]	2005 Title 24 Reduction[2]	2005 Title 24[3]		Non-Title 24[4]		Overall based on 2005 Title 24		Non-Title 24[4]		Overall based on 2008 Title 24	15% Improvement over Title 24[6]		Non-Title 24[4]		Overall Project[6]	Overall based on 2005 Title 24	Overall based on 2008 Title 24	Overall Project[6]
R&D	Large Office	Electricity	kWh	15.25	6.00	8.5%	5.49	+	9.25	=	14.74	+	9.25	=	14.47	4.43	+	9.25	=	13.69	4.25E-03	3.77E-03	3.56E-03
		Natural Gas	kBTU	23.28	22.11	5.8%	20.83	+	1.17	=	22.00	+	1.17	=	20.04	16.04	+	1.17	=	17.21	1.17E-03	1.06E-03	9.13E-04
Community Space and Artist Studio	Large Office	Electricity	kWh	15.25	6.00	8.5%	5.49	+	9.25	=	14.74	+	9.25	=	14.47	4.43	+	9.25	=	13.69	4.25E-03	3.77E-03	3.56E-03
		Natural Gas	kBTU	23.28	22.11	5.8%	20.83	+	1.17	=	22.00	+	1.17	=	20.04	16.04	+	1.17	=	17.21	1.17E-03	1.06E-03	9.13E-04
Neighborhood Retail	Retail	Electricity	kWh	12.65	3.07	8.5%	2.81	+	9.57	=	12.39	+	9.57	=	12.25	2.27	+	9.57	=	11.85	3.57E-03	3.19E-03	3.08E-03
		Natural Gas	kBTU	5.51	4.80	5.8%	4.53	+	0.71	=	5.23	+	0.71	=	4.81	3.49	+	0.71	=	4.19	2.78E-04	2.55E-04	2.23E-04

Notes:

1. Baseline usage rates for all buildings except for the stadium were taken from the 2006 California Commercial End-Use Survey (CEUS), performed by Itron under contract to the California Energy Commission (CEC). ENVIRON used data for PG&E, Zone 5.
2. Baseline Title 24 usage rates shown in this table have been adjusted to reflect improvements in Title 24 building codes since their introduction in 2002. CEC discusses average savings for improvements from 2002 to 2005 ("Impact Analysis for 2005 Energy Efficiency Standards") as well as from 2005 to 2008 ("Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings"). ENVIRON used these CEC average savings percentages, which are: for electricity: 8.5% reduction in 2005 and 4.9% reduction in 2008; for gas: 5.8% reduction in 2005 and 9.4% reduction in 2008.
3. Includes only Title 24-regulated building envelope uses of electricity (heating, cooling, ventilation, water heating) and gas (heating, water heating).
4. Includes all other uses of electricity (cooking, refrigeration, exterior lighting, interior lighting, office equipment, miscellaneous, process, motors, air compressors) and gas (cooking, miscellaneous, process) not included in the Title 24-regulation building envelope energy use.
5. GHG emission factors (EF) are calculated by multiplying the corresponding usage rates or usages by the conversion factors listed in Table 3-15. The 2005 Title 24 scenario uses the current PG&E electricity carbon intensity factor. All other scenarios use the electricity carbon intensity value that has been adjusted to account for the 20% RPS in 2010.
6. The usage rate with 15% improvement over Title 24 is calculated as the baseline Title 24 usage reduced by 15% plus the baseline non-Title 24 usage.

Abbreviations:

CEC - California Energy Commission
CEUS - California Commerical End-Use Survey
CO$_2$e - carbon dioxide equivalent
EF - emission factor
GHG - greenhouse gas
kBTU - kilo (1000) British thermal units
kWh - kilowatt hours
PG & E - Pacific Gas and Electric
RPS - Renewable Portfolio Standard
SF - square feet
tonnes - metric tonnes
yr - year

Sources:

Itron, Incorporated. 2006. California Commercial End-Use Survey Results. CEC-400-2006-005. Available at http://www.energy.ca.gov/ceus/
San Francisco Department of the Environment and San Francisco Public Utilities Commission. 2004. Climate Action Plan for San Francisco.
California Energy Commission. 2003. Impact Analysis: 2005 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2005standards/archive/rulemaking/documents/2003-07-11_400-03-014.PDF
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Table 3-17
Electricity Usage and Resulting GHG Emissions for Non-Residential Building Types: Project
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Candlestick Point

Building Type	CEUS Building Type	Total Area [SF]	Energy Source	Unit	Usage Rate[1] [Unit/SF-yr]: Overall based on 2005 Title 24[2]	Usage Rate[1]: Overall based on 2008 Title 24[2]	Usage Rate[1]: Overall Project[3]	CO_2e EF[4] [tonnes/SF-yr]: Overall based on 2005 Title 24	CO_2e EF[4]: Overall based on 2008 Title 24	CO_2e EF[4]: Overall Project	Annual Total based on 2005 Title 24: Usage [Unit/yr] Overall	Annual Total based on 2005 Title 24: CO_2e Emissions[4] [tonnes/yr] Overall	Annual Total based on 2008 Title 24: Usage [Unit/yr] Overall	Annual Total based on 2008 Title 24: CO_2e Emissions[4] [tonnes/yr] Overall	Annual Total (with 15% Improvement over Title 24): Usage[3] [Unit/yr] Overall	Annual Total (with 15% Improvement over Title 24): CO_2e Emissions[4] [tonnes/yr] Overall
Hotel	Lodging	150,000	Electricity	kWh	9.76	9.62	9.22	2.82E-03	2.51E-03	2.40E-03	1,464,745	422	1,443,680	376	1,382,354	360
			Natural Gas	kBTU	37.29	34.46	30.36	1.98E-03	1.83E-03	1.61E-03	5,593,967	297	5,168,788	274	4,554,088	242
Office	Large Office	150,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	2,210,867	637	2,170,546	565	2,053,163	534
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	3,300,084	175	3,006,396	160	2,581,798	137
Community Space	Large Office	50,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	736,956	212	723,515	188	684,388	178
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	1,100,028	58	1,002,132	53	860,599	46
Retail	Retail	760,000	Electricity	kWh	12.39	12.25	11.85	3.57E-03	3.19E-03	3.08E-03	9,413,888	2,714	9,309,170	2,423	9,004,310	2,344
			Natural Gas	kBTU	5.23	4.81	4.19	2.78E-04	2.55E-04	2.23E-04	3,977,575	211	3,654,250	194	3,186,805	169
Performance Venue	Miscellaneous	75,000	Electricity	kWh	8.83	8.76	8.54	2.55E-03	2.28E-03	2.22E-03	662,573	191	656,949	171	640,577	167
			Natural Gas	kBTU	26.06	24.26	21.65	1.38E-03	1.29E-03	1.15E-03	1,954,241	104	1,819,256	97	1,624,103	86
Grand Total Area		1,185,000								Electricity	14,489,028	4,178	14,303,859	3,724	13,764,791	3,583
										Natural Gas	15,925,895	845	14,650,823	778	12,807,394	680

Hunter's Point Shipyard

Building Type	CEUS Building Type	Total Area [SF]	Energy Source	Unit	Usage Rate[1] [Unit/SF-yr]: Overall based on 2005 Title 24[2]	Usage Rate[1]: Overall based on 2008 Title 24[2]	Usage Rate[1]: Overall Project[3]	CO_2e EF[4] [tonnes/SF-yr]: Overall based on 2005 Title 24	CO_2e EF[4]: Overall based on 2008 Title 24	CO_2e EF[4]: Overall Project	Annual Total based on 2005 Title 24: Usage [Unit/yr] Overall	Annual Total based on 2005 Title 24: CO_2e Emissions[4] [tonnes/yr] Overall	Annual Total based on 2008 Title 24: Usage [Unit/yr] Overall	Annual Total based on 2008 Title 24: CO_2e Emissions[4] [tonnes/yr] Overall	Annual Total (with 15% Improvement over Title 24): Usage[3] [Unit/yr] Overall	Annual Total (with 15% Improvement over Title 24): CO_2e Emissions[4] [tonnes/yr] Overall
R&D	Large Office	2,500,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	38,026,906	10,965	37,333,387	9,719	35,314,398	9,193
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	56,761,451	3,012	51,710,017	2,744	44,406,932	2,357
Community Space and Artist Studio	Large Office	80,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	1,179,129	340	1,157,624	301	1,095,020	285
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	1,760,045	93	1,603,411	85	1,376,959	73
Neighborhood Retail	Retail	125,000	Electricity	kWh	12.39	12.25	11.85	3.57E-03	3.19E-03	3.08E-03	1,548,337	446	1,531,113	399	1,480,972	386
			Natural Gas	kBTU	5.23	4.81	4.19	2.78E-04	2.55E-04	2.23E-04	654,206	35	601,028	32	524,145	28
											Annual Based on 1990 Energy Use				**Annual Based on 20% Better Energy Use for New Stadium**	
Stadium[5]	---	---	Electricity	kWh							5,100,000	1,471			4,080,000	1,062
			Natural Gas	kBTU							9,000,000	478			7,200,000	382
Grand Total Area		2,705,000								Electricity	45,854,371	13,222	40,022,124	10,419	41,970,390	10,926
										Natural Gas	68,175,703	3,618	53,914,456	2,861	53,508,037	2,840

Notes:

1. Baseline usage rates for all buildings except for the stadium were taken from the 2006 California Commercial End-Use Survey (CEUS), performed by Itron under contract to the California Energy Commission (CEC). ENVIRON used data for PG&E, Zone 5.
2. Baseline Title 24 usage rates shown in this table have been adjusted to reflect improvements in Title 24 building codes since their introduction in 2002. CEC discusses average savings for improvements from 2002 to 2005 ("Impact Analysis for 2005 Energy Efficiency Standards") as well as from 2005 to 2008 ("Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings"). ENVIRON used these CEC average savings percentages, which are: for electricity: 8.5% reduction in 2005 and 4.9% reduction in 2008; for gas: 5.8% reduction in 2005 and 9.4% reduction in 2008.
3. The usage rate with 15% improvement over Title 24 is calculated as the baseline Title 24 usage reduced by 15% plus the baseline non-Title 24 usage.
4. GHG emission factors (EF) are calculated by multiplying the corresponding usage rates or usages by the conversion factors listed in Table 3-15. The 2005 Title 24 scenaro uses the current PG&E electricity carbon intensity factor. All other scenarios use the electricity carbon intensity value that has been adjusted to account for the 20% RPS in 2010.
5. The energy use for the Stadium is based on the energy use in 1990 from Climate Action Plan for San Francisco Table 2.4 estimate of energy use and assumes a 20% decrease in energy use for a new stadium.

Abbreviations:

CEC - California Energy Commission
CEUS - California Commerical End-Use Survey
CO_2e - carbon dioxide equivalent
EF - emission factor
GHG - greenhouse gas
kBTU - kilo (1000) British thermal units
kWh - kilowatt hours
PG & E - Pacific Gas and Electric
RPS - Renewable Portfolio Standard
SF - square feet
tonnes - metric tonnes
yr - year

Sources:

Itron, Incorporated. 2006. California Commercial End-Use Survey Results. CEC-400-2006-005. Available at http://www.energy.ca.gov/ceus/
San Francisco Department of the Environment and San Francisco Public Utilities Commission. 2004. Climate Action Plan for San Francisco.
California Energy Commission. 2003. Impact Analysis: 2005 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2005standards/archive/rulemaking/documents/2003-07-11_400-03-014.PDF
California Energy Commission. 2007. Impact Analysis: 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF

Table 3-18
Electricity Usage and Resulting GHG Emissions for Non-Residential Building Types: Variant 1
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Candlestick Point											Annual Total based on 2005 Title 24		Annual Total based on 2008 Title 24		Annual Total (with 15% Improvement over Title 24)	
Building Type	CEUS Building Type	Total Area [SF]	Energy Source	Unit	Usage Rate[1] [Unit/SF-yr]			CO_2e EF[4] [tonnes/SF-yr]			Usage [Unit/yr]	CO_2e Emissions[4] [tonnes/yr]	Usage [Unit/yr]	CO_2e Emissions[4] [tonnes/yr]	Usage[3] [Unit/yr]	CO_2e Emissions[4] [tonnes/yr]
					Overall based on 2005 Title 24[2]	Overall based on 2008 Title 24[2]	Overall Project[3]	Overall based on 2005 Title 24	Overall based on 2008 Title 24	Overall Project	Overall	Overall	Overall	Overall	Overall	Overall
Hotel	Lodging	150,000	Electricity	kWh	9.76	9.62	9.22	2.82E-03	2.51E-03	2.40E-03	1,464,745	422	1,443,680	376	1,382,354	360
			Natural Gas	kBTU	37.29	34.46	30.36	1.98E-03	1.83E-03	1.61E-03	5,593,967	297	5,168,788	274	4,554,088	242
Office	Large Office	150,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	2,210,867	637	2,170,546	565	2,053,163	534
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	3,300,084	175	3,006,396	160	2,581,798	137
Community Space	Large Office	50,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	736,956	212	723,515	188	684,388	178
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	1,100,028	58	1,002,132	53	860,599	46
Retail	Retail	760,000	Electricity	kWh	12.39	12.25	11.85	3.57E-03	3.19E-03	3.08E-03	9,413,888	2,714	9,309,170	2,423	9,004,310	2,344
			Natural Gas	kBTU	5.23	4.81	4.19	2.78E-04	2.55E-04	2.23E-04	3,977,575	211	3,654,250	194	3,186,805	169
Miscellaneous	Miscellaneous	75,000	Electricity	kWh	8.83	8.76	8.54	2.55E-03	2.28E-03	2.22E-03	662,573	191	656,949	171	640,577	167
			Natural Gas	kBTU	26.06	24.26	21.65	1.38E-03	1.29E-03	1.15E-03	1,954,241	104	1,819,256	97	1,624,103	86
Grand Total Area		1,185,000								Electricity	14,489,028	4,178	14,303,859	3,724	13,764,791	3,583
										Natural Gas	15,925,895	845	14,650,823	778	12,807,394	680

Hunter's Point Shipyard											Annual Total based on 2005 Title 24		Annual Total based on 2008 Title 24		Annual Total (with 15% Improvement over Title 24)	
Building Type	CEUS Building Type	Total Area [SF]	Energy Source	Unit	Usage Rate[1] [Unit/SF-yr]			CO_2e EF[4] [tonnes/SF-yr]			Usage [Unit/yr]	CO_2e Emissions[4] [tonnes/yr]	Usage [Unit/yr]	CO_2e Emissions[4] [tonnes/yr]	Usage[3] [Unit/yr]	CO_2e Emissions[4] [tonnes/yr]
					Overall based on 2005 Title 24[2]	Overall based on 2008 Title 24[2]	Overall Project[3]	Overall based on 2005 Title 24	Overall based on 2008 Title 24	Overall Project	Overall	Overall	Overall	Overall	Overall	Overall
R&D	Large Office	5,000,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	73,695,553	21,249	72,351,525	18,835	68,438,755	17,816
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	110,002,813	5,838	100,213,211	5,318	86,059,946	4,567
Community Space and Artist Studio	Large Office	80,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	1,179,129	340	1,157,624	301	1,095,020	285
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	1,760,045	93	1,603,411	85	1,376,959	73
Neighborhood Retail	Retail	125,000	Electricity	kWh	12.39	12.25	11.85	3.57E-03	3.19E-03	3.08E-03	1,548,337	446	1,531,113	399	1,480,972	386
			Natural Gas	kBTU	5.23	4.81	4.19	2.78E-04	2.55E-04	2.23E-04	654,206	35	601,028	32	524,145	28
Grand Total Area		5,205,000								Electricity	76,423,019	22,036	75,040,262	19,535	71,014,747	18,487
										Natural Gas	112,417,064	5,966	102,417,650	5,435	87,961,051	4,668

Notes:
1. Baseline usage rates for all buildings except for the stadium were taken from the 2006 California Commercial End-Use Survey (CEUS), performed by Itron under contract to the California Energy Commission (CEC). ENVIRON used data for PG&E, Zone 5.
2. Baseline Title 24 usage rates shown in this table have been adjusted to reflect improvements in Title 24 building codes since their introduction in 2002. CEC discusses average savings for improvements from 2002 to 2005 ("Impact Analysis for 2005 Energy Efficiency Standards") as well as from 2005 to 2008 ("Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings"). ENVIRON used these CEC average savings percentages, which are: for electricity: 8.5% reduction in 2005 and 4.9% reduction in 2008; for gas: 5.8% reduction in 2005 and 9.4% reduction in 2008.
3. The usage rate with 15% improvement over Title 24 is calculated as the baseline Title 24 usage reduced by 15% plus the baseline non-Title 24 usage.
4. GHG emission factors (EF) are calculated by multiplying the corresponding usage rates or usages by the conversion factors listed in Table 3-15. The 2005 Title 24 scenaro uses the current PG&E electricity carbon intensity factor. All other scenarios use the electricity carbon intensity value that has been adjusted to account for the 20% RPS in 2010.

Abbreviations:
CEC - California Energy Commission
CEUS - California Commerical End-Use Survey
CO_2e - carbon dioxide equivalent
EF - emission factor
GHG - greenhouse gas
kBTU - kilo (1000) British thermal units
kWh - kilowatt hours
PG & E - Pacific Gas and Electric
RPS - Renewable Portfolio Standard
SF - square feet
tonnes - metric tonnes
yr - year

Sources:
Itron, Incorporated. 2006. California Commercial End-Use Survey Results. CEC-400-2006-005. Available at http://www.energy.ca.gov/ceus/
San Francisco Department of the Environment and San Francisco Public Utilities Commission. 2004. Climate Action Plan for San Francisco.
California Energy Commission. 2003. Impact Analysis: 2005 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2005standards/archive/rulemaking/documents/2003-07-11_400-03-014.PDF
California Energy Commission. 2007. Impact Analysis: 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF

Table 3-19
Electricity Usage and Resulting GHG Emissions for Non-Residential Building Types: Variant 2
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Candlestick Point

Building Type	CEUS Building Type	Total Area [SF]	Energy Source	Unit	Usage Rate[1] [Unit/SF-yr]: Overall based on 2005 Title 24[2]	Usage Rate[1] [Unit/SF-yr]: Overall based on 2008 Title 24[2]	Usage Rate[1] [Unit/SF-yr]: Overall Project[3]	CO_2e EF[4] [tonnes/SF-yr]: Overall based on 2005 Title 24	CO_2e EF[4] [tonnes/SF-yr]: Overall based on 2008 Title 24	CO_2e EF[4] [tonnes/SF-yr]: Overall Project	Annual Total based on 2005 Title 24: Usage [Unit/yr] Overall	Annual Total based on 2005 Title 24: CO_2e Emissions[4] [tonnes/yr] Overall	Annual Total based on 2008 Title 24: Usage [Unit/yr] Overall	Annual Total based on 2008 Title 24: CO_2e Emissions[4] [tonnes/yr] Overall	Annual Total (with 15% Improvement over Title 24): Usage[3] [Unit/yr] Overall	Annual Total (with 15% Improvement over Title 24): CO_2e Emissions[4] [tonnes/yr] Overall
Hotel	Lodging	150,000	Electricity	kWh	9.76	9.62	9.22	2.82E-03	2.51E-03	2.40E-03	1,464,745	422	1,443,680	376	1,382,354	360
			Natural Gas	kBTU	37.29	34.46	30.36	1.98E-03	1.83E-03	1.61E-03	5,593,967	297	5,168,788	274	4,554,088	242
Office	Large Office	150,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	2,210,867	637	2,170,546	565	2,053,163	534
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	3,300,084	175	3,006,396	160	2,581,798	137
Community Space	Large Office	50,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	736,956	212	723,515	188	684,388	178
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	1,100,028	58	1,002,132	53	860,599	46
Retail	Retail	760,000	Electricity	kWh	12.39	12.25	11.85	3.57E-03	3.19E-03	3.08E-03	9,413,888	2,714	9,309,170	2,423	9,004,310	2,344
			Natural Gas	kBTU	5.23	4.81	4.19	2.78E-04	2.55E-04	2.23E-04	3,977,575	211	3,654,250	194	3,186,805	169
Miscellaneous	Miscellaneous	75,000	Electricity	kWh	8.83	8.76	8.54	2.55E-03	2.28E-03	2.22E-03	662,573	191	656,949	171	640,577	167
			Natural Gas	kBTU	26.06	24.26	21.65	1.38E-03	1.29E-03	1.15E-03	1,954,241	104	1,819,256	97	1,624,103	86
Grand Total Area		1,185,000								Electricity	14,489,028	4,178	14,303,859	3,724	13,764,791	3,583
										Natural Gas	15,925,895	845	14,650,823	778	12,807,394	680

Hunter's Point Shipyard

Building Type	CEUS Building Type	Total Area [SF]	Energy Source	Unit	Usage Rate[1] [Unit/SF-yr]: Overall based on 2005 Title 24[2]	Usage Rate[1] [Unit/SF-yr]: Overall based on 2008 Title 24[2]	Usage Rate[1] [Unit/SF-yr]: Overall Project[3]	CO_2e EF[4] [tonnes/SF-yr]: Overall based on 2005 Title 24	CO_2e EF[4] [tonnes/SF-yr]: Overall based on 2008 Title 24	CO_2e EF[4] [tonnes/SF-yr]: Overall Project	Annual Total based on 2005 Title 24: Usage [Unit/yr] Overall	Annual Total based on 2005 Title 24: CO_2e Emissions[4] [tonnes/yr] Overall	Annual Total based on 2008 Title 24: Usage [Unit/yr] Overall	Annual Total based on 2008 Title 24: CO_2e Emissions[4] [tonnes/yr] Overall	Annual Total (with 15% Improvement over Title 24): Usage[3] [Unit/yr] Overall	Annual Total (with 15% Improvement over Title 24): CO_2e Emissions[4] [tonnes/yr] Overall
R&D	Large Office	2,500,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	36,847,777	10,625	36,175,762	9,417	34,219,378	8,908
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	55,001,406	2,919	50,106,605	2,659	43,029,973	2,284
Community Space and Artist Studio	Large Office	80,000	Electricity	kWh	14.74	14.47	13.69	4.25E-03	3.77E-03	3.56E-03	1,179,129	340	1,157,624	301	1,095,020	285
			Natural Gas	kBTU	22.00	20.04	17.21	1.17E-03	1.06E-03	9.13E-04	1,760,045	93	1,603,411	85	1,376,959	73
Neighborhood Retail	Retail	125,000	Electricity	kWh	12.39	12.25	11.85	3.57E-03	3.19E-03	3.08E-03	1,548,337	446	1,531,113	399	1,480,972	386
			Natural Gas	kBTU	5.23	4.81	4.19	2.78E-04	2.55E-04	2.23E-04	654,206	35	601,028	32	524,145	28
Grand Total Area		2,705,000								Electricity	39,575,242	11,411	38,864,500	10,117	36,795,370	9,579
										Natural Gas	57,415,658	3,047	52,311,045	2,776	44,931,078	2,385

Notes:
1. Baseline usage rates for all buildings except for the stadium were taken from the 2006 California Commercial End-Use Survey (CEUS), performed by Itron under contract to the California Energy Commission (CEC). ENVIRON used data for PG&E, Zone 5.
2. Baseline Title 24 usage rates shown in this table have been adjusted to reflect improvements in Title 24 building codes since their introduction in 2002. CEC discusses average savings for improvements from 2002 to 2005 ("Impact Analysis for 2005 Energy Efficiency Standards") as well as from 2005 to 2008 ("Impact Analysis 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings"). ENVIRON used these CEC average savings percentages, which are: for electricity: 8.5% reduction in 2005 and 4.9% reduction in 2008; for gas: 5.8% reduction in 2005 and 9.4% reduction in 2008.
3. The usage rate with 15% improvement over Title 24 is calculated as the baseline Title 24 usage reduced by 15% plus the baseline non-Title 24 usage.
4. GHG emission factors (EF) are calculated by multiplying the corresponding usage rates or usages by the conversion factors listed in Table 3-15. The 2005 Title 24 scenaro uses the current PG&E electricity carbon intensity factor. All other scenarios use the electricity carbon intensity value that has been adjusted to account for the 20% RPS in 2010.

Abbreviations:
CEC - California Energy Commission
CEUS - California Commerical End-Use Survey
CO_2e - carbon dioxide equivalent
EF - emission factor
GHG - greenhouse gas
kBTU - kilo (1000) British thermal units
kWh - kilowatt hours
PG & E - Pacific Gas and Electric
RPS - Renewable Portfolio Standard
SF - square feet
tonnes - metric tonnes
yr - year

Sources:

Itron, Incorporated. 2006. California Commercial End-Use Survey Results. CEC-400-2006-005. Available at http://www.energy.ca.gov/ceus/
San Francisco Department of the Environment and San Francisco Public Utilities Commission. 2004. Climate Action Plan for San Francisco.
California Energy Commission. 2003. Impact Analysis: 2005 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2005standards/archive/rulemaking/documents/2003-07-11_400-03-014.PDF
California Energy Commission. 2007. Impact Analysis: 2008 Update to the California Energy Efficiency Standards for Residential and Nonresidential Buildings. Available at: http://www.energy.ca.gov/title24/2008standards/rulemaking/documents/2007-11-07_IMPACT_ANALYSIS.PDF

Table 3-20
Greenhouse Gas Emissions from Vehicles for the Year 2020: Project with Pavley Standards
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Trip Type[1]		Daily One-Way Trips[2] Unadjusted	Daily One-Way Trips[2] Weekend/Weekday Adjustment[3]	Trip Distance[4] (miles)	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total Annual CO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
Hunter's Point	Residential - Home Based Work	2,734	2,578	14.90	38,405	14,017,979	**310**	**108**	4,346	102	4,447	4,681
	Residential - Home Based Other	4,015	3,786	9.10	34,451	12,574,433			3,898	149	4,047	4,260
	Residential - Non-Home Based	1,794	1,692	9.50	16,069	5,865,325			1,818	67	1,885	1,984
	Residential - Internal Trips	4,398	4,147	1.00	4,147	1,513,583			469	164	633	666
	Nonresidential - Home Based Work	3,640	3,432	14.90	51,143	18,667,174			5,787	135	5,922	6,234
	Nonresidential - Home Based Other	6,801	6,412	9.10	58,350	21,297,687			6,602	253	6,855	7,216
	Nonresidential - Non-Home Based	3,828	3,610	9.50	34,290	12,515,967			3,880	142	4,022	4,234
	Nonresidential - Internal Trips	7,236	6,823	1.00	6,823	2,490,244			772	269	1,041	1,096
Total Trips		**34,447**	**32,478**		**243,678**	**88,942,393**			**27,572**	**1,281**	**28,853**	**30,371**
Candlestick Point	Residential - Home Based Work	7,889	7,438	14.90	110,824	40,450,805	**310**	**108**	12,540	293	12,833	13,508
	Residential - Home Based Other	11,586	10,924	9.10	99,412	36,285,254			11,248	431	11,679	12,294
	Residential - Non-Home Based	5,177	4,881	9.50	46,370	16,925,200			5,247	192	5,439	5,726
	Residential - Internal Trips	12,379	11,672	1.00	11,672	4,260,273			1,321	460	1,781	1,875
	Nonresidential - Home Based Work	7,818	7,371	14.90	109,834	40,089,485			12,428	291	12,718	13,388
	Nonresidential - Home Based Other	14,605	13,771	9.10	125,312	45,738,753			14,179	543	14,722	15,497
	Nonresidential - Non-Home Based	8,222	7,752	9.50	73,642	26,879,197			8,333	306	8,638	9,093
	Nonresidential - Internal Trips	14,710	13,870	1.00	13,870	5,062,481			1,569	547	2,116	2,228
	Music Venue-Worker	400	400	14.90	5,960	894,000			277	16	293	308
	Music Venue-Customer	2,666	2,666	9.10	24,261	3,639,090			1,128	43	1,171	1,233
Total Trips		**85,453**	**80,745**		**621,156**	**220,224,539**			**68,270**	**3,122**	**71,392**	**75,149**
Totals		**119,899**	**113,223**		**864,834**	**309,166,932**			**95,842**	**4,403**	**100,244**	**105,520**

Notes:

1. The trip type distribution is based on Fehr and Peers traffic study. The trip type distribution is consistent with Caltrans Household Travel Survey. This applies to everything except internal trips and the Music Venue.

Trip Type	Residential Trip Type Distribution	NonResidential Trip Type Distribution
Home Based Work	32%	26%
Home Based Other	47%	48%
Non-Home Based	21%	27%

2. The daily trips are based on Candlestick Point-Hunter's Point Shipyard Phase II Development Transportation Study trip generation rates for residential land use. For internal trips a vehicle occupance of 1.6 persons was assumed.

3. Daily trips were adjusted to account for differences between the weekend and the weekday traffic based on a report by Sonoma Technologies. No adjustment was made to the music venue trips since this is based on a per event calculation. It is assumed that there are 150 events per year.

4. Trip distances were provided by Fehr and Peers . The trip length is based on CP-HPS Plan's street network and land use plan as well as the regional roadway network and land use distribution.
5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for San Francisco. The emission factor has been updated to incorporate Pavley vehicle emission standards.
6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.
7. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:
ADT - Average Daily Trip
CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
GHG - Greenhouse Gas
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
VMT - Vehicle Miles Traveled

Sources:
CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunter's Point Shipyard Phase II Development Transportation Study.
Sonoma Technologies, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 3-21
Alternative Greenhouse Gas Emissions from Vehicles for the Year 2020: Project with Pavley Standards
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Trip Type[1]		Daily One-Way Trips[2]		Trip Distance[4]	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total AnnualCO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
		Unadjusted	Weekend/Weekday Adjustment[3]	(miles)								
Hunter's Point	Home Based Work	2,734	2,578	14.90	38,405	14,017,979			4,346	102	4,447	4,681
	Home Based Other	4,015	3,786	9.10	34,451	12,574,433			3,898	149	4,047	4,260
	Non-Home Based	1,794	1,692	9.50	16,069	5,865,325	**310**	**108**	1,818	67	1,885	1,984
	Internal Trips	4,398	4,147	1.00	4,147	1,513,583			469	164	633	666
Total Resident Trips		**12,941**	**12,202**		**93,072**	**33,971,321**			**10,531**	**481**	**11,012**	**11,592**
Candlestick Point	Home Based Work	7,889	7,438	14.90	110,824	40,450,805			12,540	293	12,833	13,508
	Home Based Other	11,586	10,924	9.10	99,412	36,285,254			11,248	431	11,679	12,294
	Non-Home Based	5,177	4,881	9.50	46,370	16,925,200	**310**	**108**	5,247	192	5,439	5,726
	Internal Trips	12,379	11,672	1.00	11,672	4,260,273			1,321	460	1,781	1,875
	Music Venue-Customer	2,666	2,666	9.10	24,261	6,065,150			1,880	72	1,952	2,055
Total Resident Trips		**39,697**	**37,581**		**292,539**	**103,986,683**			**32,236**	**1,449**	**33,685**	**35,458**
Totals		**52,639**	**49,783**		**385,611**	**137,958,003**			**42,767**	**1,930**	**44,697**	**47,049**

Notes:

1. The trip type distribution is based on Fehr and Peers traffic study. The trip type distribution is consistent with Caltrans Household Travel Survey. This applies to everything except internal trips and the Music Venue.

Trip Type	Trip Type Distribution
Home Based Work	32%
Home Based Other	47%
Non-Home Based	21%

2. The daily trips are based on Candlestick Point-Hunter's Point Shipyard Phase II Development Transportation Study trip generation rates for residential land use. For internal trips a vehicle occupance of 1.6 persons was assumed. Only the Customer Music Venue trips are considered "new" trips.
3. Daily trips were adjusted to account for differences between the weekend and the weekday traffic based on a report by Sonoma Technologies. No adjustment was made to the music venue trips since this is based on a per event calculation. It is assumed that there are 250 events per year.
4. Trip distances were provided by Fehr and Peers . The trip length is based on CP-HPS Plan's street network and land use plan as well as the regional roadway network and land use distribution.
5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for San Francisco. The emission factor has been updated to incorporate Pavley vehicle emission standards.
6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.
7. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

ADT - Average Daily Trip
CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
GHG - Greenhouse Gas
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
VMT - Vehicle Miles Traveled

Sources:

CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunter's Point Shipyard Phase II Development Transportation Study.
Sonoma Technologies, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 3-22
Greenhouse Gas Emissions from Vehicles for the Year 2020: Variant 1 with Pavley Standards
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Trip Type[1]		Daily One-Way Trips[2] Unadjusted	Daily One-Way Trips[2] Weekend/Weekday Adjustment[3]	Trip Distance[4] (miles)	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total Annual CO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
Hunter's Point	Residential - Home Based Work	2,981	2,810	14.90	41,876	15,284,733	**310**	**108**	4,738	111	4,849	5,104
	Residential - Home Based Other	4,378	4,128	9.10	37,564	13,710,739			4,250	163	4,413	4,645
	Residential - Non-Home Based	1,956	1,844	9.50	17,522	6,395,353			1,983	73	2,055	2,163
	Residential - Internal Trips	3,404	3,209	1.00	3,209	1,171,376			363	127	490	515
	Nonresidential - Home Based Work	5,556	5,556	14.90	82,792	30,218,924			9,368	219	9,587	10,092
	Nonresidential - Home Based Other	10,380	10,380	9.10	94,458	34,477,268			10,688	409	11,097	11,681
	Nonresidential - Non-Home Based	5,843	5,843	9.50	55,510	20,261,184			6,281	230	6,511	6,854
	Nonresidential - Internal Trips	7,949	7,949	1.00	7,949	2,901,506			899	313	1,213	1,277
Total Trips		**42,448**	**41,721**		**340,880**	**124,421,083**			**38,571**	**1,645**	**40,216**	**42,332**
Candlestick Point	Residential - Home Based Work	7,889	7,438	14.90	110,824	40,450,805	**310**	**108**	12,540	293	12,833	13,508
	Residential - Home Based Other	11,586	10,924	9.10	99,412	36,285,254			11,248	431	11,679	12,294
	Residential - Non-Home Based	5,177	4,881	9.50	46,370	16,925,200			5,247	192	5,439	5,726
	Residential - Internal Trips	12,379	11,672	1.00	11,672	4,260,273			1,321	460	1,781	1,875
	Nonresidential - Home Based Work	7,818	7,818	14.90	116,491	42,519,150			13,181	308	13,489	14,199
	Nonresidential - Home Based Other	14,605	14,605	9.10	132,906	48,510,799			15,038	576	15,614	16,436
	Nonresidential - Non-Home Based	8,222	8,222	9.50	78,105	28,508,240			8,838	324	9,162	9,644
	Nonresidential - Internal Trips	14,710	14,710	1.00	14,710	5,369,299			1,664	580	2,245	2,363
	Music Venue-Worker	400	400	14.90	5,960	894,000			277	16	293	308
	Music Venue-Customer	2,666	2,666	9.10	24,261	3,639,090			1,128	43	1,171	1,233
Total Trips		**85,453**	**83,337**		**640,711**	**227,362,110**			**70,482**	**3,224**	**73,706**	**77,586**
Totals		**127,900**	**125,057**		**981,591**	**351,783,194**			**109,053**	**4,869**	**113,922**	**119,918**

Notes:

1. The trip type distribution is based on Fehr and Peers traffic study. The trip type distribution is consistent with Caltrans Household Travel Survey. This applies to everything except internal trips and the Music Venue.

Trip Type	Residential Type Distribution	NonResidential Trip Type Distribution
Home Based Work	32%	26%
Home Based Other	47%	48%
Non-Home Based	21%	27%

2. The daily trips are based on Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study trip generation rates for residential land use. For internal trips a vehicle occupance of 1.6 persons was assumed.

3. Daily trips were adjusted to account for differences between the weekend and the weekday traffic based on a report by Sonoma Technologies. No adjustment was made to the music venue trips since this is based on a per event calculation. It is assumed that there are 150 events per year.

4. Trip distances were provided by Fehr and Peers . The trip length is based on CP-HPS Plan's street network and land use plan as well as the regional roadway network and land use distribution.

5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for San Francisco. The emission factor has been updated to incorporate Pavley vehicle emission standards.

6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.

7. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4 N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

ADT - Average Daily Trip
CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
GHG - Greenhouse Gas
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
VMT - Vehicle Miles Traveled

Sources:

CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study.
Sonoma Technologies, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 3-23
Alternative Greenhouse Gas Emissions from Vehicles for the Year 2020: Variant 1 with Pavley Standards Alternative Method
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Trip Type[1]		Daily One-Way Trips[2] Unadjusted	Daily One-Way Trips[2] Weekend/Weekday Adjustment[3]	Trip Distance[4] (miles)	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total Annual CO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
Hunter's Point	Home Based Work	2,981	2,810	14.90	41,876	15,284,733	**310**	**108**	4,738	111	4,849	5,104
	Home Based Other	4,378	4,128	9.10	37,564	13,710,739			4,250	163	4,413	4,645
	Non-Home Based	1,956	1,844	9.50	17,522	6,395,353			1,983	73	2,055	2,163
	Internal Trips	3,404	3,209	1.00	3,209	1,171,376			363	127	490	515
Total Resident Trips		**12,719**	**11,992**		**100,170**	**36,562,202**			**11,334**	**473**	**11,807**	**12,429**
Candlestick Point	Home Based Work	7,889	7,438	14.90	110,824	40,450,805	**310**	**108**	12,540	293	12,833	13,508
	Home Based Other	11,586	10,924	9.10	99,412	36,285,254			11,248	431	11,679	12,294
	Non-Home Based	5,177	4,881	9.50	46,370	16,925,200			5,247	192	5,439	5,726
	Internal Trips	12,379	11,672	1.00	11,672	4,260,273			1,321	460	1,781	1,875
	Music Venue-Customer	2,666	2,666	9.10	24,261	6,065,150			1,880	72	1,952	2,055
Total Resident Trips		**39,697**	**37,581**		**292,539**	**103,986,683**			**32,236**	**1,449**	**33,685**	**35,458**
Totals		**52,416**	**49,573**		**392,709**	**140,548,884**			**43,570**	**1,922**	**45,492**	**47,886**

Notes:

1. The trip type distribution is based on Fehr and Peers traffic study. The trip type distribution is consistent with Caltrans Household Travel Survey. This applies to everything except internal trips and the Music Venue.

Trip Type	Trip Type Distribution
Home Based Work	32%
Home Based Other	47%
Non-Home Based	21%

2. The daily trips are based on Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study trip generation rates for residential land use. For internal trips a vehicle occupance of 1.6 persons was assumed. Only the Customer Music Venue trips are considered "new" trips.

3. Daily trips were adjusted to account for differences between the weekend and the weekday traffic based on a report by Sonoma Technologies. No adjustment was made to the music venue trips since this is based on a per event calculation. It is assumed that there are 250 events per year.

4. Trip distances were provided by Fehr and Peers . The trip length is based on CP-HPS Plan's street network and land use plan as well as the regional roadway network and land use distribution.

5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for San Francisco. The emission factor has been updated to incorporate Pavley vehicle emission standards.

6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.

7. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

ADT - Average Daily Trip
CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
GHG - Greenhouse Gas
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
VMT - Vehicle Miles Traveled

Sources:

CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study.
Sonoma Technologies, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 3-24
Greenhouse Gas Emissions from Vehicles for the Year 2020: Variant 2 with Pavley Standards
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Trip Type[1]		Daily One-Way Trips[2]		Trip Distance[4]	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total AnnualCO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
		Unadjusted	Weekend/Weekday Adjustment[3]	(miles)								
Hunter's Point	Residential - Home Based Work	3,813	3,595	14.90	53,564	19,551,003	**310**	**108**	6,061	142	6,203	6,529
	Residential - Home Based Other	5,600	5,280	9.10	48,048	17,537,677			5,437	208	5,645	5,942
	Residential - Non-Home Based	2,502	2,359	9.50	22,412	8,180,422			2,536	93	2,629	2,767
	Residential - Internal Trips	7,898	7,446	1.00	7,446	2,717,868			843	294	1,136	1,196
	Nonresidential - Home Based Work	3,319	3,319	14.90	49,456	18,051,356			5,596	131	5,727	6,028
	Nonresidential - Home Based Other	6,201	6,201	9.10	56,425	20,595,089			6,384	244	6,629	6,978
	Nonresidential - Non-Home Based	3,490	3,490	9.50	33,159	12,103,073			3,752	138	3,890	4,094
	Nonresidential - Internal Trips	8,426	8,426	1.00	8,426	3,075,427			953	332	1,286	1,353
Total Trips		**41,248**	**40,116**		**278,937**	**101,811,915**			**31,562**	**1,582**	**33,144**	**34,888**
Candlestick Point	Residential - Home Based Work	6,898	6,503	14.90	96,901	35,369,021	**310**	**108**	10,964	256	11,221	11,811
	Residential - Home Based Other	10,131	9,552	9.10	86,923	31,726,783			9,835	377	10,212	10,749
	Residential - Non-Home Based	4,527	4,268	9.50	40,545	14,798,909			4,588	168	4,756	5,006
	Residential - Internal Trips	8,524	8,037	1.00	8,037	2,933,388			909	317	1,226	1,291
	Nonresidential - Home Based Work	8,307	8,307	14.90	123,770	45,176,121			14,005	328	14,332	15,086
	Nonresidential - Home Based Other	15,518	15,518	9.10	141,211	51,542,181			15,978	612	16,590	17,463
	Nonresidential - Non-Home Based	8,735	8,735	9.50	82,985	30,289,685			9,390	344	9,734	10,247
	Nonresidential - Internal Trips	12,354	12,354	1.00	12,354	4,509,273			1,398	487	1,885	1,984
	Music Venue-Worker	400	400	14.90	5,960	894,000			277	16	293	308
	Music Venue-Customer	2,666	2,666	9.10	24,261	3,639,090			1,128	43	1,171	1,233
Total Trips		**78,059**	**76,340**		**622,948**	**220,878,451**			**68,472**	**2,948**	**71,421**	**75,180**
Totals		**119,307**	**116,456**		**901,884**	**322,690,366**			**100,034**	**4,530**	**104,564**	**110,068**

Notes:

1. The trip type distribution is based on Fehr and Peers traffic study. The trip type distribution is consistent with Caltrans Household Travel Survey.

Trip Type	Residential Trip Type Distribution	NonResidential Trip Type Distribution
Home Based Work	32%	26%
Home Based Other	47%	48%
Non-Home Based	21%	27%

2. The daily trips are based on Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study trip generation rates for residential land use. For internal trips a vehicle occupance of 1.6 persons was assumed.
3. Daily trips were adjusted to account for differences between the weekend and the weekday traffic based on a report by Sonoma Technologies. No adjustment was made to the music venue trips since this is based on a per event calculation. It is assumed that there are 150 ev per year.
4. Trip distances were provided by Fehr and Peers . The trip length is based on CP-HPS Plan's street network and land use plan as well as the regional roadway network and land use distribution.
5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for San Francisco. The emission factor has been updated to incorporate Pavley vehicle emission standards.
6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.
7. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4 N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

ADT - Average Daily Trip
CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
GHG - Greenhouse Gas
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
VMT - Vehicle Miles Traveled

Sources:

CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study.
Sonoma Technologies, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 3-25
Alternative Greenhouse Gas Emissions from Vehicles for the Year 2020: Variant 2 with Pavley Standards
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Trip Type[1]		Daily One-Way Trips[2]		Trip Distance[4]	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total AnnualCO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
		Unadjusted	Weekend/Weekday Adjustment[3]	(miles)								
Hunter's Point	Home Based Work	3,813	3,595	14.90	53,564	19,551,003			6,061	142	6,203	6,529
	Home Based Other	5,600	5,280	9.10	48,048	17,537,677			5,437	208	5,645	5,942
	Non-Home Based	2,502	2,359	9.50	22,412	8,180,422	**310**	**108**	2,536	93	2,629	2,767
	Internal Trips	7,898	7,446	1.00	7,446	2,717,868			843	294	1,136	1,196
Total Resident Trips		**19,813**	**18,680**		**131,471**	**47,986,970**			**14,876**	**737**	**15,613**	**16,434**
Candlestick Point	Home Based Work	6,898	6,503	14.90	96,901	35,369,021			10,964	256	11,221	11,811
	Home Based Other	10,131	9,552	9.10	86,923	31,726,783			9,835	377	10,212	10,749
	Non-Home Based	4,527	4,268	9.50	40,545	14,798,909			4,588	168	4,756	5,006
	Internal Trips	8,524	8,037	1.00	8,037	2,933,388	**310**	**108**	909	317	1,226	1,291
	Music Venue-Customer	2,666	2,666	9.10	24,261	6,065,150			1,880	72	1,952	2,055
Total Resident Trips		**32,745**	**31,026**		**256,666**	**90,893,250**			**28,177**	**1,190**	**29,367**	**30,913**
Totals		**52,557**	**49,706**		**388,138**	**138,880,220**			**43,053**	**1,927**	**44,980**	**47,347**

Notes:

1. The trip type distribution is based on Fehr and Peers traffic study. The trip type distribution is consistent with Caltrans Household Travel Survey.

Trip Type	Trip Type Distribution
Home Based Work	32%
Home Based Other	47%
Non-Home Based	21%

2. The daily trips are based on Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study trip generation rates for residential land use.
3. Daily trips were adjusted to account for differences between the weekend and the weekday traffic based on a report by Sonoma Technologies.
4. Trip distances were provided by Fehr and Peers . The trip length is based on CP-HPS Plan's street network and land use plan as well as the regional roadway network and land use distribution.
5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for San Francisco. The emission factor has been updated to incorporate Pavley vehicle emission standards.
6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.
7. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

ADT - Average Daily Trip
CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
GHG - Greenhouse Gas
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
VMT - Vehicle Miles Traveled

Sources:

CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study.
Sonoma Technologies, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 3-26
Greenhouse Gas Emission from Transit Area
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, CA

Scenario	Net New Miles[1]	Net New Idling Time[1]	Emission Factor[2,3]		CO_2 Emisisons[4]		Total CO_2e Emissions
			Running	Idling	Running	Idling	
	(miles/yr)	(minutes/yr)	(g/mile)	(g/idle-hr)	(metric tonnes)		
No Action Taken	974,303	2,205,615	2,805	4,098	2,733	151	2,884
Project			1,683	2,459	1,640	90	1,730

Notes:

1. Net new annual miles and net new idling time for SFMTA transit due to the project are based on data from Fehr & Peers.
2. The running emission factors are based on EMFAC emission factors for an urban diesel bus. The idling emission factors are based on a diesel school bus.
3. For the Project scenario the running emission factor value has been adjusted to account for fuel economy improvements resulting from using hybrid buses. The running and idling emission factors have been reduced by 25% to account for the increased fuel efficiency of hybrid buses based on SFMTA reports on fuel improvements above 25%. The running and idling emission factors have been further adjusted to account for reduced CO_2 emissions resulting from the use of B20 fuel instead of regular diesel. Based on CCAR recommendations, emissions from burning biodiesel are not included as direct mobile emissions.
4. GHG Running Emission calculation formula: GHG Emissions = Net New Miles x Running Emission Factor x Conversion Factors
   GHG Idling Emission calculation formula: GHG Emissions = New New Idling Time x Idling Emission Factor x Conversion Factors

Abbreviations:

B20 - a blend of 20 percent by volume biodiesel with 80 percent by volume petroleum diesel
CO_2 - carbon dioxide
CCAR - California Climate Action Registry
EMFAC - Emission Factors Database
SFMTA - San Francisco Municipal Transportation Agency

Sources:

California Climate Action Registry (CCAR) General Reporting Protocol Version 3.1, January 2009.
SFMTA Climate Action Plan, Draft for Public Review, December 19, 2008.

Table 3-27
Net New Transit Annual Vehicle Miles Traveled and Idle Time
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Line	Type of Vehicle	Net New One-Way Freeway Mileage	Net New One-Way Local Mileage	Total Annual Runs	Net New Annual Miles	Net New Annual Idle Time (mins)[1]	Net New Annual Idle Time (days)
CPX	MC STD	4	4.6	15,300	131,580	145,350	101
HPX	MC STD	1.3	5.2	12,750	82,875	121,125	84
Route 48 (current 19)	MC STD	0	0.5	47,925	23,963	95,850	67
Route 48 Short Line	MC STD	0	5.2	9,450	49,140	196,560	137
Route 23	MC STD						
Route 24	TC STD	0	1.7	106,650	181,305	533,250	370
Route 28L Extension	MC STD	0	5.5	55,350	304,425	608,850	423
Route 28L Short Line	MC STD	0	6.5	37,800	245,700	491,400	341
Route 29 Extension	MC STD	0	0.3	62,100	18,630	74,520	52
Route 29 Short Line	MC STD	0	4.6	25,650	117,990	471,960	328
Route 44	MC STD						
Route 54	MC STD						
T-Third	LRV2						
Hybrid Motor Coach			*MC STD*		*974,303*	*2,205,615*	*1,532*
Electric Trolley Car			*TC STD*		*181,305*	*533,250*	*370*
Light Rail Vehicle		***Total by Vehicle Type***	*LRV2*				
		Total			***1,155,608***	***2,738,865***	***1,902***

Notes: Shaded cells indicate transit lines where the mileage does not change in the CP/HP project.

1. Idle time represents two factors: layover time at the end of each run and the time spent idling at stops. Layover time is assumed to be two minutes for each one-way transit trip and is only used for the CPX and HPX lines as they are the only new transit lines for CP/HP. The two minutes assumes that the driver will turn off the vehicle's engine for a majority of the layover time. The time spent idling at stops is based on new stops along each line. The stops are assumed to be located about every 1/8 mile for local routes and about every 1/4 mile for the express and limited routes, with modifications made based on the CP/HP Proposed Transit Plan.

Source: Fehr & Peers, 2009

Table 3-28
GHG Emission Factors for Municipal Sources: Project Scenario with Renewable Portfolio Standard
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, CA

Source[1]	Energy Requirements	Units	Emission Factor[11]	Units	Source Quantity		Units	Total CO_2e Emissions		Units
					CP	HPS		CP	HPS	
Lighting										
Public Lighting[2]	141	kW-hr/capita/yr	0.037	tonne CO_2e/capita/year	17,694	6,175	residents (capita)	651	227.28	tonne CO_2e
Municipal Vehicles										
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	17,694	6,175	residents (capita)	885	309	
Water and Wastewater [4]										
Water Supply and Conveyance (Potable)[5]	0	kW-hr/Mgal	0.00	tonne CO_2e/Mgal	0.88	0.79	MM gallons/day	0	0	tonne CO_2e
Water Treatment (Potable)[6]	111	kW-hr/Mgal	0.03	tonne CO_2e/Mgal	0.88	0.79	MM gallons/day	9	8	tonne CO_2e
Water Distribution (Potable)[7]	1,272	kW-hr/Mgal	0.33	tonne CO_2e/Mgal	0.88	0.79	MM gallons/day	106	95	tonne CO_2e
Wastewater Treatment and Discharge (Indirect Emissions)[8]	1,688	kW-hr/Mgal	0.44	tonne CO_2e/Mgal	0.88	0.79	MM gallons/day	141	127	tonne CO_2e
Wastewater Treament Plant (Direct Emissions)[9]	--	--	0.084	tonne CO_2e/capita/year	0.00	0.00	MM gallons/day	0	0	tonne CO_2e
					Water and Wastewater Total:			**257**	**230**	tonne CO_2e
					Municipal Sources Total:			**1,793**	**766**	tonne CO_2e

Notes:

1. Public lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from PG&E. The CP-HPS Plan to install energy-efficient street lighting which will reduce street lighting electricity demand by 16%. The resultant energy savings is calculated from the annual energy costs found on page 4 of NYSERDA's 2002 How-to Guide to Effective Energy-Efficient Street Lighting.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. Source quantities for water and wastewater are based on ARUP's estimates.

5. Emission factor for the supply and conveyance of potable water is based on a CEC (2006) study. 85% of the water supply in San Francisco is supplied via gravity from the Hetch Hetchy basin. The CEC (2006) study suggests that Hetch Hetchy system is gravity-dominated and has minimal net carbon emissions.

6.Emission factor for water treatment is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.

7.Emission factor for water distribution is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.

8. Emission factor for wastewater treatment are from the energy requirements for the Southeast Pollution Control Center provided in a Request for Proposals. This information was provided in "SFPUC Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101".

9. All methane emissions from the wastewater at the Southeast Wastewater Treatment Plant is burned at the flare station or cogeneration plant, and no methane emissions are directly emitted from the wastewater as directed by the plant's air per

11. GHG emissions attributed to electricity use are calculated using the PG&E carbon-intensity factor, which is 0.574 lbs CO2 per kW-hr after adjustment to reflect 20% renewable energy in accordance with the Renewables Portfolio Standard.

Abbreviations:

CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
EPRI - Electric Power Research Institute
GHG - greenhouse gas
HPS - Hunter's Point Shipyard
kW-hr - kilowatt hour
MMgal - million gallons
MW-hr - megawatt hour
NYSERDA - New York State Energy Research and Development Authority
PG&E - Pacific Gas and Electric
psi - pound per square inch
SFPUC - San Francisco Public Utility Commission
Tg - teragram
USEPA - United States Environmental Protection Agency

Sources:

California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
City of Medford. 2001. Climate Action Plan. October. http://www.massclimateaction.org/pdf/MedfordPlan2001.pdf
City of Northampton. 2006. Greenhouse Gas Emissions Inventory. Cities for Climate Protection Campaign. June. http://www.northamptonma.gov/uploads/listWidget/3208/NorthamptonInventoryClimateProtection.pdf
City of Santa Rosa. Cities for Climate Protection: Santa Rosa. http://ci.santa-rosa.ca.us/City_Hall/City_Manager/CCPFinalReport.pdf
EPRI. 2001. Summary Report for California Energy Commission Energy Efficiency Studies. Http://www.energy.ca.gov/pier/iaw/reports/2003_09_26_Appendix_2_7.pdf
New York State Energy Research and Development Authority (NYSERDA), 2002.*How-to Guide to Effective Energy-Efficient Street Lighting for Municipal Elected/Appointed Officials.* October.
San Francisco Public Utilities Commission. 2003. Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101.
Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives.
U.S. Census Bureau. http://www.census.gov/main/www/cen2000.html
USEPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. #430-R-07-002. April. http://epa.gov/climatechange/emissions/downloads06/07Waste.pdf

Table 3-29
GHG Emission Factors for Municipal Sources: Variant 1 with Renewable Portfolio Standard
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, CA

Source[1]	Energy Requirements	Units	Emission Factor[10]	Units	Source Quantity		Units	Total CO_2e		Units
					CP	HPS[11]		CP	HPS	
Lighting										
Public Lighting[2]	141	kW-hr/capita/yr	0.037	tonne CO_2e/capita/year	17,694	6,175	residents (capita)	651	227.28	tonne CO_2e
Municipal Vehicles										
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	17,694	6,175	residents (capita)	885	309	
Water and Wastewater [4]										
Water Supply and Conveyance (Potable)[5]	0	kW-hr/Mgal	0.00	tonne CO_2e/Mgal	0.88	1.11	MM gallons/day	0	0	tonne CO_2e
Water Treatment (Potable)[6]	111	kW-hr/Mgal	0.03	tonne CO_2e/Mgal	0.88	1.11	MM gallons/day	9	12	tonne CO_2e
Water Distribution (Potable)[7]	1,272	kW-hr/Mgal	0.33	tonne CO_2e/Mgal	0.88	1.11	MM gallons/day	106	134	tonne CO_2e
Wastewater Treatment and Discharge (Indirect Emissions) [8]	1,688	kW-hr/Mgal	0.44	tonne CO_2e/Mgal	0.88	1.11	MM gallons/day	141	178	tonne CO_2e
Wastewater Treament Plant (Direct Emissions) [9]	--	--	0.084	tonne CO_2e/capita/year	0.00	0.00	MM gallons/day	0	0	tonne CO_2e
							Water and Wastewater Total:	**257**	**324**	tonne CO_2e
							Municipal Sources Total:	**1,793**	**860**	tonne CO_2e

Notes:

1. Public lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from PG&E. The CP-HPS Plan to install energy-efficient street lighting which will reduce street lighting electricity demand by 16%. The resultant energy savings is calculated from the annual energy costs found on page 4 of NYSERDA's 2002 How-to Guide to Effective Energy-Efficient Street Lighting.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. Source quantities for water and wastewater are based on ARUP's estimates.

5. Emission factor for the supply and conveyance of potable water is based on a CEC (2006) study. 85% of the water supply in San Francisco is supplied via gravity from the Hetch Hetchy basin. The CEC (2006) study suggests that Hetch Hetchy system is gravity-dominated and has minimal net carbon emissions.
6.Emission factor for water treatment is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.
7.Emission factor for water distribution is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.
8. Emission factor for wastewater treatment are from the energy requirements for the Southeast Pollution Control Center provided in a Request for Proposals. This information was provided in "SFPUC Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101".

9. All methane emissions from the wastewater at the Southeast Wastewater Treatment Plant is burned at the flare station or cogeneration plant, and no methane emissions are directly emitted from the wastewater as directed by the plant's air permit.

10. GHG emissions attributed to electricity use are calculated using the PG&E carbon-intensity factor, which is 0.574 lbs CO2 per kWh after adjustment to reflect 20% renewable energy in accordance with the Renewables Portfolio Standard.

11. Water demand for Hunter's Point has been adjusted from the Project Scenario in two ways: (1) water demand allocated for the stadium has been removed to reflect the "no stadium" scenario, and (2) the water demand allocated for research & development has been doubled to reflect the correspoinding increase in square footage. No changes were made to water dermand for Candlestick Point.

Abbreviations:

CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
EPRI - Electric Power Research Institute
GHG - greenhouse gas
HPS - Hunter's Point Shipyard
IB - India Basin
kW-hr - kilowatt hour
MMgal - million gallons
MW-hr - megawatt hour
NYSERDA - New York State Energy Research and Development Authority
PG&E - Pacific Gas and Electric
psi - pound per square inch
SFPUC - San Francisco Public Utility Commission
Tg - teragram
USEPA - United States Environmental Protection Agency

Sources:

California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
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EPRI. 2001. Summary Report for California Energy Commission Energy Efficiency Studies. Http://www.energy.ca.gov/pier/iaw/reports/2003_09_26_Appendix_2_7.pdf
New York State Energy Research and Development Authority (NYSERDA), 2002. *How-to Guide to Effective Energy-Efficient Street Lighting for Municipal Elected/Appointed Officials.* October.
San Francisco Public Utilities Commission. 2003. Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101.
Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives.
U.S. Census Bureau. http://www.census.gov/main/www/cen2000.html
USEPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. #430-R-07-002. April. http://epa.gov/climatechange/emissions/downloads06/07Waste.pdf

Table 3-30
GHG Emission Factors for Municipal Sources: Variant 2 with Renewable Portfolio Standard
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, CA

Source[1]	Energy Requirements	Units	Emission Factor[10]	Units	Source Quantity		Units	Total CO_2e Emissions		Units
					CP[12]	HPS[11]		CP[13]	HPS[13]	
Lighting										
Public Lighting[2]	141	kW-hr/capita/yr	0.037	tonne CO_2e/capita/year	14,549	9,320	residents (capita)	536	343	tonne CO_2e
Municipal Vehicles										
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	14,549	9,320	residents (capita)	727	466	
Water and Wastewater [4]										
Water Supply and Conveyance (Potable)[5]	0	kW-hr/Mgal	0.00	tonne CO_2e/Mgal	0.77	0.88	MM gallons/day	0	0	tonne CO_2e
Water Treatment (Potable)[6]	111	kW-hr/Mgal	0.03	tonne CO_2e/Mgal	0.77	0.88	MM gallons/day	8	9	tonne CO_2e
Water Distribution (Potable)[7]	1,272	kW-hr/Mgal	0.33	tonne CO_2e/Mgal	0.77	0.88	MM gallons/day	93	106	tonne CO_2e
Wastewater Treatment and Discharge (Indirect Emissions) [8]	1,688	kW-hr/Mgal	0.44	tonne CO_2e/Mgal	0.77	0.88	MM gallons/day	123	141	tonne CO_2e
Wastewater Treament Plant (Direct Emissions) [9]	--	--	0.084	tonne CO_2e/capita/year	0.00	0.00	MM gallons/day	0	0	tonne CO_2e
							Water and Wastewater Total:	**225**	**257**	tonne CO_2e
							Municipal Sources Total:	**1,488**	**1,066**	tonne CO_2e

Notes:

1. Public lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from PG&E. The CP-HPS Plan to install energy-efficient street lighting which will reduce street lighting electricity demand by 16%. The resultant energy savings is calculated from the annual energy costs found on page 4 of NYSERDA's 2002 How-to Guide to Effective Energy-Efficient Street Lighting.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. Source quantities for water and wastewater are based on ARUP's estimates.

5. Emission factor for the supply and conveyance of potable water is based on a CEC (2006) study. 85% of the water supply in San Francisco is supplied via gravity from the Hetch Hetchy basin. The CEC (2006) study suggests that Hetch Hetchy system is gravity-dominated and has minimal net carbon emissions.

6.Emission factor for water treatment is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.

7.Emission factor for water distribution is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.

8. Emission factor for wastewater treatment are from the energy requirements for the Southeast Pollution Control Center provided in a Request for Proposals. This information was provided in "SFPUC Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101".

9. All methane emissions from the wastewater at the Southeast Wastewater Treatment Plant is burned at the flare station or cogeneration plant, and no methane emissions are directly emitted from the wastewater as directed by the plant's air permit.

10. GHG emissions attributed to electricity use are calculated using the PG&E carbon-intensity factor, which is 0.574 lbs CO2 per kW-hr after adjustment to reflect 20% renewable energy in accordance with the Renewables Portfolio Standard.

11. Water demand for Hunter's Point was adjusted from Project Scenario in two ways: (1) water demand allocated for the stadium has been removed to reflect the "no stadium" scenario, and (2) residential water demand was increased to reflect the increase in dwelling units from 2,650 to 4,000.

12. Water demand for Candlestick Point was decreased to reflect a decrease in dwelling units from 7,594 to 6244.

13. The change in dwelling units at Hunter's Point and Candlestick Point caused proportional changes to energy use for municipal lighting and vehicles.

Abbreviations:

CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
EPRI - Electric Power Research Institute
GHG - greenhouse gas
IB - India Basin
kW-hr - kilowatt hour
MMgal - million gallons
MW-hr - megawatt hour
NYSERDA - New York State Energy Research and Development Authority
PG&E - Pacific Gas and Electric
psi - pound per square inch
SFPUC - San Francisco Public Utility Commission
Tg - teragram
USEPA - United States Environmental Protection Agency

Sources:

California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
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Table 3-31
GHG Emissions from Area Sources-Hearth Fuel Combustion
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, CA

Natural Gas Fireplace Dwelling Unit Type[1]	Quantity[2]	Quantity[2]	Average Energy Use[3]	Usage Rate[4]	Energy Use per Year (Mbtu/year)	Energy Use per Year (Mbtu/year)	CO_2 Emission Factor[5]	Annual CO_2 Emission (tonnes/year)	
	CP	HPS	(Btu/hour/unit)	(hours/year)	CP	HPS	(lb CO_2/Mbtu)	CP	HPS
Multi-family	759	265	20,000	200	3,038	1,060	117	161	56
							Natural Gas Fireplaces Total:	**161**	**56**

Notes:
1. There will be no wood-burning stoves or fireplaces at Candlestick Point-Hunters Point Shipyard Phase II Development Plan.
2. Lennar anticipates 10% of the multi-family residences to have a natural gas fireplace.
3. Average energy use values are URBEMIS default values.
4. Usage rate of 200 hours/year is the URBEMIS default value.
5. Emission factor based on AP-42 value for natural gas combustion.

Abbreviations:
CO2 - Carbon Dioxide
CP - Candlestick Point
HPS - Hunter's Point
lb - pound
Mbtu - Million British
USEPA - United States Environmental

Sources:

USEPA. 1995. AP-42, Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. January. Available at: http://www.epa.gov/ttn/chief/ap42/
South Coast Air Quality Management District. Software User's Guide: URBEMIS2007 for Windows. Prepared by Jones & Stokes Associates. November. Available at: http://www.aqmd.gov/CEQA/urbemis.html

Table 3-32
GHG Emissions from Area Sources-Hearth Fuel Combustion: Variant 2
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, CA

Natural Gas Fireplace Dwelling Unit Type[1]	Quantity[2]	Quantity[2]	Average Energy Use[3]	Usage Rate[4]	Energy Use per Year (Mbtu/year)	Energy Use per Year (Mbtu/year)	CO_2 Emission Factor[5]	Annual CO_2 Emission (tonnes/year)	
	CP	HPS	(Btu/hour/unit)	(hours/year)	CP	HPS	(lb CO_2/Mbtu)	CP	HPS
Multi-family	624	400	20,000	200	2,498	1,600	117	132	85
							Natural Gas Fireplaces Total:	**132**	**85**

Notes:
1. There will be no wood-burning stoves or fireplaces at Candlestick Point-Hunters Point Shipyard Phase II Development Plan.
2. Lennar anticipates 10% of the multi-family residences to have a natural gas fireplace.
3. Average energy use values are URBEMIS default values.
4. Usage rate of 200 hours/year is the URBEMIS default value.
5. Emission factor based on AP-42 value for natural gas combustion.

Abbreviations:
CO2 - Carbon Dioxide
CP - Candlestick Point
HPS - Hunter's Point
lb - pound
Mbtu - Million British
USEPA - United States Environmental

Sources:
USEPA. 1995. AP-42, Fifth Edition. Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources. January. Available at: http://www.epa.gov/ttn/chief/ap42/
South Coast Air Quality Management District. Software User's Guide: URBEMIS2007 for Windows. Prepared by Jones & Stokes Associates. November. Available at: http://www.aqmd.gov/CEQA/urbemis.html

Table 3-33
GHG Emissions from Waste Disposal: Project Scenario
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Land Use	Units		Units	Rate of Waste Disposal[1]		Waste Disposal[2]		Annual CO_2 Emissions[3]	
	CP	HPS		Value	Units	CP	HPS	CP	HPS
						(tonnes/year)		(tonnes CO_2e/year)	
Residential Units	7,594	2,650	dwelling units	1957	lb/unit/year	6,742	2,353	454	159
Retail	760,000	125,000	square feet	2.1	lb/sf/year	724	119	49	8
Office	150,000	0	square feet	1.87	lb/sf/year	127	0	9	0
Hotel	220	0	rooms	1840	lb/room/year	184	0	12	0
R&D	0	2,500,000	square feet	2.19	lb/sf/year	0	2,483	0	167
Stadium	0	69,000	seats	17.2	lb/seat/year	0	538	0	36
Community Center/Artist Studios	50,000	80,000	square feet	1.87	lb/sf/year	42	68	3	5
Music Venue	10,000	0	seats	17.2	lb/seat/year	78	0	5	0
Total								**532**	**375**

Notes:

1. Residential waste disposal rates for San Francisco of 0.42 lb/person/year which is based on CIWMB 2009 assuming 2.33 people per dwelling unit. R&D is based on industrial waste generation rate from CIWMB 2007. All other waste disposal rates are based on CIWMB 2006 Table 21 of Appendix A. The waste disposal rate for community center and artists studios is assumed to be the same as office space.
2. Waste Disposal amounts are based on project projections multiplied by waste disposal rates mulitplied by conversion factors.
3. CO_2 emissions are based on Altamont Landfill 2005 GHG non-biogenic emissions, which is 0.0674 metric tonnes of CO_2 emissions/ metric ton of waste/ year based on information from the BAAQMD. CO_2 emissions are calculated as follows: [tonnes of waste disposed] * 0.0674 [tonnes of CO_2 emissions/tonne of waste.

Abbreviations:

CIWMB-California Integrated Waste Management Board
CO_2-carbon dioxide
CO_2e-carbon dioxide equivalent
CP-Candlestick Point
HPS-Hunter's Point Shipyard
lb-pound
R&D-research and development

Sources:

CIWMB. 1999 Statewide Waste Characterization Study: Results and Final Report. 340-00-009. Available at http://www.ciwmb.ca.gov/wastechar/Resdisp.htm
CIWMB. 2007. Estimated Solid Waste Generation Rates for Industrial Establishments. Available at http://www.ciwmb.ca.gov/WasteChar/wasteGenRates/Industrial.htm
CIWMB. 2006. Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups. 341-06-006. Available at http://www.ciwmb.ca.gov/WasteChar/WasteStudies.htm#2006Industry

Table 3-34
GHG Emissions from Waste Disposal: Variant 1
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Land Use	Units		Units	Rate of Waste Disposal[1]		Waste Disposal[2]		Annual CO_2 Emissions[3]	
	CP	HPS		Value	Units	CP	HPS	CP	HPS
						(tonnes/year)		(tonnes CO_2e/year)	
Residential Units	7,594	2,650	dwelling units	1957	lb/unit/year	6742	2353	454	159
Retail	760,000	125,000	square feet	2.1	lb/sf/year	724	119	49	8
Office	150,000	-	square feet	1.87	lb/sf/year	127	--	9	--
Hotel	220	-	rooms	1840	lb/room/year	184	--	12	--
R&D	-	5,000,000	square feet	2.19	lb/sf/year	--	4967	--	335
Community Center/Artist Studios	50,000	80,000	square feet	1.87	lb/sf/year	42	68	3	5
Music Venue	10,000	-	Seats	17.2	lb/seat/year	78	0	5	0
Total								**532**	**506**

Notes:

1. Residential waste disposal rates for San Francisco of 0.42 lb/person/year which is based on CIWMB 2009 assuming 2.33 people per dwelling unit. R&D is based on industrial waste generation rate from CIWMB 2007. All other waste disposal rates are based on CIWMB 2006 Table 21 of Appendix A. The waste disposal rate for community center and artists studios is assumed to be the same as office space.
2. Waste Disposal amounts are based on project projections multiplied by waste disposal rates mulitplied by conversion factors.
3. CO_2 emissions are based on Altamont Landfill 2005 GHG non-biogenic emissions, which is 0.0674 metric tonnes of CO_2 emissions/ metric ton of waste/ year based on information from the BAAQMD. CO_2 emissions are calculated as follows: [tonnes of waste disposed] * 0.0674 [tonnes of CO_2 emissions/tonne of waste.

Abbreviations:

CIWMB-California Integrated Waste Management Board
CO_2-Carbon Dioxide
CO_2e-Carbon Dioxide Equivalent
CP-Candlestick Point
HPS-Hunter's Point Shipyard
lb-pound
R&D-Research and Development

Sources:

CIWMB. 1999 Statewide Waste Characterization Study: Results and Final Report. 340-00-009. Available at http://www.ciwmb.ca.gov/wastechar/Resdisp.htm
CIWMB. 2007. Estimated Solid Waste Generation Rates for Industrial Establishments. Available at http://www.ciwmb.ca.gov/WasteChar/wasteGenRates/Industrial.htm
CIWMB. 2006. Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups. 341-06-006. Available at http://www.ciwmb.ca.gov/WasteChar/WasteStudies.htm#2006Industry

Table 3-35
GHG Emissions from Waste Disposal: Variant 2
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Land Use	Units		Units	Rate of Waste Disposal[1]		Waste Disposal[2]		Annual CO_2 Emissions[3]	
	CP	HPS		Value	Units	CP	HPS	CP	HPS
						(tonnes/year)		(tonnes CO_2e/year)	
Residential Units	6,244	4,000	dwelling units	1957	lb/unit/year	5543	3551	374	239
Retail	760,000	125,000	square feet	2.1	lb/sf/year	724	119	49	8
Office	150,000	-	square feet	1.87	lb/sf/year	127	--	9	--
Hotel	220	-	rooms	1840	lb/room/year	184	--	12	--
R&D	-	5,000,000	square feet	2.19	lb/sf/year	--	4967	--	335
Community Center/Artist Studios	50,000	80,000	square feet	1.87	lb/sf/year	42	68	3	5
Music Venue	10,000	-	Seats	17.2	lb/seat/year	78	0	5	0
Total								**451**	**587**

Notes:

1. Residential waste disposal rates for San Francisco of 0.42 lb/person/year which is based on CIWMB 2009 assuming 2.33 people per dwelling unit. R&D is based on industrial waste generation rate from CIWMB 2007. All other waste disposal rates are based on CIWMB 2006 Table 21 of Appendix A. The waste disposal rate for community center and artists studios is assumed to be the same as office space.
2. Waste Disposal amounts are based on project projections multiplied by waste disposal rates mulitplied by conversion factors.
3. CO_2 emissions are based on Altamont Landfill 2005 GHG non-biogenic emissions, which is 0.0674 metric tonnes of CO_2 emissions/ metric ton of waste/ year based on information from the BAAQMD. CO_2 emissions are calculated as follows: [tonnes of waste disposed] * 0.0674 [tonnes of CO_2 emissions/tonne of waste.

Abbreviations:

CIWMB-California Integrated Waste Management Board
CO_2-Carbon Dioxide
CO_2e-Carbon Dioxide Equivalent
CP-Candlestick Point
HPS-Hunter's Point Shipyard
lb-pound
R&D-Research and Development

Sources:

CIWMB. 1999 Statewide Waste Characterization Study: Results and Final Report. 340-00-009. Available at http://www.ciwmb.ca.gov/wastechar/Resdisp.htm
CIWMB. 2007. Estimated Solid Waste Generation Rates for Industrial Establishments. Available at http://www.ciwmb.ca.gov/WasteChar/wasteGenRates/Industrial.htm
CIWMB. 2006. Targeted Statewide Waste Characterization Study: Waste Disposal and Diversion Findings for Selected Industry Groups. 341-06-006. Available at http://www.ciwmb.ca.gov/WasteChar/WasteStudies.htm#2006Industry

Table 3-36
Summary of Greenhouse Gas Emissions for Candlestick Point-Hunters Point Shipyard Phase II Development Plan Project
San Francisco, California

Source	GHG Emissions				Percentage of Annual CO_2e Emissions (%)		
		HPS	CP	CP-HPS Plan	HP	CP	CP-HPS Plan
Vegetation[1]	tonnes CO_2e total	-3,500	-3,500	-7,000	NA	NA	NA
Construction[2]		46,061	59,526	105,587	NA	NA	NA
Total (one time emissions)		**42,561**	**56,026**	**98,587**	NA	NA	NA
Residential[3]	tonnes CO_2e / year	6,642	19,035	25,677	13%	19%	17%
Non-Residential[4]		13,766	4,263	18,028	26%	4%	12%
Mobile[5]		30,371	75,149	105,520	57%	74%	68%
Municipal[6]		766	1,793	2,559	1%	2%	2%
Area		56	161	217	0%	0%	0%
Waste		375	532	907	1%	1%	1%
Transit Area		865	865	1,730	2%	1%	1%
Total (annual emissions)		**52,842**	**101,798**	**154,639**	NA	NA	NA
Annualized Total[8]	**tonnes CO_2e / year**	**53,906**	**103,198**	**157,104**	**NA**	**NA**	**NA**

Notes:

1. Vegetation emissions are one-time emissions resulting from the planting of new vegetation. Data for emissions calculations are primarily from the Intergovernmental Panel on Climate Change (IPCC) Guildelines for National Greenhouse Gas Inventories.

2. Construction emissions are one-time emissions reported in total metric tonnes during the construction period . Emissions are calculated using URBEMIS default values, EMFAC2007 and model inputs prepared by MacTech. Sources of emissions include construction equipment and vehicles associated with worker commuting and haul trucks.

3. Residential emissions for dwelling units include emissions associated with electricity and natural gas use. Emissions estimates were developed from the Residential Appliance Saturation Survey. As specified in the CP-HPS Plan, a total of 10244 dwelling units are considered.

4. Non-Residential emissions account for electricity and natural gas use. Emissions estimates for non-residential buildings except for the Stadium were developed from the California Commercial End-Use Survey (CEUS), published by the California Energy Commission in 2006. The Stadium was estimated on a 20% improvement over 1990 Stadium energy use.

5. Mobile source emissions were calculated using EMFAC and Bayview Waterfront Project Transportation Study. Mobile source emissions account for all residential and nonresidential trips. CO_2 emissions were scaled to reflect CO_2e emissions based on data from the US Environmental Protection Agency (USEPA).

6. Municipal emissions account for emissions due to energy production associated with water supply, public/street lighting, and municipal vehicles. Energy use estimates for water supply are based primarily on ARUP's Carbon Report. Emissions from street lighting and municipal vehicles were based upon studies of other cities.

7. Percentages only apply to annual CO_2e emissions; annual and one-time CO_2e emissions cannot be directly compared.

8. One-time emissions (vegetation and construction) are "annualized" in this Total row. This is done by dividing by an annualization factor, 40 years, effectively converting the one-time emission into an annual emission rate. One-time emissions are not annualized in their respective rows above.

Abbreviations:

CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
EIA - Energy Information Administration
EIR - Environmental Impact Report
EMFAC - Emission Factors Database
GHG - Greenhouse Gas
HPS -Hunter's Point Shipyard
N_2O - nitrous oxide
URBEMIS - Urban Emissions Model

Table 3-37
Alternative Summary of Greenhouse Gas Emissions for Candlestick Point-Hunters Point Shipyard Phase II Development Plan Project
San Francisco, California

Source	GHG Emissions				Percentage of Annual CO_2e Emissions (%)		
		HPS	CP	CP-HPS Plan	HP	CP	CP-HPS Plan
Vegetation[1]	tonnes CO_2e total	-3,500	-3,500	-7,000	NA	NA	NA
Construction[2]		46,061	59,526	105,587	NA	NA	NA
Total (one time emissions)		**42,561**	**56,026**	**98,587**	NA	NA	NA
Residential[3]	tonnes CO_2e / year	6,642	19,035	25,677	20%	31%	27%
Non-Residential[4]		13,766	4,263	18,028	40%	7%	19%
Mobile[5]		11,592	35,458	47,049	34%	57%	49%
Municipal[6]		766	1,793	2,559	2%	3%	3%
Area		56	161	217	0%	0%	0%
Waste		375	532	907	1%	1%	1%
Transit Area		865	865	1,730	3%	1%	2%
Total (annual emissions)		**34,062**	**62,106**	**96,168**	NA	NA	NA
Annualized Total[8]	**tonnes CO_2e / year**	**35,126**	**63,507**	**98,633**	**NA**	**NA**	**NA**

Notes:

1. Vegetation emissions are one-time emissions resulting from the planting of new vegetation. Data for emissions calculations are primarily from the Intergovernmental Panel on Climate Change (IPCC) Guildelines for National Greenhouse Gas Inventories.

2. Construction emissions are one-time emissions reported in total metric tonnes during the construction period . Emissions are calculated using URBEMIS default values, EMFAC2007 and model inputs prepared by MacTech. Sources of emissions include construction equipment and vehicles associated with worker commuting and haul trucks.

3. Residential emissions for dwelling units include emissions associated with electricity and natural gas use. Emissions estimates were developed from the Residential Appliance Saturation Survey. As specified in the CP-HPS Plan, a total of 10244 dwelling units are considered.

4. Non-Residential emissions account for electricity and natural gas use. Emissions estimates for non-residential buildings except for the Stadium were developed from the California Commercial End-Use Survey (CEUS), published by the California Energy Commission in 2006. The Stadium was estimated on a 20% improvement over 1990 Stadium energy use.

5. Mobile source emissions were calculated using URBEMIS and EMFAC. Mobile source emissions account for residential trips. CO_2 emissions were scaled to reflect CO_2e emissions based on data from the US Environmental Protection Agency (USEPA).

6. Municipal emissions account for emissions due to energy production associated with water supply, public/street lighting, and municipal vehicles. Energy use estimates for water supply are based primarily on ARUP's Carbon Report. Emissions from street lighting and municipal vehicles were based upon studies of other cities.

7. Percentages only apply to annual CO_2e emissions; annual and one-time CO_2e emissions cannot be directly compared.

8. One-time emissions (vegetation and construction) are "annualized" in this Total row. This is done by dividing by an annualization factor, 40 years, effectively converting the one-time emission into an annual emission rate. One-time emissions are not annualized in their respective rows above.

Abbreviations:

CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
EIA - Energy Information Administration
EIR - Environmental Impact Report
EMFAC - Emission Factors Database
GHG - Greenhouse Gas
HPS -Hunter's Point Shipyard
N_2O - nitrous oxide
URBEMIS - Urban Emissions Model

Table 3-38
Summary of Greenhouse Gas Emissions for Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Variant 1
San Francisco, California

Source	GHG Emissions				Percentage of Annual CO_2e Emissions (%)		
		HPS	CP	CP-HPS Plan	HP	CP	CP-HPS Plan
Vegetation[1]	tonnes CO_2e total	-3,500	-3,500	-7,000	NA	NA	NA
Construction[2]		46,061	59,526	105,587	NA	NA	NA
Total (one time emissions)		**42,561**	**56,026**	**98,587**	NA	NA	NA
Residential[3]	tonnes CO_2e / year	6,642	19,035	25,677	9%	18%	14%
Non-Residential[4]		23,155	4,263	27,418	31%	4%	15%
Mobile[5]		42,332	77,586	119,918	57%	74%	67%
Municipal[6]		860	1,793	2,653	1%	2%	1%
Area		56	161	217	0%	0%	0%
Waste		506	532	1,038	1%	1%	1%
Transit Area		865	865	1,730	1%	1%	2%
Total (annual emissions)		**74,416**	**104,234**	**178,651**	NA	NA	NA
Annualized Total[8]	**tonnes CO_2e / year**	**75,480**	**105,635**	**181,115**	**NA**	**NA**	**NA**

Notes:

1. Vegetation emissions are one-time emissions resulting from the planting of new vegetation. Data for emissions calculations are primarily from the Intergovernmental Panel on Climate Change (IPCC) Guildelines for National Greenhouse Gas Inventories.
2. Construction emissions are one-time emissions reported in total metric tonnes during the construction period . Emissions are calculated using URBEMIS default values, EMFAC2007 and model inputs prepared by MacTech. Sources of emissions include construction equipment and vehicles associated with worker commuting and haul trucks.
3. Residential emissions for dwelling units include emissions associated with electricity and natural gas use. Emissions estimates were developed from the Residential Appliance Saturation Survey. As specified in the CP-HPS Plan, a total of 10244 dwelling units are considered.
4. Non-Residential emissions account for electricity and natural gas use. Emissions estimates for non-residential buildings were developed from the California Commercial End-Use Survey (CEUS), published by the California Energy Commission in 2006.
5. Mobile source emissions were calculated using EMFAC and Bayview Waterfront Project Transportation Study. Mobile source emissions account for all residential and nonresidential trips. CO_2 emissions were scaled to reflect CO_2e emissions based on data from the US Environmental Protection Agency (USEPA).
6. Municipal emissions account for emissions due to energy production associated with water supply, public/street lighting, and municipal vehicles. Energy use estimates for water supply are based primarily on ARUP's Carbon Report. Emissions from street lighting and municipal vehicles were based upon studies of other cities.
7. Percentages only apply to annual CO_2e emissions; annual and one-time CO_2e emissions cannot be directly compared.
8. One-time emissions (vegetation and construction) are "annualized" in this Total row. This is done by dividing by an annualization factor, years, effectively converting the one-time emission into an annual emission rate. One-time emissions are not annualized in their respective rows above.

Abbreviations:
CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
EIA - Energy Information Administration
EIR - Environmental Impact Report
EMFAC - Emission Factors Database
GHG - Greenhouse Gas
HPS -Hunter's Point Shipyard
N_2O - nitrous oxide
URBEMIS - Urban Emissions Model

Table 3-39
Alternative Summary of Greenhouse Gas Emissions for Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Variant 1
San Francisco, California

Source	GHG Emissions				Percentage of Annual CO_2e Emissions (%)		
		HPS	CP	CP-HPS Plan	HP	CP	CP-HPS Plan
Vegetation[1]	tonnes CO_2e total	-3,500	-3,500	-7,000	NA	NA	NA
Construction[2]	tonnes CO_2e total	46,061	59,526	105,587	NA	NA	NA
Total (one time emissions)	tonnes CO_2e total	**42,561**	**56,026**	**98,587**	NA	NA	NA
Residential[3]	tonnes CO_2e / year	6,642	19,035	25,677	15%	31%	24%
Non-Residential[4]	tonnes CO_2e / year	23,155	4,263	27,418	52%	7%	26%
Mobile[5]	tonnes CO_2e / year	12,429	35,458	47,886	28%	57%	45%
Municipal[6]	tonnes CO_2e / year	860	1,793	2,653	2%	3%	2%
Area	tonnes CO_2e / year	56	161	217	0%	0%	0%
Waste	tonnes CO_2e / year	506	532	1,038	1%	1%	2%
Transit Area	tonnes CO_2e / year	865	865	1,730	2%	2%	4%
Total (annual emissions)	tonnes CO_2e / year	**44,513**	**62,106**	**106,619**	NA	NA	NA
Annualized Total[8]	**tonnes CO_2e / year**	**45,577**	**63,507**	**109,084**	**NA**	**NA**	**NA**

Notes:

1. Vegetation emissions are one-time emissions resulting from the planting of new vegetation. Data for emissions calculations are primarily from the Intergovernmental Panel on Climate Change (IPCC) Guildelines for National Greenhouse Gas Inventories.
2. Construction emissions are one-time emissions reported in total metric tonnes during the construction period . Emissions are calculated using URBEMIS default values, EMFAC2007 and model inputs prepared by MacTech. Sources of emissions include construction equipment and vehicles associated with worker commuting and haul trucks.
3. Residential emissions for dwelling units include emissions associated with electricity and natural gas use. Emissions estimates were developed from the Residential Appliance Saturation Survey. As specified in the CP-HPS Plan, a total of 10244 dwelling units are considered.
4. Non-Residential emissions account for electricity and natural gas use. Emissions estimates for non-residential buildings were developed from the California Commercial End-Use Survey (CEUS), published by the California Energy Commission in 2006.
5. Mobile source emissions were calculated using URBEMIS and EMFAC. Mobile source emissions account for residential trips. CO_2 emissions were scaled to reflect CO_2e emissions based on data from the US Environmental Protection Agency (USEPA).
6. Municipal emissions account for emissions due to energy production associated with water supply, public/street lighting, and municipal vehicles. Energy use estimates for water supply are based primarily on ARUP's Carbon Report. Emissions from street lighting and municipal vehicles were based upon studies of other cities.
7. Percentages only apply to annual CO_2e emissions; annual and one-time CO_2e emissions cannot be directly compared.
8. One-time emissions (vegetation and construction) are "annualized" in this Total row. This is done by dividing by an annualization factor, years, effectively converting the one-time emission into an annual emission rate. One-time emissions are not annualized in their respective rows above.

Abbreviations:
CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
EIA - Energy Information Administration
EIR - Environmental Impact Report
EMFAC - Emission Factors Database
GHG - Greenhouse Gas
HPS -Hunter's Point Shipyard
N_2O - nitrous oxide
URBEMIS - Urban Emissions Model

Table 3-40
Summary of Greenhouse Gas Emissions for Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Variant 2
San Francisco, California

Source		GHG Emissions			Percentage of Annual CO_2e Emissions (%)		
		HPS	CP	Variant 2	HP	CP	Variant 2
Vegetation[1]	tonnes CO_2e total	-3,500	-3,500	-7,000	NA	NA	NA
Construction[2]		46,061	59,526	105,587	NA	NA	NA
Total (one time emissions)		**42,561**	**56,026**	**98,587**	NA	NA	NA
Residential[3]	tonnes CO_2e / year	10,026	15,651	25,677	17%	16%	16%
Non-Residential[4]		11,963	4,263	16,226	20%	4%	10%
Mobile[5]		34,888	75,180	110,068	58%	77%	70%
Municipal[6]		1,488	1,066	2,553	2%	1%	2%
Area		85	132	217	0%	0%	0%
Waste		587	451	1,038	1%	1%	2%
Transit Area		865	865	1,730	1%	1%	3%
Total (annual emissions)		**59,901**	**97,608**	**157,509**	NA	NA	NA
Annualized Total[8]	**tonnes CO_2e / year**	**60,965**	**99,009**	**159,974**	**NA**	**NA**	**NA**

Notes:
1. Vegetation emissions are one-time emissions resulting from the planting of new vegetation. Data for emissions calculations are primarily from the Intergovernmental Panel on Climate Change (IPCC) Guildelines for National Greenhouse Gas Inventories.
2. Construction emissions are one-time emissions reported in total metric tonnes during the construction period . Emissions are calculated using URBEMIS default values, EMFAC2007 and model inputs prepared by MacTech. Sources of emissions include construction equipment and vehicles associated with worker commuting and haul trucks.
3. Residential emissions for dwelling units include emissions associated with electricity and natural gas use. Emissions estimates were developed from the Residential Appliance Saturation Survey. As specified in the CP-HPS Plan, a total of 10244 dwelling units are considered.
4. Non-Residential emissions account for electricity and natural gas use. Emissions estimates for non-residential buildings were developed from the California Commercial End-Use Survey (CEUS), published by the California Energy Commission in 2006.
5. Mobile source emissions were calculated using EMFAC and Bayview Waterfront Project Transportation Study. Mobile source emissions account for all residential and nonresidential trips. CO_2 emissions were scaled to reflect CO_2e emissions based on data from the US Environmental Protection Agency (USEPA).
6. Municipal emissions account for emissions due to energy production associated with water supply, public/street lighting, and municipal vehicles. Energy use estimates for water supply are based primarily on ARUP's Carbon Report. Emissions from street lighting and municipal vehicles were based upon studies of other cities.
7. Percentages only apply to annual CO_2e emissions; annual and one-time CO_2e emissions cannot be directly compared.
8. One-time emissions (vegetation and construction) are "annualized" in this Total row. This is done by dividing by an annualization factor, years, effectively converting the one-time emission into an annual emission rate. One-time emissions are not annualized in their respective rows above.

Abbreviations:
CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
EIA - Energy Information Administration
EIR - Environmental Impact Report
EMFAC - Emission Factors Database
GHG - Greenhouse Gas
HPS -Hunter's Point Shipyard
N_2O - nitrous oxide
URBEMIS - Urban Emissions Model

Table 3-41
Alternative Summary of Greenhouse Gas Emissions for Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Variant 2
San Francisco, California

Source	**GHG Emissions**				**Percentage of Annual CO_2e Emissions (%)**		
		HPS	**CP**	**Variant 2**	**HP**	**CP**	**Variant 2**
Vegetation[1]	tonnes CO_2e total	-3,500	-3,500	-7,000	NA	NA	NA
Construction[2]		46,061	59,526	105,587	NA	NA	NA
Total (one time emissions)		**42,561**	**56,026**	**98,587**	NA	NA	NA
Residential[3]	tonnes CO_2e / year	10,026	15,651	25,677	24%	29%	27%
Non-Residential[4]		11,963	4,263	16,226	29%	8%	17%
Mobile[5]		16,434	30,913	47,347	40%	58%	50%
Municipal[6]		1,488	1,066	2,553	4%	2%	3%
Area		85	132	217	0%	0%	0%
Waste		587	451	1,038	1%	1%	3%
Transit Area		865	865	1,730	2%	2%	4%
Total (annual emissions)		**41,448**	**53,341**	**94,789**	NA	NA	NA
Annualized Total[8]	**tonnes CO_2e / year**	**42,512**	**54,742**	**97,254**	**NA**	**NA**	**NA**

Notes:
1. Vegetation emissions are one-time emissions resulting from the planting of new vegetation. Data for emissions calculations are primarily from the Intergovernmental Panel on Climate Change (IPCC) Guildelines for National Greenhouse Gas Inventories.
2. Construction emissions are one-time emissions reported in total metric tonnes during the construction period . Emissions are calculated using URBEMIS default values, EMFAC2007 and model inputs prepared by MacTech. Sources of emissions include construction equipment and vehicles associated with worker commuting and haul trucks.
3. Residential emissions for dwelling units include emissions associated with electricity and natural gas use. Emissions estimates were developed from the Residential Appliance Saturation Survey. As specified in the CP-HPS Plan, a total of 10244 dwelling units are considered.
4. Non-Residential emissions account for electricity and natural gas use. Emissions estimates for non-residential buildings were developed from the California Commercial End-Use Survey (CEUS), published by the California Energy Commission in 2006.
5. Mobile source emissions were calculated using URBEMIS and EMFAC. Mobile source emissions account for residential trips. CO_2 emissions were scaled to reflect CO_2e emissions based on data from the US Environmental Protection Agency (USEPA).
6. Municipal emissions account for emissions due to energy production associated with water supply, public/street lighting, and municipal vehicles. Energy use estimates for water supply are based primarily on ARUP's Carbon Report. Emissions from street lighting and municipal vehicles were based upon studies of other cities.
7. Percentages only apply to annual CO_2e emissions; annual and one-time CO_2e emissions cannot be directly compared.
8. One-time emissions (vegetation and construction) are "annualized" in this Total row. This is done by dividing by an annualization factor, years, effectively converting the one-time emission into an annual emission rate. One-time emissions are not annualized in their respective rows above.

Abbreviations:
CH_4 - methane
CO_2 - carbon dioxide
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
EIA - Energy Information Administration
EIR - Environmental Impact Report
EMFAC - Emission Factors Database
GHG - Greenhouse Gas
HPS -Hunter's Point Shipyard
N_2O - nitrous oxide
URBEMIS - Urban Emissions Model

Table 4-1
Candlestick Point-Hunters Point Shipyard Phase II Development Plan Context Supporting Calculations
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

	Tonnes / Year	%
2004 World Emissions	2.68E+10	0.00058%
2004 USA Emissions	7.00E+09	0.0022%
2004 CA Emissions	4.80E+08	0.0322%
Total Project Annual Emissions	1.55E+05	

No Action Taken Projected 2020 CO_2e emissions	5.96E+08	tonnes
CA 1990 CO_2e emissions	4.27E+08	tonnes
Difference	1.69E+08	tonnes
% reduction / increase	28%	%
CA 2020 population	4.22E+07	people
1990 emissions / 2020 population	10.1	tonnes / capita

Candlestick Point-Hunters Point Shipyard Phase II Development Plan Population	24,539

	Tonnes CO_2 / year	Tonnes / capita / year
Candlestick Point-Hunters Point Shipyard Phase II Development Plan Mobile Emissions	105,520	4.3
Candlestick Point-Hunters Point Shipyard Phase II Development Plan Residential Emissions	25,677	1.0
Candlestick Point-Hunters Point Shipyard Phase II Development Plan Mobile + Residential	131,197	5.3

Table 4-2
Greenhouse Gas Emissions from Vehicles for the Year 2020: No Action Taken for Project
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Trip Type[1]		Daily One-Way Trips[2]		Trip Distance[4]	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total AnnualCO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
		Unadjusted	Weekend/Weekday Adjustment[3]	(miles)								
	Residential - Home Based Work	4,927	4,646	14.90	69,222	25,266,165			11,749	183	11,932	12,560
	Residential - Home Based Other	7,237	6,824	9.10	62,094	22,664,301			10,539	269	10,808	11,377
Hunter's Point	Residential - Non-Home Based	3,234	3,049	9.50	28,964	10,571,728	**465**	**108**	4,916	120	5,036	5,301
	Nonresidential - Home Based Work	6,463	6,093	14.90	90,793	33,139,267			15,410	240	15,650	16,474
	Nonresidential - Home Based Other	12,073	11,383	9.10	103,587	37,809,136			17,581	449	18,030	18,979
	Nonresidential - Non-Home Based	6,796	6,408	9.50	60,875	22,219,216			10,332	253	10,585	11,142
Total Resident Trips		**40,730**	**38,403**		**415,534**	**151,669,813**			**70,526**	**1,514**	**72,041**	**75,832**
	Residential - Home Based Work	14,119	13,312	14.90	198,352	72,398,605			33,665	525	34,190	35,990
	Residential - Home Based Other	20,737	19,552	9.10	177,926	64,943,128			30,199	771	30,970	32,600
	Residential - Non-Home Based	9,266	8,736	9.50	82,993	30,292,621			14,086	344	14,431	15,190
Candlestick Point	Nonresidential - Home Based Work	13,376	12,612	14.90	187,915	68,588,812	**465**	**108**	31,894	497	32,391	34,096
	Nonresidential - Home Based Other	24,988	23,560	9.10	214,395	78,254,106			36,388	929	37,317	39,281
	Nonresidential - Non-Home Based	14,066	13,262	9.50	125,993	45,987,426			21,384	523	21,907	23,060
	Music Venue-Worker	400	400	14.90	5,960	894,000			416	16	431	454
	Music Venue-Customer	2,666	2,666	9.10	24,261	3,639,090			1,692	43	1,735	1,827
Total Resident Trips		**99,618**	**94,101**		**1,017,795**	**364,997,788**			**169,724**	**3,649**	**173,373**	**182,497**
Totals		**140,348**	**132,503**		**1,433,329**	**516,667,601**			**240,250**	**5,163**	**245,413**	**258,330**

Notes:

1. The trip type distribution is based on . The trip type distribution is consistent with Caltrans Household Travel Survey. This applies to everything except the Music Venue.

Trip Type	Residential Type Distribution	NonResidential Trip Type Distribution
Home Based Work	32%	26%
Home Based Other	47%	48%
Non-Home Based	21%	27%

2. The daily trips are based on assuming all trips are made by automobile, and no mitigation measures such as transit, biking, or walking are used. The daily trips are based on Bayview Waterfront Project Transporation Study trip generation rates for residential land use. A vehicle occupance of 1.6 persons was assumed for all trips.

3. Daily trips were adjusted to account for differences between the weekend and the weekday traffic based on a report by Sonoma Technologies. No adjustment was made to the music venue trips since this is based on a per event calculation. It is assumed that there are 150 events per year.

4. Trip distances were provided by Fehr and Peers . The trip length is based on CP-HPS Plan's street network and land use plan as well as the regional roadway network and land use distribution.

5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for San Francisco.

6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.

7. CO_2e=CO_2/0.95: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

ADT - Average Daily Trip
CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
GHG - Greenhouse Gas
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
VMT - Vehicle Miles Traveled

Sources:

CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study.
Sonoma Technologies, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 4-3
Greenhouse Gas Emissions from Vehicles for the Year 2020: No Action Taken for Variant 1
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Trip Type[1]		Daily One-Way Trips[2] Unadjusted	Daily One-Way Trips[2] Weekend/Weekday Adjustment[3]	Trip Distance[4] (miles)	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total Annual CO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
Hunter's Point	Residential - Home Based Work	4,927	4,646	14.90	69,222	25,266,165	**465**	**108**	11,749	183	11,932	12,560
	Residential - Home Based Other	7,237	6,824	9.10	62,094	22,664,301			10,539	269	10,808	11,377
	Residential - Non-Home Based	3,234	3,049	9.50	28,964	10,571,728			4,916	120	5,036	5,301
	Nonresidential - Home Based Work	9,116	8,595	14.90	128,067	46,744,525			21,736	339	22,075	23,237
	Nonresidential - Home Based Other	17,030	16,056	9.10	146,114	53,331,599			24,799	633	25,432	26,771
	Nonresidential - Non-Home Based	9,586	9,039	9.50	85,866	31,341,269			14,574	356	14,930	15,716
Total Resident Trips		**51,130**	**48,208**		**520,328**	**189,919,585**			**88,313**	**1,901**	**90,214**	**94,962**
Candlestick Point	Residential - Home Based Work	14,119	13,312	14.90	198,352	72,398,605	**465**	**108**	33,665	525	34,190	35,990
	Residential - Home Based Other	20,737	19,552	9.10	177,926	64,943,128			30,199	771	30,970	32,600
	Residential - Non-Home Based	9,266	8,736	9.50	82,993	30,292,621			14,086	344	14,431	15,190
	Nonresidential - Home Based Work	13,376	12,612	14.90	187,915	68,588,812			31,894	497	32,391	34,096
	Nonresidential - Home Based Other	24,988	23,560	9.10	214,395	78,254,106			36,388	929	37,317	39,281
	Nonresidential - Non-Home Based	14,066	13,262	9.50	125,993	45,987,426			21,384	523	21,907	23,060
	Music Venue-Worker	400	400	14.90	5,960	894,000			416	16	431	454
	Music Venue-Customer	2,666	2,666	9.10	24,261	3,639,090			1,692	43	1,735	1,827
Total Resident Trips		**99,618**	**94,101**		**1,017,795**	**364,997,788**			**169,724**	**3,649**	**173,373**	**182,497**
Totals		**150,748**	**142,309**		**1,538,123**	**554,917,373**			**258,037**	**5,550**	**263,586**	**277,459**

Notes:

1. The trip type distribution is based on . The trip type distribution is consistent with Caltrans Household Travel Survey. This applies to everything except the Music Venue.

Trip Type	Residential Type Distribution	NonResidential Trip Type Distribution
Home Based Work	32%	26%
Home Based Other	47%	48%
Non-Home Based	21%	27%

2. The daily trips are based on assuming all trips are made by automobile, and no mitigation measures such as transit, biking, or walking are used. The daily trips are based on Bayview Waterfront Project Transporation Study trip generation rates for residential land use. A vehicle occupance of 1.6 persons was assumed for all trips.
3. Daily trips were adjusted to account for differences between the weekend and the weekday traffic based on a report by Sonoma Technologies. No adjustment was made to the music venue trips since this is based on a per event calculation. It is assumed that there are 150 events per year.
4. Trip distances were provided by Fehr and Peers . The trip length is based on CP-HPS Plan's street network and land use plan as well as the regional roadway network and land use distribution.
5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for San Francisco.
6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.
7. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

ADT - Average Daily Trip
CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
GHG - Greenhouse Gas
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
VMT - Vehicle Miles Traveled

Sources:

CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study.
Sonoma Technologies, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 4-4
Greenhouse Gas Emissions from Vehicles for the Year 2020: No Action Taken for Variant 2
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Trip Type[1]		Daily One-Way Trips[2]		Trip Distance[4]	Daily Adjusted VMT (miles)	Annual Adjusted VMT (miles)	Emission Factor Running (g/mile)[5]	Emission Factor Starts (g/start)[6]	Annual CO_2 Emissions Running (tonne)	Annual CO_2 Emissions Starts (tonne)	Total AnnualCO_2 Emissions (tonne)	Total Annual CO_2e Emissions (tonne)[7]
		Unadjusted	Weekend/Weekday Adjustment[3]	(miles)								
Hunter's Point	Residential - Home Based Work	7,437	7,012	14.90	104,476	38,133,892			17,732	276	18,009	18,957
	Residential - Home Based Other	10,923	10,299	9.10	93,718	34,206,933			15,906	406	16,312	17,171
	Residential - Non-Home Based	4,880	4,602	9.50	43,714	15,955,771	**465**	**108**	7,419	181	7,601	8,001
	Nonresidential - Home Based Work	6,358	5,994	14.90	89,316	32,600,290			15,159	236	15,396	16,206
	Nonresidential - Home Based Other	11,877	11,198	9.10	101,902	37,194,208			17,295	442	17,737	18,670
	Nonresidential - Non-Home Based	6,686	6,304	9.50	59,884	21,857,842			10,164	249	10,412	10,960
Total Resident Trips		**48,160**	**45,408**		**493,011**	**179,948,935**			**83,676**	**1,791**	**85,467**	**89,965**
Candlestick Point	Residential - Home Based Work	11,609	10,946	14.90	163,089	59,527,596			27,680	432	28,112	29,592
	Residential - Home Based Other	17,051	16,076	9.10	146,295	53,397,552			24,830	634	25,464	26,804
	Residential - Non-Home Based	7,618	7,183	9.50	68,239	24,907,205			11,582	283	11,865	12,490
	Nonresidential - Home Based Work	13,376	12,612	14.90	187,915	68,588,812	**465**	**108**	31,894	497	32,391	34,096
	Nonresidential - Home Based Other	24,988	23,560	9.10	214,395	78,254,106			36,388	929	37,317	39,281
	Nonresidential - Non-Home Based	14,066	13,262	9.50	125,993	45,987,426			21,384	523	21,907	23,060
	Music Venue-Worker	400	400	14.90	5,960	894,000			416	16	431	454
	Music Venue-Customer	2,666	2,666	9.10	24,261	3,639,090			1,692	43	1,735	1,827
Total Resident Trips		**91,774**	**86,705**		**936,146**	**335,195,787**			**155,866**	**3,357**	**159,223**	**167,603**
Totals		**139,934**	**132,113**		**1,429,157**	**515,144,722**			**239,542**	**5,148**	**244,690**	**257,568**

Notes:

1. The trip type distribution is based on . The trip type distribution is consistent with Caltrans Household Travel Survey. This applies to everything except the Music Venue.

Trip Type	Residential Type Distribution	NonResidential Trip Type Distribution
Home Based Work	32%	26%
Home Based Other	47%	48%
Non-Home Based	21%	27%

2. The daily trips are based on assuming all trips are made by automobile, and no mitigation measures such as transit, biking, or walking are used. The daily trips are based on Bayview Waterfront Project Transporation Study trip generation rates for residential land use. A vehicle occupance of 1.6 persons was assumed for all trips.

3. Daily trips were adjusted to account for differences between the weekend and the weekday traffic based on a report by Sonoma Technologies. No adjustment was made to the music venue trips since this is based on a per event calculation. It is assumed that there are 150 events per year.

4. Trip distances were provided by Fehr and Peers . The trip length is based on CP-HPS Plan's street network and land use plan as well as the regional roadway network and land use distribution.

5. Emission factors for vehicles based on EMFAC files for 2020, based on LDA, LDT1, LDT2, MDV, and MCY for San Francisco.

6. Starting emission factors are based on the weighted average distribution of time between trip starts based on URBEMIS defaults.

7. $CO_2e=CO_2/0.95$: The United States Environmental Protection Agency (USEPA) recommends assuming that CH_4, N_2O, and HFCs are 5% of emissions on a CO_2e basis.

Abbreviations:

ADT - Average Daily Trip
CH_4 - Methane
CO_2 - Carbon Dioxide
CO_2e - Carbon Dioxide Equivalent
GHG - Greenhouse Gas
HFC - Hydro fluorocarbon
N_2O - Nitrous oxide
VMT - Vehicle Miles Traveled

Sources:

CHS Consulting Group, Fehr and Peers, and LCW Consulting. 2009. Candlestick Point-Hunters Point Shipyard Phase II Development Transportation Study.
Sonoma Technologies, Inc. 2004. Correction and Analysis of Weekend/Weekday Emissions Activity Data in the South Coast Air Basin. May.

Table 4-5
GHG Emission Factors for Municipal Sources: No Action Taken Project
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, CA

Source[1]	Energy Requirements	Units	Emission Factor[10]	Units	Source Quantity		Units	Total CO_2e		Units
					CP	HPS		CP	HPS	
Lighting										
Public Lighting[2]	149	kW-hr/capita/yr	0.043	tonne CO_2e/capita/year	17,694	6,175	residents (capita)	758	264.68	tonne CO_2e
							Public Lighting Total:	**758**	**265**	
Municipal Vehicles										
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	17,694	6,175	residents (capita)	885	309	
							Municipal Vehicles Total:	**885**	**309**	
Water and Wastewater [9]										
Water Supply and Conveyance (Potable)[4]	0	kW-hr/Mgal	0.00	tonne CO_2e/Mgal	0.88	0.79	MM gallons/day	0	0	tonne CO_2e
Water Treatment (Potable)[5]	111	kW-hr/Mgal	0.03	tonne CO_2e/Mgal	0.88	0.79	MM gallons/day	10	9	tonne CO_2e
Water Distribution (Potable)[6]	1,272	kW-hr/Mgal	0.37	tonne CO_2e/Mgal	0.88	0.79	MM gallons/day	118	106	tonne CO_2e
Wastewater Treatment and Discharge (Indirect Emissions) [7]	1,688	kW-hr/Mgal	0.49	tonne CO_2e/Mgal	0.88	0.79	MM gallons/day	156	140	tonne CO_2e
Wastewater Treatment Plant (Direct Emissions) [8]	--	--	0.084	tonne CO_2e/capita/year	0.00	0.00	MM gallons/day	0	0	tonne CO_2e
							Water and Wastewater Total:	**284**	**255**	tonne CO_2e
							Municipal Sources Total:	**1,928**	**829**	tonne CO_2e

Notes:

1. Public lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from PG&E.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. Emission factor for the supply and conveyance of potable water is based on a CEC (2006) study. 85% of the water supply in San Francisco is supplied via gravity from the Hetch Hetchy basin. The CEC (2006) study suggests that Hetch Hetchy system is gravity-dominated and has minimal net carbon emissions.

5.Emission factor for water treatment is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.

6.Emission factor for water distribution is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.

7. Emission factor for wastewater treatment are from the energy requirements for the Southeast Pollution Control Center provided in a Request for Proposals. This information was provided in "SFPUC Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101".

8. All methane emissions from the wastewater at the Southeast Wastewater Treatment Plant is burned at the flare station or cogeneration plant, and no methane emissions are directly emitted from the wastewater as directed by the plant's air permit.

9. Source quantities for water and wastewater are based on ARUP's estimates.

10. GHG emissions attributed to electricity use are calculated using the PG&E carbon-intensity factor, which is 0.636 lbs CO2 per kW-hr.

Abbreviations:

CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
EPRI - Electric Power Research Institute
GHG - greenhouse gas
HPS - Hunter's Point Shipyard
kW-hr - kilowatt hour
MMgal - million gallons
MW-hr - megawatt hour
NYSERDA - New York State Energy Research and Development Authority
PG&E - Pacific Gas and Electric
psi - pound per square inch
SFPUC - San Francisco Public Utility Commission
Tg - teragram
USEPA - United States Environmental Protection Agency

Sources:

California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
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San Francisco Public Utilities Commission. 2003. Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101.
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Table 4-6
GHG Emission Factors for Municipal Sources: No Action Taken Variant 1
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, CA

Source[1]	Energy Requirements	Units	Emission Factor[10]	Units	Source Quantity[11] CP	Source Quantity[11] HPS	Units	Total CO_2e CP	Total CO_2e HPS	Units
Lighting										
Public Lighting[2]	149	kW-hr/capita/yr	0.043	tonne CO_2e/capita/year	17,694	6,175	residents (capita)	758	264.68	tonne CO_2e
Municipal Vehicles										
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	17,694	6,175	residents (capita)	885	309	
Water and Wastewater [9]										
Water Supply and Conveyance (Potable)[4]	0	kW-hr/Mgal	0.00	tonne CO_2e/Mgal	0.88	1.11	MM gallons/day	0	0	tonne CO_2e
Water Treatment (Potable)[5]	111	kW-hr/Mgal	0.03	tonne CO_2e/Mgal	0.88	1.11	MM gallons/day	10	13	tonne CO_2e
Water Distribution (Potable)[6]	1,272	kW-hr/Mgal	0.37	tonne CO_2e/Mgal	0.88	1.11	MM gallons/day	118	149	tonne CO_2e
Wastewater Treatment and Discharge (Indirect Emissions)[7]	1,688	kW-hr/Mgal	0.49	tonne CO_2e/Mgal	0.88	1.11	MM gallons/day	156	197	tonne CO_2e
Wastewater Treatment Plant (Direct Emissions)[8]	--	--	0.084	tonne CO_2e/capita/year	0.00	0.00	MM gallons/day	0	0	tonne CO_2e
					Water and Wastewater Total:			**284**	**359**	tonne CO_2e
					Municipal Sources Total:			**1,928**	**932**	tonne CO_2e

Notes:

1. Public lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from PG&E.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. Emission factor for the supply and conveyance of potable water is based on a CEC (2006) study. 85% of the water supply in San Francisco is supplied via gravity from the Hetch Hetchy basin. The CEC (2006) study suggests that H Hetchy system is gravity-dominated and has minimal net carbon emissions.

5.Emission factor for water treatment is based on information provided i

6.Emission factor for water distribution is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.

7. Emission factor for wastewater treatment are from the energy requirements for the Southeast Pollution Control Center provided in a Request for Proposals. This information was provided in "SFPUC Hetch Hetchy Water and Power I Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101".

8. All methane emissions from the wastewater at the Southeast Wastewater Treatment Plant is burned at the flare station or cogeneration plant, and no methane emissions are directly emitted from the wastewater as directed by the plant' permit.

9. Source quantities for water and wastewater are based on ARUP's estimates.

10. GHG emissions attributed to electricity use are calculated using the PG&E carbon-intensity factor, which is 0.636 lbs CO2 per kW-hr.

11. Water demand for Hunter's Point has been adjusted from Project Scenario in two ways: (1) water demand allocated for the stadium has been removed to reflect the "no stadium" scenario, and (2) the water demand allocated for research & development bas been doubled to reflect the corresponding increase in square footage. No changes were made to water demand for Candlestick Point.

Abbreviations:

CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
EPRI - Electric Power Research Institute
GHG - greenhouse gas
IB - India Basin
kW-hr - kilowatt hour
MMgal - million gallons
MW-hr - megawatt hour
NYSERDA - New York State Energy Research and Development Authority
PG&E - Pacific Gas and Electric
psi - pound per square inch
SFPUC - San Francisco Public Utility Commission
Tg - teragram
USEPA - United States Environmental Protection Agency

Sources:

California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
City of Medford. 2001. Climate Action Plan. October. http://www.massclimateaction.org/pdf/MedfordPlan2001.pdf

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EPRI. 2001. Summary Report for California Energy Commission Energy Efficiency Studies. Http://www.energy.ca.gov/pier/iaw/reports/2003_09_26_Appendix_2_7.pdf
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San Francisco Public Utilities Commission. 2003. Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101.
Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives.
U.S. Census Bureau. http://www.census.gov/main/www/cen2000.html
USEPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. #430-R-07-002. April. http://epa.gov/climatechange/emissions/downloads06/07Waste.pdf

Table 4-7
GHG Emission Factors for Municipal Sources: No Action Taken Variant 2
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, CA

Source[1]	Energy Requirements	Units	Emission Factor[10]	Units	Source Quantity CP	Source Quantity HPS	Units	Total CO_2e CP	Total CO_2e HPS	Units
Lighting										
Public Lighting[2]	149	kW-hr/capita/yr	0.043	tonne CO_2e/capita/year	14,549	9,320	residents (capita)	624	400	tonne CO_2e
Municipal Vehicles										
Municipal Vehicles[3]	--	--	0.05	tonne CO_2e/capita/year	14,549	9,320	residents (capita)	727	466	
Water and Wastewater [9]										
Water Supply and Conveyance (Potable)[4]	0	kW-hr/Mgal	0.00	tonne CO_2e/Mgal	0.77	0.88	MM gallons/day	0	0	tonne CO_2e
Water Treatment (Potable)[5]	111	kW-hr/Mgal	0.03	tonne CO_2e/Mgal	0.77	0.88	MM gallons/day	9	10	tonne CO_2e
Water Distribution (Potable)[6]	1,272	kW-hr/Mgal	0.37	tonne CO_2e/Mgal	0.77	0.88	MM gallons/day	103	118	tonne CO_2e
Wastewater Treatment and Discharge (Indirect Emissions) [7]	1,688	kW-hr/Mgal	0.49	tonne CO_2e/Mgal	0.77	0.88	MM gallons/day	137	156	tonne CO_2e
Wastewater Treatment Plant (Direct Emissions) [8]	--	--	0.084	tonne CO_2e/capita/year	0.00	0.00	MM gallons/day	0	0	tonne CO_2e
							Water and Wastewater Total:	**249**	**284**	tonne CO_2e
							Municipal Sources Total:	**1,600**	**1,150**	tonne CO_2e

Notes:

1. Public lighting includes streetlights, traffic signals, area lighting and lighting municipal buildings. Emissions from the Water and Wastewater category are primarily due to the energy required for supply, treatment and distribution.

2. Emission factor for public lighting is based on a study of energy usage and GHG emissions from Duluth, MN (Skoog, 2001) and the electricity generation emission factor from PG&E.

3. Emission factors for municipal vehicles are based on the most conservative number from studies of GHG emissions for four cities of different sizes: Medford, MA; Duluth, MN; Northampton, MA; and Santa Rosa, CA. Population data provided by the US Census (2000).

4. Emission factor for the supply and conveyance of potable water is based on a CEC (2006) study. 85% of the water supply in San Francisco is supplied via gravity from the Hetch Hetchy basin. The CEC (2006) study suggests that Hetch Hetchy system is gravity-dominated and has minimal net carbon emissions.

5.Emission factor for water treatment is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.

6.Emission factor for water distribution is based on information provided in CEC 2006 and the electricity generation emission factor from Pacific Gas and Electric. This factor is applied to potable water demand.

7. Emission factor for wastewater treatment are from the energy requirements for the Southeast Pollution Control Center provided in a Request for Proposals. This information was provided in "SFPUC Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101".

8. All methane emissions from the wastewater at the Southeast Wastewater Treatment Plant is burned at the flare station or cogeneration plant, and no methane emissions are directly emitted from the wastewater as directed by the plant's air permit.

9. Source quantities for water and wastewater are based on ARUP's estimates.

10. GHG emissions attributed to electricity use are calculated using the PG&E carbon-intensity factor, which is 0.636 lbs CO2 per kW-hr.

11. Water demand for Hunter's Point was adjusted from Project Scenario in two ways: (1) water demand allocated for the stadium has been removed to reflect the "no stadium" scenario, and (2) residential water demand was increased to reflect

12. Water demand for Candlestick Point was decreased to reflect a decrease in dwelling units from 7,594 to 6244.

13. The change in dwelling units at Hunter's Point and Candlestick Point caused proportional changes to energy use for municipal lighting and vehicles.

Abbreviations:

CEC - California Energy Commission
CO_2e - carbon dioxide equivalent
CP - Candlestick Point
CP-HPS Plan - Candlestick Point-Hunters Point Shipyard Phase II Development Plan
GHG - greenhouse gas
HPS - Hunter's Point Shipyard
IB - India Basin
kW-hr - kilowatt hour
MMgal - million gallons
MW-hr - megawatt hour
NYSERDA - New York State Energy Research and Development Authority
PG&E - Pacific Gas and Electric
psi - pound per square inch
SFPUC - San Francisco Public Utility Commission
Tg - teragram
USEPA - United States Environmental Protection Agency

Sources:

California Energy Commission. 2006. Refining Estimates of Water-Related Energy Use in California. PIER Final Project Report. Prepared by Navigant Consulting, Inc. CEC-500-2006-118. December.
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EPRI. 2001. Summary Report for California Energy Commission Energy Efficiency Studies. Http://www.energy.ca.gov/pier/iaw/reports/2003_09_26_Appendix_2_7.pdf
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San Francisco Public Utilities Commission. 2003. Hetch Hetchy Water and Power RFP - Solar Photovoltaic Renewable Energy Plant at the Southeast Water Pollution Control Plant Agreement No. DB-101.
Skoog., C. 2001. Greenhouse Gas Inventory and Forecast Report. City of Duluth Facilities Management and The International Council for Local Environmental Initiatives.
U.S. Census Bureau. http://www.census.gov/main/www/cen2000.html
USEPA. 2007. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005. #430-R-07-002. April. http://epa.gov/climatechange/emissions/downloads06/07Waste.pdf

Table 4-8
GHG Emissions Comparison of No Action Taken to Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Source	Candlestick Point			Hunter's Point			Total		
	GHG Emissions (tonnes CO_2e / year)		Percentage Improvement over No Action Taken[1]	GHG Emissions (tonnes CO_2e / year)		Percentage Improvement over No Action Taken[1]	GHG Emissions (tonnes CO_2e / year)		Improvement over No Action Taken[1]
	No Action Taken[2]	CP[2]	(%)	No Action Taken[2]	HPS[2]	(%)	No Action Taken[2]	Project[2]	(%)
Vegetation[3]	0	-3,500	--	0	-3,500	--	0	-7,000	--
Construction	59,526	59,526	0%	46,061	46,061	0%	105,587	105,587	0%
Total (one-time emissions)	**59,526**	**56,026**	6%	**46,061**	**42,561**	8%	**105,587**	**98,587**	7%
Residential[4]	23,934	19,035	20%	8,352	6,642	20%	32,286	25,677	20%
Non-Residential[5]	5,023	4,263	15%	16,840	13,766	18%	21,863	18,028	18%
Mobile[6]	182,497	75,149	59%	75,832	30,371	60%	258,330	105,520	59%
Municipal[7]	1,928	1,793	7%	829	766	8%	2,756	2,559	7%
Area	161	161	0%	56	56	0%	217	217	0%
Waste	532	532	0%	375	375	0%	907	907	0%
Transit Area	1,442	865	40%	1,442	865	40%	2,884	1,730	40%
Total (annual emissions)	**215,517**	**101,798**	**53%**	**103,726**	**52,842**	**49%**	**319,242**	**154,639**	**52%**
Annualized Total[8]	**217,005**	**103,198**	**52%**	**104,877**	**53,906**	**49%**	**321,882**	**157,104**	**51%**

Notes:
1. The percentage improvement over No Action Taken is an estimate. There are some source categories where appropriate comparisons are available. It is estimated that this value is on the conservative side.
2. The carbon intensity from indirect energy use is based on PG&E's 2007 carbon intensity for all No Action Taken categories. The 20% Renewable Portfolio Standard has been used to adjust the carbon intensity value for indirect electricity use for all Project categor
3. No Action Taken vegetation emissions are based on no net trees being planted.
4. No Action Taken residential emissions reflect minimally Title-24 (2005) compliant homes without Energy Star appliances.
5. No Action Taken non-residential emissions reflect minimally Title-24 (2005) compliant buildings.
6. No Action Taken mobile emissions is based on a comparison of trip rates adjusted for average San Francisco trip rates and no Pavley Vehicle Emission Standards.
7. Municipal emissions included here are related to water treatment, waste water treatment, street lighting, and municipal vehicles.
8. One-time emissions are annualized over 40 years and then added to the total annual emissions.

Abbreviations:
CP - Candlestick Point
CO_2e - Carbon Dioxide Equivalent
HPS -Hunter's Point Shipyard

Table 4-9
GHG Emissions Comparison of No Action Taken to Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Variant 1
San Francisco, California

Source	Candlestick Point			Hunter's Point			Total		
	GHG Emissions (tonnes CO_2e / year)		Percentage Improvement over No Action Taken[1]	GHG Emissions (tonnes CO_2e / year)		Percentage Improvement over No Action Taken[1]	GHG Emissions (tonnes CO_2e / year)		Percentage Improvement over No Action Taken[1]
	No Action Taken[2]	CP[2]	(%)	No Action Taken[2]	HPS[2]	(%)	No Action Taken[2]	Variant 1[2]	(%)
Vegetation[3]	0	-3,500	--	0	-3,500	--	0	-7,000	--
Construction	59,526	59,526	0%	46,061	46,061	0%	105,587	105,587	0%
Total (one-time emissions)	**59,526**	**56,026**	6%	**46,061**	**42,561**	8%	**105,587**	**98,587**	7%
Residential[4]	23,934	19,035	20%	8,352	6,642	20%	32,286	25,677	20%
Non-Residential[5]	5,023	4,263	15%	28,002	23,155	17%	33,025	27,418	17%
Mobile[6]	182,497	77,586	57%	94,962	42,332	55%	277,459	119,918	57%
Municipal[7]	1,928	1,793	7%	932	860	8%	2,860	2,653	7%
Area	161	161	0%	56	56	0%	217	217	0%
Waste	532	532	0%	506	506	0%	1,038	1,038	0%
Transit Area	1,442	865	40%	1,442	865	40%	2,884	1,730	40%
Total (annual emissions)	**215,517**	**104,234**	**52%**	**134,252**	**74,416**	**45%**	**349,768**	**178,651**	**49%**
Annualized Total[8]	**217,005**	**105,635**	**51%**	**135,403**	**75,480**	**44%**	**352,408**	**181,115**	**49%**

Notes:
1. The percentage improvement over No Action Taken is an estimate. There are some source categories where appropriate comparisons are available. It is estimated that this value is on the conservative side.
2. The carbon intensity from indirect energy use is based on PG&E's 2007 carbon intensity for all No Action Taken categories. The 20% Renewable Portfolio Standard has been used to adjust the carbon intensity value for indirect electricity use for all Project categories
3. No Action Taken vegetation emissions are based on no net trees being planted.
4. No Action Taken residential emissions reflect minimally Title-24 (2005) compliant homes without Energy Star appliances.
5. No Action Taken non-residential emissions reflect minimally Title-24 (2005) compliant buildings.
6. No Action Taken mobile emissions is based on a comparison of trip rates adjusted for average San Francisco trip rates and no Pavley Vehicle Emission Standards.
7. Municipal emissions included here are related to water treatment, waste water treatment, street lighting, and municipal vehicles.
8. One-time emissions are annualized over 40 years and then added to the total annual emissions.

Abbreviations:
CP - Candlestick Point
CO_2e - Carbon Dioxide Equivalent
HPS -Hunter's Point Shipyard

Table 4-10
GHG Emissions Comparison of No Action Taken to Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
Variant 2
San Francisco, California

Source	Candlestick Point			Hunter's Point			Total		
	GHG Emissions (tonnes CO_2e / year)		Percentage Improvement over No Action Taken[1]	GHG Emissions (tonnes CO_2e / year)		Percentage Improvement over No Action Taken[1]	GHG Emissions (tonnes CO_2e / year)		Percentage Improvement over No Action Taken[1]
	No Action Taken[2]	CP[2]	(%)	No Action Taken[2]	HPS[2]	(%)	No Action Taken[2]	Variant 2[2]	(%)
Vegetation[3]	0	-3,500	--	0	-3,500	--	0	-7,000	--
Construction	59,526	59,526	0%	46,061	46,061	0%	105,587	105,587	0%
Total (one-time emissions)	**59,526**	**56,026**	6%	**46,061**	**42,561**	8%	**105,587**	**98,587**	7%
Residential[4]	19,679	15,651	20%	12,607	10,026	20%	32,286	25,677	20%
Non-Residential[5]	4,728	4,263	10%	14,458	11,963	17%	19,186	16,226	15%
Mobile[6]	167,603	75,180	55%	89,965	34,888	61%	257,568	110,068	57%
Municipal[7]	1,600	1,066	33%	1,150	1,488	-29%	2,750	2,553	7%
Area	132	132	0%	85	85	0%	217	217	0%
Waste	451	451	0%	587	587	0%	1,038	1,038	0%
Transit Area	1,442	865	40%	1,442	865	40%	2,884	1,730	40%
Total (annual emissions)	**195,636**	**97,608**	**50%**	**120,293**	**59,901**	**50%**	**315,929**	**157,509**	**50%**
Annualized Total[8]	**197,124**	**99,009**	**50%**	**121,445**	**60,965**	**50%**	**318,569**	**159,974**	**50%**

Notes:

1. The percentage improvement over No Action Taken is an estimate. There are some source categories where appropriate comparisons are available. It is estimated that this value is on the conservative side.
2. The carbon intensity from indirect energy use is based on PG&E's 2007 carbon intensity for all No Action Taken categories. The 20% Renewable Portfolio Standard has been used to adjust the carbon intensity value for indirect electricity use for all Project categories.
3. No Action Taken vegetation emissions are based on no net trees being planted.
4. No Action Taken residential emissions reflect minimally Title-24 (2005) compliant homes without Energy Star appliances.
5. No Action Taken non-residential emissions reflect minimally Title-24 (2005) compliant buildings.
6. No Action Taken mobile emissions is based on a comparison of trip rates adjusted for average San Francisco trip rates and no Pavley Vehicle Emission Standards.
7. Municipal emissions included here are related to water treatment, waste water treatment, street lighting, and municipal vehicles.
8. One-time emissions are annualized over 40 years and then added to the total annual emissions.

Abbreviations:
CP - Candlestick Point
CO_2e - Carbon Dioxide Equivalent
HPS -Hunter's Point Shipyard

Table 5-1
GHG Emissions from Renewable Power Standards
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Renewable Energy Source [1]	**Energy Delivered**[1] **[million kWh]**	**Percentage of Renewable Energy Delivered [%]**
Wind	1,357	15%
Small hydro	1,900	21%
Biogas	0	0%
Solar	0	<1
Biomass	3,076	34%
Geothermal	2,714	30%
Total[2]	9,047	100%
% of Total Energy From Renewables[1]	11%	
% of Total Energy From Non-Renewables	89%	
Total Energy Delivery[2]	79,450,904	MWh
from renewables	9,047,125	MWh
from non-renewables	70,403,779	MWh
CO_2 Emissions per Total Energy Delivered	635.67	lbs CO_2/MWh delivered
Total CO_2 Emissions[3]	22,908,502	metric tonnes CO_2
CO_2 Emissions per Total Non-Renewable Energy[4]	717.36	lbs CO_2/MWh delivered
Estimated Emission Factors for Total Energy Delivered [5]		
2010 RPS (20%)	573.9	lbs CO_2/MWh delivered
2020 RPS (33%)	480.6	lbs CO_2/MWh delivered

Notes:

1. The renewable energy portfolio for Pacific Gas and Electric, the power utility that is most likely to provide power to the Candlestick Point-Hunters Point Shipyard Phase II Development Plan . The renewable energy distribution is based on 2007 data available at:
http://www.pgecorp.com/corp_responsibility/reports/2007/environment/energy-future.html

2. Total energy value reported for 2007 by Pacific Gas and Electric in its 2008 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector report. Available at:
http://www.pge.com/mybusiness/edusafety/systemworks/electric/energymix/index.shtml

3. The amount of CO2 emissions is provided in Pacific Gas and Electric's 2008 Annual Entity Emissions: Electric Power Generation/Electric Utility Sector for 2007 report. Available at:
http://www.pge.com/mybusiness/edusafety/systemworks/electric/energymix/index.shtml

4. The emissions metric presented here is calculated based on the total CO_2 emissions divided by the energy delivered from non-renewable sources.

5. The emission factors for total energy delivered are estimated by multiplying the percentage of energy delivered from non-renewable energy by the CO_2 emissions per total non-renewable energy metric calculated above. Two emission factors are presented here for the current 20% RPS goal for 2010 and the presumed 33% RPS for 2020. The estimate provided here and the 2006 PUP report issued by Southern California Edison assume that renewable energy sources do not result in any CO_2 emissions. This is not necessarily true for biogas- and biomass-sourced energy but some consider these sources to be "carbon neutral."

Abbreviations:
CO_2 = carbon dioxide
kWh = kilowatt-hour
lbs = pounds
MWh = Megawatt-hour
PUP = Power/Utility Protocol
RPS = Renewables Portfolio Standard
SCE = Southern California Edison

Table 5-2
Low Carbon Fuel Standard (LCFS) Effects on Vehicle Tailpipe Emissions[1]
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Baseline Scenario					
Fuel	**Emission Factor[2]** **[kg CO_2/gal]**	**Fuel Economy[3]** **[mpg]**	**[g CO_2/mile]**	**VMT[4]** **[miles/year]**	**Emissions[5]** **[metric tonne CO_2/year]**
Gasoline	8.81	20.3	434	134,922,927	58,503
Diesel	10.15	7.9	1,283	2,897,118	3,717
					62,220
Scenario A: Replace California Diesel with 100% Biodiesel (B100)[6]					
Fuel	**Emission Factor** **[kg CO_2/gal]**	**Fuel Economy** **[mpg]**	**Emission Rate** **[g CO_2/mile]**	**VMT**	**[metric tonne CO_2/year]**
Gasoline	8.81	20.3	434	134,922,927	58,503
Biodiesel	9.46	7.1	1,329	2,897,118	3,850
					62,353
			Percent Difference from Baseline		0.2%
Scenario B: Replace California Gasoline with 85% Ethanol Blend (E85)[7]					
Fuel	**Emission Factor** **[kg CO_2/gal]**	**Fuel Economy** **[mpg]**	**Emission Rate** **[g CO_2/mile]**	**VMT** **[miles/year]**	**Emissions** **[metric tonne CO_2/year]**
E85	6.10	15.2	400	134,922,927	54,010
Diesel	10.15	7.9	1,283	2,897,118	3,717
					57,727
			Percent Difference from Baseline		-7.2%
Scenario C: Replace California Gasoline with Compressed Natural Gas (CNG)[8]					
Fuel	**Emission Factor** **[kg CO_2/gal]**	**Fuel Economy** **[mpg]**	**Emission Rate**	**VMT** **[miles/year]**	**Emissions** **[metric tonne CO_2/year]**
CNG	5.31	28.0	190	134,922,927	25,587
Diesel	10.15	7.9	1,283	2,897,118	3,717
					29,305
			Percent Difference from Baseline		-52.9%

Notes:

1. The Low Carbon Fuel Standard (LCFS) mandated under Governor Schwarzenegger's Executive Order S-01-07 and currently being developed by the California Air Resources Board (ARB) requires a reduction in carbon intensity of California's transportation fuels by at least 10% by 2020. At present, the ARB only has a "concept outline" of the LCFS regulation which proposes an Average Fuel Carbon Intensity (AFCI) of 83 g CO_2e/megajoule (MJ) of energy in the fuel for gasoline and 64 g CO_2e/MJ for diesel. However, one must consider that the LCFS considers the life cycle analysis (LCA) emissions for each fuel whereas the emissions presented in this inventory only account for vehicular tailpipe emissions. Thus, the impact on vehicle tailpipe emissions are only speculative.

In this table, ENVIRON presents the various extreme scenarios by which gasoline or diesel is replaced by various alternative fuels which have lower LCA emissions. This analysis assumes that engine technology will not change (i.e., emission factors and fuel economy are constant) and that the vehicle miles travelled (VMT) for the same population will also be similar in 2020. In reality, the fuel-specific emission factors and fuel economy are likely to improve with advanced technologies. However, overall VMT will likely increase for CP-HPS Plan if the population increases. For purposes of this analysis, the emission estimates presented here for future scenarios are attributable to the same population as in the baseline population.

2. Emission factors for various fuels from the California Climate Action Registry (CCAR) General Reporting Protocol (GRP) (2007).

3. Average fuel economy for California gasoline and diesel vehicles obtained from forecasts of fuel consumption and vehicle miles travelled for 2008 from the California Department of Transportation (2005).

4. Vehicle miles travelled (VMT) split between gasoline (or replacement) and diesel (or replacement) assumes 95% VMT by gasoline vehicles and 5% VMT by diesel vehicles.

5. These emissions only account for running CO_2 emissions and do not account for starting emissions. The emissions estimated here are derived differently compared to emissions calculated from the EMFAC model runs for the Cp-HPS Plan; the estimated emissions for the baseline scenario are roughly within 10% of the vehicle emissions developed using EMFAC. This difference is likely due to improvements in vehicle technology estimated for 2011. However, for purposes of this semi-quantitative analysis, this should be acceptable since the emissions presented in this table are only for comparative purposes and are not meant to represent actual emissions at CP-HPS Plan.

6. Scenario A assumes that California diesel would be replaced entirely by 100% biodiesel (B100). The fuel economy of biodiesel is assumed to be 10% lower than that for California diesel based on US Department of Energy estimates (2008) (http://www.fueleconomy.gov/feg/biodiesel.shtml). Some consider the CO_2 emissions from biological sources to be "carbon neutral". However for purposes of this analysis, the CO_2 from the combustion of biodiesel are accounted for.

7. Scenario B assumes that California gasoline would be replaced entirely by 85% ethanol blend (E85). The fuel economy of E85 is assumed to be 20-30% lower than that for gasoline based on US Department of Energy estimates (2008) (http://www.fueleconomy.gov/feg/ethanol.shtml).

8. Scenario C assumes that California gasoline would be replaced entirely by compressed natural gas (CNG). The fuel economy of CNG is assumed to be 28 mpg based on US Department of Energy estimates (2008) for a 2008 Honda Civic powered on CNG.

Abbreviations:

ARB = California Air Resources Board
B100 = 100% biodiesel
CNG = compressed natural gas
CO_2 = carbon dioxide
E85 = 85% ethanol blend
gal = gallon
LCA = life cycle analysis
LCFS = Low Carbon Fuel Standard
mpg = miles per gallon
VMT = vehicle miles travelled

Sources:

California Climate Action Registry (CCAR). 2007. General Reporting Protocol, Version 2.2, March. Available at: http://www.climateregistry.org/docs/PROTOCOLS/GRP%20V2-March2007.pdf
California Department of Transportation. 2005. California Motor Vehicle Stock, Travel, and Fuel Forecast. Available at: http://www.dot.ca.gov/hq/tsip/smb/documents/mvstaff/mvstaff05.pdf

Appendix A
ARUP Water Demand Memorandum

To	Lennar -	Reference number 131878/RRJ	
cc		File reference	
From	Rowan Roderick-Jones/Manish Dalia x 27222 (San Francisco)	Date September 25, 2009	
Subject	**Candlestick Point / Hunters Point Shipyard Phase II** **Water Demand Memorandum** **Revision # 15**		

1 Purpose

This Water Demand Memorandum (Memo) presents a summary approach, references, assumptions, and results of calculations undertaken by Arup to estimate a range of potential water demands and sanitary sewer flows for the Candlestick Point/Hunters Point Shipyard (CP/HPS) Development including the Proposed Project as well as the R&D and Housing Variants.

The Memo establishes a historical baseline condition and makes adjustments to account for current California building code requirements as well as the San Francisco Green Building Ordinance. The basis for these analyses and the results are presented herein.

Arup worked in conjunction with Winzler & Kelly to develop water demand and sanitary sewer flow values appropriate for use in engineering design.

2 Approach

To develop reasonable water demand estimates for the CP/HPS development the following steps were taken.

1) The Proposed Project was divided into land uses as identified in Table 1. Two project variants exclude the stadium. The R&D Variant also includes an additional 2,500,000 square feet of research and development space, as shown in Table 2. The Housing Variant does not include any additional program but shifts 1,350 housing units from Candlestick Point to Hunters Point, as shown in Table 3. The methodology for developing water demands was the same for the Proposed Project and Project Variants.

2) A **Historical Benchmark** demand was estimated for each land use based on a series of assumptions and references. Key references used were:

   a. The Urban Water Management Plan for the City of San Francisco

   b. The SFPUC Wholesale Customer Demand Projections Technical Report (URS, 2004)

   c. The City of Los Angeles CEQA Threshold Guide, 2006

   d. The EPA, Onsite Wastewater Treatment Systems Manual, 2002

A number of other references were also used and these are provided at the end of this memorandum. Arup collected information from a number of sources and selected a method of estimating demands that we believed to be appropriate and reasonable for the area. Assumptions and references are provided in Section 4.

3) The demands were then distributed between indoor and outdoor end uses which were estimated based on published data in the SFPUC Wholesale Customer Demand Projections Report (URS 2004). End use distributions for the stadium and performance venues were assumed rather than taken directly from the SFPUC's projections. The distribution ratios are provided in Table 21 and Table 22.

4) Next, the Historical Benchmark was adjusted to an **Adjusted to California Codes** scenario using new fixture flow rates from California and Federal Buildings standards as well as the International Plumbing Code.

5) The Adjusted to California Codes demand estimate does not include the requirements of the **San Francisco Green Building Ordinance (SFGBO)**. The SFGBO is based on LEED for New Construction (LEED NC) and requires a 50% reduction in landscape irrigation demands. The SFGBO does not specify what code is to be used as the baseline for irrigation demands. Therefore the current code was assumed to be equivalent to the irrigation amount allowed under the California Water Efficient Landscape Ordinance. This rule was assumed to be applicable to both private and public landscape irrigation. In addition, the SFGBO requires a 30% reduction in potable water demand. The SFGBO does not provide specific language as to which portions of demand are to be included in the 30% reduction. However, the intention of the similar LEED NC credit (Water Efficiency Credit 3) is to reduce building water demand by 30%. The total 30% reduction in building water efficiency may be achieved by any number of means including improved fixture efficiency, mechanical building efficiency, or by providing an alternative water supply. The demand estimates, when adjusted for the SFGBO represent the final demands for the Proposed Project and Project Variants.

   The SFGBO demand was developed by using the California code as a baseline and using a trajectory or possible means of water saving strategies and/or alternative water supplies to achieve the SFGBO. The assumptions and references used to make these adjustments are provided in Table 23.

6) Potential reclaimed water demands as well as sewage generation were determined based on end use distributions.

The results of the study are presented at the beginning of this report. References and Assumptions used for making the demand estimations are provided after the results in Section 3.

Table 1: CP/HPS Land Use Program (Proposed Project)

		Hunters Point Shipyard	Candlestick Point	Project Total
Land Use				
Residential				
	Density, 15-75 units per acre (units)	680	1,325	2,005
	Density, 50-125 units per acre (units)	1,415	2,865	4,280
	Density, 100-175 units per acre (units)	265	2,000	2,265
	Density, 175-285 units per acre (units)	290	1,660	1,950
	Total Project (units)	**2,650**	**7,850**	**10,500**
Retail				
	Regional Retail (sqft))	0	635,000	635,000
	Neighborhood Retail (sqft)	125,000	125,000	250,000
	Total (sqft)	**125,000**	**760,000**	**885,000**
Office (sqft)		0	150,000	150,000
Community Uses (sqft)		50,000	50,000	100,000
Research & Development (sqft)		2,500,000	0	2,500,000
Hotel (sqft)		0	150,000	150,000
Artist's Studios				
	1:1 Studio Renovation & Replacement (sqft)	225,000	0	225,000
	New Artist Center (sqft)	30,000	0	30,000
	Total (sqft)	**255,000**	**0**	**255,000**
Parks & Open Space				
	New City Parks (acres)	138	11.8	149.8
	New Sports Fields & Active Recreation (acres)	101.5	0	101.5
	New Open Space and Restored State Parkland (acres)	0	84	84
	Total (acres)	**239.5**	**95.8**	**335.3**
Football Stadium (seats)		69,000	0	69,000
Performance Venue (seats)		0	10,000	10,000

Source: Lennar, August 2009.

Table 2: CP/HPS Land Use Program (R&D Variant)

		Hunters Point Shipyard	Candlestick Point	Project Total
Land Use				
Residential				
	Density, 15-75 units per acre (units)	680	1,325	2,005
	Density, 50-125 units per acre (units)	1,415	2,865	4,280
	Density, 100-175 units per acre (units)	265	2,000	2,265
	Density, 175-285 units per acre (units)	290	1,660	1,950
	Total Project (units)	**2,650**	**7,850**	**10,500**
Retail				
	Regional Retail (sqft))	0	635,000	635,000
	Neighborhood Retail (sqft)	125,000	125,000	250,000
	Total (sqft)	**125,000**	**760,000**	**885,000**
Office (sqft)		0	150,000	150,000
Community Uses (sqft)		50,000	50,000	100,000
Research & Development (sqft)		5,000,000	0	5,000,000
Hotel (sqft)		0	150,000	150,000
Artist's Studios				
	1:1 Studio Renovation & Replacement (sqft)	225,000	0	225,000
	New Artist Center (sqft)	30,000	0	30,000
	Total (sqft)	**255,000**	**0**	**255,000**
Parks & Open Space				
	New City Parks (acres)	138	11.8	149.8
	New Sports Fields & Active Recreation (acres)	101.5	0	101.5
	New Open Space and Restored State Parkland (acres)	0	84	84
	Total (acres)	**239.5**	**95.8**	**335.3**
Football Stadium (seats)		0	0	0
Performance Venue (seats)		0	10,000	10,000

Source: Lennar, August 2009.

Table 3: CP/HPS Land Use Program (Housing Variant)

		Hunters Point Shipyard	Candlestick Point	Project Total
Land Use				
Residential				
	Density, 15-75 units per acre (units)	1,540	1,395	2,935
	Density, 50-125 units per acre (units)	1,905	3,270	5,175
	Density, 100-175 units per acre (units)	265	1,250	1,515
	Density, 175-285 units per acre (units)	290	585	875
	Total Project (units)	**4,000**	**6,500**	**10,500**
Retail				
	Regional Retail (sqft))	0	635,000	635,000
	Neighborhood Retail (sqft)	125,000	125,000	250,000
	Total (sqft)	**125,000**	**760,000**	**885,000**
Office (sqft)		0	150,000	150,000
Community Uses (sqft)		50,000	50,000	100,000
Research & Development (sqft)		2,500,000	0	2,500,000
Hotel (sqft)		0	150,000	150,000
Artist's Studios				
	1:1 Studio Renovation & Replacement (sqft)	225,000	0	225,000
	New Artist Center (sqft)	30,000	0	30,000
	Total (sqft)	**255,000**	**0**	**255,000**
Parks & Open Space				
	New City Parks (acres)	138	11.8	149.8
	New Sports Fields & Active Recreation (acres)	101.5	0	101.5
	New Open Space and Restored State Parkland (acres)	0	84	84
	Total (acres)	**239.5**	**95.8**	**335.3**
Football Stadium (seats)		69,000	0	69,000
Performance Venue (seats)		0	10,000	10,000

Source: Lennar, August 2009.

3 Results

This section provides the results of the water demand assessment. The results are provided by land use as well as by end use (fixture type). The overall results for the proposed project are summarized by Figure 1. Similar summaries for the two project variants are provided in Figure 2and Figure 3.

Table 4: Potable water demands for Proposed Project and Project Variants.

	Proposed Project Demand (MGD)	R&D Variant Demand (MGD)	Housing Variant Demand (MGD)
Historical Baseline	2.95	3.47	2.92
Adjusted to California Codes	2.46	2.92	2.44
Adjusted to San Francisco Green Building Ordinance	1.67	1.99	1.66

T**he above table in**dicates that the R&D Variant will have the highest potable water demands under the requirements of the SFGBO of 1.99 MGD.

Figures 1 through 3 provide the Proposed Project and Project Variant demands for the Historical Benchmark, the Adjusted to California Codes and the San Francisco Green Building Ordinance cases. They also illustrate the Sustainable Case trajectory defined by the step down line. The first five steps in the “sustainable Case” step-down graph are demand reduction strategies while the later five steps are achieved by utilizing alternative water supplies. Additional demand breakdowns by land use and end use are provided in Table 5 through Table 13 for the Proposed Project and Project Variants. Reclaimed water demands and sanitary flows by end use for the Proposed Project are provided in Table 14 through Table 19.

Please note that in all reported annual water demand and sanitary flow data in Table 5 through Table 19 are in million gallons per day (MGD) and are rounded to the nearest 0.01 millionth gallon. When reporting the calculations within the tables slight rounding errors on the order of 0.01 MGD may occur.

Figure 1: Water demand results summary step down graph- Proposed Project

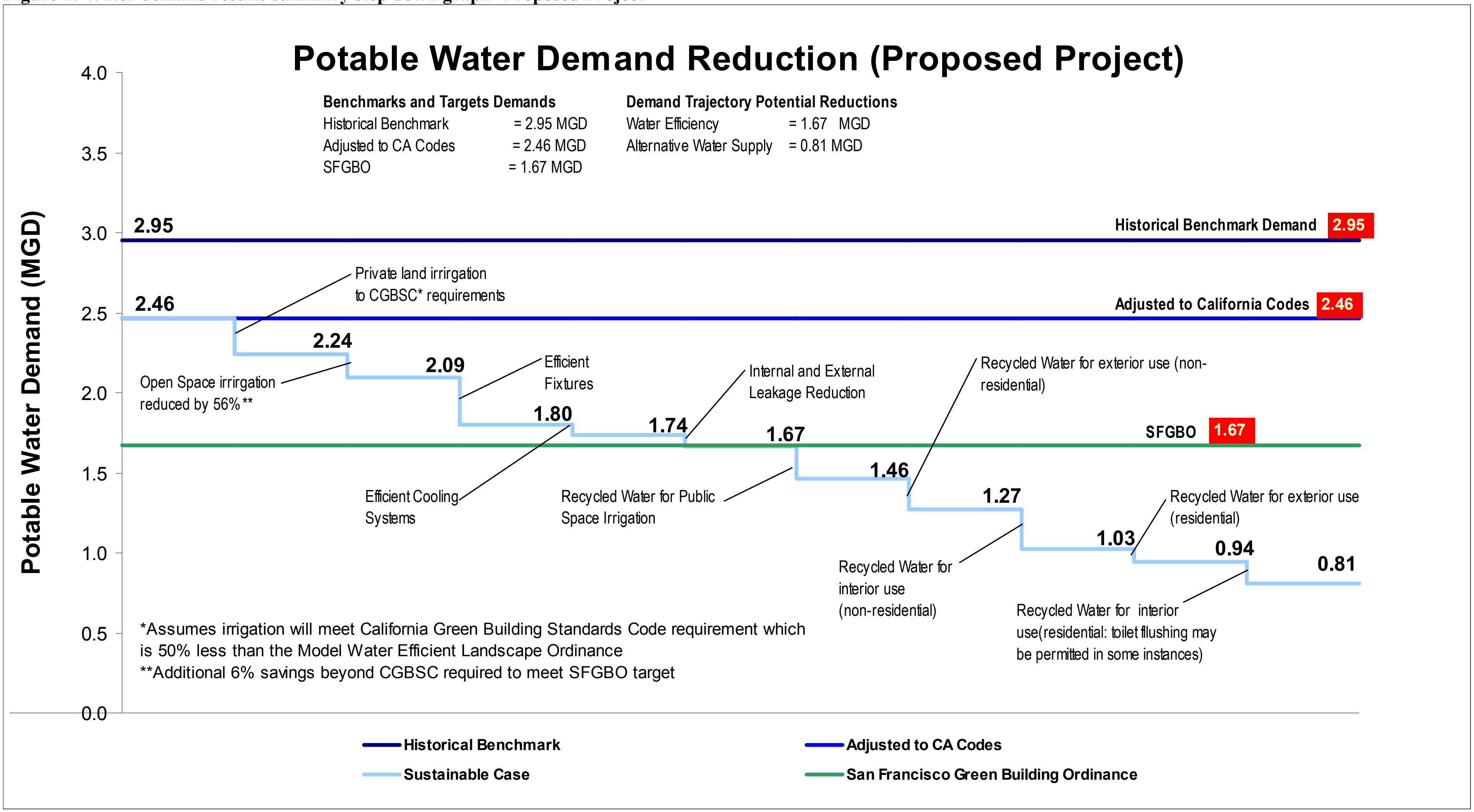

Figure 2: Water demand results summary (R&D Variant)

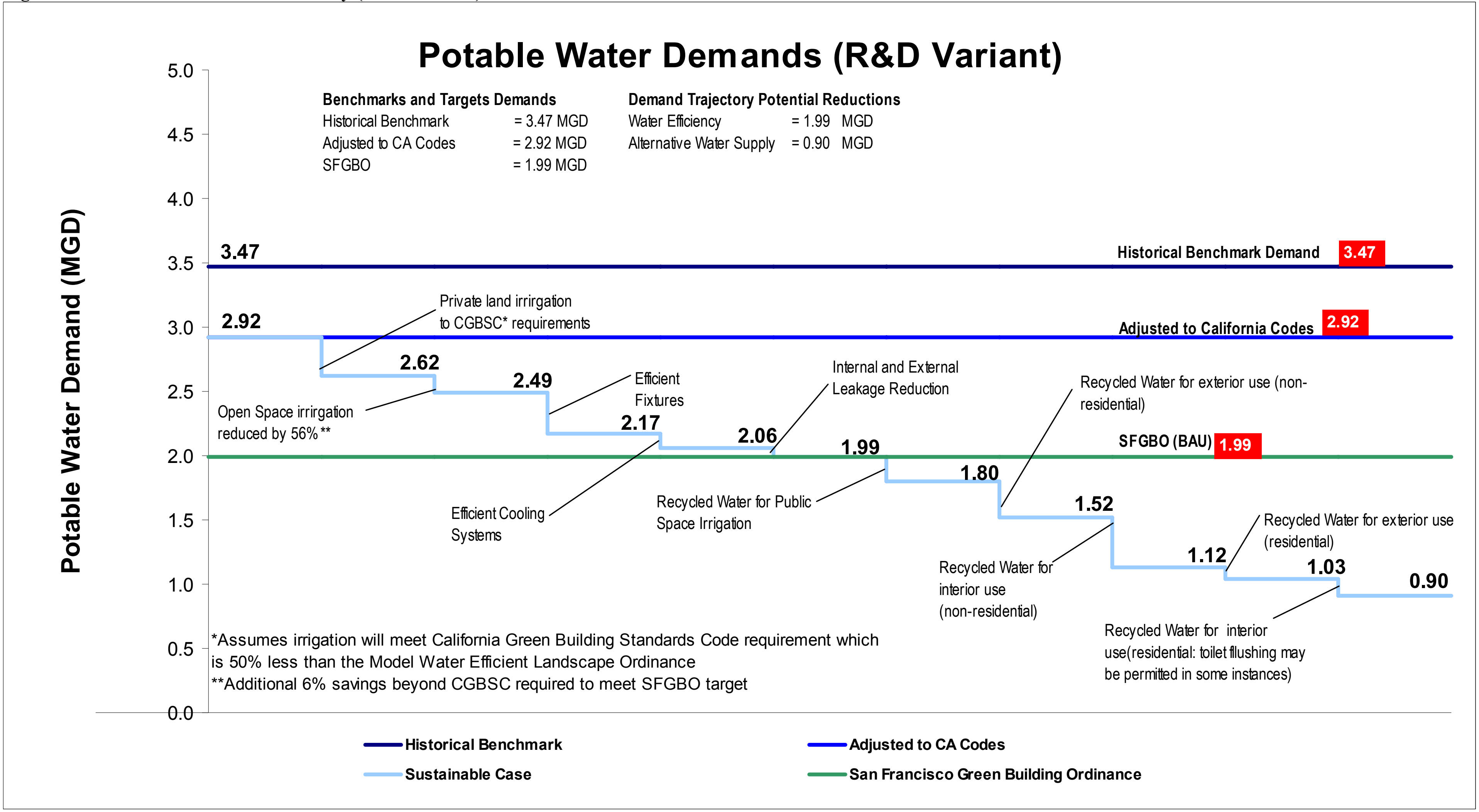

Figure 3: Water demand results summary (Housing Variant)

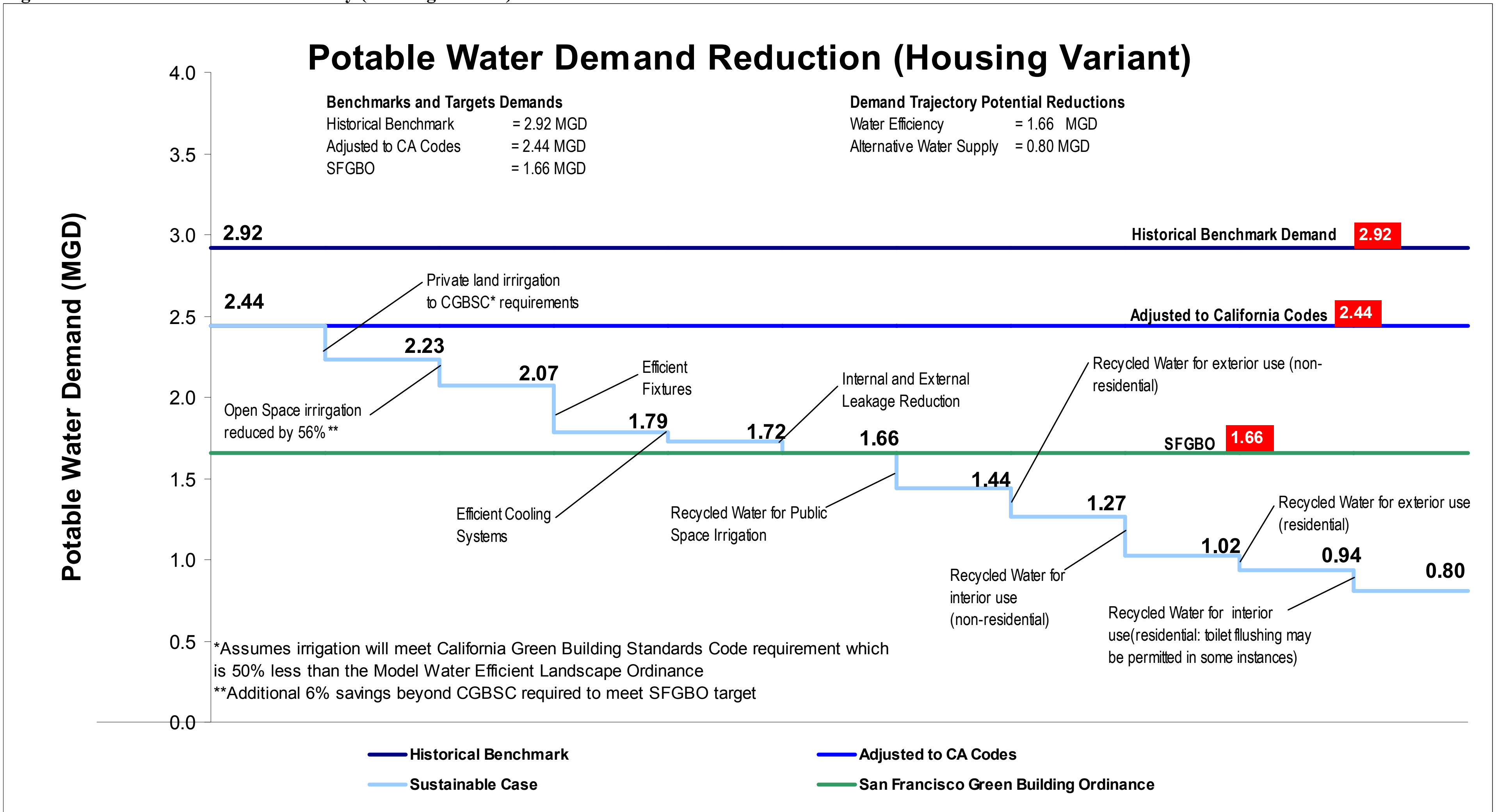

Table 5: Historical Benchmark demand by land use and end use – Proposed Project

Land Use	Historical Benchmark Demand (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	1.13	0.38	1.52
Hotel	0.08	0.00	0.08
Office	0.07	0.03	0.10
Research and Development	0.00	0.61	0.61
Neighborhood Retail	0.03	0.03	0.06
Regional Retail	0.13	0.00	0.13
Community Uses	0.02	0.02	0.03
Football Stadium	0.00	0.05	0.05
Performance Venue	0.03	0.00	0.03
Total demand excluding Parks and Open Space	**1.49**	**1.11**	**2.60**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.59**	**1.36**	**2.95**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.03	0.01	0.04
Toilets (med-high density Residential)	0.25	0.08	0.32
Toilets (all other uses)	0.05	0.10	0.15
Urinals	0.01	0.02	0.02
Laundry (low density residential)	0.02	0.01	0.03
Laundry (medium and high density residential)	0.20	0.06	0.26
Laundry (all other uses)	0.02	0.03	0.04
Shower	0.19	0.08	0.27
Bath	0.02	0.01	0.02
Faucets	0.19	0.10	0.29
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.16	0.09	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**1.24**	**0.75**	**2.00**
Outdoor Uses			
Irrigation and landscaping	0.18	0.26	0.45
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.24**	**0.36**	**0.60**
Total excluding Parks and Open Space	**1.49**	**1.11**	**2.60**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.59**	**1.36**	**2.95**

Table 6: Adjusted to CA Codes demand by land use and end use- Proposed Project

Land Use	Adjusted to CA Codes Demand (MGD) Candlestick Point	Hunters Point	Total Development
Residential	0.87	0.29	1.16
Hotel	0.07	0.00	0.07
Office	0.06	0.03	0.09
Research and Development	0.00	0.54	0.54
Neighborhood Retail	0.02	0.02	0.05
Regional Retail	0.12	0.00	0.12
Community Uses	0.01	0.01	0.03
Football Stadium	0.00	0.04	0.04
Performance Venue	0.02	0.00	0.02
Total demand excluding Parks and Open Space	**1.18**	**0.94**	**2.11**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.28**	**1.19**	**2.46**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.11	0.04	0.15
Toilets (all other uses)	0.02	0.05	0.07
Urinals	0.00	0.01	0.01
Laundry (low density residential)	0.02	0.01	0.02
Laundry (medium and high density residential)	0.14	0.05	0.19
Laundry (all other uses)	0.01	0.02	0.03
Shower	0.15	0.06	0.21
Bath	0.02	0.01	0.02
Faucets	0.16	0.09	0.25
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.16	0.09	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**0.93**	**0.58**	**1.51**
Outdoor Uses			
Irrigation and landscaping	0.18	0.26	0.45
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.24**	**0.36**	**0.60**
Total excluding Parks and Open Space	**1.18**	**0.94**	**2.11**
Parks and Open Space	0.10	0.25	0.35
Total Demand	**1.28**	**1.19**	**2.46**

Table 7: SFGBO demands by land use and end use – Proposed Project

Land Use	SFGBO Demand (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.61	0.22	0.83
Hotel	0.05	0.00	0.05
Office	0.04	0.02	0.06
Research and Development	0.00	0.36	0.36
Neighborhood Retail	0.02	0.02	0.03
Regional Retail	0.08	0.00	0.08
Community Uses	0.01	0.01	0.02
Football Stadium	0.00	0.02	0.02
Performance Venue	0.01	0.00	0.01
Total demand excluding Parks and Open Space	**0.82**	**0.64**	**1.47**
Parks and Open Space	0.06	0.15	0.21
Total Demand	**0.88**	**0.79**	**1.67**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
	Indoor Uses		
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.09	0.03	0.12
Toilets (all other uses)	0.02	0.04	0.06
Urinals	0.00	0.00	0.00
Laundry (low density residential)	0.01	0.01	0.02
Laundry (medium and high density residential)	0.10	0.03	0.13
Laundry (all other uses)	0.01	0.01	0.02
Shower	0.10	0.04	0.15
Bath	0.02	0.01	0.02
Faucets	0.11	0.06	0.18
Process Water	0.04	0.10	0.14
Dishwashers	0.02	0.02	0.04
Internal Leakage	0.12	0.07	0.19
Other domestic	0.02	0.01	0.03
Subtotal	**0.68**	**0.42**	**1.11**
	Outdoor Uses		
Irrigation and landscaping	0.09	0.14	0.23
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.01	0.04	0.05
External Leakage	0.01	0.01	0.02
Subtotal	**0.14**	**0.22**	**0.36**
Total excluding Parks and Open Space	**0.82**	**0.64**	**1.47**
Parks and Open Space	0.06	0.15	0.21
Total Demand	**0.88**	**0.79**	**1.67**

Table 8: Historical Benchmark demand by land use and end use – R&D Variant

Land Use	Historical Benchmark Demand (MGD) Candlestick Point	Hunters Point	Total Development
Residential	1.13	0.38	1.52
Hotel	0.08	0.00	0.08
Office	0.07	0.03	0.10
Research and Development	0.00	1.21	1.21
Neighborhood Retail	0.03	0.03	0.06
Regional Retail	0.13	0.00	0.13
Community Uses	0.02	0.02	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.03	0.00	0.03
Total demand excluding Parks and Open Space	**1.49**	**1.67**	**3.16**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.58**	**1.89**	**3.47**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.03	0.01	0.04
Toilets (med-high density Residential)	0.25	0.08	0.32
Toilets (all other uses)	0.05	0.18	0.23
Urinals	0.01	0.02	0.03
Laundry (low density residential)	0.02	0.01	0.03
Laundry (medium and high density residential)	0.20	0.06	0.26
Laundry (all other uses)	0.02	0.05	0.07
Shower	0.19	0.09	0.28
Bath	0.02	0.01	0.02
Faucets	0.19	0.14	0.33
Process Water	0.05	0.24	0.29
Dishwashers	0.03	0.06	0.09
Internal Leakage	0.16	0.12	0.28
Other domestic	0.03	0.01	0.04
Subtotal	**1.24**	**1.08**	**2.32**
Outdoor Uses			
Irrigation and landscaping	0.18	0.43	0.61
Pools and Fountains	0.01	0.02	0.03
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.10	0.12
External Leakage	0.01	0.03	0.04
Subtotal	**0.24**	**0.59**	**0.83**
Total excluding Parks and Open Space	**1.49**	**1.67**	**3.16**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.58**	**1.89**	**3.47**

Table 9: Adjusted to CA Codes demand by land use and end use- R&D Variant

Land Use	Adjusted to Codes BAU Demand (MGD) Candlestick Point	Hunters Point	Total Development
Residential	0.87	0.29	1.16
Hotel	0.07	0.00	0.07
Office	0.06	0.03	0.09
Research and Development	0.00	1.08	1.08
Neighborhood Retail	0.02	0.02	0.05
Regional Retail	0.12	0.00	0.12
Community Uses	0.01	0.01	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.02	0.00	0.02
Total demand excluding Parks and Open Space	**1.18**	**1.43**	**2.61**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.27**	**1.66**	**2.92**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.11	0.04	0.15
Toilets (all other uses)	0.02	0.08	0.11
Urinals	0.00	0.01	0.01
Laundry (low density residential)	0.02	0.01	0.02
Laundry (medium and high density residential)	0.14	0.05	0.19
Laundry (all other uses)	0.01	0.04	0.05
Shower	0.15	0.08	0.23
Bath	0.02	0.01	0.02
Faucets	0.16	0.12	0.29
Process Water	0.05	0.24	0.29
Dishwashers	0.03	0.05	0.08
Internal Leakage	0.16	0.12	0.28
Other domestic	0.03	0.01	0.04
Subtotal	**0.93**	**0.84**	**1.77**
Outdoor Uses			
Irrigation and landscaping	0.18	0.43	0.61
Pools and Fountains	0.01	0.02	0.03
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.02	0.10	0.12
External Leakage	0.01	0.03	0.04
Subtotal	**0.24**	**0.59**	**0.83**
Total excluding Parks and Open Space	**1.18**	**1.43**	**2.61**
Parks and Open Space	0.09	0.22	0.31
Total Demand	**1.27**	**1.66**	**2.92**

Table 10: SFGBO demands by land use and end use – R&D Variant

Land Use	SFGBO (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.61	0.22	0.83
Hotel	0.05	0.00	0.05
Office	0.04	0.02	0.06
Research and Development	0.00	0.71	0.71
Neighborhood Retail	0.02	0.02	0.03
Regional Retail	0.08	0.00	0.08
Community Uses	0.01	0.01	0.02
Football Stadium	0.00	0.00	0.00
Performance Venue	0.01	0.00	0.01
Total demand excluding Parks and Open Space	**0.82**	**0.97**	**1.80**
Parks and Open Space	0.05	0.14	0.19
Total Demand	**0.88**	**1.11**	**1.99**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.09	0.03	0.12
Toilets (all other uses)	0.02	0.07	0.08
Urinals	0.00	0.00	0.00
Laundry (low density residential)	0.01	0.01	0.02
Laundry (medium and high density residential)	0.10	0.03	0.13
Laundry (all other uses)	0.01	0.03	0.03
Shower	0.10	0.05	0.16
Bath	0.02	0.01	0.02
Faucets	0.11	0.08	0.20
Process Water	0.04	0.18	0.22
Dishwashers	0.02	0.03	0.05
Internal Leakage	0.12	0.09	0.21
Other domestic	0.02	0.01	0.03
Subtotal	**0.68**	**0.62**	**1.30**
Outdoor Uses			
Irrigation and landscaping	0.09	0.22	0.32
Pools and Fountains	0.01	0.02	0.03
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.01	0.00	0.01
Cooling	0.01	0.08	0.09
External Leakage	0.01	0.02	0.03
Subtotal	**0.14**	**0.36**	**0.50**
Total excluding Parks and Open Space	**0.82**	**0.97**	**1.80**
Parks and Open Space	0.05	0.14	0.19
Total Demand	**0.88**	**1.11**	**1.99**

Table 11: Historical Benchmark demand by land use and end use – Housing Variant

Land Use	Historical Benchmark Demand (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.94	0.58	1.52
Hotel	0.08	0.00	0.08
Office	0.07	0.04	0.10
Research and Development	0.00	0.61	0.61
Neighborhood Retail	0.03	0.03	0.06
Regional Retail	0.13	0.00	0.13
Community Uses	0.02	0.02	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.03	0.00	0.03
Total demand excluding Parks and Open Space	**1.29**	**1.26**	**2.55**
Parks and Open Space	0.11	0.26	0.37
Total Demand	**1.39**	**1.53**	**2.92**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.03	0.01	0.04
Toilets (med-high density Residential)	0.20	0.12	0.32
Toilets (all other uses)	0.05	0.10	0.15
Urinals	0.01	0.01	0.02
Laundry (low density residential)	0.02	0.01	0.03
Laundry (medium and high density residential)	0.16	0.10	0.26
Laundry (all other uses)	0.02	0.03	0.04
Shower	0.16	0.11	0.26
Bath	0.01	0.01	0.02
Faucets	0.16	0.13	0.29
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.14	0.11	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**1.07**	**0.91**	**1.98**
Outdoor Uses			
Irrigation and landscaping	0.17	0.26	0.43
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.00	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.22**	**0.35**	**0.57**
Total excluding Parks and Open Space	**1.29**	**1.26**	**2.55**
Parks and Open Space	0.11	0.26	0.37
Total Demand	**1.39**	**1.53**	**2.92**

Table 12: Adjusted to CA Codes demand by land use and end use- Housing Variant

Land Use	Adjusted to Codes BAU Demand (MGD) Candlestick Point	Hunters Point	Total Development
Residential	0.72	0.44	1.16
Hotel	0.07	0.00	0.07
Office	0.06	0.03	0.09
Research and Development	0.00	0.54	0.54
Neighborhood Retail	0.02	0.02	0.05
Regional Retail	0.12	0.00	0.12
Community Uses	0.01	0.01	0.03
Football Stadium	0.00	0.00	0.00
Performance Venue	0.02	0.00	0.02
Total demand excluding Parks and Open Space	**1.02**	**1.05**	**2.07**
Parks and Open Space	0.11	0.26	0.37
Total Demand	**1.13**	**1.31**	**2.44**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.09	0.06	0.15
Toilets (all other uses)	0.02	0.04	0.07
Urinals	0.00	0.00	0.01
Laundry (low density residential)	0.02	0.01	0.02
Laundry (medium and high density residential)	0.12	0.07	0.19
Laundry (all other uses)	0.01	0.02	0.03
Shower	0.13	0.09	0.21
Bath	0.01	0.01	0.02
Faucets	0.14	0.11	0.25
Process Water	0.05	0.13	0.18
Dishwashers	0.03	0.03	0.06
Internal Leakage	0.14	0.11	0.25
Other domestic	0.03	0.01	0.04
Subtotal	**0.80**	**0.70**	**1.50**
Outdoor Uses			
Irrigation and landscaping	0.17	0.26	0.43
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.00	0.00	0.01
Cooling	0.02	0.05	0.07
External Leakage	0.01	0.02	0.03
Subtotal	**0.22**	**0.35**	**0.57**
Total excluding Parks and Open Space	**1.02**	**1.05**	**2.07**
Parks and Open Space	0.11	0.26	0.37
Total Demand	**1.13**	**1.31**	**2.44**

Table 13: SFGBO demands by land use and end use – Housing Variant

Land Use	SFGBO (MGD)		
	Candlestick Point	Hunters Point	Total Development
Residential	0.51	0.33	0.83
Hotel	0.05	0.00	0.05
Office	0.04	0.02	0.06
Research and Development	0.00	0.36	0.36
Neighborhood Retail	0.02	0.02	0.03
Regional Retail	0.08	0.00	0.08
Community Uses	0.01	0.01	0.02
Football Stadium	0.00	0.00	0.00
Performance Venue	0.01	0.00	0.01
Total demand excluding Parks and Open Space	**0.71**	**0.73**	**1.45**
Parks and Open Space	0.06	0.15	0.22
Total Demand	**0.77**	**0.88**	**1.66**
End Use	**Candlestick Point**	**Hunters Point**	**Total Development**
Indoor Uses			
Toilets (low density residential)	0.01	0.01	0.02
Toilets (med-high density Residential)	0.07	0.05	0.12
Toilets (all other uses)	0.02	0.03	0.05
Urinals	0.00	0.00	0.00
Laundry (low density residential)	0.01	0.01	0.02
Laundry (medium and high density residential)	0.08	0.05	0.13
Laundry (all other uses)	0.01	0.01	0.02
Shower	0.09	0.06	0.15
Bath	0.01	0.01	0.02
Faucets	0.10	0.08	0.18
Process Water	0.04	0.10	0.14
Dishwashers	0.02	0.02	0.04
Internal Leakage	0.10	0.08	0.19
Other domestic	0.02	0.01	0.03
Subtotal	**0.58**	**0.51**	**1.10**
Outdoor Uses			
Irrigation and landscaping	0.08	0.14	0.22
Pools and Fountains	0.01	0.01	0.02
Wash down of houses and facilities	0.01	0.01	0.02
Car Washing	0.00	0.00	0.01
Cooling	0.01	0.04	0.05
External Leakage	0.01	0.01	0.02
Subtotal	**0.13**	**0.22**	**0.34**
Total excluding Parks and Open Space	**0.71**	**0.73**	**1.45**
Parks and Open Space	0.06	0.15	0.22
Total Demand	**0.77**	**0.88**	**1.66**

Potential reclaimed water demands and sanitary flows by end use were estimated for the Proposed Project and Project Variants. These are provided below in Table 14 through Table 19.

Table 14: Reclaimed water demands by end use – Proposed Project

End Use	Reclaimed Water Demands by End Use (MGD)		
	Historical Benchmark	Adjusted to CA Codes	SFGBO
Toilets (residential)	0.36	0.17	0.14
Toilets (non-residential))	0.15	0.07	0.06
Urinals	0.02	0.01	0.00
Process Water (non-residential)	0.18	0.18	0.14
Irrigation and landscaping (residential)	0.12	0.12	0.06
Irrigation and Landscaping (non-residential)	0.33	0.33	0.16
Pools and Fountains (residential)	0.01	0.01	0.01
Pools and Fountains (non-residential)	0.01	0.01	0.01
Wash down (residential)	0.01	0.01	0.01
Wash down (non-residential)	0.01	0.01	0.01
Car Washing (residential)	0.01	0.01	0.01
Car Washing (non-residential)	0.00	0.00	0.00
Cooling (non-residential)	0.07	0.07	0.05
Total flow excluding Parks and Open Space	**1.29**	**1.00**	**0.66**
Parks and Open Space	0.35	0.35	0.21
Total Demand	**1.64**	**1.35**	**0.86**

Table 15: Sanitary flows by end use – Proposed Project

End Use	Sanitary Flows by End Use (MGD)		
	Historical Benchmark	Adjusted to CA Codes	SFGBO
Toilets	0.52	0.24	0.19
Urinals	0.02	0.01	0.00
Laundry	0.34	0.24	0.17
Shower	0.27	0.21	0.15
Bath	0.02	0.02	0.02
Faucets	0.29	0.25	0.18
Process Water	0.18	0.18	0.14
Dishwashers	0.06	0.06	0.04
Other domestic	0.04	0.04	0.03
Cooling (non res)	0.07	0.07	0.05
Total	**1.82**	**1.33**	**0.98**

Table 16: Reclaimed water demands by end use – R&D Variant

End Use	Reclaimed Water Demands by End Use (MGD)		
	Historical Benchmark	Adjusted to Codes BAU	SFGBO
Toilets (residential)	0.36	0.17	0.14
Toilets (non-residential))	0.23	0.11	0.08
Urinals	0.03	0.01	0.00
Process Water (non-residential)	0.29	0.29	0.22
Irrigation and landscaping (residential)	0.12	0.12	0.06
Irrigation and Landscaping (non-residential)	0.49	0.49	0.25
Pools and Fountains (residential)	0.01	0.01	0.01
Pools and Fountains (non-residential)	0.02	0.02	0.02
Wash down (residential)	0.01	0.01	0.01
Wash down (non-residential)	0.02	0.02	0.02
Car Washing (residential)	0.01	0.01	0.01
Car Washing (non-residential)	0.00	0.00	0.00
Cooling (non-residential)	0.12	0.12	0.09
Total flow excluding Parks and Open Space	**1.71**	**1.37**	**0.90**
Parks and Open Space	0.31	0.31	0.19
Total Demand	**2.02**	**1.68**	**1.09**

Table 17: Sanitary flows by end use – R&D Variant

End Use	Sanitary Flows by End Use (MGD)		
	Historical Benchmark	Adjusted to Codes BAU	SFGBO
Toilets	0.60	0.27	0.22
Urinals	0.03	0.01	0.00
Laundry	0.36	0.26	0.18
Shower	0.28	0.23	0.16
Bath	0.02	0.02	0.02
Faucets	0.33	0.29	0.20
Process Water	0.29	0.29	0.22
Dishwashers	0.09	0.08	0.05
Other domestic	0.04	0.04	0.03
Cooling (non res)	0.12	0.12	0.09
Total	**2.16**	**1.61**	**1.18**

Table 18: Reclaimed water demands by end use – Housing Variant

End Use	Reclaimed Water Demands by End Use (MGD)		
	Historical Benchmark	Adjusted to Codes BAU	SFGBO
Toilets (residential)	0.36	0.17	0.14
Toilets (non-residential))	0.15	0.07	0.05
Urinals	0.02	0.01	0.00
Process Water (non-residential)	0.18	0.18	0.14
Irrigation and landscaping (residential)	0.12	0.12	0.06
Irrigation and Landscaping (non-residential)	0.30	0.30	0.15
Pools and Fountains (residential)	0.01	0.01	0.01
Pools and Fountains (non-residential)	0.01	0.01	0.01
Wash down (residential)	0.01	0.01	0.01
Wash down (non-residential)	0.01	0.01	0.01
Car Washing (residential)	0.01	0.01	0.01
Car Washing (non-residential)	0.00	0.00	0.00
Cooling (non-residential)	0.07	0.07	0.05
Total flow excluding Parks and Open Space	**1.25**	**0.97**	**0.64**
Parks and Open Space	0.37	0.37	0.22
Total Demand	**1.62**	**1.33**	**0.86**

Table 19: Sanitary flows by end use – Housing Variant

End Use	Sanitary Flows by End Use (MGD)		
	Historical Benchmark	Adjusted to Codes BAU	SFGBO
Toilets	0.51	0.23	0.19
Urinals	0.02	0.01	0.00
Laundry	0.34	0.24	0.17
Shower	0.26	0.21	0.15
Bath	0.02	0.02	0.02
Faucets	0.29	0.25	0.18
Process Water	0.18	0.18	0.14
Dishwashers	0.06	0.06	0.04
Other domestic	0.04	0.04	0.03
Cooling (non res)	0.07	0.07	0.05
Total	**1.80**	**1.32**	**0.97**

4 Assumptions and References

This section describes assumptions used to:

1) Estimate historical baseline demands;
2) Distribute the historical baseline demands to specific end uses such as toilets, showers, irrigation etc…;
3) Adjust the historical baseline demands to current California code; and
4) Adjust the to-code demands to a sustainable case wherein efficiency measures such as efficient fixturesare applied. The efficiency measures applied in the Sustainable Case have been tailored to meet the demand reduction requirements of the SFGBO.

Table 20: Assumptions for estimating business as usual water demands by land use.

Assumptions Summary for BAU Demand Estimation						
Land use	**ID#**	**Description**	**Value**	**Unit**	**Reference or Assumption**	**Notes**
Residential						
	1	No. of residents per unit - low density	2.33	residents	Mundie & Associates, 2009	
	2	No. of residents per unit - medium density	2.33	residents	Mundie & Associates, 2009	
	3	No. of residents per unit - high density	2.33	residents	Mundie & Associates, 2009	
	4	Average consumption per capita	62	gallons per day (gp)	SFPUC, 2005	
	5	Average outdoor water use for single family residences	10	%	SFPUC, 2005	Note reference states that average demand is less than 10%
Regional Retail						
	1	Regional Retail jobs creation	350	Square feet (sqft)/job	Economic and Planning Systems, 2009.	
	2	Area of retail space per customer	22	sqft/customer	British Standards Institution. 2006	
	3	Sewage generation per employee	10	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	4	Sewage generation per visitor	2	gpd	EPA, 2002	EPA sites 2 gpd / parking spot. Sewage generation is only a fraction of overall consumption
	5	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	
	6	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer

Neighborhood Retail						
	1	Neighborhood retail jobs creation	270	sqft/job	Economic and Planning Systems, 2009.	
	2	Area of retail space per customer	22	sqft/customer	British Standards Institution. 2006	
	3	Sewage generation per employee	10	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	4	Water generation per visitor	2	gpd	EPA, 2002	EPA sites 2 gpd / parking spot. Sewage generation is only a fraction of overall consumption
	5	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	Sewage generation is only a fraction of overall consumption
	6	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Office						
Office estimates also include jobs created by residential development and artist studios						
	1	Office job creation	276	sqft/job	Economic and Planning Systems, 2009.	
	2	Residential jobs creation	25	Units/job	Economic and Planning Systems, 2009.	
	3	Water consumption per employee	85	gpd	URS, 2004.	
	4	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	
	5	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Community Uses						

	1	Community use job creation	276	sqft/job	Assumed similar to office	Actual Community uses are not finalized therefore community use water demands have been estimated in a similar manner as office land use.
	2	Water consumption per employee	85	gpd	Assumed similar to office	
	3	Average outdoor water use for non-residential customers	43	percent	Assumed similar to office	
	4	Ratio of sewage generation to total water consumed on site	57	percent	Assumed similar to office	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Research and Development						
	1	R&D jobs creation (office)	267	sqft/job	Economic and Planning Systems, 2009.	
	2	Sewage generation per employee for office R&D space	85	gpd	URS, 2004.	Sewage generation is only a fraction of overall consumption
	3	Average outdoor water use for non-residential customers for all R&D	43	percent	URS, 2004.	Sewage generation is only a fraction of overall consumption
	4	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Assumption is conservative in that some water consumed indoors would not go to sanitary sewer
	5	Type of R&D Spaces	1/3,1/3, and 1/3	Fraction	Email from Lennar	From email correspondence with Lennar it has been assumed that 1/3 of the R&D space will be office, 1/3 will be wet laboratory, and the remaining 1/3 will be light production which is similar to industrial.
	6	Water Usage for Wet Laboratory R&D Space	0.547	gpsfd	2020 UC Berkeley LRDP Draft EIR (http://www.cp.berkeley.edu/LRDP_2020 draft.htm) - Table 4.13-1	Source provided by Winzler & Kelly. The report states that 0.32 is for sustainable lab case with efficient fixtures built in, and calculations were worked backwards to calculate the BAU.
	7	Water usage profile for	Varies	%	URS, 2004	The water usage profile for wet lab

		Wet Lab Space				space has been assumed to be the average of the commercial and industrial usage profile.
	8	Water Usage for Light Projection R&D Space	0.1	gpsfd	City of Los Angeles, L.A. CEQA Threshold Guide, 2006, Exhibit M.2. - 12 Sewage Generation Factors	
Hotel						
	1	Hotel job creation	700	sqft/job	Economic and Planning Systems, 2009	
	2	Average guest room size	600	sqft	Assumed	This includes the space for reception, kitchens and conference facilities
	3	Average guests / room	1.9	guests	Assumed	
	4	Sewage generation per guest	50	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	5	Sewage generation per employee	10	gpd	EPA, 2002	Sewage generation is only a fraction of overall consumption
	6	Average outdoor water use for non-residential customers	43	percent	URS, 2004.	Sewage generation is only a fraction of overall consumption
	7	Ratio of sewage generation to total water consumed on site	57	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Artist Studios						
	1	# of artists	252	people	Lennar, 2009	
	2	Consumption per artist	85	gpd	URS, 2004.	
Parks and Open Space						
	1	Total irrigation demand from landscape architect	350,180	gpd	Per landscape irrigation prepared by RHAA 7/31/08	
Football Stadium						
	1	Football games / year	10	Home games	Economic and Planning Systems, 2009.	
	2	Attendance at football games	69000	people	Economic and Planning Systems, 2009.	

	3	Other venues per year	20	Other venues	Economic and Planning Systems, 2009.	
	4	Attendance at other venues	37500	people	Lennar, 2009	
	5	Employees (football day)	3625	people	Stadium Staffing Numbers from SF 49ers, (Lennar, 2009)	Includes 2900 employees and 725 media personnel
	6	Employees (event day)	1,922	people	Pro-rated using football day attendance and employees on football days	
	7	Employee (nonevent days)	48	people	Stadium Staffing Numbers from SF 49ers, (Lennar, 2009)	
	8	No. of players/performers (event day)	200	people	Assumed	100 people per team for players and staff. Assumed same number for other event days
	9	Stadium average daily irrigation	23979	gpd	Marty Laporte, 2009	
	10	Sewage generation per seat and employee on game days	4	gpd	EPA, 2002.	EPA value is for "auditorium" Sewage generation is only a fraction of overall consumption
	11	Ratio of sewage generation to total water consumed on site	95	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
	12	Water consumption per permanent employee per day	85	gpd	URS, 2004.	
Performance Venue						
	1	Performance venue job creation	40	seats/job	Economic and Planning Systems, 2009.	
	2	Performance events per year	250	events	Economic and Planning Systems, 2009.	
	3	Employees - typical day	7	people	Assumed	Prorated to be similar to stadium
	4	Visitors per performance	10,000	people	Per CP/HPS development program, 2009	

	6	Water consumption per permanent employee per day	85	gpd	URS, 2004.	
	7	Sewage generation per seat and employee on event days	4	gpd	EPA, 2002.	EPA value is for "auditorium". Sewage generation is only a fraction of overall consumption
	12	Ratio of sewage generation to total water consumed on site	95	percent	Assumed based on URS 2004.	Required to convert sewage generation to total water consumption. Conservative in that a small portion of water consumed indoors would not go to sanitary sewer
Sanitary Sewer						
	1	Ratio of sewage generation to indoor water consumption	100%	Percent	Assumed per URS 2004 and conversations with W&K	
	2	Amount of Losses for Process Water	100%	Percent	Assumed per URS 2004 and conversations with W&K.	
	3	Amount of Losses for Cooling Tower (Non Res)	50%	Percent	Assumed per conversations with W&K	

Table 21: End use demand distributions by land use (URS 2004)

Table 3-3
End-Use Data - Initial Percentage Assumptions

End Use	Initial Percentages by Customer-Billing Category				
	Single-Family Residential	Multi-Family Residential	Commercial	Industrial	Institutional
Indoor Usage					
Toilets (indoor)	26.7%	26.7%	25%	23%	20%
Urinals (indoor)	NA	NA	0%	7%	0%
Laundry (indoor)	21.7%	21.7%	8%	5%	10%
Showers (indoor)	16.8%	16.8%	5%	5%	16%
Bath (indoor)	1.7%	1.7%	NA	NA	NA
Faucets (indoor)	15.7%	15.7%	10%	15%	19%
Process (indoor)	NA	NA	34%	30%	5%
Dishwashers (indoor)	1.4%	1.4%	8%	5%	15%
Internal Leakage (indoor)	13.7%	13.7%	10%	10%	15%
Other Domestic (indoor)	2.2%	2.2%	NA	NA	NA
Outdoor Usage					
Irrigation and Landscaping (outdoor)	80%	80%	75%	65%	70%
Pools and Fountains (outdoor)	5%	5%	2%	5%	5%
Wash-down of house/facilities (outdoor)	5%	5%	3%	0%	5%
Car Washing (outdoor)	5%	5%	0%	0%	0%
Cooling (outdoor)	0%	0%	15%	25%	15%
External Leakage (outdoor)	5%	5%	5%	5%	5%

NA – Not Applicable

Sources: AWWARF, Konen (1986), Behling et al. (1992)

Table 22: Assumed end use distributions for the stadium and performance venue

Indoor Usage	%	95%
Outdoor Usage	%	5%
Indoor Uses		
Toilets	%	30%
Urinals	%	30%
Laundry	%	0%
Shower	%	5%
Bath	%	0%
Faucets	%	15%
Process Water	%	10%
Dishwashers	%	0%
Internal Leakage	%	10%
Other domestic	%	0%
Outdoor Uses		
Irrigation and landscaping	%	20%
Pools and Fountains	%	0%
Wash down of houses and facilities	%	20%
Car Washing	%	0%
Cooling	%	50%
External Leakage	%	10%

Table 23: Assumptions used to adjust between water demand scenarios

	Historical Benchmark		Adjusted to CA Code		Sustainable Case		
	Max Flow or Quantity	Note / Reference	Max Flow or Quantity	Note / Reference	Max Flow or Quantity	Note/Reference	Unit
Plumbing Fixture							
Lavatory faucet, private	2.5		2.2	2007 California Plumbing Code	1.5	EPA WaterSense	gpm at 60 psi
Lavatory faucet, public, (metering)	0.25		0.25	2006 International Plumbing Code	0.2	CA Green Building Standard 2008	gallon per metering cycle
(not metering)	0.6		0.5	IPC	0.5	n.a.	gpm at 60 psi
Shower head	3.125	URS 2004*	2.5	2007 California Plumbing Code	1.75	EPA WaterSense	gpm at 80 psi
Sink faucet	2.5		2.2	Plumbing Code	1.5	EPA WaterSense	gpm at 60 psi
Urinal	2	URS 2004*	1	2007 California Plumbing Code	0.125	EPA Water Sense	gallon per flushing cycle
Water closet	3.5	URS 2004*	1.6	2007 California Plumbing Code	1.28	EPA Water Sense and CA Green Building Standard 2008	gallon per flushing cycle
Other Appliances							
Dishwasher (Residential)	7		6	US Department of Energy 2007	4	Energy Star	gallons/cy capacity
Dishwasher (Commercial)	1.75		1.46	Energy Star	0.92	Energy Star	gallons per rack
Laundry	36.4	URS 2004	26	(US Federal Standard by 2011)	18	n.a. (calc)	gal/load
Laundry	13.2		8.5	CA Green Building Standard 2008	6	EPA Water Sense	gal/load-cf (Water Factor)
Irrigation							
Private Lands		Based on water demand distribution		California Water Efficient Landscape Ordinance (CWELO)	50%	CA Green Building Standard 2008	Fractional reduction compared to CWELO
Public Open Space		Per Landscape Architect Estimates		Per Landscape Architect Estimates - Note that this is less than CWELO	50%	CA Green Building Standard 2008	Fractional reduction compared to CWELO

Table 24: Other assumptions used to adjust theCA code demand to the sustainable case

Improved Cooling Efficiency		
Total fraction demand reductiont due to building envelope improvement measures and improved cooling technologies	0.25	
Reduced Losses		
Fractional demand reduction due to new piping and metering	0.25	

5 References

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Appendix B
EMFAC and Pavley Adjustments

Table 5-3
Pavley Vehicle Standards[1]
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Model Year[2, 3]	Greenhouse Gas Emission Standards	
	PC/LDT1[4]	LDT2[5]
	[g CO_2e/mile]	[g CO_2e/mile]
2009	323	439
2010	301	420
2011	267	390
2012	233	361
2013	227	355
2014	222	350
2015	213	341
2016	205	332
2017	195	310
2018	185	285
2019	180	270
2020	175	265

Notes:

1. The Pavley vehicle standards (Pavley Standards) presented here are pursuant to Assembly Bill 1493 (AB 1493) which requires that the California Air Resources Board (ARB) develop and adopt regulations that achieve the maximum feasible and cost-effective reduction of GHG emissions from motor vehicles. The vehicle GHG emission standards are codified in Title 13 of the California Code of Regulations Section 1961.1(a)(1)(A). Post-2016 and fleet average standards are based on assumptions of fleet mix and further GHG emission reductions from an ARB technical assessment (2008).
2. The Pavley Standards would go into effect starting with model year 2009 vehicles.
3. The Pavley Standards developed by the ARB mandate emission reductions up to 2016. The standards presented for years 2017 through 2020 represent a commitment by the ARB to further reduce vehicle emissions for the 2020 goals of AB 32.
4. The Passenger Car (PC) and Light-Duty Trucks 1 (LDT1) category covers all passenger cars and light-duty trucks up to 3,750 lbs.
5. The Light-Duty Trucks 2 (LDT2) category covers light-duty trucks between 3,751 - 8,500 lbs and all medium-duty passenger vehicles.

Abbreviations:
AB = Assembly Bill
ARB = California Air Resources Board
CO_2e = carbon dioxide equivalent
GHG = greenhouse gas
LDT = light duty truck
PC = passenger car

Source:
California Air Resources Board (ARB). 2008. Comparison of Greenhouse Gas Reductions For the United States and Canada Under U.S. CAFE Standards and California Air Resources Board Greenhouse Gas Regulations.

Table 5-4
Running Emission Factor Assuming Pavley Vehicle Standards
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Vehicle type (all model years)	VMT (miles)	Percent of Vehicles	EMFAC	PAVLEY
			grams CO_2/mile[1]	
LDA	8,746,676	65%	414	268
LDT1	1,592,169	12%	520	316
LDT2	2,248,496	17%	528	402
MDV	739,112	5%	719	479
MCY	130,784	1%	171	171
Weighted Average[2]			465	310

Notes:

1. The running emission factor for a vehicle type is calculated from EMFAC's burden mode. This weighted average in each vehicle type represents the emission factor from the population of model year vehicles present in 2020.
2. The overall average running emission factor takes into account the percentage of vehicle types used in San Francisco based on the estimated VMT used in EMFAC for 2020.

```
Title    : SF 2011 and 2020_BURDEN
Version  : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:04:08
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season   : Annual
Area     : San Francisco County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
********************************************************************************
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************************************************
,LDA-NCAT,LDA-CAT,LDA-DSL,LDA-TOT,LDT1-NCAT,LDT1-CAT,LDT1-DSL,LDT1-TOT,LDT2-
NCAT,LDT2-CAT,LDT2-DSL,LDT2-TOT,MDV-NCAT,MDV-CAT,MDV-DSL,MDV-TOT,LHDT1-
NCAT,LHDT1-CAT,LHDT1-DSL,LHDT1-TOT,LHDT2-NCAT,LHDT2-CAT,LHDT2-DSL,LHDT2-
TOT,MHDT-NCAT,MHDT-CAT,MHDT-DSL,MHDT-TOT,HHDT-NCAT,HHDT-CAT,HHDT-DSL,HHDT-
TOT,OBUS-NCAT,OBUS-CAT,OBUS-DSL,OBUS-TOT,SBUS-NCAT,SBUS-CAT,SBUS-DSL,SBUS-
TOT,UB-NCAT,UB-CAT,UB-DSL,UB-TOT,MH-NCAT,MH-CAT,MH-DSL,MH-TOT,MCY-NCAT,MCY-
CAT,MCY-DSL,MCY-TOT,ALL-TOT
Vehicles,     2176.,   265294.,      783.,   268252.,      422.,    46721.,
709.,    47853.,      209.,    67125.,      168.,    67501.,       56.,
19208.,       83.,    19347.,        5.,     1472.,      389.,     1866.,
8.,     1064.,      884.,     1956.,       91.,     1349.,     5225.,     6665.,
28.,      132.,      186.,      346.,        3.,      244.,      230.,
477.,        1.,       57.,      227.,      285.,       25.,       52.,
1027.,     1105.,       67.,      620.,       46.,      733.,     9216.,
5260.,        0.,    14476.,   430862.,
VMT/1000,       31.,     7829.,       16.,     7875.,        7.,     1406.,
18.,     1432.,        4.,     2079.,        4.,     2087.,        1.,
683.,        2.,      687.,        0.,       58.,       16.,       74.,
0.,       36.,       30.,       66.,        1.,       54.,      301.,      356.,
0.,        9.,       32.,       42.,        0.,       11.,       13.,       24.,
0.,        2.,        9.,       12.,        3.,        6.,      125.,      135.,
1.,        7.,        1.,        8.,       64.,       51.,        0.,      115.,
12911.,
Trips   ,     8582.,  1666520.,     4246.,  1679350.,     1687.,   291234.,
4287.,   297208.,      840.,   423410.,     1007.,   425258.,      237.,
121344.,      503.,   122084.,      163.,    48671.,     4896.,    53730.,
264.,    35181.,    11117.,    46561.,     4155.,    61594.,   146520.,
212269.,     1278.,     6038.,      940.,     8257.,      128.,    11160.,
6441.,    17729.,        3.,      229.,      909.,     1142.,      100.,
209.,     4110.,     4419.,        7.,       62.,        5.,       73.,
18431.,    10519.,        0.,    28950.,  2897030.,
Total Organic Gas Emissions
Run Exh ,      0.26,      0.75,      0.00,      1.01,      0.06,      0.19,
0.00,      0.25,      0.03,      0.25,      0.00,      0.28,      0.01,
0.12,      0.00,      0.13,      0.00,      0.02,      0.00,      0.02,
0.00,      0.02,      0.01,      0.04,      0.01,      0.04,      0.08,
0.12,      0.01,      0.04,      0.03,      0.07,      0.00,      0.01,
0.00,      0.01,      0.00,      0.00,      0.00,      0.01,      0.03,
0.08,      0.13,      0.24,      0.00,      0.01,      0.00,      0.01,
0.30,      0.12,      0.00,      0.42,      2.62,
Idle Exh,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.01,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
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0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.02,
Start Ex, 0.06, 0.90, 0.00, 0.96, 0.01, 0.18,
0.00, 0.19, 0.01, 0.26, 0.00, 0.26, 0.00,
0.11, 0.00, 0.11, 0.00, 0.03, 0.00, 0.03,
0.00, 0.03, 0.00, 0.04, 0.05, 0.12, 0.00,
0.17, 0.03, 0.03, 0.00, 0.06, 0.00, 0.02,
0.00, 0.02, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.06, 0.03, 0.00, 0.09, 1.94,
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Total Ex, 0.31, 1.65, 0.00, 1.97, 0.07, 0.37,
0.00, 0.45, 0.04, 0.51, 0.00, 0.55, 0.01,
0.23, 0.00, 0.24, 0.00, 0.05, 0.00, 0.06,
0.00, 0.06, 0.01, 0.08, 0.06, 0.16, 0.08,
0.30, 0.03, 0.07, 0.04, 0.14, 0.00, 0.03,
0.00, 0.03, 0.00, 0.00, 0.00, 0.01, 0.04,
0.08, 0.13, 0.24, 0.00, 0.01, 0.00, 0.01,
0.36, 0.15, 0.00, 0.51, 4.58,

Diurnal , 0.01, 0.14, 0.00, 0.14, 0.00, 0.03,
0.00, 0.03, 0.00, 0.03, 0.00, 0.03, 0.00,
0.01, 0.00, 0.01, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.01, 0.01, 0.00, 0.02, 0.23,
Hot Soak, 0.03, 0.34, 0.00, 0.37, 0.01, 0.07,
0.00, 0.08, 0.00, 0.08, 0.00, 0.08, 0.00,
0.02, 0.00, 0.02, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.01, 0.01, 0.00, 0.01, 0.57,
Running , 0.17, 0.90, 0.00, 1.06, 0.02, 0.37,
0.00, 0.39, 0.01, 0.39, 0.00, 0.40, 0.00,
0.09, 0.00, 0.10, 0.00, 0.03, 0.00, 0.03,
0.00, 0.06, 0.00, 0.06, 0.02, 0.04, 0.00,
0.06, 0.01, 0.01, 0.00, 0.01, 0.00, 0.01,
0.00, 0.01, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.05, 0.03, 0.00, 0.08, 2.20,
Resting , 0.01, 0.10, 0.00, 0.11, 0.00, 0.02,
0.00, 0.02, 0.00, 0.02, 0.00, 0.02, 0.00,
0.01, 0.00, 0.01, 0.00, 0.00, 0.00, 0.00,
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0.00, 0.01, 0.00, 0.01, 0.17,

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Total   ,      0.52,      3.13,      0.00,      3.65,      0.10,      0.86,
0.00,      0.96,      0.05,      1.03,      0.00,      1.08,      0.02,
0.36,      0.00,      0.37,      0.00,      0.08,      0.00,      0.09,
0.01,      0.13,      0.01,      0.14,      0.08,      0.20,      0.08,
0.36,      0.04,      0.08,      0.04,      0.15,      0.00,      0.03,
0.00,      0.04,      0.00,      0.00,      0.00,      0.01,      0.04,
0.08,      0.13,      0.25,      0.00,      0.01,      0.00,      0.01,
0.43,      0.21,      0.00,      0.64,      7.75,
Carbon Monoxide Emissions
Run Exh ,      2.70,     17.50,      0.02,     20.21,      0.65,      4.82,
0.02,      5.49,      0.32,      6.17,      0.00,      6.49,      0.17,
2.37,      0.00,      2.53,      0.02,      0.18,      0.02,      0.22,
0.02,      0.28,      0.04,      0.35,      0.12,      0.57,      0.64,
1.33,      0.19,      0.44,      0.11,      0.75,      0.00,      0.12,
0.03,      0.15,      0.01,      0.02,      0.03,      0.05,      0.65,
0.32,      0.64,      1.60,      0.10,      0.17,      0.00,      0.27,
3.19,      0.67,      0.00,      3.85,     43.29,
Idle Exh,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.01,      0.00,      0.01,
0.00,      0.01,      0.00,      0.01,      0.00,      0.02,      0.01,
0.03,      0.00,      0.00,      0.02,      0.02,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.01,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.09,
Start Ex,      0.28,     10.03,      0.00,     10.31,      0.06,      2.34,
0.00,      2.40,      0.03,      3.11,      0.00,      3.14,      0.01,
1.17,      0.00,      1.18,      0.01,      0.34,      0.00,      0.35,
0.01,      0.44,      0.00,      0.45,      0.28,      1.89,      0.00,
2.17,      0.35,      0.48,      0.00,      0.83,      0.01,      0.33,
0.00,      0.34,      0.00,      0.01,      0.00,      0.01,      0.01,
0.03,      0.00,      0.04,      0.00,      0.00,      0.00,      0.00,
0.17,      0.17,      0.00,      0.34,     21.56,
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Total Ex,      2.98,     27.53,      0.02,     30.52,      0.70,      7.16,
0.02,      7.88,      0.34,      9.28,      0.00,      9.63,      0.18,
3.54,      0.00,      3.72,      0.02,      0.54,      0.02,      0.58,
0.04,      0.73,      0.04,      0.81,      0.40,      2.48,      0.66,
3.53,      0.54,      0.92,      0.13,      1.60,      0.01,      0.45,
0.03,      0.49,      0.01,      0.03,      0.03,      0.07,      0.66,
0.35,      0.64,      1.64,      0.10,      0.17,      0.00,      0.27,
3.35,      0.84,      0.00,      4.19,     64.94,
Oxides of Nitrogen Emissions
Run Exh ,      0.15,      1.73,      0.02,      1.90,      0.04,      0.48,
0.03,      0.55,      0.02,      0.88,      0.01,      0.91,      0.01,
0.40,      0.00,      0.41,      0.00,      0.03,      0.07,      0.10,
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0.00,       0.04,       0.19,       0.23,       0.00,       0.14,       2.59,
2.73,       0.01,       0.14,       0.40,       0.55,       0.00,       0.04,
0.11,       0.15,       0.00,       0.00,       0.12,       0.13,       0.01,
0.06,       3.07,       3.15,       0.00,       0.02,       0.01,       0.03,
0.09,       0.06,       0.00,       0.15,      10.99,
Idle Exh,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.04,
0.04,       0.00,       0.00,       0.04,       0.04,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.01,       0.01,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.10,
Start Ex,       0.01,       0.63,       0.00,       0.64,       0.00,       0.13,
0.00,       0.13,       0.00,       0.28,       0.00,       0.28,       0.00,
0.11,       0.00,       0.11,       0.00,       0.09,       0.00,       0.09,
0.00,       0.08,       0.00,       0.08,       0.00,       0.19,       0.00,
0.19,       0.01,       0.06,       0.00,       0.06,       0.00,       0.04,
0.00,       0.04,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.01,       0.00,       0.00,       0.01,       1.63,
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Total Ex,       0.16,       2.36,       0.02,       2.54,       0.04,       0.61,
0.03,       0.68,       0.02,       1.16,       0.01,       1.19,       0.01,
0.51,       0.00,       0.52,       0.00,       0.12,       0.07,       0.19,
0.00,       0.12,       0.19,       0.31,       0.01,       0.32,       2.63,
2.96,       0.01,       0.20,       0.44,       0.65,       0.00,       0.08,
0.11,       0.19,       0.00,       0.01,       0.13,       0.14,       0.01,
0.06,       3.07,       3.15,       0.00,       0.02,       0.01,       0.03,
0.10,       0.06,       0.00,       0.17,      12.72,
Carbon Dioxide Emissions (000)
Run Exh ,       0.02,       3.55,       0.01,       3.58,       0.00,       0.79,
0.01,       0.81,       0.00,       1.18,       0.00,       1.18,       0.00,
0.53,       0.00,       0.53,       0.00,       0.06,       0.01,       0.07,
0.00,       0.04,       0.02,       0.06,       0.00,       0.04,       0.50,
0.54,       0.00,       0.01,       0.06,       0.07,       0.00,       0.01,
0.02,       0.03,       0.00,       0.00,       0.02,       0.02,       0.00,
0.01,       0.39,       0.39,       0.00,       0.00,       0.00,       0.01,
0.01,       0.01,       0.00,       0.02,       7.31,
Idle Exh,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.01,
Start Ex,       0.00,       0.13,       0.00,       0.13,       0.00,       0.03,
0.00,       0.03,       0.00,       0.04,       0.00,       0.04,       0.00,
0.02,       0.00,       0.02,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
0.00,       0.00,       0.00,       0.00,       0.00,       0.00,       0.00,
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0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.23,
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Total Ex,     0.02,      3.69,      0.01,      3.71,      0.01,      0.82,
0.01,      0.84,      0.00,      1.22,      0.00,      1.23,      0.00,
0.55,      0.00,      0.55,      0.00,      0.06,      0.01,      0.07,
0.00,      0.04,      0.02,      0.06,      0.00,      0.04,      0.50,
0.55,      0.00,      0.01,      0.07,      0.07,      0.00,      0.01,
0.02,      0.03,      0.00,      0.00,      0.02,      0.02,      0.00,
0.01,      0.39,      0.39,      0.00,      0.00,      0.00,      0.01,
0.01,      0.01,      0.00,      0.02,      7.55,
PM10 Emissions
Run Exh ,     0.00,      0.11,      0.00,      0.11,      0.00,      0.02,
0.00,      0.02,      0.00,      0.07,      0.00,      0.07,      0.00,
0.03,      0.00,      0.03,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.08,
0.08,      0.00,      0.00,      0.01,      0.01,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.05,      0.05,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.39,
Idle Exh,     0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,
Start Ex,     0.00,      0.01,      0.00,      0.01,      0.00,      0.00,
0.00,      0.00,      0.00,      0.01,      0.00,      0.01,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.02,
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Total Ex,     0.00,      0.12,      0.00,      0.12,      0.00,      0.03,
0.00,      0.03,      0.00,      0.07,      0.00,      0.07,      0.00,
0.03,      0.00,      0.03,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.08,
0.08,      0.00,      0.00,      0.02,      0.02,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.05,      0.05,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.41,
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TireWear,      0.00,      0.07,      0.00,      0.07,      0.00,      0.01,
0.00,      0.01,      0.00,      0.02,      0.00,      0.02,      0.00,
0.01,      0.00,      0.01,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.12,
BrakeWr ,      0.00,      0.11,      0.00,      0.11,      0.00,      0.02,
0.00,      0.02,      0.00,      0.03,      0.00,      0.03,      0.00,
0.01,      0.00,      0.01,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.18,
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Total   ,      0.00,      0.30,      0.00,      0.30,      0.00,      0.06,
0.00,      0.06,      0.00,      0.12,      0.00,      0.12,      0.00,
0.04,      0.00,      0.04,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.09,
0.09,      0.00,      0.00,      0.02,      0.02,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.05,      0.05,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.01,      0.70,
Lead    ,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,
SOx     ,      0.00,      0.04,      0.00,      0.04,      0.00,      0.01,
0.00,      0.01,      0.00,      0.01,      0.00,      0.01,      0.00,
0.01,      0.00,      0.01,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.01,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.07,
Fuel Consumption (000 gallons)
Gasoline,      2.75,    382.36,      0.00,    385.11,      0.65,     85.56,
0.00,     86.21,      0.32,    126.74,      0.00,    127.06,      0.13,
56.55,      0.00,     56.68,      0.02,      6.69,      0.00,      6.71,
0.03,      4.21,      0.00,      4.24,      0.23,      4.97,      0.00,
5.20,      0.15,      0.81,      0.00,      0.96,      0.01,      0.97,
0.00,      0.98,      0.00,      0.22,      0.00,      0.23,      0.38,
0.62,      0.00,      0.99,      0.06,      0.54,      0.00,      0.60,
1.72,      1.25,      0.00,      2.97,    677.94,
Diesel  ,      0.00,      0.00,      0.56,      0.56,      0.00,      0.00,
0.64,      0.64,      0.00,      0.00,      0.15,      0.15,      0.00,
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0.00,   0.08,   0.08,   0.00,   0.00,   0.83,   0.83,
0.00,   0.00,   1.60,   1.60,   0.00,   0.00,   45.08,
45.08,   0.00,   0.00,   6.04,   6.04,   0.00,   0.00,
1.93,   1.93,   0.00,   0.00,   1.44,   1.44,   0.00,
0.00,   34.84,   34.84,   0.00,   0.00,   0.08,   0.08,
0.00,   0.00,   0.00,   0.00,   93.28,
Title   : SF 2011 and 2020_BURDEN
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:04:08
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season   : Annual
Area   : San Francisco County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
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,LDA-NCAT,LDA-CAT,LDA-DSL,LDA-TOT,LDT1-NCAT,LDT1-CAT,LDT1-DSL,LDT1-TOT,LDT2-
NCAT,LDT2-CAT,LDT2-DSL,LDT2-TOT,MDV-NCAT,MDV-CAT,MDV-DSL,MDV-TOT,LHDT1-
NCAT,LHDT1-CAT,LHDT1-DSL,LHDT1-TOT,LHDT2-NCAT,LHDT2-CAT,LHDT2-DSL,LHDT2-
TOT,MHDT-NCAT,MHDT-CAT,MHDT-DSL,MHDT-TOT,HHDT-NCAT,HHDT-CAT,HHDT-DSL,HHDT-
TOT,OBUS-NCAT,OBUS-CAT,OBUS-DSL,OBUS-TOT,SBUS-NCAT,SBUS-CAT,SBUS-DSL,SBUS-
TOT,UB-NCAT,UB-CAT,UB-DSL,UB-TOT,MH-NCAT,MH-CAT,MH-DSL,MH-TOT,MCY-NCAT,MCY-
CAT,MCY-DSL,MCY-TOT,ALL-TOT
Vehicles,   31.,   299925.,   255.,   300211.,   12.,   52939.,
346.,   53296.,   8.,   75433.,   75.,   75516.,   10.,
21638.,   46.,   21694.,   0.,   1655.,   430.,   2085.,
0.,   1193.,   954.,   2147.,   11.,   1522.,   5984.,   7517.,
0.,   71.,   224.,   295.,   0.,   193.,   334.,   528.,
0.,   55.,   257.,   311.,   0.,   88.,   1117.,   1205.,
2.,   724.,   72.,   798.,   6375.,   9754.,   0.,   16129.,
481735.,
VMT/1000,   0.,   8742.,   5.,   8747.,   0.,   1584.,
8.,   1592.,   0.,   2247.,   2.,   2248.,   0.,   738.,
1.,   739.,   0.,   61.,   16.,   77.,   0.,   44.,
34.,   78.,   0.,   66.,   320.,   386.,   0.,
3.,   40.,   43.,   0.,   7.,   19.,   26.,   0.,
2.,   11.,   13.,   0.,   11.,   136.,   147.,   0.,
8.,   1.,   9.,   47.,   84.,   0.,   131.,   14235.,
Trips   ,   117., 1865720.,   1311., 1867150.,   45.,   324932.,
1923.,   326899.,   32.,   466133.,   418.,   466583.,   39.,
133684.,   258.,   133980.,   11.,   54740.,   5404.,   60155.,
7.,   39436.,   12006.,   51449.,   501.,   69523.,   167791.,   237815.,
18.,   3238.,   1135.,   4390.,   0.,   8828.,   9379.,
18207.,   0.,   218.,   1028.,   1246.,   0.,   352.,
4469.,   4821.,   0.,   72.,   7.,   80.,   12749.,
19507.,   0.,   32255., 3205030.,
Total Organic Gas Emissions
Run Exh ,   0.00,   0.38,   0.00,   0.38,   0.00,   0.10,
0.00,   0.11,   0.00,   0.16,   0.00,   0.16,   0.00,
0.08,   0.00,   0.08,   0.00,   0.01,   0.00,   0.01,
0.00,   0.01,   0.01,   0.02,   0.00,   0.01,   0.05,
0.07,   0.00,   0.01,   0.02,   0.03,   0.00,   0.00,
0.00,   0.01,   0.00,   0.00,   0.01,   0.01,   0.00,
0.15,   0.14,   0.29,   0.00,   0.00,   0.00,   0.00,
0.22,   0.20,   0.00,   0.42,   1.58,

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Idle Exh,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.01,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.02,
Start Ex,      0.00,      0.38,      0.00,      0.38,      0.00,      0.09,
0.00,      0.09,      0.00,      0.15,      0.00,      0.15,      0.00,
0.07,      0.00,      0.07,      0.00,      0.02,      0.00,      0.02,
0.00,      0.02,      0.00,      0.02,      0.01,      0.07,      0.00,
0.08,      0.00,      0.02,      0.00,      0.02,      0.00,      0.01,
0.00,      0.01,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.04,      0.05,      0.00,      0.09,      0.93,
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Total Ex,      0.00,      0.75,      0.00,      0.76,      0.00,      0.19,
0.00,      0.20,      0.00,      0.31,      0.00,      0.31,      0.00,
0.14,      0.00,      0.15,      0.00,      0.03,      0.00,      0.04,
0.00,      0.03,      0.01,      0.04,      0.01,      0.09,      0.06,
0.15,      0.00,      0.03,      0.02,      0.05,      0.00,      0.02,
0.00,      0.02,      0.00,      0.00,      0.01,      0.01,      0.00,
0.15,      0.14,      0.29,      0.00,      0.00,      0.00,      0.00,
0.26,      0.25,      0.00,      0.51,      2.52,

Diurnal ,      0.00,      0.10,      0.00,      0.10,      0.00,      0.03,
0.00,      0.03,      0.00,      0.03,      0.00,      0.03,      0.00,
0.01,      0.00,      0.01,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.02,      0.00,      0.02,      0.19,
Hot Soak,      0.00,      0.29,      0.00,      0.29,      0.00,      0.07,
0.00,      0.07,      0.00,      0.09,      0.00,      0.09,      0.00,
0.03,      0.00,      0.03,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.01,      0.00,      0.01,      0.50,
Running ,      0.00,      0.62,      0.00,      0.62,      0.00,      0.30,
0.00,      0.30,      0.00,      0.37,      0.00,      0.37,      0.00,
0.10,      0.00,      0.10,      0.00,      0.04,      0.00,      0.04,
0.00,      0.04,      0.00,      0.04,      0.00,      0.03,      0.00,
0.03,      0.00,      0.00,      0.00,      0.00,      0.00,      0.01,
0.00,      0.01,      0.00,      0.00,      0.00,      0.00,      0.00,
0.01,      0.00,      0.01,      0.00,      0.00,      0.00,      0.00,
0.01,      0.04,      0.00,      0.05,      1.57,
Resting ,      0.00,      0.09,      0.00,      0.09,      0.00,      0.02,
0.00,      0.02,      0.00,      0.03,      0.00,      0.03,      0.00,
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0.01,      0.00,      0.01,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.01,      0.00,      0.01,      0.17,
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Total   ,     0.00,     1.86,     0.00,     1.87,     0.00,     0.61,
0.00,      0.61,      0.00,      0.84,      0.00,      0.84,      0.00,
0.29,      0.00,      0.29,      0.00,      0.07,      0.00,      0.08,
0.00,      0.08,      0.01,      0.08,      0.01,      0.12,      0.06,
0.19,      0.00,      0.03,      0.02,      0.06,      0.00,      0.02,
0.00,      0.02,      0.00,      0.00,      0.01,      0.01,      0.00,
0.16,      0.14,      0.30,      0.00,      0.00,      0.00,      0.00,
0.27,      0.33,      0.00,      0.60,      4.95,
Carbon Monoxide Emissions
Run Exh ,     0.02,     9.57,     0.00,     9.59,     0.01,     2.79,
0.01,      2.81,      0.01,      4.20,      0.00,      4.21,      0.04,
1.73,      0.00,      1.77,      0.00,      0.09,      0.02,      0.11,
0.00,      0.09,      0.04,      0.13,      0.01,      0.18,      0.53,
0.72,      0.00,      0.13,      0.07,      0.21,      0.00,      0.05,
0.03,      0.07,      0.00,      0.02,      0.04,      0.06,      0.00,
0.50,      0.53,      1.03,      0.00,      0.05,      0.00,      0.06,
2.23,      0.91,      0.00,      3.14,     23.89,
Idle Exh,     0.00,     0.00,     0.00,     0.00,     0.00,     0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.01,      0.00,      0.01,
0.00,      0.01,      0.00,      0.01,      0.00,      0.02,      0.02,
0.04,      0.00,      0.00,      0.02,      0.02,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.01,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.09,
Start Ex,     0.00,     4.86,     0.00,     4.86,     0.00,     1.26,
0.00,      1.27,      0.00,      1.98,      0.00,      1.98,      0.00,
0.80,      0.00,      0.80,      0.00,      0.25,      0.00,      0.25,
0.00,      0.24,      0.00,      0.24,      0.03,      1.17,      0.00,
1.20,      0.00,      0.25,      0.00,      0.26,      0.00,      0.22,
0.00,      0.22,      0.00,      0.01,      0.00,      0.01,      0.00,
0.05,      0.00,      0.05,      0.00,      0.00,      0.00,      0.00,
0.11,      0.29,      0.00,      0.41,     11.54,
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Total Ex,     0.02,    14.42,     0.00,    14.44,     0.01,     4.06,
0.01,      4.08,      0.01,      6.18,      0.00,      6.19,      0.04,
2.53,      0.00,      2.57,      0.00,      0.36,      0.02,      0.38,
0.00,      0.33,      0.04,      0.37,      0.04,      1.37,      0.54,
1.96,      0.01,      0.39,      0.09,      0.48,      0.00,      0.27,
0.03,      0.30,      0.00,      0.03,      0.04,      0.07,      0.00,
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0.55, 0.53, 1.08, 0.00, 0.06, 0.00, 0.06,
2.34, 1.20, 0.00, 3.54, 35.52,
Oxides of Nitrogen Emissions
Run Exh , 0.00, 0.83, 0.01, 0.84, 0.00, 0.26,
0.01, 0.27, 0.00, 0.49, 0.00, 0.49, 0.00,
0.22, 0.00, 0.23, 0.00, 0.02, 0.04, 0.06,
0.00, 0.02, 0.10, 0.12, 0.00, 0.05, 1.08,
1.13, 0.00, 0.04, 0.18, 0.22, 0.00, 0.02,
0.05, 0.07, 0.00, 0.01, 0.12, 0.12, 0.00,
0.11, 2.73, 2.85, 0.00, 0.01, 0.00, 0.01,
0.07, 0.10, 0.00, 0.17, 6.58,
Idle Exh, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.05,
0.05, 0.00, 0.00, 0.05, 0.05, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.01, 0.01, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.12,
Start Ex, 0.00, 0.27, 0.00, 0.27, 0.00, 0.07,
0.00, 0.07, 0.00, 0.16, 0.00, 0.16, 0.00,
0.07, 0.00, 0.07, 0.00, 0.09, 0.00, 0.09,
0.00, 0.07, 0.00, 0.07, 0.00, 0.12, 0.00,
0.12, 0.00, 0.03, 0.00, 0.03, 0.00, 0.03,
0.00, 0.03, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.01, 0.01, 0.00, 0.01, 0.91,
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Total Ex, 0.00, 1.10, 0.01, 1.11, 0.00, 0.32,
0.01, 0.34, 0.00, 0.65, 0.00, 0.65, 0.00,
0.29, 0.00, 0.29, 0.00, 0.11, 0.05, 0.16,
0.00, 0.08, 0.10, 0.19, 0.00, 0.17, 1.13,
1.30, 0.00, 0.07, 0.23, 0.30, 0.00, 0.04,
0.05, 0.10, 0.00, 0.01, 0.13, 0.14, 0.00,
0.12, 2.73, 2.85, 0.00, 0.01, 0.00, 0.01,
0.07, 0.10, 0.00, 0.18, 7.61,
Carbon Dioxide Emissions (000)
Run Exh , 0.00, 3.99, 0.00, 3.99, 0.00, 0.91,
0.00, 0.91, 0.00, 1.31, 0.00, 1.31, 0.00,
0.58, 0.00, 0.59, 0.00, 0.07, 0.01, 0.07,
0.00, 0.05, 0.02, 0.07, 0.00, 0.05, 0.53,
0.58, 0.00, 0.00, 0.08, 0.08, 0.00, 0.01,
0.03, 0.04, 0.00, 0.00, 0.02, 0.02, 0.00,
0.01, 0.40, 0.41, 0.00, 0.01, 0.00, 0.01,
0.01, 0.02, 0.00, 0.02, 8.10,
Idle Exh, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,
0.00, 0.00, 0.00, 0.00, 0.00, 0.00, 0.00,

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0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.01,
Start Ex,      0.00,      0.15,      0.00,      0.15,      0.00,      0.03,
0.00,      0.03,      0.00,      0.05,      0.00,      0.05,      0.00,
0.02,      0.00,      0.02,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.25,
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Total Ex,      0.00,      4.14,      0.00,      4.14,      0.00,      0.94,
0.00,      0.94,      0.00,      1.35,      0.00,      1.35,      0.00,
0.60,      0.00,      0.60,      0.00,      0.07,      0.01,      0.08,
0.00,      0.05,      0.02,      0.07,      0.00,      0.05,      0.53,
0.59,      0.00,      0.00,      0.08,      0.09,      0.00,      0.01,
0.03,      0.04,      0.00,      0.00,      0.02,      0.02,      0.00,
0.01,      0.40,      0.41,      0.00,      0.01,      0.00,      0.01,
0.01,      0.02,      0.00,      0.03,      8.36,
PM10 Emissions
Run Exh ,      0.00,      0.13,      0.00,      0.13,      0.00,      0.03,
0.00,      0.03,      0.00,      0.08,      0.00,      0.08,      0.00,
0.03,      0.00,      0.03,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.05,
0.06,      0.00,      0.00,      0.01,      0.01,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.01,      0.01,      0.00,
0.00,      0.04,      0.04,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.39,
Idle Exh,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,
Start Ex,      0.00,      0.01,      0.00,      0.01,      0.00,      0.00,
0.00,      0.00,      0.00,      0.01,      0.00,      0.01,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.02,
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Total Ex,      0.00,      0.14,      0.00,      0.14,      0.00,      0.03,
0.00,      0.03,      0.00,      0.09,      0.00,      0.09,      0.00,
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0.04,      0.00,      0.04,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.05,
0.06,      0.00,      0.00,      0.01,      0.01,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.01,      0.01,      0.00,
0.00,      0.04,      0.04,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.42,

TireWear,      0.00,      0.08,      0.00,      0.08,      0.00,      0.01,
0.00,      0.01,      0.00,      0.02,      0.00,      0.02,      0.00,
0.01,      0.00,      0.01,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.01,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.13,
BrakeWr ,      0.00,      0.12,      0.00,      0.12,      0.00,      0.02,
0.00,      0.02,      0.00,      0.03,      0.00,      0.03,      0.00,
0.01,      0.00,      0.01,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.01,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.20,
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Total   ,      0.00,      0.34,      0.00,      0.34,      0.00,      0.07,
0.00,      0.07,      0.00,      0.14,      0.00,      0.14,      0.00,
0.05,      0.00,      0.05,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.06,
0.07,      0.00,      0.00,      0.01,      0.01,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.01,      0.01,      0.00,
0.00,      0.04,      0.04,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.75,
Lead    ,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,
SOx     ,      0.00,      0.04,      0.00,      0.04,      0.00,      0.01,
0.00,      0.01,      0.00,      0.01,      0.00,      0.01,      0.00,
0.01,      0.00,      0.01,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.01,
0.01,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.00,      0.00,      0.00,
0.00,      0.00,      0.00,      0.00,      0.08,
Fuel Consumption (000 gallons)
Gasoline,      0.03,    426.12,      0.00,    426.15,      0.02,     97.10,
0.00,     97.12,      0.01,    139.66,      0.00,    139.67,      0.03,
62.19,      0.00,     62.22,      0.00,      7.04,      0.00,      7.04,
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0.00,       5.07,       0.00,       5.07,       0.03,       5.67,       0.00,
5.70,       0.00,       0.26,       0.00,       0.26,       0.00,       0.63,
0.00,       0.63,       0.00,       0.21,       0.00,       0.21,       0.00,
1.04,       0.00,       1.04,       0.00,       0.64,       0.00,       0.65,
1.26,       2.14,       0.00,       3.40,     749.15,
Diesel  ,       0.00,       0.00,       0.16,       0.16,       0.00,       0.00,
0.27,       0.27,       0.00,       0.00,       0.06,       0.06,       0.00,
0.00,       0.04,       0.04,       0.00,       0.00,       0.81,       0.81,
0.00,       0.00,       1.79,       1.79,       0.00,       0.00,      48.07,
48.07,       0.00,       0.00,       7.49,       7.49,       0.00,       0.00,
2.91,       2.91,       0.00,       0.00,       1.63,       1.63,       0.00,
0.00,      35.90,      35.90,       0.00,       0.00,       0.12,       0.12,
0.00,       0.00,       0.00,       0.00,      99.24,
```

Title   : SF 2011 and 2020_EMFAC
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season   : Annual
Area   : San Francisco
****
****
Year:,2011,, -- Model Years,,1967, to ,2011, Inclusive --,,,Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,, San Francisco,,,,,,County Average

,,,,Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Total Organic Gases,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000, 23.300,
24.256,   3.612, 19.799, 23.300, 23.890,   3.612, 14.654, 23.300, 24.180,
3.612,   6.797,   0.000,   0.000, 12.951,   9.949, 23.300, 23.553,   3.612,
12.687,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
23.300, 23.456,   3.612,   7.651,   0.000,   0.000,   0.000,   0.000,   0.209,
0.317,   3.080,   0.438,
5, 20.833,   0.302,   0.502,   0.383, 20.968,   0.404,   0.274,   0.509,
20.484,   0.378,   0.282,   0.414, 26.650,   0.544,   0.245,   0.586, 22.053,
0.790,   0.487,   0.754, 22.053,   1.792,   0.784,   1.380, 33.073,   2.957,
0.640,   1.058, 94.927, 21.669,   8.969, 12.497, 33.073,   3.061,   0.615,
1.756, 40.707, 42.209,   2.685,   5.414,   6.821,   4.214,   0.000,   5.671,
33.073,   1.671,   0.943,   1.181, 33.073,   3.934,   0.404,   5.931, 13.793,
0.417,   1.550,   0.584,
10, 14.839,   0.201,   0.394,   0.259, 14.935,   0.274,   0.215,   0.349,
14.591,   0.253,   0.221,   0.278, 18.981,   0.362,   0.193,   0.393, 14.454,
0.518,   0.382,   0.508, 14.454,   1.175,   0.615,   0.951, 21.675,   1.939,
0.502,   0.764, 62.204, 14.202,   4.983,   7.503, 21.675,   2.008,   0.483,
1.195, 26.677, 27.660,   1.948,   3.723,   5.390,   3.120,   0.000,   4.388,
21.675,   1.096,   0.741,   0.872, 21.675,   2.580,   0.318,   3.892, 10.023,
0.279,   1.065,   0.399,
15, 11.061,   0.141,   0.316,   0.184, 11.132,   0.195,   0.172,   0.251,
10.876,   0.178,   0.178,   0.197, 14.148,   0.254,   0.155,   0.277,   9.876,
0.354,   0.307,   0.357,   9.876,   0.804,   0.494,   0.684, 14.808,   1.326,
0.403,   0.573, 42.489,   9.704,   2.387,   4.345, 14.808,   1.374,   0.387,
0.849, 18.224, 18.894,   1.463,   2.667,   4.456,   2.436,   0.000,   3.565,
14.808,   0.750,   0.594,   0.666, 14.808,   1.764,   0.255,   2.663,   7.647,
0.197,   0.741,   0.286,
20,   8.628,   0.104,   0.259,   0.138,   8.684,   0.145,   0.141,   0.190,
8.484,   0.132,   0.146,   0.147, 11.035,   0.187,   0.127,   0.205,   7.034,

```
0.252,   0.252,   0.262,   7.034,   0.573,   0.405,   0.512,  10.546,   0.945,
0.331,   0.445,  30.254,   6.912,   1.285,   2.775,  10.546,   0.980,   0.318,
0.628,  12.978,  13.454,   1.138,   1.989,   3.855,   2.004,   0.000,   3.039,
10.546,   0.535,   0.488,   0.526,  10.546,   1.258,   0.209,   1.899,   6.126,
0.145,   0.556,   0.215,
   25,   7.043,   0.080,   0.217,   0.108,   7.088,   0.113,   0.119,   0.150,
6.925,   0.102,   0.122,   0.114,   9.007,   0.145,   0.106,   0.159,   5.223,
0.187,   0.211,   0.200,   5.223,   0.426,   0.340,   0.398,   7.829,   0.703,
0.277,   0.357,  22.455,   5.132,   1.048,   2.132,   7.829,   0.729,   0.267,
0.484,   9.634,   9.986,   0.917,   1.543,   3.490,   1.738,   0.000,   2.717,
7.829,   0.398,   0.409,   0.428,   7.829,   0.935,   0.175,   1.412,   5.154,
0.113,   0.457,   0.172,
   30,   6.016,   0.065,   0.186,   0.089,   6.054,   0.093,   0.102,   0.124,
5.915,   0.083,   0.105,   0.093,   7.693,   0.118,   0.091,   0.130,   4.043,
0.145,   0.181,   0.158,   4.043,   0.330,   0.291,   0.321,   6.059,   0.544,
0.238,   0.296,  17.373,   3.972,   0.857,   1.686,   6.059,   0.565,   0.229,
0.387,   7.455,   7.726,   0.765,   1.246,   3.306,   1.588,   0.000,   2.548,
6.059,   0.309,   0.351,   0.358,   6.059,   0.724,   0.150,   1.095,   4.553,
0.092,   0.385,   0.144,
   35,   5.377,   0.056,   0.163,   0.077,   5.411,   0.080,   0.089,   0.107,
5.287,   0.071,   0.092,   0.080,   6.876,   0.100,   0.080,   0.111,   3.262,
0.117,   0.159,   0.130,   3.262,   0.266,   0.255,   0.268,   4.887,   0.440,
0.208,   0.253,  14.010,   3.205,   0.714,   1.378,   4.887,   0.457,   0.200,
0.321,   6.013,   6.231,   0.661,   1.046,   3.277,   1.527,   0.000,   2.505,
4.887,   0.250,   0.307,   0.309,   4.887,   0.585,   0.132,   0.884,   4.224,
0.078,   0.333,   0.126,
   40,   5.028,   0.050,   0.146,   0.070,   5.061,   0.071,   0.080,   0.097,
4.944,   0.063,   0.082,   0.072,   6.430,   0.089,   0.072,   0.100,   2.743,
0.099,   0.142,   0.112,   2.743,   0.224,   0.229,   0.232,   4.110,   0.370,
0.187,   0.222,  11.778,   2.696,   0.619,   1.173,   4.110,   0.385,   0.179,
0.276,   5.056,   5.239,   0.592,   0.913,   3.398,   1.547,   0.000,   2.581,
4.110,   0.210,   0.275,   0.273,   4.110,   0.492,   0.118,   0.744,   4.115,
0.070,   0.297,   0.116,
   45,   4.921,   0.047,   0.134,   0.066,   4.952,   0.067,   0.073,   0.092,
4.838,   0.059,   0.075,   0.068,   6.292,   0.084,   0.066,   0.094,   2.405,
0.086,   0.130,   0.099,   2.405,   0.197,   0.209,   0.208,   3.602,   0.325,
0.171,   0.201,  10.320,   2.363,   0.570,   1.049,   3.602,   0.338,   0.164,
0.246,   4.431,   4.590,   0.549,   0.828,   3.686,   1.650,   0.000,   2.788,
3.602,   0.185,   0.252,   0.248,   3.602,   0.432,   0.108,   0.653,   4.210,
0.066,   0.273,   0.112,
   50,   5.039,   0.046,   0.125,   0.066,   5.071,   0.066,   0.068,   0.092,
4.954,   0.058,   0.070,   0.067,   6.443,   0.082,   0.061,   0.093,   2.197,
0.079,   0.122,   0.091,   2.197,   0.180,   0.196,   0.192,   3.290,   0.297,
0.160,   0.187,   9.426,   2.159,   0.569,   0.995,   3.290,   0.309,   0.154,
0.227,   4.048,   4.193,   0.527,   0.780,   4.185,   1.853,   0.000,   3.156,
3.290,   0.169,   0.236,   0.231,   3.290,   0.395,   0.101,   0.597,   4.523,
0.066,   0.261,   0.113,
   55,   5.398,   0.048,   0.120,   0.069,   5.433,   0.067,   0.065,   0.095,
5.308,   0.060,   0.067,   0.069,   6.903,   0.085,   0.059,   0.096,   2.092,
0.075,   0.117,   0.087,   2.092,   0.171,   0.188,   0.183,   3.133,   0.283,
0.153,   0.179,   8.973,   2.055,   0.615,   1.004,   3.133,   0.294,   0.147,
0.217,   3.854,   3.992,   0.523,   0.763,   4.972,   2.190,   0.000,   3.744,
3.133,   0.161,   0.226,   0.221,   3.133,   0.376,   0.097,   0.568,   5.103,
0.068,   0.258,   0.121,
   60,   6.052,   0.052,   0.117,   0.075,   6.091,   0.073,   0.064,   0.104,
5.950,   0.065,   0.066,   0.075,   7.739,   0.092,   0.057,   0.105,   2.076,
0.075,   0.114,   0.086,   2.076,   0.170,   0.184,   0.181,   3.109,   0.280,
```

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0.150,   0.176,   8.904,   2.040,   0.708,   1.071,   3.109,   0.292,   0.144,
0.214,   3.824,   3.961,   0.539,   0.775,   6.180,   2.726,   0.000,   4.656,
3.109,   0.160,   0.221,   0.217,   3.109,   0.373,   0.095,   0.564,   6.045,
0.075,   0.264,   0.135,
   65,   7.099,   0.059,   0.117,   0.087,   7.145,   0.082,   0.064,   0.119,
6.980,   0.074,   0.066,   0.086,   9.079,   0.105,   0.057,   0.120,   2.147,
0.077,   0.114,   0.088,   2.147,   0.176,   0.184,   0.184,   3.215,   0.290,
0.150,   0.177,   9.209,   2.109,   0.848,   1.197,   3.215,   0.302,   0.144,
0.218,   3.955,   4.097,   0.574,   0.817,   8.039,   3.573,   0.000,   6.068,
3.215,   0.165,   0.221,   0.218,   3.215,   0.386,   0.095,   0.583,   7.519,
0.087,   0.280,   0.160,
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Pollutant Name: Carbon Monoxide,,,,Temperature: 57F,,Relative Humidity: 65%

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Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000, 136.515,
139.843,  26.300, 115.330, 136.515, 138.570,  26.300,  87.433, 136.515, 139.579,
26.300,  43.844,   0.000,   0.000,  49.102,  37.722, 136.515, 137.395,  26.300,
76.860,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
136.515, 137.058,  26.300,  48.845,   0.000,   0.000,   0.000,   0.000,   1.224,
1.833,  19.868,   2.620,
    5, 176.881,   3.289,   2.864,   3.971, 176.652,   5.260,   2.323,   6.116,
173.656,   4.397,   2.350,   4.694, 293.828,   5.086,   2.247,   5.557, 391.137,
7.412,   3.032,   7.000, 391.137,  18.274,   3.709,  12.511, 586.706,  34.325,
7.042,  12.354,2334.887, 183.966,  13.028,  69.819, 586.706,  35.700,   6.829,
20.470, 667.140, 151.610,  18.503,  39.498,  48.466,  15.108,   0.000,  33.747,
586.706,  19.538,   9.353,  13.045, 586.706,  83.799,   4.819, 117.053, 129.661,
4.345,   9.326,   5.657,
   10, 128.922,   2.919,   1.975,   3.413, 128.756,   4.570,   1.601,   5.179,
126.572,   3.893,   1.620,   4.106, 214.162,   4.518,   1.550,   4.856, 260.228,
4.931,   2.090,   4.673, 260.228,  12.158,   2.558,   8.364, 390.342,  22.837,
4.855,   8.364,1553.427, 122.395,   9.264,  46.910, 390.342,  23.751,   4.709,
13.709, 443.856, 100.868,  11.645,  25.660,  39.749,  13.285,   0.000,  28.072,
390.342,  12.999,   6.449,   8.859, 390.342,  55.752,   3.323,  77.884,  94.941,
3.723,   6.201,   4.627,
   15,  98.958,   2.617,   1.425,   2.993,  98.830,   4.031,   1.156,   4.488,
97.154,   3.482,   1.169,   3.644, 164.386,   4.052,   1.118,   4.309, 182.922,
3.466,   1.508,   3.293, 182.922,   8.546,   1.846,   5.901, 274.383,  16.053,
3.504,   5.956,1091.948,  86.035,   6.511,  32.974, 274.383,  16.696,   3.398,
9.685, 311.999,  70.903,   7.783,  17.663,  34.331,  11.949,   0.000,  24.455,
274.383,   9.137,   4.654,   6.323, 274.383,  39.190,   2.398,  54.751,  73.642,
3.259,   4.328,   3.920,
   20,  79.992,   2.365,   1.076,   2.668,  79.889,   3.601,   0.873,   3.964,
78.534,   3.142,   0.883,   3.272, 132.881,   3.665,   0.844,   3.870, 135.851,
2.574,   1.139,   2.450, 135.851,   6.347,   1.394,   4.393, 203.777,  11.922,
2.646,   4.460, 810.960,  63.896,   4.869,  24.515, 203.777,  12.399,   2.566,
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7.216, 231.713,  52.658,   5.523,  12.878,  31.227,  10.969,   0.000,  22.288,
203.777,   6.786,   3.515,   4.743, 203.777,  29.105,   1.811,  40.664,  60.503,
2.900,   3.188,   3.415,
   25,  68.096,   2.154,   0.851,   2.411,  68.008,   3.254,   0.690,   3.559,
66.854,   2.858,   0.698,   2.968, 113.119,   3.339,   0.667,   3.512, 106.597,
2.020,   0.900,   1.924, 106.597,   4.980,   1.102,   3.451, 159.896,   9.355,
2.091,   3.513, 636.331,  50.137,   4.175,  19.508, 159.896,   9.729,   2.028,
5.670, 181.817,  41.319,   4.162,   9.945,  29.912,  10.272,   0.000,  21.246,
159.896,   5.325,   2.778,   3.737, 159.896,  22.838,   1.431,  31.909,  52.646,
2.615,   2.493,   3.046,
   30,  61.047,   1.976,   0.704,   2.206,  60.968,   2.972,   0.571,   3.243,
59.934,   2.619,   0.577,   2.717, 101.410,   3.063,   0.552,   3.218,  88.372,
1.675,   0.745,   1.594,  88.372,   4.129,   0.911,   2.860, 132.559,   7.755,
1.730,   2.909, 527.537,  41.565,   3.595,  16.275, 132.559,   8.066,   1.678,
4.698, 150.731,  34.254,   3.330,   8.133,  30.174,   9.825,   0.000,  21.195,
132.559,   4.414,   2.298,   3.094, 132.559,  18.933,   1.184,  26.453,  48.510,
2.386,   2.045,   2.773,
   35,  57.635,   1.824,   0.609,   2.041,  57.561,   2.741,   0.494,   2.998,
56.585,   2.417,   0.500,   2.509,  95.742,   2.828,   0.478,   2.974,  77.406,
1.467,   0.645,   1.395,  77.406,   3.616,   0.789,   2.501, 116.108,   6.793,
1.498,   2.533, 462.071,  36.407,   3.128,  14.239, 116.108,   7.065,   1.452,
4.106, 132.026,  30.003,   2.829,   7.042,  32.055,   9.626,   0.000,  22.158,
116.108,   3.867,   1.989,   2.692, 116.108,  16.584,   1.025,  23.169,  47.329,
2.199,   1.760,   2.573,
   40,  57.304,   1.696,   0.552,   1.912,  57.230,   2.555,   0.447,   2.813,
56.259,   2.246,   0.453,   2.339,  95.192,   2.628,   0.433,   2.775,  71.633,
1.357,   0.584,   1.288,  71.633,   3.347,   0.715,   2.307, 107.450,   6.286,
1.357,   2.319, 427.613,  33.692,   2.774,  13.085, 107.450,   6.538,   1.316,
3.784, 122.181,  27.766,   2.552,   6.456,  35.862,   9.707,   0.000,  24.321,
107.450,   3.578,   1.802,   2.460, 107.450,  15.347,   0.929,  21.440,  48.889,
2.047,   1.588,   2.436,
   45,  60.001,   1.588,   0.523,   1.815,  59.923,   2.408,   0.424,   2.682,
58.907,   2.104,   0.429,   2.201,  99.671,   2.460,   0.411,   2.614,  70.039,
1.327,   0.554,   1.256,  70.039,   3.272,   0.678,   2.246, 105.059,   6.147,
1.286,   2.234, 418.099,  32.942,   2.533,  12.656, 105.059,   6.393,   1.247,
3.679, 119.462,  27.148,   2.445,   6.265,  42.252,  10.144,   0.000,  28.085,
105.059,   3.499,   1.709,   2.363, 105.059,  15.006,   0.880,  20.961,  53.459,
1.927,   1.506,   2.358,
   50,  66.161,   1.498,   0.519,   1.751,  66.075,   2.297,   0.421,   2.605,
64.955,   1.986,   0.426,   2.095, 109.904,   2.320,   0.407,   2.492,  72.353,
1.371,   0.550,   1.292,  72.353,   3.380,   0.672,   2.308, 108.530,   6.350,
1.276,   2.263, 431.911,  34.030,   2.405,  12.912, 108.530,   6.604,   1.238,
3.773, 123.408,  28.045,   2.487,   6.436,  52.425,  11.079,   0.000,  34.181,
108.530,   3.614,   1.695,   2.385, 108.530,  15.501,   0.874,  21.651,  61.870,
1.836,   1.502,   2.345,
   55,  76.829,   1.427,   0.539,   1.722,  76.729,   2.223,   0.437,   2.589,
75.428,   1.893,   0.442,   2.021, 127.625,   2.208,   0.423,   2.411,  78.969,
1.496,   0.571,   1.404,  78.969,   3.689,   0.698,   2.503, 118.454,   6.930,
1.326,   2.413, 471.406,  37.142,   2.391,  13.913, 118.454,   7.208,   1.285,
4.082, 134.693,  30.610,   2.686,   6.998,  68.502,  12.767,   0.000,  43.909,
118.454,   3.945,   1.761,   2.532, 118.454,  16.919,   0.907,  23.628,  75.776,
1.776,   1.576,   2.413,
   60,  93.955,   1.375,   0.586,   1.738,  93.833,   2.191,   0.475,   2.647,
92.242,   1.826,   0.481,   1.984, 156.074,   2.125,   0.460,   2.376,  91.064,
1.726,   0.620,   1.611,  91.064,   4.254,   0.759,   2.865, 136.596,   7.992,
1.441,   2.708, 543.603,  42.830,   2.490,  15.838, 136.596,   8.312,   1.397,
4.661, 155.322,  35.298,   3.080,   8.054,  94.263,  15.668,   0.000,  59.583,
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136.596,   4.549,   1.913,   2.827, 136.596, 19.510,   0.986, 27.243, 98.197,
1.752,   1.743,   2.593,
   65, 121.001,   1.345,   0.667,   1.815, 120.844,   2.210,   0.540,   2.807,
118.795,   1.788,   0.547,   1.993, 201.002,   2.075,   0.523,   2.401, 110.948,
2.102,   0.705,   1.952, 110.948,   5.183,   0.863,   3.463, 166.422,   9.737,
1.639,   3.201, 662.300, 52.183,   2.703, 19.042, 166.422, 10.126,   1.589,
5.617, 189.237, 43.005,   3.751,   9.811, 136.601, 20.623,   0.000, 85.425,
166.422,   5.542,   2.176,   3.321, 166.422, 23.770,   1.121, 33.186, 134.617,
1.774,   2.029,   2.944,

Pollutant Name: Oxides of Nitrogen,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   1.436,
1.499, 75.051, 17.375,   1.436,   1.475, 75.051, 34.984,   1.436,   1.494,
75.051, 63.655,   0.000,   0.000, 112.860, 86.704,   1.436,   1.453, 75.051,
41.556,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
1.436,   1.446, 75.051, 60.067,   0.000,   0.000,   0.000,   0.000,   0.013,
0.020, 55.152,   2.442,
    5,   3.453,   0.326,   2.058,   0.341,   3.376,   0.517,   2.087,   0.552,
3.330,   0.638,   2.083,   0.645,   5.137,   0.884,   2.094,   0.895,   1.780,
0.419,   6.354,   1.702,   1.780,   0.925,   8.851,   4.537,   2.670,   1.778,
11.581, 10.064, 16.398, 10.460, 29.597, 25.209,   2.670,   2.764, 11.067,
7.288,   3.327,   7.345, 43.815, 41.174,   1.070,   1.275,   0.000,   1.161,
2.670,   1.560, 19.229, 15.635,   2.670,   1.999, 14.654,   2.906,   2.122,
0.459, 18.853,   1.282,
   10,   3.631,   0.281,   1.707,   0.297,   3.550,   0.440,   1.731,   0.473,
3.501,   0.547,   1.728,   0.555,   5.401,   0.756,   1.737,   0.767,   1.870,
0.440,   5.272,   1.485,   1.870,   0.971,   7.344,   3.876,   2.805,   1.868,
9.608,   8.411, 17.229, 10.990, 20.658, 18.467,   2.805,   2.904,   9.182,
6.325,   3.496,   7.718, 33.515, 31.615,   1.122,   1.193,   0.000,   1.153,
2.805,   1.639, 15.953, 13.043,   2.805,   2.100, 12.158,   2.834,   2.229,
0.400, 14.795,   1.049,
   15,   3.813,   0.248,   1.468,   0.265,   3.727,   0.384,   1.488,   0.416,
3.676,   0.480,   1.485,   0.487,   5.672,   0.661,   1.493,   0.672,   1.960,
0.462,   4.532,   1.342,   1.960,   1.018,   6.313,   3.432,   2.940,   1.958,
8.259,   7.285, 18.060, 11.520, 15.050, 14.284,   2.940,   3.044,   7.893,
5.686,   3.665,   8.090, 26.950, 25.531,   1.174,   1.134,   0.000,   1.157,
2.940,   1.718, 13.714, 11.275,   2.940,   2.202, 10.451,   2.816,   2.338,
0.357, 12.154,   0.893,
   20,   3.998,   0.223,   1.307,   0.240,   3.909,   0.343,   1.326,   0.374,
3.855,   0.429,   1.323,   0.437,   5.948,   0.591,   1.330,   0.602,   2.050,
0.483,   4.037,   1.252,   2.050,   1.065,   5.623,   3.143,   3.076,   2.048,
7.356,   6.536, 18.892, 12.050, 12.756, 12.647,   3.076,   3.184,   7.030,
5.280,   3.833,   8.462, 22.782, 21.676,   1.228,   1.093,   0.000,   1.168,

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3.076,   1.797,  12.215,  10.098,   3.076,   2.303,   9.309,   2.836,   2.449,
0.325,  10.520,   0.792,
   25,   4.187,   0.205,   1.206,   0.223,   4.093,   0.314,   1.223,   0.345,
4.037,   0.392,   1.221,   0.401,   6.229,   0.539,   1.227,   0.551,   2.141,
0.504,   3.725,   1.202,   2.141,   1.112,   5.189,   2.971,   3.211,   2.138,
6.789,   6.071,  19.723,  12.580,  12.073,  12.247,   3.211,   3.324,   6.488,
5.048,   4.002,   8.835,  20.246,  19.339,   1.282,   1.068,   0.000,   1.188,
3.211,   1.876,  11.273,   9.364,   3.211,   2.404,   8.591,   2.885,   2.562,
0.302,   9.554,   0.729,
   30,   4.379,   0.192,   1.154,   0.210,   4.281,   0.293,   1.170,   0.325,
4.222,   0.366,   1.168,   0.374,   6.514,   0.503,   1.174,   0.515,   2.231,
0.525,   3.562,   1.183,   2.231,   1.159,   4.962,   2.893,   3.346,   2.228,
6.492,   5.834,  20.554,  13.111,  11.521,  11.949,   3.346,   3.464,   6.204,
4.957,   4.171,   9.207,  18.915,  18.123,   1.337,   1.057,   0.000,   1.213,
3.346,   1.955,  10.780,   8.987,   3.346,   2.506,   8.215,   2.956,   2.676,
0.286,   9.036,   0.692,
   35,   4.574,   0.183,   1.143,   0.202,   4.471,   0.280,   1.159,   0.313,
4.410,   0.348,   1.157,   0.357,   6.803,   0.478,   1.163,   0.491,   2.321,
0.547,   3.529,   1.193,   2.321,   1.206,   4.916,   2.898,   3.481,   2.318,
6.432,   5.797,  21.385,  13.641,  11.100,  11.751,   3.481,   3.604,   6.147,
4.990,   4.339,   9.579,  18.578,  17.830,   1.392,   1.058,   0.000,   1.244,
3.481,   2.034,  10.680,   8.924,   3.481,   2.607,   8.139,   3.048,   2.792,
0.276,   8.899,   0.677,
   40,   4.770,   0.177,   1.173,   0.197,   4.663,   0.273,   1.190,   0.307,
4.600,   0.338,   1.188,   0.347,   7.096,   0.464,   1.194,   0.478,   2.411,
0.568,   3.623,   1.230,   2.411,   1.253,   5.047,   2.983,   3.617,   2.408,
6.603,   5.956,  22.217,  14.171,  10.811,  11.654,   3.617,   3.745,   6.311,
5.143,   4.508,   9.952,  19.182,  18.413,   1.447,   1.071,   0.000,   1.281,
3.617,   2.113,  10.964,   9.167,   3.617,   2.708,   8.356,   3.160,   2.908,
0.271,   9.127,   0.683,
   45,   4.969,   0.175,   1.248,   0.196,   4.857,   0.272,   1.266,   0.308,
4.791,   0.334,   1.263,   0.344,   7.391,   0.460,   1.270,   0.474,   2.501,
0.589,   3.854,   1.297,   2.501,   1.299,   5.369,   3.156,   3.752,   2.499,
7.024,   6.325,  23.048,  14.701,  10.652,  11.657,   3.752,   3.885,   6.713,
5.425,   4.676,  10.324,  20.821,  19.959,   1.503,   1.096,   0.000,   1.323,
3.752,   2.192,  11.663,   9.739,   3.752,   2.810,   8.888,   3.293,   3.026,
0.270,   9.752,   0.711,
   50,   5.169,   0.177,   1.376,   0.199,   5.053,   0.276,   1.395,   0.316,
4.984,   0.338,   1.392,   0.348,   7.688,   0.465,   1.400,   0.481,   2.592,
0.610,   4.248,   1.398,   2.592,   1.346,   5.917,   3.431,   3.887,   2.589,
7.741,   6.946,  23.879,  15.231,  10.625,  11.762,   3.887,   4.025,   7.398,
5.863,   4.845,  10.696,  23.759,  22.714,   1.558,   1.133,   0.000,   1.371,
3.887,   2.271,  12.854,  10.704,   3.887,   2.911,   9.796,   3.451,   3.144,
0.274,  10.864,   0.765,
   55,   5.369,   0.182,   1.571,   0.205,   5.249,   0.288,   1.593,   0.330,
5.177,   0.348,   1.590,   0.360,   7.987,   0.481,   1.598,   0.498,   2.682,
0.632,   4.851,   1.545,   2.682,   1.393,   6.757,   3.839,   4.023,   2.679,
8.840,   7.888,  24.710,  15.762,  10.729,  11.967,   4.023,   4.165,   8.448,
6.499,   5.014,  11.069,  28.502,  27.146,   1.614,   1.184,   0.000,   1.424,
4.023,   2.350,  14.679,  12.174,   4.023,   3.012,  11.186,   3.643,   3.262,
0.283,  12.629,   0.851,
   60,   5.570,   0.190,   1.859,   0.215,   5.445,   0.306,   1.885,   0.353,
5.370,   0.367,   1.881,   0.379,   8.285,   0.508,   1.891,   0.526,   2.772,
0.653,   5.740,   1.754,   2.772,   1.440,   7.995,   4.429,   4.158,   2.769,
10.460,   9.271,  25.541,  16.292,  10.965,  12.273,   4.158,   4.305,   9.996,
7.406,   5.182,  11.441,  35.945,  34.090,   1.669,   1.250,   0.000,   1.484,
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4.158,   2.429, 17.369, 14.332,   4.158,   3.114, 13.236,   3.878,   3.380,
0.297, 15.335,   0.985,
   65,   5.770,   0.203,   2.279,   0.229,   5.641,   0.334,   2.311,   0.387,
5.564,   0.396,   2.307,   0.409,   8.583,   0.550,   2.319,   0.570,   2.862,
0.674,   7.037,   2.051,   2.862,   1.487,   9.802,   5.277,   4.293,   2.859,
12.824, 11.283, 26.373, 16.822, 11.331, 12.680,   4.293,   4.445, 12.255,
8.701,   5.351, 11.813, 47.655, 45.002,   1.724,   1.334,   0.000,   1.552,
4.293,   2.508, 21.294, 17.475,   4.293,   3.215, 16.227,   4.178,   3.497,
0.317, 19.472,   1.187,

Pollutant Name: Carbon Dioxide,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,4776.899,4776.899,4098.000,4630.356,4776.899,4776.900,4098.000,4467.706,4776.900,4776.900,4098.001,4203.182,   0.000,
0.000,6541.715,5025.632,4776.900,4776.899,4098.000,4406.973,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,
0.000,4776.900,4776.900,4098.000,4236.204,   0.000,   0.000,   0.000,   0.000,
42.843, 62.877,3032.935, 193.230,
    5,1313.985, 950.206, 358.500, 950.455,1317.129,1183.039,
347.738,1172.955,1318.508,1187.900, 347.857,1186.415,1589.569,1622.578,
346.311,1617.962,2513.510,2513.510, 521.855,2083.604,2513.510,2513.510,
535.498,1612.654,2513.510,2513.510,1505.000,1661.247,2513.510,2513.510,3845.361,
3536.696,2513.510,2513.511,1505.000,1963.983,2513.510,2513.510,2805.121,2784.734, 226.346, 273.767,   0.000,
247.271,2513.510,2513.510,1505.000,1710.302,2513.510,2513.510,1505.000,2445.325,
748.944,1075.561,1762.458,1102.899,
   10, 992.919, 718.027, 358.500, 718.391, 995.294, 893.968, 347.738, 887.446,
996.337, 897.642, 347.857, 896.694,1201.165,1226.109,
346.311,1222.923,1672.267,1672.267, 521.855,1423.947,1672.267,1672.267,
535.498,1154.543,1672.267,1672.267,1505.000,1530.915,1672.267,1672.267,3165.447,
2819.393,1672.267,1672.268,1505.000,1581.125,1672.267,1672.267,2805.121,2725.925, 193.648, 226.843,   0.000,
208.295,1672.267,1672.267,1505.000,1539.051,1672.267,1672.267,1505.000,1660.958,
568.802, 809.432,1723.944, 847.524,
   15, 778.741, 563.145, 358.500, 563.584, 780.604, 701.134, 347.738, 696.987,
781.421, 704.016, 347.857, 703.425, 942.067, 961.630, 346.311,
959.398,1175.484,1175.484, 521.855,1034.396,1175.484,1175.484, 535.498,
884.012,1175.485,1175.484,1505.000,1453.949,1175.484,1175.484,2595.958,2266.754,
1175.484,1175.484,1505.000,1355.035,1175.484,1175.484,2805.121,2691.195,
168.252, 194.311,   0.000,
179.751,1175.484,1175.485,1505.000,1437.921,1175.484,1175.484,1505.000,1197.763,
449.437, 632.862,1691.685, 677.795,
   20, 633.910, 458.411, 358.500, 458.901, 635.427, 570.737, 347.738, 568.196,
636.092, 573.082, 347.857, 572.734, 766.861, 782.785, 346.311, 781.199, 873.000,

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873.000, 521.855, 797.204, 873.000, 873.000, 535.498, 719.290, 873.000,
873.000,1505.000,1407.085, 873.000, 873.000,2183.161,1879.523, 873.000,
873.000,1505.000,1217.371, 873.000, 873.000,2805.121,2670.049, 148.464, 172.036,
0.000, 158.865, 873.000, 873.000,1505.000,1376.344, 873.000, 873.000,1505.000,
915.729, 368.708, 513.963,1668.302, 563.426,
   25, 535.572, 387.298, 358.500, 387.824, 536.854, 482.199, 347.738, 480.749,
537.416, 484.181, 347.857, 483.997, 647.898, 661.353, 346.311, 660.205, 685.012,
685.012, 521.855, 649.794, 685.011, 685.012, 535.498, 616.918, 685.012,
685.011,1505.000,1377.960, 685.011, 685.012,2042.685,1728.036, 685.012,
685.012,1505.000,1131.816, 685.012, 685.011,2805.121,2656.907, 133.042, 157.439,
0.000, 143.807, 685.012, 685.012,1505.000,1338.075, 685.012, 685.012,1505.000,
740.451, 313.530, 433.495,1660.344, 486.366,
   30, 469.639, 339.619, 358.500, 340.168, 470.763, 422.837, 347.738, 422.118,
471.256, 424.575, 347.857, 424.501, 568.137, 579.935, 346.311, 579.081, 567.895,
567.895, 521.855, 557.957, 567.895, 567.895, 535.498, 553.140, 567.895,
567.894,1505.000,1359.815, 567.895, 567.895,1924.234,1609.894, 567.895,
567.895,1505.000,1078.515, 567.895, 567.895,2805.121,2648.719, 121.079, 148.964,
0.000, 133.383, 567.895, 567.895,1505.000,1314.234, 567.895, 567.895,1505.000,
631.252, 276.002, 379.682,1653.634, 434.765,
   35, 427.431, 309.096, 358.500, 309.660, 428.454, 384.835, 347.738, 384.584,
428.903, 386.417, 347.857, 386.414, 517.077, 527.815, 346.311, 527.148, 497.421,
497.421, 521.855, 502.695, 497.421, 497.421, 535.498, 514.762, 497.421,
497.421,1505.000,1348.897, 497.421, 497.421,1827.808,1519.483, 497.421,
497.421,1505.000,1046.442, 497.421, 497.421,2805.121,2643.793, 111.907, 145.791,
0.000, 126.858, 497.421, 497.421,1505.000,1299.888, 497.421, 497.421,1505.000,
565.543, 251.313, 345.310,1648.172, 401.748,
   40, 403.761, 291.979, 358.500, 292.551, 404.727, 363.524, 347.738, 363.535,
405.151, 365.018, 347.857, 365.054, 488.442, 498.585, 346.311, 498.024, 460.326,
460.326, 521.855, 473.608, 460.326, 460.326, 535.498, 494.562, 460.326,
460.326,1505.000,1343.150, 460.326, 460.326,1753.407,1453.728, 460.326,
460.326,1505.000,1029.560, 460.326, 460.326,2805.121,2641.200, 105.040, 147.681,
0.000, 123.855, 460.326, 460.326,1505.000,1292.336, 460.326, 460.326,1505.000,
530.956, 236.590, 326.086,1643.958, 383.223,
   45, 395.857, 286.263, 358.500, 286.838, 396.804, 356.407, 347.738, 356.506,
397.219, 357.872, 347.857, 357.921, 478.880, 488.825, 346.311, 488.299, 450.085,
450.085, 521.855, 465.577, 450.085, 450.085, 535.498, 488.985, 450.085,
450.085,1505.000,1341.563, 450.085, 450.085,1701.031,1411.116, 450.085,
450.085,1505.000,1024.899, 450.085, 450.085,2805.121,2640.484, 100.130, 154.947,
0.000, 124.318, 450.085, 450.085,1505.000,1290.252, 450.085, 450.085,1505.000,
521.407, 230.274, 319.726,1640.991, 377.012,
   50, 402.816, 291.296, 358.500, 291.869, 403.780, 362.673, 347.738, 362.695,
404.203, 364.164, 347.857, 364.202, 487.300, 497.419, 346.311, 496.862, 464.953,
464.953, 521.855, 477.235, 464.953, 464.953, 535.498, 497.082, 464.953,
464.953,1505.000,1343.867, 464.953, 464.953,1670.679,1391.244, 464.953,
464.953,1505.000,1031.665, 464.953, 464.953,2805.121,2641.523,  96.935, 168.525,
0.000, 128.524, 464.953, 464.953,1505.000,1293.278, 464.953, 464.953,1505.000,
535.270, 231.800, 325.497,1639.271, 382.417,
   55, 425.434, 307.652, 358.500, 308.216, 426.452, 383.037, 347.738, 382.808,
426.898, 384.611, 347.857, 384.611, 514.661, 525.348, 346.311, 524.691, 507.469,
507.469, 521.855, 510.574, 507.469, 507.469, 535.498, 520.235, 507.469,
507.469,1505.000,1350.454, 507.469, 507.469,1662.352,1394.701, 507.469,
507.469,1505.000,1051.015, 507.469, 507.469,2805.121,2644.496,  95.303, 190.159,
0.000, 137.159, 507.469, 507.469,1505.000,1301.933, 507.469, 507.469,1505.000,
574.912, 241.500, 344.069,1638.800, 400.075,
   60, 466.351, 337.241, 358.500, 337.791, 467.467, 419.877, 347.738, 419.193,
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585.190, 521.855, 571.519, 585.190, 585.190, 535.498, 562.558, 585.190,
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647.378, 260.689, 377.654,1639.576, 432.092,
   65, 530.579, 383.687, 358.500, 384.214, 531.848, 477.703, 347.738, 476.308,
532.405, 479.666, 347.857, 479.491, 641.857, 655.186, 346.311, 654.060, 712.968,
712.968, 521.855, 671.715, 712.968, 712.968, 535.498, 632.142, 712.968,
712.968,1505.000,1382.292, 712.968, 712.968,1711.772,1480.293, 712.968,
712.968,1505.000,1144.539, 712.968, 712.968,2805.121,2658.861, 96.493, 271.152,
0.000, 173.561, 712.968, 712.968,1505.000,1343.766, 712.968, 712.968,1505.000,
766.517, 291.957, 430.446,1641.599, 482.465,

Pollutant Name: Sulfur Dioxide,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.049,
0.049,   0.039,   0.047,   0.049,   0.049,   0.039,   0.044,   0.049,   0.049,
0.039,   0.041,   0.000,   0.000,   0.062,   0.048,   0.049,   0.049,   0.039,
0.043,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.049,   0.049,   0.039,   0.041,   0.000,   0.000,   0.000,   0.000,   0.000,
0.001,   0.029,   0.002,
    5,   0.016,   0.009,   0.003,   0.009,   0.016,   0.011,   0.003,   0.011,
0.016,   0.011,   0.003,   0.011,   0.020,   0.016,   0.003,   0.016,   0.031,
0.024,   0.005,   0.020,   0.031,   0.024,   0.005,   0.016,   0.034,   0.025,
0.014,   0.016,   0.062,   0.028,   0.037,   0.035,   0.034,   0.025,   0.014,
0.019,   0.035,   0.028,   0.027,   0.027,   0.003,   0.003,   0.000,   0.003,
0.034,   0.024,   0.014,   0.016,   0.034,   0.026,   0.014,   0.025,   0.010,
0.010,   0.017,   0.011,
   10,   0.012,   0.007,   0.003,   0.007,   0.012,   0.009,   0.003,   0.009,
0.012,   0.009,   0.003,   0.009,   0.015,   0.012,   0.003,   0.012,   0.020,
0.016,   0.005,   0.014,   0.020,   0.016,   0.005,   0.011,   0.023,   0.016,
0.014,   0.015,   0.041,   0.018,   0.030,   0.028,   0.023,   0.016,   0.014,
0.015,   0.024,   0.018,   0.027,   0.026,   0.003,   0.002,   0.000,   0.003,
0.023,   0.016,   0.014,   0.015,   0.023,   0.017,   0.014,   0.017,   0.007,
0.008,   0.016,   0.008,
   15,   0.009,   0.005,   0.003,   0.005,   0.009,   0.007,   0.003,   0.007,
0.009,   0.007,   0.003,   0.007,   0.012,   0.009,   0.003,   0.009,   0.014,
0.011,   0.005,   0.010,   0.014,   0.011,   0.005,   0.009,   0.016,   0.012,
0.014,   0.014,   0.029,   0.013,   0.025,   0.022,   0.016,   0.012,   0.014,
0.013,   0.017,   0.013,   0.027,   0.026,   0.002,   0.002,   0.000,   0.002,
0.016,   0.011,   0.014,   0.014,   0.016,   0.012,   0.014,   0.012,   0.006,
0.006,   0.016,   0.007,
   20,   0.008,   0.004,   0.003,   0.004,   0.008,   0.006,   0.003,   0.006,
0.008,   0.006,   0.003,   0.006,   0.010,   0.008,   0.003,   0.008,   0.011,
0.008,   0.005,   0.008,   0.011,   0.008,   0.005,   0.007,   0.012,   0.009,
0.014,   0.013,   0.021,   0.010,   0.021,   0.018,   0.012,   0.009,   0.014,

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0.012,   0.012,   0.010,   0.027,   0.026,   0.002,   0.002,   0.000,   0.002,
0.012,   0.008,   0.014,   0.013,   0.012,   0.009,   0.014,   0.009,   0.005,
0.005,   0.016,   0.005,
   25,   0.006,   0.004,   0.003,   0.004,   0.006,   0.005,   0.003,   0.005,
0.006,   0.005,   0.003,   0.005,   0.008,   0.006,   0.003,   0.006,   0.008,
0.007,   0.005,   0.006,   0.008,   0.007,   0.005,   0.006,   0.009,   0.007,
0.014,   0.013,   0.017,   0.007,   0.020,   0.017,   0.009,   0.007,   0.014,
0.011,   0.010,   0.007,   0.027,   0.025,   0.002,   0.002,   0.000,   0.002,
0.009,   0.007,   0.014,   0.013,   0.009,   0.007,   0.014,   0.008,   0.004,
0.004,   0.016,   0.005,
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0.006,   0.004,   0.003,   0.004,   0.007,   0.006,   0.003,   0.006,   0.007,
0.005,   0.005,   0.005,   0.007,   0.006,   0.005,   0.005,   0.008,   0.006,
0.014,   0.013,   0.014,   0.006,   0.018,   0.016,   0.008,   0.006,   0.014,
0.010,   0.008,   0.006,   0.027,   0.025,   0.002,   0.002,   0.000,   0.002,
0.008,   0.006,   0.014,   0.013,   0.008,   0.006,   0.014,   0.006,   0.004,
0.004,   0.016,   0.004,
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0.005,   0.004,   0.003,   0.004,   0.007,   0.005,   0.003,   0.005,   0.006,
0.005,   0.005,   0.005,   0.006,   0.005,   0.005,   0.005,   0.007,   0.005,
0.014,   0.013,   0.012,   0.005,   0.017,   0.015,   0.007,   0.005,   0.014,
0.010,   0.007,   0.005,   0.027,   0.025,   0.002,   0.002,   0.000,   0.002,
0.007,   0.005,   0.014,   0.012,   0.007,   0.005,   0.014,   0.006,   0.003,
0.003,   0.016,   0.004,
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0.005,   0.004,   0.003,   0.004,   0.006,   0.005,   0.003,   0.005,   0.006,
0.004,   0.005,   0.005,   0.006,   0.004,   0.005,   0.005,   0.006,   0.005,
0.014,   0.013,   0.011,   0.005,   0.017,   0.014,   0.006,   0.005,   0.014,
0.010,   0.006,   0.005,   0.027,   0.025,   0.002,   0.002,   0.000,   0.002,
0.006,   0.004,   0.014,   0.012,   0.006,   0.005,   0.014,   0.005,   0.003,
0.003,   0.016,   0.004,
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0.004,   0.005,   0.004,   0.005,   0.004,   0.005,   0.005,   0.006,   0.004,
0.014,   0.013,   0.011,   0.005,   0.016,   0.014,   0.006,   0.004,   0.014,
0.010,   0.006,   0.005,   0.027,   0.025,   0.002,   0.002,   0.000,   0.002,
0.006,   0.004,   0.014,   0.012,   0.006,   0.005,   0.014,   0.005,   0.003,
0.003,   0.016,   0.004,
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0.005,   0.004,   0.003,   0.004,   0.007,   0.005,   0.003,   0.005,   0.006,
0.004,   0.005,   0.005,   0.006,   0.005,   0.005,   0.005,   0.006,   0.005,
0.014,   0.013,   0.011,   0.005,   0.016,   0.013,   0.006,   0.005,   0.014,
0.010,   0.006,   0.005,   0.027,   0.025,   0.002,   0.002,   0.000,   0.002,
0.006,   0.005,   0.014,   0.012,   0.006,   0.005,   0.014,   0.005,   0.003,
0.003,   0.016,   0.004,
   55,   0.005,   0.003,   0.003,   0.003,   0.005,   0.004,   0.003,   0.004,
0.005,   0.004,   0.003,   0.004,   0.007,   0.005,   0.003,   0.005,   0.006,
0.005,   0.005,   0.005,   0.006,   0.005,   0.005,   0.005,   0.007,   0.005,
0.014,   0.013,   0.012,   0.005,   0.016,   0.014,   0.007,   0.005,   0.014,
0.010,   0.007,   0.005,   0.027,   0.025,   0.002,   0.002,   0.000,   0.002,
0.007,   0.005,   0.014,   0.012,   0.007,   0.005,   0.014,   0.006,   0.004,
0.003,   0.016,   0.004,
   60,   0.006,   0.003,   0.003,   0.003,   0.006,   0.004,   0.003,   0.004,
0.006,   0.004,   0.003,   0.004,   0.008,   0.006,   0.003,   0.006,   0.007,
0.006,   0.005,   0.006,   0.007,   0.006,   0.005,   0.005,   0.008,   0.006,
0.014,   0.013,   0.014,   0.006,   0.016,   0.014,   0.008,   0.006,   0.014,
0.010,   0.008,   0.006,   0.027,   0.025,   0.003,   0.002,   0.000,   0.002,
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0.008, 0.006, 0.014, 0.013, 0.008, 0.006, 0.014, 0.007, 0.004,
0.004, 0.016, 0.004,
65, 0.007, 0.004, 0.003, 0.004, 0.007, 0.005, 0.003, 0.005,
0.007, 0.005, 0.003, 0.005, 0.009, 0.006, 0.003, 0.006, 0.009,
0.007, 0.005, 0.006, 0.009, 0.007, 0.005, 0.006, 0.009, 0.007,
0.014, 0.013, 0.017, 0.008, 0.016, 0.014, 0.009, 0.007, 0.014,
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0.009, 0.007, 0.014, 0.013, 0.009, 0.007, 0.014, 0.008, 0.005,
0.004, 0.016, 0.005,

Pollutant Name: PM10,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

0, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000,
0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000,
0.000, 0.798, 0.172, 0.000, 0.000, 0.973, 0.443, 0.000, 0.000,
0.886, 0.748, 0.000, 0.000, 1.449, 1.113, 0.000, 0.000, 1.030,
0.561, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000,
0.000, 0.000, 0.801, 0.638, 0.000, 0.000, 0.000, 0.000, 0.000,
0.000, 0.661, 0.029,
5, 0.104, 0.046, 0.333, 0.047, 0.101, 0.054, 0.160, 0.055,
0.105, 0.106, 0.165, 0.106, 0.106, 0.123, 0.139, 0.123, 0.101,
0.039, 0.109, 0.054, 0.101, 0.052, 0.147, 0.096, 0.101, 0.052,
0.670, 0.574, 0.101, 0.108, 1.598, 1.253, 0.101, 0.062, 0.653,
0.384, 0.101, 0.103, 0.941, 0.882, 0.080, 0.005, 0.000, 0.047,
0.101, 0.043, 0.988, 0.796, 0.101, 0.023, 0.661, 0.072, 0.090,
0.062, 0.712, 0.090,
10, 0.074, 0.030, 0.261, 0.031, 0.072, 0.035, 0.126, 0.037,
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0.526, 0.450, 0.066, 0.071, 1.096, 0.858, 0.066, 0.041, 0.513,
0.298, 0.066, 0.068, 0.683, 0.640, 0.063, 0.004, 0.000, 0.037,
0.066, 0.028, 0.776, 0.624, 0.066, 0.015, 0.519, 0.053, 0.067,
0.040, 0.537, 0.062,
15, 0.055, 0.021, 0.210, 0.021, 0.054, 0.024, 0.101, 0.026,
0.056, 0.047, 0.104, 0.048, 0.056, 0.055, 0.087, 0.056, 0.045,
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0.237, 0.045, 0.046, 0.513, 0.480, 0.052, 0.003, 0.000, 0.031,
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0.028, 0.415, 0.045,
20, 0.043, 0.015, 0.172, 0.015, 0.042, 0.018, 0.083, 0.019,
0.044, 0.034, 0.085, 0.035, 0.044, 0.040, 0.072, 0.040, 0.032,
0.012, 0.056, 0.022, 0.032, 0.017, 0.076, 0.044, 0.032, 0.017,
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0.193, 0.032, 0.033, 0.399, 0.373, 0.045, 0.003, 0.000, 0.026,

0.032, 0.014, 0.511, 0.410, 0.032, 0.007, 0.341, 0.032, 0.044,
0.020, 0.331, 0.034,
25, 0.035, 0.011, 0.144, 0.012, 0.034, 0.014, 0.069, 0.014,
0.036, 0.026, 0.071, 0.026, 0.036, 0.031, 0.060, 0.031, 0.024,
0.009, 0.047, 0.017, 0.024, 0.012, 0.064, 0.036, 0.024, 0.012,
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0.161, 0.024, 0.024, 0.321, 0.301, 0.041, 0.002, 0.000, 0.024,
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0.030, 0.021, 0.061, 0.021, 0.031, 0.025, 0.052, 0.025, 0.019,
0.007, 0.040, 0.014, 0.019, 0.010, 0.055, 0.030, 0.019, 0.010,
0.249, 0.212, 0.019, 0.020, 0.381, 0.297, 0.019, 0.011, 0.243,
0.137, 0.019, 0.019, 0.268, 0.251, 0.039, 0.002, 0.000, 0.023,
0.019, 0.008, 0.367, 0.294, 0.019, 0.004, 0.245, 0.022, 0.034,
0.012, 0.234, 0.022,
35, 0.027, 0.008, 0.108, 0.008, 0.026, 0.009, 0.052, 0.010,
0.027, 0.018, 0.054, 0.018, 0.027, 0.021, 0.045, 0.021, 0.015,
0.006, 0.035, 0.012, 0.015, 0.008, 0.048, 0.026, 0.015, 0.008,
0.218, 0.186, 0.015, 0.016, 0.346, 0.269, 0.015, 0.009, 0.213,
0.120, 0.015, 0.015, 0.232, 0.217, 0.038, 0.002, 0.000, 0.022,
0.015, 0.006, 0.322, 0.258, 0.015, 0.003, 0.215, 0.019, 0.033,
0.010, 0.205, 0.019,
40, 0.025, 0.007, 0.097, 0.007, 0.024, 0.008, 0.047, 0.009,
0.025, 0.016, 0.048, 0.016, 0.026, 0.019, 0.041, 0.019, 0.013,
0.005, 0.032, 0.011, 0.013, 0.006, 0.043, 0.023, 0.013, 0.007,
0.195, 0.166, 0.013, 0.013, 0.332, 0.258, 0.013, 0.008, 0.191,
0.107, 0.013, 0.013, 0.207, 0.194, 0.040, 0.002, 0.000, 0.023,
0.013, 0.005, 0.288, 0.231, 0.013, 0.003, 0.193, 0.016, 0.033,
0.009, 0.185, 0.017,
45, 0.024, 0.007, 0.089, 0.007, 0.024, 0.008, 0.043, 0.008,
0.025, 0.015, 0.044, 0.015, 0.025, 0.017, 0.037, 0.018, 0.011,
0.004, 0.029, 0.010, 0.011, 0.006, 0.039, 0.021, 0.011, 0.006,
0.179, 0.152, 0.011, 0.012, 0.340, 0.264, 0.011, 0.007, 0.175,
0.098, 0.011, 0.011, 0.192, 0.180, 0.043, 0.002, 0.000, 0.025,
0.011, 0.005, 0.264, 0.211, 0.011, 0.003, 0.176, 0.015, 0.035,
0.009, 0.172, 0.016,
50, 0.025, 0.006, 0.083, 0.007, 0.024, 0.008, 0.040, 0.008,
0.025, 0.015, 0.041, 0.015, 0.026, 0.017, 0.035, 0.017, 0.010,
0.004, 0.027, 0.009, 0.010, 0.005, 0.037, 0.020, 0.010, 0.005,
0.168, 0.142, 0.010, 0.011, 0.370, 0.287, 0.010, 0.006, 0.163,
0.092, 0.010, 0.010, 0.185, 0.172, 0.049, 0.002, 0.000, 0.029,
0.010, 0.004, 0.247, 0.198, 0.010, 0.002, 0.165, 0.014, 0.038,
0.009, 0.165, 0.016,
55, 0.027, 0.007, 0.080, 0.007, 0.026, 0.008, 0.038, 0.008,
0.027, 0.015, 0.039, 0.015, 0.027, 0.018, 0.033, 0.018, 0.010,
0.004, 0.026, 0.008, 0.010, 0.005, 0.035, 0.019, 0.010, 0.005,
0.160, 0.136, 0.010, 0.010, 0.421, 0.326, 0.010, 0.006, 0.156,
0.088, 0.010, 0.010, 0.183, 0.171, 0.058, 0.003, 0.000, 0.034,
0.010, 0.004, 0.237, 0.189, 0.010, 0.002, 0.158, 0.013, 0.044,
0.009, 0.163, 0.016,
60, 0.030, 0.007, 0.078, 0.008, 0.029, 0.009, 0.037, 0.009,
0.031, 0.017, 0.039, 0.017, 0.031, 0.020, 0.033, 0.020, 0.009,
0.004, 0.025, 0.008, 0.009, 0.005, 0.035, 0.018, 0.009, 0.005,
0.157, 0.133, 0.009, 0.010, 0.493, 0.381, 0.009, 0.006, 0.153,
0.086, 0.009, 0.010, 0.189, 0.176, 0.073, 0.004, 0.000, 0.042,

0.009,   0.004,   0.231,   0.185,   0.009,   0.002,   0.155,   0.013,   0.053,
0.010,   0.166,   0.017,
65,   0.035,   0.009,   0.078,   0.009,   0.034,   0.010,   0.037,   0.010,
0.036,   0.019,   0.039,   0.019,   0.036,   0.023,   0.033,   0.023,   0.010,
0.004,   0.025,   0.008,   0.010,   0.005,   0.035,   0.018,   0.010,   0.005,
0.157,   0.133,   0.010,   0.010,   0.587,   0.454,   0.010,   0.006,   0.153,
0.086,   0.010,   0.010,   0.201,   0.188,   0.095,   0.005,   0.000,   0.055,
0.010,   0.004,   0.231,   0.185,   0.010,   0.002,   0.155,   0.013,   0.068,
0.011,   0.175,   0.019,

Pollutant Name: PM10 - Tire Wear,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,
5,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
10,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
15,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
20,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,

```
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
   25,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
   30,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
   35,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
   40,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
   45,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
   50,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
   55,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
   60,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
```

0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,
   65,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.030,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.006,
0.008,   0.012,   0.008,

Pollutant Name: PM10 - Brake Wear,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,
    5,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   10,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   15,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   20,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,

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0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   25,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   30,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   35,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   40,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   45,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   50,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   55,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   60,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
```

0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,
   65,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.009,
0.013,   0.013,   0.013,

Pollutant Name: Gasoline - mi/gal,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,
    5,   5.357,   9.267,   0.000,   9.251,   5.346,   7.431,   0.000,   7.420,
5.362,   7.410,   0.000,   7.406,   4.158,   5.429,   0.000,   5.427,   2.774,
3.506,   0.000,   3.505,   2.774,   3.478,   0.000,   3.475,   2.507,   3.440,
0.000,   3.428,   1.370,   3.090,   0.000,   3.031,   2.507,   3.436,   0.000,
3.434,   2.406,   3.079,   0.000,   2.860, 27.442, 28.576,   0.000, 27.943,
2.507,   3.476,   0.000,   3.463,   2.507,   3.335,   0.000,   3.267, 17.829,
8.518,   0.000,   8.603,
   10,   7.147, 12.253,   0.000, 12.233,   7.133,   9.825,   0.000,   9.810,
7.153,   9.797,   0.000,   9.792,   5.557,   7.179,   0.000,   7.177,   4.171,
5.270,   0.000,   5.268,   4.171,   5.228,   0.000,   5.224,   3.770,   5.170,
0.000,   5.152,   2.061,   4.646,   0.000,   4.557,   3.770,   5.165,   0.000,
5.162,   3.617,   4.631,   0.000,   4.302, 32.552, 34.476,   0.000, 33.401,
3.770,   5.225,   0.000,   5.205,   3.770,   5.013,   0.000,   4.911, 21.485,
11.259,   0.000, 11.352,
   15,   9.160, 15.610,   0.000, 15.585,   9.143, 12.515,   0.000, 12.498,
9.167, 12.481,   0.000, 12.475,   7.131,   9.147,   0.000,   9.144,   5.937,
7.497,   0.000,   7.494,   5.937,   7.438,   0.000,   7.432,   5.367,   7.356,
0.000,   7.331,   2.936,   6.614,   0.000,   6.488,   5.367,   7.349,   0.000,
7.345,   5.151,   6.596,   0.000,   6.127, 37.625, 40.215,   0.000, 38.768,
5.367,   7.434,   0.000,   7.405,   5.367,   7.133,   0.000,   6.988, 25.220,
14.340,   0.000, 14.439,
   20, 11.282, 19.163,   0.000, 19.131, 11.260, 15.362,   0.000, 15.341,
11.290, 15.320,   0.000, 15.313,   8.785, 11.230,   0.000, 11.226,   8.001,
10.095,   0.000, 10.091,   8.001, 10.016,   0.000, 10.008,   7.235,   9.906,
0.000,   9.872,   3.960,   8.914,   0.000,   8.743,   7.235,   9.897,   0.000,
9.891,   6.945,   8.897,   0.000,   8.264, 42.388, 45.386,   0.000, 43.711,

```
7.235,  10.010,   0.000,   9.971,   7.235,   9.606,   0.000,   9.411,  28.830,
17.599,   0.000,  17.702,
   25,  13.353,  22.668,   0.000,  22.631,  13.327,  18.172,   0.000,  18.146,
13.362,  18.122,   0.000,  18.114,  10.393,  13.285,   0.000,  13.280,  10.207,
12.866,   0.000,  12.861,  10.207,  12.767,   0.000,  12.756,   9.233,  12.627,
0.000,  12.584,   5.057,  11.373,   0.000,  11.156,   9.233,  12.615,   0.000,
12.608,   8.865,  11.363,   0.000,  10.553,  46.524,  49.573,   0.000,  47.869,
9.233,  12.758,   0.000,  12.709,   9.233,  12.245,   0.000,  11.997,  32.068,
20.815,   0.000,  20.918,
   30,  15.185,  25.841,   0.000,  25.799,  15.156,  20.715,   0.000,  20.685,
15.196,  20.659,   0.000,  20.649,  11.807,  15.145,   0.000,  15.140,  12.327,
15.520,   0.000,  15.515,  12.327,  15.401,   0.000,  15.388,  11.156,  15.234,
0.000,  15.182,   6.116,  13.737,   0.000,  13.474,  11.156,  15.219,   0.000,
15.211,  10.714,  13.742,   0.000,  12.760,  49.681,  52.395,   0.000,  50.878,
11.156,  15.391,   0.000,  15.332,  11.156,  14.774,   0.000,  14.476,  34.652,
23.725,   0.000,  23.824,
   35,  16.592,  28.390,   0.000,  28.344,  16.561,  22.758,   0.000,  22.725,
16.606,  22.697,   0.000,  22.686,  12.878,  16.639,   0.000,  16.633,  14.093,
17.720,   0.000,  17.714,  14.093,  17.586,   0.000,  17.571,  12.760,  17.396,
0.000,  17.337,   7.002,  15.706,   0.000,  15.406,  12.760,  17.380,   0.000,
17.370,  12.259,  15.734,   0.000,  14.606,  51.501,  53.556,   0.000,  52.408,
12.760,  17.574,   0.000,  17.506,  12.760,  16.872,   0.000,  16.533,  36.297,
26.058,   0.000,  26.151,
   40,  17.415,  30.060,   0.000,  30.010,  17.382,  24.096,   0.000,  24.061,
17.432,  24.032,   0.000,  24.020,  13.482,  17.618,   0.000,  17.611,  15.250,
19.149,   0.000,  19.142,  15.250,  19.006,   0.000,  18.990,  13.814,  18.802,
0.000,  18.739,   7.590,  16.998,   0.000,  16.674,  13.814,  18.785,   0.000,
18.775,  13.277,  17.053,   0.000,  15.828,  51.658,  52.892,   0.000,  52.202,
13.814,  18.993,   0.000,  18.920,  13.814,  18.237,   0.000,  17.873,  36.745,
27.580,   0.000,  27.664,
   45,  17.552,  30.673,   0.000,  30.622,  17.520,  24.589,   0.000,  24.551,
17.573,  24.523,   0.000,  24.511,  13.543,  17.977,   0.000,  17.969,  15.620,
19.586,   0.000,  19.579,  15.620,  19.441,   0.000,  19.425,  14.157,  19.234,
0.000,  19.170,   7.787,  17.413,   0.000,  17.081,  14.157,  19.217,   0.000,
19.207,  13.611,  17.496,   0.000,  16.236,  49.913,  50.406,   0.000,  50.131,
14.157,  19.427,   0.000,  19.354,  14.157,  18.658,   0.000,  18.287,  35.816,
28.129,   0.000,  28.199,
   50,  16.981,  30.163,   0.000,  30.111,  16.951,  24.180,   0.000,  24.142,
17.006,  24.116,   0.000,  24.103,  13.045,  17.677,   0.000,  17.669,  15.142,
18.961,   0.000,  18.954,  15.142,  18.822,   0.000,  18.806,  13.732,  18.624,
0.000,  18.562,   7.562,  16.883,   0.000,  16.562,  13.732,  18.607,   0.000,
18.597,  13.207,  16.990,   0.000,  15.763,  46.196,  46.285,   0.000,  46.235,
13.732,  18.809,   0.000,  18.738,  13.732,  18.067,   0.000,  17.710,  33.456,
27.643,   0.000,  27.696,
   55,  15.759,  28.582,   0.000,  28.531,  15.732,  22.914,   0.000,  22.876,
15.787,  22.853,   0.000,  22.840,  12.042,  16.749,   0.000,  16.741,  13.894,
17.374,   0.000,  17.368,  13.894,  17.248,   0.000,  17.233,  12.606,  17.068,
0.000,  17.011,   6.950,  15.493,   0.000,  15.199,  12.606,  17.052,   0.000,
17.043,  12.128,  15.615,   0.000,  14.484,  40.684,  40.883,   0.000,  40.772,
12.606,  17.235,   0.000,  17.170,  12.606,  16.558,   0.000,  16.233,  29.793,
26.174,   0.000,  26.207,
   60,  14.019,  26.097,   0.000,  26.050,  13.996,  20.923,   0.000,  20.886,
14.050,  20.867,   0.000,  20.855,  10.643,  15.292,   0.000,  15.284,  12.065,
15.067,   0.000,  15.062,  12.065,  14.959,   0.000,  14.947,  10.952,  14.804,
0.000,  14.755,   6.044,  13.455,   0.000,  13.200,  10.952,  14.791,   0.000,
14.783,  10.541,  13.581,   0.000,  12.595,  33.852,  34.678,   0.000,  34.217,
```

10.952, 14.948,   0.000, 14.892, 10.952, 14.363,   0.000, 14.082, 25.155,
23.876,   0.000, 23.887,
   65, 11.943, 22.959,   0.000, 22.915, 11.925, 18.407,   0.000, 18.373,
11.975, 18.358,   0.000, 18.347,   8.997, 13.452,   0.000, 13.444,   9.915,
12.368,   0.000, 12.363,   9.915, 12.280,   0.000, 12.269,   9.005, 12.153,
0.000, 12.113,   4.975, 11.059,   0.000, 10.850,   9.005, 12.143,   0.000,
12.136,   8.669, 11.177,   0.000, 10.364, 26.436, 28.200,   0.000, 27.215,
9.005, 12.271,   0.000, 12.225,   9.005, 11.792,   0.000, 11.563, 20.043,
20.982,   0.000, 20.973,

Pollutant Name: Diesel - mi/gal,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,
    5,   0.000,   0.000, 28.117, 28.117,   0.000,   0.000, 28.987, 28.987,
0.000,   0.000, 28.977, 28.977,   0.000,   0.000, 29.106, 29.106,   0.000,
0.000, 19.315, 19.315,   0.000,   0.000, 18.823, 18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   2.621,   2.621,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   8.360,   8.360,
   10,   0.000,   0.000, 28.117, 28.117,   0.000,   0.000, 28.987, 28.987,
0.000,   0.000, 28.977, 28.977,   0.000,   0.000, 29.106, 29.106,   0.000,
0.000, 19.315, 19.315,   0.000,   0.000, 18.823, 18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   3.184,   3.184,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   8.392,   8.392,
   15,   0.000,   0.000, 28.117, 28.117,   0.000,   0.000, 28.987, 28.987,
0.000,   0.000, 28.977, 28.977,   0.000,   0.000, 29.106, 29.106,   0.000,
0.000, 19.315, 19.315,   0.000,   0.000, 18.823, 18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   3.883,   3.883,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   8.432,   8.432,
   20,   0.000,   0.000, 28.117, 28.117,   0.000,   0.000, 28.987, 28.987,
0.000,   0.000, 28.977, 28.977,   0.000,   0.000, 29.106, 29.106,   0.000,
0.000, 19.315, 19.315,   0.000,   0.000, 18.823, 18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   4.617,   4.617,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,

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0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   8.473,   8.473,
   25,   0.000,   0.000,  28.117,  28.117,   0.000,   0.000,  28.987,  28.987,
0.000,   0.000,  28.977,  28.977,   0.000,   0.000,  29.106,  29.106,   0.000,
0.000,  19.315,  19.315,   0.000,   0.000,  18.823,  18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   4.935,   4.935,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
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0.000,   8.491,   8.491,
   30,   0.000,   0.000,  28.117,  28.117,   0.000,   0.000,  28.987,  28.987,
0.000,   0.000,  28.977,  28.977,   0.000,   0.000,  29.106,  29.106,   0.000,
0.000,  19.315,  19.315,   0.000,   0.000,  18.823,  18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   5.238,   5.238,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   8.508,   8.508,
   35,   0.000,   0.000,  28.117,  28.117,   0.000,   0.000,  28.987,  28.987,
0.000,   0.000,  28.977,  28.977,   0.000,   0.000,  29.106,  29.106,   0.000,
0.000,  19.315,  19.315,   0.000,   0.000,  18.823,  18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   5.515,   5.515,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   8.524,   8.524,
   40,   0.000,   0.000,  28.117,  28.117,   0.000,   0.000,  28.987,  28.987,
0.000,   0.000,  28.977,  28.977,   0.000,   0.000,  29.106,  29.106,   0.000,
0.000,  19.315,  19.315,   0.000,   0.000,  18.823,  18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   5.749,   5.749,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   8.537,   8.537,
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0.000,  19.315,  19.315,   0.000,   0.000,  18.823,  18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   5.926,   5.926,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
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0.000,   0.000,  28.977,  28.977,   0.000,   0.000,  29.106,  29.106,   0.000,
0.000,  19.315,  19.315,   0.000,   0.000,  18.823,  18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   6.033,   6.033,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   8.553,   8.553,
   55,   0.000,   0.000,  28.117,  28.117,   0.000,   0.000,  28.987,  28.987,
0.000,   0.000,  28.977,  28.977,   0.000,   0.000,  29.106,  29.106,   0.000,
0.000,  19.315,  19.315,   0.000,   0.000,  18.823,  18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   6.064,   6.064,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   8.555,   8.555,
   60,   0.000,   0.000,  28.117,  28.117,   0.000,   0.000,  28.987,  28.987,
0.000,   0.000,  28.977,  28.977,   0.000,   0.000,  29.106,  29.106,   0.000,
0.000,  19.315,  19.315,   0.000,   0.000,  18.823,  18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   6.014,   6.014,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
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0.000,   8.552,   8.552,
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0.000,   0.000,  28.977,  28.977,   0.000,   0.000,  29.106,  29.106,   0.000,
0.000,  19.315,  19.315,   0.000,   0.000,  18.823,  18.823,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   5.889,   5.889,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.593,   3.593,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   8.545,   8.545,
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Title    : SF 2011 and 2020_EMFAC
Version  : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season   : Annual
Area     : San Francisco
********************************************************************************
*********
Year:,2011,, -- Model Years,,1967, to ,2011, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,,  San Francisco,,,,,,County Average

,,,,Table  2:  Starting Emissions (grams/trip)

Pollutant Name: Total Organic Gases,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O
BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    5,   5.057,   0.069,   0.000,   0.094,   4.954,   0.081,   0.000,   0.108,
4.801,   0.074,   0.000,   0.083,   6.092,   0.109,   0.000,   0.120,   8.279,
0.232,   0.000,   0.235,   8.279,   0.388,   0.000,   0.340,  12.419,   0.740,
0.000,   0.458,  20.912,   2.198,   0.000,   4.846,  12.419,   0.647,   0.000,
0.497,  15.286,   1.628,   0.000,   0.423,   2.516,   0.400,   0.000,   1.747,
12.419,   0.401,   0.000,   0.116,  12.419,   0.834,   0.000,   1.835,   5.261,
0.104,   0.000,   0.162,
   10,   5.014,   0.135,   0.000,   0.160,   4.912,   0.159,   0.000,   0.183,
4.760,   0.146,   0.000,   0.154,   6.039,   0.213,   0.000,   0.223,   8.208,
0.454,   0.000,   0.436,   8.208,   0.756,   0.000,   0.618,  12.312,   1.443,
0.000,   0.660,  20.733,   4.285,   0.000,   6.344,  12.312,   1.262,   0.000,
0.883,  15.155,   3.173,   0.000,   0.493,   2.495,   0.779,   0.000,   1.871,
12.312,   0.783,   0.000,   0.192,  12.312,   1.625,   0.000,   2.495,   5.215,
0.204,   0.000,   0.253,
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4.805,   0.279,   0.000,   0.287,   6.097,   0.408,   0.000,   0.418,   8.286,
0.865,   0.000,   0.808,   8.286,   1.435,   0.000,   1.132,  12.430,   2.735,
0.000,   1.037,  20.931,   8.123,   0.000,   9.181,  12.430,   2.392,   0.000,
1.596,  15.300,   6.015,   0.000,   0.631,   2.518,   1.477,   0.000,   2.140,
12.430,   1.484,   0.000,   0.333,  12.430,   3.081,   0.000,   3.737,   5.265,
0.389,   0.000,   0.424,
   30,   5.289,   0.369,   0.000,   0.393,   5.181,   0.432,   0.000,   0.453,
5.021,   0.399,   0.000,   0.407,   6.371,   0.586,   0.000,   0.595,   8.659,
1.233,   0.000,   1.144,   8.659,   2.038,   0.000,   1.589,  12.988,   3.878,
0.000,   1.379,  21.872,  11.515,   0.000,  11.808,  12.988,   3.391,   0.000,
2.229,  15.987,   8.526,   0.000,   0.765,   2.632,   2.094,   0.000,   2.436,
12.988,   2.103,   0.000,   0.459,  12.988,   4.368,   0.000,   4.877,   5.502,
0.554,   0.000,   0.580,
   40,   5.696,   0.467,   0.000,   0.493,   5.580,   0.547,   0.000,   0.568,
5.407,   0.507,   0.000,   0.516,   6.861,   0.747,   0.000,   0.755,   9.325,
1.560,   0.000,   1.441,   9.325,   2.565,   0.000,   1.991,  13.988,   4.869,
0.000,   1.687,  23.555,  14.461,   0.000,  14.222,  13.988,   4.259,   0.000,
2.782,  17.217,  10.707,   0.000,   0.896,   2.834,   2.630,   0.000,   2.760,
13.988,   2.641,   0.000,   0.570,  13.988,   5.485,   0.000,   5.913,   5.925,
0.701,   0.000,   0.721,
   50,   6.283,   0.554,   0.000,   0.582,   6.155,   0.648,   0.000,   0.670,
5.964,   0.603,   0.000,   0.612,   7.568,   0.890,   0.000,   0.899,  10.285,
1.844,   0.000,   1.701,  10.286,   3.014,   0.000,   2.336,  15.428,   5.711,
0.000,   1.959,  25.980,  16.960,   0.000,  16.426,  15.428,   4.995,   0.000,
3.256,  18.990,  12.557,   0.000,   1.024,   3.126,   3.084,   0.000,   3.111,
15.428,   3.098,   0.000,   0.666,  15.428,   6.433,   0.000,   6.847,   6.536,
0.828,   0.000,   0.846,
   60,   6.532,   0.628,   0.000,   0.656,   6.399,   0.734,   0.000,   0.756,
6.201,   0.686,   0.000,   0.695,   7.868,   1.015,   0.000,   1.024,  10.693,
2.085,   0.000,   1.921,  10.693,   3.388,   0.000,   2.620,  16.040,   6.402,
0.000,   2.172,  27.010,  19.013,   0.000,  18.086,  16.040,   5.599,   0.000,
3.641,  19.743,  14.077,   0.000,   1.113,   3.250,   3.458,   0.000,   3.325,
16.040,   3.473,   0.000,   0.743,  16.040,   7.212,   0.000,   7.561,   6.795,
0.937,   0.000,   0.949,
  120,   4.931,   0.789,   0.000,   0.808,   4.831,   0.874,   0.000,   0.883,
4.681,   0.876,   0.000,   0.881,   5.940,   1.338,   0.000,   1.342,   8.072,
2.117,   0.000,   1.942,   8.072,   3.084,   0.000,   2.376,  12.109,   5.466,
0.000,   1.823,  20.390,  15.856,   0.000,  14.753,  12.109,   4.956,   0.000,
3.207,  14.904,   9.101,   0.000,   0.768,   2.453,   3.208,   0.000,   2.728,
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1.060,   0.000,   1.043,
  180,   5.368,   0.582,   0.000,   0.605,   5.258,   0.674,   0.000,   0.690,
5.096,   0.656,   0.000,   0.663,   6.466,   0.994,   0.000,   1.000,   8.787,
2.087,   0.000,   1.917,   8.787,   3.200,   0.000,   2.468,  13.181,   5.800,
0.000,   1.941,  22.196,  16.824,   0.000,  15.741,  13.181,   5.259,   0.000,
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13.181,   3.344,   0.000,   0.709,  13.181,   4.622,   0.000,   5.109,   5.584,
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0.000, 2.680, 34.837, 22.742, 0.000, 22.025, 20.688, 7.108, 0.000,
4.624, 25.464, 13.053, 0.000, 1.194, 4.192, 3.670, 0.000, 4.002,
20.688, 4.520, 0.000, 0.966, 20.688, 6.247, 0.000, 7.167, 8.763,
1.195, 0.000, 1.213,
660, 8.861, 0.832, 0.000, 0.871, 8.681, 0.963, 0.000, 0.993,
8.412, 0.944, 0.000, 0.957, 10.674, 1.438, 0.000, 1.450, 14.507,
2.972, 0.000, 2.736, 14.507, 4.491, 0.000, 3.475, 21.760, 8.089,
0.000, 2.773, 36.643, 23.464, 0.000, 22.833, 21.760, 7.334, 0.000,
4.774, 26.784, 13.468, 0.000, 1.243, 4.409, 3.787, 0.000, 4.183,
21.760, 4.664, 0.000, 0.998, 21.760, 6.446, 0.000, 7.433, 9.218,
1.237, 0.000, 1.257,
720, 9.298, 0.860, 0.000, 0.901, 9.109, 0.995, 0.000, 1.026,
8.827, 0.977, 0.000, 0.990, 11.200, 1.488, 0.000, 1.501, 15.222,
3.069, 0.000, 2.826, 15.222, 4.628, 0.000, 3.583, 22.832, 8.328,
0.000, 2.863, 38.449, 24.156, 0.000, 23.619, 22.832, 7.551, 0.000,
4.918, 28.104, 13.865, 0.000, 1.292, 4.626, 3.899, 0.000, 4.362,
22.832, 4.801, 0.000, 1.029, 22.832, 6.636, 0.000, 7.691, 9.672,
1.277, 0.000, 1.300,

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Pollutant Name: Carbon Monoxide,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O
BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    5,  23.770,   0.723,   0.000,   0.839,  23.914,   0.996,   0.000,   1.112,
23.545,   0.862,   0.000,   0.905,  41.689,   1.149,   0.000,   1.222,  42.016,
2.711,   0.000,   2.583,  42.016,   4.997,   0.000,   4.013,  63.024,  12.087,
0.000,   4.741, 260.302,  31.683,   0.000,  63.475,  63.024,  11.608,   0.000,
7.762,  71.664,  25.193,   0.000,   2.815,   6.484,   2.425,   0.000,   5.009,
63.024,   6.667,   0.000,   1.518,  63.024,  16.008,   0.000,  19.276,  28.487,
1.273,   0.000,   1.529,
   10,  21.049,   1.422,   0.000,   1.519,  21.176,   1.957,   0.000,   2.038,
20.850,   1.697,   0.000,   1.731,  36.917,   2.259,   0.000,   2.317,  37.206,
5.323,   0.000,   4.934,  37.206,   9.796,   0.000,   7.612,  55.809,  23.683,
0.000,   7.965, 230.504,  62.078,   0.000,  81.089,  55.809,  22.744,   0.000,
14.720,  63.460,  49.362,   0.000,   3.771,   5.742,   4.751,   0.000,   5.382,
55.809,  13.064,   0.000,   2.781,  55.809,  31.366,   0.000,  31.617,  25.225,
2.499,   0.000,   2.621,
   20,  16.249,   2.746,   0.000,   2.808,  16.347,   3.775,   0.000,   3.792,
16.095,   3.281,   0.000,   3.299,  28.497,   4.365,   0.000,   4.393,  28.721,
10.247,   0.000,   9.369,  28.721,  18.800,   0.000,  14.367,  43.081,  45.402,
0.000,  14.018, 177.935, 119.007,   0.000, 114.582,  43.081,  43.602,   0.000,
27.757,  48.987,  94.630,   0.000,   5.580,   4.432,   9.108,   0.000,   6.131,
43.081,  25.044,   0.000,   5.150,  43.081,  60.131,   0.000,  54.800,  19.473,
4.813,   0.000,   4.688,
   30,  12.304,   3.972,   0.000,   4.005,  12.378,   5.453,   0.000,   5.414,
12.188,   4.753,   0.000,   4.756,  21.579,   6.317,   0.000,   6.321,  21.748,
14.773,   0.000,  13.448,  21.748,  27.012,   0.000,  20.533,  32.623,  65.156,
0.000,  19.545, 134.739, 170.787,   0.000, 145.760,  32.623,  62.573,   0.000,
39.622,  37.095, 135.803,   0.000,   7.255,   3.356,  13.071,   0.000,   6.886,
32.623,  35.941,   0.000,   7.307,  32.623,  86.294,   0.000,  75.989,  14.745,
6.942,   0.000,   6.596,
   40,   9.215,   5.101,   0.000,   5.109,   9.271,   6.991,   0.000,   6.903,
9.128,   6.112,   0.000,   6.104,  16.162,   8.117,   0.000,   8.099,  16.289,
18.902,   0.000,  17.171,  16.289,  34.432,   0.000,  26.109,  24.433,  82.946,
0.000,  24.547, 100.915, 217.418,   0.000, 174.624,  24.433,  79.657,   0.000,
50.317,  27.783, 172.882,   0.000,   8.796,   2.514,  16.640,   0.000,   7.647,
24.433,  45.754,   0.000,   9.253,  24.433, 109.855,   0.000,  95.182,  11.044,
8.886,   0.000,   8.345,
   50,   6.983,   6.131,   0.000,   6.120,   7.025,   8.389,   0.000,   8.261,
6.916,   7.359,   0.000,   7.341,  12.246,   9.763,   0.000,   9.727,  12.342,
22.632,   0.000,  20.538,  12.342,  41.061,   0.000,  31.095,  18.513,  98.771,
0.000,  29.023,  76.464, 258.899,   0.000, 201.173,  18.513,  94.855,   0.000,
59.840,  21.051, 205.866,   0.000,  10.201,   1.905,  19.815,   0.000,   8.413,
18.513,  54.483,   0.000,  10.988,  18.513, 130.814,   0.000, 112.379,   8.368,
10.644,   0.000,   9.936,
   60,   5.605,   7.064,   0.000,   7.039,   5.639,   9.648,   0.000,   9.486,
5.552,   8.493,   0.000,   8.468,   9.831,  11.256,   0.000,  11.206,   9.908,
```

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25.964,   0.000,  23.549,   9.908,  46.898,   0.000,  35.492,  14.862, 112.632,
0.000,  32.973,  61.384, 295.230,   0.000, 225.407,  14.862, 108.166,   0.000,
68.193,  16.900, 234.756,   0.000,  11.471,   1.529,  22.596,   0.000,   9.184,
14.862,  62.129,   0.000,  12.513,  14.862, 149.171,   0.000, 127.582,   6.718,
12.217,   0.000,  11.369,
  120,  18.544,   9.555,   0.000,   9.577,  18.656,  12.106,   0.000,  11.968,
18.369,  11.520,   0.000,  11.506,  32.524,  15.300,   0.000,  15.270,  32.779,
23.527,   0.000,  21.411,  32.779,  36.511,   0.000,  27.773,  49.168,  81.742,
0.000,  24.681, 203.075, 203.882,   0.000, 180.543,  49.168,  81.439,   0.000,
51.617,  55.908, 134.124,   0.000,   7.603,   5.059,  22.563,   0.000,  11.419,
49.168,  47.814,   0.000,   9.737,  49.168,  82.850,   0.000,  74.579,  22.224,
13.478,   0.000,  12.726,
  180,  29.302,   6.451,   0.000,   6.552,  29.478,   8.630,   0.000,   8.624,
29.024,   7.891,   0.000,   7.914,  51.390,  10.358,   0.000,  10.395,  51.793,
20.711,   0.000,  18.918,  51.793,  35.899,   0.000,  27.418,  77.689,  84.131,
0.000,  25.933, 320.874, 209.842,   0.000, 203.142,  77.689,  83.820,   0.000,
53.322,  88.340, 138.045,   0.000,   8.523,   7.993,  15.087,   0.000,  10.571,
77.689,  49.212,   0.000,  10.099,  77.689,  85.272,   0.000,  79.221,  35.115,
10.359,   0.000,  10.004,
  240,  38.919,   6.818,   0.000,   6.965,  39.154,   9.083,   0.000,   9.122,
38.551,   8.372,   0.000,   8.412,  68.257,  10.964,   0.000,  11.030,  68.792,
21.687,   0.000,  19.854,  68.792,  37.129,   0.000,  28.444, 103.188,  86.600,
0.000,  27.148, 426.189, 215.998,   0.000, 223.951, 103.188,  86.279,   0.000,
55.054, 117.334, 142.095,   0.000,   9.372,  10.616,  15.529,   0.000,  12.402,
103.188,  50.656,   0.000,  10.462, 103.188,  87.773,   0.000,  83.656,  46.641,
10.858,   0.000,  10.607,
  300,  47.396,   7.157,   0.000,   7.344,  47.682,   9.505,   0.000,   9.584,
46.947,   8.812,   0.000,   8.866,  83.124,  11.521,   0.000,  11.612,  83.775,
22.611,   0.000,  20.736,  83.775,  38.358,   0.000,  29.457, 125.663,  89.147,
0.000,  28.327, 519.019, 222.351,   0.000, 242.970, 125.663,  88.816,   0.000,
56.814, 142.891, 146.274,   0.000,  10.149,  12.929,  15.986,   0.000,  14.040,
125.663,  52.146,   0.000,  10.825, 125.663,  90.355,   0.000,  87.884,  56.800,
11.328,   0.000,  11.167,
  360,  54.733,   7.466,   0.000,   7.689,  55.063,   9.896,   0.000,  10.009,
54.215,   9.210,   0.000,   9.277,  95.992,  12.028,   0.000,  12.142,  96.744,
23.481,   0.000,  21.564,  96.744,  39.586,   0.000,  30.458, 145.116,  91.772,
0.000,  29.470, 599.364, 228.901,   0.000, 260.200, 145.116,  91.432,   0.000,
58.601, 165.011, 150.583,   0.000,  10.854,  14.930,  16.457,   0.000,  15.485,
145.116,  53.682,   0.000,  11.189, 145.116,  93.016,   0.000,  91.905,  65.592,
11.769,   0.000,  11.684,
  420,  60.930,   7.747,   0.000,   7.999,  61.297,  10.256,   0.000,  10.397,
60.353,   9.567,   0.000,   9.645, 106.860,  12.486,   0.000,  12.618, 107.698,
24.299,   0.000,  22.338, 107.698,  40.813,   0.000,  31.447, 161.546,  94.477,
0.000,  30.576, 667.224, 235.647,   0.000, 275.641, 161.546,  94.127,   0.000,
60.416, 183.693, 155.021,   0.000,  11.487,  16.620,  16.942,   0.000,  16.737,
161.546,  55.264,   0.000,  11.553, 161.546,  95.757,   0.000,  95.718,  73.019,
12.183,   0.000,  12.158,
  480,  65.986,   7.999,   0.000,   8.275,  66.384,  10.585,   0.000,  10.749,
65.362,   9.882,   0.000,   9.968, 115.729,  12.894,   0.000,  13.041, 116.636,
25.064,   0.000,  23.058, 116.636,  42.039,   0.000,  32.424, 174.954,  97.260,
0.000,  31.647, 722.600, 242.589,   0.000, 289.292, 174.954,  96.900,   0.000,
62.258, 198.939, 159.588,   0.000,  12.049,  18.000,  17.441,   0.000,  17.797,
174.954,  56.892,   0.000,  11.918, 174.954,  98.579,   0.000,  99.325,  79.079,
12.568,   0.000,  12.589,
  540,  69.903,   8.222,   0.000,   8.517,  70.325,  10.882,   0.000,  11.063,
69.242,  10.156,   0.000,  10.248, 122.598,  13.253,   0.000,  13.410, 123.559,
25.776,   0.000,  23.725, 123.559,  43.264,   0.000,  33.389, 185.338, 100.122,
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0.000, 32.680, 765.491, 249.728,   0.000, 301.154, 185.338, 99.751,   0.000,
64.128, 210.747, 164.284,   0.000, 12.538, 19.068, 17.954,   0.000, 18.664,
185.338, 58.566,   0.000, 12.284, 185.338, 101.479,   0.000, 102.723, 83.773,
12.924,   0.000, 12.976,
  600, 72.680,   8.417,   0.000,   8.724, 73.118, 11.149,   0.000, 11.340,
71.992, 10.388,   0.000, 10.485, 127.468, 13.562,   0.000, 13.727, 128.467,
26.436,   0.000, 24.337, 128.467, 44.488,   0.000, 34.342, 192.700, 103.063,
0.000, 33.678, 795.897, 257.063,   0.000, 311.226, 192.700, 102.681,   0.000,
66.026, 219.118, 169.109,   0.000, 12.956, 19.826, 18.482,   0.000, 19.337,
192.700, 60.286,   0.000, 12.650, 192.700, 104.460,   0.000, 105.915, 87.100,
13.252,   0.000, 13.321,
  660, 74.316,   8.582,   0.000,   8.897, 74.765, 11.385,   0.000, 11.580,
73.613, 10.579,   0.000, 10.678, 130.338, 13.822,   0.000, 13.991, 131.359,
27.043,   0.000, 24.896, 131.359, 45.711,   0.000, 35.282, 197.039, 106.083,
0.000, 34.639, 813.818, 264.594,   0.000, 319.509, 197.039, 105.690,   0.000,
67.951, 224.052, 174.064,   0.000, 13.302, 20.272, 19.023,   0.000, 19.818,
197.039, 62.053,   0.000, 13.017, 197.039, 107.521,   0.000, 108.899, 89.061,
13.552,   0.000, 13.622,
  720, 74.813,   8.719,   0.000,   9.035, 75.264, 11.589,   0.000, 11.784,
74.105, 10.728,   0.000, 10.828, 131.209, 14.032,   0.000, 14.202, 132.237,
27.597,   0.000, 25.400, 132.237, 46.933,   0.000, 36.211, 198.356, 109.181,
0.000, 35.564, 819.255, 272.322,   0.000, 326.002, 198.356, 108.777,   0.000,
69.903, 225.549, 179.148,   0.000, 13.576, 20.408, 19.579,   0.000, 20.106,
198.356, 63.865,   0.000, 13.385, 198.356, 110.661,   0.000, 111.677, 89.656,
13.823,   0.000, 13.880,

Pollutant Name: Oxides of Nitrogen,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O
BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    5,   1.199,   0.209,   0.000,   0.213,   1.176,   0.242,   0.000,   0.244,
1.163,   0.402,   0.000,   0.402,   1.805,   0.550,   0.000,   0.550,   0.609,
1.322,   0.000,   1.199,   0.609,   1.389,   0.000,   1.053,   0.913,   1.725,
0.000,   0.518,   3.781,   5.320,   0.000,   4.476,   0.913,   2.061,   0.000,
1.304,   1.138,   2.901,   0.000,   0.163,   0.292,   0.089,   0.000,   0.218,
0.913,   1.229,   0.000,   0.249,   0.913,   1.370,   0.000,   1.242,   0.786,
0.348,   0.000,   0.331,
   10,   1.303,   0.242,   0.000,   0.247,   1.279,   0.281,   0.000,   0.283,
1.264,   0.451,   0.000,   0.452,   1.962,   0.617,   0.000,   0.617,   0.661,
1.607,   0.000,   1.457,   0.661,   1.921,   0.000,   1.455,   0.992,   2.599,
0.000,   0.774,   4.110,   8.016,   0.000,   6.499,   0.992,   3.105,   0.000,
1.962,   1.237,   4.371,   0.000,   0.235,   0.317,   0.134,   0.000,   0.251,
0.992,   1.852,   0.000,   0.375,   0.992,   2.064,   0.000,   1.837,   0.854,
0.427,   0.000,   0.405,
   20,   1.493,   0.301,   0.000,   0.306,   1.465,   0.352,   0.000,   0.353,
1.448,   0.539,   0.000,   0.540,   2.248,   0.736,   0.000,   0.736,   0.758,
2.109,   0.000,   1.913,   0.758,   2.856,   0.000,   2.162,   1.137,   4.134,
0.000,   1.222,   4.709, 12.751,   0.000, 10.054,   1.137,   4.940,   0.000,

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3.117,   1.417,   6.953,   0.000,   0.361,   0.364,   0.213,   0.000,   0.309,
1.137,   2.947,   0.000,   0.595,   1.137,   3.284,   0.000,   2.882,   0.978,
0.566,   0.000,   0.535,
   30,   1.657,   0.349,   0.000,   0.355,   1.626,   0.410,   0.000,   0.411,
1.607,   0.613,   0.000,   0.613,   2.495,   0.835,   0.000,   0.835,   0.841,
2.523,   0.000,   2.288,   0.841,   3.619,   0.000,   2.740,   1.262,   5.385,
0.000,   1.587,   5.227,  16.609,   0.000,  12.956,   1.262,   6.434,   0.000,
4.059,   1.573,   9.057,   0.000,   0.463,   0.404,   0.278,   0.000,   0.358,
1.262,   3.838,   0.000,   0.774,   1.262,   4.277,   0.000,   3.734,   1.086,
0.681,   0.000,   0.642,
   40,   1.796,   0.388,   0.000,   0.394,   1.762,   0.456,   0.000,   0.456,
1.742,   0.671,   0.000,   0.672,   2.704,   0.914,   0.000,   0.914,   0.912,
2.847,   0.000,   2.582,   0.912,   4.212,   0.000,   3.187,   1.368,   6.351,
0.000,   1.870,   5.665,  19.591,   0.000,  15.204,   1.368,   7.589,   0.000,
4.787,   1.704,  10.683,   0.000,   0.543,   0.437,   0.327,   0.000,   0.397,
1.368,   4.527,   0.000,   0.913,   1.368,   5.045,   0.000,   4.393,   1.177,
0.770,   0.000,   0.726,
   50,   1.909,   0.416,   0.000,   0.423,   1.874,   0.489,   0.000,   0.490,
1.852,   0.715,   0.000,   0.716,   2.875,   0.973,   0.000,   0.973,   0.969,
3.082,   0.000,   2.795,   0.969,   4.633,   0.000,   3.506,   1.454,   7.033,
0.000,   2.069,   6.024,  21.695,   0.000,  16.799,   1.454,   8.404,   0.000,
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0.779,   0.000,   0.726,

Pollutant Name: Carbon Dioxide,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O

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BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
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0.000, 120.482, 428.299, 386.318,   0.000, 348.833, 428.299, 386.318,   0.000,
246.265, 428.299, 386.319,   0.000,  27.959,  86.131,  72.304,   0.000,  81.107,
428.299, 386.319,   0.000,  78.762, 428.299, 386.319,   0.000, 365.847, 206.317,
204.562,   0.000, 191.522,
```

600, 281.045, 186.807, 0.000, 186.817, 281.731, 232.180, 0.000, 229.112, 282.030, 232.066, 0.000, 231.615, 340.223, 317.972, 0.000, 316.705, 428.633, 398.788, 0.000, 362.540, 428.633, 402.820, 0.000, 306.792, 428.633, 406.430, 0.000, 126.324, 428.633, 406.430, 0.000, 363.592, 428.633, 406.430, 0.000, 258.927, 428.633, 406.430, 0.000, 28.916, 86.198, 76.068, 0.000, 82.517, 428.633, 406.430, 0.000, 82.800, 428.633, 406.430, 0.000, 382.896, 206.479, 217.620, 0.000, 203.586,
660, 281.265, 197.957, 0.000, 197.882, 281.951, 245.885, 0.000, 242.543, 282.251, 246.136, 0.000, 245.624, 340.489, 336.944, 0.000, 335.562, 428.968, 420.413, 0.000, 382.130, 428.968, 422.580, 0.000, 321.724, 428.968, 424.519, 0.000, 131.579, 428.968, 424.519, 0.000, 376.873, 428.968, 424.519, 0.000, 270.316, 428.968, 424.519, 0.000, 29.778, 86.265, 79.454, 0.000, 83.790, 428.968, 424.519, 0.000, 86.432, 428.968, 424.519, 0.000, 398.234, 206.640, 230.343, 0.000, 215.342,
720, 281.484, 208.876, 0.000, 208.719, 282.171, 259.266, 0.000, 255.656, 282.471, 259.973, 0.000, 259.401, 340.755, 355.521, 0.000, 354.027, 429.303, 441.009, 0.000, 400.787, 429.303, 440.786, 0.000, 335.482, 429.303, 440.585, 0.000, 136.248, 429.303, 440.585, 0.000, 388.674, 429.303, 440.585, 0.000, 280.431, 429.303, 440.585, 0.000, 30.545, 86.333, 82.461, 0.000, 84.926, 429.303, 440.586, 0.000, 89.658, 429.303, 440.586, 0.000, 411.860, 206.801, 242.732, 0.000, 226.788,

Pollutant Name: Sulfur Dioxide,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

5, 0.002, 0.000, 0.000, 0.000, 0.002, 0.000, 0.000, 0.000, 0.002, 0.000, 0.000, 0.000, 0.002, 0.000, 0.000, 0.000, 0.003, 0.000, 0.000, 0.000, 0.003, 0.000, 0.000, 0.000, 0.003, 0.000, 0.000, 0.000, 0.006, 0.001, 0.000, 0.001, 0.003, 0.000, 0.000, 0.000, 0.003, 0.001, 0.000, 0.000, 0.000, 0.000, 0.196, 0.000, 0.003, 0.000, 0.000, 0.000, 0.003, 0.000, 0.000, 0.001, 0.001, 0.000, 0.000, 0.000,
10, 0.002, 0.000, 0.000, 0.000, 0.002, 0.000, 0.000, 0.000, 0.002, 0.000, 0.000, 0.000, 0.002, 0.000, 0.000, 0.000, 0.003, 0.000, 0.000, 0.000, 0.003, 0.000, 0.000, 0.000, 0.003, 0.001, 0.000, 0.000, 0.006, 0.001, 0.000, 0.002, 0.003, 0.001, 0.000, 0.000, 0.003, 0.001, 0.000, 0.000, 0.001, 0.000, 0.196, 0.000, 0.003, 0.000, 0.000, 0.000, 0.003, 0.001, 0.000, 0.001, 0.001, 0.000, 0.000, 0.000,
20, 0.002, 0.000, 0.000, 0.000, 0.002, 0.000, 0.000, 0.000, 0.002, 0.000, 0.000, 0.000, 0.002, 0.000, 0.000, 0.000, 0.003, 0.001, 0.000, 0.000, 0.003, 0.001, 0.000, 0.001, 0.003, 0.001, 0.000, 0.000, 0.005, 0.002, 0.000, 0.003, 0.003, 0.001, 0.000, 0.001, 0.003, 0.002, 0.000, 0.000, 0.001, 0.000, 0.196, 0.000, 0.003, 0.001, 0.000, 0.000, 0.003, 0.001, 0.000, 0.001, 0.001, 0.000, 0.000, 0.000,

```
   30,  0.002,  0.000,  0.000,  0.000,  0.002,  0.000,  0.000,  0.000,
0.002,  0.000,  0.000,  0.000,  0.002,  0.000,  0.000,  0.000,  0.003,
0.001,  0.000,  0.001,  0.003,  0.001,  0.000,  0.001,  0.003,  0.002,
0.000,  0.001,  0.005,  0.003,  0.000,  0.003,  0.003,  0.002,  0.000,
0.001,  0.003,  0.003,  0.000,  0.000,  0.001,  0.000,  0.196,  0.001,
0.003,  0.001,  0.000,  0.000,  0.003,  0.002,  0.000,  0.002,  0.001,
0.000,  0.000,  0.000,
   40,  0.002,  0.000,  0.000,  0.000,  0.002,  0.000,  0.000,  0.000,
0.002,  0.000,  0.000,  0.000,  0.002,  0.001,  0.000,  0.001,  0.003,
0.001,  0.000,  0.001,  0.003,  0.001,  0.000,  0.001,  0.003,  0.002,
0.000,  0.001,  0.005,  0.004,  0.000,  0.004,  0.003,  0.002,  0.000,
0.001,  0.003,  0.004,  0.000,  0.000,  0.001,  0.000,  0.196,  0.001,
0.003,  0.001,  0.000,  0.000,  0.003,  0.003,  0.000,  0.002,  0.002,
0.000,  0.000,  0.000,
   50,  0.002,  0.000,  0.000,  0.000,  0.002,  0.001,  0.000,  0.001,
0.002,  0.001,  0.000,  0.001,  0.003,  0.001,  0.000,  0.001,  0.003,
0.001,  0.000,  0.001,  0.003,  0.002,  0.000,  0.001,  0.004,  0.003,
0.000,  0.001,  0.005,  0.005,  0.000,  0.005,  0.004,  0.002,  0.000,
0.002,  0.004,  0.004,  0.000,  0.000,  0.001,  0.001,  0.196,  0.001,
0.004,  0.002,  0.000,  0.000,  0.004,  0.003,  0.000,  0.003,  0.002,
0.001,  0.000,  0.001,
   60,  0.002,  0.001,  0.000,  0.001,  0.002,  0.001,  0.000,  0.001,
0.002,  0.001,  0.000,  0.001,  0.003,  0.001,  0.000,  0.001,  0.003,
0.001,  0.000,  0.001,  0.003,  0.002,  0.000,  0.001,  0.004,  0.003,
0.000,  0.001,  0.005,  0.006,  0.000,  0.005,  0.004,  0.003,  0.000,
0.002,  0.004,  0.005,  0.000,  0.000,  0.001,  0.001,  0.196,  0.001,
0.004,  0.002,  0.000,  0.000,  0.004,  0.004,  0.000,  0.003,  0.002,
0.001,  0.000,  0.001,
  120,  0.003,  0.001,  0.000,  0.001,  0.003,  0.001,  0.000,  0.001,
0.003,  0.001,  0.000,  0.001,  0.004,  0.002,  0.000,  0.002,  0.005,
0.002,  0.000,  0.002,  0.005,  0.002,  0.000,  0.002,  0.005,  0.003,
0.000,  0.001,  0.008,  0.005,  0.000,  0.005,  0.005,  0.003,  0.000,
0.002,  0.005,  0.004,  0.000,  0.000,  0.001,  0.001,  0.196,  0.001,
0.005,  0.003,  0.000,  0.001,  0.005,  0.003,  0.000,  0.003,  0.002,
0.001,  0.000,  0.001,
  180,  0.003,  0.001,  0.000,  0.001,  0.003,  0.001,  0.000,  0.001,
0.003,  0.001,  0.000,  0.001,  0.004,  0.002,  0.000,  0.002,  0.005,
0.002,  0.000,  0.002,  0.005,  0.003,  0.000,  0.002,  0.006,  0.004,
0.000,  0.001,  0.010,  0.006,  0.000,  0.006,  0.006,  0.004,  0.000,
0.002,  0.006,  0.005,  0.000,  0.000,  0.001,  0.001,  0.196,  0.001,
0.006,  0.003,  0.000,  0.001,  0.006,  0.004,  0.000,  0.004,  0.003,
0.001,  0.000,  0.001,
  240,  0.003,  0.001,  0.000,  0.001,  0.003,  0.002,  0.000,  0.002,
0.003,  0.002,  0.000,  0.002,  0.004,  0.002,  0.000,  0.002,  0.005,
0.003,  0.000,  0.003,  0.005,  0.003,  0.000,  0.002,  0.006,  0.004,
0.000,  0.001,  0.011,  0.006,  0.000,  0.006,  0.006,  0.004,  0.000,
0.003,  0.006,  0.005,  0.000,  0.000,  0.001,  0.001,  0.196,  0.001,
0.006,  0.003,  0.000,  0.001,  0.006,  0.004,  0.000,  0.004,  0.003,
0.001,  0.000,  0.001,
  300,  0.004,  0.001,  0.000,  0.001,  0.004,  0.002,  0.000,  0.002,
0.004,  0.002,  0.000,  0.002,  0.005,  0.002,  0.000,  0.002,  0.006,
0.003,  0.000,  0.003,  0.006,  0.003,  0.000,  0.003,  0.006,  0.004,
0.000,  0.001,  0.013,  0.007,  0.000,  0.007,  0.006,  0.004,  0.000,
0.003,  0.007,  0.005,  0.000,  0.000,  0.001,  0.001,  0.196,  0.001,
0.006,  0.004,  0.000,  0.001,  0.006,  0.004,  0.000,  0.004,  0.003,
0.002,  0.000,  0.002,
```

360, 0.004, 0.001, 0.000, 0.001, 0.004, 0.002, 0.000, 0.002,
0.004, 0.002, 0.000, 0.002, 0.005, 0.003, 0.000, 0.002, 0.006,
0.003, 0.000, 0.003, 0.006, 0.004, 0.000, 0.003, 0.007, 0.005,
0.000, 0.001, 0.014, 0.007, 0.000, 0.007, 0.007, 0.005, 0.000,
0.003, 0.007, 0.006, 0.000, 0.000, 0.001, 0.001, 0.196, 0.001,
0.007, 0.004, 0.000, 0.001, 0.007, 0.005, 0.000, 0.004, 0.003,
0.002, 0.000, 0.002,
420, 0.004, 0.002, 0.000, 0.002, 0.004, 0.002, 0.000, 0.002,
0.004, 0.002, 0.000, 0.002, 0.005, 0.003, 0.000, 0.003, 0.006,
0.004, 0.000, 0.003, 0.006, 0.004, 0.000, 0.003, 0.007, 0.005,
0.000, 0.002, 0.015, 0.007, 0.000, 0.008, 0.007, 0.005, 0.000,
0.003, 0.007, 0.006, 0.000, 0.000, 0.001, 0.001, 0.196, 0.001,
0.007, 0.004, 0.000, 0.001, 0.007, 0.005, 0.000, 0.005, 0.003,
0.002, 0.000, 0.002,
480, 0.004, 0.002, 0.000, 0.002, 0.004, 0.002, 0.000, 0.002,
0.004, 0.002, 0.000, 0.002, 0.005, 0.003, 0.000, 0.003, 0.006,
0.004, 0.000, 0.003, 0.006, 0.004, 0.000, 0.003, 0.007, 0.005,
0.000, 0.002, 0.016, 0.008, 0.000, 0.008, 0.007, 0.005, 0.000,
0.003, 0.008, 0.006, 0.000, 0.000, 0.001, 0.001, 0.196, 0.001,
0.007, 0.004, 0.000, 0.001, 0.007, 0.005, 0.000, 0.005, 0.003,
0.002, 0.000, 0.002,
540, 0.004, 0.002, 0.000, 0.002, 0.004, 0.002, 0.000, 0.002,
0.004, 0.002, 0.000, 0.002, 0.005, 0.003, 0.000, 0.003, 0.006,
0.004, 0.000, 0.004, 0.006, 0.004, 0.000, 0.003, 0.007, 0.005,
0.000, 0.002, 0.017, 0.008, 0.000, 0.008, 0.007, 0.005, 0.000,
0.003, 0.008, 0.007, 0.000, 0.000, 0.001, 0.001, 0.196, 0.001,
0.007, 0.005, 0.000, 0.001, 0.007, 0.005, 0.000, 0.005, 0.003,
0.002, 0.000, 0.002,
600, 0.004, 0.002, 0.000, 0.002, 0.004, 0.002, 0.000, 0.002,
0.004, 0.002, 0.000, 0.002, 0.005, 0.003, 0.000, 0.003, 0.006,
0.004, 0.000, 0.004, 0.006, 0.005, 0.000, 0.004, 0.008, 0.006,
0.000, 0.002, 0.017, 0.008, 0.000, 0.009, 0.008, 0.006, 0.000,
0.004, 0.008, 0.007, 0.000, 0.001, 0.001, 0.001, 0.196, 0.001,
0.008, 0.005, 0.000, 0.001, 0.008, 0.006, 0.000, 0.005, 0.004,
0.002, 0.000, 0.002,
660, 0.004, 0.002, 0.000, 0.002, 0.004, 0.003, 0.000, 0.003,
0.004, 0.003, 0.000, 0.003, 0.006, 0.003, 0.000, 0.003, 0.007,
0.005, 0.000, 0.004, 0.007, 0.005, 0.000, 0.004, 0.008, 0.006,
0.000, 0.002, 0.017, 0.009, 0.000, 0.009, 0.008, 0.006, 0.000,
0.004, 0.008, 0.007, 0.000, 0.001, 0.001, 0.001, 0.196, 0.001,
0.008, 0.005, 0.000, 0.001, 0.008, 0.006, 0.000, 0.006, 0.004,
0.002, 0.000, 0.002,
720, 0.004, 0.002, 0.000, 0.002, 0.004, 0.003, 0.000, 0.003,
0.004, 0.003, 0.000, 0.003, 0.006, 0.004, 0.000, 0.004, 0.007,
0.005, 0.000, 0.004, 0.007, 0.005, 0.000, 0.004, 0.008, 0.006,
0.000, 0.002, 0.018, 0.009, 0.000, 0.009, 0.008, 0.006, 0.000,
0.004, 0.008, 0.007, 0.000, 0.001, 0.001, 0.001, 0.196, 0.001,
0.008, 0.005, 0.000, 0.001, 0.008, 0.006, 0.000, 0.006, 0.004,
0.003, 0.000, 0.002,

Pollutant Name: PM10,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O
BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
,ALL,ALL,ALL,

```
min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    5,   0.011,   0.001,   0.000,   0.001,   0.011,   0.001,   0.000,   0.001,
0.011,   0.001,   0.000,   0.001,   0.012,   0.001,   0.000,   0.001,   0.011,
0.001,   0.000,   0.001,   0.011,   0.001,   0.000,   0.001,   0.011,   0.001,
0.000,   0.001,   0.011,   0.002,   0.000,   0.003,   0.011,   0.002,   0.000,
0.001,   0.011,   0.002,   0.000,   0.000,   0.020,   0.000,   0.000,   0.013,
0.011,   0.001,   0.000,   0.000,   0.011,   0.000,   0.000,   0.001,   0.016,
0.001,   0.000,   0.001,
   10,   0.010,   0.001,   0.000,   0.001,   0.010,   0.001,   0.000,   0.001,
0.010,   0.002,   0.000,   0.002,   0.010,   0.003,   0.000,   0.003,   0.010,
0.002,   0.000,   0.001,   0.010,   0.002,   0.000,   0.002,   0.010,   0.003,
0.000,   0.001,   0.010,   0.004,   0.000,   0.004,   0.010,   0.003,   0.000,
0.002,   0.010,   0.003,   0.000,   0.000,   0.017,   0.000,   0.000,   0.011,
0.010,   0.002,   0.000,   0.000,   0.010,   0.001,   0.000,   0.002,   0.014,
0.001,   0.000,   0.002,
   20,   0.008,   0.002,   0.000,   0.002,   0.008,   0.003,   0.000,   0.003,
0.008,   0.004,   0.000,   0.004,   0.008,   0.006,   0.000,   0.006,   0.008,
0.003,   0.000,   0.003,   0.008,   0.005,   0.000,   0.004,   0.008,   0.005,
0.000,   0.002,   0.008,   0.007,   0.000,   0.006,   0.008,   0.006,   0.000,
0.004,   0.008,   0.007,   0.000,   0.000,   0.013,   0.001,   0.000,   0.009,
0.008,   0.003,   0.000,   0.001,   0.008,   0.001,   0.000,   0.002,   0.011,
0.003,   0.000,   0.003,
   30,   0.006,   0.003,   0.000,   0.003,   0.006,   0.004,   0.000,   0.004,
0.006,   0.007,   0.000,   0.006,   0.006,   0.008,   0.000,   0.008,   0.006,
0.004,   0.000,   0.004,   0.006,   0.007,   0.000,   0.005,   0.006,   0.007,
0.000,   0.002,   0.006,   0.010,   0.000,   0.008,   0.006,   0.008,   0.000,
0.005,   0.006,   0.009,   0.000,   0.001,   0.010,   0.001,   0.000,   0.007,
0.006,   0.004,   0.000,   0.001,   0.006,   0.002,   0.000,   0.002,   0.008,
0.004,   0.000,   0.004,
   40,   0.004,   0.004,   0.000,   0.004,   0.004,   0.005,   0.000,   0.005,
0.004,   0.008,   0.000,   0.008,   0.004,   0.010,   0.000,   0.010,   0.004,
0.006,   0.000,   0.005,   0.004,   0.009,   0.000,   0.007,   0.004,   0.009,
0.000,   0.003,   0.004,   0.012,   0.000,   0.010,   0.004,   0.010,   0.000,
0.007,   0.004,   0.012,   0.000,   0.001,   0.008,   0.001,   0.000,   0.005,
0.004,   0.005,   0.000,   0.001,   0.004,   0.003,   0.000,   0.003,   0.006,
0.005,   0.000,   0.005,
   50,   0.003,   0.005,   0.000,   0.005,   0.003,   0.006,   0.000,   0.006,
0.003,   0.010,   0.000,   0.010,   0.003,   0.013,   0.000,   0.013,   0.003,
0.007,   0.000,   0.006,   0.003,   0.010,   0.000,   0.008,   0.003,   0.011,
0.000,   0.003,   0.003,   0.015,   0.000,   0.011,   0.003,   0.012,   0.000,
0.008,   0.003,   0.014,   0.000,   0.001,   0.006,   0.002,   0.000,   0.004,
0.003,   0.006,   0.000,   0.001,   0.003,   0.003,   0.000,   0.003,   0.005,
0.006,   0.000,   0.006,
   60,   0.003,   0.005,   0.000,   0.005,   0.003,   0.007,   0.000,   0.007,
0.003,   0.012,   0.000,   0.012,   0.003,   0.015,   0.000,   0.015,   0.003,
0.008,   0.000,   0.007,   0.003,   0.012,   0.000,   0.009,   0.003,   0.012,
0.000,   0.004,   0.003,   0.017,   0.000,   0.013,   0.003,   0.014,   0.000,
0.009,   0.003,   0.016,   0.000,   0.001,   0.005,   0.002,   0.000,   0.004,
0.003,   0.007,   0.000,   0.001,   0.003,   0.004,   0.000,   0.003,   0.004,
0.007,   0.000,   0.007,
  120,   0.007,   0.008,   0.000,   0.008,   0.007,   0.010,   0.000,   0.010,
0.007,   0.018,   0.000,   0.018,   0.007,   0.022,   0.000,   0.022,   0.007,
```

```
0.011,   0.000,   0.010,   0.007,   0.016,   0.000,   0.012,   0.007,   0.017,
0.000,   0.005,   0.007,   0.023,   0.000,   0.018,   0.007,   0.019,   0.000,
0.012,   0.007,   0.022,   0.000,   0.001,   0.013,   0.002,   0.000,   0.009,
0.007,   0.010,   0.000,   0.002,   0.007,   0.005,   0.000,   0.005,   0.010,
0.011,   0.000,   0.010,
  180,   0.011,   0.009,   0.000,   0.009,   0.011,   0.011,   0.000,   0.010,
0.012,   0.019,   0.000,   0.019,   0.012,   0.024,   0.000,   0.024,   0.011,
0.011,   0.000,   0.010,   0.011,   0.017,   0.000,   0.013,   0.011,   0.017,
0.000,   0.005,   0.011,   0.024,   0.000,   0.019,   0.011,   0.020,   0.000,
0.013,   0.011,   0.023,   0.000,   0.001,   0.020,   0.002,   0.000,   0.014,
0.011,   0.010,   0.000,   0.002,   0.011,   0.005,   0.000,   0.005,   0.016,
0.012,   0.000,   0.011,
  240,   0.015,   0.009,   0.000,   0.009,   0.015,   0.011,   0.000,   0.011,
0.015,   0.020,   0.000,   0.020,   0.015,   0.025,   0.000,   0.025,   0.015,
0.012,   0.000,   0.011,   0.015,   0.018,   0.000,   0.013,   0.015,   0.018,
0.000,   0.005,   0.015,   0.025,   0.000,   0.020,   0.015,   0.021,   0.000,
0.013,   0.015,   0.024,   0.000,   0.001,   0.026,   0.002,   0.000,   0.018,
0.015,   0.011,   0.000,   0.002,   0.015,   0.005,   0.000,   0.006,   0.021,
0.012,   0.000,   0.012,
  300,   0.018,   0.010,   0.000,   0.010,   0.018,   0.012,   0.000,   0.012,
0.019,   0.022,   0.000,   0.021,   0.019,   0.027,   0.000,   0.026,   0.018,
0.012,   0.000,   0.011,   0.018,   0.018,   0.000,   0.014,   0.018,   0.018,
0.000,   0.006,   0.018,   0.025,   0.000,   0.021,   0.018,   0.021,   0.000,
0.013,   0.018,   0.024,   0.000,   0.002,   0.032,   0.003,   0.000,   0.021,
0.018,   0.011,   0.000,   0.002,   0.018,   0.005,   0.000,   0.006,   0.025,
0.013,   0.000,   0.012,
  360,   0.021,   0.010,   0.000,   0.010,   0.021,   0.012,   0.000,   0.012,
0.021,   0.023,   0.000,   0.022,   0.022,   0.028,   0.000,   0.028,   0.021,
0.013,   0.000,   0.012,   0.021,   0.019,   0.000,   0.014,   0.021,   0.019,
0.000,   0.006,   0.021,   0.026,   0.000,   0.022,   0.021,   0.022,   0.000,
0.014,   0.021,   0.025,   0.000,   0.002,   0.037,   0.003,   0.000,   0.025,
0.021,   0.011,   0.000,   0.002,   0.021,   0.006,   0.000,   0.007,   0.029,
0.014,   0.000,   0.013,
  420,   0.023,   0.011,   0.000,   0.011,   0.023,   0.013,   0.000,   0.013,
0.024,   0.023,   0.000,   0.023,   0.024,   0.029,   0.000,   0.029,   0.023,
0.013,   0.000,   0.012,   0.023,   0.019,   0.000,   0.015,   0.023,   0.019,
0.000,   0.006,   0.023,   0.027,   0.000,   0.023,   0.023,   0.022,   0.000,
0.014,   0.023,   0.026,   0.000,   0.002,   0.041,   0.003,   0.000,   0.027,
0.023,   0.012,   0.000,   0.002,   0.023,   0.006,   0.000,   0.007,   0.033,
0.014,   0.000,   0.014,
  480,   0.025,   0.011,   0.000,   0.011,   0.025,   0.013,   0.000,   0.013,
0.026,   0.024,   0.000,   0.024,   0.026,   0.030,   0.000,   0.030,   0.025,
0.013,   0.000,   0.012,   0.025,   0.020,   0.000,   0.015,   0.025,   0.020,
0.000,   0.006,   0.025,   0.028,   0.000,   0.024,   0.025,   0.023,   0.000,
0.015,   0.025,   0.026,   0.000,   0.002,   0.045,   0.003,   0.000,   0.029,
0.025,   0.012,   0.000,   0.002,   0.025,   0.006,   0.000,   0.007,   0.035,
0.015,   0.000,   0.014,
  540,   0.027,   0.011,   0.000,   0.011,   0.026,   0.014,   0.000,   0.014,
0.027,   0.025,   0.000,   0.025,   0.028,   0.031,   0.000,   0.031,   0.027,
0.014,   0.000,   0.013,   0.027,   0.020,   0.000,   0.016,   0.027,   0.021,
0.000,   0.007,   0.027,   0.028,   0.000,   0.025,   0.027,   0.024,   0.000,
0.015,   0.027,   0.027,   0.000,   0.002,   0.047,   0.003,   0.000,   0.031,
0.027,   0.012,   0.000,   0.003,   0.027,   0.006,   0.000,   0.008,   0.037,
0.015,   0.000,   0.014,
  600,   0.028,   0.012,   0.000,   0.012,   0.027,   0.014,   0.000,   0.014,
0.029,   0.025,   0.000,   0.025,   0.029,   0.031,   0.000,   0.031,   0.028,
0.014,   0.000,   0.013,   0.028,   0.021,   0.000,   0.016,   0.028,   0.021,
```

0.000,   0.007,   0.028,   0.029,   0.000,   0.026,   0.028,   0.025,   0.000,
0.016,   0.028,   0.028,   0.000,   0.002,   0.049,   0.003,   0.000,   0.032,
0.028,   0.013,   0.000,   0.003,   0.028,   0.006,   0.000,   0.008,   0.039,
0.015,   0.000,   0.015,
  660,   0.029,   0.012,   0.000,   0.012,   0.028,   0.014,   0.000,   0.014,
0.029,   0.026,   0.000,   0.026,   0.029,   0.032,   0.000,   0.032,   0.029,
0.015,   0.000,   0.013,   0.029,   0.022,   0.000,   0.016,   0.029,   0.022,
0.000,   0.007,   0.029,   0.030,   0.000,   0.026,   0.029,   0.025,   0.000,
0.016,   0.029,   0.029,   0.000,   0.002,   0.050,   0.003,   0.000,   0.033,
0.029,   0.013,   0.000,   0.003,   0.029,   0.006,   0.000,   0.008,   0.040,
0.016,   0.000,   0.015,
  720,   0.029,   0.012,   0.000,   0.012,   0.028,   0.014,   0.000,   0.014,
0.029,   0.026,   0.000,   0.026,   0.030,   0.032,   0.000,   0.032,   0.029,
0.015,   0.000,   0.014,   0.029,   0.022,   0.000,   0.017,   0.029,   0.022,
0.000,   0.007,   0.029,   0.031,   0.000,   0.027,   0.029,   0.026,   0.000,
0.017,   0.029,   0.030,   0.000,   0.002,   0.051,   0.003,   0.000,   0.033,
0.029,   0.013,   0.000,   0.003,   0.029,   0.007,   0.000,   0.008,   0.040,
0.016,   0.000,   0.015,

Title   : SF 2011 and 2020_EMFAC
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season   : Annual
Area   : San Francisco
****
****
Year:,2011,, -- Model Years,,1967, to ,2011, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,, San Francisco,,,,,,County Average

,,,,Table 4: Hot Soak Emissions (grams/trip)

Pollutant Name: Total Organic Gases,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O
BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    5,   0.821,   0.053,   0.000,   0.057,   0.834,   0.063,   0.000,   0.067,
0.827,   0.046,   0.000,   0.048,   0.403,   0.041,   0.000,   0.042,   0.356,
0.020,   0.000,   0.020,   0.356,   0.044,   0.000,   0.035,   0.205,   0.017,
0.000,   0.009,   0.205,   0.019,   0.000,   0.046,   0.205,   0.012,   0.000,
0.009,   0.857,   0.343,   0.000,   0.036,   0.110,   0.155,   0.000,   0.126,

0.202,   0.009,   0.000,   0.002,   0.204,   0.082,   0.000,   0.088,   0.353,
0.051,   0.000,   0.052,
   10,   1.513,   0.098,   0.000,   0.105,   1.536,   0.117,   0.000,   0.123,
1.523,   0.086,   0.000,   0.088,   0.743,   0.076,   0.000,   0.077,   0.657,
0.038,   0.000,   0.036,   0.656,   0.081,   0.000,   0.065,   0.378,   0.032,
0.000,   0.017,   0.378,   0.035,   0.000,   0.084,   0.378,   0.023,   0.000,
0.017,   1.578,   0.633,   0.000,   0.066,   0.202,   0.288,   0.000,   0.233,
0.373,   0.017,   0.000,   0.004,   0.376,   0.151,   0.000,   0.162,   0.650,
0.095,   0.000,   0.096,
   20,   2.568,   0.168,   0.000,   0.179,   2.607,   0.200,   0.000,   0.210,
2.585,   0.146,   0.000,   0.151,   1.261,   0.130,   0.000,   0.131,   1.114,
0.065,   0.000,   0.062,   1.114,   0.139,   0.000,   0.112,   0.641,   0.056,
0.000,   0.029,   0.642,   0.062,   0.000,   0.144,   0.642,   0.039,   0.000,
0.029,   2.678,   1.079,   0.000,   0.112,   0.344,   0.497,   0.000,   0.400,
0.632,   0.029,   0.000,   0.008,   0.638,   0.257,   0.000,   0.275,   1.103,
0.162,   0.000,   0.163,
   30,   3.280,   0.215,   0.000,   0.230,   3.328,   0.256,   0.000,   0.270,
3.301,   0.188,   0.000,   0.194,   1.610,   0.167,   0.000,   0.169,   1.422,
0.084,   0.000,   0.081,   1.422,   0.180,   0.000,   0.144,   0.818,   0.074,
0.000,   0.038,   0.820,   0.081,   0.000,   0.186,   0.819,   0.050,   0.000,
0.038,   3.419,   1.385,   0.000,   0.143,   0.440,   0.647,   0.000,   0.516,
0.807,   0.037,   0.000,   0.010,   0.814,   0.329,   0.000,   0.353,   1.409,
0.208,   0.000,   0.210,
   40,   3.539,   0.233,   0.000,   0.249,   3.590,   0.278,   0.000,   0.292,
3.560,   0.204,   0.000,   0.210,   1.737,   0.181,   0.000,   0.183,   1.534,
0.092,   0.000,   0.088,   1.534,   0.196,   0.000,   0.157,   0.883,   0.082,
0.000,   0.041,   0.884,   0.089,   0.000,   0.202,   0.884,   0.055,   0.000,
0.041,   3.688,   1.498,   0.000,   0.154,   0.476,   0.706,   0.000,   0.559,
0.871,   0.040,   0.000,   0.011,   0.878,   0.356,   0.000,   0.381,   1.520,
0.225,   0.000,   0.227,

Hot soak results are scaled to reflect zero emissions for trip lengths of less than 5 minutes (about 25% of in-use trips).

Title   : SF 2011 and 2020_EMFAC
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season   : Annual
Area   : San Francisco
****
****
Year:,2011,, -- Model Years,,1967, to ,2011, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,, San Francisco,,,,,,County Average

,,,,Table 5a: Partial Day Diurnal Loss Emissions (grams/hour)

Pollutant Name: Total Organic Gases,,,,Temperature: ALL,,Relative Humidity: ALL

Temp,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,
degF,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

57, 0.255, 0.037, 0.000, 0.039, 0.253, 0.045, 0.000, 0.046,
0.256, 0.033, 0.000, 0.034, 0.131, 0.030, 0.000, 0.030, 0.014,
0.002, 0.000, 0.001, 0.014, 0.004, 0.000, 0.002, 0.013, 0.004,
0.000, 0.001, 0.012, 0.003, 0.000, 0.002, 0.013, 0.002, 0.000,
0.001, 0.011, 0.006, 0.000, 0.001, 0.038, 0.143, 0.000, 0.076,
0.017, 0.001, 0.000, 0.000, 0.014, 0.009, 0.000, 0.009, 0.087,
0.038, 0.000, 0.039,

Title : SF 2011 and 2020_EMFAC
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season : Annual
Area : San Francisco
****
Year:,2011,, -- Model Years,,1967, to ,2011, Inclusive --,,,Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,, San Francisco,,,,,,County Average

,,,,Table 5b: Multi-Day Diurnal Loss Emissions (grams/hour)

Pollutant Name: Total Organic Gases,,,,Temperature: ALL,,Relative Humidity: ALL

Temp,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,
degF,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

57, 0.015, 0.003, 0.000, 0.003, 0.015, 0.004, 0.000, 0.004,
0.015, 0.003, 0.000, 0.003, 0.008, 0.002, 0.000, 0.002, 0.000,
0.000, 0.000, 0.000, 0.001, 0.000, 0.000, 0.000, 0.001, 0.000,
0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.001, 0.000, 0.000,
0.000, 0.003, 0.002, 0.000, 0.000, 0.002, 0.014, 0.000, 0.006,
0.001, 0.000, 0.000, 0.000, 0.001, 0.000, 0.000, 0.000, 0.005,
0.003, 0.000, 0.003,

```
Title    : SF 2011 and 2020_EMFAC
Version  : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season   : Annual
Area     : San Francisco
********************************************************************************
*********
Year:,2011,, -- Model Years,,1967, to ,2011, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,,  San Francisco,,,,,,County Average

,,,,Table 6a:  Partial Day Resting Loss Emissions (grams/hour)

Pollutant Name: Total Organic Gases,,,,Temperature: ALL,,Relative Humidity: ALL

Temp,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O
BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
,ALL,ALL,ALL,
degF,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CA
T,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NC
AT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,A
LL,

   57,   0.159,   0.020,   0.000,   0.021,   0.159,   0.024,   0.000,   0.025,
0.162,   0.018,   0.000,   0.019,   0.084,   0.017,   0.000,   0.017,   0.009,
0.001,   0.000,   0.001,   0.010,   0.002,   0.000,   0.001,   0.009,   0.002,
0.000,   0.001,   0.008,   0.002,   0.000,   0.001,   0.009,   0.001,   0.000,
0.001,   0.007,   0.004,   0.000,   0.000,   0.022,   0.059,   0.000,   0.036,
0.012,   0.001,   0.000,   0.000,   0.010,   0.006,   0.000,   0.006,   0.054,
0.020,   0.000,   0.021,
```


```
Title    : SF 2011 and 2020_EMFAC
Version  : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season   : Annual
Area     : San Francisco
********************************************************************************
*********
Year:,2011,, -- Model Years,,1967, to ,2011, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,,  San Francisco,,,,,,County Average
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,,,,Table 6b:  Multi-Day Resting Loss Emissions (grams/hour)
```

Pollutant Name: Total Organic Gases,,,,Temperature: ALL,,Relative Humidity: ALL

Temp,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,
degF,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

```
   57,   0.010,   0.002,   0.000,   0.002,   0.010,   0.002,   0.000,   0.002,
0.010,   0.001,   0.000,   0.001,   0.005,   0.001,   0.000,   0.001,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.002,   0.001,   0.000,   0.000,   0.001,   0.006,   0.000,   0.003,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.003,
0.002,   0.000,   0.002,
```

Title   : SF 2011 and 2020_EMFAC
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season   : Annual
Area   : San Francisco
****
Year:,2011,, -- Model Years,,1967, to ,2011, Inclusive --,,,Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,, San Francisco,,,,,,County Average

,,,,Table 7: Estimated Travel Fractions

Pollutant Name: ,,,,Temperature: ALL,,Relative Humidity: ALL

,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,
,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

```
%VMT,   0.002,   0.606,   0.001,   0.610,   0.001,   0.109,   0.001,   0.111,
0.000,   0.161,   0.000,   0.162,   0.000,   0.053,   0.000,   0.053,   0.000,
0.004,   0.001,   0.006,   0.000,   0.003,   0.002,   0.005,   0.000,   0.004,
0.023,   0.028,   0.000,   0.001,   0.002,   0.003,   0.000,   0.001,   0.001,
0.002,   0.000,   0.000,   0.010,   0.010,   0.005,   0.004,   0.000,   0.009,
0.000,   0.000,   0.001,   0.001,   0.000,   0.001,   0.000,   0.001,   0.009,
0.947,   0.044,   1.000,
```

```
%TRIP,   0.003,   0.575,   0.001,   0.580,   0.001,   0.101,   0.001,   0.103,
0.000,   0.146,   0.000,   0.147,   0.000,   0.042,   0.000,   0.042,   0.000,
0.017,   0.002,   0.019,   0.000,   0.012,   0.004,   0.016,   0.001,   0.021,
0.051,   0.073,   0.000,   0.002,   0.000,   0.003,   0.000,   0.004,   0.002,
0.006,   0.000,   0.000,   0.001,   0.002,   0.006,   0.004,   0.000,   0.010,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.012,
0.924,   0.064,   1.000,
%VEH,   0.005,   0.616,   0.002,   0.623,   0.001,   0.108,   0.002,   0.111,
0.000,   0.156,   0.000,   0.157,   0.000,   0.045,   0.000,   0.045,   0.000,
0.003,   0.001,   0.004,   0.000,   0.002,   0.002,   0.005,   0.000,   0.003,
0.012,   0.015,   0.000,   0.000,   0.000,   0.001,   0.000,   0.001,   0.001,
0.001,   0.000,   0.000,   0.002,   0.003,   0.021,   0.012,   0.000,   0.034,
0.000,   0.000,   0.001,   0.001,   0.000,   0.001,   0.000,   0.002,   0.029,
0.948,   0.023,   1.000,
```

```
Title    : SF 2011 and 2020_EMFAC
Version  : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2011 -- All model years in the range 1967 to 2011 selected
Season   : Annual
Area     : San Francisco
********************************************************************************
*********
Year:,2011,, -- Model Years,,1967, to ,2011, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,,  San Francisco,,,,,,County Average

,,,,Table  8:  Evaporative Running Loss Emissions (grams/minute)

Pollutant Name: Total Organic Gases,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O
BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    1,   1.501,   0.014,   0.000,   0.020,   1.596,   0.581,   0.000,   0.579,
1.544,   0.398,   0.000,   0.399,   0.812,   0.302,   0.000,   0.301,   1.710,
0.387,   0.000,   0.305,   1.621,   1.096,   0.000,   0.598,   1.646,   0.374,
0.000,   0.060,   2.595,   0.566,   0.000,   0.147,   1.897,   0.302,   0.000,
0.139,   3.705,   5.276,   0.000,   0.333,   0.152,   0.003,   0.000,   0.086,
1.952,   0.204,   0.000,   0.047,   1.315,   3.763,   0.000,   3.321,   0.794,
0.172,   0.000,   0.170,
    2,   1.393,   0.018,   0.000,   0.023,   1.155,   0.298,   0.000,   0.298,
1.102,   0.204,   0.000,   0.206,   0.524,   0.155,   0.000,   0.156,   1.137,
0.205,   0.000,   0.162,   1.090,   0.576,   0.000,   0.315,   1.111,   0.213,
```

```
0.000,   0.035,   1.726,   0.309,   0.000,   0.083,   1.179,   0.159,   0.000,
0.074,   2.117,   2.772,   0.000,   0.179,   0.154,   0.085,   0.000,   0.123,
1.178,   0.108,   0.000,   0.025,   0.952,   1.994,   0.000,   1.779,   0.667,
0.096,   0.000,   0.097,
    3,   1.358,   0.022,   0.000,   0.027,   1.008,   0.206,   0.000,   0.208,
0.955,   0.142,   0.000,   0.143,   0.429,   0.109,   0.000,   0.109,   0.946,
0.146,   0.000,   0.115,   0.913,   0.405,   0.000,   0.222,   0.932,   0.161,
0.000,   0.026,   1.437,   0.225,   0.000,   0.062,   0.940,   0.115,   0.000,
0.053,   1.588,   1.939,   0.000,   0.128,   0.155,   0.128,   0.000,   0.143,
0.921,   0.078,   0.000,   0.018,   0.833,   1.407,   0.000,   1.268,   0.625,
0.073,   0.000,   0.075,
    4,   1.341,   0.026,   0.000,   0.031,   0.935,   0.162,   0.000,   0.164,
0.882,   0.112,   0.000,   0.113,   0.381,   0.087,   0.000,   0.088,   0.851,
0.117,   0.000,   0.093,   0.825,   0.321,   0.000,   0.176,   0.843,   0.136,
0.000,   0.022,   1.293,   0.185,   0.000,   0.052,   0.821,   0.094,   0.000,
0.043,   1.324,   1.523,   0.000,   0.102,   0.157,   0.152,   0.000,   0.155,
0.792,   0.065,   0.000,   0.015,   0.778,   1.116,   0.000,   1.015,   0.605,
0.063,   0.000,   0.065,
    5,   1.331,   0.028,   0.000,   0.033,   0.891,   0.136,   0.000,   0.138,
0.839,   0.095,   0.000,   0.096,   0.352,   0.075,   0.000,   0.075,   0.794,
0.101,   0.000,   0.080,   0.772,   0.271,   0.000,   0.149,   0.790,   0.121,
0.000,   0.020,   1.207,   0.161,   0.000,   0.046,   0.749,   0.082,   0.000,
0.038,   1.165,   1.274,   0.000,   0.087,   0.160,   0.167,   0.000,   0.163,
0.715,   0.057,   0.000,   0.013,   0.746,   0.943,   0.000,   0.864,   0.594,
0.058,   0.000,   0.060,
   10,   1.313,   0.034,   0.000,   0.039,   0.805,   0.088,   0.000,   0.090,
0.752,   0.063,   0.000,   0.064,   0.295,   0.052,   0.000,   0.052,   0.681,
0.070,   0.000,   0.055,   0.667,   0.176,   0.000,   0.097,   0.685,   0.093,
0.000,   0.016,   1.036,   0.113,   0.000,   0.034,   0.607,   0.060,   0.000,
0.028,   0.849,   0.778,   0.000,   0.056,   0.171,   0.200,   0.000,   0.184,
0.561,   0.043,   0.000,   0.010,   0.683,   0.599,   0.000,   0.565,   0.576,
0.048,   0.000,   0.051,
   15,   1.309,   0.036,   0.000,   0.041,   0.778,   0.075,   0.000,   0.078,
0.725,   0.055,   0.000,   0.056,   0.277,   0.047,   0.000,   0.047,   0.644,
0.062,   0.000,   0.049,   0.634,   0.149,   0.000,   0.082,   0.651,   0.086,
0.000,   0.014,   0.980,   0.099,   0.000,   0.030,   0.561,   0.055,   0.000,
0.025,   0.745,   0.614,   0.000,   0.046,   0.181,   0.211,   0.000,   0.194,
0.511,   0.040,   0.000,   0.009,   0.664,   0.488,   0.000,   0.469,   0.574,
0.046,   0.000,   0.049,
   20,   1.309,   0.038,   0.000,   0.043,   0.765,   0.071,   0.000,   0.074,
0.712,   0.053,   0.000,   0.054,   0.268,   0.046,   0.000,   0.046,   0.626,
0.060,   0.000,   0.048,   0.617,   0.139,   0.000,   0.077,   0.634,   0.084,
0.000,   0.014,   0.954,   0.093,   0.000,   0.028,   0.538,   0.054,   0.000,
0.025,   0.694,   0.533,   0.000,   0.041,   0.191,   0.217,   0.000,   0.202,
0.486,   0.040,   0.000,   0.009,   0.655,   0.435,   0.000,   0.422,   0.577,
0.047,   0.000,   0.049,
   25,   1.310,   0.039,   0.000,   0.044,   0.758,   0.071,   0.000,   0.074,
0.705,   0.054,   0.000,   0.055,   0.263,   0.047,   0.000,   0.047,   0.617,
0.060,   0.000,   0.048,   0.608,   0.136,   0.000,   0.075,   0.625,   0.084,
0.000,   0.014,   0.939,   0.090,   0.000,   0.028,   0.525,   0.055,   0.000,
0.026,   0.664,   0.486,   0.000,   0.038,   0.201,   0.220,   0.000,   0.210,
0.472,   0.041,   0.000,   0.010,   0.650,   0.405,   0.000,   0.396,   0.581,
0.048,   0.000,   0.050,
   30,   1.313,   0.039,   0.000,   0.044,   0.760,   0.072,   0.000,   0.074,
0.707,   0.054,   0.000,   0.055,   0.264,   0.047,   0.000,   0.047,   0.618,
0.060,   0.000,   0.048,   0.610,   0.136,   0.000,   0.075,   0.627,   0.084,
0.000,   0.014,   0.941,   0.090,   0.000,   0.028,   0.527,   0.055,   0.000,
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0.026,   0.666,   0.487,   0.000,   0.038,   0.201,   0.221,   0.000,   0.210,
0.473,   0.041,   0.000,   0.010,   0.652,   0.406,   0.000,   0.398,   0.582,
0.048,   0.000,   0.050,
   35,   1.316,   0.039,   0.000,   0.044,   0.762,   0.072,   0.000,   0.074,
0.709,   0.054,   0.000,   0.055,   0.264,   0.047,   0.000,   0.047,   0.620,
0.060,   0.000,   0.048,   0.611,   0.137,   0.000,   0.076,   0.628,   0.084,
0.000,   0.014,   0.944,   0.090,   0.000,   0.028,   0.528,   0.055,   0.000,
0.026,   0.667,   0.489,   0.000,   0.038,   0.202,   0.221,   0.000,   0.210,
0.474,   0.041,   0.000,   0.010,   0.654,   0.407,   0.000,   0.399,   0.584,
0.048,   0.000,   0.050,
   40,   1.319,   0.039,   0.000,   0.044,   0.764,   0.072,   0.000,   0.074,
0.710,   0.054,   0.000,   0.055,   0.265,   0.047,   0.000,   0.047,   0.621,
0.060,   0.000,   0.048,   0.613,   0.137,   0.000,   0.076,   0.630,   0.084,
0.000,   0.014,   0.946,   0.091,   0.000,   0.028,   0.530,   0.055,   0.000,
0.026,   0.669,   0.490,   0.000,   0.038,   0.202,   0.222,   0.000,   0.211,
0.475,   0.041,   0.000,   0.010,   0.655,   0.408,   0.000,   0.400,   0.585,
0.048,   0.000,   0.050,
   45,   1.322,   0.039,   0.000,   0.044,   0.766,   0.072,   0.000,   0.075,
0.712,   0.054,   0.000,   0.055,   0.266,   0.047,   0.000,   0.047,   0.623,
0.060,   0.000,   0.048,   0.614,   0.137,   0.000,   0.076,   0.631,   0.084,
0.000,   0.014,   0.948,   0.091,   0.000,   0.028,   0.531,   0.055,   0.000,
0.026,   0.671,   0.491,   0.000,   0.038,   0.203,   0.222,   0.000,   0.211,
0.476,   0.041,   0.000,   0.010,   0.657,   0.410,   0.000,   0.401,   0.586,
0.048,   0.000,   0.050,
   50,   1.296,   0.039,   0.000,   0.044,   0.760,   0.072,   0.000,   0.075,
0.707,   0.054,   0.000,   0.055,   0.265,   0.047,   0.000,   0.048,   0.620,
0.060,   0.000,   0.048,   0.611,   0.137,   0.000,   0.076,   0.627,   0.085,
0.000,   0.014,   0.940,   0.091,   0.000,   0.028,   0.532,   0.056,   0.000,
0.026,   0.671,   0.493,   0.000,   0.038,   0.199,   0.222,   0.000,   0.209,
0.478,   0.041,   0.000,   0.010,   0.655,   0.411,   0.000,   0.402,   0.576,
0.048,   0.000,   0.050,
   55,   1.259,   0.039,   0.000,   0.043,   0.751,   0.072,   0.000,   0.075,
0.699,   0.054,   0.000,   0.055,   0.263,   0.047,   0.000,   0.048,   0.615,
0.060,   0.000,   0.048,   0.606,   0.138,   0.000,   0.076,   0.620,   0.085,
0.000,   0.014,   0.928,   0.091,   0.000,   0.028,   0.533,   0.056,   0.000,
0.026,   0.671,   0.494,   0.000,   0.039,   0.193,   0.223,   0.000,   0.206,
0.479,   0.041,   0.000,   0.010,   0.652,   0.411,   0.000,   0.402,   0.562,
0.048,   0.000,   0.050,
   60,   1.228,   0.038,   0.000,   0.043,   0.744,   0.072,   0.000,   0.075,
0.693,   0.054,   0.000,   0.056,   0.262,   0.047,   0.000,   0.048,   0.611,
0.060,   0.000,   0.048,   0.601,   0.138,   0.000,   0.076,   0.615,   0.085,
0.000,   0.014,   0.918,   0.091,   0.000,   0.028,   0.534,   0.056,   0.000,
0.026,   0.671,   0.495,   0.000,   0.039,   0.188,   0.223,   0.000,   0.203,
0.480,   0.041,   0.000,   0.010,   0.649,   0.412,   0.000,   0.403,   0.550,
0.047,   0.000,   0.050,
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Title    : SF 2011 and 2020_EMFAC
Version  : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season   : Annual
Area     : San Francisco
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Year:,2020,, -- Model Years,,1976, to ,2020, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,,  San Francisco,,,,,,County Average

,,,,Table  1:  Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Total Organic Gases,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,  21.754,
22.793,   3.612,  18.867,  21.754,  23.152,   3.612,  14.598,  21.754,  22.896,
3.612,   6.890,   0.000,   0.000,   9.682,   9.074,   0.000,  22.419,   3.612,
8.549,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,  22.126,   3.612,   6.854,   0.000,   0.000,   0.000,   0.000,   0.043,
0.302,   3.093,   0.417,
    5,  10.081,   0.133,   0.363,   0.133,   8.243,   0.194,   0.256,   0.195,
8.818,   0.222,   0.238,   0.223,  33.582,   0.321,   0.227,   0.330,  20.589,
0.384,   0.415,   0.392,  20.589,   0.471,   0.477,   0.475,  30.878,   0.814,
0.419,   0.493,  89.683,  21.693,   4.184,   5.291,   0.000,   1.953,   0.349,
0.770,   0.000,  49.630,   2.634,   6.067,   6.762,   4.437,   0.000,   5.273,
0.000,   2.020,   1.101,   1.262,  30.878,   1.274,   0.280,   1.246,   6.973,
0.242,   1.191,   0.304,
   10,   7.182,   0.088,   0.285,   0.088,   5.873,   0.130,   0.201,   0.131,
6.283,   0.147,   0.187,   0.147,  23.918,   0.212,   0.178,   0.218,  13.495,
0.252,   0.326,   0.268,  13.495,   0.309,   0.375,   0.339,  20.236,   0.534,
0.329,   0.368,  58.768,  14.218,   2.289,   3.043,   0.000,   1.281,   0.274,
0.538,   0.000,  32.522,   1.910,   4.147,   5.343,   3.260,   0.000,   4.009,
0.000,   1.325,   0.864,   0.945,  20.236,   0.836,   0.220,   0.821,   5.477,
0.162,   0.832,   0.208,
   15,   5.355,   0.061,   0.229,   0.061,   4.379,   0.092,   0.162,   0.093,
4.685,   0.102,   0.150,   0.103,  17.826,   0.148,   0.143,   0.152,   9.221,
0.172,   0.261,   0.191,   9.221,   0.211,   0.301,   0.251,  13.825,   0.365,
0.264,   0.284,  40.143,   9.714,   1.091,   1.636,   0.000,   0.876,   0.220,
0.392,   0.000,  22.215,   1.435,   2.953,   4.418,   2.526,   0.000,   3.206,
0.000,   0.906,   0.693,   0.731,  13.825,   0.572,   0.176,   0.564,   4.505,
0.114,   0.595,   0.149,
   20,   4.178,   0.045,   0.188,   0.045,   3.418,   0.068,   0.132,   0.069,
3.656,   0.075,   0.123,   0.075,  13.904,   0.108,   0.117,   0.112,   6.568,
0.123,   0.214,   0.142,   6.568,   0.151,   0.247,   0.193,   9.846,   0.260,
0.217,   0.226,  28.583,   6.919,   0.622,   1.020,   0.000,   0.625,   0.180,
0.297,   0.000,  15.818,   1.117,   2.191,   3.822,   2.065,   0.000,   2.696,
0.000,   0.646,   0.569,   0.582,   9.846,   0.408,   0.145,   0.404,   3.879,
0.084,   0.456,   0.113,
```

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   25,   3.411,   0.034,   0.157,   0.035,   2.791,   0.053,   0.111,   0.053,
2.985,   0.058,   0.103,   0.058,  11.348,   0.083,   0.098,   0.086,   4.877,
0.091,   0.180,   0.110,   4.877,   0.112,   0.207,   0.154,   7.310,   0.193,
0.182,   0.185,  21.215,   5.138,   0.530,   0.821,   0.000,   0.464,   0.151,
0.233,   0.000,  11.740,   0.900,   1.692,   3.460,   1.779,   0.000,   2.384,
0.000,   0.481,   0.477,   0.478,   7.310,   0.303,   0.121,   0.301,   3.497,
0.066,   0.374,   0.090,
   30,   2.915,   0.028,   0.135,   0.028,   2.385,   0.043,   0.095,   0.044,
2.551,   0.047,   0.088,   0.047,   9.692,   0.067,   0.084,   0.070,   3.775,
0.071,   0.154,   0.088,   3.775,   0.087,   0.177,   0.127,   5.657,   0.150,
0.156,   0.156,  16.413,   3.977,   0.452,   0.675,   0.000,   0.360,   0.130,
0.190,   0.000,   9.083,   0.751,   1.360,   3.278,   1.616,   0.000,   2.214,
0.000,   0.373,   0.409,   0.403,   5.657,   0.235,   0.104,   0.234,   3.301,
0.054,   0.316,   0.076,
   35,   2.606,   0.024,   0.118,   0.024,   2.132,   0.037,   0.083,   0.037,
2.280,   0.040,   0.078,   0.040,   8.662,   0.057,   0.074,   0.059,   3.046,
0.057,   0.135,   0.073,   3.046,   0.070,   0.155,   0.108,   4.564,   0.121,
0.136,   0.135,  13.237,   3.208,   0.389,   0.567,   0.000,   0.291,   0.114,
0.160,   0.000,   7.325,   0.649,   1.137,   3.248,   1.548,   0.000,   2.159,
0.000,   0.301,   0.358,   0.348,   4.564,   0.190,   0.091,   0.190,   3.261,
0.046,   0.274,   0.067,
   40,   2.437,   0.021,   0.106,   0.021,   1.994,   0.033,   0.075,   0.033,
2.133,   0.035,   0.069,   0.036,   8.100,   0.051,   0.066,   0.053,   2.562,
0.048,   0.121,   0.063,   2.562,   0.059,   0.139,   0.094,   3.838,   0.102,
0.122,   0.120,  11.128,   2.698,   0.340,   0.489,   0.000,   0.245,   0.102,
0.139,   0.000,   6.158,   0.581,   0.988,   3.368,   1.562,   0.000,   2.211,
0.000,   0.253,   0.321,   0.309,   3.838,   0.160,   0.082,   0.160,   3.371,
0.042,   0.245,   0.062,
   45,   2.385,   0.020,   0.097,   0.020,   1.952,   0.031,   0.068,   0.031,
2.087,   0.033,   0.064,   0.033,   7.927,   0.048,   0.061,   0.050,   2.246,
0.042,   0.111,   0.056,   2.246,   0.052,   0.128,   0.085,   3.363,   0.089,
0.112,   0.109,   9.751,   2.365,   0.305,   0.435,   0.000,   0.215,   0.093,
0.125,   0.000,   5.396,   0.538,   0.893,   3.655,   1.661,   0.000,   2.378,
0.000,   0.222,   0.294,   0.281,   3.363,   0.140,   0.075,   0.141,   3.649,
0.040,   0.225,   0.060,
   50,   2.442,   0.019,   0.091,   0.020,   1.998,   0.030,   0.064,   0.031,
2.137,   0.033,   0.060,   0.033,   8.117,   0.047,   0.057,   0.049,   2.052,
0.038,   0.104,   0.052,   2.052,   0.047,   0.119,   0.079,   3.073,   0.082,
0.105,   0.102,   8.906,   2.161,   0.284,   0.403,   0.000,   0.196,   0.087,
0.116,   0.000,   4.928,   0.517,   0.839,   4.149,   1.862,   0.000,   2.684,
0.000,   0.203,   0.275,   0.263,   3.073,   0.128,   0.070,   0.129,   4.133,
0.041,   0.214,   0.062,
   55,   2.616,   0.020,   0.087,   0.020,   2.140,   0.031,   0.061,   0.031,
2.289,   0.034,   0.057,   0.034,   8.696,   0.049,   0.054,   0.051,   1.954,
0.037,   0.099,   0.050,   1.954,   0.045,   0.114,   0.075,   2.925,   0.078,
0.100,   0.097,   8.478,   2.057,   0.278,   0.391,   0.000,   0.187,   0.084,
0.111,   0.000,   4.692,   0.513,   0.819,   4.929,   2.200,   0.000,   3.181,
0.000,   0.194,   0.263,   0.251,   2.925,   0.122,   0.067,   0.123,   4.899,
0.043,   0.210,   0.067,
   60,   2.932,   0.022,   0.085,   0.022,   2.399,   0.033,   0.060,   0.034,
2.566,   0.037,   0.056,   0.037,   9.750,   0.053,   0.053,   0.056,   1.939,
0.036,   0.097,   0.049,   1.939,   0.045,   0.112,   0.074,   2.903,   0.077,
0.098,   0.095,   8.413,   2.042,   0.287,   0.398,   0.000,   0.186,   0.082,
0.109,   0.000,   4.655,   0.529,   0.830,   6.127,   2.739,   0.000,   3.957,
0.000,   0.192,   0.258,   0.246,   2.903,   0.121,   0.065,   0.122,   6.080,
0.049,   0.212,   0.076,
```

65, 3.439, 0.025, 0.085, 0.025, 2.813, 0.038, 0.060, 0.038,
3.009, 0.042, 0.056, 0.042, 11.439, 0.061, 0.053, 0.064, 2.005,
0.038, 0.097, 0.050, 2.005, 0.046, 0.112, 0.075, 3.002, 0.080,
0.098, 0.096, 8.701, 2.111, 0.309, 0.423, 0.000, 0.192, 0.082,
0.111, 0.000, 4.815, 0.563, 0.874, 7.970, 3.595, 0.000, 5.168,
0.000, 0.199, 0.258, 0.247, 3.002, 0.125, 0.065, 0.126, 7.896,
0.058, 0.222, 0.091,

Pollutant Name: Carbon Monoxide,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

0, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000,
0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 127.976,
132.067, 26.300, 110.419, 127.976, 133.482, 26.300, 86.557, 127.976, 132.472,
26.300, 44.349, 0.000, 0.000, 44.861, 42.043, 0.000, 130.596, 26.300,
53.676, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000,
0.000, 129.441, 26.300, 44.361, 0.000, 0.000, 0.000, 0.000, 0.251,
1.747, 20.792, 2.534,
5, 75.615, 1.548, 2.512, 1.552, 114.596, 2.585, 2.262, 2.597,
116.271, 2.650, 2.200, 2.657, 382.816, 3.306, 2.171, 3.402, 366.674,
3.448, 3.004, 3.387, 366.674, 4.816, 2.843, 3.969, 550.011, 9.033,
5.431, 6.161,2217.604, 197.359, 6.811, 18.997, 0.000, 22.708, 4.679,
9.411, 0.000, 141.681, 14.121, 23.440, 47.170, 13.426, 0.000, 25.556,
0.000, 23.469, 10.981, 13.168, 550.011, 21.830, 3.488, 21.283, 50.588,
2.250, 7.301, 2.624,
10, 55.113, 1.388, 1.732, 1.391, 83.525, 2.276, 1.560, 2.283,
84.746, 2.374, 1.517, 2.379, 279.022, 2.968, 1.497, 3.037, 243.952,
2.294, 2.072, 2.269, 243.952, 3.204, 1.960, 2.671, 365.928, 6.010,
3.744, 4.208,1475.397, 131.305, 4.297, 12.420, 0.000, 15.108, 3.226,
6.345, 0.000, 94.262, 8.888, 15.125, 38.686, 12.070, 0.000, 21.637,
0.000, 15.614, 7.572, 8.980, 365.928, 14.524, 2.405, 14.168, 40.989,
1.955, 4.812, 2.205,
15, 42.304, 1.254, 1.250, 1.256, 64.112, 2.028, 1.126, 2.032,
65.049, 2.142, 1.094, 2.146, 214.171, 2.683, 1.080, 2.735, 171.481,
1.612, 1.495, 1.603, 171.481, 2.252, 1.414, 1.894, 257.222, 4.224,
2.702, 3.016,1037.099, 92.298, 2.636, 8.370, 0.000, 10.620, 2.328,
4.505, 0.000, 66.259, 5.940, 10.347, 33.413, 10.987, 0.000, 19.048,
0.000, 10.976, 5.464, 6.429, 257.222, 10.209, 1.735, 9.963, 35.035,
1.729, 3.332, 1.908,
20, 34.196, 1.140, 0.944, 1.141, 51.825, 1.825, 0.850, 1.827,
52.582, 1.946, 0.827, 1.948, 173.124, 2.439, 0.816, 2.481, 127.354,
1.198, 1.129, 1.194, 127.354, 1.673, 1.068, 1.414, 191.031, 3.137,
2.041, 2.268, 770.225, 68.547, 1.872, 6.136, 0.000, 7.887, 1.758,
3.367, 0.000, 49.209, 4.215, 7.502, 30.392, 10.112, 0.000, 17.402,
0.000, 8.151, 4.126, 4.831, 191.031, 7.582, 1.311, 7.401, 31.582,
1.550, 2.446, 1.689,

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   25,  29.111,   1.042,   0.746,   1.043,  44.117,   1.657,   0.672,   1.657,
44.762,   1.777,   0.653,   1.779, 147.377,   2.230,   0.645,   2.265,  99.930,
0.940,   0.892,   0.938,  99.930,   1.313,   0.844,   1.112, 149.895,   2.462,
1.613,   1.789, 604.368,  53.787,   1.709,   5.039,   0.000,   6.189,   1.390,
2.649,   0.000,  38.612,   3.176,   5.765,  29.112,   9.408,   0.000,  16.491,
0.000,   6.396,   3.261,   3.810, 149.895,   5.949,   1.036,   5.808,  30.019,
1.405,   1.913,   1.522,
   30,  26.097,   0.957,   0.617,   0.958,  39.551,   1.516,   0.556,   1.516,
40.129,   1.632,   0.540,   1.634, 132.123,   2.050,   0.533,   2.081,  82.845,
0.779,   0.738,   0.777,  82.845,   1.088,   0.698,   0.921, 124.268,   2.041,
1.334,   1.481, 501.039,  44.591,   1.584,   4.334,   0.000,   5.131,   1.149,
2.194,   0.000,  32.011,   2.541,   4.694,  29.367,   8.855,   0.000,  16.228,
0.000,   5.302,   2.698,   3.154, 124.268,   4.932,   0.857,   4.815,  30.081,
1.285,   1.574,   1.394,
   35,  24.639,   0.884,   0.534,   0.885,  37.340,   1.399,   0.481,   1.399,
37.886,   1.507,   0.468,   1.508, 124.738,   1.893,   0.462,   1.923,  72.564,
0.682,   0.639,   0.679,  72.564,   0.953,   0.605,   0.804, 108.846,   1.788,
1.155,   1.286, 438.861,  39.057,   1.496,   3.898,   0.000,   4.494,   0.995,
1.913,   0.000,  28.038,   2.159,   4.050,  31.198,   8.446,   0.000,  16.625,
0.000,   4.644,   2.335,   2.740, 108.846,   4.320,   0.742,   4.217,  31.772,
1.185,   1.362,   1.296,
   40,  24.497,   0.820,   0.484,   0.821,  37.126,   1.301,   0.436,   1.301,
37.668,   1.398,   0.424,   1.400, 124.021,   1.757,   0.418,   1.787,  67.153,
0.631,   0.579,   0.626,  67.153,   0.882,   0.548,   0.739, 100.729,   1.654,
1.046,   1.171, 406.134,  36.144,   1.445,   3.665,   0.000,   4.159,   0.901,
1.756,   0.000,  25.948,   1.948,   3.701,  34.903,   8.192,   0.000,  17.794,
0.000,   4.298,   2.116,   2.498, 100.729,   3.998,   0.672,   3.901,  35.367,
1.102,   1.238,   1.224,
   45,  25.650,   0.765,   0.459,   0.766,  38.873,   1.220,   0.413,   1.221,
39.441,   1.305,   0.402,   1.307, 129.857,   1.639,   0.397,   1.671,  65.659,
0.617,   0.549,   0.609,  65.659,   0.862,   0.519,   0.715,  98.488,   1.618,
0.992,   1.120, 397.098,  35.340,   1.433,   3.601,   0.000,   4.066,   0.855,
1.698,   0.000,  25.370,   1.866,   3.583,  41.123,   8.121,   0.000,  19.984,
0.000,   4.202,   2.006,   2.391,  98.488,   3.909,   0.637,   3.812,  41.488,
1.034,   1.182,   1.177,
   50,  28.283,   0.718,   0.455,   0.719,  42.864,   1.154,   0.410,   1.156,
43.490,   1.225,   0.399,   1.227, 143.190,   1.538,   0.394,   1.573,  67.828,
0.638,   0.545,   0.624,  67.828,   0.891,   0.515,   0.730, 101.742,   1.671,
0.984,   1.123, 410.216,  36.508,   1.457,   3.699,   0.000,   4.201,   0.848,
1.728,   0.000,  26.208,   1.898,   3.674,  51.023,   8.292,   0.000,  23.652,
0.000,   4.341,   1.991,   2.402, 101.742,   4.038,   0.632,   3.936,  51.281,
0.980,   1.186,   1.159,
   55,  32.844,   0.679,   0.473,   0.680,  49.775,   1.104,   0.426,   1.107,
50.503,   1.157,   0.414,   1.160, 166.277,   1.452,   0.409,   1.493,  74.030,
0.696,   0.566,   0.676,  74.030,   0.972,   0.535,   0.784, 111.045,   1.824,
1.022,   1.182, 447.727,  39.846,   1.519,   3.971,   0.000,   4.585,   0.881,
1.853,   0.000,  28.605,   2.050,   3.990,  66.670,   8.811,   0.000,  29.608,
0.000,   4.738,   2.067,   2.535, 111.045,   4.407,   0.657,   4.293,  66.786,
0.941,   1.250,   1.176,
   60,  40.165,   0.646,   0.514,   0.648,  60.870,   1.070,   0.463,   1.075,
61.760,   1.102,   0.450,   1.105, 203.342,   1.382,   0.444,   1.433,  85.368,
0.803,   0.615,   0.771,  85.368,   1.121,   0.582,   0.889, 128.052,   2.103,
1.111,   1.307, 516.298,  45.949,   1.619,   4.454,   0.000,   5.287,   0.957,
2.094,   0.000,  32.986,   2.351,   4.589,  91.742,   9.875,   0.000,  39.302,
0.000,   5.464,   2.247,   2.810, 128.052,   5.082,   0.714,   4.946,  91.635,
0.917,   1.385,   1.243,
```

65, 51.727, 0.621, 0.585, 0.623, 78.393, 1.055, 0.526, 1.062,
79.539, 1.059, 0.512, 1.064, 261.877, 1.327, 0.505, 1.394, 104.009,
0.978, 0.699, 0.930, 104.009, 1.366, 0.662, 1.063, 156.013, 2.562,
1.264, 1.518, 629.033, 55.982, 1.756, 5.224, 0.000, 6.441, 1.089,
2.494, 0.000, 40.188, 2.862, 5.589, 132.948, 11.845, 0.000, 55.376,
0.000, 6.657, 2.555, 3.274, 156.013, 6.192, 0.812, 6.021, 132.457,
0.914, 1.613, 1.387,

Pollutant Name: Oxides of Nitrogen,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
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0.142,   9.978,   0.556,
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0.151, 12.860,   0.685,

Pollutant Name: Carbon Dioxide,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

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0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
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712.968, 520.110, 673.495, 712.968, 712.968, 524.552, 630.479, 712.968,
712.968,1505.000,1370.347, 712.968, 712.968,1711.772,1649.035,   0.000,
712.968,1505.000,1297.105,   0.000, 712.968,2657.996,2515.894, 98.764, 300.085,
0.000, 227.720,   0.000, 712.968,1505.000,1366.310, 712.968, 712.968,1505.000,
783.812, 109.781, 424.846,1671.960, 475.646,

Pollutant Name: Sulfur Dioxide,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.048,
0.048,   0.039,   0.047,   0.048,   0.049,   0.039,   0.044,   0.048,   0.049,
0.039,   0.041,   0.000,   0.000,   0.062,   0.059,   0.000,   0.048,   0.039,
0.042,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.048,   0.039,   0.041,   0.000,   0.000,   0.000,   0.000,   0.000,
0.001,   0.031,   0.002,
    5,   0.014,   0.009,   0.003,   0.009,   0.015,   0.011,   0.003,   0.011,
0.015,   0.011,   0.003,   0.011,   0.024,   0.016,   0.003,   0.016,   0.030,
0.024,   0.005,   0.020,   0.030,   0.024,   0.005,   0.016,   0.033,   0.024,
0.014,   0.016,   0.060,   0.028,   0.037,   0.036,   0.000,   0.025,   0.014,
0.017,   0.000,   0.028,   0.025,   0.026,   0.003,   0.003,   0.000,   0.003,
0.000,   0.025,   0.014,   0.016,   0.033,   0.024,   0.014,   0.024,   0.003,
0.010,   0.017,   0.010,
   10,   0.011,   0.007,   0.003,   0.007,   0.011,   0.009,   0.003,   0.009,
0.011,   0.009,   0.003,   0.009,   0.018,   0.012,   0.003,   0.012,   0.020,
0.016,   0.005,   0.014,   0.020,   0.016,   0.005,   0.011,   0.022,   0.016,
0.014,   0.015,   0.040,   0.018,   0.030,   0.029,   0.000,   0.016,   0.014,
0.015,   0.000,   0.018,   0.025,   0.025,   0.003,   0.003,   0.000,   0.003,
0.000,   0.016,   0.014,   0.015,   0.022,   0.016,   0.014,   0.016,   0.003,
0.008,   0.017,   0.008,
   15,   0.008,   0.005,   0.003,   0.005,   0.009,   0.007,   0.003,   0.007,
0.009,   0.007,   0.003,   0.007,   0.014,   0.009,   0.003,   0.009,   0.014,
0.011,   0.005,   0.010,   0.014,   0.011,   0.005,   0.009,   0.016,   0.011,
0.014,   0.014,   0.028,   0.013,   0.025,   0.024,   0.000,   0.011,   0.014,
0.014,   0.000,   0.013,   0.025,   0.024,   0.002,   0.002,   0.000,   0.002,
0.000,   0.011,   0.014,   0.014,   0.016,   0.011,   0.014,   0.012,   0.002,
0.006,   0.017,   0.006,
   20,   0.007,   0.004,   0.003,   0.004,   0.007,   0.005,   0.003,   0.005,
0.007,   0.006,   0.003,   0.006,   0.012,   0.008,   0.003,   0.008,   0.010,
0.008,   0.005,   0.008,   0.010,   0.008,   0.005,   0.007,   0.012,   0.008,
0.014,   0.013,   0.021,   0.010,   0.021,   0.020,   0.000,   0.009,   0.014,
0.013,   0.000,   0.010,   0.025,   0.024,   0.002,   0.002,   0.000,   0.002,

```
0.000,   0.009,   0.014,   0.013,   0.012,   0.009,   0.014,   0.009,   0.002,
0.005,   0.016,   0.005,
   25,   0.006,   0.004,   0.003,   0.004,   0.006,   0.005,   0.003,   0.005,
0.006,   0.005,   0.003,   0.005,   0.010,   0.006,   0.003,   0.006,   0.008,
0.007,   0.005,   0.006,   0.008,   0.007,   0.005,   0.006,   0.009,   0.007,
0.014,   0.013,   0.016,   0.008,   0.020,   0.019,   0.000,   0.007,   0.014,
0.012,   0.000,   0.007,   0.025,   0.024,   0.002,   0.002,   0.000,   0.002,
0.000,   0.007,   0.014,   0.013,   0.009,   0.007,   0.014,   0.007,   0.002,
0.004,   0.016,   0.005,
   30,   0.005,   0.003,   0.003,   0.003,   0.005,   0.004,   0.003,   0.004,
0.005,   0.004,   0.003,   0.004,   0.009,   0.006,   0.003,   0.006,   0.007,
0.005,   0.005,   0.005,   0.007,   0.005,   0.005,   0.005,   0.007,   0.005,
0.014,   0.013,   0.013,   0.006,   0.018,   0.018,   0.000,   0.006,   0.014,
0.012,   0.000,   0.006,   0.025,   0.024,   0.002,   0.002,   0.000,   0.002,
0.000,   0.006,   0.014,   0.013,   0.007,   0.006,   0.014,   0.006,   0.002,
0.004,   0.016,   0.004,
   35,   0.005,   0.003,   0.003,   0.003,   0.005,   0.004,   0.003,   0.004,
0.005,   0.004,   0.003,   0.004,   0.008,   0.005,   0.003,   0.005,   0.006,
0.005,   0.005,   0.005,   0.006,   0.005,   0.005,   0.005,   0.007,   0.005,
0.014,   0.013,   0.012,   0.005,   0.017,   0.017,   0.000,   0.005,   0.014,
0.012,   0.000,   0.005,   0.025,   0.024,   0.002,   0.002,   0.000,   0.002,
0.000,   0.005,   0.014,   0.013,   0.007,   0.005,   0.014,   0.006,   0.002,
0.003,   0.016,   0.004,
   40,   0.004,   0.003,   0.003,   0.003,   0.005,   0.003,   0.003,   0.003,
0.005,   0.004,   0.003,   0.004,   0.008,   0.005,   0.003,   0.005,   0.006,
0.004,   0.005,   0.005,   0.006,   0.004,   0.005,   0.005,   0.006,   0.004,
0.014,   0.013,   0.011,   0.005,   0.017,   0.016,   0.000,   0.004,   0.014,
0.012,   0.000,   0.005,   0.025,   0.024,   0.002,   0.002,   0.000,   0.002,
0.000,   0.004,   0.014,   0.013,   0.006,   0.004,   0.014,   0.005,   0.002,
0.003,   0.016,   0.004,
   45,   0.004,   0.003,   0.003,   0.003,   0.005,   0.003,   0.003,   0.003,
0.005,   0.003,   0.003,   0.003,   0.008,   0.005,   0.003,   0.005,   0.005,
0.004,   0.005,   0.004,   0.005,   0.004,   0.005,   0.005,   0.006,   0.004,
0.014,   0.013,   0.011,   0.005,   0.016,   0.016,   0.000,   0.004,   0.014,
0.012,   0.000,   0.005,   0.025,   0.024,   0.002,   0.002,   0.000,   0.002,
0.000,   0.004,   0.014,   0.013,   0.006,   0.004,   0.014,   0.005,   0.002,
0.003,   0.016,   0.004,
   50,   0.004,   0.003,   0.003,   0.003,   0.005,   0.003,   0.003,   0.003,
0.005,   0.004,   0.003,   0.004,   0.008,   0.005,   0.003,   0.005,   0.006,
0.004,   0.005,   0.005,   0.006,   0.004,   0.005,   0.005,   0.006,   0.004,
0.014,   0.013,   0.011,   0.005,   0.016,   0.015,   0.000,   0.005,   0.014,
0.012,   0.000,   0.005,   0.025,   0.024,   0.002,   0.002,   0.000,   0.002,
0.000,   0.005,   0.014,   0.013,   0.006,   0.005,   0.014,   0.005,   0.002,
0.003,   0.016,   0.004,
   55,   0.005,   0.003,   0.003,   0.003,   0.005,   0.004,   0.003,   0.004,
0.005,   0.004,   0.003,   0.004,   0.008,   0.005,   0.003,   0.005,   0.006,
0.005,   0.005,   0.005,   0.006,   0.005,   0.005,   0.005,   0.007,   0.005,
0.014,   0.013,   0.012,   0.006,   0.016,   0.015,   0.000,   0.005,   0.014,
0.012,   0.000,   0.005,   0.025,   0.024,   0.002,   0.002,   0.000,   0.002,
0.000,   0.005,   0.014,   0.013,   0.007,   0.005,   0.014,   0.006,   0.002,
0.003,   0.016,   0.004,
   60,   0.005,   0.003,   0.003,   0.003,   0.006,   0.004,   0.003,   0.004,
0.006,   0.004,   0.003,   0.004,   0.010,   0.006,   0.003,   0.006,   0.007,
0.006,   0.005,   0.005,   0.007,   0.006,   0.005,   0.005,   0.008,   0.006,
0.014,   0.013,   0.014,   0.006,   0.016,   0.015,   0.000,   0.006,   0.014,
0.012,   0.000,   0.006,   0.025,   0.024,   0.002,   0.003,   0.000,   0.003,
```

```
0.000,   0.006,   0.014,   0.013,   0.008,   0.006,   0.014,   0.006,   0.003,
0.004,   0.016,   0.004,
   65,   0.006,   0.004,   0.003,   0.004,   0.006,   0.005,   0.003,   0.005,
0.007,   0.005,   0.003,   0.005,   0.011,   0.006,   0.003,   0.006,   0.008,
0.007,   0.005,   0.006,   0.008,   0.007,   0.005,   0.006,   0.009,   0.007,
0.014,   0.013,   0.017,   0.008,   0.016,   0.016,   0.000,   0.007,   0.014,
0.012,   0.000,   0.008,   0.025,   0.024,   0.003,   0.003,   0.000,   0.003,
0.000,   0.007,   0.014,   0.013,   0.009,   0.007,   0.014,   0.008,   0.003,
0.004,   0.016,   0.005,
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Pollutant Name: PM10,,,,Temperature: 57F,,Relative Humidity: 65%

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Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.784,   0.160,   0.000,   0.000,   0.863,   0.378,   0.000,   0.000,
0.828,   0.687,   0.000,   0.000,   0.470,   0.440,   0.000,   0.000,   0.864,
0.637,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.785,   0.647,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.592,   0.025,
    5,   0.104,   0.048,   0.231,   0.048,   0.077,   0.056,   0.148,   0.056,
0.119,   0.122,   0.134,   0.123,   0.109,   0.143,   0.127,   0.143,   0.101,
0.046,   0.086,   0.054,   0.101,   0.042,   0.087,   0.062,   0.101,   0.049,
0.426,   0.362,   0.101,   0.106,   0.337,   0.322,   0.000,   0.066,   0.358,
0.281,   0.000,   0.100,   0.792,   0.741,   0.080,   0.006,   0.000,   0.032,
0.000,   0.072,   1.058,   0.885,   0.101,   0.018,   0.409,   0.054,   0.081,
0.066,   0.478,   0.083,
   10,   0.074,   0.031,   0.182,   0.031,   0.055,   0.036,   0.116,   0.037,
0.084,   0.080,   0.105,   0.080,   0.078,   0.093,   0.100,   0.093,   0.066,
0.030,   0.067,   0.038,   0.066,   0.028,   0.068,   0.045,   0.066,   0.032,
0.335,   0.283,   0.066,   0.069,   0.251,   0.240,   0.000,   0.043,   0.281,
0.218,   0.000,   0.066,   0.574,   0.537,   0.063,   0.004,   0.000,   0.025,
0.000,   0.047,   0.830,   0.693,   0.066,   0.012,   0.321,   0.040,   0.064,
0.043,   0.364,   0.056,
   15,   0.055,   0.021,   0.146,   0.021,   0.041,   0.025,   0.093,   0.025,
0.063,   0.054,   0.084,   0.054,   0.058,   0.064,   0.080,   0.064,   0.045,
0.021,   0.054,   0.027,   0.045,   0.019,   0.055,   0.035,   0.045,   0.022,
0.269,   0.227,   0.045,   0.047,   0.187,   0.178,   0.000,   0.029,   0.225,
0.174,   0.000,   0.045,   0.431,   0.403,   0.052,   0.003,   0.000,   0.021,
0.000,   0.032,   0.666,   0.555,   0.045,   0.008,   0.258,   0.031,   0.052,
0.029,   0.284,   0.040,
   20,   0.043,   0.015,   0.120,   0.015,   0.032,   0.018,   0.076,   0.018,
0.049,   0.039,   0.069,   0.039,   0.045,   0.046,   0.066,   0.046,   0.032,
0.015,   0.044,   0.021,   0.032,   0.014,   0.045,   0.027,   0.032,   0.016,
0.220,   0.186,   0.032,   0.034,   0.147,   0.140,   0.000,   0.021,   0.185,
0.142,   0.000,   0.032,   0.336,   0.313,   0.045,   0.003,   0.000,   0.018,
```

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0.000,   0.023,   0.547,   0.455,   0.032,   0.006,   0.211,   0.024,   0.045,
0.021,   0.228,   0.030,
   25,   0.035,   0.012,   0.100,   0.012,   0.026,   0.014,   0.064,   0.014,
0.040,   0.030,   0.058,   0.030,   0.037,   0.035,   0.055,   0.035,   0.024,
0.011,   0.037,   0.016,   0.024,   0.010,   0.037,   0.022,   0.024,   0.012,
0.185,   0.155,   0.024,   0.025,   0.134,   0.127,   0.000,   0.016,   0.155,
0.118,   0.000,   0.024,   0.270,   0.252,   0.041,   0.002,   0.000,   0.016,
0.000,   0.017,   0.458,   0.381,   0.024,   0.004,   0.177,   0.020,   0.041,
0.016,   0.190,   0.023,
   30,   0.030,   0.009,   0.086,   0.009,   0.022,   0.011,   0.055,   0.011,
0.034,   0.024,   0.050,   0.024,   0.031,   0.028,   0.047,   0.028,   0.019,
0.008,   0.032,   0.013,   0.019,   0.008,   0.032,   0.018,   0.019,   0.009,
0.158,   0.133,   0.019,   0.019,   0.126,   0.119,   0.000,   0.012,   0.133,
0.101,   0.000,   0.018,   0.226,   0.211,   0.039,   0.002,   0.000,   0.015,
0.000,   0.013,   0.393,   0.326,   0.019,   0.003,   0.152,   0.017,   0.039,
0.013,   0.162,   0.019,
   35,   0.027,   0.008,   0.075,   0.008,   0.020,   0.009,   0.048,   0.010,
0.031,   0.020,   0.044,   0.020,   0.028,   0.024,   0.041,   0.024,   0.015,
0.007,   0.028,   0.011,   0.015,   0.006,   0.028,   0.016,   0.015,   0.007,
0.139,   0.116,   0.015,   0.016,   0.125,   0.118,   0.000,   0.010,   0.116,
0.088,   0.000,   0.015,   0.195,   0.182,   0.038,   0.002,   0.000,   0.015,
0.000,   0.011,   0.344,   0.286,   0.015,   0.003,   0.133,   0.014,   0.038,
0.011,   0.142,   0.016,
   40,   0.025,   0.007,   0.067,   0.007,   0.019,   0.008,   0.043,   0.009,
0.029,   0.018,   0.039,   0.018,   0.026,   0.021,   0.037,   0.021,   0.013,
0.006,   0.025,   0.010,   0.013,   0.005,   0.025,   0.014,   0.013,   0.006,
0.124,   0.104,   0.013,   0.013,   0.130,   0.123,   0.000,   0.008,   0.104,
0.079,   0.000,   0.012,   0.175,   0.163,   0.040,   0.002,   0.000,   0.016,
0.000,   0.009,   0.309,   0.256,   0.013,   0.002,   0.119,   0.013,   0.040,
0.010,   0.129,   0.015,
   45,   0.024,   0.007,   0.062,   0.007,   0.018,   0.008,   0.040,   0.008,
0.028,   0.017,   0.036,   0.017,   0.026,   0.020,   0.034,   0.020,   0.011,
0.005,   0.023,   0.009,   0.011,   0.005,   0.023,   0.013,   0.011,   0.005,
0.114,   0.095,   0.011,   0.011,   0.142,   0.134,   0.000,   0.007,   0.096,
0.072,   0.000,   0.011,   0.162,   0.151,   0.043,   0.002,   0.000,   0.017,
0.000,   0.008,   0.283,   0.234,   0.011,   0.002,   0.109,   0.012,   0.043,
0.009,   0.120,   0.014,
   50,   0.025,   0.007,   0.058,   0.007,   0.019,   0.008,   0.037,   0.008,
0.029,   0.017,   0.033,   0.017,   0.026,   0.020,   0.032,   0.020,   0.010,
0.005,   0.022,   0.008,   0.010,   0.004,   0.022,   0.012,   0.010,   0.005,
0.107,   0.089,   0.010,   0.010,   0.160,   0.150,   0.000,   0.007,   0.089,
0.068,   0.000,   0.010,   0.155,   0.145,   0.049,   0.002,   0.000,   0.019,
0.000,   0.007,   0.264,   0.219,   0.010,   0.002,   0.102,   0.011,   0.049,
0.009,   0.115,   0.014,
   55,   0.027,   0.007,   0.055,   0.007,   0.020,   0.008,   0.035,   0.008,
0.031,   0.018,   0.032,   0.018,   0.028,   0.020,   0.030,   0.020,   0.010,
0.004,   0.021,   0.008,   0.010,   0.004,   0.021,   0.011,   0.010,   0.005,
0.102,   0.085,   0.010,   0.010,   0.184,   0.173,   0.000,   0.006,   0.086,
0.065,   0.000,   0.009,   0.154,   0.144,   0.058,   0.003,   0.000,   0.023,
0.000,   0.007,   0.253,   0.210,   0.010,   0.002,   0.098,   0.010,   0.058,
0.009,   0.113,   0.014,
   60,   0.030,   0.008,   0.054,   0.008,   0.022,   0.009,   0.035,   0.009,
0.034,   0.019,   0.031,   0.019,   0.032,   0.022,   0.030,   0.022,   0.009,
0.004,   0.020,   0.008,   0.009,   0.004,   0.020,   0.011,   0.009,   0.005,
0.100,   0.084,   0.009,   0.010,   0.214,   0.202,   0.000,   0.006,   0.084,
0.063,   0.000,   0.009,   0.159,   0.148,   0.073,   0.003,   0.000,   0.028,
```

```
0.000,   0.007,   0.248,   0.205,   0.009,   0.002,   0.096,   0.010,   0.072,
0.010,   0.115,   0.015,
   65,   0.035,   0.009,   0.054,   0.009,   0.026,   0.010,   0.035,   0.010,
0.040,   0.022,   0.031,   0.022,   0.037,   0.026,   0.030,   0.026,   0.010,
0.004,   0.020,   0.008,   0.010,   0.004,   0.020,   0.011,   0.010,   0.005,
0.100,   0.084,   0.010,   0.010,   0.251,   0.236,   0.000,   0.006,   0.084,
0.063,   0.000,   0.010,   0.169,   0.158,   0.095,   0.005,   0.000,   0.037,
0.000,   0.007,   0.248,   0.205,   0.010,   0.002,   0.096,   0.010,   0.093,
0.012,   0.120,   0.017,
```

Pollutant Name: PM10 - Tire Wear,,,,Temperature: 57F,,Relative Humidity: 65%

```
Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,
    5,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
0.008,   0.013,   0.008,
   10,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
0.008,   0.013,   0.008,
   15,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
0.008,   0.013,   0.008,
   20,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
```

```
   0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
   0.008,   0.013,   0.008,
      25,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
   0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
   0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
   0.008,   0.013,   0.008,
      30,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
   0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
   0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
   0.008,   0.013,   0.008,
      35,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
   0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
   0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
   0.008,   0.013,   0.008,
      40,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
   0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
   0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
   0.008,   0.013,   0.008,
      45,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
   0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
   0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
   0.008,   0.013,   0.008,
      50,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
   0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
   0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
   0.008,   0.013,   0.008,
      55,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
   0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
   0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
   0.008,   0.013,   0.008,
      60,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
   0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
   0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
```

0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
0.008,   0.013,   0.008,
   65,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,
0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.008,   0.012,
0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,
0.012,   0.012,   0.012,   0.012,   0.036,   0.034,   0.000,   0.012,   0.012,
0.012,   0.000,   0.012,   0.008,   0.008,   0.004,   0.004,   0.000,   0.004,
0.000,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.012,   0.004,
0.008,   0.013,   0.008,

Pollutant Name: PM10 - Brake Wear,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,
    5,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   10,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   15,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   20,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,

```
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   25,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   30,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   35,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   40,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   45,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   50,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   55,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   60,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
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0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,
   65,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,
0.013,   0.013,   0.028,   0.028,   0.028,   0.028,   0.000,   0.013,   0.013,
0.013,   0.000,   0.013,   0.013,   0.013,   0.006,   0.006,   0.000,   0.006,
0.000,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.013,   0.006,
0.013,   0.014,   0.013,

Pollutant Name: Gasoline - mi/gal,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,
    5,   6.057,   9.465,   0.000,   9.465,   5.695,   7.520,   0.000,   7.520,
5.680,   7.420,   0.000,   7.420,   3.481,   5.447,   0.000,   5.446,   2.812,
3.516,   0.000,   3.516,   2.812,   3.513,   0.000,   3.513,   2.553,   3.502,
0.000,   3.501,   1.414,   3.068,   0.000,   3.065,   0.000,   3.468,   0.000,
3.468,   0.000,   3.072,   0.000,   3.072, 27.180, 28.010,   0.000, 27.712,
0.000,   3.466,   0.000,   3.466,   2.553,   3.473,   0.000,   3.471, 26.689,
8.708,   0.000,   8.772,
   10,   8.048, 12.521,   0.000, 12.520,   7.575,   9.947,   0.000,   9.946,
7.555,   9.813,   0.000,   9.813,   4.656,   7.204,   0.000,   7.203,   4.228,
5.285,   0.000,   5.285,   4.228,   5.280,   0.000,   5.280,   3.840,   5.264,
0.000,   5.262,   2.127,   4.612,   0.000,   4.608,   0.000,   5.213,   0.000,
5.213,   0.000,   4.621,   0.000,   4.621, 32.227, 33.903,   0.000, 33.300,
0.000,   5.210,   0.000,   5.210,   3.840,   5.220,   0.000,   5.217, 31.661,
11.509,   0.000, 11.580,
   15, 10.289, 15.957,   0.000, 15.957,   9.688, 12.676,   0.000, 12.675,
9.665, 12.505,   0.000, 12.505,   5.977,   9.181,   0.000,   9.180,   6.018,
7.519,   0.000,   7.519,   6.018,   7.512,   0.000,   7.512,   5.466,   7.489,
0.000,   7.487,   3.029,   6.566,   0.000,   6.560,   0.000,   7.417,   0.000,
7.417,   0.000,   6.583,   0.000,   6.583, 37.245, 39.609,   0.000, 38.759,
0.000,   7.413,   0.000,   7.413,   5.466,   7.426,   0.000,   7.422, 36.612,
14.657,   0.000, 14.734,
   20, 12.657, 19.596,   0.000, 19.595, 11.918, 15.565,   0.000, 15.564,
11.889, 15.354,   0.000, 15.354,   7.365, 11.273,   0.000, 11.272,   8.109,
10.124,   0.000, 10.124,   8.109, 10.115,   0.000, 10.115,   7.368, 10.085,
0.000, 10.081,   4.086,   8.849,   0.000,   8.841,   0.000,   9.987,   0.000,
9.987,   0.000,   8.882,   0.000,   8.882, 41.970, 44.700,   0.000, 43.719,

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0.000,   9.982,   0.000,   9.982,   7.368,  10.000,   0.000,   9.994,  41.278,
17.987,   0.000,  18.069,
   25,  14.981,  23.187,   0.000,  23.187,  14.101,  18.416,   0.000,  18.416,
14.068,  18.166,   0.000,  18.166,   8.713,  13.338,   0.000,  13.337,  10.345,
12.903,   0.000,  12.903,  10.345,  12.891,   0.000,  12.891,   9.403,  12.853,
0.000,  12.848,   5.218,  11.290,   0.000,  11.279,   0.000,  12.730,   0.000,
12.730,   0.000,  11.349,   0.000,  11.349,  46.092,  48.745,   0.000,  47.791,
0.000,  12.723,   0.000,  12.723,   9.403,  12.745,   0.000,  12.738,  45.354,
21.270,   0.000,  21.355,
   30,  17.062,  26.437,   0.000,  26.437,  16.047,  20.997,   0.000,  20.997,
16.009,  20.712,   0.000,  20.711,   9.894,  15.207,   0.000,  15.205,  12.492,
15.565,   0.000,  15.564,  12.492,  15.550,   0.000,  15.550,  11.359,  15.504,
0.000,  15.499,   6.310,  13.636,   0.000,  13.623,   0.000,  15.357,   0.000,
15.357,   0.000,  13.730,   0.000,  13.730,  49.267,  51.367,   0.000,  50.613,
0.000,  15.349,   0.000,  15.349,  11.359,  15.375,   0.000,  15.366,  48.500,
24.238,   0.000,  24.324,
   35,  18.698,  29.047,   0.000,  29.046,  17.562,  23.070,   0.000,  23.069,
17.519,  22.755,   0.000,  22.755,  10.785,  16.707,   0.000,  16.706,  14.280,
17.770,   0.000,  17.770,  14.280,  17.754,   0.000,  17.753,  12.991,  17.702,
0.000,  17.696,   7.224,  15.591,   0.000,  15.576,   0.000,  17.535,   0.000,
17.535,   0.000,  15.728,   0.000,  15.728,  51.144,  52.292,   0.000,  51.879,
0.000,  17.526,   0.000,  17.526,  12.991,  17.555,   0.000,  17.545,  50.367,
26.615,   0.000,  26.698,
   40,  19.713,  30.752,   0.000,  30.752,  18.481,  24.425,   0.000,  24.424,
18.435,  24.092,   0.000,  24.092,  11.279,  17.689,   0.000,  17.687,  15.452,
19.203,   0.000,  19.202,  15.452,  19.185,   0.000,  19.185,  14.064,  19.130,
0.000,  19.123,   7.829,  16.873,   0.000,  16.858,   0.000,  18.951,   0.000,
18.951,   0.000,  17.057,   0.000,  17.057,  51.395,  51.394,   0.000,  51.394,
0.000,  18.941,   0.000,  18.941,  14.064,  18.972,   0.000,  18.961,  50.633,
28.159,   0.000,  28.238,
   45,  19.991,  31.373,   0.000,  31.373,  18.696,  24.919,   0.000,  24.918,
18.647,  24.581,   0.000,  24.580,  11.314,  18.047,   0.000,  18.045,  15.825,
19.640,   0.000,  19.640,  15.825,  19.622,   0.000,  19.622,  14.411,  19.566,
0.000,  19.560,   8.032,  17.285,   0.000,  17.269,   0.000,  19.386,   0.000,
19.386,   0.000,  17.509,   0.000,  17.509,  49.777,  48.724,   0.000,  49.102,
0.000,  19.376,   0.000,  19.376,  14.411,  19.406,   0.000,  19.394,  49.056,
28.706,   0.000,  28.778,
   50,  19.495,  30.842,   0.000,  30.841,  18.175,  24.498,   0.000,  24.497,
18.126,  24.167,   0.000,  24.167,  10.880,  17.743,   0.000,  17.741,  15.340,
19.013,   0.000,  19.013,  15.340,  18.996,   0.000,  18.995,  13.977,  18.942,
0.000,  18.935,   7.799,  16.759,   0.000,  16.743,   0.000,  18.769,   0.000,
18.769,   0.000,  17.012,   0.000,  17.012,  46.203,  44.514,   0.000,  45.121,
0.000,  18.759,   0.000,  18.759,  13.977,  18.787,   0.000,  18.776,  45.551,
28.195,   0.000,  28.256,
   55,  18.276,  29.214,   0.000,  29.214,  16.973,  23.206,   0.000,  23.206,
16.924,  22.895,   0.000,  22.895,  10.021,  16.808,   0.000,  16.806,  14.074,
17.421,   0.000,  17.420,  14.074,  17.405,   0.000,  17.405,  12.830,  17.356,
0.000,  17.350,   7.167,  15.378,   0.000,  15.364,   0.000,  17.199,   0.000,
17.199,   0.000,  15.644,   0.000,  15.644,  40.827,  39.148,   0.000,  39.751,
0.000,  17.190,   0.000,  17.190,  12.830,  17.215,   0.000,  17.205,  40.269,
26.681,   0.000,  26.729,
   60,  16.464,  26.663,   0.000,  26.663,  15.216,  21.181,   0.000,  21.181,
15.169,  20.899,   0.000,  20.899,   8.834,  15.342,   0.000,  15.341,  12.221,
15.107,   0.000,  15.107,  12.221,  15.094,   0.000,  15.094,  11.145,  15.052,
0.000,  15.047,   6.233,  13.356,   0.000,  13.344,   0.000,  14.917,   0.000,
14.917,   0.000,  13.613,   0.000,  13.613,  34.097,  33.107,   0.000,  33.463,
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0.000, 14.910,   0.000, 14.910, 11.145, 14.930,   0.000, 14.921, 33.652,
24.324,   0.000, 24.357,
   65, 14.244, 23.447,   0.000, 23.446, 13.085, 18.627,   0.000, 18.627,
13.041, 18.381,   0.000, 18.381,   7.445, 13.493,   0.000, 13.491, 10.043,
12.400,   0.000, 12.400, 10.043, 12.389,   0.000, 12.389,   9.163, 12.355,
0.000, 12.351,   5.130, 10.977,   0.000, 10.967,   0.000, 12.245,   0.000,
12.245,   0.000, 11.209,   0.000, 11.209, 26.729, 26.899,   0.000, 26.838,
0.000, 12.239,   0.000, 12.239,   9.163, 12.255,   0.000, 12.248, 26.403,
21.364,   0.000, 21.382,

Pollutant Name: Diesel - mi/gal,,,,Temperature: 57F,,Relative Humidity: 65%

Speed,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LH
D1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,
OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,AL
L,ALL,ALL,ALL,

MPH,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    0,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   0.000,
    5,   0.000,   0.000, 28.574, 28.574,   0.000,   0.000, 29.028, 29.028,
0.000,   0.000, 29.099, 29.099,   0.000,   0.000, 29.126, 29.126,   0.000,
0.000, 19.380, 19.380,   0.000,   0.000, 19.216, 19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   2.621,   2.621,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.380,   7.380,
   10,   0.000,   0.000, 28.574, 28.574,   0.000,   0.000, 29.028, 29.028,
0.000,   0.000, 29.099, 29.099,   0.000,   0.000, 29.126, 29.126,   0.000,
0.000, 19.380, 19.380,   0.000,   0.000, 19.216, 19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   3.184,   3.184,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.418,   7.418,
   15,   0.000,   0.000, 28.574, 28.574,   0.000,   0.000, 29.028, 29.028,
0.000,   0.000, 29.099, 29.099,   0.000,   0.000, 29.126, 29.126,   0.000,
0.000, 19.380, 19.380,   0.000,   0.000, 19.216, 19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   3.883,   3.883,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.465,   7.465,
   20,   0.000,   0.000, 28.574, 28.574,   0.000,   0.000, 29.028, 29.028,
0.000,   0.000, 29.099, 29.099,   0.000,   0.000, 29.126, 29.126,   0.000,
0.000, 19.380, 19.380,   0.000,   0.000, 19.216, 19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   4.617,   4.617,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,

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0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.514,   7.514,
   25,   0.000,   0.000,  28.574,  28.574,   0.000,   0.000,  29.028,  29.028,
0.000,   0.000,  29.099,  29.099,   0.000,   0.000,  29.126,  29.126,   0.000,
0.000,  19.380,  19.380,   0.000,   0.000,  19.216,  19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   4.935,   4.935,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.536,   7.536,
   30,   0.000,   0.000,  28.574,  28.574,   0.000,   0.000,  29.028,  29.028,
0.000,   0.000,  29.099,  29.099,   0.000,   0.000,  29.126,  29.126,   0.000,
0.000,  19.380,  19.380,   0.000,   0.000,  19.216,  19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   5.238,   5.238,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.556,   7.556,
   35,   0.000,   0.000,  28.574,  28.574,   0.000,   0.000,  29.028,  29.028,
0.000,   0.000,  29.099,  29.099,   0.000,   0.000,  29.126,  29.126,   0.000,
0.000,  19.380,  19.380,   0.000,   0.000,  19.216,  19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   5.515,   5.515,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.575,   7.575,
   40,   0.000,   0.000,  28.574,  28.574,   0.000,   0.000,  29.028,  29.028,
0.000,   0.000,  29.099,  29.099,   0.000,   0.000,  29.126,  29.126,   0.000,
0.000,  19.380,  19.380,   0.000,   0.000,  19.216,  19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   5.749,   5.749,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.590,   7.590,
   45,   0.000,   0.000,  28.574,  28.574,   0.000,   0.000,  29.028,  29.028,
0.000,   0.000,  29.099,  29.099,   0.000,   0.000,  29.126,  29.126,   0.000,
0.000,  19.380,  19.380,   0.000,   0.000,  19.216,  19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   5.926,   5.926,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.602,   7.602,
   50,   0.000,   0.000,  28.574,  28.574,   0.000,   0.000,  29.028,  29.028,
0.000,   0.000,  29.099,  29.099,   0.000,   0.000,  29.126,  29.126,   0.000,
0.000,  19.380,  19.380,   0.000,   0.000,  19.216,  19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   6.033,   6.033,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.610,   7.610,
   55,   0.000,   0.000,  28.574,  28.574,   0.000,   0.000,  29.028,  29.028,
0.000,   0.000,  29.099,  29.099,   0.000,   0.000,  29.126,  29.126,   0.000,
0.000,  19.380,  19.380,   0.000,   0.000,  19.216,  19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   6.064,   6.064,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.612,   7.612,
   60,   0.000,   0.000,  28.574,  28.574,   0.000,   0.000,  29.028,  29.028,
0.000,   0.000,  29.099,  29.099,   0.000,   0.000,  29.126,  29.126,   0.000,
0.000,  19.380,  19.380,   0.000,   0.000,  19.216,  19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   6.014,   6.014,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
```

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0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.608,   7.608,
   65,   0.000,   0.000,  28.574,  28.574,   0.000,   0.000,  29.028,  29.028,
0.000,   0.000,  29.099,  29.099,   0.000,   0.000,  29.126,  29.126,   0.000,
0.000,  19.380,  19.380,   0.000,   0.000,  19.216,  19.216,   0.000,   0.000,
6.698,   6.698,   0.000,   0.000,   5.889,   5.889,   0.000,   0.000,   6.698,
6.698,   0.000,   0.000,   3.792,   3.792,   0.000,   0.000,   0.000,   0.000,
0.000,   0.000,   6.698,   6.698,   0.000,   0.000,   6.698,   6.698,   0.000,
0.000,   7.600,   7.600,
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Title    : SF 2011 and 2020_EMFAC
Version  : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season   : Annual
Area     : San Francisco
********************************************************************************
*********
Year:,2020,, -- Model Years,,1976, to ,2020, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,,  San Francisco,,,,,,County Average

,,,,Table  2:  Starting Emissions (grams/trip)

Pollutant Name: Total Organic Gases,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O
BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    5,   2.067,   0.024,   0.000,   0.024,   1.610,   0.034,   0.000,   0.034,
1.723,   0.035,   0.000,   0.035,   6.898,   0.056,   0.000,   0.058,   7.729,
0.154,   0.000,   0.141,   7.729,   0.190,   0.000,   0.147,  11.594,   0.405,
0.000,   0.143,  19.757,   2.197,   0.000,   1.699,   0.000,   0.549,   0.000,
0.266,   0.000,   1.620,   0.000,   0.118,   2.346,   0.359,   0.000,   1.144,
0.000,   0.449,   0.000,   0.079,  11.594,   0.351,   0.000,   0.350,   2.726,
0.048,   0.000,   0.056,
   10,   2.049,   0.047,   0.000,   0.047,   1.596,   0.067,   0.000,   0.067,
1.709,   0.069,   0.000,   0.069,   6.839,   0.110,   0.000,   0.111,   7.663,
0.302,   0.000,   0.276,   7.663,   0.372,   0.000,   0.286,  11.495,   0.790,
0.000,   0.255,  19.587,   4.283,   0.000,   3.237,   0.000,   1.070,   0.000,
0.519,   0.000,   3.158,   0.000,   0.231,   2.326,   0.699,   0.000,   1.342,
0.000,   0.876,   0.000,   0.153,  11.495,   0.684,   0.000,   0.652,   2.703,
0.094,   0.000,   0.099,
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   20,   2.069,   0.090,   0.000,   0.090,   1.611,   0.129,   0.000,   0.128,
1.725,   0.133,   0.000,   0.133,   6.904,   0.211,   0.000,   0.213,   7.736,
0.579,   0.000,   0.528,   7.736,   0.711,   0.000,   0.546,  11.604,   1.498,
0.000,   0.462,  19.775,   8.119,   0.000,   6.067,   0.000,   2.028,   0.000,
0.983,   0.000,   5.988,   0.000,   0.437,   2.349,   1.326,   0.000,   1.730,
0.000,   1.660,   0.000,   0.291,  11.604,   1.297,   0.000,   1.209,   2.728,
0.180,   0.000,   0.179,
   30,   2.162,   0.130,   0.000,   0.130,   1.684,   0.184,   0.000,   0.183,
1.802,   0.192,   0.000,   0.192,   7.215,   0.305,   0.000,   0.307,   8.084,
0.832,   0.000,   0.759,   8.084,   1.018,   0.000,   0.781,  12.126,   2.124,
0.000,   0.646,  20.663,  11.509,   0.000,   8.572,   0.000,   2.875,   0.000,
1.394,   0.000,   8.488,   0.000,   0.620,   2.454,   1.879,   0.000,   2.106,
0.000,   2.353,   0.000,   0.412,  12.126,   1.839,   0.000,   1.702,   2.851,
0.257,   0.000,   0.252,
   40,   2.328,   0.165,   0.000,   0.165,   1.813,   0.234,   0.000,   0.233,
1.941,   0.246,   0.000,   0.246,   7.770,   0.391,   0.000,   0.393,   8.706,
1.062,   0.000,   0.968,   8.706,   1.291,   0.000,   0.990,  13.059,   2.667,
0.000,   0.807,  22.253,  14.454,   0.000,  10.749,   0.000,   3.610,   0.000,
1.750,   0.000,  10.659,   0.000,   0.779,   2.643,   2.360,   0.000,   2.472,
0.000,   2.955,   0.000,   0.518,  13.059,   2.309,   0.000,   2.131,   3.070,
0.326,   0.000,   0.317,
   50,   2.568,   0.197,   0.000,   0.197,   2.000,   0.279,   0.000,   0.277,
2.141,   0.295,   0.000,   0.295,   8.570,   0.469,   0.000,   0.471,   9.603,
1.267,   0.000,   1.154,   9.603,   1.531,   0.000,   1.175,  14.404,   3.128,
0.000,   0.945,  24.545,  16.951,   0.000,  12.601,   0.000,   4.234,   0.000,
2.053,   0.000,  12.501,   0.000,   0.913,   2.915,   2.768,   0.000,   2.826,
0.000,   3.466,   0.000,   0.607,  14.404,   2.708,   0.000,   2.497,   3.387,
0.387,   0.000,   0.375,
   60,   2.669,   0.225,   0.000,   0.225,   2.079,   0.317,   0.000,   0.316,
2.226,   0.339,   0.000,   0.339,   8.910,   0.539,   0.000,   0.541,   9.983,
1.448,   0.000,   1.319,   9.983,   1.738,   0.000,   1.333,  14.975,   3.506,
0.000,   1.057,  25.518,  19.003,   0.000,  14.118,   0.000,   4.746,   0.000,
2.301,   0.000,  14.014,   0.000,   1.024,   3.031,   3.103,   0.000,   3.074,
0.000,   3.886,   0.000,   0.680,  14.975,   3.036,   0.000,   2.796,   3.521,
0.440,   0.000,   0.425,
  120,   2.015,   0.302,   0.000,   0.302,   1.570,   0.403,   0.000,   0.401,
1.680,   0.474,   0.000,   0.473,   6.726,   0.766,   0.000,   0.766,   7.536,
1.744,   0.000,   1.589,   7.536,   1.920,   0.000,   1.473,  11.305,   3.063,
0.000,   0.919,  19.264,  16.100,   0.000,  11.952,   0.000,   4.246,   0.000,
2.059,   0.000,   9.304,   0.000,   0.680,   2.288,   3.381,   0.000,   2.949,
0.000,   3.527,   0.000,   0.618,  11.305,   2.256,   0.000,   2.078,   2.658,
0.523,   0.000,   0.498,
  180,   2.194,   0.221,   0.000,   0.221,   1.709,   0.306,   0.000,   0.304,
1.829,   0.348,   0.000,   0.348,   7.322,   0.560,   0.000,   0.561,   8.204,
1.612,   0.000,   1.469,   8.204,   1.850,   0.000,   1.419,  12.306,   3.250,
0.000,   0.976,  20.970,  17.084,   0.000,  12.684,   0.000,   4.505,   0.000,
2.184,   0.000,   9.872,   0.000,   0.721,   2.491,   2.741,   0.000,   2.642,
0.000,   3.742,   0.000,   0.655,  12.306,   2.394,   0.000,   2.206,   2.893,
0.431,   0.000,   0.414,
  240,   2.372,   0.234,   0.000,   0.234,   1.848,   0.324,   0.000,   0.322,
1.978,   0.369,   0.000,   0.369,   7.917,   0.594,   0.000,   0.595,   8.871,
1.709,   0.000,   1.557,   8.871,   1.958,   0.000,   1.502,  13.307,   3.431,
0.000,   1.031,  22.676,  18.036,   0.000,  13.393,   0.000,   4.756,   0.000,
2.306,   0.000,  10.422,   0.000,   0.761,   2.693,   2.894,   0.000,   2.815,
0.000,   3.950,   0.000,   0.692,  13.307,   2.527,   0.000,   2.330,   3.129,
0.457,   0.000,   0.439,
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  300,   2.551,   0.247,   0.000,   0.247,   1.987,   0.341,   0.000,   0.340,
2.127,   0.390,   0.000,   0.390,   8.513,   0.628,   0.000,   0.629,   9.539,
1.804,   0.000,   1.643,   9.539,   2.065,   0.000,   1.584,  14.308,   3.606,
0.000,   1.084,  24.382,  18.956,   0.000,  14.079,   0.000,   4.999,   0.000,
2.424,   0.000,  10.954,   0.000,   0.800,   2.896,   3.042,   0.000,   2.984,
0.000,   4.152,   0.000,   0.727,  14.308,   2.656,   0.000,   2.450,   3.364,
0.481,   0.000,   0.463,
  360,   2.729,   0.259,   0.000,   0.259,   2.126,   0.359,   0.000,   0.357,
2.276,   0.410,   0.000,   0.410,   9.109,   0.661,   0.000,   0.662,  10.206,
1.897,   0.000,   1.728,  10.206,   2.168,   0.000,   1.663,  15.309,   3.776,
0.000,   1.136,  26.088,  19.846,   0.000,  14.742,   0.000,   5.233,   0.000,
2.538,   0.000,  11.468,   0.000,   0.838,   3.098,   3.185,   0.000,   3.151,
0.000,   4.347,   0.000,   0.761,  15.309,   2.781,   0.000,   2.566,   3.599,
0.506,   0.000,   0.486,
  420,   2.908,   0.272,   0.000,   0.272,   2.265,   0.376,   0.000,   0.374,
2.424,   0.430,   0.000,   0.430,   9.704,   0.694,   0.000,   0.695,  10.874,
1.989,   0.000,   1.812,  10.874,   2.270,   0.000,   1.741,  16.310,   3.939,
0.000,   1.186,  27.794,  20.704,   0.000,  15.382,   0.000,   5.460,   0.000,
2.647,   0.000,  11.964,   0.000,   0.874,   3.301,   3.322,   0.000,   3.314,
0.000,   4.535,   0.000,   0.794,  16.310,   2.901,   0.000,   2.677,   3.835,
0.529,   0.000,   0.509,
  480,   3.086,   0.284,   0.000,   0.284,   2.404,   0.393,   0.000,   0.391,
2.573,   0.450,   0.000,   0.450,  10.300,   0.726,   0.000,   0.727,  11.541,
2.079,   0.000,   1.894,  11.541,   2.369,   0.000,   1.817,  17.312,   4.096,
0.000,   1.234,  29.500,  21.532,   0.000,  15.999,   0.000,   5.678,   0.000,
2.753,   0.000,  12.443,   0.000,   0.909,   3.504,   3.455,   0.000,   3.474,
0.000,   4.716,   0.000,   0.826,  17.312,   3.017,   0.000,   2.785,   4.070,
0.552,   0.000,   0.532,
  540,   3.265,   0.296,   0.000,   0.296,   2.543,   0.409,   0.000,   0.407,
2.722,   0.470,   0.000,   0.470,  10.896,   0.758,   0.000,   0.759,  12.209,
2.168,   0.000,   1.975,  12.209,   2.465,   0.000,   1.891,  18.313,   4.248,
0.000,   1.280,  31.206,  22.328,   0.000,  16.593,   0.000,   5.888,   0.000,
2.855,   0.000,  12.902,   0.000,   0.943,   3.706,   3.583,   0.000,   3.632,
0.000,   4.891,   0.000,   0.856,  18.313,   3.129,   0.000,   2.889,   4.306,
0.575,   0.000,   0.554,
  600,   3.443,   0.308,   0.000,   0.308,   2.682,   0.425,   0.000,   0.423,
2.871,   0.489,   0.000,   0.489,  11.491,   0.789,   0.000,   0.791,  12.876,
2.255,   0.000,   2.054,  12.876,   2.560,   0.000,   1.964,  19.314,   4.393,
0.000,   1.325,  32.912,  23.092,   0.000,  17.164,   0.000,   6.089,   0.000,
2.953,   0.000,  13.344,   0.000,   0.975,   3.909,   3.706,   0.000,   3.786,
0.000,   5.058,   0.000,   0.886,  19.314,   3.236,   0.000,   2.989,   4.541,
0.597,   0.000,   0.575,
  660,   3.621,   0.319,   0.000,   0.319,   2.821,   0.441,   0.000,   0.438,
3.020,   0.508,   0.000,   0.508,  12.087,   0.820,   0.000,   0.822,  13.543,
2.340,   0.000,   2.132,  13.543,   2.652,   0.000,   2.034,  20.315,   4.533,
0.000,   1.368,  34.618,  23.826,   0.000,  17.712,   0.000,   6.283,   0.000,
3.046,   0.000,  13.768,   0.000,   1.006,   4.112,   3.823,   0.000,   3.937,
0.000,   5.219,   0.000,   0.914,  20.315,   3.339,   0.000,   3.085,   4.776,
0.618,   0.000,   0.596,
  720,   3.800,   0.331,   0.000,   0.331,   2.960,   0.456,   0.000,   0.454,
3.168,   0.527,   0.000,   0.527,  12.683,   0.850,   0.000,   0.852,  14.211,
2.423,   0.000,   2.208,  14.211,   2.741,   0.000,   2.103,  21.316,   4.667,
0.000,   1.409,  36.324,  24.528,   0.000,  18.236,   0.000,   6.468,   0.000,
3.136,   0.000,  14.174,   0.000,   1.036,   4.314,   3.936,   0.000,   4.085,
0.000,   5.373,   0.000,   0.941,  21.316,   3.437,   0.000,   3.177,   5.012,
0.639,   0.000,   0.617,
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Pollutant Name: Carbon Monoxide,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

```
    5,  10.945,   0.293,   0.000,   0.293,  16.544,   0.457,   0.000,   0.457,
16.786,   0.465,   0.000,   0.465,  56.743,   0.664,   0.000,   0.679,  39.388,
1.691,   0.000,   1.546,  39.388,   2.237,   0.000,   1.720,  59.082,   6.599,
0.000,   2.054, 247.227,  30.596,   0.000,  23.555,   0.000,   9.799,   0.000,
4.751,   0.000,  23.807,   0.000,   1.739,   6.277,   2.146,   0.000,   3.779,
0.000,   7.147,   0.000,   1.251,  59.082,   6.546,   0.000,   6.102,   8.836,
0.629,   0.000,   0.623,
   10,   9.692,   0.577,   0.000,   0.577,  14.650,   0.899,   0.000,   0.896,
14.865,   0.916,   0.000,   0.916,  50.247,   1.309,   0.000,   1.320,  34.879,
3.328,   0.000,   3.035,  34.879,   4.397,   0.000,   3.375,  52.318,  12.931,
0.000,   3.890, 218.925,  59.948,   0.000,  45.091,   0.000,  19.199,   0.000,
9.309,   0.000,  46.646,   0.000,   3.408,   5.558,   4.206,   0.000,   4.740,
0.000,  14.003,   0.000,   2.452,  52.318,  12.827,   0.000,  11.784,   7.824,
1.236,   0.000,   1.184,
   20,   7.482,   1.118,   0.000,   1.117,  11.309,   1.739,   0.000,   1.730,
11.475,   1.778,   0.000,   1.777,  38.788,   2.538,   0.000,   2.544,  26.924,
6.441,   0.000,   5.866,  26.924,   8.486,   0.000,   6.508,  40.387,  24.789,
0.000,   7.332, 168.998, 114.924,   0.000,  85.439,   0.000,  36.806,   0.000,
17.847,   0.000,  89.423,   0.000,   6.533,   4.291,   8.063,   0.000,   6.572,
0.000,  26.845,   0.000,   4.701,  40.387,  24.590,   0.000,  22.427,   6.040,
2.385,   0.000,   2.248,
   30,   5.665,   1.623,   0.000,   1.622,   8.564,   2.520,   0.000,   2.506,
8.689,   2.586,   0.000,   2.584,  29.371,   3.688,   0.000,   3.688,  20.388,
9.341,   0.000,   8.504,  20.388,  12.266,   0.000,   9.405,  30.582,  35.574,
0.000,  10.464, 127.971, 164.926,   0.000, 122.155,   0.000,  52.820,   0.000,
25.612,   0.000, 128.331,   0.000,   9.376,   3.249,  11.571,   0.000,   8.282,
0.000,  38.526,   0.000,   6.746,  30.582,  35.289,   0.000,  32.110,   4.574,
3.447,   0.000,   3.231,
   40,   4.243,   2.092,   0.000,   2.091,   6.414,   3.241,   0.000,   3.222,
6.508,   3.340,   0.000,   3.337,  21.998,   4.759,   0.000,   4.755,  15.270,
12.026,   0.000,  10.946,  15.270,  15.738,   0.000,  12.065,  22.905,  45.287,
0.000,  13.288,  95.846, 209.957,   0.000, 155.240,   0.000,  67.242,   0.000,
32.604,   0.000, 163.370,   0.000,  11.936,   2.433,  14.730,   0.000,   9.870,
0.000,  49.045,   0.000,   8.588,  22.905,  44.924,   0.000,  40.833,   3.425,
4.423,   0.000,   4.136,
   50,   3.215,   2.526,   0.000,   2.525,   4.860,   3.902,   0.000,   3.879,
4.931,   4.041,   0.000,   4.037,  16.668,   5.751,   0.000,   5.743,  11.570,
14.496,   0.000,  13.194,  11.570,  18.901,   0.000,  14.489,  17.355,  53.927,
0.000,  15.802,  72.623, 250.014,   0.000, 184.692,   0.000,  80.071,   0.000,
38.825,   0.000, 194.539,   0.000,  14.213,   1.844,  17.540,   0.000,  11.336,
0.000,  58.402,   0.000,  10.227,  17.355,  53.495,   0.000,  48.596,   2.595,
5.313,   0.000,   4.961,
   60,   2.581,   2.925,   0.000,   2.923,   3.901,   4.504,   0.000,   4.477,
3.959,   4.688,   0.000,   4.684,  13.381,   6.664,   0.000,   6.653,   9.288,
```

```
16.753,   0.000,  15.247,   9.288,  21.756,   0.000,  16.678,  13.933,  61.495,
0.000,  18.007,  58.301, 285.100,   0.000, 210.512,   0.000,  91.307,   0.000,
44.274,   0.000, 221.839,   0.000,  16.207,   1.480,  20.001,   0.000,  12.681,
0.000,  66.597,   0.000,  11.662,  13.933,  61.002,   0.000,  55.400,   2.084,
6.115,   0.000,   5.707,
  120,   8.539,   4.176,   0.000,   4.173,  12.907,   6.004,   0.000,   5.969,
13.096,   6.790,   0.000,   6.785,  44.268,   9.614,   0.000,   9.605,  30.728,
19.200,   0.000,  17.477,  30.728,  22.615,   0.000,  17.339,  46.093,  45.611,
0.000,  13.431, 192.874, 200.173,   0.000, 148.412,   0.000,  69.377,   0.000,
33.640,   0.000, 128.402,   0.000,   9.381,   4.897,  24.045,   0.000,  16.477,
0.000,  51.254,   0.000,   8.975,  46.093,  39.645,   0.000,  36.105,   6.893,
7.064,   0.000,   6.611,
  180,  13.492,   2.799,   0.000,   2.798,  20.394,   4.187,   0.000,   4.164,
20.693,   4.574,   0.000,   4.571,  69.946,   6.432,   0.000,   6.438,  48.553,
14.777,   0.000,  13.455,  48.553,  18.730,   0.000,  14.363,  72.830,  46.944,
0.000,  13.877, 304.756, 206.025,   0.000, 153.175,   0.000,  71.405,   0.000,
34.623,   0.000, 132.156,   0.000,   9.655,   7.737,  14.715,   0.000,  11.957,
0.000,  52.752,   0.000,   9.237,  72.830,  40.804,   0.000,  37.230,  10.892,
5.368,   0.000,   5.048,
  240,  17.920,   2.989,   0.000,   2.988,  27.088,   4.443,   0.000,   4.420,
27.484,   4.905,   0.000,   4.902,  92.904,   6.881,   0.000,   6.893,  64.489,
15.735,   0.000,  14.330,  64.489,  19.757,   0.000,  15.153,  96.734,  48.321,
0.000,  14.330, 404.781, 212.070,   0.000, 158.033,   0.000,  73.500,   0.000,
35.639,   0.000, 136.033,   0.000,   9.938,  10.277,  15.147,   0.000,  13.222,
0.000,  54.300,   0.000,   9.508,  96.734,  42.001,   0.000,  38.382,  14.466,
5.666,   0.000,   5.340,
  300,  21.823,   3.160,   0.000,   3.159,  32.988,   4.678,   0.000,   4.654,
33.470,   5.201,   0.000,   5.199, 113.139,   7.284,   0.000,   7.301,  78.536,
16.603,   0.000,  15.123,  78.536,  20.709,   0.000,  15.884, 117.804,  49.742,
0.000,  14.790, 492.948, 218.307,   0.000, 162.986,   0.000,  75.662,   0.000,
36.687,   0.000, 140.034,   0.000,  10.231,  12.515,  15.593,   0.000,  14.376,
0.000,  55.897,   0.000,   9.788, 117.804,  43.236,   0.000,  39.560,  17.617,
5.941,   0.000,   5.610,
  360,  25.201,   3.313,   0.000,   3.312,  38.095,   4.890,   0.000,   4.866,
38.652,   5.464,   0.000,   5.461, 130.654,   7.643,   0.000,   7.664,  90.693,
17.384,   0.000,  15.835,  90.693,  21.584,   0.000,  16.557, 136.040,  51.207,
0.000,  15.257, 569.257, 224.737,   0.000, 168.034,   0.000,  77.890,   0.000,
37.768,   0.000, 144.159,   0.000,  10.532,  14.452,  16.052,   0.000,  15.420,
0.000,  57.543,   0.000,  10.076, 136.040,  44.510,   0.000,  40.766,  20.345,
6.194,   0.000,   5.857,
  420,  28.055,   3.448,   0.000,   3.447,  42.408,   5.080,   0.000,   5.055,
43.028,   5.692,   0.000,   5.689, 145.446,   7.957,   0.000,   7.982, 100.962,
18.075,   0.000,  16.466, 100.962,  22.384,   0.000,  17.171, 151.442,  52.717,
0.000,  15.730, 633.709, 231.360,   0.000, 173.176,   0.000,  80.186,   0.000,
38.881,   0.000, 148.407,   0.000,  10.842,  16.089,  16.525,   0.000,  16.352,
0.000,  59.239,   0.000,  10.373, 151.442,  45.822,   0.000,  41.998,  22.648,
6.424,   0.000,   6.081,
  480,  30.383,   3.564,   0.000,   3.563,  45.927,   5.248,   0.000,   5.222,
46.599,   5.886,   0.000,   5.883, 157.517,   8.226,   0.000,   8.254, 109.341,
18.677,   0.000,  17.016, 109.341,  23.107,   0.000,  17.727, 164.011,  54.270,
0.000,  16.211, 686.303, 238.176,   0.000, 178.414,   0.000,  82.548,   0.000,
40.026,   0.000, 152.780,   0.000,  11.162,  17.424,  17.012,   0.000,  17.175,
0.000,  60.984,   0.000,  10.679, 164.011,  47.171,   0.000,  43.258,  24.528,
6.632,   0.000,   6.283,
  540,  32.187,   3.661,   0.000,   3.661,  48.653,   5.393,   0.000,   5.367,
49.365,   6.045,   0.000,   6.043, 166.867,   8.450,   0.000,   8.480, 115.831,
19.191,   0.000,  17.485, 115.831,  23.754,   0.000,  18.224, 173.746,  55.867,
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0.000, 16.698, 727.040, 245.185,   0.000, 183.746,   0.000, 84.977,   0.000,
41.204,   0.000, 157.275,   0.000, 11.490, 18.458, 17.512,   0.000, 17.886,
0.000, 62.779,   0.000, 10.993, 173.746, 48.560,   0.000, 44.544, 25.984,
6.818,   0.000,   6.462,
  600, 33.465,   3.740,   0.000,   3.740, 50.586,   5.516,   0.000,   5.489,
51.326,   6.171,   0.000,   6.168, 173.495,   8.630,   0.000,   8.661, 120.432,
19.616,   0.000, 17.872, 120.432, 24.325,   0.000, 18.662, 180.648, 57.508,
0.000, 17.193, 755.919, 252.387,   0.000, 189.173,   0.000, 87.473,   0.000,
42.414,   0.000, 161.895,   0.000, 11.828, 19.191, 18.027,   0.000, 18.487,
0.000, 64.623,   0.000, 11.316, 180.648, 49.986,   0.000, 45.857, 27.016,
6.981,   0.000,   6.619,
  660, 34.219,   3.801,   0.000,   3.800, 51.725,   5.616,   0.000,   5.590,
52.481,   6.262,   0.000,   6.260, 177.402,   8.765,   0.000,   8.797, 123.144,
19.952,   0.000, 18.179, 123.144, 24.821,   0.000, 19.042, 184.715, 59.193,
0.000, 17.694, 772.940, 259.782,   0.000, 194.695,   0.000, 90.036,   0.000,
43.657,   0.000, 166.638,   0.000, 12.174, 19.624, 18.555,   0.000, 18.977,
0.000, 66.516,   0.000, 11.647, 184.715, 51.450,   0.000, 47.198, 27.624,
7.122,   0.000,   6.752,
  720, 34.447,   3.843,   0.000,   3.842, 52.071,   5.695,   0.000,   5.668,
52.832,   6.319,   0.000,   6.317, 178.587,   8.854,   0.000,   8.887, 123.966,
20.200,   0.000, 18.404, 123.966, 25.240,   0.000, 19.363, 185.949, 60.921,
0.000, 18.202, 778.104, 267.369,   0.000, 200.312,   0.000, 92.666,   0.000,
44.932,   0.000, 171.506,   0.000, 12.530, 19.755, 19.097,   0.000, 19.357,
0.000, 68.459,   0.000, 11.988, 185.949, 52.953,   0.000, 48.565, 27.809,
7.240,   0.000,   6.863,

Pollutant Name: Oxides of Nitrogen,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

    5,   0.752,   0.088,   0.000,   0.088,   0.672,   0.121,   0.000,   0.121,
0.752,   0.225,   0.000,   0.225,   2.334,   0.325,   0.000,   0.325,   0.546,
1.366,   0.000,   1.243,   0.546,   1.282,   0.000,   0.983,   0.818,   0.999,
0.000,   0.294,   3.426,   5.150,   0.000,   3.812,   0.000,   1.774,   0.000,
0.860,   0.000,   2.936,   0.000,   0.215,   0.301,   0.098,   0.000,   0.178,
0.000,   1.431,   0.000,   0.251,   0.818,   0.764,   0.000,   0.696,   0.336,
0.195,   0.000,   0.183,
   10,   0.817,   0.098,   0.000,   0.098,   0.730,   0.137,   0.000,   0.136,
0.818,   0.245,   0.000,   0.245,   2.537,   0.356,   0.000,   0.355,   0.593,
1.534,   0.000,   1.396,   0.593,   1.531,   0.000,   1.174,   0.890,   1.505,
0.000,   0.442,   3.724,   7.760,   0.000,   5.738,   0.000,   2.672,   0.000,
1.296,   0.000,   4.424,   0.000,   0.323,   0.327,   0.148,   0.000,   0.219,
0.000,   2.157,   0.000,   0.378,   0.890,   1.151,   0.000,   1.047,   0.365,
0.232,   0.000,   0.218,
   20,   0.936,   0.117,   0.000,   0.117,   0.836,   0.165,   0.000,   0.165,
0.937,   0.282,   0.000,   0.282,   2.906,   0.410,   0.000,   0.410,   0.679,
1.833,   0.000,   1.668,   0.679,   1.971,   0.000,   1.511,   1.019,   2.394,
0.000,   0.702,   4.266, 12.342,   0.000,   9.120,   0.000,   4.251,   0.000,

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2.061,   0.000,   7.037,   0.000,   0.514,   0.374,   0.236,   0.000,   0.291,
0.000,   3.430,   0.000,   0.601,   1.019,   1.831,   0.000,   1.665,   0.419,
0.297,   0.000,   0.279,
   30,   1.039,   0.132,   0.000,   0.132,   0.928,   0.189,   0.000,   0.188,
1.040,   0.313,   0.000,   0.313,   3.226,   0.456,   0.000,   0.456,   0.754,
2.081,   0.000,   1.894,   0.754,   2.334,   0.000,   1.789,   1.131,   3.118,
0.000,   0.914,   4.736,  16.077,   0.000,  11.877,   0.000,   5.537,   0.000,
2.685,   0.000,   9.166,   0.000,   0.670,   0.415,   0.307,   0.000,   0.350,
0.000,   4.468,   0.000,   0.782,   1.131,   2.385,   0.000,   2.168,   0.465,
0.351,   0.000,   0.329,
   40,   1.126,   0.144,   0.000,   0.144,   1.006,   0.208,   0.000,   0.207,
1.127,   0.338,   0.000,   0.338,   3.496,   0.493,   0.000,   0.493,   0.817,
2.280,   0.000,   2.075,   0.817,   2.619,   0.000,   2.008,   1.226,   3.677,
0.000,   1.078,   5.133,  18.963,   0.000,  14.007,   0.000,   6.531,   0.000,
3.167,   0.000,  10.811,   0.000,   0.790,   0.450,   0.362,   0.000,   0.397,
0.000,   5.270,   0.000,   0.923,   1.226,   2.814,   0.000,   2.557,   0.504,
0.393,   0.000,   0.369,
   50,   1.197,   0.154,   0.000,   0.153,   1.070,   0.222,   0.000,   0.220,
1.199,   0.357,   0.000,   0.357,   3.718,   0.521,   0.000,   0.521,   0.869,
2.429,   0.000,   2.210,   0.869,   2.827,   0.000,   2.167,   1.304,   4.073,
0.000,   1.193,   5.458,  21.000,   0.000,  15.511,   0.000,   7.233,   0.000,
3.507,   0.000,  11.973,   0.000,   0.875,   0.479,   0.401,   0.000,   0.432,
0.000,   5.836,   0.000,   1.022,   1.304,   3.116,   0.000,   2.831,   0.536,
0.424,   0.000,   0.398,
   60,   1.253,   0.160,   0.000,   0.160,   1.119,   0.231,   0.000,   0.230,
1.254,   0.370,   0.000,   0.370,   3.890,   0.540,   0.000,   0.540,   0.909,
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0.391,   0.000,   0.365,

Pollutant Name: Carbon Dioxide,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O

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BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

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199.617,   0.000, 186.448,
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394.753,   0.000, 359.296, 428.633, 395.994,   0.000, 303.590, 428.633, 406.430,
0.000, 119.720, 428.633, 406.430,   0.000, 301.481,   0.000, 406.430,   0.000,
197.072,   0.000, 406.430,   0.000, 29.693, 89.416, 75.413,   0.000, 80.947,
0.000, 406.430,   0.000, 71.169, 428.633, 406.430,   0.000, 370.025, 106.542,
212.919,   0.000, 198.843,
660, 281.265, 193.411,   0.000, 193.281, 289.232, 243.165,   0.000, 241.741,
289.180, 245.795,   0.000, 245.578, 394.658, 335.276,   0.000, 334.648, 428.968,
418.245,   0.000, 380.674, 428.968, 418.912,   0.000, 321.157, 428.968, 424.519,
0.000, 125.009, 428.968, 424.519,   0.000, 314.825,   0.000, 424.519,   0.000,
205.843,   0.000, 424.519,   0.000, 31.015, 89.485, 78.769,   0.000, 83.005,
0.000, 424.519,   0.000, 74.336, 428.968, 424.519,   0.000, 386.442, 106.625,
226.065,   0.000, 211.093,
720, 281.484, 204.829,   0.000, 204.690, 289.458, 257.338,   0.000, 255.829,
289.406, 260.293,   0.000, 260.062, 394.966, 354.835,   0.000, 354.165, 429.303,
441.233,   0.000, 401.592, 429.303, 441.164,   0.000, 338.213, 429.303, 440.585,
0.000, 129.706, 429.303, 440.586,   0.000, 326.676,   0.000, 440.586,   0.000,
213.633,   0.000, 440.586,   0.000, 32.189, 89.555, 81.750,   0.000, 84.835,
0.000, 440.585,   0.000, 77.149, 429.303, 440.585,   0.000, 401.024, 106.709,
239.057,   0.000, 223.198,

Pollutant Name: Sulfur Dioxide,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

5,   0.001,   0.000,   0.000,   0.000,   0.001,   0.000,   0.000,   0.000,
0.001,   0.000,   0.000,   0.000,   0.003,   0.000,   0.000,   0.000,   0.002,
0.000,   0.000,   0.000,   0.002,   0.000,   0.000,   0.000,   0.003,   0.000,
0.000,   0.000,   0.006,   0.001,   0.000,   0.000,   1.062,   0.000,   0.000,
0.000,   0.934,   0.000,   0.000,   0.000,   0.001,   0.000,   0.206,   0.000,
0.000,   0.000,   0.000,   0.000,   0.003,   0.000,   0.000,   0.000,   0.001,
0.000,   0.000,   0.000,
10,   0.001,   0.000,   0.000,   0.000,   0.001,   0.000,   0.000,   0.000,
0.001,   0.000,   0.000,   0.000,   0.003,   0.000,   0.000,   0.000,   0.003,
0.000,   0.000,   0.000,   0.003,   0.000,   0.000,   0.000,   0.003,   0.000,
0.000,   0.000,   0.006,   0.001,   0.000,   0.001,   1.062,   0.001,   0.000,
0.000,   0.934,   0.001,   0.000,   0.000,   0.001,   0.000,   0.206,   0.000,
0.000,   0.000,   0.000,   0.000,   0.003,   0.000,   0.000,   0.000,   0.001,
0.000,   0.000,   0.000,
20,   0.002,   0.000,   0.000,   0.000,   0.002,   0.000,   0.000,   0.000,
0.002,   0.000,   0.000,   0.000,   0.003,   0.000,   0.000,   0.000,   0.003,
0.000,   0.000,   0.000,   0.003,   0.001,   0.000,   0.000,   0.003,   0.001,
0.000,   0.000,   0.005,   0.002,   0.000,   0.002,   1.062,   0.001,   0.000,
0.000,   0.934,   0.002,   0.000,   0.000,   0.001,   0.000,   0.206,   0.000,
0.000,   0.001,   0.000,   0.000,   0.003,   0.001,   0.000,   0.001,   0.001,
0.000,   0.000,   0.000,

```
   30,   0.002,   0.000,   0.000,   0.000,   0.002,   0.000,   0.000,   0.000,
0.002,   0.000,   0.000,   0.000,   0.003,   0.000,   0.000,   0.000,   0.003,
0.001,   0.000,   0.001,   0.003,   0.001,   0.000,   0.001,   0.003,   0.001,
0.000,   0.000,   0.005,   0.003,   0.000,   0.002,   1.062,   0.001,   0.000,
0.001,   0.934,   0.003,   0.000,   0.000,   0.001,   0.000,   0.206,   0.000,
0.000,   0.001,   0.000,   0.000,   0.003,   0.001,   0.000,   0.001,   0.001,
0.000,   0.000,   0.000,
   40,   0.002,   0.000,   0.000,   0.000,   0.002,   0.000,   0.000,   0.000,
0.002,   0.000,   0.000,   0.000,   0.003,   0.001,   0.000,   0.001,   0.003,
0.001,   0.000,   0.001,   0.003,   0.001,   0.000,   0.001,   0.003,   0.001,
0.000,   0.000,   0.005,   0.004,   0.000,   0.003,   1.062,   0.002,   0.000,
0.001,   0.934,   0.003,   0.000,   0.000,   0.001,   0.000,   0.206,   0.001,
0.000,   0.002,   0.000,   0.000,   0.003,   0.001,   0.000,   0.001,   0.001,
0.000,   0.000,   0.000,
   50,   0.002,   0.000,   0.000,   0.000,   0.002,   0.000,   0.000,   0.000,
0.002,   0.000,   0.000,   0.000,   0.003,   0.001,   0.000,   0.001,   0.003,
0.001,   0.000,   0.001,   0.003,   0.001,   0.000,   0.001,   0.003,   0.002,
0.000,   0.001,   0.005,   0.005,   0.000,   0.004,   1.062,   0.002,   0.000,
0.001,   0.934,   0.004,   0.000,   0.000,   0.001,   0.001,   0.206,   0.001,
0.000,   0.002,   0.000,   0.000,   0.003,   0.002,   0.000,   0.002,   0.001,
0.000,   0.000,   0.000,
   60,   0.002,   0.000,   0.000,   0.000,   0.002,   0.001,   0.000,   0.001,
0.002,   0.001,   0.000,   0.001,   0.003,   0.001,   0.000,   0.001,   0.003,
0.001,   0.000,   0.001,   0.003,   0.001,   0.000,   0.001,   0.004,   0.002,
0.000,   0.001,   0.005,   0.006,   0.000,   0.004,   1.062,   0.003,   0.000,
0.001,   0.934,   0.005,   0.000,   0.000,   0.001,   0.001,   0.206,   0.001,
0.000,   0.002,   0.000,   0.000,   0.004,   0.002,   0.000,   0.002,   0.001,
0.001,   0.000,   0.001,
  120,   0.003,   0.001,   0.000,   0.001,   0.003,   0.001,   0.000,   0.001,
0.003,   0.001,   0.000,   0.001,   0.005,   0.002,   0.000,   0.002,   0.005,
0.002,   0.000,   0.002,   0.005,   0.002,   0.000,   0.002,   0.005,   0.003,
0.000,   0.001,   0.008,   0.005,   0.000,   0.004,   1.062,   0.003,   0.000,
0.001,   0.934,   0.004,   0.000,   0.000,   0.001,   0.001,   0.206,   0.001,
0.000,   0.003,   0.000,   0.000,   0.005,   0.002,   0.000,   0.002,   0.001,
0.001,   0.000,   0.001,
  180,   0.003,   0.001,   0.000,   0.001,   0.003,   0.001,   0.000,   0.001,
0.003,   0.001,   0.000,   0.001,   0.005,   0.002,   0.000,   0.002,   0.005,
0.002,   0.000,   0.002,   0.005,   0.002,   0.000,   0.002,   0.006,   0.003,
0.000,   0.001,   0.009,   0.006,   0.000,   0.004,   1.062,   0.003,   0.000,
0.002,   0.934,   0.004,   0.000,   0.000,   0.001,   0.001,   0.206,   0.001,
0.000,   0.003,   0.000,   0.001,   0.006,   0.003,   0.000,   0.003,   0.001,
0.001,   0.000,   0.001,
  240,   0.003,   0.001,   0.000,   0.001,   0.003,   0.001,   0.000,   0.001,
0.003,   0.001,   0.000,   0.001,   0.005,   0.002,   0.000,   0.002,   0.005,
0.003,   0.000,   0.002,   0.005,   0.003,   0.000,   0.002,   0.006,   0.003,
0.000,   0.001,   0.011,   0.006,   0.000,   0.005,   1.062,   0.004,   0.000,
0.002,   0.934,   0.005,   0.000,   0.000,   0.001,   0.001,   0.206,   0.001,
0.000,   0.003,   0.000,   0.001,   0.006,   0.003,   0.000,   0.003,   0.001,
0.001,   0.000,   0.001,
  300,   0.003,   0.001,   0.000,   0.001,   0.003,   0.002,   0.000,   0.002,
0.003,   0.002,   0.000,   0.002,   0.006,   0.002,   0.000,   0.002,   0.006,
0.003,   0.000,   0.003,   0.006,   0.003,   0.000,   0.002,   0.006,   0.004,
0.000,   0.001,   0.012,   0.007,   0.000,   0.005,   1.062,   0.004,   0.000,
0.002,   0.934,   0.005,   0.000,   0.000,   0.001,   0.001,   0.206,   0.001,
0.000,   0.004,   0.000,   0.001,   0.006,   0.003,   0.000,   0.003,   0.001,
0.001,   0.000,   0.001,
```

360, 0.003, 0.001, 0.000, 0.001, 0.003, 0.002, 0.000, 0.002,
0.003, 0.002, 0.000, 0.002, 0.006, 0.002, 0.000, 0.002, 0.006,
0.003, 0.000, 0.003, 0.006, 0.003, 0.000, 0.002, 0.007, 0.004,
0.000, 0.001, 0.013, 0.007, 0.000, 0.005, 1.062, 0.004, 0.000,
0.002, 0.934, 0.006, 0.000, 0.000, 0.001, 0.001, 0.206, 0.001,
0.000, 0.004, 0.000, 0.001, 0.007, 0.004, 0.000, 0.003, 0.001,
0.002, 0.000, 0.002,
420, 0.003, 0.001, 0.000, 0.001, 0.003, 0.002, 0.000, 0.002,
0.003, 0.002, 0.000, 0.002, 0.006, 0.003, 0.000, 0.003, 0.006,
0.003, 0.000, 0.003, 0.006, 0.004, 0.000, 0.003, 0.007, 0.004,
0.000, 0.001, 0.014, 0.007, 0.000, 0.005, 1.062, 0.005, 0.000,
0.002, 0.934, 0.006, 0.000, 0.000, 0.001, 0.001, 0.206, 0.001,
0.000, 0.004, 0.000, 0.001, 0.007, 0.004, 0.000, 0.004, 0.001,
0.002, 0.000, 0.002,
480, 0.003, 0.002, 0.000, 0.002, 0.004, 0.002, 0.000, 0.002,
0.004, 0.002, 0.000, 0.002, 0.006, 0.003, 0.000, 0.003, 0.006,
0.004, 0.000, 0.003, 0.006, 0.004, 0.000, 0.003, 0.007, 0.004,
0.000, 0.001, 0.015, 0.008, 0.000, 0.006, 1.062, 0.005, 0.000,
0.002, 0.934, 0.006, 0.000, 0.000, 0.001, 0.001, 0.206, 0.001,
0.000, 0.005, 0.000, 0.001, 0.007, 0.004, 0.000, 0.004, 0.002,
0.002, 0.000, 0.002,
540, 0.003, 0.002, 0.000, 0.002, 0.004, 0.002, 0.000, 0.002,
0.004, 0.002, 0.000, 0.002, 0.007, 0.003, 0.000, 0.003, 0.006,
0.004, 0.000, 0.004, 0.006, 0.004, 0.000, 0.003, 0.007, 0.005,
0.000, 0.001, 0.016, 0.008, 0.000, 0.006, 1.062, 0.005, 0.000,
0.003, 0.934, 0.006, 0.000, 0.000, 0.001, 0.001, 0.206, 0.001,
0.000, 0.005, 0.000, 0.001, 0.007, 0.005, 0.000, 0.004, 0.002,
0.002, 0.000, 0.002,
600, 0.003, 0.002, 0.000, 0.002, 0.004, 0.002, 0.000, 0.002,
0.004, 0.002, 0.000, 0.002, 0.007, 0.003, 0.000, 0.003, 0.006,
0.004, 0.000, 0.004, 0.006, 0.004, 0.000, 0.003, 0.007, 0.005,
0.000, 0.001, 0.016, 0.008, 0.000, 0.006, 1.062, 0.005, 0.000,
0.003, 0.934, 0.007, 0.000, 0.000, 0.001, 0.001, 0.206, 0.001,
0.000, 0.005, 0.000, 0.001, 0.007, 0.005, 0.000, 0.004, 0.002,
0.002, 0.000, 0.002,
660, 0.003, 0.002, 0.000, 0.002, 0.004, 0.002, 0.000, 0.002,
0.004, 0.002, 0.000, 0.002, 0.007, 0.003, 0.000, 0.003, 0.006,
0.004, 0.000, 0.004, 0.006, 0.004, 0.000, 0.003, 0.007, 0.005,
0.000, 0.002, 0.017, 0.009, 0.000, 0.006, 1.062, 0.006, 0.000,
0.003, 0.934, 0.007, 0.000, 0.001, 0.001, 0.001, 0.206, 0.001,
0.000, 0.005, 0.000, 0.001, 0.007, 0.005, 0.000, 0.005, 0.002,
0.002, 0.000, 0.002,
720, 0.003, 0.002, 0.000, 0.002, 0.004, 0.003, 0.000, 0.003,
0.004, 0.003, 0.000, 0.003, 0.007, 0.004, 0.000, 0.004, 0.006,
0.005, 0.000, 0.004, 0.006, 0.005, 0.000, 0.004, 0.008, 0.005,
0.000, 0.002, 0.017, 0.009, 0.000, 0.007, 1.062, 0.006, 0.000,
0.003, 0.934, 0.007, 0.000, 0.001, 0.001, 0.001, 0.206, 0.001,
0.000, 0.005, 0.000, 0.001, 0.008, 0.005, 0.000, 0.005, 0.002,
0.002, 0.000, 0.002,

Pollutant Name: PM10,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

```
min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    5,   0.011,   0.000,   0.000,   0.000,   0.008,   0.001,   0.000,   0.001,
0.013,   0.001,   0.000,   0.001,   0.012,   0.002,   0.000,   0.002,   0.011,
0.001,   0.000,   0.001,   0.011,   0.001,   0.000,   0.001,   0.011,   0.001,
0.000,   0.000,   0.011,   0.002,   0.000,   0.001,   0.000,   0.001,   0.000,
0.001,   0.000,   0.002,   0.000,   0.000,   0.020,   0.000,   0.000,   0.008,
0.000,   0.002,   0.000,   0.000,   0.011,   0.000,   0.000,   0.000,   0.019,
0.001,   0.000,   0.001,
   10,   0.010,   0.001,   0.000,   0.001,   0.007,   0.001,   0.000,   0.001,
0.011,   0.003,   0.000,   0.003,   0.010,   0.003,   0.000,   0.003,   0.010,
0.002,   0.000,   0.002,   0.010,   0.002,   0.000,   0.001,   0.010,   0.002,
0.000,   0.001,   0.010,   0.004,   0.000,   0.003,   0.000,   0.003,   0.000,
0.001,   0.000,   0.003,   0.000,   0.000,   0.017,   0.000,   0.000,   0.007,
0.000,   0.003,   0.000,   0.001,   0.010,   0.001,   0.000,   0.001,   0.017,
0.001,   0.000,   0.001,
   20,   0.008,   0.002,   0.000,   0.002,   0.006,   0.002,   0.000,   0.002,
0.009,   0.005,   0.000,   0.005,   0.008,   0.006,   0.000,   0.006,   0.008,
0.003,   0.000,   0.003,   0.008,   0.003,   0.000,   0.002,   0.008,   0.005,
0.000,   0.001,   0.008,   0.007,   0.000,   0.005,   0.000,   0.006,   0.000,
0.003,   0.000,   0.006,   0.000,   0.000,   0.013,   0.001,   0.000,   0.006,
0.000,   0.006,   0.000,   0.001,   0.008,   0.001,   0.000,   0.001,   0.013,
0.003,   0.000,   0.003,
   30,   0.006,   0.003,   0.000,   0.003,   0.004,   0.003,   0.000,   0.003,
0.007,   0.007,   0.000,   0.007,   0.006,   0.009,   0.000,   0.009,   0.006,
0.005,   0.000,   0.004,   0.006,   0.005,   0.000,   0.004,   0.006,   0.007,
0.000,   0.002,   0.006,   0.010,   0.000,   0.007,   0.000,   0.008,   0.000,
0.004,   0.000,   0.009,   0.000,   0.001,   0.010,   0.001,   0.000,   0.005,
0.000,   0.009,   0.000,   0.001,   0.006,   0.002,   0.000,   0.002,   0.010,
0.004,   0.000,   0.004,
   40,   0.004,   0.004,   0.000,   0.004,   0.003,   0.004,   0.000,   0.004,
0.005,   0.009,   0.000,   0.009,   0.005,   0.011,   0.000,   0.011,   0.004,
0.006,   0.000,   0.005,   0.004,   0.006,   0.000,   0.005,   0.004,   0.009,
0.000,   0.003,   0.004,   0.012,   0.000,   0.009,   0.000,   0.010,   0.000,
0.005,   0.000,   0.012,   0.000,   0.001,   0.008,   0.001,   0.000,   0.004,
0.000,   0.011,   0.000,   0.002,   0.004,   0.002,   0.000,   0.002,   0.007,
0.005,   0.000,   0.005,
   50,   0.003,   0.004,   0.000,   0.004,   0.002,   0.005,   0.000,   0.005,
0.004,   0.011,   0.000,   0.011,   0.003,   0.014,   0.000,   0.014,   0.003,
0.007,   0.000,   0.007,   0.003,   0.007,   0.000,   0.006,   0.003,   0.010,
0.000,   0.003,   0.003,   0.015,   0.000,   0.011,   0.000,   0.012,   0.000,
0.006,   0.000,   0.014,   0.000,   0.001,   0.006,   0.002,   0.000,   0.003,
0.000,   0.013,   0.000,   0.002,   0.003,   0.003,   0.000,   0.003,   0.006,
0.006,   0.000,   0.006,
   60,   0.003,   0.005,   0.000,   0.005,   0.002,   0.006,   0.000,   0.006,
0.003,   0.013,   0.000,   0.013,   0.003,   0.016,   0.000,   0.016,   0.003,
0.008,   0.000,   0.008,   0.003,   0.008,   0.000,   0.006,   0.003,   0.012,
0.000,   0.003,   0.003,   0.017,   0.000,   0.012,   0.000,   0.014,   0.000,
0.007,   0.000,   0.016,   0.000,   0.001,   0.005,   0.002,   0.000,   0.003,
0.000,   0.015,   0.000,   0.003,   0.003,   0.003,   0.000,   0.003,   0.005,
0.007,   0.000,   0.007,
  120,   0.007,   0.008,   0.000,   0.008,   0.005,   0.010,   0.000,   0.010,
0.008,   0.021,   0.000,   0.021,   0.008,   0.026,   0.000,   0.025,   0.007,
```

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0.013,   0.000,   0.012,   0.007,   0.012,   0.000,   0.009,   0.007,   0.016,
0.000,   0.005,   0.007,   0.023,   0.000,   0.017,   0.000,   0.019,   0.000,
0.009,   0.000,   0.022,   0.000,   0.002,   0.013,   0.002,   0.000,   0.006,
0.000,   0.020,   0.000,   0.004,   0.007,   0.004,   0.000,   0.004,   0.012,
0.011,   0.000,   0.011,
  180,   0.011,   0.009,   0.000,   0.009,   0.008,   0.011,   0.000,   0.011,
0.013,   0.024,   0.000,   0.024,   0.012,   0.028,   0.000,   0.028,   0.011,
0.014,   0.000,   0.013,   0.011,   0.013,   0.000,   0.010,   0.011,   0.016,
0.000,   0.005,   0.011,   0.024,   0.000,   0.018,   0.000,   0.020,   0.000,
0.010,   0.000,   0.022,   0.000,   0.002,   0.020,   0.002,   0.000,   0.009,
0.000,   0.021,   0.000,   0.004,   0.011,   0.005,   0.000,   0.004,   0.019,
0.013,   0.000,   0.012,
  240,   0.015,   0.010,   0.000,   0.010,   0.011,   0.012,   0.000,   0.012,
0.017,   0.026,   0.000,   0.026,   0.016,   0.031,   0.000,   0.030,   0.015,
0.015,   0.000,   0.013,   0.015,   0.014,   0.000,   0.010,   0.015,   0.017,
0.000,   0.005,   0.015,   0.025,   0.000,   0.018,   0.000,   0.020,   0.000,
0.010,   0.000,   0.023,   0.000,   0.002,   0.026,   0.002,   0.000,   0.012,
0.000,   0.021,   0.000,   0.004,   0.015,   0.005,   0.000,   0.004,   0.026,
0.014,   0.000,   0.013,
  300,   0.018,   0.010,   0.000,   0.010,   0.014,   0.012,   0.000,   0.012,
0.021,   0.027,   0.000,   0.027,   0.019,   0.033,   0.000,   0.033,   0.018,
0.016,   0.000,   0.014,   0.018,   0.014,   0.000,   0.011,   0.018,   0.017,
0.000,   0.005,   0.018,   0.025,   0.000,   0.019,   0.000,   0.021,   0.000,
0.010,   0.000,   0.024,   0.000,   0.002,   0.032,   0.003,   0.000,   0.014,
0.000,   0.022,   0.000,   0.004,   0.018,   0.005,   0.000,   0.004,   0.031,
0.015,   0.000,   0.014,
  360,   0.021,   0.011,   0.000,   0.011,   0.016,   0.013,   0.000,   0.013,
0.024,   0.029,   0.000,   0.029,   0.022,   0.034,   0.000,   0.034,   0.021,
0.016,   0.000,   0.015,   0.021,   0.015,   0.000,   0.011,   0.021,   0.018,
0.000,   0.005,   0.021,   0.026,   0.000,   0.019,   0.000,   0.021,   0.000,
0.010,   0.000,   0.024,   0.000,   0.002,   0.037,   0.003,   0.000,   0.016,
0.000,   0.023,   0.000,   0.004,   0.021,   0.005,   0.000,   0.005,   0.036,
0.015,   0.000,   0.014,
  420,   0.023,   0.011,   0.000,   0.011,   0.017,   0.014,   0.000,   0.014,
0.027,   0.030,   0.000,   0.030,   0.025,   0.036,   0.000,   0.036,   0.023,
0.017,   0.000,   0.015,   0.023,   0.015,   0.000,   0.012,   0.023,   0.018,
0.000,   0.005,   0.023,   0.027,   0.000,   0.020,   0.000,   0.022,   0.000,
0.011,   0.000,   0.025,   0.000,   0.002,   0.041,   0.003,   0.000,   0.018,
0.000,   0.023,   0.000,   0.004,   0.023,   0.005,   0.000,   0.005,   0.040,
0.016,   0.000,   0.015,
  480,   0.025,   0.012,   0.000,   0.012,   0.019,   0.014,   0.000,   0.014,
0.029,   0.031,   0.000,   0.031,   0.027,   0.037,   0.000,   0.037,   0.025,
0.018,   0.000,   0.016,   0.025,   0.016,   0.000,   0.012,   0.025,   0.019,
0.000,   0.006,   0.025,   0.028,   0.000,   0.020,   0.000,   0.023,   0.000,
0.011,   0.000,   0.026,   0.000,   0.002,   0.045,   0.003,   0.000,   0.019,
0.000,   0.024,   0.000,   0.004,   0.025,   0.005,   0.000,   0.005,   0.044,
0.017,   0.000,   0.016,
  540,   0.027,   0.012,   0.000,   0.012,   0.020,   0.015,   0.000,   0.014,
0.031,   0.032,   0.000,   0.032,   0.028,   0.038,   0.000,   0.038,   0.027,
0.018,   0.000,   0.016,   0.027,   0.016,   0.000,   0.013,   0.027,   0.019,
0.000,   0.006,   0.027,   0.028,   0.000,   0.021,   0.000,   0.023,   0.000,
0.011,   0.000,   0.027,   0.000,   0.002,   0.047,   0.003,   0.000,   0.020,
0.000,   0.025,   0.000,   0.004,   0.027,   0.005,   0.000,   0.005,   0.046,
0.017,   0.000,   0.016,
  600,   0.028,   0.012,   0.000,   0.012,   0.021,   0.015,   0.000,   0.015,
0.032,   0.033,   0.000,   0.033,   0.029,   0.039,   0.000,   0.039,   0.028,
0.018,   0.000,   0.017,   0.028,   0.017,   0.000,   0.013,   0.028,   0.020,
```

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0.000,   0.006,   0.028,   0.029,   0.000,   0.022,   0.000,   0.024,   0.000,
0.012,   0.000,   0.027,   0.000,   0.002,   0.049,   0.003,   0.000,   0.021,
0.000,   0.025,   0.000,   0.004,   0.028,   0.006,   0.000,   0.005,   0.048,
0.017,   0.000,   0.016,
  660,   0.029,   0.012,   0.000,   0.012,   0.021,   0.015,   0.000,   0.015,
0.033,   0.033,   0.000,   0.033,   0.030,   0.039,   0.000,   0.039,   0.029,
0.019,   0.000,   0.017,   0.029,   0.017,   0.000,   0.013,   0.029,   0.021,
0.000,   0.006,   0.029,   0.030,   0.000,   0.022,   0.000,   0.025,   0.000,
0.012,   0.000,   0.028,   0.000,   0.002,   0.050,   0.003,   0.000,   0.022,
0.000,   0.026,   0.000,   0.005,   0.029,   0.006,   0.000,   0.005,   0.049,
0.018,   0.000,   0.017,
  720,   0.029,   0.013,   0.000,   0.013,   0.021,   0.015,   0.000,   0.015,
0.033,   0.033,   0.000,   0.033,   0.030,   0.040,   0.000,   0.039,   0.029,
0.019,   0.000,   0.017,   0.029,   0.017,   0.000,   0.013,   0.029,   0.021,
0.000,   0.006,   0.029,   0.031,   0.000,   0.023,   0.000,   0.025,   0.000,
0.012,   0.000,   0.029,   0.000,   0.002,   0.051,   0.003,   0.000,   0.022,
0.000,   0.027,   0.000,   0.005,   0.029,   0.006,   0.000,   0.005,   0.049,
0.018,   0.000,   0.017,
```

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Title    : SF 2011 and 2020_EMFAC
Version  : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season   : Annual
Area     : San Francisco
*********************************************************************************
*********
Year:,2020,, -- Model Years,,1976, to ,2020, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,,  San Francisco,,,,,,County Average

,,,,Table  4:  Hot Soak Emissions (grams/trip)

Pollutant Name: Total Organic Gases,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD
1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,O
BUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL
,ALL,ALL,ALL,

min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT
,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCA
T,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,AL
L,

    5,   0.368,   0.042,   0.000,   0.042,   0.680,   0.058,   0.000,   0.057,
0.673,   0.053,   0.000,   0.053,   0.153,   0.052,   0.000,   0.052,   0.353,
0.023,   0.000,   0.021,   0.353,   0.032,   0.000,   0.025,   0.203,   0.013,
0.000,   0.004,   0.203,   0.027,   0.000,   0.021,   0.000,   0.018,   0.000,
0.009,   0.000,   0.328,   0.000,   0.024,   0.017,   0.120,   0.000,   0.079,
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0.000,   0.019,   0.000,   0.003,   0.200,   0.046,   0.000,   0.042,   0.032,
0.045,   0.000,   0.042,
   10,   0.682,   0.078,   0.000,   0.078,   1.252,   0.106,   0.000,   0.106,
1.240,   0.098,   0.000,   0.098,   0.282,   0.096,   0.000,   0.096,   0.650,
0.043,   0.000,   0.039,   0.650,   0.059,   0.000,   0.045,   0.374,   0.023,
0.000,   0.008,   0.375,   0.050,   0.000,   0.038,   0.000,   0.034,   0.000,
0.016,   0.000,   0.605,   0.000,   0.044,   0.031,   0.222,   0.000,   0.147,
0.000,   0.036,   0.000,   0.006,   0.368,   0.085,   0.000,   0.078,   0.058,
0.084,   0.000,   0.078,
   20,   1.173,   0.132,   0.000,   0.132,   2.125,   0.181,   0.000,   0.180,
2.105,   0.167,   0.000,   0.167,   0.479,   0.164,   0.000,   0.164,   1.104,
0.073,   0.000,   0.067,   1.104,   0.100,   0.000,   0.077,   0.636,   0.040,
0.000,   0.013,   0.636,   0.086,   0.000,   0.066,   0.000,   0.058,   0.000,
0.028,   0.000,   1.031,   0.000,   0.075,   0.053,   0.382,   0.000,   0.252,
0.000,   0.061,   0.000,   0.011,   0.625,   0.144,   0.000,   0.132,   0.099,
0.142,   0.000,   0.133,
   30,   1.520,   0.169,   0.000,   0.169,   2.713,   0.232,   0.000,   0.231,
2.687,   0.214,   0.000,   0.214,   0.612,   0.211,   0.000,   0.210,   1.409,
0.094,   0.000,   0.086,   1.409,   0.129,   0.000,   0.099,   0.811,   0.052,
0.000,   0.017,   0.811,   0.112,   0.000,   0.086,   0.000,   0.074,   0.000,
0.036,   0.000,   1.322,   0.000,   0.097,   0.068,   0.495,   0.000,   0.326,
0.000,   0.078,   0.000,   0.014,   0.798,   0.184,   0.000,   0.169,   0.127,
0.182,   0.000,   0.170,
   40,   1.653,   0.183,   0.000,   0.183,   2.926,   0.250,   0.000,   0.249,
2.898,   0.232,   0.000,   0.232,   0.660,   0.228,   0.000,   0.227,   1.520,
0.102,   0.000,   0.093,   1.520,   0.140,   0.000,   0.107,   0.875,   0.057,
0.000,   0.019,   0.875,   0.123,   0.000,   0.094,   0.000,   0.081,   0.000,
0.039,   0.000,   1.429,   0.000,   0.104,   0.073,   0.538,   0.000,   0.354,
0.000,   0.084,   0.000,   0.015,   0.860,   0.199,   0.000,   0.183,   0.137,
0.197,   0.000,   0.184,
```

Hot soak results are scaled to reflect zero emissions for trip lengths of less than 5 minutes (about 25% of in-use trips).

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Title    : SF 2011 and 2020_EMFAC
Version  : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season   : Annual
Area     : San Francisco
********************************************************************************
*********
Year:,2020,, -- Model Years,,1976, to ,2020, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,,  San Francisco,,,,,,County Average

,,,,Table 5a:  Partial Day Diurnal Loss Emissions (grams/hour)

Pollutant Name: Total Organic Gases,,,,Temperature: ALL,,Relative Humidity: ALL
```

Temp,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,
degF,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

57, 0.348, 0.027, 0.000, 0.027, 0.275, 0.039, 0.000, 0.039,
0.273, 0.036, 0.000, 0.036, 0.062, 0.036, 0.000, 0.036, 0.018,
0.002, 0.000, 0.002, 0.018, 0.003, 0.000, 0.001, 0.016, 0.002,
0.000, 0.001, 0.010, 0.004, 0.000, 0.001, 0.000, 0.002, 0.000,
0.001, 0.000, 0.006, 0.000, 0.000, 0.006, 0.110, 0.000, 0.069,
0.000, 0.002, 0.000, 0.000, 0.017, 0.005, 0.000, 0.005, 0.009,
0.032, 0.000, 0.031,

Title : SF 2011 and 2020_EMFAC
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season : Annual
Area : San Francisco
****

Year:,2020,, -- Model Years,,1976, to ,2020, Inclusive --,,,Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,, San Francisco,,,,,,County Average

,,,,Table 5b: Multi-Day Diurnal Loss Emissions (grams/hour)

Pollutant Name: Total Organic Gases,,,,Temperature: ALL,,Relative Humidity: ALL

Temp,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,
degF,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

57, 0.021, 0.002, 0.000, 0.002, 0.016, 0.003, 0.000, 0.003,
0.016, 0.003, 0.000, 0.003, 0.004, 0.003, 0.000, 0.003, 0.001,
0.000, 0.000, 0.000, 0.001, 0.000, 0.000, 0.000, 0.001, 0.000,
0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000,
0.000, 0.000, 0.002, 0.000, 0.000, 0.000, 0.010, 0.000, 0.006,
0.000, 0.000, 0.000, 0.000, 0.001, 0.000, 0.000, 0.000, 0.001,
0.003, 0.000, 0.002,

Title   : SF 2011 and 2020_EMFAC
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season   : Annual
Area   : San Francisco
****
****
Year:,2020,, -- Model Years,,1976, to ,2020, Inclusive --,,,Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,, San Francisco,,,,,,County Average

,,,,Table 6a: Partial Day Resting Loss Emissions (grams/hour)

Pollutant Name: Total Organic Gases,,,,Temperature: ALL,,Relative Humidity: ALL

Temp,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,
degF,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

57,   0.217,   0.017,   0.000,   0.017,   0.185,   0.024,   0.000,   0.024,
0.183,   0.024,   0.000,   0.024,   0.042,   0.024,   0.000,   0.024,   0.013,
0.001,   0.000,   0.001,   0.013,   0.002,   0.000,   0.001,   0.012,   0.002,
0.000,   0.000,   0.008,   0.003,   0.000,   0.001,   0.000,   0.002,   0.000,
0.001,   0.000,   0.004,   0.000,   0.000,   0.004,   0.049,   0.000,   0.031,
0.000,   0.002,   0.000,   0.000,   0.012,   0.003,   0.000,   0.003,   0.005,
0.020,   0.000,   0.019,

Title   : SF 2011 and 2020_EMFAC
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season   : Annual
Area   : San Francisco
****
****
Year:,2020,, -- Model Years,,1976, to ,2020, Inclusive --,,,Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,, San Francisco,,,,,,County Average

,,,,Table 6b: Multi-Day Resting Loss Emissions (grams/hour)

Pollutant Name: Total Organic Gases,,,,Temperature: ALL,,Relative Humidity: ALL

Temp,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,
degF,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

57, 0.014, 0.001, 0.000, 0.001, 0.012, 0.002, 0.000, 0.002,
0.012, 0.002, 0.000, 0.002, 0.003, 0.002, 0.000, 0.002, 0.000,
0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000,
0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000, 0.000,
0.000, 0.000, 0.001, 0.000, 0.000, 0.000, 0.005, 0.000, 0.003,
0.000, 0.000, 0.000, 0.000, 0.001, 0.000, 0.000, 0.000, 0.000,
0.002, 0.000, 0.002,

Title : SF 2011 and 2020_EMFAC
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season : Annual
Area : San Francisco
****
Year:,2020,, -- Model Years,,1976, to ,2020, Inclusive --,,,Annual
Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,, San Francisco,,,,,,County Average

,,,,Table 7: Estimated Travel Fractions

Pollutant Name: ,,,,Temperature: ALL,,Relative Humidity: ALL

,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,
,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

%VMT, 0.000, 0.614, 0.000, 0.614, 0.000, 0.111, 0.001, 0.112,
0.000, 0.158, 0.000, 0.158, 0.000, 0.052, 0.000, 0.052, 0.000,
0.004, 0.001, 0.005, 0.000, 0.003, 0.002, 0.005, 0.000, 0.005,
0.023, 0.027, 0.000, 0.000, 0.003, 0.003, 0.000, 0.000, 0.001,
0.002, 0.000, 0.001, 0.010, 0.010, 0.003, 0.006, 0.000, 0.009,
0.000, 0.000, 0.001, 0.001, 0.000, 0.001, 0.000, 0.001, 0.003,
0.955, 0.042, 1.000,

%TRIP,   0.000,   0.582,   0.000,   0.583,   0.000,   0.101,   0.001,   0.102,
0.000,   0.145,   0.000,   0.146,   0.000,   0.042,   0.000,   0.042,   0.000,
0.017,   0.002,   0.019,   0.000,   0.012,   0.004,   0.016,   0.000,   0.022,
0.052,   0.074,   0.000,   0.001,   0.000,   0.001,   0.000,   0.003,   0.003,
0.006,   0.000,   0.000,   0.001,   0.002,   0.004,   0.006,   0.000,   0.010,
0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.000,   0.004,
0.932,   0.064,   1.000,
%VEH,   0.000,   0.623,   0.001,   0.623,   0.000,   0.110,   0.001,   0.111,
0.000,   0.157,   0.000,   0.157,   0.000,   0.045,   0.000,   0.045,   0.000,
0.003,   0.001,   0.004,   0.000,   0.002,   0.002,   0.004,   0.000,   0.003,
0.012,   0.016,   0.000,   0.000,   0.000,   0.001,   0.000,   0.000,   0.001,
0.001,   0.000,   0.000,   0.002,   0.003,   0.013,   0.020,   0.000,   0.033,
0.000,   0.000,   0.001,   0.001,   0.000,   0.002,   0.000,   0.002,   0.013,
0.966,   0.021,   1.000,

Title   : SF 2011 and 2020_EMFAC
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2009/06/09 16:05:58
Scen Year: 2020 -- All model years in the range 1976 to 2020 selected
Season   : Annual
Area   : San Francisco
****
Year:,2020,, -- Model Years,,1976, to ,2020, Inclusive --,,,Annual
     Emfac2007 Emission Factors: V2.3 Nov 1 2006

County Average,,,,, San Francisco,,,,,,County Average

,,,,Table 8: Evaporative Running Loss Emissions (grams/minute)

Pollutant Name: Total Organic Gases,,,,Temperature: 57F,,Relative Humidity: ALL

Time,LDA,LDA,LDA,LDA,LDT1,LDT1,LDT1,LDT1,LDT2,LDT2,LDT2,LDT2,MDV,MDV,MDV,MDV,LHD1,LHD1,LHD1,LHD1,LHD2,LHD2,LHD2,LHD2,MHD,MHD,MHD,MHD,HHD,HHD,HHD,HHD,OBUS,OBUS,OBUS,OBUS,UBUS,UBUS,UBUS,UBUS,MCY,MCY,MCY,MCY,SBUS,SBUS,SBUS,SBUS,MH,MH,MH,MH,ALL,ALL,ALL,ALL,

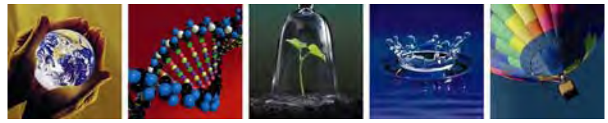
min,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,NCAT,CAT,DSL,ALL,

    1,   1.042,   0.011,   0.000,   0.011,   1.206,   0.449,   0.000,   0.447,
1.197,   0.366,   0.000,   0.366,   0.334,   0.323,   0.000,   0.322,   1.916,
0.428,   0.000,   0.340,   1.791,   0.777,   0.000,   0.437,   1.682,   0.296,
0.000,   0.051,   5.163,   0.824,   0.000,   0.052,   0.000,   0.430,   0.000,
0.113,   0.000,   8.368,   0.000,   0.611,   0.022,   0.004,   0.000,   0.011,
0.000,   0.405,   0.000,   0.071,   2.008,   3.142,   0.000,   2.858,   0.045,
0.152,   0.000,   0.146,
    2,   0.827,   0.011,   0.000,   0.011,   0.695,   0.229,   0.000,   0.228,
0.690,   0.187,   0.000,   0.187,   0.188,   0.165,   0.000,   0.165,   1.073,
0.221,   0.000,   0.176,   1.010,   0.398,   0.000,   0.224,   0.955,   0.160,

0.000, 0.027, 2.699, 0.439, 0.000, 0.028, 0.000, 0.221, 0.000,
0.058, 0.000, 4.308, 0.000, 0.315, 0.023, 0.058, 0.000, 0.045,
0.000, 0.208, 0.000, 0.036, 1.252, 1.617, 0.000, 1.472, 0.038,
0.081, 0.000, 0.078,
3, 0.756, 0.013, 0.000, 0.013, 0.525, 0.158, 0.000, 0.157,
0.521, 0.130, 0.000, 0.130, 0.139, 0.115, 0.000, 0.115, 0.792,
0.155, 0.000, 0.123, 0.749, 0.275, 0.000, 0.154, 0.713, 0.117,
0.000, 0.020, 1.877, 0.314, 0.000, 0.020, 0.000, 0.156, 0.000,
0.041, 0.000, 2.957, 0.000, 0.216, 0.023, 0.086, 0.000, 0.063,
0.000, 0.146, 0.000, 0.026, 1.006, 1.113, 0.000, 1.013, 0.035,
0.060, 0.000, 0.058,
4, 0.721, 0.015, 0.000, 0.015, 0.440, 0.124, 0.000, 0.124,
0.436, 0.103, 0.000, 0.103, 0.115, 0.092, 0.000, 0.092, 0.652,
0.123, 0.000, 0.098, 0.619, 0.214, 0.000, 0.120, 0.592, 0.096,
0.000, 0.016, 1.467, 0.254, 0.000, 0.016, 0.000, 0.126, 0.000,
0.033, 0.000, 2.283, 0.000, 0.167, 0.023, 0.103, 0.000, 0.074,
0.000, 0.119, 0.000, 0.021, 0.884, 0.863, 0.000, 0.786, 0.034,
0.051, 0.000, 0.049,
5, 0.700, 0.017, 0.000, 0.017, 0.389, 0.105, 0.000, 0.104,
0.386, 0.087, 0.000, 0.087, 0.100, 0.079, 0.000, 0.078, 0.568,
0.104, 0.000, 0.083, 0.541, 0.178, 0.000, 0.100, 0.519, 0.084,
0.000, 0.014, 1.220, 0.218, 0.000, 0.014, 0.000, 0.108, 0.000,
0.028, 0.000, 1.879, 0.000, 0.137, 0.024, 0.113, 0.000, 0.081,
0.000, 0.102, 0.000, 0.018, 0.811, 0.713, 0.000, 0.650, 0.034,
0.046, 0.000, 0.044,
10, 0.659, 0.021, 0.000, 0.021, 0.287, 0.066, 0.000, 0.066,
0.284, 0.057, 0.000, 0.057, 0.071, 0.053, 0.000, 0.053, 0.400,
0.068, 0.000, 0.054, 0.385, 0.109, 0.000, 0.061, 0.374, 0.061,
0.000, 0.010, 0.728, 0.148, 0.000, 0.009, 0.000, 0.074, 0.000,
0.019, 0.000, 1.072, 0.000, 0.078, 0.026, 0.135, 0.000, 0.096,
0.000, 0.071, 0.000, 0.012, 0.665, 0.416, 0.000, 0.380, 0.034,
0.036, 0.000, 0.035,
15, 0.647, 0.022, 0.000, 0.023, 0.253, 0.055, 0.000, 0.055,
0.251, 0.048, 0.000, 0.048, 0.061, 0.046, 0.000, 0.046, 0.344,
0.058, 0.000, 0.046, 0.334, 0.088, 0.000, 0.049, 0.326, 0.055,
0.000, 0.009, 0.564, 0.126, 0.000, 0.008, 0.000, 0.064, 0.000,
0.017, 0.000, 0.806, 0.000, 0.059, 0.028, 0.142, 0.000, 0.101,
0.000, 0.062, 0.000, 0.011, 0.618, 0.321, 0.000, 0.293, 0.036,
0.034, 0.000, 0.033,
20, 0.643, 0.023, 0.000, 0.023, 0.236, 0.051, 0.000, 0.051,
0.234, 0.046, 0.000, 0.046, 0.057, 0.043, 0.000, 0.043, 0.316,
0.054, 0.000, 0.043, 0.308, 0.079, 0.000, 0.045, 0.302, 0.053,
0.000, 0.009, 0.482, 0.116, 0.000, 0.007, 0.000, 0.061, 0.000,
0.016, 0.000, 0.675, 0.000, 0.049, 0.029, 0.146, 0.000, 0.104,
0.000, 0.059, 0.000, 0.010, 0.595, 0.275, 0.000, 0.251, 0.037,
0.033, 0.000, 0.032,
25, 0.641, 0.024, 0.000, 0.024, 0.227, 0.049, 0.000, 0.049,
0.225, 0.045, 0.000, 0.045, 0.054, 0.043, 0.000, 0.043, 0.300,
0.052, 0.000, 0.041, 0.293, 0.075, 0.000, 0.042, 0.288, 0.052,
0.000, 0.009, 0.433, 0.110, 0.000, 0.007, 0.000, 0.059, 0.000,
0.016, 0.000, 0.598, 0.000, 0.044, 0.031, 0.149, 0.000, 0.106,
0.000, 0.058, 0.000, 0.010, 0.581, 0.250, 0.000, 0.228, 0.039,
0.033, 0.000, 0.032,
30, 0.641, 0.024, 0.000, 0.024, 0.227, 0.049, 0.000, 0.049,
0.225, 0.045, 0.000, 0.045, 0.054, 0.043, 0.000, 0.043, 0.300,
0.052, 0.000, 0.042, 0.293, 0.076, 0.000, 0.042, 0.289, 0.052,
0.000, 0.009, 0.434, 0.110, 0.000, 0.007, 0.000, 0.060, 0.000,

```
0.016,   0.000,   0.600,   0.000,   0.044,   0.031,   0.149,   0.000,   0.107,
0.000,   0.058,   0.000,   0.010,   0.583,   0.250,   0.000,   0.229,   0.039,
0.033,   0.000,   0.032,
   35,   0.642,   0.024,   0.000,   0.024,   0.228,   0.049,   0.000,   0.049,
0.226,   0.045,   0.000,   0.045,   0.054,   0.043,   0.000,   0.043,   0.301,
0.052,   0.000,   0.042,   0.294,   0.076,   0.000,   0.043,   0.289,   0.052,
0.000,   0.009,   0.435,   0.111,   0.000,   0.007,   0.000,   0.060,   0.000,
0.016,   0.000,   0.601,   0.000,   0.044,   0.031,   0.149,   0.000,   0.107,
0.000,   0.058,   0.000,   0.010,   0.585,   0.251,   0.000,   0.229,   0.039,
0.033,   0.000,   0.032,
   40,   0.642,   0.024,   0.000,   0.024,   0.228,   0.049,   0.000,   0.049,
0.226,   0.045,   0.000,   0.045,   0.054,   0.043,   0.000,   0.043,   0.301,
0.052,   0.000,   0.042,   0.295,   0.076,   0.000,   0.043,   0.290,   0.052,
0.000,   0.009,   0.436,   0.111,   0.000,   0.007,   0.000,   0.060,   0.000,
0.016,   0.000,   0.603,   0.000,   0.044,   0.031,   0.150,   0.000,   0.107,
0.000,   0.058,   0.000,   0.010,   0.586,   0.252,   0.000,   0.230,   0.039,
0.033,   0.000,   0.032,
   45,   0.642,   0.024,   0.000,   0.024,   0.228,   0.049,   0.000,   0.049,
0.226,   0.045,   0.000,   0.045,   0.054,   0.043,   0.000,   0.043,   0.302,
0.052,   0.000,   0.042,   0.295,   0.076,   0.000,   0.043,   0.291,   0.052,
0.000,   0.009,   0.437,   0.111,   0.000,   0.007,   0.000,   0.060,   0.000,
0.016,   0.000,   0.605,   0.000,   0.044,   0.031,   0.150,   0.000,   0.107,
0.000,   0.058,   0.000,   0.010,   0.588,   0.252,   0.000,   0.231,   0.039,
0.033,   0.000,   0.032,
   50,   0.611,   0.024,   0.000,   0.024,   0.229,   0.049,   0.000,   0.049,
0.227,   0.045,   0.000,   0.045,   0.054,   0.043,   0.000,   0.043,   0.303,
0.053,   0.000,   0.042,   0.296,   0.076,   0.000,   0.043,   0.291,   0.052,
0.000,   0.009,   0.438,   0.111,   0.000,   0.007,   0.000,   0.060,   0.000,
0.016,   0.000,   0.606,   0.000,   0.044,   0.031,   0.150,   0.000,   0.107,
0.000,   0.058,   0.000,   0.010,   0.589,   0.253,   0.000,   0.231,   0.038,
0.033,   0.000,   0.032,
   55,   0.568,   0.024,   0.000,   0.024,   0.229,   0.050,   0.000,   0.049,
0.227,   0.045,   0.000,   0.045,   0.054,   0.043,   0.000,   0.043,   0.303,
0.053,   0.000,   0.042,   0.296,   0.076,   0.000,   0.043,   0.292,   0.052,
0.000,   0.009,   0.439,   0.111,   0.000,   0.007,   0.000,   0.060,   0.000,
0.016,   0.000,   0.608,   0.000,   0.044,   0.030,   0.150,   0.000,   0.107,
0.000,   0.058,   0.000,   0.010,   0.590,   0.254,   0.000,   0.232,   0.037,
0.033,   0.000,   0.032,
   60,   0.532,   0.024,   0.000,   0.024,   0.229,   0.050,   0.000,   0.049,
0.227,   0.045,   0.000,   0.045,   0.055,   0.043,   0.000,   0.043,   0.304,
0.053,   0.000,   0.042,   0.297,   0.076,   0.000,   0.043,   0.292,   0.052,
0.000,   0.009,   0.440,   0.111,   0.000,   0.007,   0.000,   0.060,   0.000,
0.016,   0.000,   0.609,   0.000,   0.045,   0.029,   0.150,   0.000,   0.107,
0.000,   0.058,   0.000,   0.010,   0.591,   0.254,   0.000,   0.232,   0.036,
0.033,   0.000,   0.032,
```

Appendix C
Life Cycle Greenhouse Gas Emissions from Building Materials



Life Cycle Greenhouse Gas Emissions from Building Materials

Prepared for:
PBS&J
San Francisco, California

Prepared by:
ENVIRON International Corporation
San Francisco, California

Date:
October 15, 2009

Project Number:
03-22796A

ENVIRON

Contents

Page

Acronyms

AP-42	Compilation of Air Pollutant Emission Factors
$CaCO_3$	limestone
CaO	calcium oxide
CCAR	California Climate Action Registry
CO_2	carbon dioxide
CO_2e	carbon dioxide equivalent
CP-HPS	Candlestick Park-Hunters Point Shipyard Redevelopment Plan Phase II
DOE	Department of Energy
EERE	Energy Efficiency and Renewable Energy
EIA	Energy Information Administration
ENVIRON	ENVIRON International Corporation
ft^2	square feet
GHG	greenhouse gas
GRP	General Reporting Protocol
kWh/m^2	kilowatt hour per square meter
LCA	life cycle analyses
MMBTU	million British thermal units

EXECUTIVE SUMMARY

This report evaluates the life cycle greenhouse gas (GHG) emissions associated with the building materials used in the construction of the Candlestick Park-Hunters Point Shipyard Redevelopment Plan Phase II (CP-HPS Plan). The life cycle GHG emissions include the embodied energy from the materials manufacture and the energy used to transport those materials to the site. This report then compares the life cycle GHG emissions to the overall annual operational emissions of CP-HPS Plan. The materials analyzed in this report include materials for 1) residential and non-residential buildings and 2) site infrastructure. This report calculates the overall life cycle emissions from construction materials to be 3,068 – 16,285 tonnes per year, or 2 – 10% of the overall CP-HPS Plan project emissions.

ENVIRON estimated the life cycle GHG emissions for buildings by conducting an analysis of available literature on life cycle analyses (LCA) for buildings. According to these studies, approximately 75 - 97% of GHG emissions from buildings are associated with energy usage during the operational phase; the other 3 - 25% of the GHG emissions are due to material manufacture and transport. Using the GHG emissions from the operation of CP-HPS Plan buildings, 3% to 25% corresponds to 1,352 – 14,568 tonnes CO_2 per year or 0.9 – 9% of CP-HPS Plan project emissions.

ENVIRON calculated the life cycle GHG emissions for infrastructure (roads, storm drains, utilities, gas, electricity, cable) to be equal to a one time emission of 68,663 tonnes CO_2. This analysis considered the manufacture and transport of concrete. Based on this analysis, the manufacture of the materials leads to 56,139 tonnes of emissions, and the transport of the materials leads to 12,524 tonnes of CO_2 emissions. The majority of the emissions for infrastructure result from the manufacture of concrete because of the higher CO_2 emission factor associated with this process. Because the concrete is locally sourced, the transportation emissions are relatively small. If a 40 year lifespan of the infrastructure is assumed, the total annualized emissions are 1,717 tonnes per year or 1.1% of CP-HPS Plan project emissions.

The overall life cycle emissions from embodied energy in CP-HPS Plan building materials, annualized by 40 years, are 3,068 – 16,285 tonnes CO_2 per year. This represents 2 – 10% of the annualized GHG emissions from the CP-HPS Plan project. The bulk of these emissions are based on general life cycle analysis studies and do not reflect the design features of CP-HPS Plan. Aspects of the project will tend to drive the life cycle emissions towards the lower end of the range; one example is the emphasis on the use of local construction materials.

1 Introduction

This report evaluates the life cycle greenhouse gas (GHG) emissions associated with the building materials used in the construction of the Candlestick Park-Hunters Point Shipyard Redevelopment Plan Phase II (CP-HPS Plan) development. The life cycle GHG emissions include the embodied energy from the materials manufacture and the energy used to transport those materials to the site. This report then compares the life cycle GHG emissions to the overall annual operational emissions of CP-HPS Plan. The materials analyzed in this report include materials for 1) residential and non-residential buildings and 2) site infrastructure.

1.1 Background on Life Cycle Analysis

LCA is a method developed to evaluate the mass balance of inputs and outputs of systems and to organize and convert those inputs and outputs into environmental themes or categories. In this case, the LCA is related to GHG emissions associated with the different stages of a life cycle. The LCA field is still relatively new, and while there are general standards for goals and general practices for LCAs[1] the specific methodologies and, in particular, the boundaries chosen for the LCA makes inter-comparison of various studies difficult. Simple choices such as the useful life of a building or road, for example, can change the LCA outcome substantially. Additionally, the geographic location, climatic zone and building type significantly influence patterns of energy consumption (and energy efficiency) and therefore determine life cycle GHG emissions, which makes comparisons among different studies difficult.

The calculations and results presented in this report are estimates and should be used only for a general comparison to the overall GHG emissions estimated in the Climate Change Technical Report prepared by ENVIRON for CP-HPS Plan. LCA emissions vary based on input assumptions and assessment boundaries (e.g., how far back to trace the origin of a material). Assumptions made in this report are generally conservative. However, due to the open-ended nature of LCAs, the analysis is not exact and may be highly uncertain.

2 Emissions Estimates

2.1 Life Cycle GHG Emissions from Building Materials

ENVIRON estimated the life cycle GHG emissions for building materials by conducting an analysis of available literature on life cycle analyses (LCA) for buildings. According to these studies, approximately 75 - 97% of GHG emissions from buildings are associated with energy usage during the operational phase; the other 3 - 25% of the GHG emissions are due to building material manufacture and transport. Based on the GHG emissions from the operation of CP-HPS Plan buildings[2], 3% to 25% corresponds to 1,352 – 14,568 tonnes CO_2 per year, as shown in Table 1. The specific LCA studies used are discussed in the next section.

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[1] ISO 14044 and ISO 14040

[2] Climate Change Technical Report: Candlestick Park-Hunters Point Shipyard Redevelopment Plan Phase II.

With the current energy generation mix in the US which relies heavily on fossil fuel based sources, focusing on energy efficiency measures (which ultimately reduces lifetime GHG emissions) is more effective in reducing the overall GHG footprint than focusing on materials with low embodied energy. As the energy generation measures reduce their GHG intensity (shift away from fossil fuel to renewable fuels), material selection will be a more critical factor in a building's GHG emissions over its life cycle.

2.1.1 LCA Studies for Buildings

The LCA literature studies tend to compare the energy used to make and transport building materials, or the embodied energy, with the operational energy use. In this manner, the relative importance of the embodied energy can be assessed. ENVIRON discusses several studies that compare the embodied energy and the operational energy.

A life cycle assessment of a 66,000 ft^2 sustainably-designed university building[3] in the US Mid-west[4] estimated that the GHG emissions associated with its energy use over a 100-year time horizon to be 135,000 metric tones of carbon dioxide equivalent (CO_2e), 96.5% of which result from operations phase activities, 3% from material production (of which ⅓ is cement production) and 0.5% from transportation and decommissioning combined. The study also notes that the GHG emissions closely matches the distribution of life cycle energy distributions, indicating that operational energy requirements are the key factor determining overall GHG emissions, especially when considering fossil fuel based energy generation. This building has a longer estimated life than CP-HPS Plan buildings, which would lead to a lower comparison of embodied energy to operational energy.

A study of single-family homes in the US Mid-west,[5] one built using standard construction techniques and the second incorporating energy efficiency measures, reached similar conclusions. Over the life cycle of the homes (assumed to be 50 years), the conventional home uses 15,000 MMBTU and the energy efficient configuration uses 6,000 MMBTU of energy, representing a 60% reduction in overall energy. As GHG emissions closely match the distribution of life cycle energy distributions, the energy efficient variant resulted in 63% fewer emissions. Of the total energy use over the structure's life cycle, 91% of the conventional house total energy results from energy consumed in the use stage (e.g., operating energy). This value drops to 74% in the energy efficient home as the energy embodied in the building materials stays the same or is slightly higher than that in the conventional home and operating energy is reduced.

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[3] Includes 4 floors of classroom and open-plan offices and 3 floors of hotel rooms, in this evaluation used as a surrogate for a generic commercial structure.

[4] Scheuer, C., G.A. Keoleian, and P. Reppe. (2003) Life cycle energy and environmental performance of a new university building: Modeling challenges and design implications. *Energy and Buildings*, **35**(10): p. 1049.

[5] Keoleian, G.A., S. Blanchard, and P. Reppe. (2000) Life-cycle energy, costs, and strategies for improving a single-family house. *Journal of Industrial Ecology*, **4**(2): p. 135.

Similarly, a review of 60 case studies of homes from nine European countries in a variety of climates[6] indicated that operating energy represents the largest part of energy demand by a building during its life cycle. In one evaluation the operating energy is reported as between 92 - 95% for conventional construction and 72 - 90% for low-energy buildings[7] (which are also consistent with other literature references[8]). Sartori and Hestnes[6] also note that buildings constructed with energy efficiency measures may have a higher energy (and concomitant GHG emissions) embodied by the materials used in construction (e.g., more insulation, higher thermal mass), but over the lifespan of the building the overall energy use (operating and embodied energy) is dramatically lower due to the large reductions in operating energy. As an example, the embodied energy was estimated to be 1171 kWh/m^2 for a conventional house and 1391 kWh/m^2 for a passive, energy efficient home, an increase of 220 kWh/m^2 or 19%. Over the lifetime of the building, however, the total energy (operating and embodied) of the conventional house was approximately 22,500 kWh/m^2, while the passive house was roughly 5,500 kWh/m^2, a four-fold decrease in the total energy over an assumed 80 year life cycle.

2.1.2 Energy Efficiency vs. Embodied Energy in Buildings

From our analysis of these assessments, we note the following major conclusions:

- To minimize GHG lifetime emissions, optimization of energy efficiency (both thermal and electrical) for the operational phase of a building should be the primary emphasis for design, especially when the energy supplied is generated from fossil fuel sources.
- Passive design measures such as the orientation of structure to maximize solar heating and daylighting as well as natural ventilation; heavy construction to increase the thermal mass of the structure with materials that have a high capacity for absorbing heat and change temperature slowly; and solar control like window shading[9] should be emphasized[10,11,12] as they have a negligible increase in embodied energy (GHG emissions from material production) and can reduce total energy substantially.[13]
- Active energy efficiency measures (e.g., mechanical ventilation, artificial cooling, free cooling) may as much as double the embodied energy of the structure, but can halve overall energy usage.

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[6] Sartori, I. and A.G. Hestnes. (2007) Energy use in the life cycle of conventional and low-energy buildings: A review article. *Energy and Buildings*, **39**(3): p. 249.

[7] Winther, B.N. and A.G. Hestnes. (1999) Solar versus green: The analysis of a Norwegian row house. *Solar Energy*, **66**(6): p. 387.

[8] Adalberth, K., A. Almgren, and E.H. Petersen. (2001) Life Cycle Assessment of Four Multi-Family Buildings. *International Journal of Low Energy and Sustainable Buildings*, **2**.

[9] United Nations Environment Program 2007 Buildings and Climate Change report whole-house system measures are recommended for the Mediterranean and desert climate zones.

[10] Browning, W.D. and J.J. Romm. (1998) *Greening the Building and the Bottom Line*. Snowmass, Colorado: Rocky Mountain Institute.

[11] United Nations Environment Program. (2007) *Buildings and Climate Change: Status, Challenges and Opportunities.*

[12] US Department of Energy Building Technologies Program. (2007) www.eere.energy.gov/buildings/. October.

[13] Sartori, I. and A.G. Hestnes. (2007) Energy use in the life cycle of conventional and low-energy buildings: A review article. *Energy and Buildings*, **39**(3): p. 249.

- With the current energy generation mix in the US which relies heavily on fossil fuel based sources, focusing on energy efficiency measures (which ultimately reduces lifetime GHG emissions) is more effective in reducing the overall GHG footprint than focusing on materials with low embodied energy. As the energy generation measures reduce their GHG intensity (shift away from fossil fuel to renewable), material selection will be a more critical factor in a building's GHG emissions over its life cycle.

One cannot evaluate the life cycle emissions of a building product independent of the impact that the building product has on energy use. For example, studies that evaluate the relative embodied energy and GHG emissions associated with the production of structural materials such as steel, concrete or wood generally indicate that the wood products have the lowest GHG emissions as it is produced from a renewable resource that may actually remove CO_2 during its production phase and sequester it during its use phase.[14,15] However, these studies do not account for the effect of the material on overall building energy efficiency, which is often heavily dependent on the climate in which the building is located. In desert climates, the thermal mass of the structure is important for energy savings, as the thermal mass cools at night and keep the house cool during the day during hot weather and conversely heats during the day keeps the house warm during the evening during cool weather. To increase thermal mass, concrete is much more effective than wood. In other types of climates (cooler with less solar heating), wood with insulation has a greater impact at improving overall building efficiency.

For some building products or systems, the net energy savings during the operational portion of the building's life cycle are comparable. If this is the case, then the alternative with the lowest embodied GHG emissions will result in the lowest life cycle GHG emissions.

Building materials with high replacement rates, like carpeting and wiring, can often have a high contribution to the overall GHG emissions as their impact is dependent on renovation schedules. For example, if two building materials have the same embodied energy but one is replaced every 5 years and the second is replaced every 25 years then the first will have five times the embodied energy over the lifetime of the building. As such Scheuer et al.[16] indicate that "[d]esign strategies that maximize the service life of building materials should be maximized." These strategies include designing the structure for minimal material use and choosing materials with low embodied energy, high recycled content, and long life spans.

From our analysis of these product or system specific assessments, we note the following major conclusions:

- Products or systems which have the greatest impact in improving overall building energy efficiency over the building's life cycle should be selected to minimize life cycle GHG

[14] Borjesson, P. and L. Gustavsson. (2000) Greenhouse gas balances in building construction: Wood versus concrete from life-cycle and forest land-use perspectives. *Energy Policy*, **28**(9): p. 575.
[15] Lenzen, M. and G. Treloar. (2002) Embodied energy in buildings: Wood versus concrete - Reply to Borjesson and Gustavsson. *Energy Policy*, **30**(3): p. 249.
[16] Scheuer, C., G.A. Keoleian, and P. Reppe. (2003) Life cycle energy and environmental performance of a new university building: Modeling challenges and design implications. *Energy and Buildings*, **35**(10): p. 1049.

emissions. These alternatives may not necessarily have the lowest embodied GHG emissions.

- When evaluating products or systems that have similar impacts on overall building energy efficiency, alternatives with the lowest embodied GHG emissions should be selected to minimize GHG emissions.
- Materials with high replacement rates (e.g., carpeting, wiring) tend to have higher embodied energy due to their short life cycle, therefore minimizing embodied GHG emissions is most critical for these types of products or systems to minimize overall GHG emissions. Materials with low replacement rates (e.g., piping, air ducts) tend to have lower embodied energy over the life cycle of the building, therefore differences in overall GHG emissions between several alternatives are likely to be small.

2.2 GHG Emissions from Manufacture of Infrastructure Materials

ENVIRON evaluated the embodied energies of materials likely to be found in the infrastructure (roads, storm drains, utilities, gas, electricity, cable) of the CP-HPS Plan. The embodied energies of different materials vary based upon the transportation distance and manufacturing processes. A material that is locally-sourced may require a large amount of energy to be produced and, on the contrary, a material with a relatively low energy intensity may be sourced from farther away. ENVIRON assumed that concrete will be among the dominant material used in the infrastructure and estimated the embodied energies of this material. The manufacture of this material results in overall CO_2 emissions of 56,139 tonnes.

2.2.1 Embodied Energy in Infrastructure

ENVIRON used volumes of virgin concrete as provided by MacTech for CP-HPS, resulting in the predicted material amounts shown in Table 3. The embodied energy in concrete for roads and sidewalks based on assuming 25% flyash and no steel reinforcement is 0.076 pound CO_2 per pound of concrete[17]. The embodied energy in concrete for bridges and parking structures based on assuming 15% flyash and 1.5% steel reinforcement is 0.182 pound CO_2 per pound of concrete[18]. One-time emissions from concrete manufacture for infrastructure materials are estimated to be 56,139 tonnes CO_2.

2.3 Transportation of Materials for Infrastructure

ENVIRON estimated the emissions from the transportation of the infrastructure. ENVIRON selected distances based on an expected trip distance of local manufacturers of cement to the CP-HPS Plan[19]. Using the infrastructure material quantities specified in Table 3, ENVIRON

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[17] This was estimated using the Athena Impact Estimator along with related databases which can be found here: http://www.athenasmi.org/tools/impactEstimator/

[18] This was estimated using the Athena Impact Estimator along with related databases which can be found here: http://www.athenasmi.org/tools/impactEstimator/

[19] The distance for concrete and asphalt assumes the use of a local source 100 miles from Candlestick Park-Hunters Point Shipyard Redevelopment Plan Phase II.

estimated emissions of 12,524 tonnes CO_2 from the transportation of the concrete and asphalt in the infrastructure.[20] Details of the calculations are outlined in Table 3.

2.3.1 Calculation of Emissions from Transportation of Materials for Buildings

Although each particular shipper operates with greater or lesser efficiencies, ENVIRON assumed an average GHG emission rate per tonne-mile[21] for each mode of transportation. Although it is likely that more dense material has a slightly lower GHG shipping intensity than does less dense material, this analysis developed a single emission factor per tonne-mile of material moved, regardless of density, for each mode of transportation.

2.3.1.1 Emissions associated with transporting the material

Emission factors were calculated from DOE EERE energy intensity indicators.[22] EERE data is presented in terms of energy per mile traveled. These were converted using AP-42 conversion factors[23] for energy in different types of fuel, and California Climate Action Registry (CCAR) General Reporting Protocol (GRP)[24] emission factors for mass of CO_2 emitted per gallon of fuel. Trains and trucks are assumed to run on diesel. These emission factors are listed in Table 3. The emission factors developed above were multiplied by the distances traveled by each type of transportation.

2.4 Summary of Emissions from Buildings and Infrastructure

Table 4 presents the summary of the life cycle greenhouse gas (GHG) emissions associated with the building materials used in the construction of the CP-HPS Plan. The life cycle GHG emissions include the embodied energy from the materials manufacture and the energy used to transport those materials to the site. The materials analyzed include materials for 1) residential and non-residential buildings and 2) site infrastructure. This report calculates the overall life cycle emissions from construction materials to be 3,068 – 16,285 tonnes per year, or 2 – 10% of the overall CP-HPS Plan project emissions. Aspects of this project such as the emphasis on the use of local construction materials are expected to drive the life cycle emissions toward the lower end of the range.

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20 For the estimates of emissions from material transportation, ENVIRON conservatively assumed that the entire concrete mix, not just cement, is transported from the source locations to the development site.

21 A tonne-mile refers to the amount of material (in tonnes) moved a distance of one mile.

22 Grams CO_2 per tonne-mile. See http://intensityindicators.pnl.gov/trend_data.stm Transportation sector data.

23 AP-42 conversions available at http://www.epa.gov/ttn/chief/ap42/appendix/appa.pdf

24 The GRP is available online at http://www.climateregistry.org/resources/docs/protocols/grp/GRP_3.1_January2009.pdf

Table 1
Life Cycle Greenhouse Gas (GHG) Emissions From Materials[1] Used for Buildings
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

GHG Emissions from Energy Usage Associated with Non-Residential Buildings[2]	Embodied Energy as Percentage of Overall Energy[3]	
	3%	25%
(tonnes CO_2 / year)		
43,705	1,352	14,568

Notes:
1. All materials were analyzed. See references below for more details.
2. Represents CO2 emissions from electricity and natural gas use. From the Candlestick Point-Hunters Point Shipyard Phase II Development Plan Climate Change Report.
3. Percentages are based upon LCA studies below. The studies compared energy used in the manufacture and transport of materials to energy use from electricity and natural gas. Varying lifetimes of buildings were assumed in each study. As buildings become more energy efficient, the portion of GHGs from embodied energy increases.

Abbreviations:
CO_2 = carbon dioxide
GHG = greenhouse gas
LCA = life cycle analysis

Sources:

Scheuer, C., G.A. Keoleian, and P. Reppe. (2003) Life cycle energy and environmental performance of a new university building: Modeling challenges and design implications. *Energy and Buildings* , **35**(10): p. 1049.
Keoleian, G.A., S. Blanchard, and P. Reppe. (2000) Life-cycle energy, costs, and strategies for improving a single-family house. *Journal of Industrial Ecology* , **4**(2): p. 135.
Sartori, I. and A.G. Hestnes. (2007) Energy use in the life cycle of conventional and low-energy buildings: A review article. *Energy and Buildings* , **39**(3): p. 249.

Winther, B.N. and A.G. Hestnes. (1999) Solar versus green: The analysis of a Norwegian row house. *Solar Energy* , **66**(6): p. 387.

Adalberth, K., A. Almgren, and E.H. Petersen. (2001) Life Cycle Assessment of Four Multi-Family Buildings. *International Journal of Low Energy and Sustainable Buildings* , **2**.

Table 2
Quantities of Infrastructure Materials
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Type of Infrastructure	Concrete Volume[1] (cu ft)		Concrete Weight[2] (lbs)		Concrete Emission Factor[3]	Concrete Emissions (tonnes CO_2)	
	HP	CP	HP	CP	(lbs CO_2/lb concrete)	HP	CP
Roads and Sidewalks	2,750,000	2,130,000	398,750,000	308,850,000	0.076	13,746	10,647
Bridge	114,453	0	16,595,685	0	0.182	1,373	0
Parking Structures	1,485,513	1,046,295	215,399,385	151,712,775	0.182	17,821	12,552

Notes:
1. Material volumes provided by MacTech.
2. Density of infrastructure concrete is 145 lbs per cubic feet.
3. Infrastructure concrete embodied carbon is based on estimates from Athena Impact Estimator assuming: 25% fly ash for roads and sidewalks and no steel reinforcement; 15% fly ash for bridge and parking structures and 1.5% steel reinforcement.

Abbreviations:
cu ft = cubic foot
lb = pound

Sources:
Athena Impact Estimator along with related databases which can be found here: http://www.athenasmi.org/tools/impactEstimator/

Table 3
Greenhouse Gas (GHG) Emissions from Transportation of Infrastructure Raw Materials
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Material	Total Mass Transported	Distance from Source Location[2,3]	Mass-Distance[4]	Emission Factor[5]	Emissions to Transport to Construction Site[6]	
		Local Source Cement	Local Source Cement	Truck	Local Source Cement	Total
	(tonnes material)	(miles)	(tonne-miles)	(grams CO_2/ tonne-mile)	(tonnes CO_2)	
Infrastructure	495,009	100	49,500,891	253	12,524	12,524

Notes:

1. The entire mass of concrete is considered because the concrete mix is transported from the source locations.

2. Distances from source to project location estimated using Google Maps.
3. Assumes all concrete aggregate originates from a local source.

4. Mass distance is the mass of material multipled by the distance traveled. ENVIRON assumed that the concrete come from local sources.

5. Emission factors for truck calculated from DOE EERE energy intensity indicators. EERE data is presented in Btu / ton mile. These were converted using AP-42 conversion factors for energy in different types of fuel, and CCAR GRP emission factors for mass CO_2 emitted per gallon of fuel. Trucks are assumed to run on diesel.

6. Emissions calculated by multiplying the mass-distance by the emission factor. Because of the close proximity of the source locations to the Project, ENVIRON conservatively assumed that all materials will be transported by truck.

Sources:
DOE EERE energy intensity indicators. http://intensityindicators.pnl.gov/trend_data.stm Transportation sector data
AP42 conversions available at http://www.epa.gov/ttn/chief/ap42/appendix/appa.pdf

Table 4
Summary of Life Cycle Greenhouse Gas (GHG) Emissions from Buildings, Infrastructure
Candlestick Point-Hunters Point Shipyard Phase II Development Plan
San Francisco, California

Emissions Source[1]		Emissions from Manufacture of Materials[3]	Emissions from Transportation of Materials[4]	Total Emissions	Assumed Lifetime of Emissions Source[5]	Total Annualized Emissions[6]	Total Annual Emissions[7]	LCA Fraction of Total Emissions[8]
		(tonnes CO_2)			(years)	(tonnes CO_2 / year)	(tonnes CO_2 / year)	(%)
Buildings[2]	Low Estimate	54,068		54,068	40	1,352	157,104	0.9%
	High Estimate	582,737		582,737		14,568		9%
Infrastructure		56,139	12,524	68,663		1,717		1.1%
TOTAL		122,731 - 651,400		122,731		3,068 - 16,285		2% - 10%

Notes:
1. ENVIRON estimated LCA emissions from two sources: buildings, and infrastructure.
2. Emissions from buildings are shown as a range from a low to a high estimate based on the range presented in Table 1. The values in Table 1 are multiplied by the assumed lifetime of 40 years to yield total emissions in tonnes CO_2.
3. Emissions from the manufacture of materials for infrastructure are from Table 2.
4. Emissions from the transportation of materials for infrastructure are from Table 3.
5. The assumed lifetime of emissions source may be adjusted; here ENVIRON has assumed a conservatively short lifetime of 40 years.
6. Total emissions are divided by the assumed lifetime of emissions sources to yield the total annualized emissions.
7. From the Climate Change Report.
8. The LCA fraction of total emissions is calculated by dividing the total annualized emissions by the total emissions from Candlestick Point-Hunters Point Shipyard Phase II Development Plan.

Abbreviations:
CO_2 = carbon dioxide
LCA = life cycle assessment

Sources:
Values are calculated using Tables 1 through 3 and the emissions presented in ENVIRON's Candlestick Point-Hunters Point Shipyard Phase II Development Plan Climate Change Report.