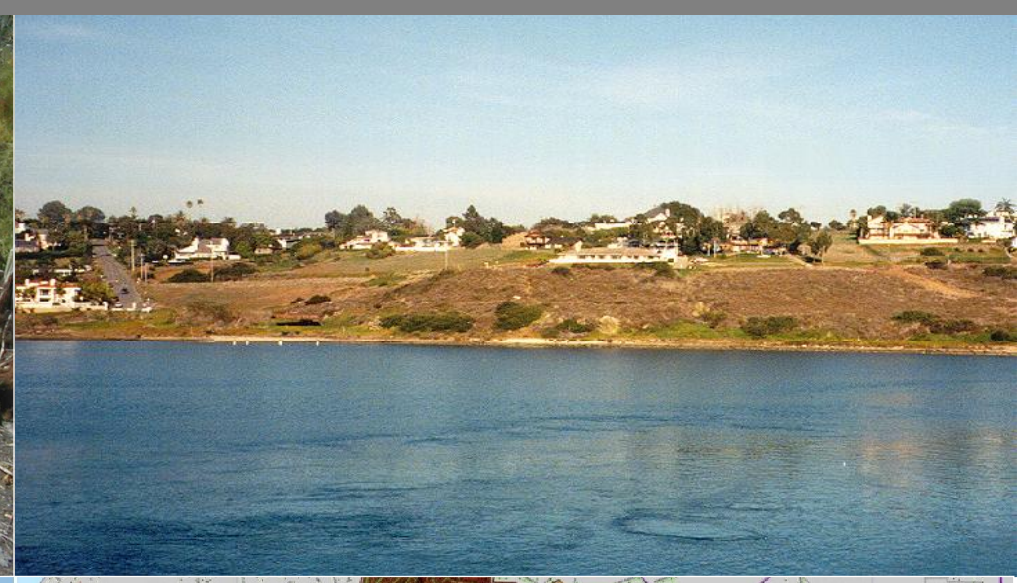
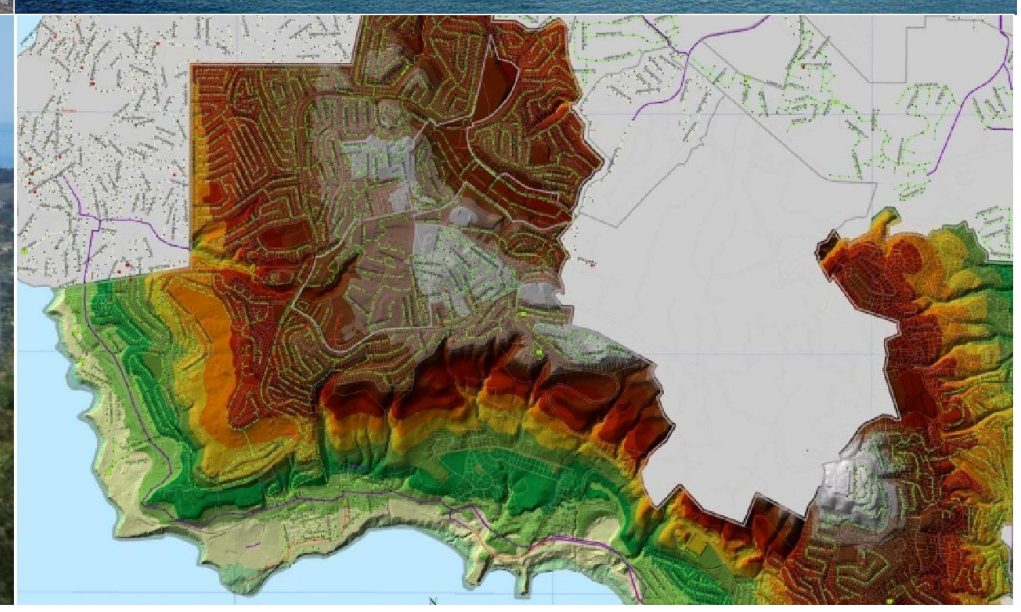
DUDEK

2012 SEWER MASTER PLAN

Final Report





April 2012

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CITY OF CARLSBAD

2012 SEWER MASTER PLAN

FINAL REPORT

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A Exhibits:
- Exhibit 1A – Existing Wastewater Collection System
- Exhibit 1B – Ultimate Wastewater Collection System
- Exhibit 2 – Future Wastewater Flow Generation Areas
- Exhibit 3 – Capital Improvement Projects

B Flow Measurement Technical Memorandum
C Encina Flow Meter Data
D Ownership/Operation Agreements with Other Agencies
E Interceptor Capacity and Flow Data Tables
F 2011 Evaluation and Field Observations Report

ABBREVIATIONS

ADWF	Average Dry Weather Flow
APN	Assessor Parcel Number
BSD	Buena Sanitation Division
CCFRPM	centrifugally cast fiberglass reinforced plastic mortar
CIP	Capital Improvement Program
City	City of Carlsbad
CWRF	Carlsbad Water Recycling Facility
DIP	Ductile iron pipe
EDU	Equivalent Dwelling Unit
EIR	Environmental Impact Report
ESD	Encinitas Sanitary Division, City of Encinitas
EWA	Encina Wastewater Authority
EWPCF	Encina Water Pollution Control Facility
fps	feet per second
GIS	Geographical Information System
gpcd	gallons per capita per day
gpd	gallons per day
gpm	gallons per minute
Hp	horsepower
hr	hour
I&I	Inflow and Infiltration
in	inches
lf	linear feet
LS	Lift station
LWWD	Leucadia Wastewater District
LFMZ	Local Facility Management Zone
mgd	million gallons per day
MFDU	multi-family dwelling unit
MG	million gallons
NAH	North Agua Hedionda
NB	North Batiquitos
PDWF	Peak Dry Weather Flow
PVC	polyvinyl chloride
PWWF	Peak Wet Weather Flow
RCP	Reinforced concrete pipe
SAH	South Agua Hedionda
SanGIS	San Diego County Geographic Information System
SFDU	single family dwelling unit
USGS	United States Geologic Survey
V/C	Vista/Carlsbad
VCP	Vitrified clay pipe
VFD	Variable frequency drive
VWD	Vallecitos Water District
WPCF	Water Pollution Control Facility
WRP	Water Reclamation Plant

The City of Carlsbad provides wastewater collection service to 30.5 square miles, approximately 78 percent of the City limits, through six interceptor pipelines, approximately 270 miles of collection and conveyance pipelines, and 16 lift stations. All wastewater flows are conveyed to the Encina Water Pollution Control Facility (EWPCF), located in Carlsbad, for treatment and then disposal through the ocean outfall or delivery to the adjacent Carlsbad Water Recycling Facility (CWRF) for reuse. Several interceptors are jointly owned with Carlsbad, and convey outside agency flows to the EWPCF in addition to flows generated within the Carlsbad service area. This 2012 Master Plan Update provides a system evaluation and capacity assessment of the wastewater collection system and recommends a capital improvement/replacement program to provide for continued reliable wastewater service through buildout conditions, which are projected to occur by 2035.

1.1 BACKGROUND

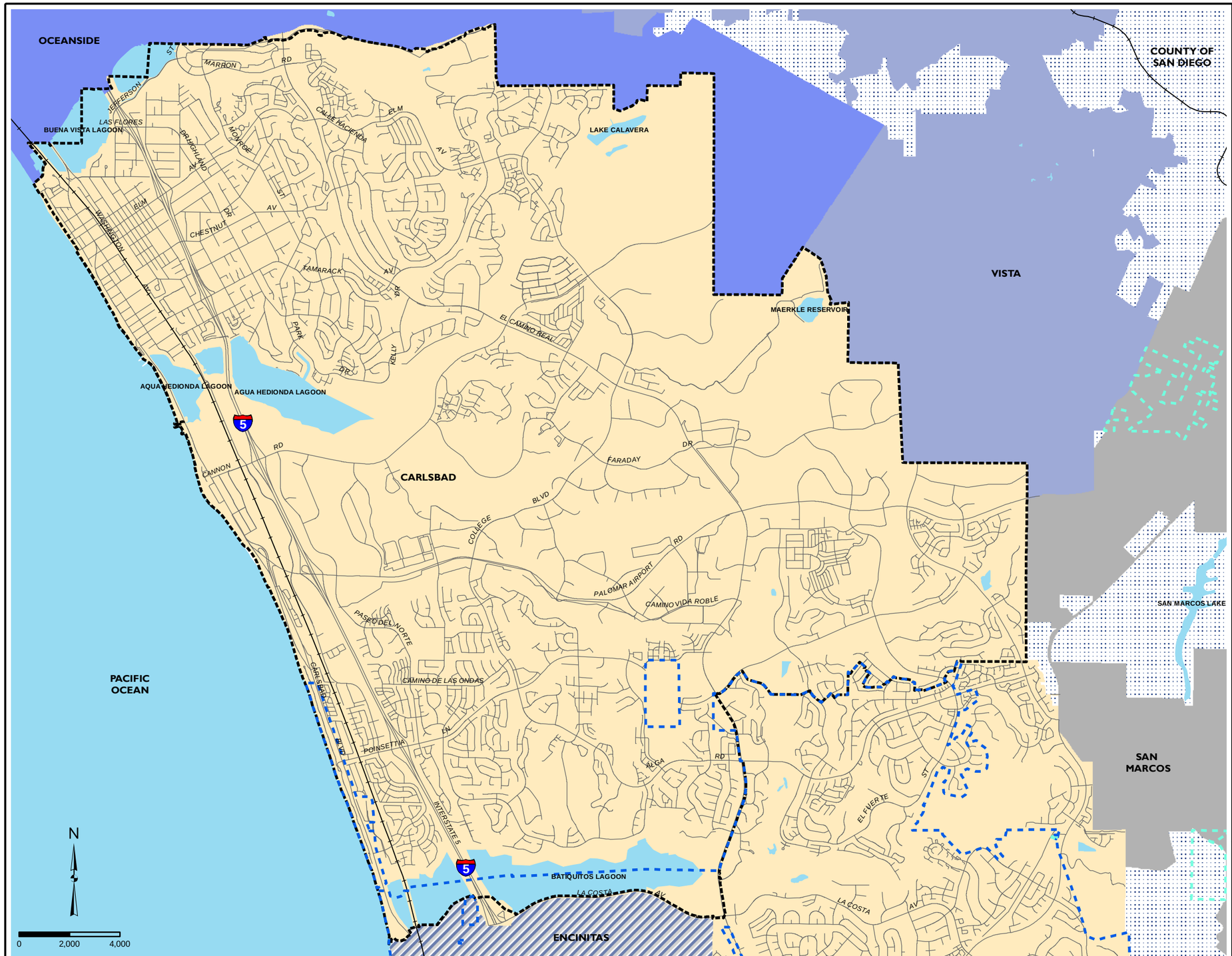
The Carlsbad Sanitary District, formed in 1929, provided the first sewer service to areas now within the City of Carlsbad. A sewage treatment plant and a system of sewer pipelines, serving the northwest corner of the present village area of the City Carlsbad, were initially constructed with the formation of the Sewer District. Thus, portions of the City's existing conveyance system date back as far as 1929. The original treatment plant location was on the south shore of the Buena Vista Lagoon, adjacent to Carlsbad Boulevard. This is the present location of the Home Plant Lift Station.

The Carlsbad Sanitary District provided sewer service until the City of Carlsbad incorporated in 1952. When the City of Carlsbad incorporated, there were approximately 600 parcels being served by the Carlsbad Sanitary District. The City of Carlsbad expanded the sewer system and increased the number of connections. By 1960, it was apparent that a larger treatment facility would be required. To meet the growing regional needs for sewer service, the City of Carlsbad and the Vista Sanitation District jointly constructed the EWPCF, located just south of Palomar Airport Road and west of Interstate 5. When the EWPCF was put into operation in 1965, wastewater flows to the old Carlsbad Sanitary District plant were diverted to the new treatment facility. The EWPCF is now jointly-owned and operated by six northern San Diego County agencies through a Joint Powers Agreement, and operated by the Encina Wastewater Authority (EWA). The member agencies of EWA are: the City of Carlsbad, City of Vista, City of Encinitas, Vallecitos Water District, Buena Sanitation District, and the Leucadia Wastewater District.

1.2 SERVICE AREA OVERVIEW

Carlsbad is a seaside resort city in northern San Diego County with a 2009 population estimated at 104,652 by the California Department of Finance. The City of Carlsbad wastewater service area covers approximately 30.5 square miles, or 78 percent of the 39.1 square miles comprising the City limits. Sewer service to the southeast corner of the City is provided by the Leucadia Wastewater District (LWWD), and the Vallecitos Water District (VWD) provides service to the eastern edge of the City limits. The Carlsbad service area boundary and adjacent district boundaries are shown on Figure 1-1. As shown on Figure 1-1, LWWD has jurisdictional ownership of three areas within Carlsbad's service area. These areas include a narrow strip of land along Carlsbad's coastline in the southwest part of the city, a rectangular parcel located in the vicinity of the future Poinsettia Lane extension, and a small triangular

parcel adjacent to El Camino Real and Dove Lane. However, LWWD has acknowledged that it is not practical for them to provide sewer service to these areas and they have agreed to cooperate with the City in the de-annexation of these areas to Carlsbad. LWWD has requested that the parcels be de-annexed through the LAFCO process when the properties are ready to be developed.



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WASTEWATER DISTRICTS

- LEUCADIA WASTEWATER DISTRICT
- VALLECITOS WATER-SEWER SERVICE
- CARLSBAD S SEWER SERVICE BOUNDARY
- WATER BODIES

CITIES

- CARLSBAD
- ENCINITAS
- OCEANSIDE
- S.D. COUNTY
- SAN MARCOS
- VISTA

FIGURE 1-1

CITY OF CARLSBAD SEWER SERVICE AREA

The geography is characterized by three lagoons and gently rolling to highly dissected mesa-like hills. Elevations range from sea level along the coast to over 700 feet along the eastern boundary. The average annual precipitation is 10.7 inches and most of the rainfall occurs between November and March. The service area is comprised of four major drainage basins, which extend from approximately the eastern service area boundary, and drain west to the coast. The major drainage basins are shown on Figure 1-2.

The northern-most drainage basin is on the south side of Buena Vista Creek, which forms the boundary between the City of Oceanside and the City of Carlsbad. It is approximately 1 mile wide. South of the Buena Vista Creek basin is the largest basin, Agua Hedionda Creek. This basin is approximately 3.5 miles wide and includes the Agua Hedionda Lagoon. Further south is the Encinas Creek Basin. Palomar Airport Road is aligned through the approximate center of the Encinas Creek basin, which includes the Encinas Canyon area. The EWPCF is located at the west end of the Encinas Creek basin. The most southerly drainage basin is the Batiquitos/San Marcos Creek basin, which includes the North La Costa area and areas along the north shore of the Batiquitos Lagoon.

1.3 LAND USE

The primary land use in the Carlsbad sewer service area is residential, with local and regional commercial centers and several large industrial business parks. There is also a small public airport and several resort complexes and tourist related facilities centered around the Legoland amusement park and the Park Hyatt Aviara Resort. According to the U.S. Census Bureau 2005-2007 American Community Survey, the population density averages 2.50 people per household. Based on the existing land use, there are approximately 1,400 acres of vacant and undeveloped lands remaining that are not within General Plan designated open space areas. This is approximately seven percent of the total sewer service area.

The oldest part of the service area is in the northwestern quadrant and includes the downtown "Village" center, a regional shopping mall, and many established single family developments and apartments that were built prior to the 1970's. The northeastern quadrant is almost exclusively residential, with the exception of commercial development along the east side of El Camino Real. Some of the residential areas are quite established while others, particularly in the last construction phases of Calavera Hills, have only recently completed construction. Most of the vacant land planned for future development is located east of El Camino Real, and there is a large undeveloped area along the northeast boundary of the City that will remain as open space. The major industrial areas, including the airport, are located in the center of the service area along Palomar Airport Road. The areas south of Palomar Airport Road are primarily residential and include the communities of Aviara, Bressi Ranch, La Costa, Rancho Carrillo, Villages of La Costa, and the Ponto Beach area, which is planned for redevelopment.

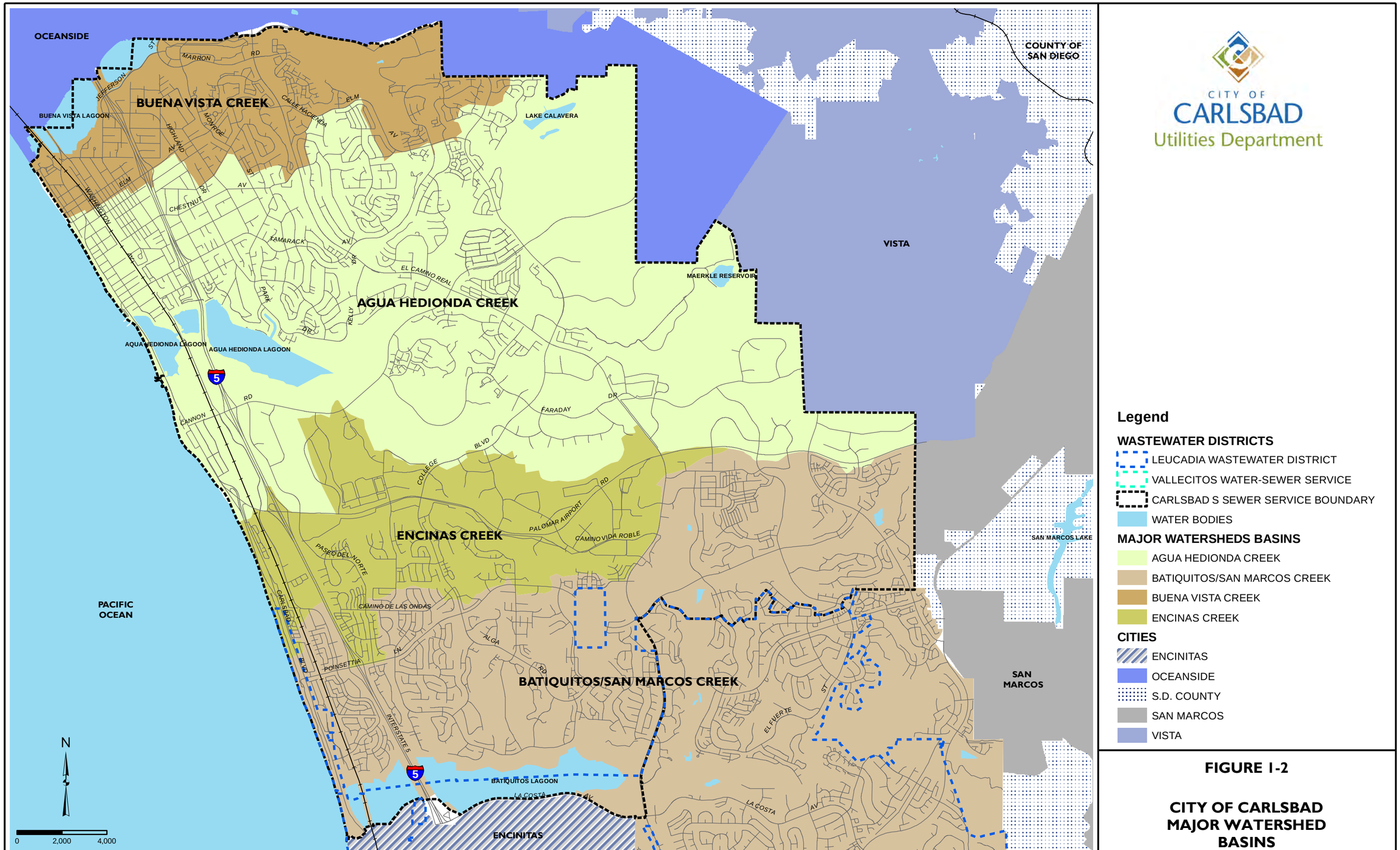


FIGURE 1-2

CITY OF CARLSBAD MAJOR WATERSHED BASINS

1.4 GROWTH MANAGEMENT PLAN

On July 1, 1986, the City Council of Carlsbad adopted a Growth Management Plan to help assure provision of adequate facilities for future development. Implementation of the Growth Management Program was envisioned as a three level system, involving 1) a Citywide Facilities and Improvement Plan, 2) the preparation of 25 Zone Facilities Plans, and 3) individual project approvals. The Citywide Plan established the following standards for sewer collection and wastewater treatment:

- Sewer Collection System Performance Standard – Trunk line capacity to meet demands as determined by the appropriate sewer district must be provided concurrent with development.
- Wastewater Treatment Capacity Performance Standard – Sewer plant capacity is adequate for at least a five year period.

As part of the Growth Management Plan, the City of Carlsbad was partitioned into 25 separate planning areas, which are identified as Local Facility Management Zones (LFMZs). The City of Carlsbad's Sewer Service Area includes all or portions of LFMZs 1-10, 13-22, 24 and 25. These LFMZs are illustrated on Figure 1-3.

The City of Carlsbad is currently in the process of updating its General Plan; however, the City is in the early phases of this process and it is unknown at this time how significant the changes will be to the updated General Plan and what affects, if any, this will have on the sewer system. An amendment to this master plan may be needed at some time in the near future.

1.5 PREVIOUS MASTER PLANS

Summaries of the four most recent Sewer Master Plans are provided in the following sub-sections.

1.5.1 1987 Master Plan of Sewerage

The 1987 Master Plan of Sewerage was the first master plan prepared in accordance with City of Carlsbad's Growth Management Plan. In 1987, the majority of development in Carlsbad was along the coastal strip and predominantly residential. The population of the 1987 study area was estimated at 39,000, and the ultimate population was projected to be 95,700. Average wastewater flows were projected at a rate of 220 gallons per day per equivalent dwelling unit (EDU). In 1987, the ultimate average flow from the City of Carlsbad's sewer service area was projected to be 13.41 million gallons per day (mgd).

1.5.2 1992 Master Plan of Sewerage

The 1992 Master Plan of Sewerage was an update of the 1987 Master Plan. By 1992, the population of the study area had increased to 65,000 and the average annual wastewater flow was 5.76 mgd. The ultimate population projection had increased to 130,000. Development was starting to progress inland and the percentage of commercial/industrial development had increased since the 1987 Master Plan. The projected population growth curve first developed in the 1987 Master Plan was revised to increase more rapidly through the year 2000, and then flatten out to an annual growth rate of approximately 1 percent from the year 2000 to buildout. In 1992, the ultimate average flow projection was increased slightly from the 1987 projection to an estimated flow of 13.84 mgd.

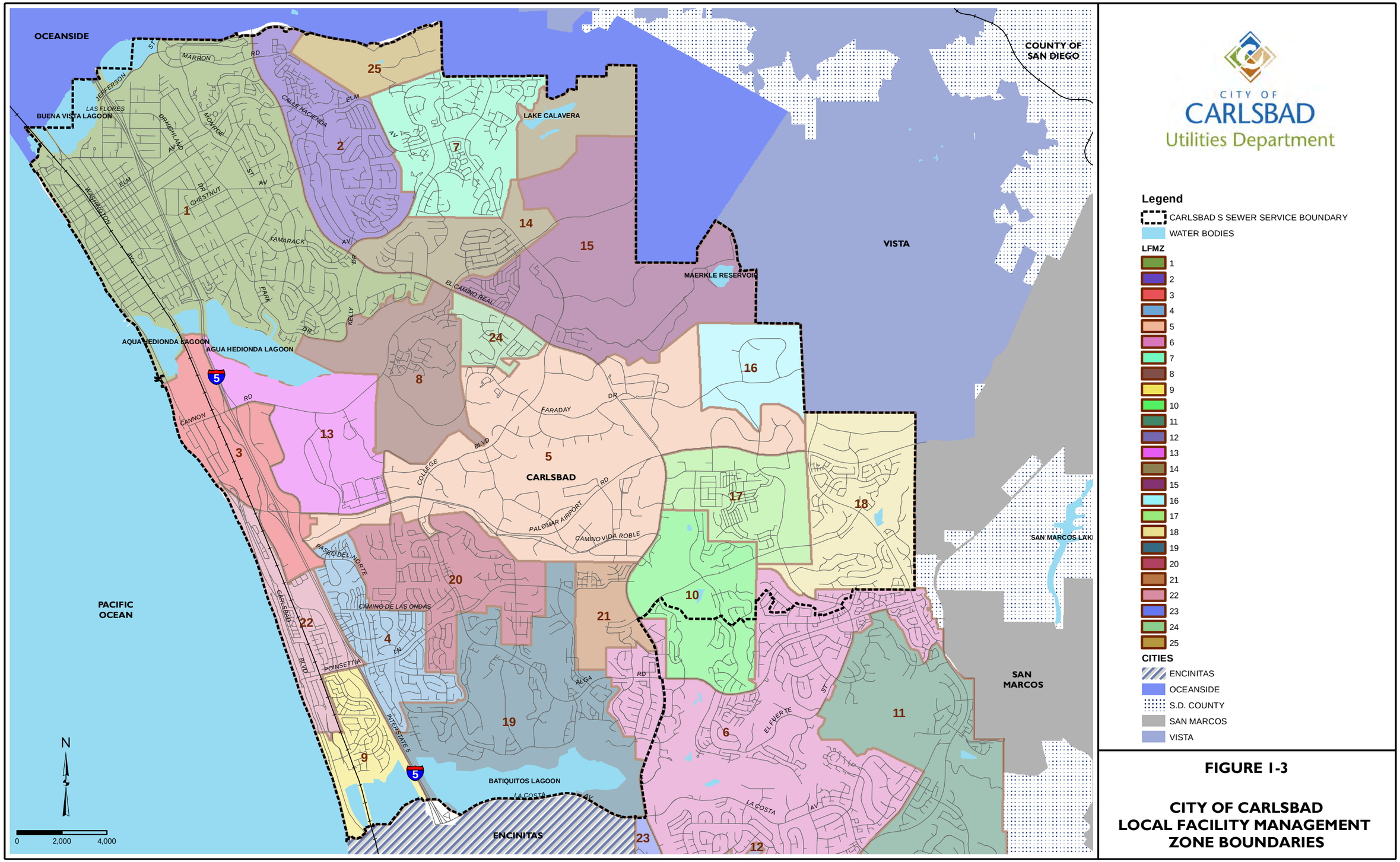


FIGURE 1-3

CITY OF CARLSBAD LOCAL FACILITY MANAGEMENT ZONE BOUNDARIES

Major improvements recommended in the 1992 update included capacity upgrades to the Vista/Carlsbad (V/C) Interceptor, replacement of the Home Plant Lift Station, and the construction of gravity sewers to lift stations in LFMZs 2 and 7. It was also recommended to divert wastewater flows from the Palomar Oaks Business Park area, located north of Palomar Airport Road and east of El Camino Real, from the South Agua Hedionda Drainage Basin into the Buena Interceptor.

1.5.3 1997 Sewer Master Plan Update

In 1994, the City of Carlsbad adopted a new General Plan. The 1997 Sewer Master Plan Update incorporated the revised 1994 land use and population projections. Because ultimate population projections were reduced only slightly from those used in the previous Master Plan, an updated capacity analysis of the interceptors was deemed unnecessary. The 1997 Master Plan Update focused on analyses of the North Agua Hedionda (NAH) and South Agua Hedionda (SAH) sewer basins to determine whether excess hydraulic capacity in the NAH Interceptor could be used to convey portions of the SAH flows. Preliminary sizing, slope and alignment of the SAH Interceptor were performed as part of this update. Also included in the update were additional hydraulic analyses of the V/C Interceptor and a detailed survey of the existing lift stations.

1.5.4 2003 Sewer Master Plan Update

By 2002, wastewater flows had increased to approximately 6.8 mgd with the development of Kelley Ranch, Rancho Carrillo, and portions of Calavera Hills and the Faraday and Loker Business Parks. Most of the remaining large planned developments in the eastern portion of the service area, including Bressi Ranch and Robertson Ranch, were in detailed planning stages. The City had developed a new planning tool, a Growth Database which projected the number of future residential units and the size of non-residential buildings for each parcel at buildout. The 2003 Sewer Master Plan Update utilized this data together with updated unit flow factors to project ultimate flows and identify facilities required for buildout of the City's service area, which was projected to occur by 2020. Ultimate wastewater flows were projected to be 9.9 mgd, approximately 40% percent lower than the 1992 Master Plan projections.

A major task included in the scope of the 2003 Master Plan was development of a Geographical Information System (GIS) for the sewer collection system and an integrated computer model of the major interceptors. The interceptors were analyzed with City of Carlsbad flows and then evaluated with respect to the pipeline capacity or Carlsbad capacity rights in jointly-owned pipelines. Extended period hydraulic simulations were performed with peaking curves derived from EWA meter data.

1.6 SEWER SYSTEM MANAGEMENT PLAN

On May 2, 2006, the State Water Resources Control Board adopted Statewide General Waste Discharge Requirements for Sanitary Sewer Systems. The intent of the Order is to regulate all collections systems in the State in an effort to reduce or eliminate the number of Sanitary Sewer Overflows (SSOs) which pollute the environment.

In response to the 2006 WDR Order, the City of Carlsbad prepared a "Sanitary Sewer System Management Plan" (SSMP), which was approved by Council Resolution No. 2009-192 at a meeting held

on July 21, 2009. The plan was subsequently submitted to the SWRCB and the requirements of the report were implemented by staff.

1.7 2012 UPDATE SCOPE AND PURPOSE

This report represents an update of the City of Carlsbad Sewer Master Plan for the planning period between 2009 and buildout of the City's service area, which is projected to occur by 2035. The scope includes tasks to document existing facilities, conduct wet weather monitoring, perform an Infiltration and Inflow analysis, update unit sewer flows, project ultimate wastewater flows, and develop a computer model of the entire collection system to perform capacity analyses of the existing and ultimate collections systems. The outcome of these analyses is a recommended long-term Capital Improvement Program (CIP) for improvement of existing wastewater collection and treatment facilities. An analysis of the sewer connection fee is also included to finance the recommended facilities.

Preparation of the 2012 Carlsbad Sewer Master Plan was authorized by the Carlsbad City Council on December 11, 2008 in the form of a contract for engineering services entitled "Agreement for Engineering Services to Update the Carlsbad Sewer Master Plan, Project No. 5511".

CHAPTER 2 - EXISTING SYSTEM DESCRIPTION

This chapter summarizes the existing wastewater facilities within the City of Carlsbad Sewer Service Area. These facilities include the main sewer interceptors, lift stations, collector sewers, and wastewater treatment and disposal facilities. Information regarding the existing wastewater collection system facilities was obtained from the City's sewer system GIS, previous reports and studies, and City Engineering and Public Works staff input. Capacity calculations for the gravity interceptors are based on the sewer system GIS and were generated from the hydraulic model.

2.1 GENERAL

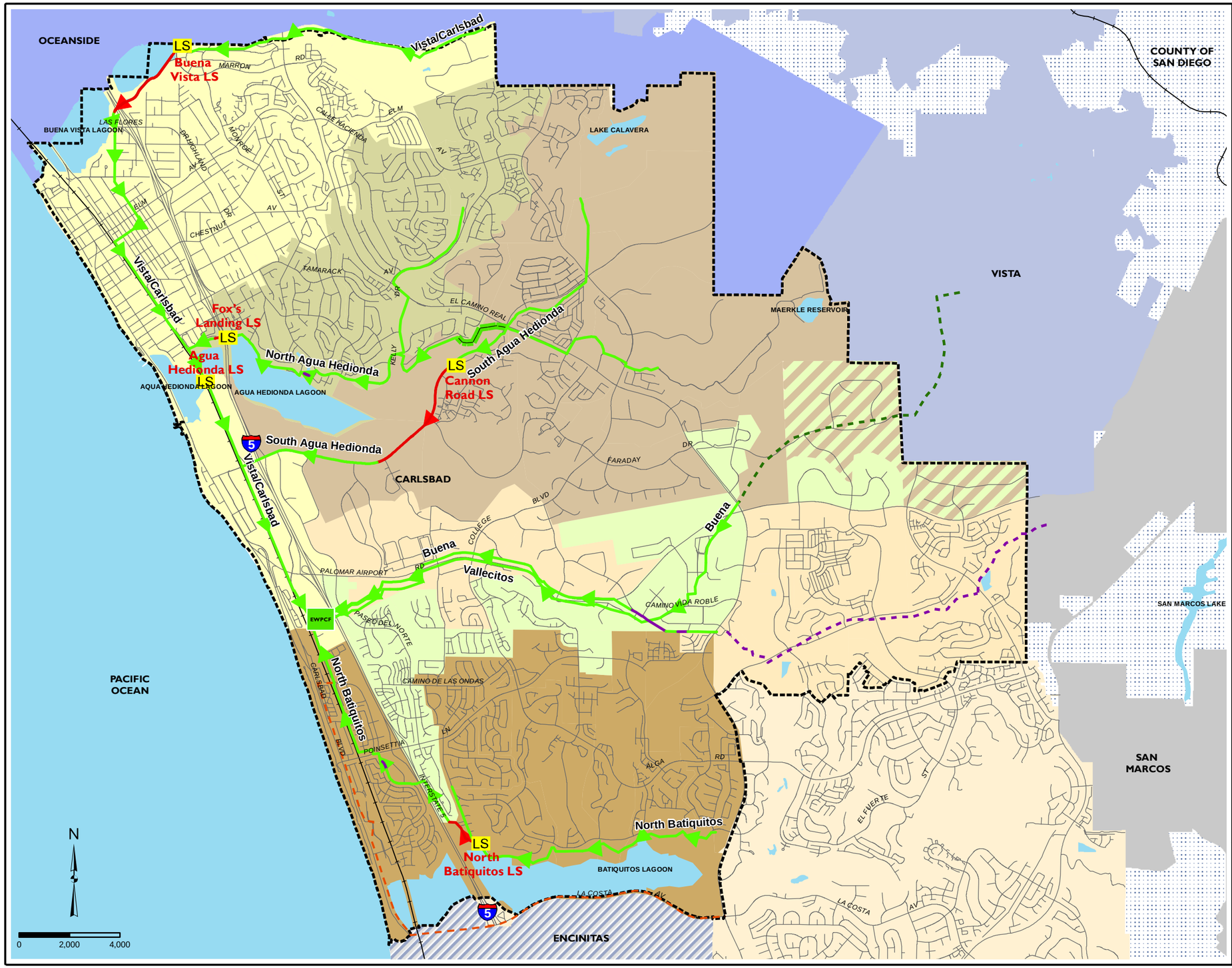
The City of Carlsbad Sewer Service Area includes the majority of the City, with the exception of the southeast corner of the City. Wastewater collection in the southeastern area, which includes the community of La Costa, is provided by the Vallecitos Water District (VWD) and the Leucadia Wastewater District (LWWD). Carlsbad's Sewer Service Area extends from the Pacific Coast approximately 4 to 5 miles inland, providing wastewater collection, treatment and disposal service to customers within its 30.5 square mile service area. Sewer flows are conveyed in six interceptors to the EWPCF, which is along the coast and approximately centered north-south in the service area. Five lift stations are part of the interceptor system and 11 smaller lift stations are required in the collection system to convey wastewater flows to the EWPCF.

2.2 INTERCEPTOR SYSTEM

The six pipeline interceptors within the City of Carlsbad Sewer Service Area are:

- Vista/Carlsbad (V/C)
- North Agua Hedionda (NAH),
- South Aqua Hedionda (SAH)
- Buena (BIS)
- Vallecitos (VIS)
- North Batiquitos (NB)

The NAH and SAH Interceptors collect only City of Carlsbad flows and discharge to the V/C Interceptor at separate locations. The other four interceptors convey City of Carlsbad plus outside agency flows to EWPCF. The alignments and reach designations of the existing interceptor sewers are shown on Figure 2-1 and also on the figures included in the following sub-sections for each individual interceptor system. The naming convention for the interceptor reaches was obtained from previous master plans or updated agency agreements and studies. Graphs showing the full pipeline capacity of each interceptor reach are also provided in the following sub-sections. It is noted that the full pipeline capacity is based on the slope calculated for each reach based on the pipeline length and manhole invert elevations in the City's GIS. In accordance with direction of City Staff, the capacity of siphons is based on the lesser capacity of the upstream or downstream gravity reach.



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- EWPCF ENCINA WATER POLLUTION CONTROL FACILITY
- LS EXISTING LIFT STATIONS

INTERCEPTORS

- FORCEMAIN
- GRAVITY
- SIPHON
- SAH EMERGECY OVERFLOW PIPE

UPSTREAM AGENCY FACILITIES

- BUENA SANITATION SIPHON
- VALLECITOS SANITATION FORCEMAINS
- LEUCADIA WASTEWATER DISTRICT DUAL FORCEMAIN
- CARLSBAD S SEWER SERVICE BOUNDARY
- WATER BODIES

ULTIMATE INTERCEPTOR SERVICE AREA

- BUENA
- NORTH AGUA HEDIONDA
- NORTH BATIQUITOS
- SOUTH AGUA HEDIONDA
- SOUTH AGUA HEDIONDA/BUENA
- VISTA/CARLSBAD
- VALLECITOS

CITIES

- CARLSBAD
- ENCINITAS
- OCEANSIDE
- S.D. COUNTY
- SAN MARCOS
- VISTA

FIGURE 2-1

CITY OF CARLSBAD EXISTING INTERCEPTOR SYSTEM

2.2.1 Vista/Carlsbad Interceptor

The Vista/Carlsbad (V/C) Interceptor is jointly owned by the City of Vista and the City of Carlsbad. The V/C Interceptor is approximately eight miles long, and extends from the Vista meter station just west of College Boulevard and Highway 78 to the EWPCF. Flow from the City of Vista and a small portion of the City of Oceanside is metered at the upstream reach. The Buena Vista Lift Station and Agua Hedionda Lift Station, both of which are maintained and operated by the Encina Wastewater Authority, are a part of the interceptor system. Flow from the NAH Interceptor enters the V/C Interceptor just upstream of the Agua Hedionda Lift Station, flow from the SAH Interceptor enters the V/C Interceptor at Cannon Road, just downstream of the Agua Hedionda Lift Station, and flow from the NB Interceptor is collected in the last reach before entering the EWPCF. Figure 2-2 illustrates the V/C Interceptor and the reach designations, VC1 through VC15, which were established in ownership agreements. It is noted that each named pipeline "reach" actually consists of multiple pipeline reaches between manholes which may have varying capacities.

The V/C Interceptor was originally constructed in 1965. Sections of the interceptor were replaced with larger diameter pipelines in 1979, 1988, and in 2003, when a two-mile section through the downtown Carlsbad area was replaced with 36-inch to 54-inch diameter pipeline (Reaches VC5 through VC11A). The City of Vista recently completed a rehabilitation project on portions of upstream reaches (VC1, VC2, and VC3), consisting of a cured-in-place liner on the interior of the pipelines and rehabilitated manholes.

The existing V/C Interceptor includes gravity pipelines ranging from 36 to 54- inches in diameter, parallel 18-inch force mains at the Agua Hedionda Lift Station, and parallel 24 and 16-inch diameter force mains at the Buena Vista Lift Station. The material for the gravity pipelines is vitrified clay pipe (VCP), reinforced concrete pipe (RCP) with a PVC (poly vinyl chloride) liner (T-Lock liner) or Hobas pipe. Approximately 3,500 linear feet of centrifugally cast fiberglass reinforced plastic mortar (CCFRPM) pipe was installed in Jefferson Street and Oak Avenue using microtunneling technology in 2001. The pipe material for this section is listed by the trade name "Hobas" on the construction drawings. The existing V/C Interceptor serves all of the Local Facility Management Zone (LFMZ) 3, portions of LFMZs 1, 2 and 22, and also collects flow from the NAH and SAH Interceptors. Ultimately the V/C Interceptor will serve LFMZ 25 and portions of LFMZ 7.

The agreement for Ownership, Operation, and Maintenance of the V/C Interceptor Sewer was most recently revised in February 2002 and is provided in Appendix D. Carlsbad's ownership rights in the interceptor are based on the full flow pipeline capacity and increase in the direction of flow, reaching approximately 50 percent ownership in the downstream reaches. The V/C Interceptor ownership, based on build-out conditions as defined in the February 2002 Agreement with the City of Vista, is shown in Table 2-1. Recently, the City has determined that it will need capacity in Reach VC1 to provide sewer service to the proposed 629 unit Quarry Creek project planned for the northeast corner of Carlsbad. Projects to replace the Buena Vista and Agua Hedionda Lift Station force mains, construct a new bridge crossing over the Agua Hedionda Lagoon (reach VC-12), and increase the capacity of reaches VC13-VC15 are currently in design and will be funded based on the percentage of capacity ownership in that portion of the interceptor.

Figure 2-2 Vista/Carlsbad Interceptor

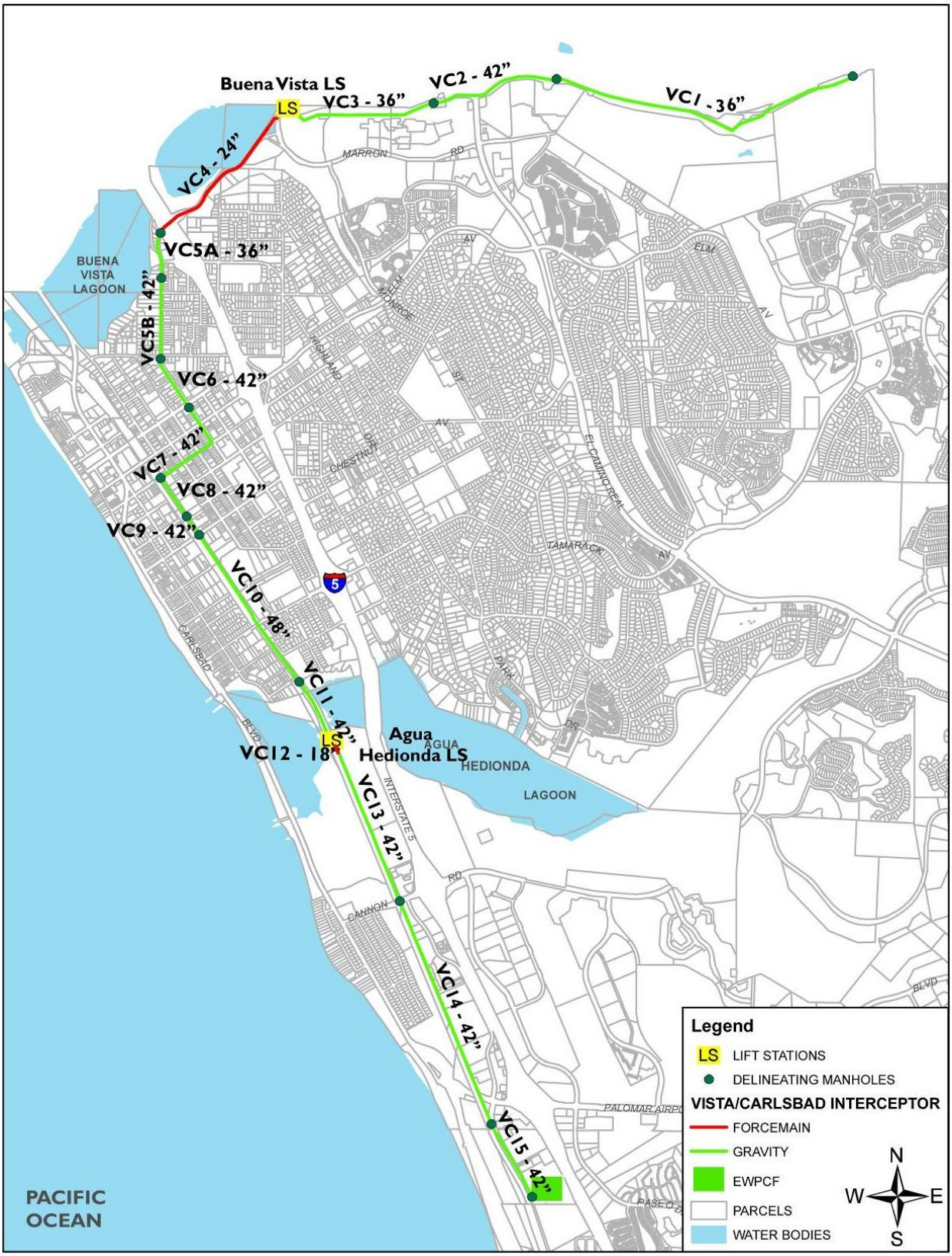


Table 2-1 Vista/Carlsbad Interceptor Ownership

(from February 2002 Agreement with the City of Vista)

Pipeline Reach	Pipe Size (inches)	Full Flow Pipe Capacity (mgd)	City of Vista			City of Carlsbad		
			Average Flow (mgd)	Percent Capacity	Capacity Rights (mgd)	Average Flow (mgd)	Percent Capacity	Capacity Rights (mgd)
(a) VC1	36	30.0	10.38	100.0%	30.00	0.00	0.0%	0.0
VC2	42	34.0	10.38	93.4%	31.77	0.73	6.6%	2.2
VC3	36	19.5	10.38	89.6%	17.48	1.20	10.4%	2.0
Buena Vista Lift Station	--	23.1	10.38	89.6%	20.71	1.20	10.4%	2.4
VC4 – FM	24	23.1	10.38	89.6%	20.71	1.20	10.4%	2.4
VC5	42	31.5	10.38	89.6%	28.24	1.20	10.4%	3.3
VC6	42	31.5	10.38	81.9%	25.81	2.29	18.1%	5.7
VC7	42	31.5	10.38	79.4%	25.02	2.69	20.6%	6.5
VC8	42	31.5	10.38	79.4%	25.02	2.69	20.6%	6.5
VC9	48	28.5	10.38	75.5%	21.51	3.37	24.5%	7.0
VC10	48	28.5	10.38	74.7%	21.30	3.51	25.3%	7.2
VC11	42	20.5	10.38	69.1%	14.16	4.65	30.9%	6.3
Agua Hedionda Lift Station	--	23.0	10.38	69.1%	15.88	4.65	30.9%	7.1
VC12 – FM	2-18	23.0	10.38	69.1%	15.88	4.65	30.9%	7.1
VC13	42	20.5	10.38	69.1%	14.10	4.65	30.9%	6.4
VC14	42	20.5	10.38	56.1%	11.51	8.11	43.9%	9.0
VC15	42	22.8	10.38	56.1%	12.79	8.13	43.9%	10.0
(b)VC16	54	67.4	10.38	50.2%	33.80	10.28	49.8%	33.6

(a) Carlsbad requires capacity from Vista in VC1 to serve the Quarry Creek Project (LFM27 & 25).

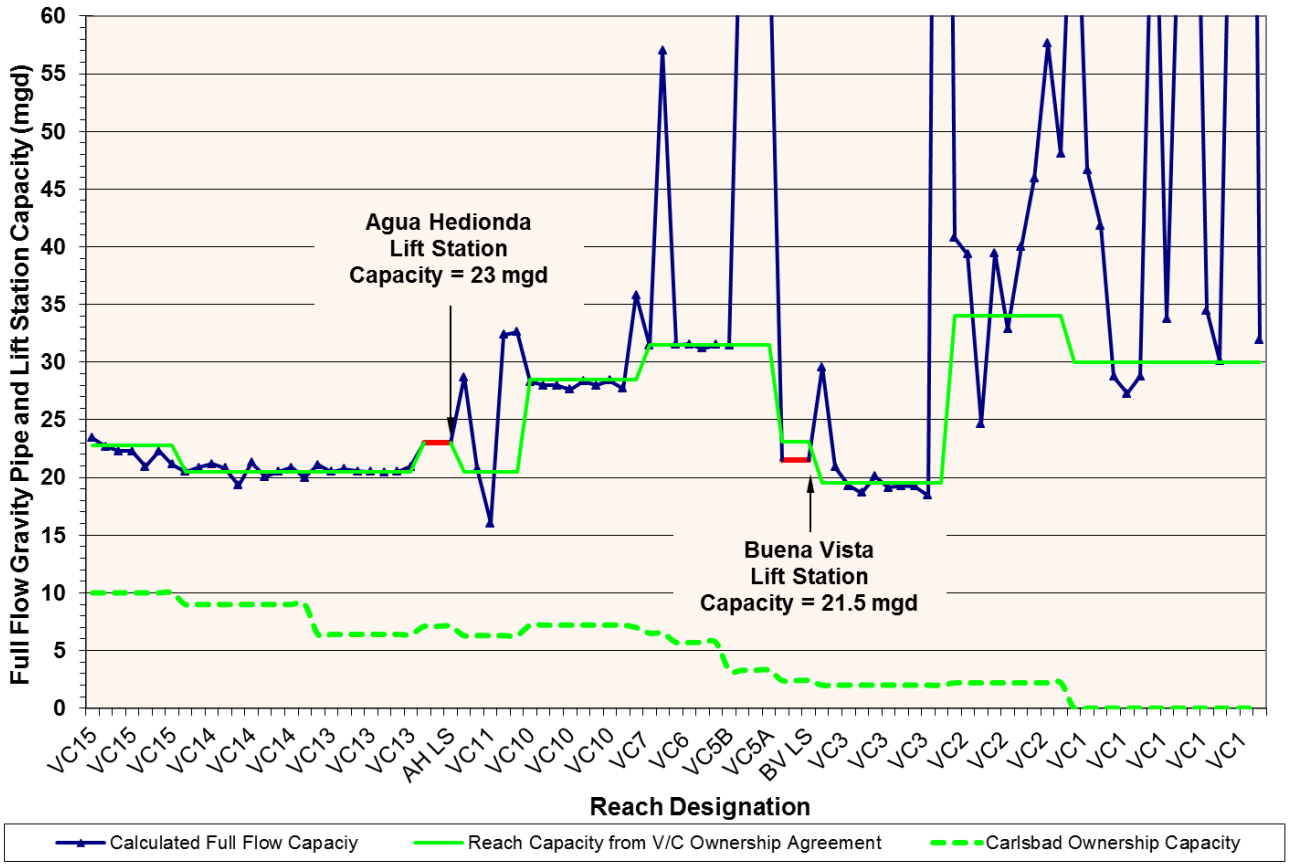
(b) A separate multi-agency agreement is to be prepared for Reach VC16, now referred to as the West Encina Influent Sewer. VC16 is no longer part of the VC Sewer System, pending the completion of the multi-agency agreement and an amendment to the 2002 Vista/Carlsbad Ownership Agreement.

The full flow capacity of each pipeline section based on the City of Carlsbad GIS is illustrated on Figure 2-3. The full pipe capacity was calculated from the sewer hydraulic model based on a Manning's coefficient ("η") of 0.013 for unlined sections, and a coefficient of 0.012 for the PVC-lined RCP and CCFRPM pipe sections (reaches VC5 through VC10). Also shown on the figure are the firm capacities of the Buena Vista and Agua Hedionda Lift Stations, as reported by Encina Wastewater Authority Operations Staff (firm capacity is defined as the capacity of installed pump facilities with the largest unit out of service) and the "average" reach capacities listed in February 2002 Agreement with Vista. It is noted that portions of the upstream reaches of the V/C Interceptor have very steep slopes, and the pipeline capacities at several locations are nearly 100 mgd, which is off the scale of the chart.

It should be noted that in previous master plans and agreements, the 54-inch pipeline that entered the Encina Water Pollution Control Facility (EWPCF) was identified as VC16 of the Vista Carlsbad Interceptor Sewer. However, since this pipeline actually conveys wastewater for Vista, Carlsbad, Encinitas and LWWD, the pipeline has since been renamed the West Encina Influent Sewer and a new ownership agreement is being written for the four agencies to provide cost share and capacity in this line. The existing 54-inch West Encina Influent Sewer was replaced in 2010 with a 60-inch diameter Hobas pipe, which extends approximately 300 LF to the Influent Junction Structure of the EWPCF. Each

agency has capacity ownership rights in the pipeline relative to their projected ultimate PWWF. The maximum capacity of the line flowing full is 84 mgd.

Figure 2-3 Full Pipe Capacity of the Vista/Carlsbad Interceptor System



2.2.2 North Agua Hedionda Interceptor

The North Agua Hedionda (NAH) Interceptor is entirely owned by the City of Carlsbad and conveys only City of Carlsbad wastewater. Beginning at the abandoned Calavera Hills Treatment Plant, the interceptor flows westerly along the north shore of the Agua Hedionda Creek and Lagoon to just east of Interstate 5. At the downstream end, the Foxes Landing Lift Station pumps the wastewater across Interstate 5 and discharges into a short gravity interceptor, which flows to the V/C Interceptor upstream of the Agua Hedionda Lift Station.

The main NAH Interceptor was constructed in 1966 and the northern branch was constructed in 1980. Several rehabilitation projects have recently been completed, including rehabilitation of manholes, replacement and alignment change for approximately 1,800 feet of 24-inch diameter pipeline along the lagoon, minor realignments and replacement of an 8-inch diameter upstream reach (NAHT1A) in Tamarack Avenue that was originally designed as the Calavera Hills Treatment Plant outfall. The gravity pipelines in the main branch range in size from 18 to 24 inches in diameter, and a triple barrel siphon with parallel 10-inch, 16-inch and 16-inch pipelines comprises Reach NAH4. The hydraulic profile of the interceptor is very flat, and most of the 24-inch and 18-inch diameter downstream reaches have a slope of less than 0.15 percent. Most of the gravity pipelines are constructed of VCP and the siphon ("Cove Siphon") pipes are cast iron with cement mortar lining. This interceptor currently serves portions of

LFMZs 1 and 2, all of LFMZ 7. When Roberson Ranch West is constructed, it will serve a portion of LFMZ 14 as well.

The full pipe capacity of the NAH Interceptor was reported to be between 4.6 and 6.8 mgd in each of the five gravity reaches in the 1992 Master Plan. However, several flatter sections exist which restrict the flow capacity. There is also a triple barrel siphon where the interceptor crosses Bristol Cove; however, only one of the 16-inch diameter pipes is typically used. The NAH Interceptor is illustrated on Figure 2-4 and the full flow gravity pipeline capacity of each reach based on the City's GIS data is plotted on Figure 2-5. The firm pumping capacity of the Foxes Landing Lift Station, 3.7 mgd, is shown in red on the capacity chart.

Figure 2-4 North Agua Hedionda Interceptor

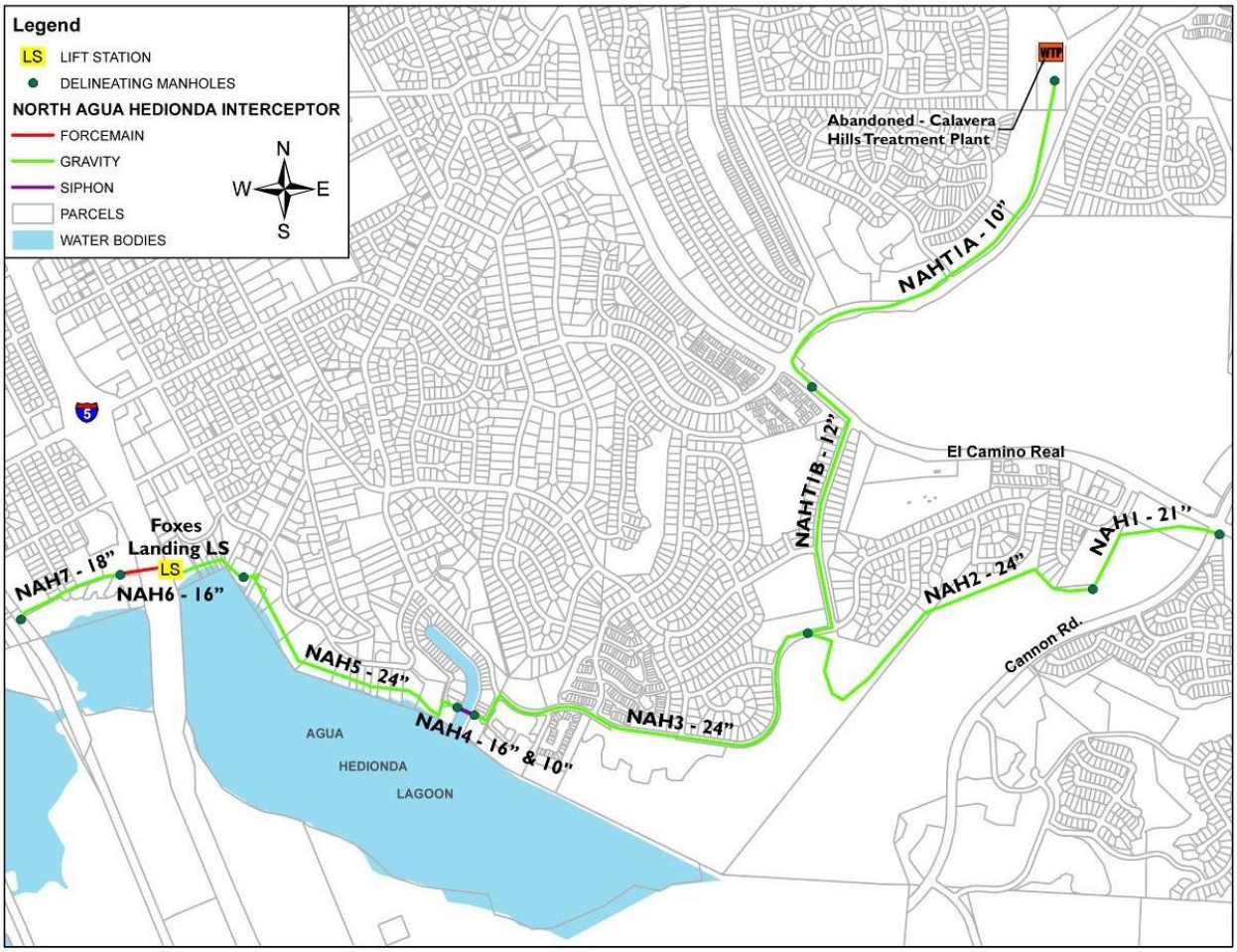
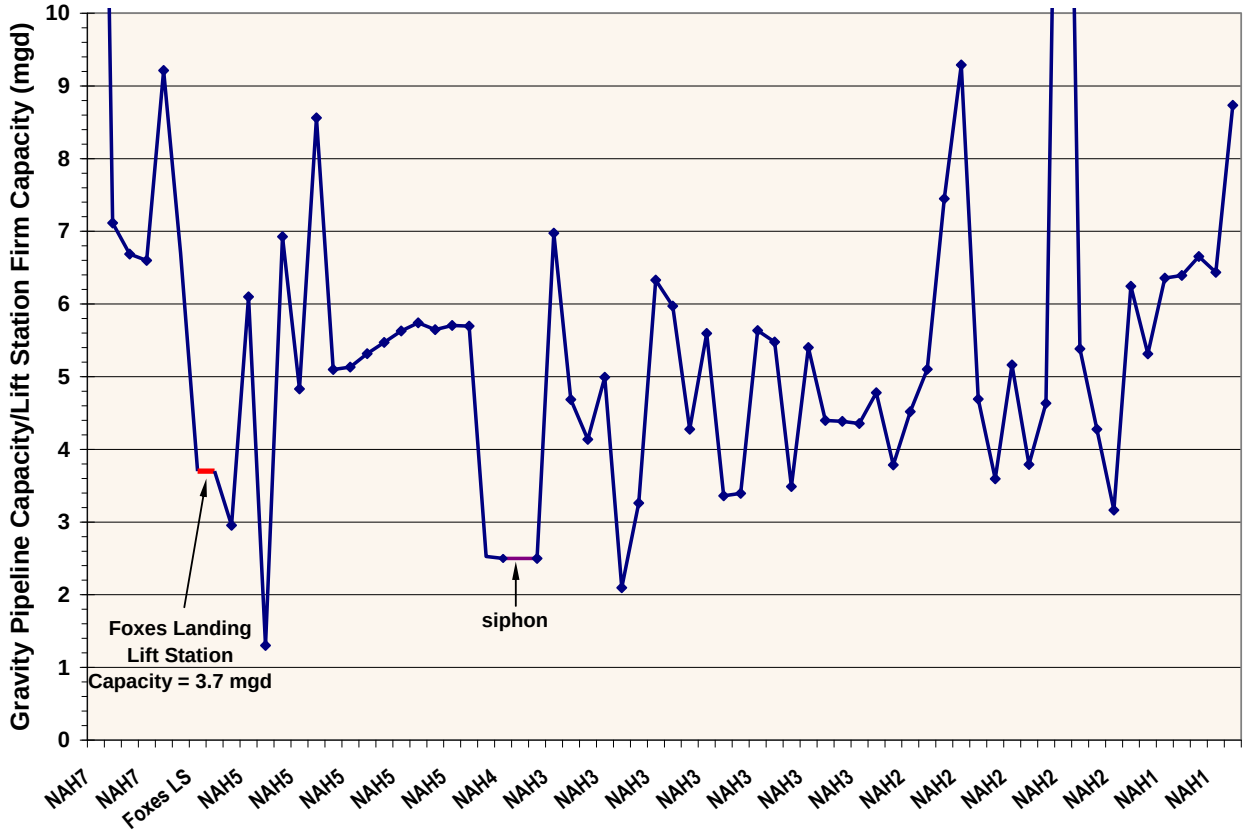


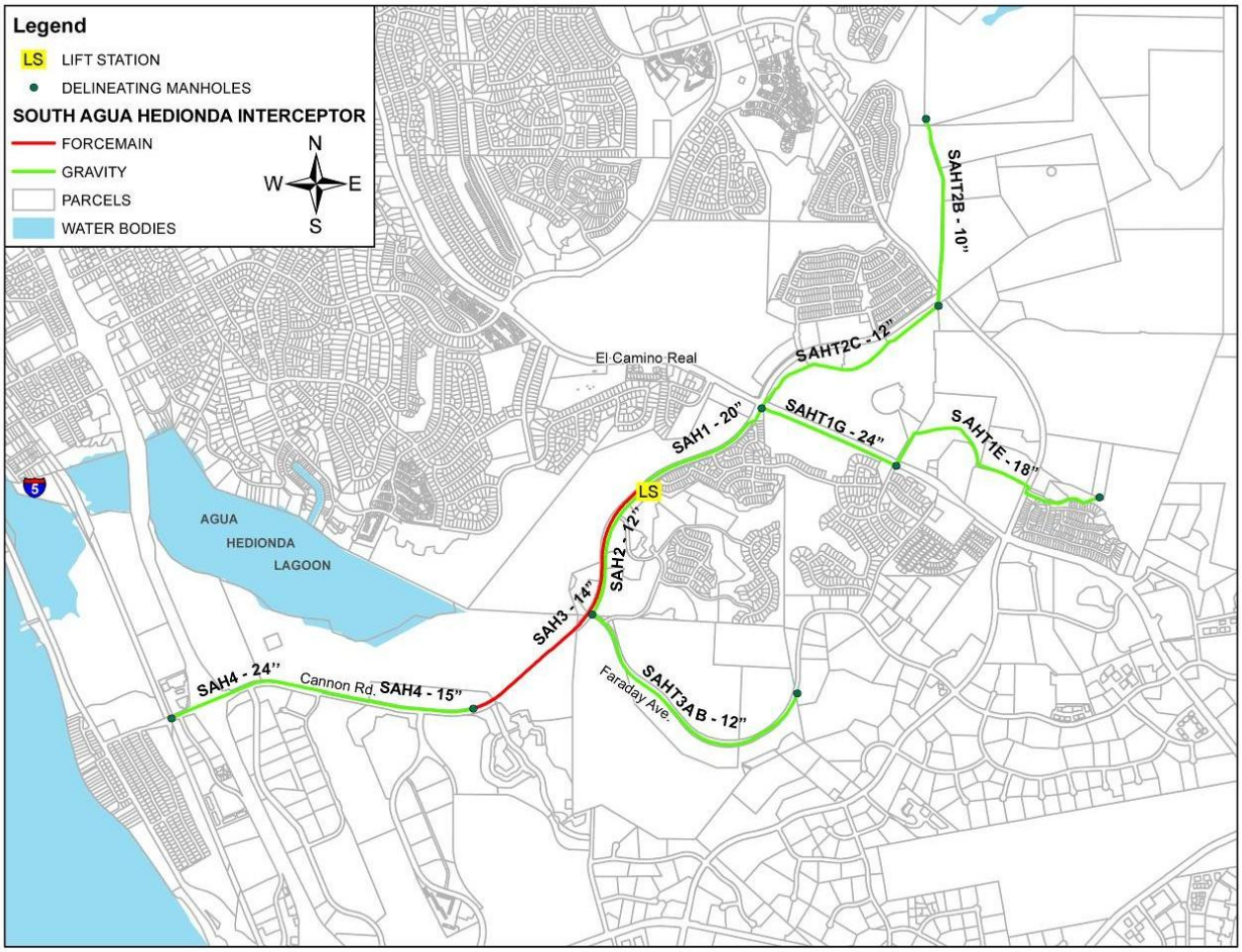
Figure 2-5 Gravity Capacity of the North Agua Hedionda Interceptor



2.2.3 South Agua Hedionda Interceptor

The South Agua Hedionda (SAH) Interceptor is the newest interceptor system and conveys only City of Carlsbad wastewater. The interceptor has two upstream branches. The northern branch begins near Lake Calavera and flows south in an easement adjacent to Calavera Creek to the intersection of Cannon Road and El Camino Real. The second branch begins in Sunny Creek Road, just east of Badger Lane, and flows west through the Rancho Carlsbad Golf Course to El Camino Real. These two branches join at El Camino Real and Cannon Road. The SAH interceptor then flows southwest in Cannon Road, which follows along the south side of the Aqua Hedionda Creek and Lagoon. Flow is pumped at the Cannon Road Lift Station, which is located just off Cannon Road between Hemmingway Drive and Frost Avenue. The Cannon Road Lift Station force main continues west in Cannon Road and discharges to a 24-inch diameter gravity main that connects with the V/C Interceptor near the intersection of Cannon Road and Avenida Encinas. The SAH Interceptor is illustrated on Figure 2-6. Pipeline capacities in the southern branch of the SAH Interceptor ranch from approximately 4 mgd to over 20 mgd in steep sloped reaches.

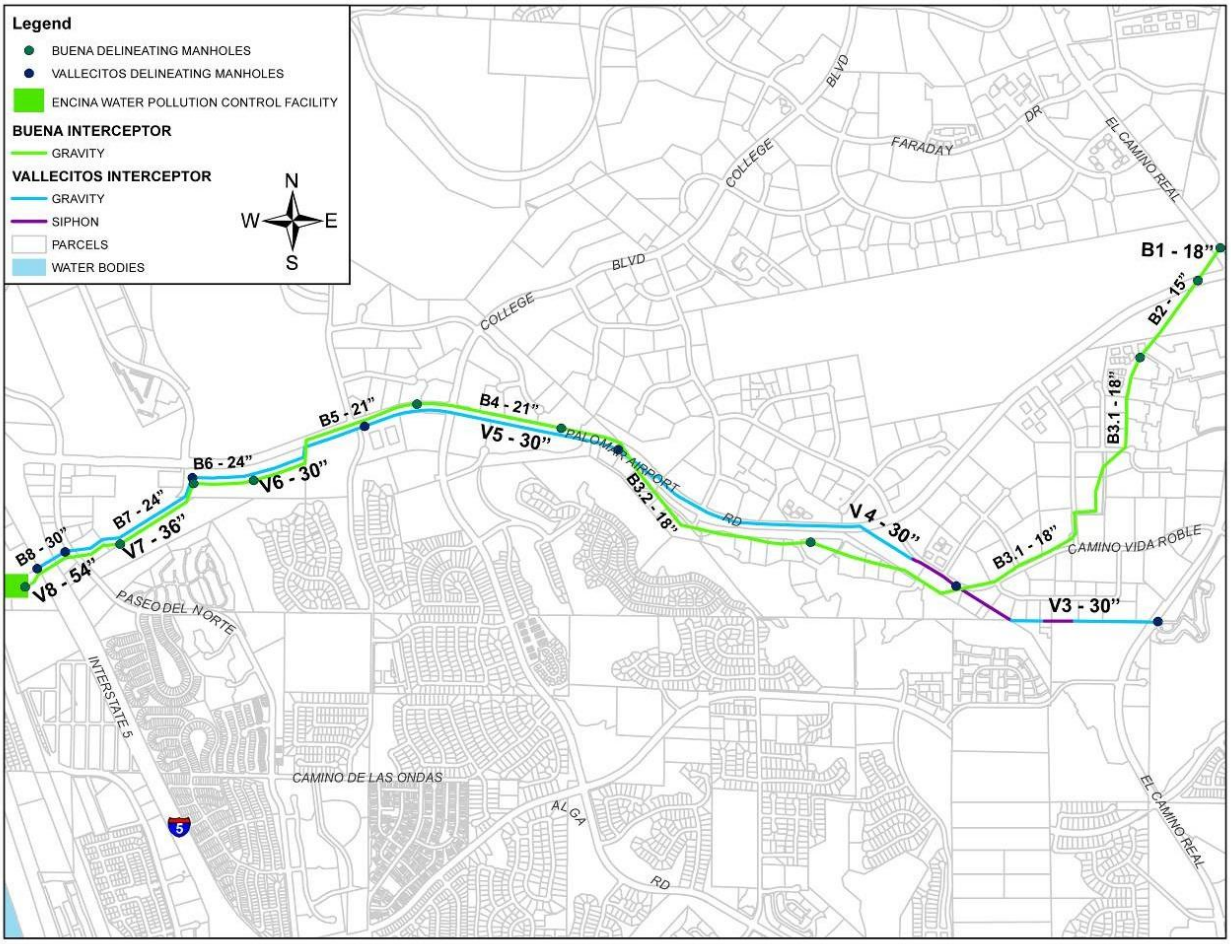
Figure 2-6 South Agua Hedionda Interceptor



2.2.4 Buena and Vallecitos Interceptors

Two major interceptors follow the Encinas Canyon to the EWPCF: the Buena Interceptor and the Vallecitos Interceptor. The City of Carlsbad has partial capacity ownership in both of these interceptors based on separate interagency agreements included in Appendix "D". Maintenance of the interceptors are the responsibility of the Buena Sanitation District and Vallecitos Water District for the Buena Interceptor and Vallecitos Interceptor, respectively. Carlsbad is responsible for paying their cost share of maintenance in proportion to their percentage ownership. The interceptors share a single alignment for much of their length, and cross over each other at three separate locations. The Buena and the Vallecitos Interceptors are both shown on Figure 2-7.

Figure 2-7 Buena and Vallecitos Interceptors



Buena Interceptor

The first interceptor constructed through the Encinas Canyon was the Buena Interceptor, built in 1964. This interceptor was owned by the Buena Sanitation District, which is now a part of the City of Vista. The City of Carlsbad has capacity rights that vary by reach in this pipeline. The Buena Interceptor begins at the corner of El Camino Real and Palomar Airport Road, downstream of the discharge of the City of Vista's Buena Creek Lift Station and Raceway Lift Station. The interceptor flows through the City of Carlsbad's industrial park and then parallels Palomar Airport Road, crossing under Interstate 5 and continuing to the EWPCF. The total length of the interceptor is approximately 4.2 miles.

Minor realignments were made to the Buena Interceptor in 1987, 1989, and 1992. The existing interceptor consists of gravity pipelines ranging from 15 to 30 inches in diameter. There are no lift stations or siphons along the alignment. Most of the gravity pipelines are constructed of VCP, with a few sections of PVC. The Buena Interceptor currently serves portions of LFMZs 3, 4, 5 and 20.

The original agreement for the lease of capacity by Carlsbad in the Buena Interceptor was prepared in 1966, and the agreement was replaced with a new agreement in 1981. The 1981 agreement defines Carlsbad's ownership rights based on a percentage of the full pipe capacity. Carlsbad's percent ownership increases in the direction of flow and approaches 35 percent ownership in the downstream

reaches. In 1987, Carlsbad entered into a temporary agreement with the Buena Sanitation District to lease an additional 0.8 mgd of capacity to accommodate flows from the Carlsbad Research Center. The 1987 agreement expired after the completion of Phase 4 of the Carlsbad Research Center in 1991, which included the construction of lift stations to pump flows to the Vallecitos Interceptor. The current ownership and capacity rights based on the 1981 agreement and flow capacities calculated from GIS data are illustrated on Figure 2-8 and summarized in Table 2-2.

Figure 2-8 Gravity Capacity of the Buena Interceptor

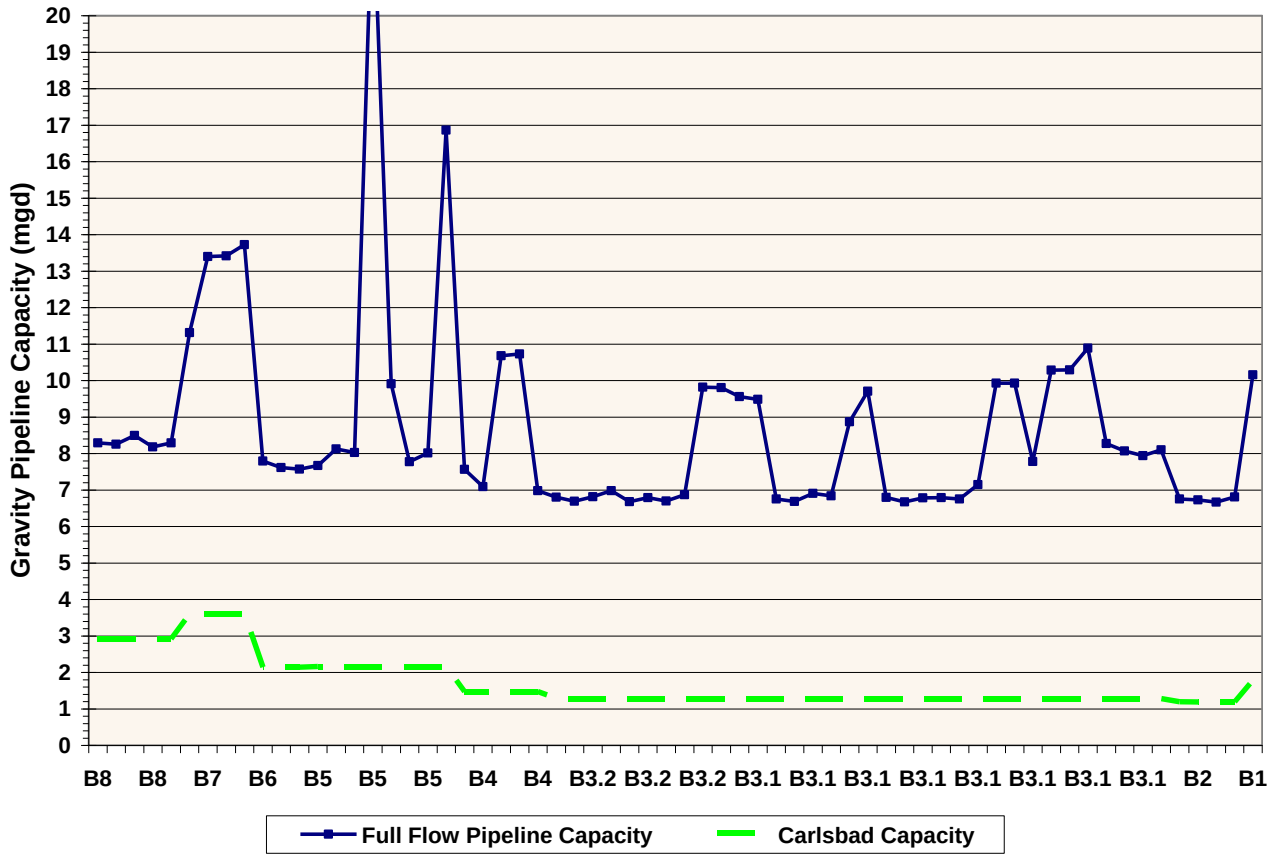


Table 2-2 Carlsbad Capacity Rights in the Buena Interceptor

Pipeline Reach	From Sta	To Sta	Min. Size (in.)	Min. Slope	Total Design Capacity (mgd)	Carlsbad % of Design Capacity	Carlsbad Capacity (mgd)
B1	0+00	20+81.43	18	2.20%	10.06	17.65%	1.78
B2	20+81.43	33+36.43	15	2.60%	6.73	17.65%	1.19
B3	33+36.43	42+28.18	18	1.00%	6.79	18.84%	1.28
B4	42+28.18	67+42.43	21	0.46%	6.94	21.13%	1.47
B5	67+42.43	87+57.43	21	0.56%	7.66	28.21%	2.16
B6	87+57.43	190+93.29	24	0.27%	7.59	28.21%	2.14
B7	190+93.29	204+08.65	24	0.60%	11.34	31.71%	3.60
B8	204+08.65	209+56.94	30	0.10%	8.38	34.88%	2.92

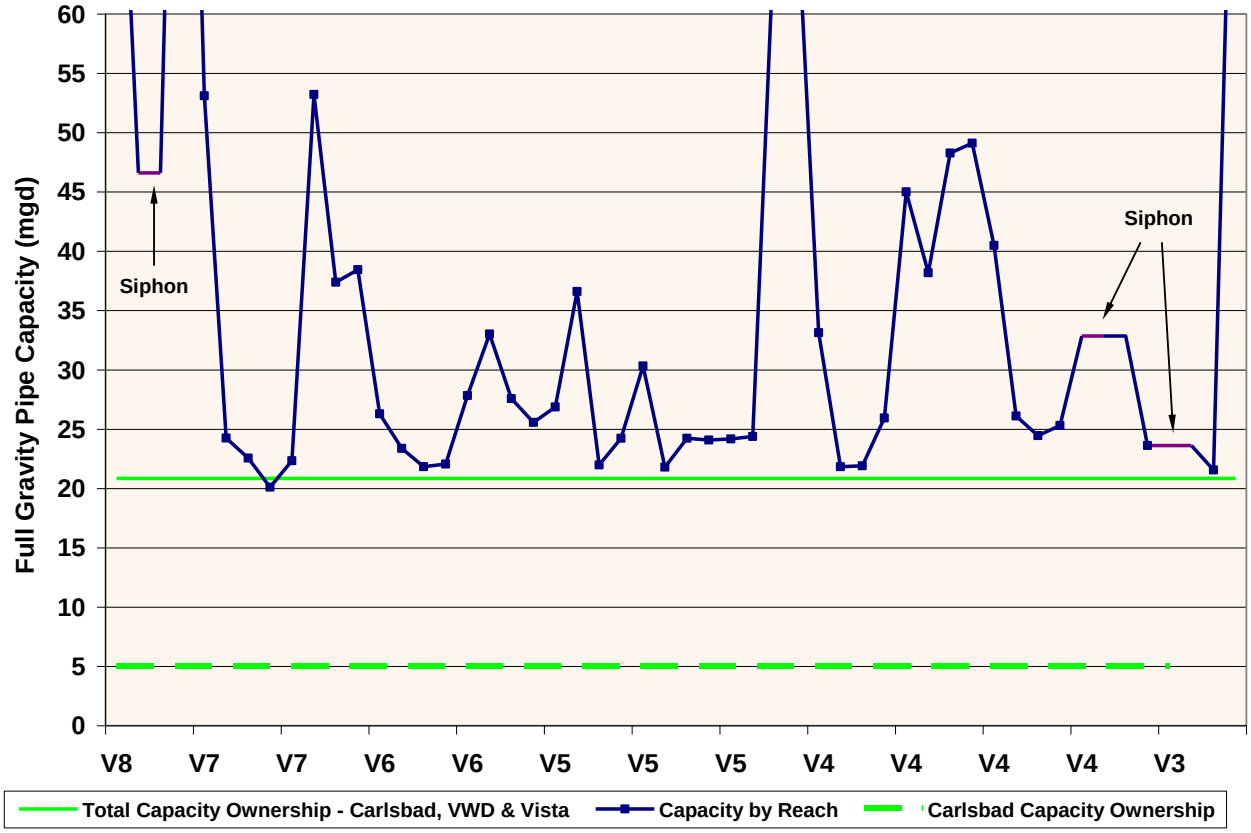
Vallecitos Interceptor

The Vallecitos Interceptor was constructed in 1984 by the San Marcos County Water District, which is now the Vallecitos Water District (VWD). The City of Carlsbad, City of Vista, and the VWD share capacity ownership in this pipeline beginning at El Camino Real. The Vallecitos Interceptor begins at the end of the Vallecitos siphon, which is near the intersection of Camino Vida Roble and El Camino Real. The interceptor then follows Palomar Airport Road in the same approximate alignment as the Buena Interceptor, crossing under Interstate 5 to the EWPCF. The total length of the interceptor is approximately 3.4 miles.

The existing interceptor consists of gravity pipelines ranging from 30 to 54 inches in diameter and includes two siphons near the upstream end and a 54-inch diameter siphon under I-5 to the EWPCF. There are no lift stations along the alignment. The gravity pipelines are constructed of VCP and the siphons are DIP or CML&C Steel pipe. The Vallecitos Interceptor currently serves portions of LFMZs 5, 6, 13, 18 20, and 21 and all of LFMZs 10 and 17.

The title of the original interagency agreement for the Vallecitos Interceptor is the Palomar Joint Land Outfall Interceptor Interagency Agreement, which was signed in 1985. Under this agreement, the VWD has a capacity ownership of 12.1 mgd, the City of Vista has an ownership of 3.75 mgd, and the City of Carlsbad's capacity ownership is 5.0 mgd. The capacity ownership is based on a total interceptor capacity of 20.85 mgd, which is the approximate minimum full flow gravity capacity of the interceptor, as shown in Figure 2-9. It should be noted that the City of Vista does not currently discharge flow into the Vallecitos Interceptor.

Figure 2-9 Capacity of the Vallecitos Interceptor



2.2.5 North Batiquitos Interceptor

The North Batiquitos (NB) Interceptor is identified by nine reaches and collects only City of Carlsbad flows in the upper reaches, NB1-NB8. The last 2,415 feet upstream of the EWPCF, Reach NB9, is jointly owned by the City of Carlsbad, the LWWD, and the City of Encinitas. This downstream section is sometimes referred to as the Ponto Sewer and it was originally termed the Occidental Sewer. The NB Interceptor begins on the north shore of the Batiquitos Lagoon near El Camino Real. The interceptor flows west along the north shore of the lagoon to the NB Lift Station. Access to the interceptor is shared with a public trail in this area. The NB Lift Station pumps City of Carlsbad flows up and across Interstate 5 to Avenida Encinas and continuing over to the railroad right-of-way. The NB interceptor turns north at Poinsettia Lane and the railroad right-of-way and then collects flow from the LWWD and City of Encinitas immediately north of the North County Transit District Coaster Station. The NB Interceptor then continues in a northerly direction adjacent to Avenida Encinas until it reaches the confluence with the Vista/Carlsbad Interceptor and the combined flow enters the West Encina Influent Sewer prior to reaching the EWPCF.

The Ponto Sewer (Reach NB8 & NB9) was constructed in 1974 and is approximately 1.6 miles in length. The last 1,000 foot section of the sewer before reaching the EWPCF was originally constructed as a 24-inch diameter siphon, but was replaced with a 48-inch diameter RCP (T-Lock Lined) gravity sewer as part of the EWPCF Phase III expansion in 1981. Ownership of Reach NB9 of the NB Interceptor (Ponto/Occidental Sewer) is stipulated in the Occidental-Carlsbad-Leucadia-Encinitas Agreement of 1972. Capacity ownership is identified as: 40.0 percent Carlsbad, 40.3 percent Leucadia and 19.7 percent

Encinitas. Based on a full flow capacity of 21.3 mgd for the 39-inch diameter pipeline section, the peak flow capacity for Carlsbad is approximately 8.5 mgd. Costs for operation and maintenance of the Ponto Interceptor are shared in the same percentages, with Carlsbad named as the agency responsible for management of maintenance.

The upstream portion of the NB interceptor that conveys only City of Carlsbad flows is approximately 5.9 miles in length. The interceptor sewer ranges in size from 15 to 48 inches in diameter, and are primarily constructed of VCP with some T-lock lined RCP. The NB Interceptor currently serves all of LFMZs 9 and 19, most of LFMZ 21, and portions of LFMZs 4, 6, 20 and 22. The ultimate service area is anticipated to remain the same.

The NB Interceptor is illustrated on Figure 2-10. Capacities of the gravity pipelines based on GIS data are shown on Figure 2-11. Improvement projects for portions of the NB Interceptor have recently been completed. The improvements include rehabilitation of manholes and a new access road from El Camino Real west to the NB Lift Station.

Figure 2-10 North Batiquitos Interceptor

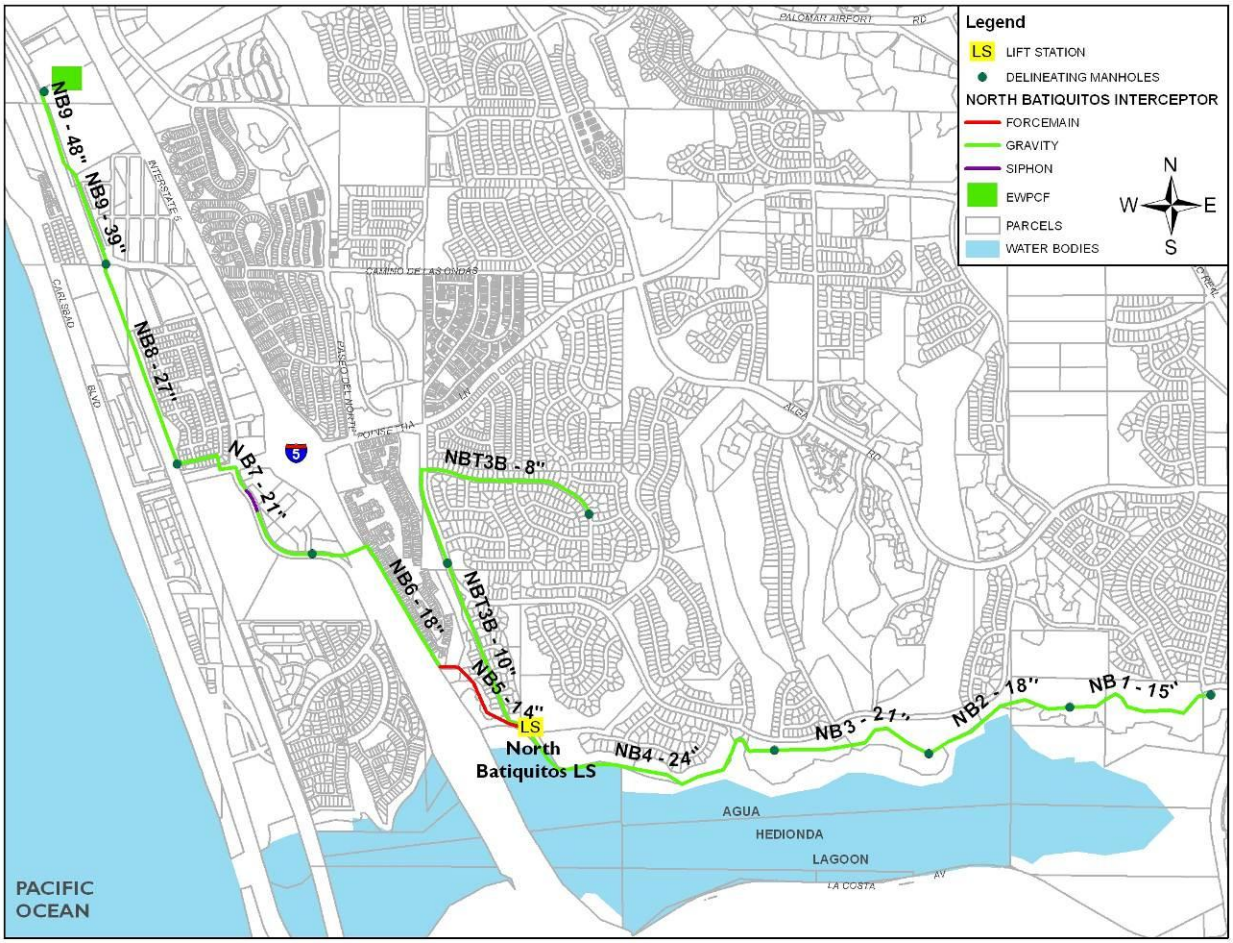
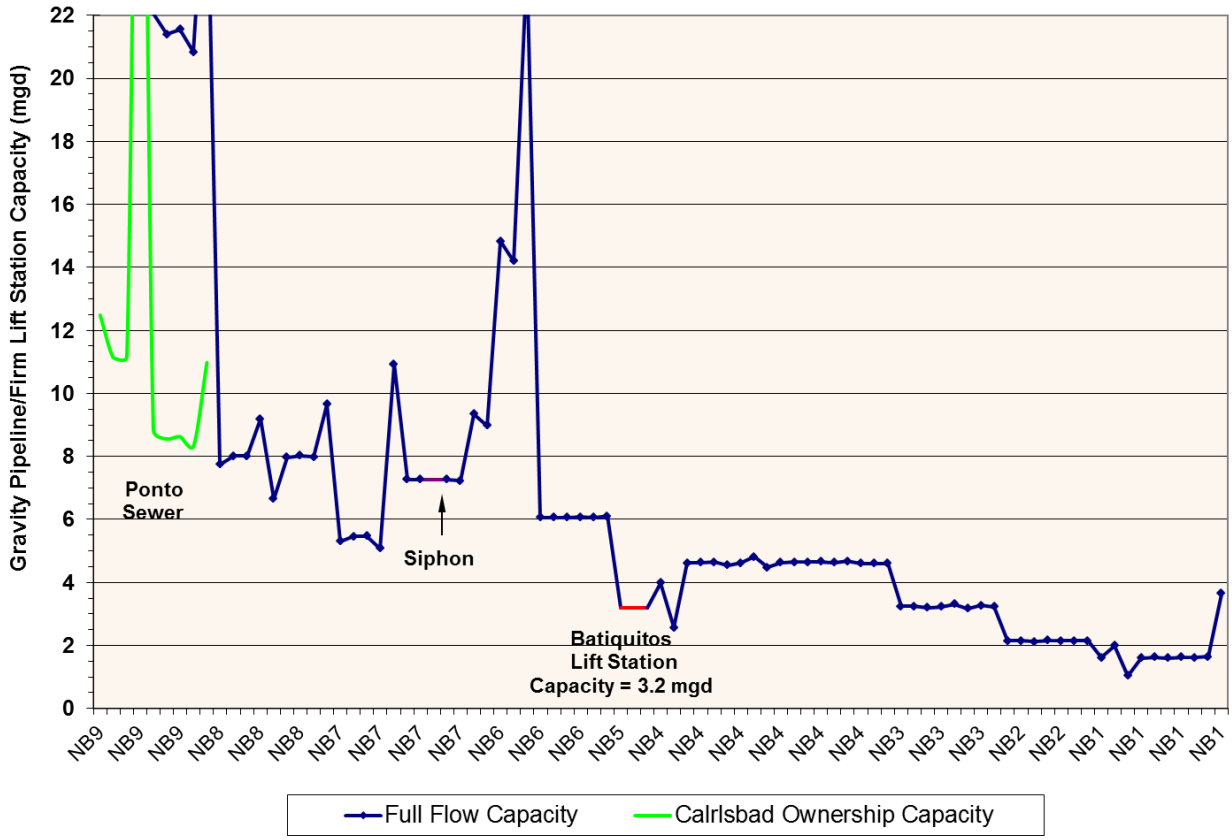


Figure 2-11 Capacity of the North Batiquitos Interceptor



2.3 COLLECTOR SYSTEM

The City of Carlsbad currently owns, operates and maintains approximately 264 miles of wastewater collection pipelines, including interceptors, gravity flow collector pipelines and inverted siphons. The Buena and Vallecitos Interceptors are not included in this total since the City of Vista and the Vallecitos Water Districts are responsible for the maintenance of these lines. Carlsbad is only responsible for a portion of the maintenance cost relative to Carlsbad's capacity ownership in each Interceptor. The collector sewer system includes approximately 6,300 manholes. The size of gravity pipelines range in size from 6 to 27 inches in diameter and up to 60-inch diameter when including interceptor sewer pipelines. The existing wastewater collection and conveyance system is illustrated on Exhibit 1 in Appendix A. Table 2-3 provides a summary by pipeline diameter of the interceptor sewers, gravity sewers, and siphons.

Pipe materials used throughout the gravity sewer system consist of predominately VCP and PVC, but other materials have also been used throughout the years as summarized in Table 2-4. VCP was predominately installed in Carlsbad prior to 1980 with approximately 3-percent of Carlsbad's gravity sewers having been installed prior to 1950. A portion of Carlsbad's sewers were installed as far back as 1929 in the "Village" area north of Carlsbad Village Drive in the proximity of State Street. Fortunately, much of Carlsbad's growth did not occur until the mid-1980's. Approximately 50-percent of Carlsbad's gravity sewer system has been installed in the past 25-years.

Table 2-3 and Table 2-4 were developed from the City of Carlsbad Sewer System GIS. Information in the Sewer System GIS was obtained from as-built drawings, construction drawings, and the City's existing Sewer Atlas Book. Information from the Sewer Atlas Books was used for pipelines for which no design drawings could be located. Much of the sewer system in the "Village" area was constructed through programs identified as Assessment District 1 and 2 (AD1 & AD2).

Table 2-3 Carlsbad Collection and Conveyance System Summary

(Includes Interceptor Sewers)

Pipeline Diameter (in)	Total Length of Pipelines		Pipeline Diameter (in)	Total Length of Pipelines	
	Gravity (lf)	Siphons (lf)		Gravity (lf)	Siphons (lf)
6	82,093	--	24	22,812	--
8	1,061,903	406	27	5,166	--
10	91,790	200	30	57	--
12	58,045	--	36	10,394	--
15	14,128	--	39	1,308	--
16	--	399	42	20,790	--
18	10,782	--	48	5,281	--
20	2,692	--	60	352	--
21	6,806	145			
TOTALS:	**Gravity - 1,396,096**		**Siphons - 1,151**		**Miles - 264.4**

Table 2-4 *Gravity Flow Sewer Pipe by Age

Time Period Installed	Pipe Material								Total Lineal Feet
	VCP	PVC	Hobas	RCP	FPVC	DI	HDPE	CI	
Pre-1950	46,417								46,417
1950s	55,915								55,915
1960s	138,221			11,220				599	150,040
1970s	192,129	15,790				3,304		320	211,543
1980s	139,632	165,317		53					305,002
1990s	19,882	314,252		2,879		50			337,063
2000s	22,642	254,094	6,238	4,314			1,609		288,897
2010s		495			860				1,355
TOTAL	**614,838**	**749,948**	**6,238**	**18,466**	**860**	**3,354**		**919**	**1,396,232**
							Total Miles		**264.4**

* *Includes all collector, trunk and interceptor pipelines maintained and operated by the City of Carlsbad, Does not include the Buena and Vallecitos Interceptor Sewers or forcemains.*

2.4 LIFT STATIONS AND FORCE MAINS

Sixteen wastewater lift stations are currently located within the City of Carlsbad Sewer Service Area. Figure 2-12 illustrates the lift station locations and associated force main alignments. The Buena Vista and Agua Hedionda Lift Stations, which are part of the V/C Interceptor Sewer System, are operated and maintained by the Encina Wastewater Authority through an agreement with Carlsbad and Vista. The remainder of the lift stations are owned and operated by the City of Carlsbad. Carlsbad owns and maintains approximately 6.2 miles of force main. Although Encina operates the 2 lift stations noted above, Carlsbad is responsible for maintenance of the force mains for those lift stations. The pipe material used for force mains includes HDPE, PVC, ACP and some DIP. In recent years, Carlsbad has been using mostly HDPE in new construction and has either been replacing or relining any Ductile Iron Pipe in the system to minimize the risk from corrosion related failures. Table 2-5 provides a summary of lift station capacities and features. Table 2-5 is organized according to the downstream interceptor system to which each lift station currently discharges. As noted on the table, several lift stations are pumping "out of basin". These lift stations are planned to be eliminated with the construction of future gravity pipelines.

Since the last master plan, construction of the SAH Interceptor and the Cannon Road Lift Station has enabled the Lower Faraday, Upper Faraday and Kelley Ranch Lift Stations to be removed from service. Additionally, the La Golondrina, Forest and Woodstock Lift Stations were recently taken out of service with the completion of new gravity sewer pipelines.

CITY OF CARLSBAD
Utilities Department

Legend

EWPCF ENCINA WATER POLLUTION CONTROL FACILITY

LIFT STATIONS

LS EXISTING LIFT STATIONS

LS EXISTING LIFT STATIONS TO BE ABANDONED

EXISTING WASTEWATER COLLECTION SYSTEM

INTERCEPTORS AND TRUNK SEWERS

FORCEMAINS

CARLSBAD S SEWER SERVICE BOUNDARY

WATER BODIES

CITIES

CARLSBAD

ENCINITAS

OCEANSIDE

S.D. COUNTY

SAN MARCOS

VISTA

FIGURE 2-12

CITY OF CARLSBAD EXISTING LIFT STATIONS AND FORCE MAINS

Table 2-5 Summary of Existing Lift Stations

Lift Station Name	Interceptor System Discharge	Construction/ Rehabilitation Date	Pump/Motor Information				Station Capacity [1]		Force Main		Comments
			Qty.	Motor Size	Motor Type	Design Point	(gpm)	(mgd)	Dia.	Mat'l	
Terramar	V/C	1972	2	3 Hp	CSD	100 gpm @ 25'	100	0.14	8"	ACP	1 duty & 1 standby
Chinquapin	V/C	1959/2001	2	7.5 Hp	CSD	360 gpm @ 50'	360	0.52	6"	PVC	1 duty & 1 standby
Home Plant	V/C	1963/1991	3	20Hp	VFD	800 gpm @ 70'	1,100	1.58	10"	PVC	2 duty & 1 standby
Buena Vista	V/C	1975/1994	4	300 Hp	VFD	6000 gpm @ 142'	14,900	21.50	16&24"	AC/DIP	operated by Encina
Agua Hedionda	V/C	1976/1988/1999	4	100 Hp	VFD	8,000 gpm	16,000	23.04	2-18"	DIP	operated by Encina; 2 duty & 2 standby pumps
Gateshead [2]	NAH	1985/2008	2	3 Hp	CSD	40 gpm @ 25'	40	0.06	4"	PVC	Gorman Rupp package station
Vancouver [2]	NAH [3]	1981	2	15 Hp	CSD	150 gpm @ 103'	150	0.22	8"	DIP	S&L package station
Simsbury [2]	NAH [3]	1985	2	50 Hp	CSD	382 gpm @ 200'	382	0.55	8"	PVC	1 duty & 1 standby
Villas	NAH	1983/2004/2010	2	15 Hp	CSD	125 gpm @ 90'	125	0.18	4"	PVC	Pumps replaced in 2010
Foxes Landing	NAH	2001	3	38.7 Hp	VFD	1500 gpm @ 61'	2,600	3.74	12"	HDPE	2 duty & 1 standby
El Fuerte	SAH/Buena	2009	2	50 Hp	CSD	970 gpm @ 127'	970	1.40	8"	HDPE	1 duty & 1 standby
Cannon Road	SAH	2005/2007	3	105 Hp	CSD	1420 gpm @ 200'	2,440	3.51	14"	HDPE	Flygt NP3301
Poinsettia	Vallecitos	1997/2008	3	125 Hp	CSD	1080 gpm @ 245'	1,550	2.23	12"	PVC	Fairbanks Morse BS444
North Batiquitos	NB	1997/2008	3	100 Hp	CSD	1210 gpm @ 164'	2,250	3.24	14"	PVC	172,300 gal overflow tank
Knots Lane	NB	1999	2	10 Hp	CSD	355 gpm @ 44'	355	0.51	6"	PVC	1 duty & 1 standby
Sand Shell	NB	2002/2009	2	6 Hp	CSD	324 gpm @ 23'	324	0.47	6"	PVC	pumps replaced in 2009

(1) Station Capacity is the duty capacity with one pump out-of-service, except for the Agua Hedionda LS which assumes 2 pumps out-of-service
(2) Temporary lift station to be eliminated with the construction of a future gravity pipeline
(3) Lift station discharges out-of-basin

The firm capacity of a lift station, as indicated in Table 2-5, is the hydraulic output of the installed pumping units with the largest pumping unit out-of-service. The "installed" capacity of a lift station is equal to the hydraulic output of all installed pumping units. The "hydraulic output" of a single pump is defined by the certified pump curve, the losses within the force main system, and design operation point for the equipment. The hydraulic output of several pumps working in parallel is defined by the cumulative hydraulic effect of the pumps, and is not equal to the mathematical sum of the individual nameplate pump capacities. A hydraulic analysis of both the pump and the force main systems is required to determine the hydraulic output of a given lift station.

The majority of the Carlsbad lift stations consist of two pumping units designed in an alternating lead/lag configuration, but operated in a duty/standby mode. This means that under normal operating conditions, only one pump is operating at a time and the pumps alternate as the pumps start and stop. However, if one pump can not keep up or fails to start, the second pump will operate automatically.

Each lift station has telemetry (SCADA system) for monitoring the pump status and wet well levels, and standby power capability consisting of either installed generators or a connection for a portable generator. When station alarms occur, a signal is sent to the City's Control Center by telephone line. However, there is no ability to change pump operations remotely.

Many of the lift stations have recently undergone, or are planned to undergo rehabilitation to improve station operation and reliability. An odor control and noise abatement project at the Poinsettia lift station and ventilation and odor control improvements at the NB Lift Station were recently completed. The Home Plant Lift Station, Terramar Lift Station and Agua Hedionda Lift Station are currently being designed to replace the existing facilities. The Agua Hedionda Lift Station project is a joint project with the City of Vista.

2.5 COLLECTION SYSTEM OPERATION AND MANAGEMENT

In July 2011, the City of Carlsbad Utilities Department selected Tilson and Associates to conduct an objective evaluation of Carlsbad's sewer system operation and management. The purpose of this effort was to assess the current effectiveness of collection system maintenance practices and provide recommendations for improvements or identify processes that may need closer examination.

A few of the primary areas of assessment included:

- Organizational structure and staffing
- Sewer use Ordinances and Regulations
- System mapping, work order / scheduling processes
- Equipment and tools used in cleaning and inspection
- Emergency response planning and execution

The results of Tilson & Associate's evaluation were presented in a report titled, "City of Carlsbad Utilities Department - Wastewater Division, Evaluation and Field Observations Report", dated September 29, 2011. A copy of this report is included herein as Appendix "F".

2.6 INTER-AGENCY AGREEMENTS

Wastewater collection systems operate primarily on a gravity flow basis. However, political boundaries are not always established to match natural drainage contours. As a result, some portions of a given service area may drain in an undesirable direction, away from the remainder of the gravity collection system. Inter-agency agreements can be developed to allow the wastewater flows to be conveyed into the collection system of an adjacent District or agency.

The City jointly owns capacity in most of the interceptors with upstream sewer agencies, as described previously in Section 2.2. The joint ownership agreements are summarized in Table 2-6 and are included in Appendix D. The active agreements date back to 1972, and it is noted that the Vallecitos Water District was formerly the San Marcos Water District and the Leucadia Wastewater District was formerly known as the Leucadia County Water District. Furthermore, the Buena Interceptor was previously referred to as the Encina Outfall, the Vallecitos Interceptor was the Palomar Joint Land Outfall, and the Occidental Sewer is now called the Ponto Interceptor.

Table 2-6 Inter-Agency Agreements for Sewer Interceptors

Interceptor	Joint Agency	Agreement/Date
Vista/ Carlsbad	City of Vista	Agreement for Ownership, Operation, and Maintenance of the Vista/Carlsbad Interceptor Sewer- 02/26/02
Buena	Buena Sanitation District	Agreement Between the BSD and City of Carlsbad for capacity in the Buena Outfall - 12/15/1981
Vallecitos	San Marcos Water District City of Vista	Palomar Joint Land Outfall Interceptor Interagency Agreement - 01/8/1985
North Batiquitos	Leucadia County Water District Encinitas Sanitary District	Occidental-Carlsbad-Leucadia-Encinitas Agreement in Regard to Construction of Sewer Pipeline South from the Encina Water Pollution Control Facility - 8/24/72

In addition to the inter-agency agreements for the interceptors, the City of Carlsbad has several agreements with adjacent agencies to provide sewer service to several small, geographically isolated areas along the service area boundary. Tract 73-29, also known as Carrillo Estates Unit No. 2, is a 111 lot subdivision located in LFMZ 6. Until recently, the wastewater from this development was pumped out of basin by the La Golondrina Lift Station to the LWWD Meadows III Pump Station service area. In 2010, a new gravity sewer line extension was constructed to convey flows through the Carlsbad system to the Vallecitos Interceptor Sewer. As a result, the La Golondrina Lift Station was taken out of service and demolished and the 03/24/2000 agreement with LWWD for the exchange of sewer flows was terminated.

The La Costa Meadows sewer line extension is another project that was recently constructed to convey flows by gravity to Carlsbad's collection system that were previously pumped out of basin to the LWWD sewer system. In October 1998, a Reimbursement Agreement for Temporary Wastewater Collection by LWWD was approved for Tract 93-04 (also known as Carrillo Estates Unit No. 2), a 25 lot subdivision located in the southwest corner of LFMZ 18. Prior to 2010, LWWD's La Costa Meadows III Lift Station collected flows from this tract and an additional 70 residential units in LWWD's service area. When the gravity sewer extension project was completed in 2010, the La Costa Meadows III Lift Station was abandoned, and wastewater from the residential units now flows by gravity to Carlsbad's collection system and into the Vallecitos Interceptor Sewer system. The 70 residential units

previously located in the LWWD service area have now been annexed into the City of Carlsbad sewer service area.

The Meadowlark Estates/Rancho Carrillo Sewer Flow Agreement dated March 24, 2000 provides for the transfer of wastewater flows from 80 residential units in the VWD to Carlsbad. VWD wastewater flows are delivered to the Carlsbad collection system at Paseo Privado from a gravity pipeline constructed in an easement. The VWD flows are then conveyed to the Poinsettia Lift Station and into the Vallecitos Interceptor.

2.7 WASTEWATER TREATMENT AND DISPOSAL

Wastewater generated within the City of Carlsbad Sewer Service Area is treated at the EWPCF. The EWPCF provides full secondary treatment, sludge handling, and disposal through a deep ocean outfall. The treatment levels meet current State and Federal requirements for secondary treatment. The EWPCF is owned and operated by the Encina Wastewater Authority (EWA), a joint powers authority made up of six northern San Diego County agencies. The EWA maintains a 10 member Board consisting of council members or directors from each of the member agencies. The EWA operates and maintains the EWPCF (Unit I) and the ocean outfall (Unit J) through an agreement known as the "Revised Basic Agreement" (RBA).The Buena Vista and Agua Hedionda Lift Stations are also operated by EWA, but through a separate agreement with Vista and Carlsbad. Vista and Carlsbad share the operation and maintenance expenses for the Buena Vista and Agua Hedionda Lift Stations in accordance with their ownership percentage. There have been five major expansions to the EWPCF in its 45 years of operation. In 1995, EWA purchased thirty-seven acres adjacent to the southern boundary of the EWPCF to provide for future facility needs. The Phase V Expansion Project was completed in December 2009 and included new biosolids and energy management facilities, plus improvements to several areas and processes within the EWPCF

2.7.1 Treatment

EWA's state-of-the-art treatment facility is designed to treat wastewater to the secondary level. Most of the treatment plant's highly treated wastewater is discharged into the ocean through an outfall. Treatment processes at the EWPCF include screening, grit removal, primary clarification, and treatment of activated sludge. The waste activated sludge is thickened and pumped to anaerobic digesters for stabilization. Biosolids are withdrawn from the digesters and are dewatered, dried and processed to produce biosolids pellets. The biosolids pellets are transported by truck and sold for reuse as biofuel or fertilizer. The energy management system maximizes on-site power generation to reduce outside energy dependence. The dryer and engine-generators can be fueled by biogas or natural gas, and recovered heat is used to heat the sludge in the anaerobic digesters.

The Encina Phase V Expansion Project, completed in 2009, increased treatment capacity to 40.51 mgd and the biosolids handing capacity to 43.31 mgd. The difference in the two capacities was based on the equivalent amount of sludge disposed back to the sewer system from the Meadowlark WRP, the Shadowridge WRP and the Gafner WRP. The Shadowridge and Gafner plants previously relied upon the EWPCF for sludge digestion, dewatering, and disposal; however, the Shadowridge WRP is no longer in service and the Gafner WRP is now a tertiary treatment plant only, treating secondary effluent pumped

from Encina and producing recycled water for irrigation at the La Costa South Golf Course. The Phase V Expansion Project also added a biosolids heat drying facility and upgraded the cogeneration plant.

2.7.2 Disposal

Effluent from the EWA plant is discharged to the Pacific Ocean through the Encina Ocean Outfall or delivered to the 4.0 mgd Carlsbad Water Recycling Facility (CWRF) or LWWD's Gafner WRP for further treatment to produce recycled water for irrigation. The Encina Ocean Outfall system includes flow equalization facilities, which were upgraded in 2005, the effluent pump station, and the outfall. When influent flows exceed the hydraulic capacity of the outfall, the excess secondary effluent is pumped to the flow equalization facilities. When flow rates fall to within acceptable levels, the stored effluent flows by gravity back to the outfall. The equalization allows the plant to pass high flows associated with storm events at a flow rate greater than the hydraulic capacity of the downstream outfall.

The Encina outfall extends along the ocean floor to a point 1.5 miles off shore, at a depth of over 150 feet. The outfall pipeline consists of two individual sections, including the original 48-inch, 6,600-foot outfall constructed in 1965 and the 72-inch, 2,300-foot extension constructed in 1973. The outfall extension project also added an 800-foot diffuser system to the end of the outfall. The current capacity of the Encina Ocean Outfall is estimated to be approximately 75 mgd. It is noted that the reported peak wet weather flow capacity of the outfall takes into account the flow equalization facilities.

2.7.3 Ownership

Each EWA member agency has capacity ownership in the EWPCF and the ocean outfall system as established in the Revised Basic Agreement. In this agreement, treatment facilities are referred to as Unit I, and the ownership is broken down into liquid and solids handling portions. The ocean outfall system is referred to as Unit J. The February 2000 Revised Basic Agreement established capacity rights based on the EWPCF Phase IV expansion. Carlsbad's Phase IV ownership capacity is 9.24 mgd (average flow) for treatment, and 25.51 mgd (peak flow) in the outfall. These capacity rights have been recently updated for the Phase V capital Improvements per the provisions of Exhibit D to the Revised Basic Agreement., which was added in 2004. The Phase V required ownership percentages based on projected wastewater flows for each agency are provided in Table 2-7. Carlsbad requested a 1.02 mgd capacity increase in the Phase V allocation. It is noted that an update to the Revised Basic Agreement which will incorporate the Phase V ownership capacities is in progress. A copy of the Revised Basic Agreement is included in Appendix D.

Table 2-7 EWPCF Phase V Capacity Ownership (tentative)

Encina Member Agency	Unit I - Treatment		Unit J - Outfall		Solids	
	2025 Ownership	2025 Capacity mgd	2025 Ownership	2025 Capacity mgd	2025 Ownership	2025 Capacity mgd
Carlsbad	25.33%	10.26	23.69%	10.26	23.69%	10.26
City of Vista	26.34%	10.67	24.64%	10.67	24.64%	10.67
Vallecitos	18.93%	7.67	24.17%	10.47	24.17%	10.47
Leucadia	17.55%	7.11	16.42%	7.11	16.42%	7.11
Buena	7.41%	3.00	6.93%	3.00	6.93%	3.00
Encinitas	4.44%	1.80	4.16%	1.80	4.16%	1.80
Totals :	**100%**	**40.51**	**100%**	**43.31**	**100%**	**43.31**

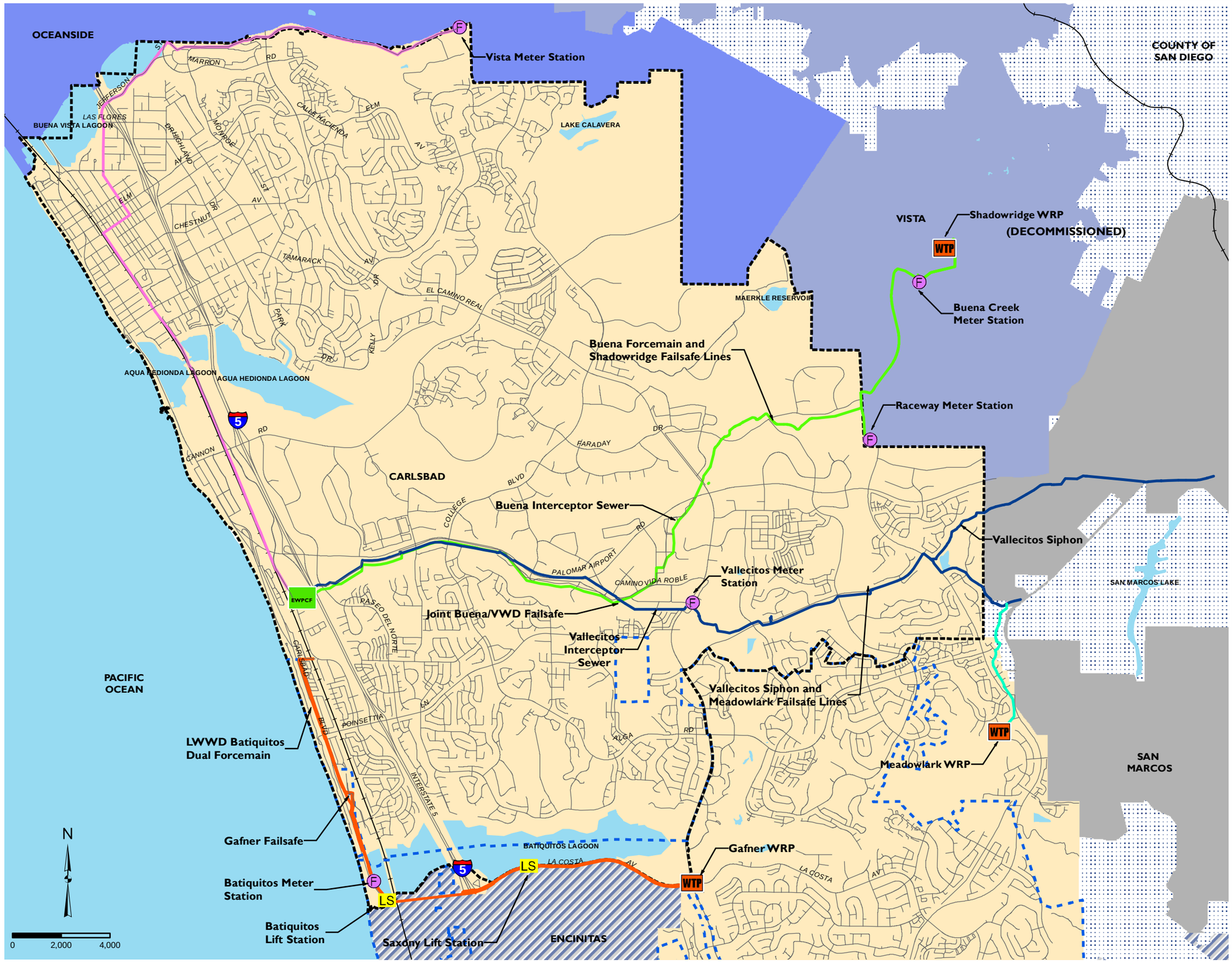
2.8 CALAVERA HILLS TREATMENT PLANT

The Calavera Hills Wastewater Treatment Plant was constructed in 1980 as a part of Carlsbad Tract No. 76-12 (Calavera Hills Development). It is located on the northwest side of Tamarack Avenue between Pontiac Drive and Edinburgh Drive. The treatment plant was to be used once the City of Carlsbad's flow rate at the EWPCF reached 5.45 MGD. However, the EWPCF was subsequently expanded and the Calavera Hills Wastewater Treatment Plant was not placed in operation. The Calavera Hills area was removed from the City's Sewer Master Plan in 1991 due to the area being annexed into the Encina Joint Powers Authority Wastewater Service Area and completion of Phase IV expansion of the EWPCF.

After the Calavera Hills Treatment Plant was abandoned, portions of the discharge lift station force main were incorporated into the NAH Interceptor (Reach NAHT1A) and used as a gravity sewer. Over the years the treatment plant site has been utilized by different City Departments for storage and training, however the site is no longer being utilized and the buildings and facilities have deteriorated. The areas surrounding the abandoned treatment facilities, as well as the facilities themselves, are located in a secluded area that is often the subject of vandalism. In January 2010, the City passed a resolution authorizing the appropriation of funds for the demolition of the remaining buildings and facilities at the project site. A demolition contract was bid and awarded in 2011 and the treatment plant is scheduled for removal in early 2012.

2.9 OTHER AGENCIES FACILITIES

In addition to the EWPCF, several wastewater facilities owned by other agencies are also located within the City of Carlsbad. These facilities include failsafe lines and outfalls from upstream wastewater treatment plants. Figure 2-13 illustrates facilities owned and operated by other agencies that are within the Carlsbad Sewer Service Area or along its boundary



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Legend

OTHER AGENCY FACILITIES

- LS LIFT STATIONS
- WTP RECLAMATION PLANTS
- F METER STATIONS
- EWPCF ENCINA WATER POLLUTION CONTROL FACILITY
- VALLECITOS SLUDGE LINE
- VALLECITOS OUTFALL
- VISTA/CARLSBAD INTORCEPTOR
- CITY OF VISTA/BUENA SANITATION DISTRICT SEWER FACILITIES
- LEUCADIA WASTEWATER DISTRICT SEWER FACILITIES
- CARLSBAD S SEWER SERVICE BOUNDARY
- LEUCADIA WASTEWATER DISTRICT
- WATER BODIES

CITIES

- CARLSBAD
- ENCINITAS
- OCEANSIDE
- S.D. COUNTY
- SAN MARCOS
- VISTA

NOTE: SEWER INTERCEPTORS CONVEYING ONLY CARLSBAD FLOWS ARE NOT SHOWN.

FIGURE 2-13

CITY OF CARLSBAD OTHER AGENCY WASTEWATER FACILITIES

As population has grown and the northern coastal areas of San Diego County continue to develop, the City of Carlsbad has experienced gradually increasing wastewater volumes. This chapter documents existing wastewater flows within the sewer service area and results of the flow measurement program. Historical wastewater flows are summarized and unit flows are developed for residential and commercial/industrial areas. Peaking curves for each interceptor system and contributing upstream agency are developed for dry weather flows. Existing defect flows from rainfall-induced inflow and infiltration are quantified based on historical events.

3.1 ENCINA FLOW METERS

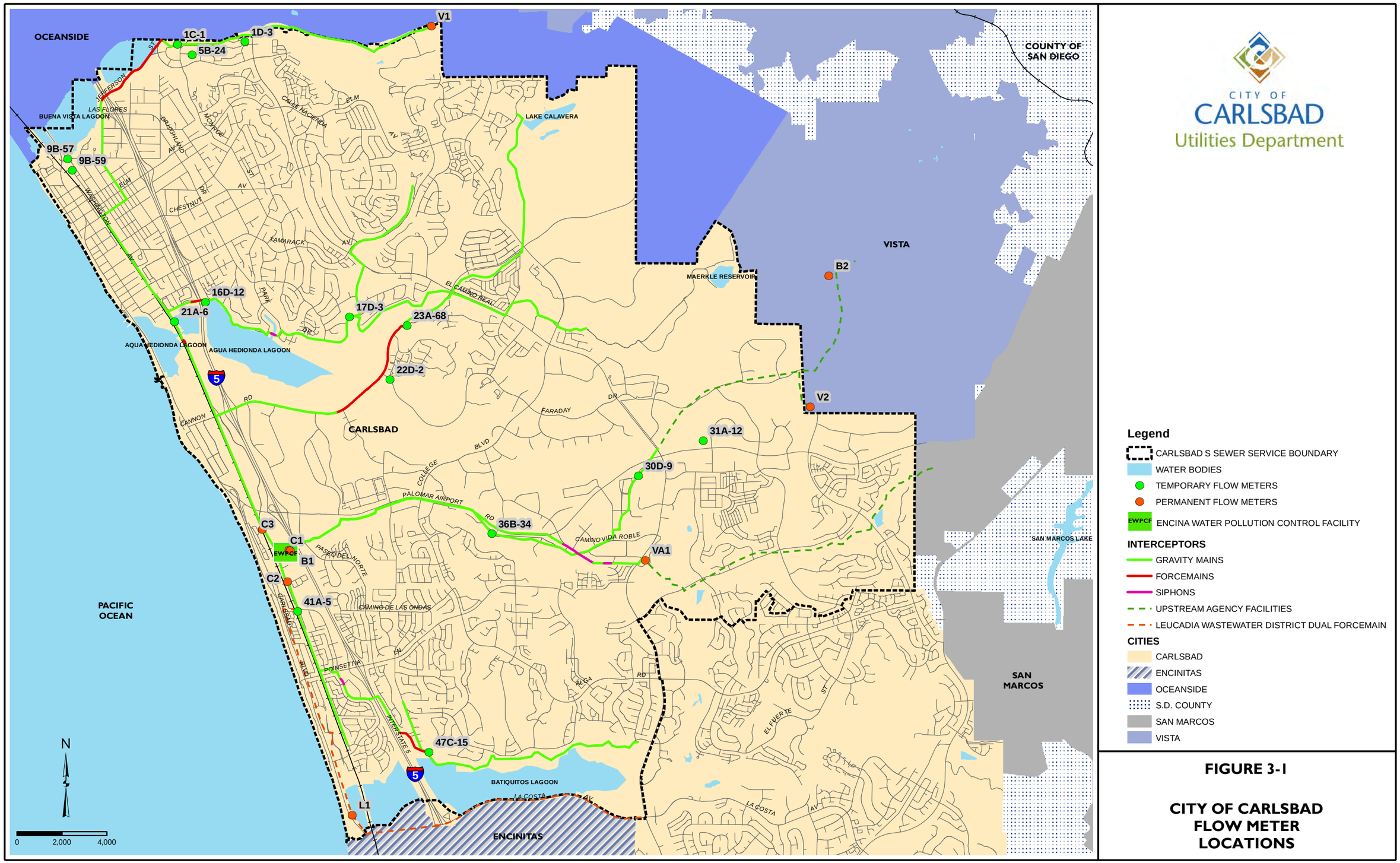
The Encina Wastewater Authority (EWA) operates and maintains numerous flow meters throughout the service areas of its six member agencies for billing and informational purposes. The flow meters used for billing purposes are calibrated semi-annually. Flow data can be downloaded from a web-based, graphical information management system and monthly flow summary reports are provided to member agencies. Wastewater flows generated within the City of Carlsbad are metered in the interceptor pipelines upstream of the EWPCF. Because of flow contributions from upstream agencies, Carlsbad flows must be determined by subtracting other agency flows from measured flows at the EWPCF, which increases the margin of error. Figure 3-1 illustrates the locations of the Encina meters (permanent meters) that are used to calculate Carlsbad flows. Details of each Encina meter are provided in Table 3-1. The total flow from Carlsbad is calculated from the following formula:

$$\text{Carlsbad Flow} = (C3\text{-}V1) + (B1\text{-}(B2 + V2)) + (C1\text{-}VA1) + (C2\text{-}L1)$$

Table 3-1 Encina Flow Meters

Meter ID.	Location	Meter Type	Metered Flow	
			Carlsbad	Other Agencies
V1	Haymar Drive in Vista	ADS 3600*	---	Vista & O'side
BVPS	Discharge of the Buena Vista LS	FlowShark	Portions of the V/C Interceptor	Vista & O'side (V1)
C3	VC influent line to the Encina WPCF	ADS 3600*	V/C and NAH Interceptors	Vista & O'side (V1)
B2	Discharge of the BSD Buena LS	FlowShark	---	Buena Sanitation District
V2	Downstream of the Vista Raceway LS	FlowShark	---	Raceway basin (Vista)
B1	Buena influent line to Encina WPCF	ADS 3600*	Buena Interceptor	BSD & Raceway (B2, V2)
VA1	Downstream of the Vallecitos LS	FlowShark	---	Vallecitos
C1	Vallecitos influent line to Encina WPCF	ADS 3600*	Vallecitos Interceptor	Vallecitos (VA1)
L1	Discharge of Batiquitos LS	FlowShark	---	LWWD and Encinitas
C2	NB influent line to the Encina WPCF	ADS 3600*	North Batiquitos Interceptor	LWWD and Encinitas (L1)

* Accuracy of the Model 3600 meter is within plus or minus 5% under ideal flow conditions



CITY OF CARLSBAD
Utilities Department

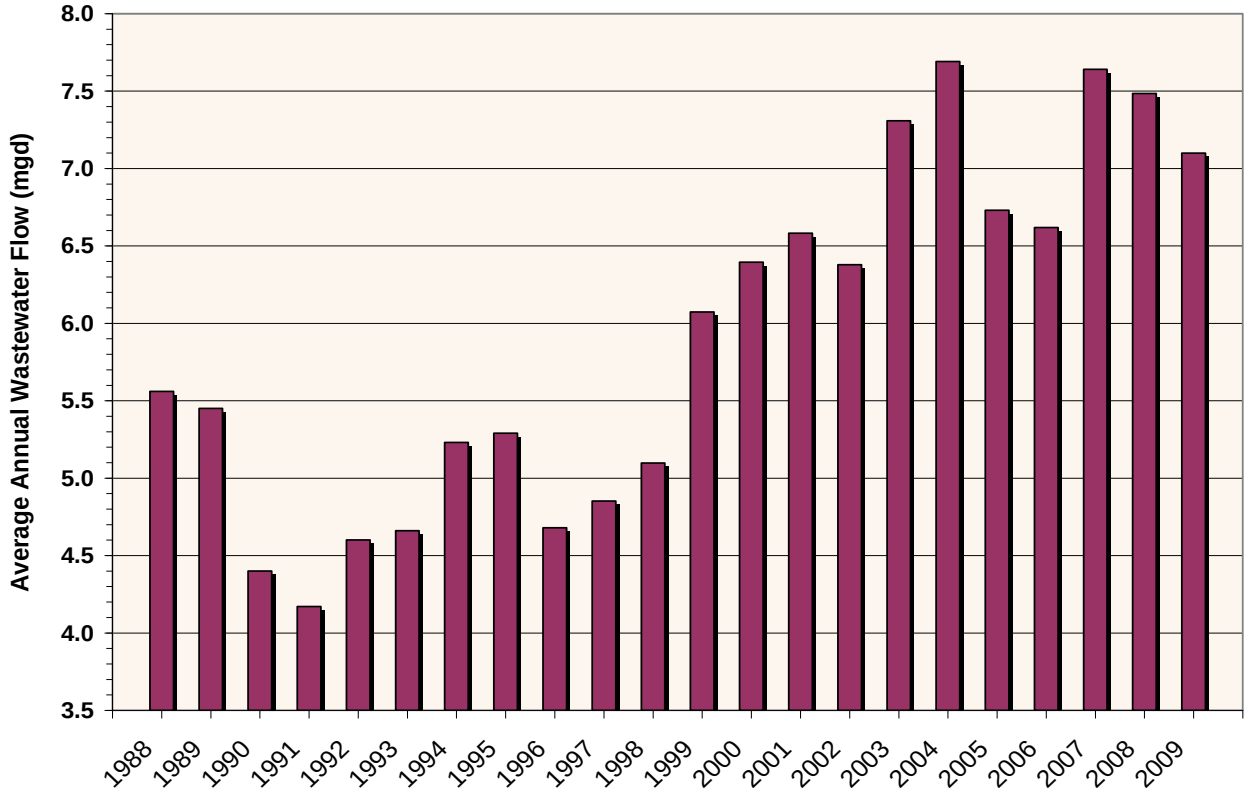
FIGURE 3-1

CITY OF CARLSBAD FLOW METER LOCATIONS

3.2 HISTORICAL FLOWS

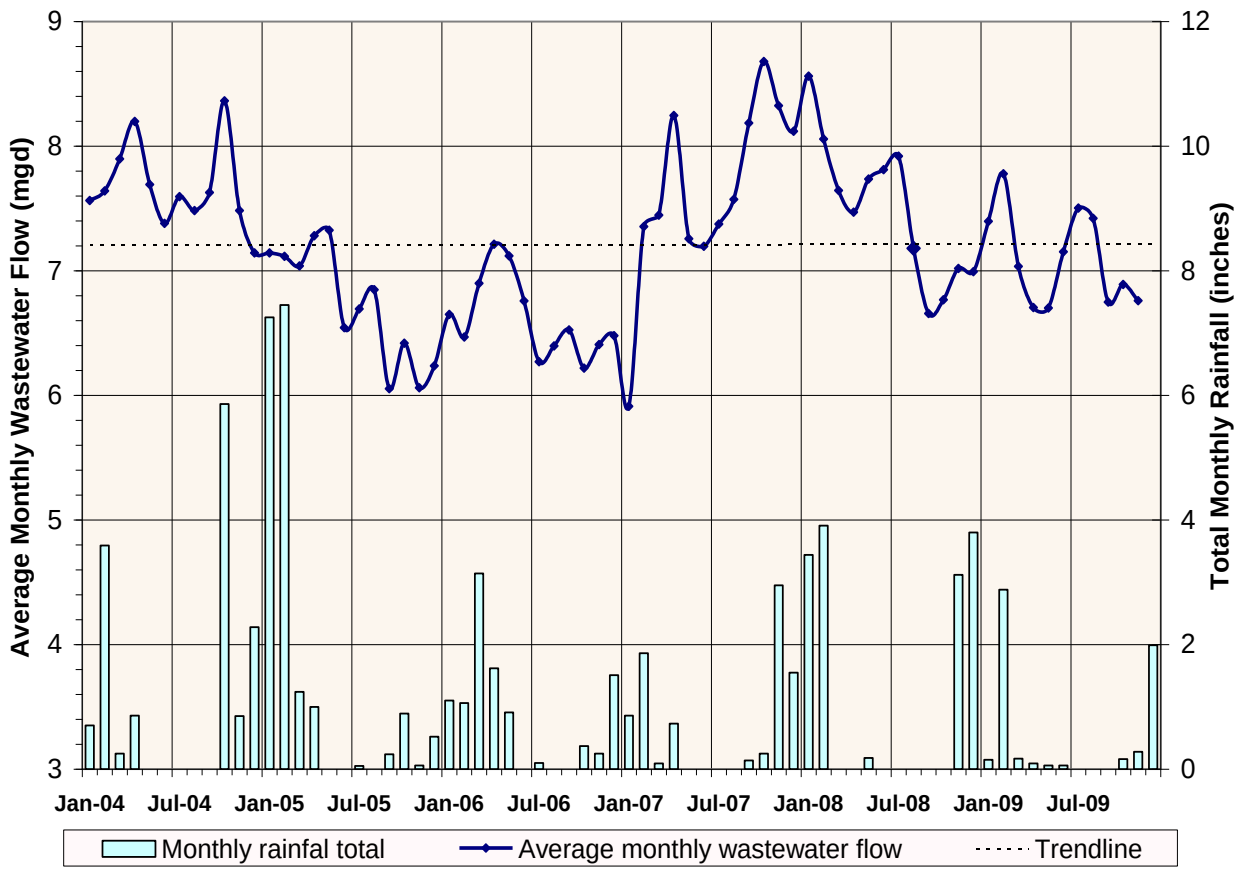
Carlsbad average annual wastewater flows, as calculated from Encina meter data, are summarized for the past 20 years on Figure 3-2. As shown on the chart, wastewater flows decreased significantly after 1989. This was typical of most Southern California sewage agencies, and can be attributed to conservation measures implemented during drought conditions. Some of the conservation measures were temporary, but many, such as the installation of low-flow bathroom fixtures, have had a lasting effect. Flow meters were replaced at the beginning of 1996, and additional upgrades were made in January 2007, which appear to have affected the flow calculations for Carlsbad. The higher flows over the past 10 years are a result of steady increases in population, as land use within the service areas has transitioned from mainly agricultural use to urbanized development. Flows are expected to stabilize or decrease over the next few years due to the economic downturn, which has dramatically slowed new construction, and water conservation measures mandated by the Level II Drought Alert, which went into effect on July 1, 2009.

Figure 3-2 Historical Wastewater Flows



Monthly wastewater flows for years 2004 through 2009 are shown on Figure 3-3, along with monthly rainfall totals. Flow and rainfall data was obtained from EWA reports. From this graph there appears to be slightly lower monthly flows during the dry summer months; however, there are also several large flow fluctuations that cannot be explained. Overall, there is no strong trend of peak flows occurring in any particular month or season.

Figure 3-3 Monthly Wastewater Flows vs. Rainfall



3.3 FEBRUARY 2009 FLOW MEASUREMENT PROGRAM

In February 2009, the City of Carlsbad conducted temporary flow metering at 15 key locations in the sanitary sewer collection system. The flow measurement locations were selected by City staff. The metered basins varied by size and most included a mix of residential and non-residential land use, although two meters measured purely non-residential flows from industrial/commercial business parks. The flow measurement locations and the approximate tributary basins are shown in Figure 3-4.

The temporary meter data was used in conjunction with Encina Wastewater Authority meter data over the same period to characterize and quantify dry and wet weather flows. Specifically, the flow measurements from all sites were analyzed to: 1) characterize the average dry weather flows, 2) determine the quantity and location of rainfall induced inflow and infiltration, 3) prioritize the location of additional field investigation of inflow and infiltration defects, and 4) support dry and wet weather hydraulic modeling. Figure 3-5 provides a flow schematic illustrating the flow routing through both the temporary and Encina meters.

Figure 3-4 Flow Measurement Tributary Basins

(Figure 1 from Flow measurement TM, insert as 11 x 17 landscape)

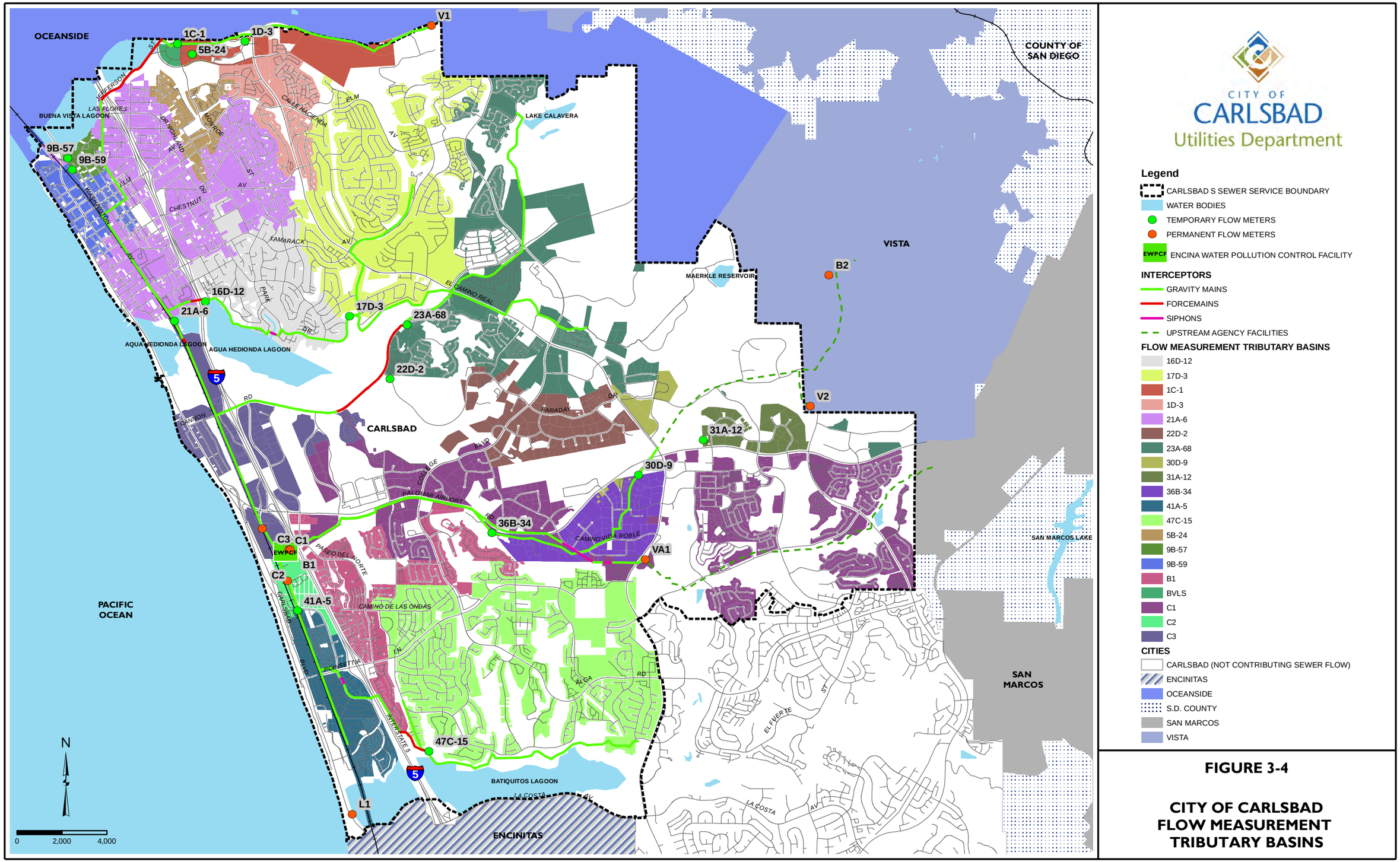
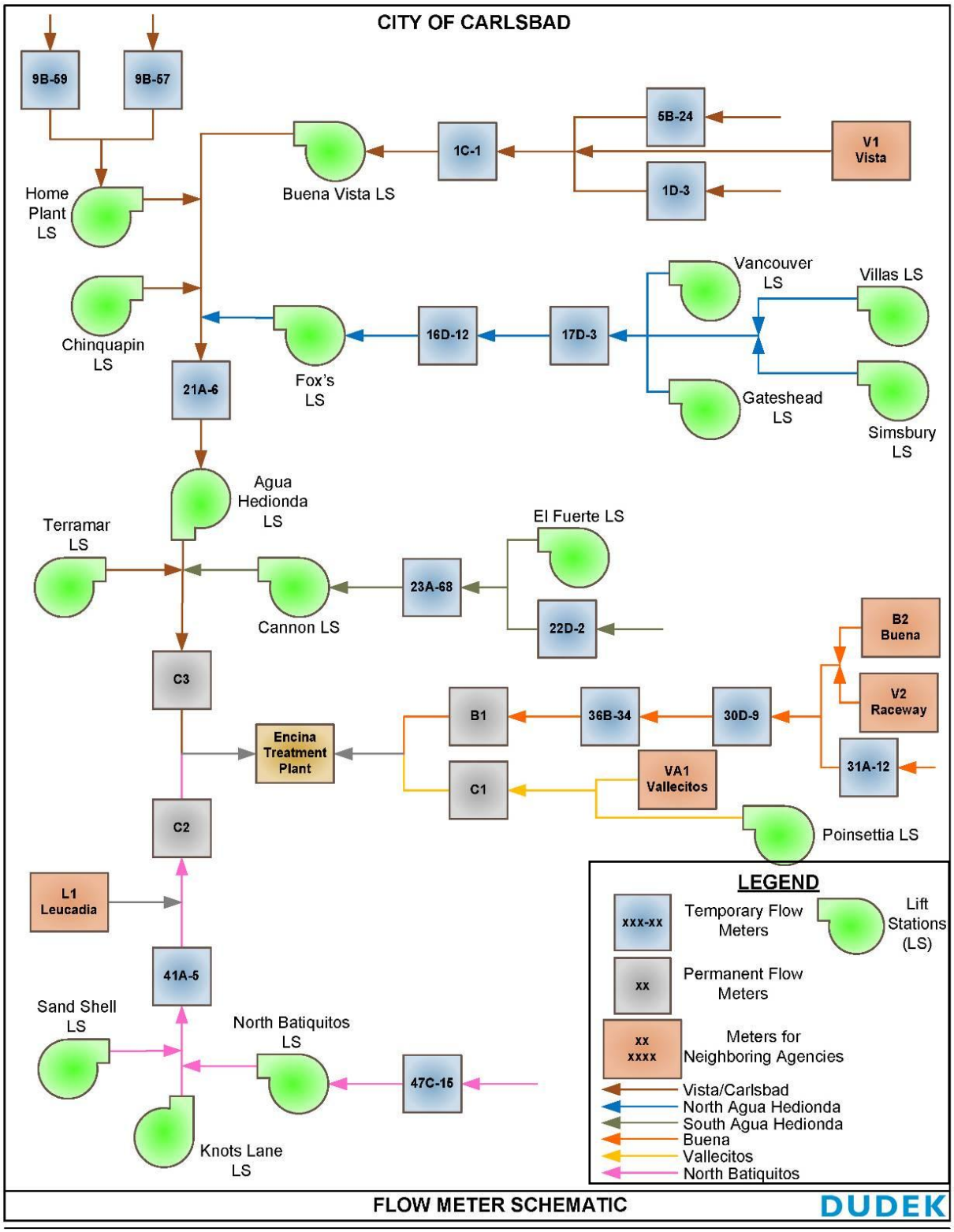


FIGURE 3-4

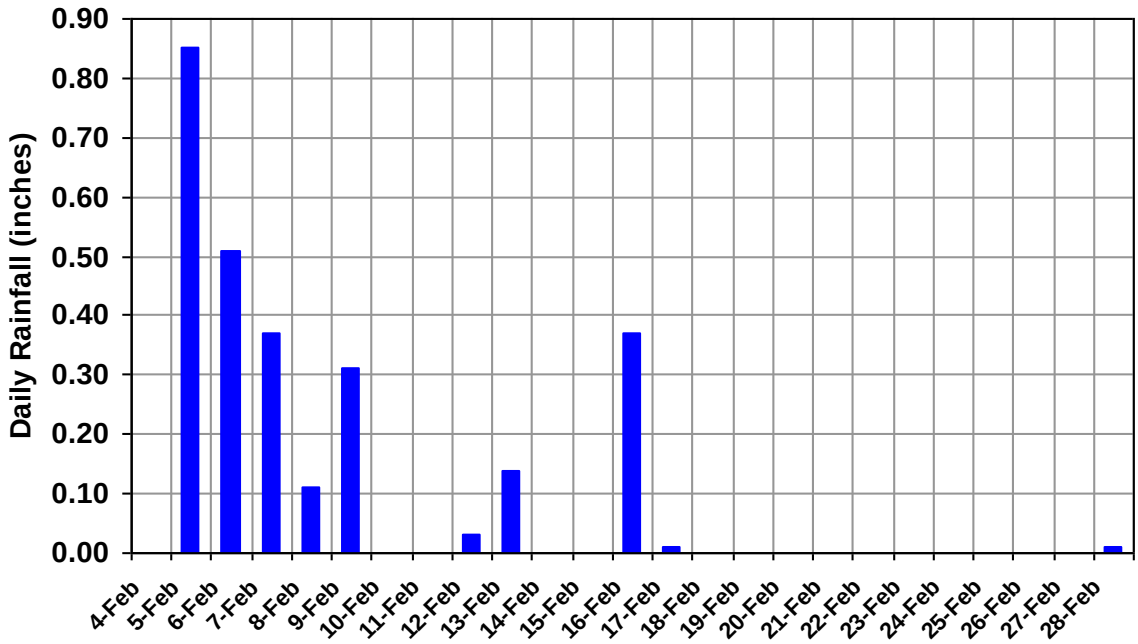
CITY OF CARLSBAD FLOW MEASUREMENT TRIBUTARY BASINS

Figure 3-5 Flow Measurement Schematic



The temporary meters were installed on February 4th and 5th 2009 and remained in place until March 8th, 2009. Data was collected and recorded every 15 minutes during the monitoring period. Figure 3-6 illustrates the daily rainfall during the measurement period, as recorded by a rain gauge located at the Palomar Airport. Although no high-intensity storms occurred during the flow monitoring period, there was sufficient rainfall to allow analysis of the collection system I&I response to rainfall. The full report of the flow measurement program and analysis of the results is provided in Appendix B. Appendix C contains EWA flow meter data from the same flow measurement period.

Figure 3-6 Rainfall in Carlsbad - February 2009



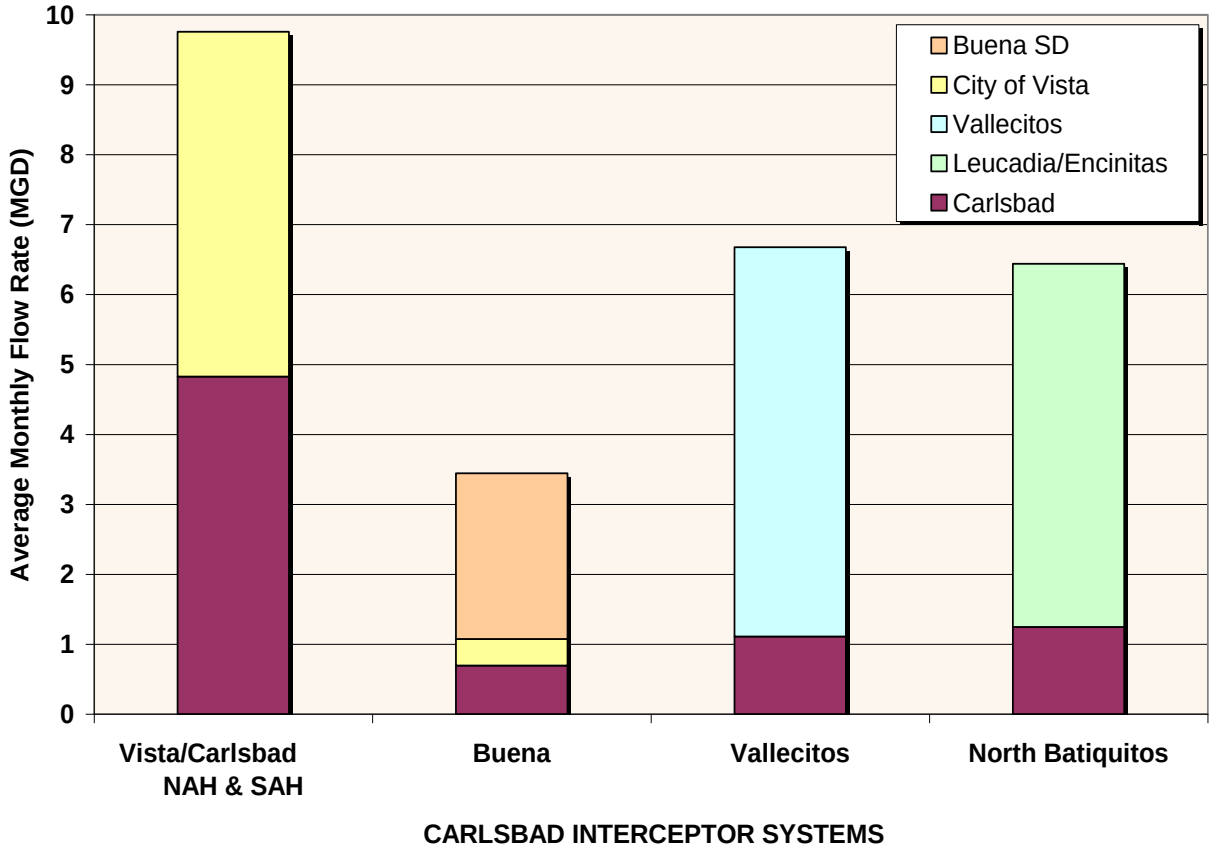
3.4 AVERAGE DRY WEATHER FLOWS

EWA and temporary flow meter data for dry days in February 2009 were used to determine the existing average dry weather flow (ADWF). Dry days are defined as those days where rainfall did not occur and in which there were no lingering effects of prior rainfalls. Table 3-2 summarizes the average dry weather flow for Carlsbad and the other EWA agencies by interceptor. This information is illustrated graphically by interceptor system on Figure 3-7.

Table 3-2 February 2009 ADWF Summary

Interceptor System	Carlsbad Flows	Other Agency Flows		Total Flow
		Agency	Flow	
Vista/Carlsbad	2.63 mgd	City of Vista Oceanside	4.93 mgd	7.56 mgd
NAH	1.13 mgd	--	--	1.13 mgd
SAH	1.07 mgd	--	--	1.07 mgd
Buena	0.69 mgd	Buena Vista (raceway)	2.37 mgd 0.38 mgd	3.45 mgd
Vallecitos	1.11 mgd	Vallecitos	5.56 mgd	6.67 mgd
North Batiquitos	1.30 mgd	Leucadia/Encinitas	5.19 mgd	6.49 mgd
Totals:	**7.93 mgd**		**18.44 mgd**	**26.37 mgd**

Figure 3-7 Flow Summary by Interceptor



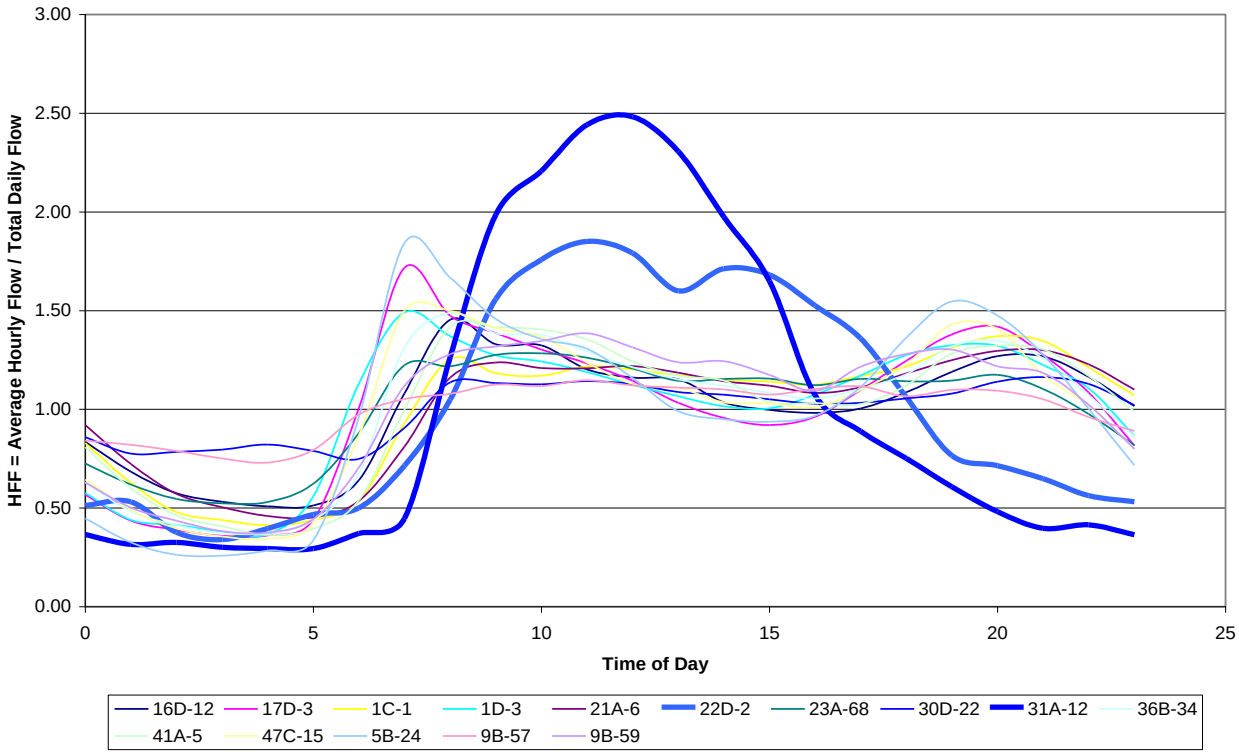
From Figure 3-7, it is apparent that Carlsbad flows comprise a minority of the total flows (20 percent or less) in the Buena, Vallecitos, and NB Interceptors. Carlsbad flows in the Vista/Carlsbad Interceptor, which conveys flows from the NAH and SAH drainage basins in the lower reaches, are approximately equal to City of Vista flows in this interceptor. Because Carlsbad flows are calculated by subtracting upstream and downstream flow meter readings, the resultant flows are dependent on the accuracy of all the meters. If the Carlsbad flow contribution is very small relative to the upstream flows, an error of even 3 percent on the upstream and downstream readings can have a significant effect on the calculated flow for Carlsbad. For example, a three percent error in flow readings for the Leucadia/Encinitas (meter

L1) will produce a 20 percent error in Carlsbad flow calculations (C2-L1). If the accuracy of both the L1 and C2 meters is considered, the flow calculated for Carlsbad in the NB Interceptor be up 40 percent in error with both meters reading within their reported accuracy range of three percent. It is noted that flow measurements from the temporary meters indicated slightly higher flows generated within Carlsbad in the NB Interceptor than calculations performed with Encina flow data, and the temporary flow data is reflected in Table 3-2.

3.5 PEAK DRY WEATHER FLOWS

Flow measurement data from the meters indicate distinct and repeatable peaking trends for weekdays and for weekends. Data from the EWPCF meters and the temporary flow meters was recorded in 15-minute intervals, and typical dry weather flow patterns were determined by averaging weekday and weekend flows during days with no rainfall. Figure 3-8 illustrates each characteristic weekday Hourly Flow Factor (HFF) for each of the temporary flow meter sites. The HFF is calculated by dividing the hourly average flow by the average daily flow. This standardizes the hourly variations regardless of the total daily volume. The peak dry weather flow (PDWF) is the maximum HFF times the average daily flow for that basin.

Figure 3-8 Hourly Flow Factors for Temporary Meters (Weekday ADWF)

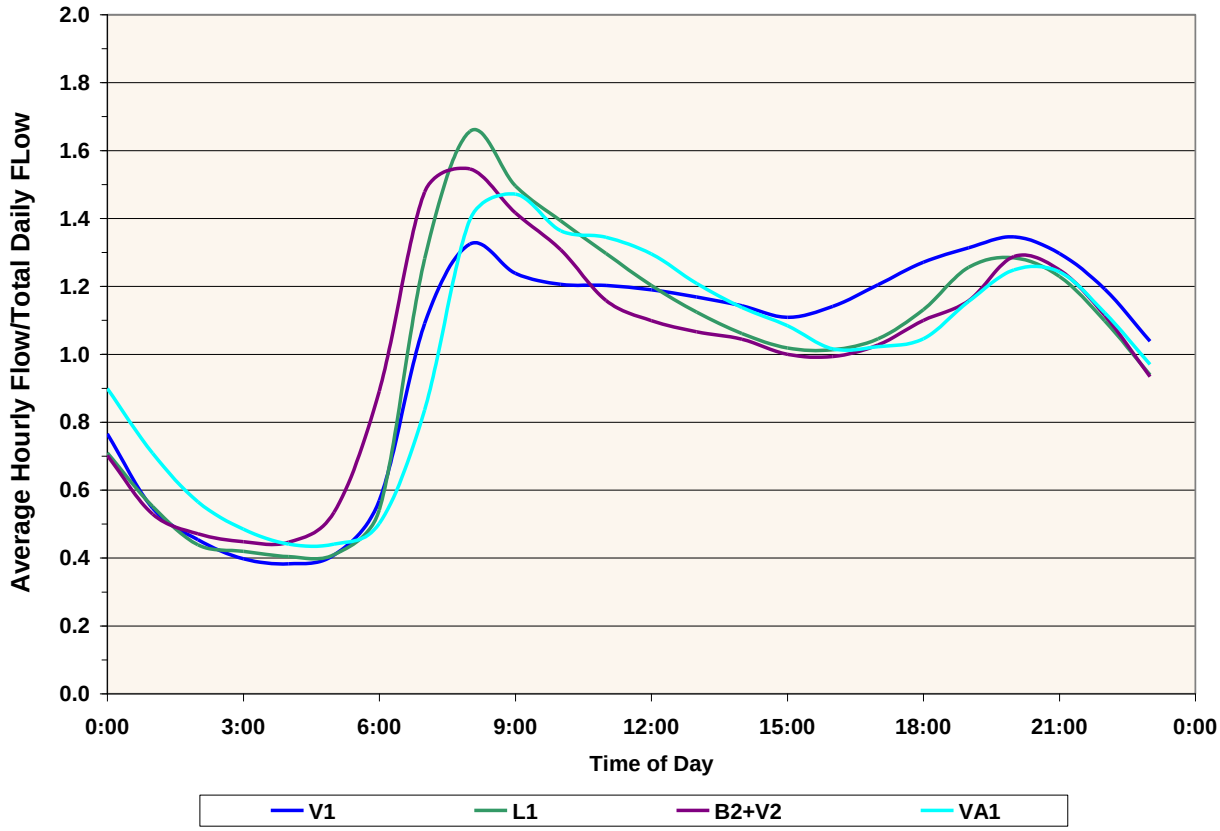


As can be seen from the hydrographs in Figure 3-8, there are two distinct flow patterns. Most sites are dominated by residential flows and have an early morning and mid-evening peak, with the highest peak generally occurring between the hours of 7:00 AM and 9:00 AM. Site 5B-24 has the highest peaking factor and is also the most homogenous residential land use. The two hydrographs with midday peaks (shown bolded) are for industrial/commercial basins. It is noted that flows from meter 31-A-12, the

Loker industrial park site, were too low for accurate measurement, as the flow depth was generally less than 0.5 inches. The site did provide good insight into the diurnal flow pattern at this location, however.

Hydrographs for upstream agency weekday flows recorded by Encina meters during the same period are shown in Figure 3-9.

Figure 3-9 Hourly Flow Factors for Upstream Agencies (Weekday ADWF)



3.6 INFLOW AND INFILTRATION

Storm water inflow and infiltration (I&I) is the combination of wet weather infiltration and direct storm inflow that establishes the maximum required hydraulic capacity of wastewater conveyance facilities. Infiltration enters the collection system underground through holes, cracks and leaky pipe or manhole joints, due to either a permanently high groundwater table or as a result of rainfall percolation and temporary rising of groundwater levels. While the amount of infiltration from rainfall events can be estimated from an evaluation of flow data and rainfall records, infiltration that occurs year-round can typically only be detected from pipeline video inspection or manhole inspections. The presence of excessive amounts of infiltration indicates broken or poorly constructed pipes, pipe joints, or manholes in areas with high groundwater elevations.

Inflow in a collection system generally refers to extraneous water that flows directly into the system as a result of storm water runoff. Entry points may be at manholes or from illicit connections to the sewer system, such as roof and yard drains. The primary characteristics of inflow are the rapid response to the

onset and cessation of rainfall. The rate of inflow depends on the amount and intensity of rainfall and the ground saturation level.

For this master plan update, the sewer system is analyzed based on the ability to convey the theoretical peak wet weather flow (PWWF), which is calculated by adding observed peak I&I rates to the PDWF. The amount of rainfall that fell during the February 2009 flow monitoring period was not significant enough to establish peak I&I rates within Carlsbad or for upstream agency flows. Encina meter data from high intensity rainfall events over the past five years was therefore reviewed to provide additional data. Rainfall during the 2004-05 rainfall season was approximately twice the average annual rainfall. On February 23, 2005, approximately 1.5 inches of rain fell between 2:00 AM and noon, with over half of this rainfall occurring during the first two hours. Previous storms in January and February of that year had saturated the soil and raised groundwater levels, which increased the runoff and I&I into the sewer system. Because the high intensity rainfall on this day coincided with minimum daily sewer flows, stormwater flows were conveyed through the sewer system without incident, and peak I&I rates could be estimated from Encina meter data. The rainfall event on Wednesday, February 23, 2005 was therefore selected as the basis for peak wet weather flows. Flow data from February 23, 2005, plotted together with the 24-hour average flow curves, is provided in Appendix C.

3.6.1 Inflow and Infiltration within Carlsbad

Data from the February 2009 flow monitoring program was analyzed to provide estimates of I&I rates within the monitored sub-basins. In each of the sub-basins there is a wide variation in the total drainage area and upstream length of pipe. To make a comparison between basins, the flows are normalized or standardized by dividing the calculated I&I by the length of upstream pipe and dividing by the total rainfall. This provides an I&I flow rate or volume per foot of pipe and per inch of rainfall. Basin unit I&I rates, or defect flows, may then be used as the basis of determining which basin is the leakiest during the flow measurement period. Table 3-3 indicates the relative ranking of I&I observed during the flow measurement period and Figure 3-10 illustrates the locations of the highest I&I in the metered basins.

Table 3-3 Metered Basins with the Highest I&I Rates

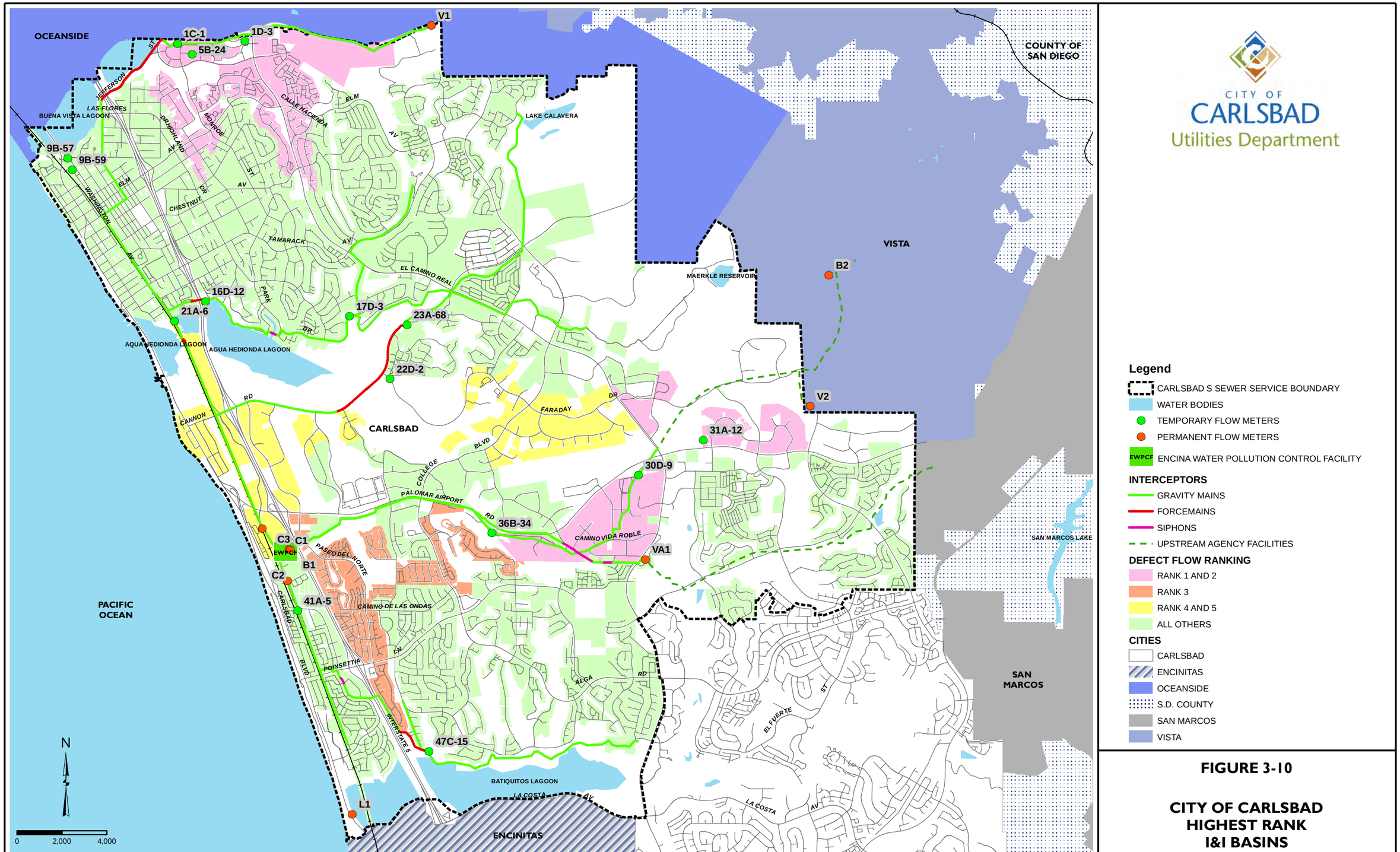
Net Unit Defect Flow		Defect Flow Volumes	
Rank	Site ID	Inflow-24hr. (gal/foot/in.)	Infil-72hr. (gal/foot/in.)
1	1C-1*	20.51	46.66
2	36B-34	8.31	16.49
3	B1	4.40	4.88
4	C-3*	2.04	10.68
5	22D-2	1.80	2.50
** Downstream locations - High 72hr. response*			

The highest ranked inflow and infiltration response was observed on the Vista/Carlsbad Interceptor between the permanent site BVPS, the nearly equivalent temporary site 1C-1 and the upstream permanent site at V1. This indicates that significant I&I is entering the interceptor system along the Highway 78 corridor between the Vista V1 Meter and the Buena Vista Lift Station at Jefferson Street. The I&I rates in this area are more than twice as high as the next highest observed flow.

The second and third highest observed I&I rates occurred along the Buena Interceptor at temporary site 36B-34 and permanent site B-1. These metered areas include the Buena Interceptor and collection systems south of the interceptor along Paseo del Norte, directly west of Aviara Parkway and on both sides of Camino Vida Roble. The City of Vista recently completed CCTV inspections on the Buena Interceptor which revealed infiltration at a number of pipe joints and manholes. A common characteristic of the top three highest rankings is that they are low and in close proximity to creeks.

The fourth highest observed flows occurred at permanent site C-3. This site measured flows in the lower reaches of the Vista/Carlsbad Interceptor and downtown areas tributary to the interceptor. The fifth highest observed flows occurred at temporary site 22D-2 which measures flows from the Carlsbad Research Center. It is noted that City Operation Staff have observed stormwater flowing into manholes along the northern end of Faraday Avenue, which is just south of Buena Vista Creek.

Peak I&I rates on February 23, 2005 were estimated for the major interceptor systems in Carlsbad from Encina meter data and then compared to the combined sub-basin I&I flows from the February 2009 monitoring program. Calculated peak I&I rates were higher based on 2005 data for all interceptors except the Buena system, where 2009 monitoring results indicated slightly higher I&I rates. For all interceptors except Buena the 2005 data was used as the basis for PWWF in the hydraulic model, and data from the 2009 monitoring program was used to distribute the total I&I within the interceptor systems. It is noted that the City of Vista completed a relining project in 2006 for reach VC3 and partial re-lining of Reaches VC1 and VC2 on the V/C Interceptor. Additionally, prior to the relining process a manhole was repaired that had been improperly abandoned and was discharging rainwater directly into the sewer system. Although I&I rates may now be potentially lower than the rates recorded in 2005, the 2009 flow monitoring program still indicated high levels of I&I in Carlsbad between the BVPS and the V1 Encina meter.



CITY OF CARLSBAD
Utilities Department

Legend

- CARLSBAD S SEWER SERVICE BOUNDARY
- WATER BODIES
- TEMPORARY FLOW METERS
- PERMANENT FLOW METERS
- EWPCF ENCINA WATER POLLUTION CONTROL FACILITY

INTERCEPTORS

- GRAVITY MAINS
- FORCEMAINS
- SIPHONS
- UPSTREAM AGENCY FACILITIES

DEFECT FLOW RANKING

- RANK 1 AND 2
- RANK 3
- RANK 4 AND 5
- ALL OTHERS

CITIES

- CARLSBAD
- ENCINITAS
- OCEANSIDE
- S.D. COUNTY
- SAN MARCOS
- VISTA

FIGURE 3-10

CITY OF CARLSBAD HIGHEST RANK I&I BASINS

3.6.2 Upstream Agency Inflow and Infiltration

Results of the I&I investigation indicate that there are high I&I rates to the V/C Interceptor from the City of Vista. In past investigations wastewater flows from Vista were observed to remain elevated for several months after periods of heavy rainfall, indicating infiltration from high groundwater levels. Although high infiltration rates were not apparent during the February 2009 flow monitoring period, wet weather flows from the February 23, 2005 rainfall event were higher than City of Vista storm flows analyzed in the City of Carlsbad 2003 Master Plan. The August 2007 City of Vista Sewer Master Plan Update includes an I&I investigation and estimates of peak I&I flow rates for the Vista, Buena, and Raceway basins. These peak I&I rates, which are based in part on February 23, 2005 rainfall data, will be used in the collection system analysis for this master plan.

The highest rate of I&I from upstream agencies was observed from the VWD collection system to the Vallecitos Interceptor (Encina meter VA1). After the first storm in February 2009, flows from VA1 took nearly three weeks to return to prior base flow levels. This indicates that the Vallecitos collection system is subject to widespread infiltration defects. The peak I&I rate from the February 23, 2005 rainfall event is estimated at 11.5 mgd, and wastewater flows during this event and on several other days that were analyzed in January and February 2005 exceeded VWD's peak flow capacity ownership of 12.1 mgd for most of the day. The maximum average hourly flowrate recorded at the VA1 meter during this period in 2005 was 16.6 mgd. It is not known whether there are currently any upstream pumping limitations that would limit the maximum flow rate that can be discharged to the Vallecitos Interceptor. It is noted that Vallecitos was completing its Sewer Master Plan Update at the time of the writing this report.

Flows analyzed from Encina meter L1 indicate a peak I&I rate to the NB Interceptor of approximately 3.5 mgd during the February 2009 storms and a rate of 6.5 mgd on February 23, 2005. The LWWD 1999 Master Plan assumes a peak I&I rate of 5.3 mgd for the ultimate flow condition. Because the measured I&I from LWWD and the City of Encinitas through the L1 meter is higher based on more recent flow data, a peak I&I rate of 6.5 mgd will be assumed for this Master Plan.

3.7 EXISTING UNIT FLOW FACTOR ANALYSIS

A unit flow factor analysis was conducted with wastewater flow data to determine flow generation factors for use in future flow projections. Land use in the upstream collection areas was reviewed for all meters. Three meters were selected for analysis based on the land use, which needed to be either primarily residential or non-residential. The meters and land use types are as follows:

- Meter 22-D2 – Carlsbad Research Center, industrial/commercial/office
- Meter 31-A12 – Loker Industrial Park, industrial/commercial/office
- Meter 5B-24 -Single and attached residential units (RLM, RM and RMH)

Wastewater flow meter data was compared and verified with water billing data over the same flow metering period. Average unit flow factors within each of these areas were then determined from non-rain days and the non-residential building area or number of residential units within each service area. Study findings are presented separately for each metered area in the following sub-sections.

3.7.1 Carlsbad Research Center Commercial/Industrial Unit Flow Study

The service area for the Carlsbad Research Center (CRC), which was previously referred to as the Faraday Industrial Park, was analyzed in the previous master plan using flow data from the Faraday Upper Lift Station, which has since been abandoned. An updated analysis for this area, which is now nearly built out, is performed using wastewater flow data from the temporary flow meter 22-D2 and water billing records. The CRC consists primarily of light industrial and office uses, with a few commercial establishments and small fast-food or deli-type eating establishments. This type of development is considered representative of future industrial business park developments planned for other areas in Carlsbad. The wastewater collection system upstream from meter 22-D2 serves approximately 130 buildings that comprise the CRC, which is shown on Figure 3-11.

Figure 3-11 Carlsbad Research Center Study Area

The wastewater duty factor for non-residential development is based on the indoor building area, and is expressed in units of gallons per day of wastewater generated per every 10,000 square feet of building area. Wastewater flows were determined from Meter 22-D2 flow data for non-rain event days and then compared to water consumption for commercial water meter accounts. Water consumption data was provided by City Staff and was prorated between two billing months to give consumption for the calendar month of February. The square footage for each building in the study area was also provided by City Staff based on a records search of building permits. It is noted that a few of the buildings have not yet been occupied, or are currently vacant. To determine which buildings were vacant, commercial water billing accounts were reviewed to verify active water usage. Buildings with no or very little water usage were not included in the duty factor calculations.

Indoor water use correlated fairly well with wastewater flow data, which provided verification of the flow meter readings. The indoor potable water return rate to the sewer system was calculated to be 84

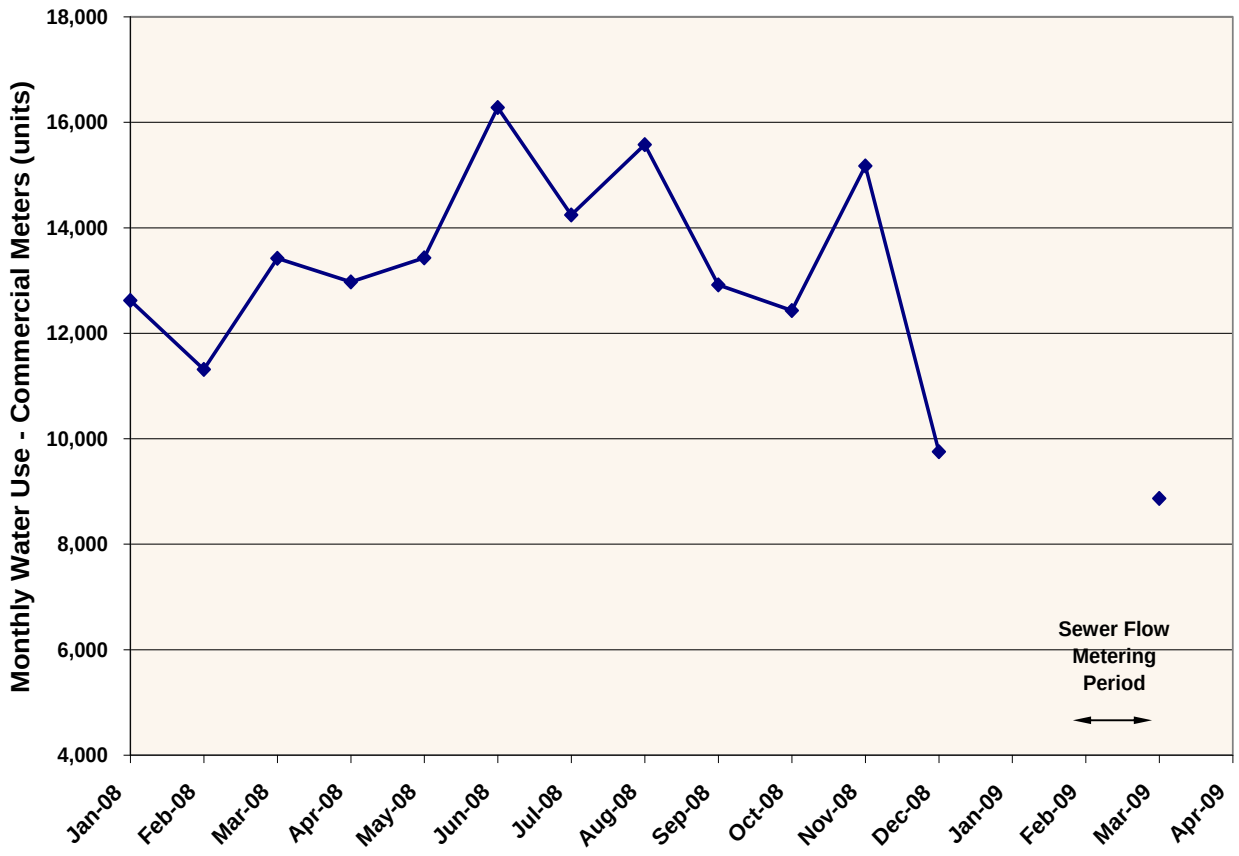
percent. A high return rate is typical in newer developments that are designed with separate irrigation meters for a recycled water supply. A summary of study results is provided in Table 3-4.

Table 3-4 Carlsbad Research Center Flow Study Results

Development Information:		
Total area of developed comm/ind parcels:	398	acres
Total indoor building area:	5,688,147	sqft
Percent coverage:	33%	
Water Billing Analysis:		
Total Feb 2009 indoor water use:	8,868	units (Commercial meters only)
	236,895	gpd
Total building area with Feb '09 water use:	5,039,929	sqft
Average Unit Indoor Water Demand :	470	gpd/10,000 sqft
Wastewater Flow Analysis (Meter 22-D2 data):		
Average flow for non-rain days:	0.199	MGD
	199,286	gpd
Indoor Water return rate to sewer:	84%	
Total building area with Feb '09 water use:	5,039,929	sqft
Average Unit Wastewater Flow:	395	gpd/10,000 sqft

The average unit wastewater flow generation rate in February 2009, based on the building size, is 395 gallons per day per 10,000 square feet of building area. This is nearly 30 percent lower than unit flow generation rates calculated for this area based on 2001 flow data in the previous master plan. The lower unit flow rate is most likely due to lower occupancy rates as a result of the economic recession. While buildings that are unoccupied and had no or very little water were eliminated from the study, many of the larger buildings with multiple tenants may only be partially occupied. This is especially true for the newest buildings, which may have floors or sections that have never been occupied. Newer water saving appliances and a focus on water conservation with the current drought condition has most likely attributed to the lower sewer flows as well. As a specific example of the lower flows, water use at one 219,000 sq. ft. corporate and manufacturing facility was determined to be approximately 65 percent lower than 2001 water use due to workforce reductions and the relocation of some manufacturing processes. Figure 3-12 Illustrates the commercial water use in the study in 2008, and the recent decrease. March 2009 water billings were approximately 30 percent lower than March 2008 billings. It is noted that water billing records from March 2009 were evaluated to determine average demands during the February flow monitoring period.

Figure 3-12 Carlsbad Research Center Monthly Use Water



The development of representative unit water demands or sewer flow factors for non-residential areas, especially industrial areas, is difficult due to the large variance in indoor water use. While there are several water-use intensive facilities within the CRC, most of which involving manufacturing or processing, the majority of buildings have a water use significantly less than the average. It is noted that restaurants will also have high unit water demands, but there are no sit-down restaurants in the CRC.

3.7.2 Loker Commercial/Industrial Unit Flow Study

The Loker Industrial Park consists of a mix of primarily light industrial uses similar to the CRC, but the area is smaller and was developed more recently. The wastewater collection system upstream from meter 31-A12 serves approximately 68 buildings and covers 156 acres. Figure 3-13 illustrates the study area.

Figure 3-13 Loker Industrial Park Study Area

Wastewater flows for the Loker Industrial Park were determined from Meter 31-A12 flow data for non-rain event days. The square footage for each building in the study area was provided by City Staff based on a records search of building permits, and February 2009 water billing data from commercial accounts were reviewed to verify active water usage. Buildings with no or very little water usage were not included in the duty factor calculations. As a check on the flow meter data, a comparison was made with February 2009 water consumption for commercial water meter accounts. A summary of study results is provided in Table 3-5.

The indoor potable water return rate to the sewer system was calculated to be 54 percent, which is unacceptably low for an area with separate irrigation and recycled water meters. Upon close review of the wastewater flow meter data, it was discovered that the average depth of flow at the meter location was less than one inch under normal flow conditions. This depth, is only slightly greater than the height of the meter, and it was concluded that flow results from Meter 31-A12 were inaccurate.

The average unit indoor water use rate in February 2009, based on the building size, is calculated to be 236 gallons per day per 10,000 square feet of building area. This is approximately half the unit water demand of the CRC. A site visit to the area revealed a large number of vacancies, most of which were in newer buildings that had only been partially occupied. Because of the significant number of vacancies, it was concluded that data from the Loker Industrial Park should not be used as a basis for establishing existing non-residential unit flows or to determine unit flow factors for future flow projections.

Table 3-5 Loker Industrial Park Flow Study Results

Development Information:		
Total area of developed comm/ind parcels:	156	acres
Total indoor building area:	2,202,281	sqft
Percent coverage:	32%	
Water Billing Analysis:		
Total Feb 2009 indoor water use:	1,901	units (Commercial meters only)
	50,796	gpd
Total building area with Feb '09 water use:	1,979,274	sqft
Average Unit Indoor Water Demand :	257	gpd/10,000 sqft
Wastewater Flow Analysis (Meter 31-A12 data)*:		
Average flow for non-rain days*:	0.025	mgd
	25,000	gpd
Indoor Water return rate to sewer:	49%	
Total building area with Feb '09 water use:	1,979,274	sqft
Average Unit Wastewater Flow:	126	gpd/10,000 sqft

** Flow data for this meter was determined to be inaccurate*

3.7.3 Residential Unit Flows

Flow Meter 5B-24 was located near the intersection of Marron Road and Monroe Street, in the northern area of the City between El Camino Real and interstate 5. General Plan land use for the metered service area is Residential Low-Medium density (58%) and Medium density (42%). The Medium density areas have mostly attached residential units. Lot sizes range from approximately 2,200 square feet up to 4 acres, but most lots range between 4,000 and 8,000 square feet. Based on information in the parcel database, homes in the service area were constructed between 1920-2008, with 60 percent of the homes constructed in 70's and 80's, before the advent of modern water-saving plumbing fixtures.

An initial analysis was performed to identify the parcels to be included in the upstream meter service area. Topographic data, aerial photographs, and sewer lateral information from the City's GIS were reviewed for this purpose. It is noted that City staff expressed concern that the lateral data had not been field verified. The lateral data was therefore not relied upon, and assumptions had to be made with regards to the number of included parcels. It is estimated that the sewer service area upstream from Meter 5B-24 includes 488 residential homes, one church, and one church with an associated school. A map of the study area upstream from Meter 5B-24 is provided on Figure 3-14.

CITY OF CARLSBAD
Utilities Department

Legend

- SEWER SERVICE BOUNDARY
- PARCELS
- WATER BODIES
- MANHOLES
- SEWER MAINS

PARCELS CONNECTED TO 5B-24

- SEWER
- SEPTIC
- VACANT
- UNKNOWN

FIGURE 3-14

CITY OF CARLSBAD RESIDENTIAL UNIT FLOW STUDY PARCELS (METER 5B-24)

The return rate to the sewer system from residential water meters is affected by the lot size and irrigation demands, and is highly variable. Although water meter records cannot be used to estimate or verify residential sewer flows, an analysis of water billing data was performed to determine the number of active residential units connected to the upstream Meter 5B-24 collection system. Water billing data provided by City Staff for February 2009 was used to identify vacant units (accounts with no or very little water usage), assign equivalent dwelling units to the two non-residential parcels, and identify residences with septic systems. City Staff provided a separate database of water accounts that were not billed for sewer services, and it was determined that eight homes on larger lots within the Meter 5B-24 service area were not connected to the sewer system. The location of vacant units and units on septic is also shown on Figure 3-14.

A summary of the residential unit flow analysis results is provided in Table 3-6. Based on the 462 residential units that were determined to be contributing sewage flows within the study area and the wastewater contribution from the two churches and the associated school, which were assigned EDUs based on the indoor water usage (commercial meters), the average unit wastewater flow per dwelling unit was calculated to be 180 gallons per day. It is noted that the largest margin of error in this study is probably the number of estimated parcels that discharge flows to the metered collection system, since accurate lateral information was not available.

Table 3-6 Residential Unit Flow Study Results

Development Information		
Total number of residential parcels:	488	
number of churches:	2	
Number of homes on septic:	8	
Water Billing Analysis		
Total Feb '09 water use:	4,702	units (hcf)
	125,606	gpd
No. of parcels with no water use in Feb '09:	18	(vacant parcel or vacant home)
Wastewater Flow Analysis (Meter 5B-24 Data)		
Average flow for non-rain days:	0.0851	MGD
	85,143	gpd
No. of EDUs contributing to sewer	473	(462 residential + 11 non-res)
Average flow per residential unit	180	gpd/DU

The level of sewer service that is provided to a community is related to the implementation of improvements that are planned and designed in accordance with accepted criteria. The sewer collection system is analyzed with a hydraulic model and results are evaluated with respect to established and verified design criteria to identify capacity deficiencies. This chapter describes the design criteria and hydraulic modeling methodology used in the evaluation of sewer collection system facilities based on 2009 conditions. The evaluation method employs the use of the MHWSoft InfoSWMM hydraulic modeling software, which performs hydraulic calculations with extended period simulations (EPS) and fully dynamic flow routing to calculate water depth in open channels and velocities and headloss in force mains. A summary of the performance of the existing system under both dry and wet weather conditions is provided.

4.1 DESIGN CRITERIA

Design criteria provide the standards against which the existing system is evaluated. These criteria are also the basis for planning of new facilities to improve existing service or to handle future wastewater flows. The design criteria in this Master Plan Update are based on existing City of Carlsbad design standards and are summarized in Table 4-1. It is noted that peaking factors used in the hydraulic analysis are based on historical dry and wet weather peak flows observed from metering data, as previously presented in Chapter 3 and discussed in more detail at the end of this chapter.

Table 4-1 Design and Evaluation Criteria

Depth-to-Diameter Ratio for Gravity Mains	For sewer mains ≤ 12-inch ..... 0.50 For sewer mains > 12-inch 0.75
Manning's Roughness Coefficient	For PVC lined pipes in the V/C Interceptor ..... 0.012 For all other pipes 0.013
Velocity for Gravity Mains	Minimum allowable velocity ..... 2 ft per sec Maximum allowable velocity ..... 12 ft per sec
Velocity for Force Mains	Minimum allowable velocity ..... 2.5 ft per sec Maximum allowable velocity ..... 8 ft per sec

The most important evaluation criteria for gravity sewers is the depth of flow, which is calculated in the hydraulic model based on Manning's Equation. The capacity of each gravity sewer is based on the relative depth of flow within the respective pipeline reach. Sewer interceptors are not typically designed to flow full, as unoccupied space at the top of the pipe is required for conveyance of sewage gasses and to provide contingent capacity for wet weather inflow and infiltration. Interceptor sizing is typically based on the pipeline flowing 75 percent full at the PWWF if the pipe is larger than 12-inches in diameter (D/d = 0.75). If the pipeline is 12-inches in diameter or smaller, a D/d factor of 0.50 is used.

Friction factors for pipelines are a required input to the model. The factors vary with the material and the age of the pipe. A roughness factor as indicated by a Mannings' coefficient ("η") of 0.013 is typically used to evaluate existing interceptors and for projection of future sizing needs. Previous studies have shown that this value typically accounts for most pipe roughness, joints, and fouling that occur after

several years of operation. At the direction of City staff, a Manning's coefficient of 0.012 was used in the evaluation of the PVC-lined RCP and CCFRPM pipeline sections of the V/C Interceptor installed in 2002 (reaches VC5 through VC11A).

In the design of sewer lift stations, it is required that spare pumping units be included for mechanical reliability. A wastewater facility must be capable of conveying peak wet weather flows with the largest operating unit out of service. Lift stations are typically equipped with a minimum of two pumps and have a secondary or emergency power source, consisting of either installed generators or a connection for a portable generator. Forcemains are evaluated based on maintenance of a minimum or maximum allowable flow velocity, varying between 2.5 and 8.0 fps. Velocities less than 2.5 fps can result in deposition in the forcemain, while velocities greater than 8.0 fps can damage the pipeline through excessive abrasion.

4.2 PIPELINE EVALUATION OR "TRIGGER" CRITERIA

As stated in the previous section, the design criteria for gravity sewers provides unoccupied space at the top of the pipe for conveyance of sewage gasses and to provide contingent capacity for wet weather inflow and infiltration. In this Master Plan, the PWWF analysis assumes peak I&I rates coincide with the PDWF, and the duration of the PWWF condition is brief. When gravity pipelines are evaluated to determine if there is adequate capacity under the PWWF condition, a separate pipeline evaluation criteria is often used to determine the permissible flow level before the pipeline should be upsized. This criteria is often referred to as "trigger" criteria. Based on discussions with City Staff and criteria established by other agencies, gravity sewers are permitted to flow up to 90 percent full at the PWWF before improvement projects will be identified.

4.3 EXISTING SYSTEM HYDRAULIC MODEL

A new model of the Carlsbad wastewater collection system was developed from the City's GIS data as part of this Master Plan Update. The existing system model includes gravity interceptors and collector pipelines, siphons, lift stations, force mains, manholes, cleanouts, and other appurtenances that were operational during the February 2009 flow metering period. The model is illustrated on Exhibit 1, provided in Appendix A, and is described in more detail in the following sections.

4.3.1 Modeling Software

Hydraulic modeling software is composed of two primary parts, the user interface and the analytical engine. The user interface is the aspect of the model that is used to input data, provide scenario settings and assumptions, initiate analyses and review results. The analytical engine performs the hydraulic calculations. The development of a new computer model for the City of Carlsbad included an evaluation of several different software packages, and the selected modeling software was InfoSWMM, a fully ArcGIS integrated, highly advanced, and comprehensive hydrologic, hydraulic, and water quality simulation model. InfoSWMM is built atop the ESRI ArcGIS platform, allowing direct importation of the existing sewer GIS maintained by the City.

InfoSWMM's analytical engine is based on the Environmental Protection Agency's Storm Water Management Model (SWMM). InfoSWMM hydraulic model has capability to perform hydraulic analysis

using a Fully Dynamic Wave routing method in addition to solving the Manning's equation for calculating the headloss. Fully Dynamic Wave routing method solves the complete one-dimensional St. Venant flow equations. These equations consist of the continuity and momentum equations and takes into account the inertial and pressure forces and can predict surcharge, overflow and backwater conditions. It also solves Hazen-William's equation for pressurized flow in the force mains.

4.3.2 Physical Data Input

In the InfoSWMM model, the collector and interceptor gravity mains, siphons, force mains, and lift stations are represented as links, whereas the wet wells, manholes, cleanouts, and other appurtenances are represented as nodes. This type of model is referred to as a link-node model. Link alignments, node locations and basin modeling data associated with links and nodes (example - invert elevations, manhole depths, pipeline diameters, pipeline lengths, etc.) were imported directly from the City's wastewater GIS. Lift station data, including wet well dimensions, were entered manually based on information provided by City Staff. It is noted that the City's GIS included some facilities based on design drawings that had either not been constructed or were not operational during the February 2009 flow metering period. These facilities included the El Fuerte Lift Station and upstream collection pipelines, and future gravity pipelines that will allow for the abandonment of the La Golondrina and La Costa Meadows III lift stations. The future facilities were removed from the model and are not depicted in Exhibit 1.

During the model development process, quality control checks were performed on the City's wastewater GIS. Missing data and obvious input errors were brought to the attention of City Staff, who made the necessary corrections to the GIS. Results from initial model calibration simulations with the corrected GIS indicated several areas in the distribution system with surcharged pipelines. Investigations of these surcharged areas revealed data errors such as pipeline sections with negative slopes or incorrect pipeline diameters. City Staff performed additional investigations to correct the GIS, which involved surveying manholes to obtain accurate data for the model. It is noted that several input errors were discovered upon more detailed review of subsequent simulation results. Data errors that were discovered after completion of the calibration runs were corrected directly within the hydraulic model, and notes were included to document the changes and assumptions.

The existing system hydraulic model consists of 6,888 pipeline segments totaling over 283 miles of pipeline. Pipeline diameters range from 4 to 54 inches. The interceptor reach naming convention established in the previous Master Plans has been maintained for this analysis.

4.3.3 Dry Weather Flow Loading

Flow loading in the existing system model is based on data from the February 2009 flow measuring program and Encina flow meter data from the same period, as summarized previously in Table 3-2. Average flows are based non-rain weekdays during the flow measuring period. Flows generated within Carlsbad (internal flows) are distributed by performing an upstream trace to calculate the number or nodes (manholes or cleanouts) within each upstream metered service area, calculating an average flow per node, and then loading each node with the average flow for that metered basin. Average flows for outside agencies (external flows) are input to interceptors at the location of each upstream Encina meter.

The hydraulic analysis is performed by peaking the average flow at each node in the model using 24-hour unit hydrographs or "diurnal curves". The use of diurnal curves when accounting for the wastewater generation of each contributor allows for a more accurate representation of flow variations and accounts for the routing of wastewater through the collection system on a temporal basis. Flows in the model are peaked based on the dry weather weekday hydrographs developed from the February 2009 flow measurement program and Encina meter data from the same period (Figure 3-8 and Figure 3-9). Internal flows within each sub-basin and external flows are peaked using the specific curve representative of that area.

4.3.4 Model Verification

The hydraulic model was verified based on dry weather weekday flows during the February 2009 flow monitoring period. Peaking curves based on Encina meter data and temporary flow metering data for outside agencies and Carlsbad flows, respectively, were applied to the distributed ADWF in the model. A twenty-four hour hydraulic simulation was performed, and downstream flows in the model at the EWPCF were compared with recorded flows from the four permanent meters at the treatment facility (Encina meters C1, C2, C3 and B1). Downstream model flows at temporary meter locations were also compared with recorded flows. The peaking curves were adjusted, as required to match the downstream flows. At the conclusion of the model verification process, all model flows were within ten percent of recorded flow, which is the general acceptance criterion for model calibration results. Additionally, effort was focused on matching peak flow rates, and the variance between modeled and recorded peak flows was generally less than 5 percent. Modeled and recorded flow comparison plots from the model verification process are provided in Appendix C.

4.3.5 Wet Weather Flow Loading

The wet weather flow analysis is performed by running a 24-hour flow simulation with dry weather flow hydrographs and adding additional flows to account for rainfall induced I&I. Wet weather flow loading is based on the peak I&I rates observed from the February 23, 2005 storm event, discussed in section 3.6 of this report. Pipeline capacity is assessed based on the PWWF, which is the peak hourly flow added to the peak I&I rate. Although peak I&I flows typically occur over a short duration, the PWWF analysis assumes a constant 24-hour I&I flow so that peak I&I rates will coincide with peak dry weather flows throughout the system.

Table 4-2 summarizes the peak I&I rate input added to the dry weather hydrographs in the model. I&I from outside agencies is input at the Encina meter locations. The distribution of I&I within Carlsbad is distributed equally over upstream manholes within metered basins based on the temporary flow monitoring program.

Table 4-2 Existing System Analysis Peak I&I Rates

Interceptor System	Carlsbad I&I	Other Agency Flows		Total I&I
		Agency	I&I	
Vista/Carlsbad	4.9 mgd	City of Vista Oceanside	8.0 mgd	12.9 mgd
N Aqua Hedionda	1.1 mgd	--	--	1.1 mgd
S Aqua Hedionda	1.0 mgd	--	--	1.0 mgd
Buena	0.6 mgd	Buena Vista (raceway)	2.6 mgd	4.4 mgd
Vallecitos	0.0 mgd	Vallecitos	11.5 mgd	11.5 mgd
North Batiquitos	2.0 mgd	Leucadia Encinitas	6.5 mgd	8.5 mgd
Totals:	**9.6 mgd**		**29.8 mgd**	**39.4 mgd**

4.4 CAPACITY ANALYSIS RESULTS

This section discusses the results of the hydraulic analyses conducted with the existing system hydraulic model and flow loading. An understanding of the hydraulic condition of the existing system is necessary to identify existing system deficiencies, and to help prioritize recommended system improvements resulting from the ultimate system analysis. The capacity of the interceptor system was evaluated under both dry and wet weather flow scenarios.

4.4.1 Gravity Pipelines

Capacity analysis of open channel systems is generally based on the consideration of the depth of flow as compared to the diameter of the pipe (D/d). For the interceptor system, this depth to diameter ratio is constrained to not exceed 0.75 for peak dry weather conditions. It is also considered undesirable to operate the system at depths over 90 percent of the diameter under peak wet weather conditions. Exceptions to these guidelines are allowed when considering siphons or other known areas of pressure flow.

The capacity analysis under peak dry weather flow conditions indicates that two flat pipeline reaches in VC14 and VC15 are flowing full (refer to Section 2.2.1). There are a few additional isolated locations where flows exceed the 75 percent full criteria in other collector system pipelines and interceptors due to a very flat or in some cases a negatively sloped reach. In initial analysis simulations, there were several locations where a flat or negatively sloped pipeline reach or reaches caused backwater effects in upstream pipelines or branches. The problem areas were investigated, and in all cases were due to incorrect GIS elevation or pipeline diameter data. A subsequent simulation made with an updated model incorporating data corrections provided by City Staff revealed that there are still a few isolated reaches flowing full. The full pipelines are not considered to be significant, since they are restricted to a single reach and may be due to additional datum errors.

Results from the existing collection system analysis with peak wet weather flows indicate that several gravity pipelines are deficient with respect to the "trigger" criteria established in Section 4.2. It is noted that the modeled peak wet weather event is conservatively based on *potential* peak flows and I&I rates, and is not based on actual recorded flows. Pipeline reaches that are flowing more than 90 percent full

with existing PWWF conditions are located in the lower reaches of the V/C Interceptor and along the Buena Interceptor, as summarized in Table 4-3.

Table 4-3 Existing PWWF Analysis Summary for Gravity Pipelines

Reach	Length (ft.)	Diam. (in.)	Location/Comments
VC11B	896	42	Approach to Agua Hedionda Lift station - single reach flowing 75% full
VC13-15	9,800	42	Downstream of AH Lift Station - pipelines flowing between 75% full & surcharged; backwater surcharging up SAHI & collector pipelines
B1-B6	18,000	18-24	Greater than 90% full or surcharging in most reaches; Backwater effects extending into several collector pipelines

The longest sections of pipelines flowing full are in the Buena Interceptor. Analysis results indicate that pipelines are surcharged with pressurized conditions over most of the interceptor length, and flows backup through the first reach on several branched collector pipelines.

4.4.2 Lift Stations

Lift station facilities within the sewer interceptor system were evaluated by comparing the peak influent wastewater volume to the lift station's "firm" pumping capacity, as documented previously in Table 2-4. The influent wastewater volume of the pump station is defined by the wastewater flowing in the pipeline(s) just upstream of each lift station in the hydraulic model. Model results indicate that all City of Carlsbad lift stations have adequate capacity to convey the existing PWWF.

For the lift stations operated by the EWA on the V/C Interceptor, results indicate that the Buena Vista Lift Station may be potentially operating near its firm capacity during severe storm events. Velocities in the Agua Hedionda forcemain and portions of the Buena Vista forcemain are also exceeding the recommended maximum velocity of 8.0 fps during PWWF flow conditions.

4.4.3 Inter-Agency Pipeline Flows

Peak wastewater flows in gravity pipelines that are jointly-owned with other sewer agencies are compared to design flows and Carlsbad capacity rights as defined in existing agreements.

Vista/Carlsbad Interceptor

Capacity improvement projects for the V/C Interceptor were recommended in the previous master plan and are currently in design. An evaluation of the V/C Interceptor is therefore presented in Chapter 5 with respect to ultimate flows.

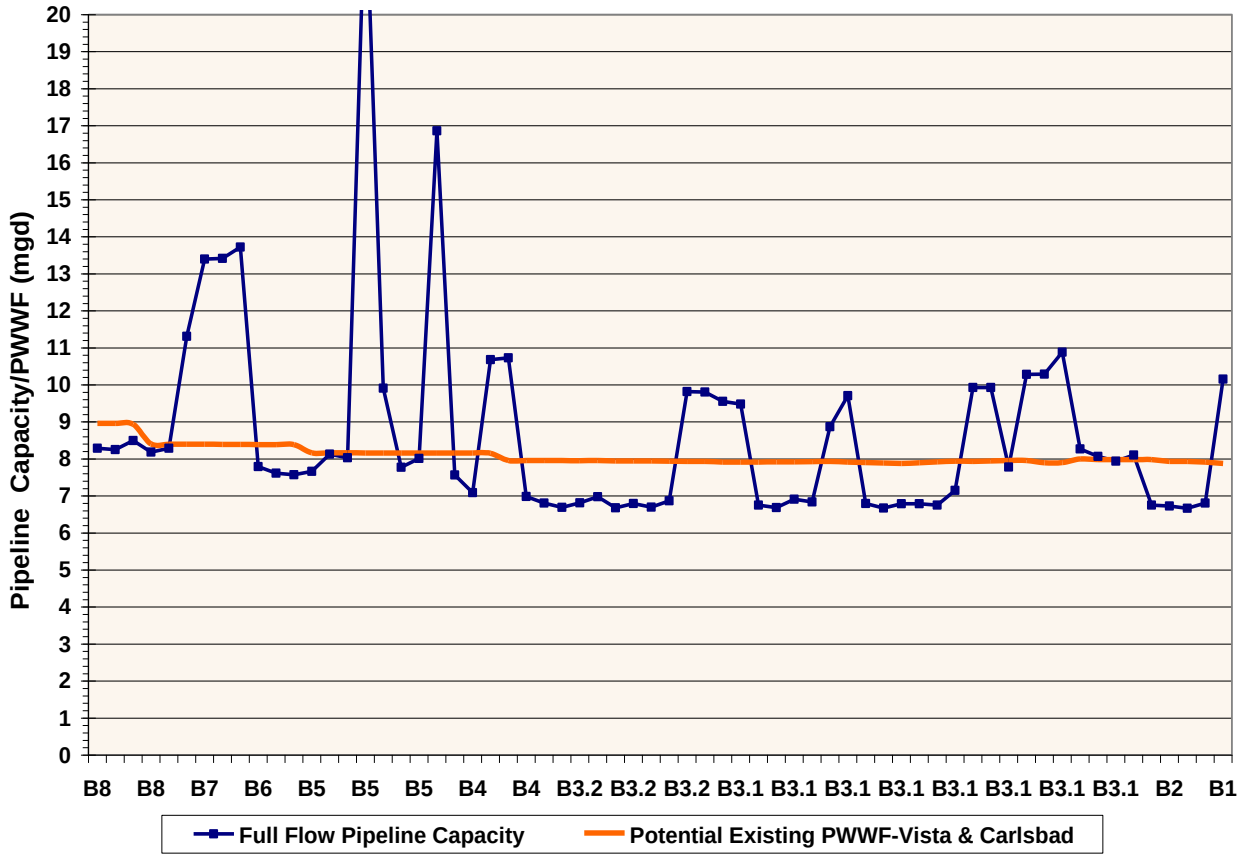
Buena Interceptor

In the existing system model, the total PWWF in the Buena Interceptor at the downstream reach is approximately 8.9 mgd. Figure 4-1 provides a graphical representation of the PWWF along each reach of the interceptor plotted together with the full pipe capacity. PWWF from the City of Carlsbad is estimated to be approximately 1.5 mgd, which includes an allocation of 0.6 mgd for the peak I&I rate.

Carlsbad's peak flow is less than the Carlsbad ownership capacity along the interceptor, which ranges from approximately 1.0 mgd at reach B1 to 3.0 mgd at the downstream Encina flow meter.

A new forcemain extension is currently being designed by the City of Vista that will allow all of Vista's flow that is currently entering the Buena Interceptor at the most easterly end to be pumped 3.5 miles further west to an existing manhole just east of I-5 where it will then flow by gravity to the Encina Water Pollution Control Facility. The existing pipeline to be used may be the Vallecitos Interceptor, the Buena Interceptor, or a combination of both. Therefore, the only flow remaining in the existing Buena Interceptor west of El Camino Real will be entirely from Carlsbad. Additionally, a manhole and pipeline rehabilitation project is planned by Carlsbad for the Buena Interceptor that should reduce the amount of I&I.

Figure 4-1 Buena Interceptor Existing PWWF Analysis Results



Vallecitos Interceptor

Carlsbad's hydraulic analysis results indicate that the Vallecitos Interceptor is flowing between 75% and 90% full in most of the downstream reaches under the existing PWWF condition. The capacity of the interceptor is listed as 20.85 mgd in the 1985 agreement with the VWD (formerly the San Marcos County Water District), which is based on the pipeline flowing full. The PWWF for the VWD is estimated at approximately 19.5 mgd, which includes 11.5 mgd of potential peak I&I. This is slightly higher than the estimates shown in the 2010 Vallecitos Master Plan, which estimates their 2010 PWWF to be 17.9 mgd. This flow rate far exceeds the VWD ownership capacity of 12.1 mgd. However, VWD

has indicated in their November 2010 master plan that they can divert up to 8.0 mgd of flow to their Meadowlark Reclamation Facility to stay within their capacity ownership in the near term. However, it is noted that the 12" Failsafe Pipeline from Meadowlark can only convey a maximum of 3 MGD. Peak flows up to approximately 16 mgd have been recorded from VWD at the VA1 meter. Carlsbad has capacity rights of 5.0 mgd in the Vallecitos Interceptor, and the PWWF from Carlsbad is estimated at approximately 2.0 mgd. The Buena Sanitation District currently owns 3.75 mgd of capacity in the Vallecitos Interceptor, but does not currently contribute any flow.

Ponto Sewer

The Ponto Sewer is part of Carlsbad's North Batiquitos Interceptor Sewer System and is jointly owned by the City of Carlsbad, the City of Encinitas, and the LWWD in accordance with an agreement dated August 24, 1972. The capacity of the 39-inch diameter gravity pipeline flowing full is approximately 21 mgd. Hydraulic analysis results indicate a potential PWWF of approximately 18 mgd in this pipeline. Carlsbad owns a total of 40.0 percent of the available capacity, or approximately 8.5 mgd and ESD / LWWD own the remaining 12.5mgd. Peak wet weather flows from Carlsbad are attenuated by the operation of the upstream NB Lift Station, and are currently estimated at approximately 4.0 mgd with two of the fixed speed pumps in operation. The City of Carlsbad is therefore using less than 50% its allocated capacity in the Ponto Sewer.

West Encina Influent Sewer

The West Encina Influent Sewer, formerly referred to as Reach VC16 of the V/C Interceptor, is a 60-inch diameter Hobas pipe that was constructed in 2010 and conveys wastewater from Carlsbad, Vista, Encinitas and the Leucadia Wastewater District into the Influent Junction Structure at the Encina Water Pollution Control Facility. Each agency has capacity ownership rights in the pipeline relative to their projected ultimate PWWF. The maximum capacity of the line flowing full is 84 mgd. An ownership agreement for the new pipeline is being prepared by the agencies, but is not yet completed.

4.5 FLOWS TO THE EWPCF AND OUTFALL

Evaluation of Carlsbad's use of EWPCF is based on the average dry weather flow for treatment plant capacity and the peak wet weather flow for capacity in the ocean outfall. As summarized in Chapter 3, the existing wastewater flow for Carlsbad, based on metered flows from February 2009, is approximately 7.9 mgd. Compared to the City Carlsbad's Phase V capacity ownership of 10.26 mgd for treatment and solids handling in the EWPCF, Carlsbad is currently using approximately 77 percent of its capacity ownership.

The Encina Ocean Outfall has a maximum instantaneous capacity of 104.9 mgd, considering the capacity enhancement of constructed flow equalization facilities. Carlsbad's peak flow capacity rights in the outfall per the Revised Basic Agreement are 25.51 mgd, which is based on a peaking factor of 2.76 times the ADWF. Peak hourly flows from Carlsbad cannot be determined from Encina flow meters since Carlsbad flows are subtracted from other agency flows. Resultant peak flows from Carlsbad at Encina are likewise not directly available from the hydraulic analysis, since peak flows in the interceptors occur at different hours in the simulation. Based on the peaking factor curves presented in Chapter 3 and the estimates of I&I generated within the Carlsbad service area, the PWWF from Carlsbad is estimated to be

approximately 20 mgd, which is 2.5 times the ADWF. It is therefore estimated that the City of Carlsbad is currently using approximately 80 percent of its capacity ownership in the Encina Ocean Outfall. It is noted that Carlsbad diverts up to 4.0 mgd of flow during summer months to produce recycled water, which reduces effluent flow to the outfall.

CHAPTER 5 - ULTIMATE FLOW PROJECTIONS AND ANALYSIS

Future flow projections are used to determine required collection system upgrades to adequately serve Carlsbad's wastewater conveyance needs under buildout conditions. The existing sewer collection system with the incorporation of planned improvements was analyzed with projected peak ultimate flows to identify capacity deficiencies and size the required improvements. For this master plan update, flow projections are based on future development through 2035, which is defined as buildout in the City's Growth Database. A parcel-based database was developed to calculate future flows from established unit flow factors and to distribute the flows in the hydraulic model. Results of the analysis are summarized and deficiencies identified. Recommended improvements to the sewer collection system to convey ultimate flows are presented in Chapter 6 of this report.

5.1 PLANNED SEWER SYSTEM IMPROVEMENTS

City Staff have identified several planned improvements to the collection system that are included in the ultimate sewer system model. These changes include the removal of several lift stations with the construction of future gravity pipelines and new gravity trunk sewers that will be required to connect future developments with existing pipelines and interceptors. Exhibit 1, provided in Appendix A, illustrates the proposed ultimate sewer collection system that was analyzed in this master plan update. Most future flows are added to existing pipelines, but several new gravity sewers have been included to properly route the future flows. It is noted that additional alignment studies will be required to determine the size and specific alignment of future collection system pipelines.

Flows from several sub-basins are currently being pumped "out-of-basin", and gravity sewers are planned, in construction or recently completed that will eliminate some existing lift stations. These lift stations are as follows:

- La Golondrina Lift Station - The La Golondrina Lift Station has recently been demolished and a gravity pipeline constructed that conveys flows from the La Golondrina service area to the Poinsettia Lift Station and the Vallecitos Interceptor. Previously, City of Carlsbad flows from this area located in LFMZ 6 were pumped to LWWD.
- Vancouver Lift Station - A future gravity pipeline will convey flows west to the V/C Interceptor. Flows are currently pumped from the Vancouver Lift Station to the NAH Interceptor.
- Simsbury Lift Station - A future gravity pipeline will be constructed with the development of Quarry Creek (LFMZ 25) to route flows north through this project to the V/C Interceptor. Flows from the Simsbury Lift Station are currently pumped south to the NAH Interceptor.
- Villas Lift Station - Flows from the Villas Lift Station, which serves several apartment complexes, are currently pumped to the NAH Interceptor. Historically, the Villas Lift Station has been considered a temporary facility. However, upon further analysis by City staff, the cost to construct a new gravity sewer that is needed to eliminate the lift station is cost prohibitive. Therefore, the Villas Lift Station will be considered a permanent asset in the Carlsbad sewer system with flows being pumped to the NAH Interceptor.
- Gateshead Lift Station - Flows from the approximately 25 single family residences served from the Gateshead Lift Station will be conveyed by gravity through the future Robertson Ranch West Village development in LFMZ 14 to either the NAH Interceptor or the SAH Interceptor,

depending on the final layout of the Robertson Ranch Sewer System. Flows are currently pumped to the NAH Interceptor.

- La Costa Meadows III Lift Station - A gravity pipeline has recently been constructed which conveys flows from LWWD's La Costa Meadows Lift Station to the Poinsettia Lift Station and the Vallecitos Interceptor. The La Costa Meadows III Lift Station served 25 homes within the City of Carlsbad service area and an additional 68 homes within LWWD. The La Costa Meadows III Lift Station has been demolished and a boundary adjustment processed through the Local Agency Formation Commission (LAFCO) to serve the 68 homes in LWWD and an adjacent vacant parcel that is planned for 6 future homes.

The El Fuerte Lift Station, which finished construction in 2009, was not operational during the 2009 flow monitoring period and was not included in the existing system model. It will serve new industrial business parks in the eastern end of the service area (LFMZs 16 and 18). A temporary sewer connection to Buena Sanitation District's (BSD) Raceway Lift Station was created in 2003 to provide sewer service to the few occupied buildings in the Raceway and Palomar Forum industrial parks area prior to the completion of the El Fuerte Lift Station. This temporary connection was removed in 2011. Final payment was made to BSD and the 2003 sewage flow agreement with the BSD was terminated by Carlsbad in a letter dated October 4, 2011. Most of the development within the El Fuerte Lift Station service area is in planning or construction phases. The El Fuerte force main discharges to a manhole that is connected to two gravity sewers, one which flows to the SAH Interceptor and the other to the Buena Interceptor. A diversion structure was installed in 2010 at this downstream manhole to split flows approximately 50/50 to each interceptor.

The City of Vista / Buena Sanitation District is currently designing a new 3.5-mile force main extension to discharge combined flows from their Buena and Raceway basins to a downstream structure proposed in Paseo Del Norte, just east of Interstate 5. At this location, the wastewater flows may be split between the Vallecitos and Buena Interceptor Sewers or BSD may purchase additional capacity from the VWD to put all of their flow into VWD's 54-inch diameter pipe that crosses under I-5 and enters the Encina Water Pollution Control Facility. The proposed forcemain is shown on Exhibit 1 in Appendix A.

5.2 FUTURE GROWTH PROJECTIONS

Build-out projections for the City of Carlsbad have been compiled into a Growth Database, which is maintained by a consultant for the City. The growth data is organized and summarized by LFMZ. Growth projections are provided for four categories: the number of residential units with a density of less than four units per acre, residential units with a density of greater than four units per acre, the total building area for commercial development, and the total building area for industrial development. The database also includes the number of dwelling units and total building area for building permits issued annually since 1992. Once a building permit has been issued, the projected number of units/building area is removed from the "future" category and assigned to the year the building permit was issued.

Most of the projected growth in the City of Carlsbad sewer service area is associated with planned developments in the eastern portion of the City. These developments include: Cantarini, Mandana Properties, Kato, Holly Springs, Rancho Carlsbad, Robertson Ranch East Village, and Quarry Creek, which are primarily residential developments; the Carlsbad Oaks North, Palomar Forum, and Carlsbad Raceway Business Parks, which are planned industrial; and Bressi Ranch and Robertson Ranch West

Village, which have a mixed land use that includes commercial development. The only multi-use future development project along the coastal corridor is the 50-acre Ponto Beachfront project. The remainder of the future growth includes later phases of larger developments that are mostly built out, smaller developments, and non-specific general "infill" and redevelopment of established neighborhoods and commercial areas located in the western portions of the City. The future development identified in the City of Carlsbad Growth Database provided by City Staff for use in this Master Plan, dated March 6, 2009, is summarized by LFMZ in Table 5-1. It is noted that the table includes only those LFMZs that are within the City's sewer service area.

Table 5-1 City of Carlsbad Growth Database Summary

As of March 6, 2009

LFMZ No.	Future Residential Dwelling	Future Building Area (sqft)	
		Commercial	Industrial
1	619	283,325	-
2	5	2,500	-
3	4	204,711	196,745
4	32	-	-
5	0	-	949,449
6	152	188,921	-
7	0	30,000	-
8	34	-	-
9	161	144,635	-
10	306	2,700	-
13	0	890,158	200,000
14	1,067	222,500	-
15	527	717,412	-
16	0	-	1,782,000
17	0	171,790	1,808,656
18	0	16,800	1,165,249
19	62	287,480	-
20	164	151,038	-
21	666	-	-
22	8	403,692	-
24	26	-	-
25	500	-	-
TOTALS:	**4,333**	**3,717,662**	**6,102,099**

Several enhancements to the Growth Database were required before it could be used to accurately project and distribute future sewer flows in the hydraulic model. The version of the Growth Database provided for the 2003 Master Plan was a database spreadsheet that identified future development at the parcel level with associated APNs. This level of detail, which is required to allocate flows to individual collector sewers, is no longer included in the current Growth Database. To determine parcel locations for future development, backup detail sheets provided with the database were reviewed. The backup sheets identify development projects by name or location, and APNs are provided for approximately half of the itemized developments. For buildout projections not associated with APNs, City GIS Staff provided most parcel numbers based on project names. Aerial photographs and ownership information in the SanGIS parcel map were used to locate the remaining future development. A separate

spreadsheet for future development in LFMZ 1 was provided by City Staff. The spreadsheet, which includes parcel numbers, is more detailed than the Growth Database backup sheet and was used to locate future development in LFMZ 1, which is primarily redevelopment in the downtown area.

Once future development projections were linked to parcels, a map of future development was prepared and reviewed for accuracy. In the Growth Database, once building permits are issued the development is assigned to that calendar year and is no longer considered future development. Construction does not necessarily begin right after permits are issued, however, and it may take several years before developments are occupied and contributing sewer flows. This creates a lag between "existing" and "future" development. Since future flows based on the Growth Database are added to the existing hydraulic model with 2009 wastewater flow data, development projects with recent building permits that have not yet been constructed or are not yet contributing wastewater flows need to be included. To identify these developments, projects in the Growth Database with building permits issued in the past three years were reviewed together with the most recent land use map, aerial photographs, and water use records. This investigation identified developments that were not contributing wastewater flows during the 2009 metering period and resulted in a significant increase in "future" development, primarily in some of the newer industrial parks, portions of Bressi Ranch, and in Robertson Ranch, where building permits have already been issued for the first phases.

Several additional refinements were also made to the modified parcel-based growth database to account for future flows to the wastewater system. These included:

- Future recreation facilities in parks and a future high school in LFMZ 14 were added.
- Residential properties that currently have septic systems were added on the assumption that they will ultimately connect to the sewer system. These parcels were identified by City Staff based on water and sewer billing records.
- Residential units within the service areas of the La Golondrina and La Costa Meadows III Lift Stations were added to account for the additional flows that have been re-directed into Carlsbad with the construction of new gravity sewers and the recent removal of the lift stations.
- Buildout projections for the proposed residential development known as Quarry Creek (LFMZ 25) were updated based on updated planning information provided by City Staff.
- The residential categories were modified to separate high density development (apartment complexes, as noted in the growth database backup sheets) from all other residential development. This was done to more accurately project sewer flows, which are influenced more by the number of people per household than the lot size.

Exhibit 2 in Appendix A illustrates the parcels with future development within the sewer service area.

5.3 FUTURE FLOW GENERATION FACTORS

Flow generation factors are used, in conjunction with the modified Growth Database, to project ultimate wastewater flows. Unit flow generation rates were developed and presented in Chapter 3 of this report based on 2009 flow data. For planning purposes, more conservative unit flow factors are typically used. The City's established planning value for wastewater flow is 220 gpd/EDU. Flow factors typically used for design of sewer systems throughout San Diego County range between approximately 200 gpd/EDU in the Cities of Encinitas and Solana Beach, to 250 gpd/EDU in the City of Vista. The City

of San Diego Water & Sewer Design Guide recommends the use of 80 gallons per capita day (gpcd), which equates to 197 gpd/DU for the City of Carlsbad (based on 2.46 persons per household). Based on these comparisons and the calculated unit flow rate for current conditions, the previously established flow generation rate of 220 gpd/EDU is considered to be appropriately conservative for flow projections in this master plan update. A lower unit flow factor of 176 gpd (80 percent of 220 gpd/EDU) is applied to high-density residential units in excess of approximately 20 units per acre (apartment complexes).

A non-residential land use flow factor of 800 gpd per 10,000 square feet of building area is applied to commercial and industrial development projections in the Growth Database. The composite commercial/industrial unit factor was approved by City Staff for planning purposes, and is higher than the average unit flow calculated in the unit flow analysis documented in Section 3.7. It is noted that projections made using this factor are based on a mix of development types in existing business/industrial parks and may not be representative of smaller areas with a single land use type. Flow projections for future schools, resort hotels, and the expansion of the Legoland Water Park are based on EDU conversions documented in the Carlsbad Municipal Code (Table 13.10.020c).

The unit flow factors established by City Staff to project ultimate wastewater flows in this Master Plan Update are summarized in Table 5-2.

Table 5-2 Wastewater Unit Flow Factors

Land Use Category	Unit Wastewater Flow
Residential Low Density to Med-High Density	220 gpd/DU
Residential High Density (Apartments)	176 gpd/DU
Commercial/Industrial	800 gpd/10,000 sq ft of building area
High School	7.33 gpd/student
Hotel	132 gpd/guest room
Water Park (Legoland)	3,740 gpd/developed acre

5.4 PROJECTED ULTIMATE FLOWS

Wastewater flow projections for future developments are made by applying the unit flow factors to the future build-out data in the modified Growth Database. Future wastewater flows are projected to be approximately 2.1 mgd and are summarized in Table 5-3. The future flows are based on flow projections for future development, and also include unit counts for existing residences that currently have septic systems and areas in LFMZ 6 that previously were pumped to LWWD from the La Golondrina and La Costa Meadows Lift Stations. It is noted that a minor wastewater service area boundary adjustment is assumed in the future to serve existing LWWD customers within the area of a proposed residential development located on the west side of El Camino Real, just south of Poinsettia Lane.

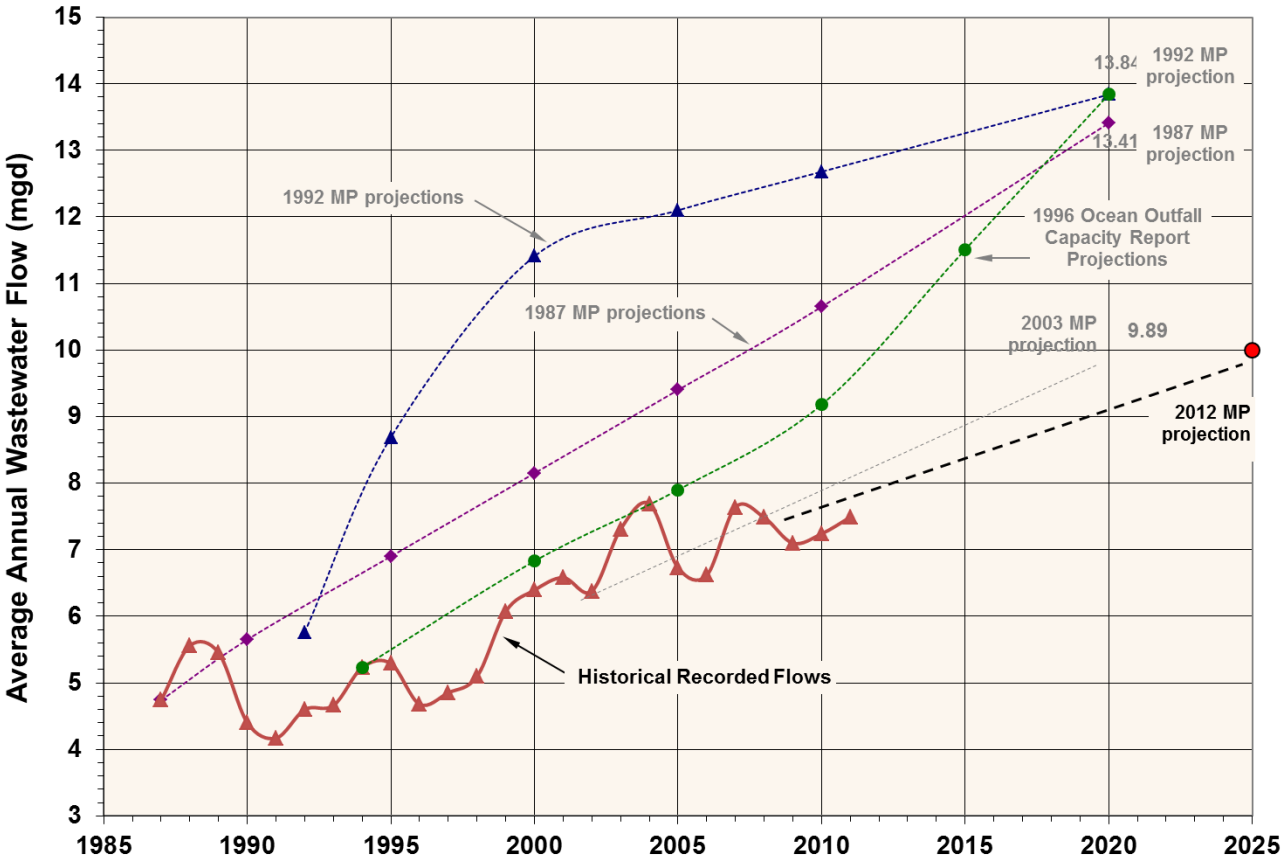
Table 5-3 Projected Future Wastewater Flows by LFMZ

LFMZ No.	Future Residential Units		Future Non-Residential Bldg Area (sqft)	Existing No. of Units on Septic	Projected ADWF (mgd)
	Low thru Med-High Density	High Density			
1	499	158	292,740	51	0.17
2	5	0	2,500	1	0.00
3	6	0	444,149	2	0.04
4	32	0	-		0.01
5	0	0	2,187,400		0.17
6	212	0	-		0.05
7	0	0	30,000		0.00
8	34	0	-		0.01
9	161	0	144,635		0.09
10	223	0	109,616		0.06
13	0	0	1,270,909		0.21
14	748*	465	222,500		0.26
15	447	80	717,413	3	0.17
16	0	0	1,782,000		0.14
17	4	0	1,531,338		0.12
18	0	0	1,848,995		0.15
19	62	0	287,480	1	0.04
20	164	0	164,705	2	0.05
21	162	504	-		0.12
22	15	78	477,373	5	0.06
24	26	0	-		0.01
25	554	75	30,000		0.14
Totals:	**3,354**	**1,360**	**11,543,753**	**65**	**2.07**

* Includes one future high school with an equivalent projected flow of 50 SFDUs.

Projected future wastewater flows are added to existing flows to estimate the ultimate flow. The ADWF flow for the ultimate wastewater system is projected to be approximately 10.0 mgd. This value is approximately 27 percent higher than existing wastewater flows. Figure 5-1 illustrates historical flows and shows the ultimate flow projected in this master plan update. Also shown for comparison purposes are flow projections from previous master plans and studies. Buildout conditions were previously projected to occur by 2020, but the buildout date has been extended to 2035 in this master plan based on ultimate development per the City's Growth Database.

Figure 5-1 Historical and Projected Ultimate Flows



5.5 OTHER AGENCY FLOW PROJECTIONS

Ultimate flow projections from other agencies that discharge to the Carlsbad sewer system were obtained from recent planning documents. Table 5-4 lists the total projected ultimate flow to the EWPCF from its member agencies, and allocates the flow to the Carlsbad interceptor systems.

Flows from other agencies are allocated to the same interceptor system to which existing flows are currently discharged with the exception of the Buena Interceptor. A new forcemain extension project is currently being planned by the City of Vista that will allow all of the flow that is currently entering the Buena Interceptor to be pumped most of the distance to the Encina Water Pollution Control Facility. The current plan has the forcemain discharging into the last gravity section upstream of the EWPCF on the east side of I-5. This may be the Vallecitos Interceptor, the Buena interceptor, or a combination of both. The remaining flow in the existing Buena Interceptor Sewer will then be entirely from Carlsbad. Carlsbad plans to utilize the available capacity in the Buena Sewer to improve operational efficiencies and reduce maintenance issues.

All of the flow from the El Fuerte Lift Station will be diverted to the Buena Interceptor instead of the South Agua Hedionda Sewer System. This will reduce the need to pump the wastewater a second time at the Cannon Road Lift Station. Additionally, the wastewater from the Poinsettia Lift Station will be

diverted to the Buena Interceptor, which will create available capacity in the VIS that can sold to Vallecitos. This will also reduce Carlsbad's maintenance responsibility and liability in the VIS.

Table 5-4 Projected Ultimate ADWF to the EWPCF

Interceptor System	Carlsbad Flows	Other Agency Flows		Total Flow
		Agency	Flow	
Vista/Carlsbad	2.96 mgd	City of Vista Oceanside	7.90 mgd 2.15 mgd	13.01 mgd
NAH	1.09 mgd	--	--	1.09 mgd
SAH	1.62 mgd	--	--	1.62 mgd
Buena Interceptor & Phase III Forcemain	1.84 mgd	Buena Vista (raceway)	4.61 mgd 0.91 mgd	7.36 mgd
Vallecitos	0.85 mgd	Vallecitos	14.84 mgd	15.69 mgd
North Batiquitos	1.66 mgd	Leucadia Encinitas	5.21 mgd 1.16 mgd	8.03 mgd
Totals:	**10.0 mgd**		**36.8 mgd**	**46.8 mgd**

Flows from Carlsbad will increase from existing flows within all existing interceptors except the NAH Interceptor, which will no longer receive flows pumped from other basins. The majority of the flow increase to the V/C Interceptor is projected to be generated by the City of Vista. The downstream reaches of this interceptor convey Carlsbad flows from the NAH and SAH Interceptors, which are not included in the V/C Interceptor flow in Table 5-4.

5.6 ULTIMATE INTERCEPTOR SYSTEM HYDRAULIC MODEL

A model of the ultimate collection system was developed by adding the planned system improvements to the existing system model, and then adding the projected future flows to the existing flows. The ADWF at individual parcels was input to the hydraulic model by either joining to the nearest manhole in the collector system using GIS techniques, or manually grouped and linked to a specific downstream manhole based on the location of future collector system pipelines. The projected ADWF from outside agencies was input at the Encina meter locations. Exhibit 1 in Appendix A includes the future pipelines that were added to the model. Lift Stations that will be removed are also indicated on the exhibit.

Hydraulic analyses were performed to determine the ability of the interceptors to convey projected peak flows. The same peaking curves and peak I&I rates used in existing system model were applied to the projected ADWF in corresponding areas of the ultimate system model. The I&I was re-distributed in the ultimate system model to include future pipelines and the collection system in the El Fuerte Lift Station service area.

5.7 CAPACITY ANALYSIS RESULTS

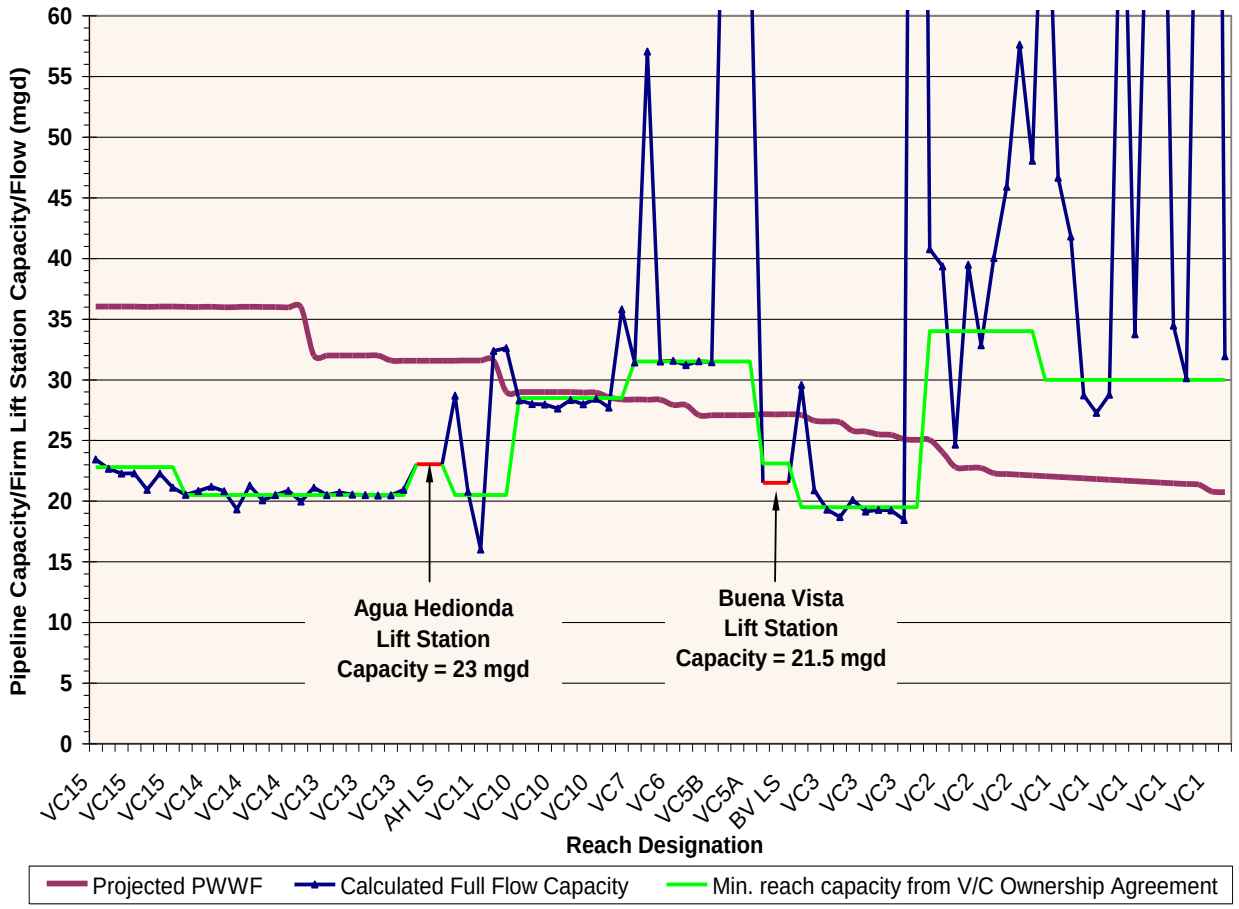
Flow analysis results from the InfoSWMM ultimate system model are presented graphically for each interceptor system and compared to the gravity pipeline capacities. The graphs illustrate the composite peak flow in each pipeline segment over the course of the 24-hour flow simulation. Flows and capacities are schematically illustrated according to the reach designations shown previously in Figure 5-1. Where lift stations are included in the interceptor, the lift station name and firm pumping capacity are indicated

on the graph. Pipeline capacity and flow data, including the projected ultimate PWWF at each interceptor reach, are provided in tabular form in Appendix E.

5.7.1 Vista/Carlsbad Interceptor

Figure 5-2 illustrates the projected ultimate PWWF in the V/C Interceptor, and provides a comparison with the pipeline capacity (d/D = 100%). At the upstream end of Reach VC1, the City of Vista and Oceanside contribute a collective projected PWWF of approximately 20.7 mgd. Between the Buena Vista and Agua Hedionda Lift stations, the V/C Interceptor collects flow from the Home Plant Lift Station and the NAH Interceptor. Flow from the SAH Interceptor is added downstream of the Agua Hedionda Lift Station at Reach VC14. From this graph it is apparent the reaches downstream of VC10, Reach VC3, and the Buena Vista and Agua Hedionda Lift Stations are not adequately sized to convey the projected PWWF.

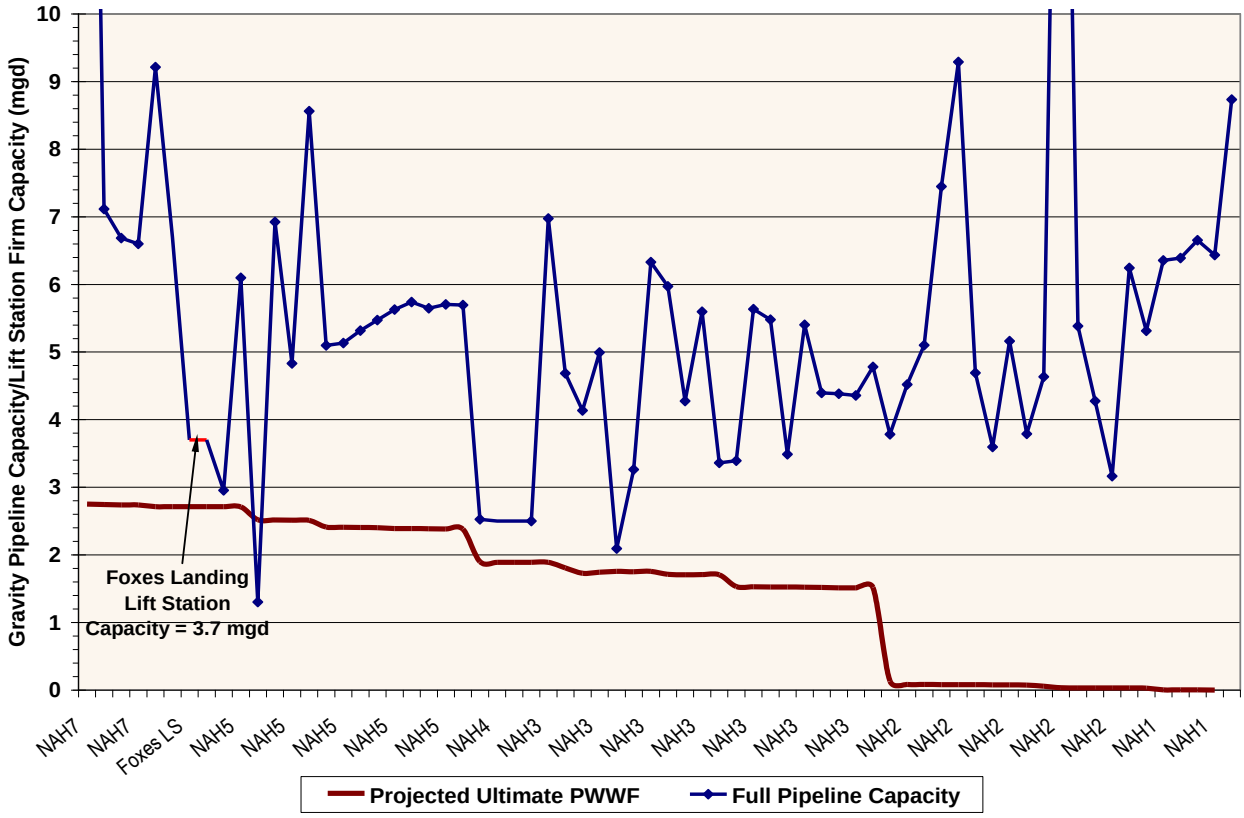
Figure 5-2 V/C Interceptor Projected Ultimate PWWF



5.7.2 North Agua Hedionda Interceptor

The projected ultimate ADWF for the NAH Interceptor is approximately 1.07 mgd, which is less than the existing ADWF of 1.3 mgd. The future flow reduction is due to areas currently being pumped to the NAH Interceptor that will flow by gravity to other interceptors in the ultimate system. Figure 5-3 illustrates the projected PWWF along the interceptor. Based on analysis results, the capacity of the NAH Interceptor is adequate to convey ultimate flows with the exception of two short reaches just upstream of the lift station, which are at a flatter slope than the adjacent upstream and downstream sections. However, the average slope across these several sections of pipe is adequate to convey the ultimate PWWF. It should be noted that the water level in these same reaches of the sewer between the lift station and Hoover Street have an increased depth of flow and lower velocity as a result of a tailwater condition caused by the grinder located at the entrance to the lift station wet well.

Figure 5-3 North Agua Hedionda Interceptor Projected Ultimate PWWF

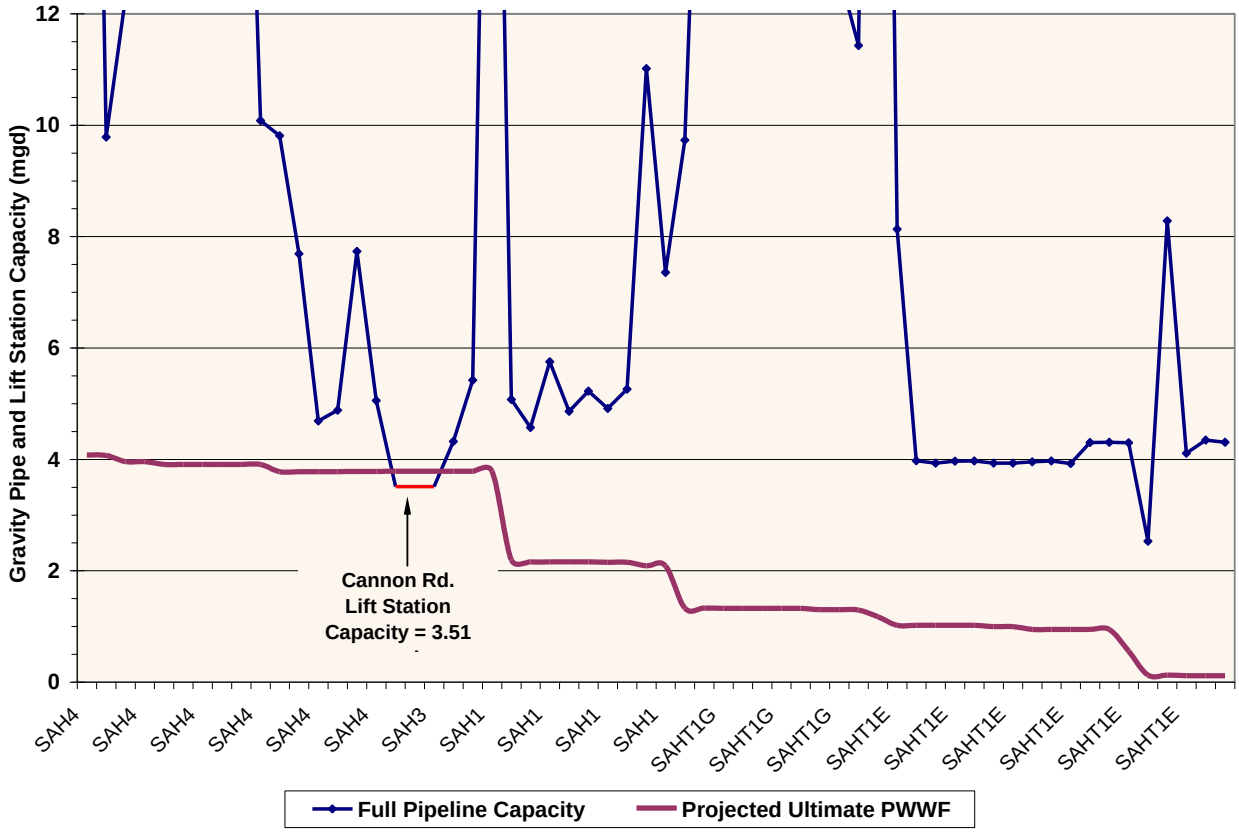


5.7.3 South Agua Hedionda Interceptor

The projected ultimate PWWF and pipeline capacity of the SAH Interceptor are illustrated on Figure 5-4. The upstream trunk sewer along El Camino Real and Sunny Creek Road (SAHT1E and SAHT1G) is also depicted in Figure 5-4, since this portion of the SAH Interceptor system conveys a significant amount of flow also. As shown on the graph, there is projected to be ample capacity in most of the gravity interceptor system. The PWWF through the Cannon Road Lift Station is projected to be approximately 3.78 mgd, which includes 50% of the flow (0.7mgd) from the El Fuerte Lift Station and results in flows that will be slightly higher than the reported lift station firm capacity of 3.51mgd. Based

on results from the flow measurement program, 1.0 mgd of I&I was distributed throughout the SAH collection system. Flows at the lift station should be monitored to assess I&I rates in the future with construction of the collection system in Robertson Ranch. However, it is not anticipated that improvements to the lift station will be needed in the future if the City monitors the flows and implements a program to reduce the I&I in this basin. The ultimate flows to the Canon Road Lift Station may be less if Robertson Ranch flows are directed to the NAH Interceptor or a larger percentage of the flow from the El Fuerte Lift Station is diverted to the Buena Interceptor.

Figure 5-4 South Agua Hedionda Projected Ultimate PWWF

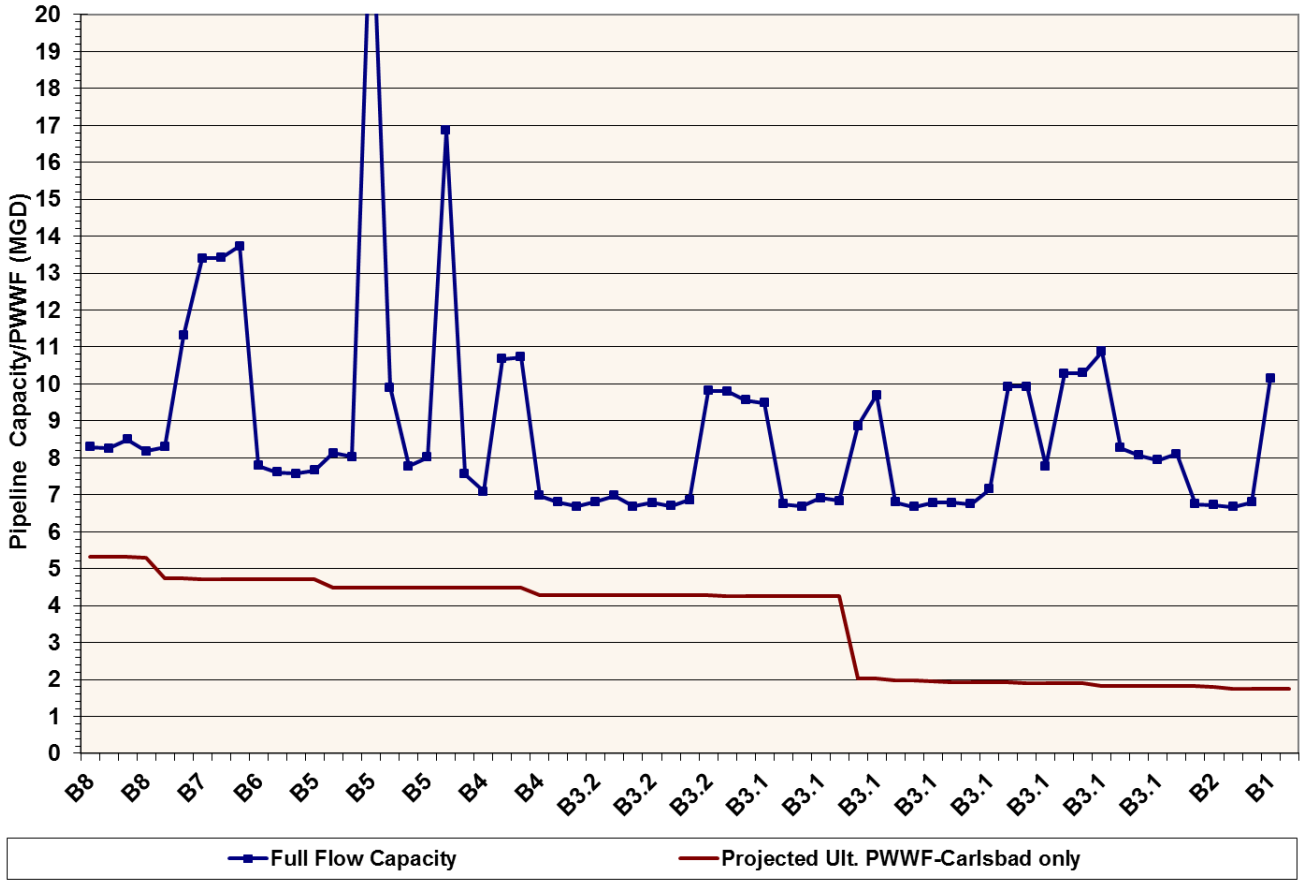


5.7.4 Buena Interceptor

The sub-drainage basins served by the Buena Interceptor in the ultimate system may undergo some significant changes once the City of Vista / Buena Sanitation District complete the extension of their forcemain project. Once this project is completed, Carlsbad will have use of the entire pipeline and will have excess capacity available.

Figure 5-5 illustrates a comparison between the full pipeline capacity and the total projected PWWF from the City of Carlsbad with all of Vista's flow removed from the Buena Interceptor. Carlsbad's ultimate flow scenario includes the addition of the remaining 50-percent of the flow from the El Fuerte Lift Station, the entire flow from the Poinsettia Lift Station and flow from a small residential housing area located along on Nicolia Drive near Cassia Road.

Figure 5-5 Buena Interceptor Projected Ultimate PWWF



5.7.5 Vallecitos Interceptor

Figure 5-6 illustrates the projected ultimate PWWF generated by Carlsbad in the Vallecitos Interceptor without any flow diversions from Carlsbad, and makes a comparison with the existing capacity rights of 5.0 mgd. Peak flows are based on the operation of two constant speed pumps at the Poinsettia Lift Station (2.23 mgd), which is a higher flow rate than the projected PWWF of the service area. Although flows to this interceptor are projected to increase by approximately 70 percent due to buildout of Bressi Ranch, transfer of flows from the LWWD, and other future development, the current capacity ownership is projected to be sufficient to convey ultimate flows, as shown on the graph.

Figure 5-6 Projected Carlsbad PWWF in the Vallecitos Interceptor

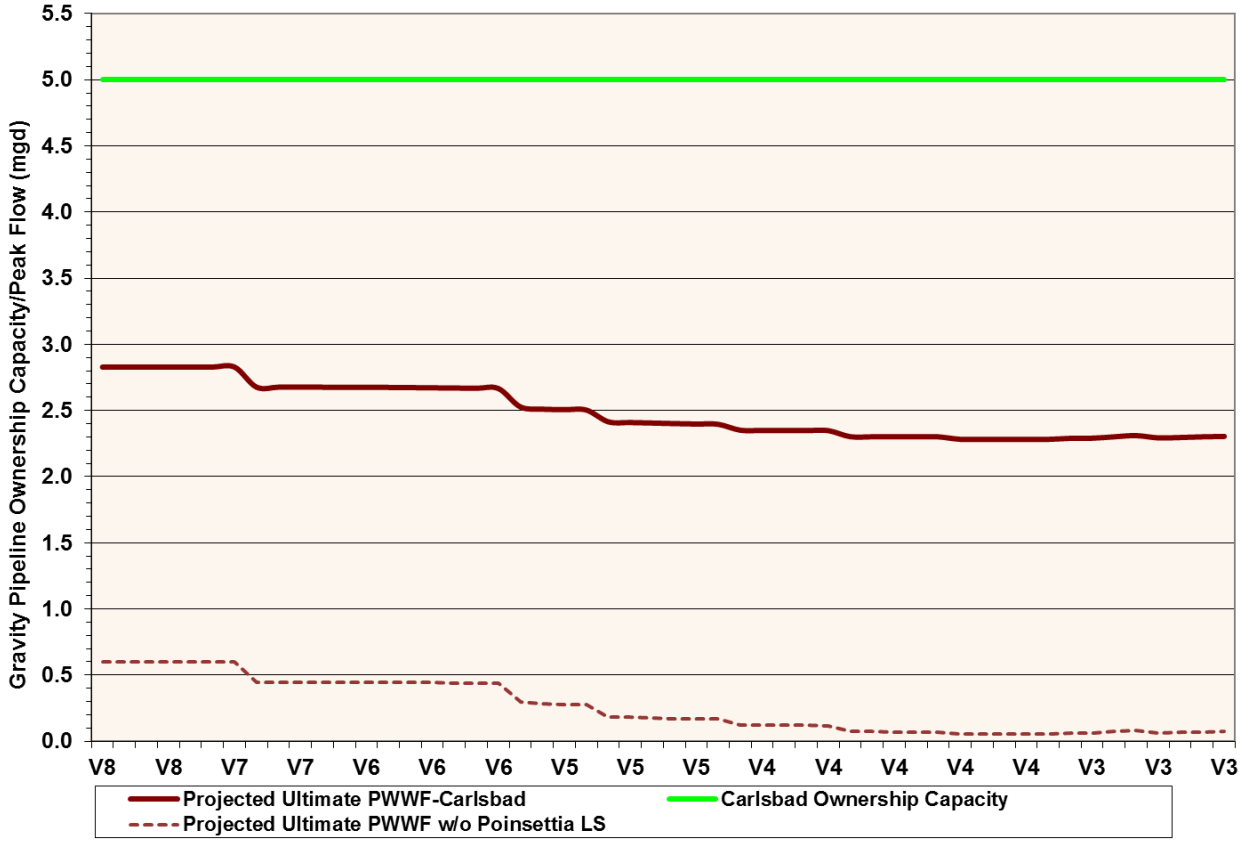
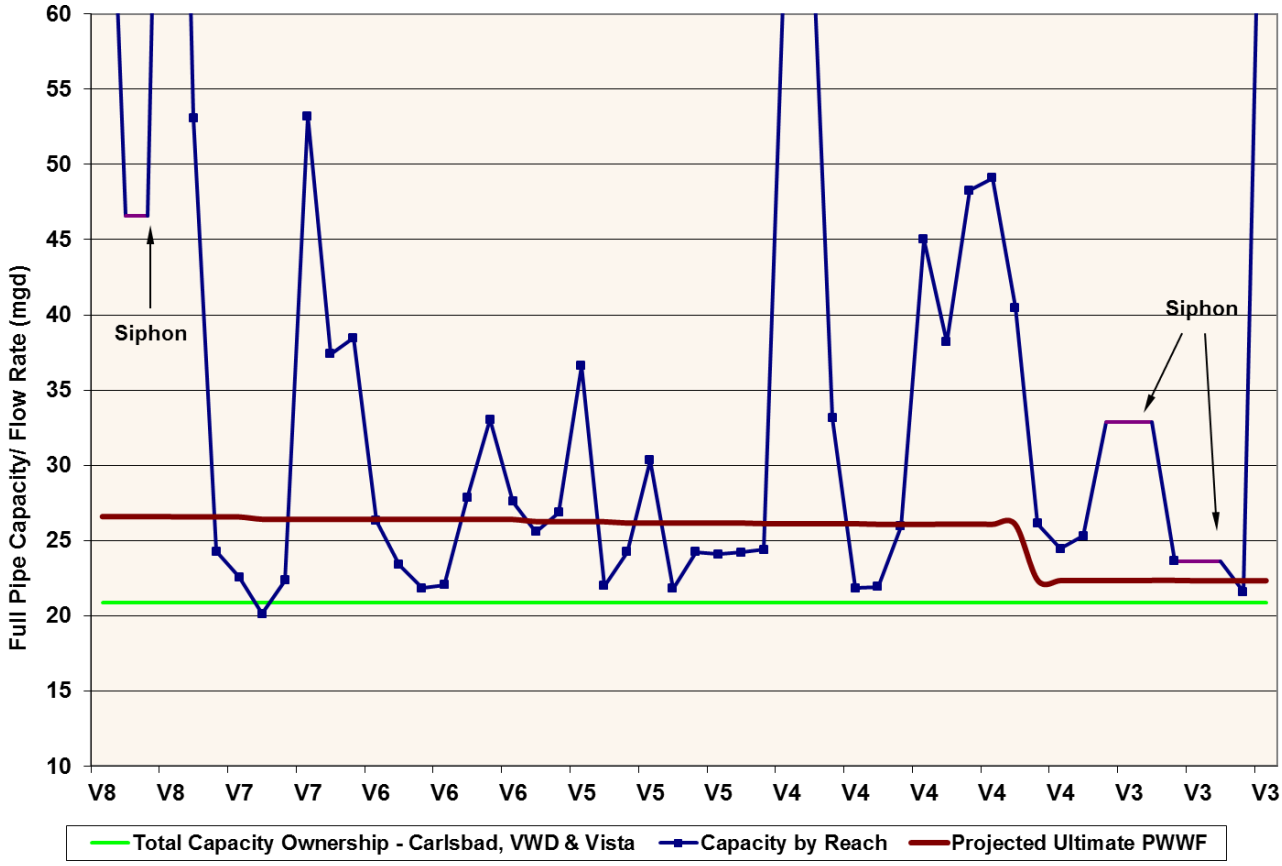


Figure 5-7 illustrates the projected PWWF from theVWD, City of Vista, and City of Carlsbad in the Vallecitos Interceptor, assuming that both Vista and Carlsbad use their full capacity rights. As previously stated, the agreed upon capacity rights in the Interceptor for VWD, Carlsbad, and Vista are 12.1 mgd, 5.0 mgd, and 3.75 mgd, respectively. However, Vallecitos Water District's recent sewer master plan dated November 2010 identifies their ultimate PWWF at 22.32 mgd that will be discharged to the Vallecitos Interceptor after diverting 8.0 mgd to their Meadowlark Reclamation Facility. It should be noted that if VWD is not be successful in the timing of the wet weather flow diversion, the Vallecitos Interceptor will spill in Carlsbad along the Palomar Airport Road corridor. As referenced in the VWD Master Plan, VWD projects that they will exceed their contracted capacity by 2015 and will have a capacity deficit of 8.59 mgd in the land outfall by 2030 and 10.22 mgd deficit by ultimate buildout.

Carlsbad, Vista and VWD have jointly been studying alternatives to address the future capacity deficits in both the Vallecitos Interceptor (VIS) and the Buena Interceptor (BIS). A final solution between the agencies has not been accepted at this time; however, the recommended alternative has Vista constructing their proposed Phase III forcemain to the existing 54-inch VIS crossing I-5 and Carlsbad diverting the Poinsettia Lift Station flow to the Buena Interceptor Sewer instead of the Vallecitos Interceptor. This would make available approximately 6.0 mgd of capacity in the VIS between Vista and Carlsbad that VWD could purchase to defer the timing and reduce the magnitude of the improvements needed to the Vallecitos Interceptor.

Figure 5-7 Vallecitos Interceptor Projected Ultimate PWWF



5.7.6 North Batiquitos Interceptor

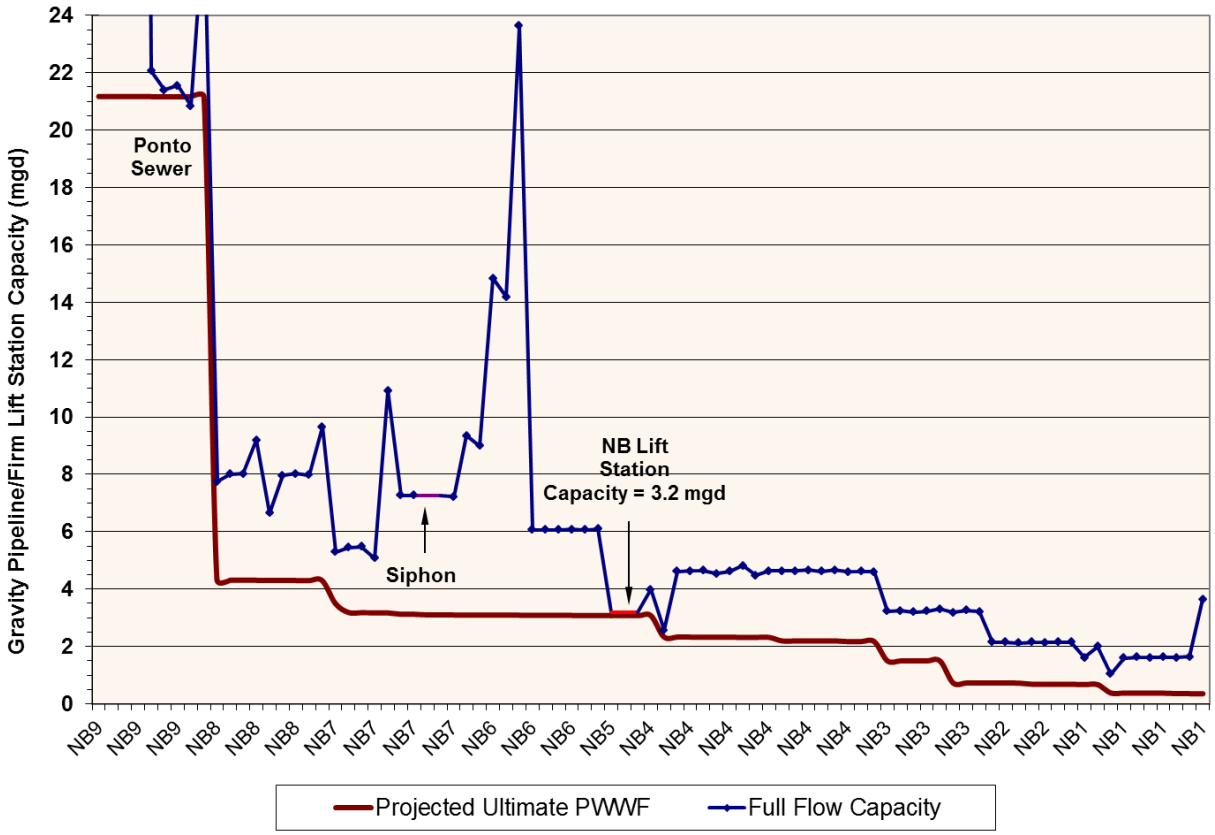
The upstream portion of the North Batiquitos (NB) Interceptor from Reach NB-1 through NB-8 conveys only City of Carlsbad flows. At the beginning of Reach NB-9, also known as the Ponto Sewer or Occidental Sewer, wastewater from LWWD and the City of Encinitas is combined with Carlsbad's flow. The Encinitas and LWWD wastewater is pumped from LWWD's Batiquitos Lift Station through dual forcemains and into a short segment of 21-inch gravity sewer identified as the Leucadia Trunk Sewer, which then connects to the NB Interceptor. Reach NB-9 of the NB Interceptor (Ponto Sewer) then extends northerly until it reaches the confluence with the Vista / Carlsbad Interceptor Sewer, which then enters the Encina Water Pollution Control Facility through the 60-inch diameter West Encina Influent Sewer.

The North Batiquitos Interceptor was analyzed with the projected PWWF and compared to the design capacity of the gravity pipelines, as illustrated in Figure 5-8. As indicated on the graph, there is sufficient capacity in the gravity pipelines to convey the projected ultimate flows. The NB Lift Station consists of two duty pumps with fixed speed drives. During peak flow periods, one pumping unit is projected to operate continuously, with the second pump cycling on and off. The NB Interceptor downstream of the lift station was analyzed with both pumps in operation.

The capacity of the 39-inch diameter gravity pipeline flowing full is approximately 21 mgd. Hydraulic analysis results indicate a potential PWWF of approximately 18 mgd in this pipeline. Carlsbad owns a

total of 40.0 percent of the available capacity, or approximately 8.5 mgd and ESD / LWWD own the remaining 12.5mgd. Peak wet weather flows from Carlsbad are attenuated by the operation of the upstream NB Lift Station, and are currently estimated at approximately 4.0 mgd with two of the fixed speed pumps in operation. The City of Carlsbad is therefore using less than 50% its allocated capacity in the Ponto Sewer.

Figure 5-8 North Batiquitos Interceptor Projected Ultimate PWWF



5.7.7 West Encina Influent Sewer

The West Encina Influent Sewer, formerly referred to as Reach VC16 of the V/C Interceptor, is a 60-inch diameter Hobas pipe that was constructed in 2010 and conveys wastewater from Carlsbad, Vista, Encinitas and the Leucadia Wastewater District into the Influent Junction Structure at the Encina Water Pollution Control Facility. Each agency has capacity ownership rights in the pipeline relative to their projected ultimate PWWF. The maximum capacity of the line flowing full is 84 mgd. An ownership agreement for the new pipeline is being prepared by the agencies, but is not yet completed.

5.7.8 Lift Stations

The projected ultimate PWWF through each of the lift stations included in the sewer interceptor system is shown in Table 5-5. Also provided in this table is the velocity in the lift station force mains based on the projected peak flow. It is noted that all the major lift stations are equipped with variable speed motors, with the exception of the Cannon Road and NB Lift Stations.

Table 5-5 Projected Ultimate PWWF at Interceptor Lift Stations

Lift Station Name	Interceptor System	Station Capacity (1)		Project Ultimate PWWF (mgd)	Force Main Diam.	Max Velocity in Force Main (2)
		(gpm)	(mgd)			
Buena Vista	V/C	14,900	21.46	27.13	16"&24"	9.8fps
					24"	13.4fps
Agua Hedionda	V/C	16,000	23.04	31.57	2-18"	13.8fps
Foxes Landing	NAH	2,600	3.74	2.71	12"	7.4fps
Cannon Road	SAH	2,440	3.51	3.64	14"	5.3fps
North Batiquitos	NB	2,250	3.24	3.08	14"	4.7fps

(1) Existing Duty Capacity with one pump out-of-service

(2) Based on the greater of station capacity or ultimate PWWF

For the remaining lift stations in the sewer collection system, flows to the El Fuerte, Poinsettia and Knots Lift Station are expected to increase significantly. Flows from development of the Ponto area are assumed to be routed through the Knots Lift station. The projected flow at each existing lift station was compared to the firm pumping capacity, and results indicate that all the existing collection system lift stations that will remain in the ultimate system have sufficient capacity based on the projected PWWF.

CHAPTER 6 - RECOMMENDATIONS

Wastewater flow generated within the City of Carlsbad is projected to increase by approximately 27 percent over existing flows, to a projected ultimate flow of approximately 10.0 mgd by the year 2035 (shown previously on Figure 5-1). In addition, outside agency flows will also increase. This chapter summarizes recommended improvements to the existing sewer system required to adequately convey, pump, treat and dispose of the projected ultimate wastewater volumes. Joint agency agreements, capacity agreements with the EWPCF, and potential future flows from other agencies, are also summarized relative to build out conditions. A recommended Capital Improvement Program is provided at the end of this chapter with an opinion of the probable project cost for each recommended project.

6.1 VISTA/CARLSBAD INTERCEPTOR IMPROVEMENTS

The V/C Interceptor Sewer collects wastewater from the City of Vista, the northern and downtown areas of the City of Carlsbad, and the NAHI and SAH Interceptors. Approximately 2.5 miles of gravity pipeline in the V/C Interceptor were replaced since the last master plan to increase capacity between the Buena Vista Lift Station force main and the Agua Hedionda Lagoon (Reaches VC5-VC11A). Additional replacement projects for reaches VC3, VC11B, VC12-15 and the Buena Vista and Agua Hedionda Lift Stations were recommended in the 2003 master plan to increase the capacity of the interceptor. These projects are now in various planning and design stages.

The projected ultimate PWWF in the V/C Interceptor, illustrated previously on Figure 5-3, is estimated to be 36.0 mgd entering the EWPCF. The projected ultimate flow in the 2003 master plan at this location was 36.6 mgd, and flows along the length of the interceptor are very similar to 2003 flow projections. Therefore, the improvement projects and sizing of new facilities recommended in the 2003 master plan are not changed by the results of this master plan analysis. Table 6-1 summarizes the projected PWWF in each deficient reach of the interceptor and lists the recommended improvements to increase capacity. It is noted that preliminary plans have been prepared for improvements at the Agua Hedionda Lift Station that include construction of a second and longer forcemain that will bypass reach VC13 and discharge to a new gravity interceptor near Cannon Road and Avenue Encinas. A new 54-inch diameter gravity sewer is planned in Avenida Encinas in addition to keeping the existing 42-inch sewer in operation. These design concepts were not modeled in this master plan since the City's design consultant will verify the size of the new facilities required to convey the PWWF, and the proposed improvements in Table 6-1 are based on the existing alignment and average slope for each pipeline reach.

Table 6-1 Summary of V/C Interceptor Recommend Improvements

Reach ID	Projected Ultimate PWWF (mgd)	Reach Length (feet)	Existing System			Recommended Project		
			Avg. Slope (ft/ft)	Diameter (in.)	Capacity (mgd)	Type	Size	Estimated Capacity (mgd)
VC3	27.1	3,200	0.0020	36	20.7	Replacement sewer	42"	31.6
BV LS	27.1	--	--	--	21.5	Additional pump	300Hp	27.0
VC4-FM	27.1	3,840	NA	16" & 24"		Replace 16" force main	24"	
VC11BS[1]	31.6	1,390	0.0008	42	18.4	Replace sewer	54"	39.0
AHLS[2]	31.6	--	--	--	23.04	Dual pump sets	--	33.0
VC12-FM	31.6	200	NA	2-18"	23.04	Additional force main	30"	
VC13	32.0	3,510	0.0010	42	20.5			
VC14	36.0	5,060	0.0009	42	19.6	Parallel sewer in Avenida Encinas	54"	40.0
VC15	36.0	1,770	0.0009	42	19.6			

[1] Replacement of this reach will include a new bridge crossing over the Agua Hedionda Lagoon.
[2] Provide dual pumping systems for reliability and efficiency 4~40hp & 4-12 hp

6.2 LIFT STATION IMPROVEMENTS

Capacity improvements based on projected ultimate peak flows are recommended for the Buena Vista and Agua Hedionda Lift Stations. The only other lift station where the projected PWWF exceeded the existing capacity is the Cannon Road lift station on the SAH Interceptor. Projected peak flows to this station are 3.64 mgd, which is only slightly higher than the existing lift station capacity of 3.51 mgd. Projected peak flows at the Cannon Road Lift station include 1.0 mgd of I&I and are based on the operation of 2 pumps at the El Fuerte Lift Station, with half the flow diverted to the SAH Interceptor. Additionally, it is anticipated that 100-percent of the flow will be diverted to the Buena Interceptor in the future, which will reduce the flow to the Cannon Road Lift Station to a level within the capacity of the lift station. Therefore PWWF at ultimate buildout conditions may vary such that the recommended capacity upgrades may not be necessary. The City should monitor peak flows to this lift station.

A summary of the City of Carlsbad proposed lift station rehabilitation projects is provided in Table 6-2. Rehabilitation projects will be required at these lift stations and are included in the City's current CIP. It is noted that a condition assessment of lift stations was not performed as part of this master plan update and recommendations are similar to those presented in the previous master plan and based on discussions with operations staff.

Table 6-2 Lift Station Recommended Improvements

Lift Station Name	Construction/ Rehabilitation Date	RECOMMENDED IMPROVEMENT					
		Gas Detectors	Ventilation Modifications	Pump Replacement	Standby Generator Connector	Wiring Repairs	Float Switch Modifications
Terramar	1972	Full lift station replacement					
Chinquapin	1959/2001	X	X				X
Home Plant	1963/1991	Full lift station replacement					
Villas	1983/2004	X	X	X		X	X
Foxes Landing	2001	X		X		X	X
North Batiquitos	1997/2004	X		X			X

6.3 JOINT INTERCEPTOR SEWERS

Carlsbad shares ownership or leases capacity in several facilities with the City of Vista, the BSD, the Vallecitos Water District, the LWWD, and the ESD. These facilities include the V/C Interceptor, the Buena Interceptor, the Vallecitos Interceptor and the Ponto Interceptor. The following discussions provide an overview of these facilities relative to projected ultimate wastewater flow conditions.

Vista/Carlsbad Interceptor

The Vista/Carlsbad Interceptor ownership percentages and capacity rights from the February 2002 ownership agreement with the City of Vista are provided in Table 2-1 of this report. Capacity rights are based on an ADWF of 10.38 mgd for Vista at the upstream end of the interceptor, and a varying flow distribution for Carlsbad. The projected ultimate ADWF for Vista is 10.05 mgd, which is within three percent of the agreement, value. However, peak I&I flows entering the interceptor upstream of the V1 meter from the City of Vista are higher than I&I flows generated within the City of Carlsbad. Currently, Carlsbad does not have capacity rights in Reach VC1 since it was assumed in previous master plans that all future flows from Carlsbad would enter the VC Sewer System at Reach VC2. Now that the Quarry Creek Project is in the planning stages, the developer has identified the need to connect into Reach VC1. Vista appears to have excess capacity in this line, which can be sold to Carlsbad as allowed in the ownership agreement.

The lower reaches of the interceptor sewer system, reaches VC11–VC15, have been identified in the hydraulic model to be undersized to carry the future flows for this basin. These reaches of the pipeline including the Agua Hedionda Lift Station are currently in design for replacement or to add a parallel pipeline. The percent capacity ownership for each City will remain as it is currently identified in the ownership agreement. Previous master plans have identified the final segment of pipe going into the Encina Water Pollution Control Facility as VC16. Because this final segment of pipe is actually owned by four agencies (Carlsbad, Vista LWWE and ESD), this pipe segment is now referred to as the West Encina Influent Sewer. A separate ownership agreement is being developed to address the ownership and maintenance of this line.

Buena Interceptor

City of Carlsbad ultimate peak flows are projected to be within the City's ownership capacity per the 1981 agreement between the Buena Sanitation District and the City of Carlsbad. However, the

combined flows in the Buena Interceptor could potentially exceed pipeline capacities during severe storm events in several reaches due to City of Vista flows in excess of their capacity ownership if no changes are made to the system. To remedy this situation, the City of Vista is currently designing the Buena Forcemain Phase III Project, which will extend Vista's existing forcemain approximately 3.5 miles westerly from its current terminus at the intersection of El Camino Real and Palomar Airport Road. The new forcemain terminus will be at an existing manhole just east of I-5 near Paseo Del Norte where it will then flow by gravity under I-5 to the Encina Water Pollution Control Facility. The existing pipeline to be utilized for the I-5 crossing may be either the Vallecitos Interceptor, the Buena Interceptor, or a combination of both.

As a result of Vista's forcemain extension project, the only flow remaining in the existing Buena Interceptor west of El Camino Real will be entirely from Carlsbad. Since Carlsbad will have unused capacity available in the pipeline, operational efficiencies can be improved within Carlsbad's system by diverting wastewater from other portions of the City into the Buena Sewer. This will reduce pumping and maintenance costs. Therefore, Carlsbad's ultimate flow scenario in the Buena Interceptor includes the addition of the remaining 50-percent of flow from the El Fuerte Lift Station, flow from the Poinsettia Lift Station and flow from a small residential housing area located along on Nicolia Drive near Cassia Road. Additionally, in order to improve the reliability of the Buena Interceptor and extend the useful life, portions of the existing pipeline and manholes will require rehabilitation.

Vallecitos Interceptor

The City of Carlsbad has a capacity ownership of 5.0 mgd in the Vallecitos Interceptor and Carlsbad's ultimate peak flows in this interceptor are projected to be approximately 2.6 mgd if Carlsbad does not divert any flow out of this basin. Additionally, the City of Vista has 3.75 mgd capacity ownership in the line but does not discharge any flow into the Vallecitos Interceptor. VWD has a 12.1 mgd capacity ownership, but has experienced higher flows during wet weather events. VWD's recent master plan dated November 2010 indicates that VWD will divert up to 8.0 mgd of wastewater to their Meadowlark Treatment Plant in order to stay within their capacity rights in the Vallecitos Interceptor. The failsafe pipeline from Meadowlark has a capacity restriction of 3.0 MGD, which would require VWD to send the remaining flow to Mahr Reservoir during a peak wet weather event. However, VWD has acknowledged that the Vallecitos Interceptor does not have the capacity to convey peak buildout flows for the upstream VWD service area.

Carlsbad, Vista and VWD have jointly been studying alternatives to address the future capacity deficits in both the Vallecitos Interceptor (VIS) and the Buena Interceptor (BIS). A final solution between the agencies has not been accepted at this time; however, staff's recommended alternative has Vista constructing their proposed Phase III forcemain project and Carlsbad diverting the Poinsettia Lift Station flow to the Buena Interceptor Sewer instead of the Vallecitos Interceptor. This will make available approximately 6.0 mgd of capacity in the VIS between Vista and Carlsbad. The sale of unused capacity by Vista and Carlsbad in the Vallecitos Interceptor will extend the time period before VWD needs to upsize the Vallecitos Interceptor and the proceeds can be used towards the construction of new pipelines by Vista and Carlsbad. However, the condition of the Vallecitos Interceptor is not known at this time, which may accelerate the need to replace or refine this pipeline. The VIS has a history of high levels of hydrogen sulfide and corrosion related failures of the siphon portion of the VIS.

Ponto Interceptor

The northerly reach of the Ponto Interceptor (Reach NB-9 of the North Batiquitos Interceptor System) is jointly owned by the City of Carlsbad, the City of Encinitas, and the LWWD. Carlsbad's ownership capacity is approximately 8.5 mgd based on a 40.3% ownership. The ultimate PWWF for Carlsbad is projected to be approximately 4.5 mgd. Analysis results indicate that the Ponto Interceptor has capacity to convey the total projected PWWF of all three agencies. However, LWWD projects that they will need to acquire an additional 1.6 mgd of conveyance capacity in the Ponto Interceptor in their most recent Master Plan. Additionally, Carlsbad has 2 collector sewer connections to the segment of gravity sewer located between the Ponto line and the forcemain discharge from LWWD's Batiquitos Lift Station. Carlsbad refers to this pipeline as the Leucadia Trunk Sewer (a.k.a. Lanakai Sewer). It is recommended that the ownership capacities defined in the 1972 Occidental Pipeline Agreement be updated based on more recent flow projections for all three agencies.

6.4 TREATMENT CAPACITY REQUIREMENTS

Wastewater generated within the City of Carlsbad service area is collected and conveyed to the Encina Water Pollution Control Facility (WPCF) for treatment and subsequent disposal. Carlsbad currently owns a total treatment capacity of 9.24 mgd in the EWPCF. The Revised Basic Agreement was amended in 2004 with Exhibit D, which allocates Phase V Capital Improvement costs. The cost allocation is based on a determination of the required ownership percentages for each agency, which will be calculated from updated wastewater flow projections. The updated ownership percentages for all the member agencies have not been finalized, but the City of Carlsbad has submitted a wastewater flow projection of 10.26 mgd. This number is two percent higher than the 10.0 mgd buildout flow projection in this master plan.

6.5 OCEAN OUTFALL CAPACITY

Wastewater tributary to the EWPCF is treated to secondary standards and discharged to the Pacific Ocean through the Encina Ocean Outfall. Capacity rights in the outfall are based on the PWWF. This outfall facility has an estimated capacity of 104.9 mgd. Carlsbad owns 24.32 percent of the available capacity, or 25.51 mgd. Because flows to the EWPCF from the City of Carlsbad are determined by subtracting upstream agency flows, the peak flow contribution from Carlsbad cannot be easily determined from meter records. In the ultimate system hydraulic model, approximately 9.6 mgd of peak I/I generated within Carlsbad was included in the model. This flow rate is based on historical flow data from storm events. By removing all flow from upstream agencies in the model, the ultimate PWWF to the EWPCF from the City of Carlsbad is estimated to be approximately 25.0 mgd. The projected PWWF is approximately 2.5 times the ADWF, which is approximately equal to the City of Carlsbad's existing outfall capacity rights. Therefore no change is recommended to Carlsbad's proportion of the outfall capacity since Encina also has the ability to reduce peak flow events with the use of the recently constructed Secondary Effluent Equalization Facilities.

6.6 RECOMMENDED CAPITAL IMPROVEMENT PROGRAM

Improvement projects identified for the 15-year Capital Improvement Program (CIP) are summarized in Table 6-3 and illustrated on Exhibit 3 in Appendix A. The projects are arranged into five groups. The

first group of projects includes rehabilitation projects that were identified by City Staff. Most of these projects are in the City's current CIP budget. The next group consists of collection system capacity projects that were identified from the hydraulic analysis performed as part of this master plan update. Interceptor capacity projects are listed in the next group. All of these projects are for the V/C Interceptor Sewer System. Project I-1 was identified in the Vista sewer master plan and four of the six projects are currently in design or construction. Also listed are new collection system projects that will be built and paid for by the developer. These projects will not be included in the City's CIP budget, but are significant projects that will be addressed in the environmental document for this master plan. The last group of projects is for miscellaneous improvements at the EWPCF or to pay-off existing debt service, which were also defined in the City's previous and current CIP.

Table 6-3 includes a planning level estimate of probable project costs. Most of the costs were obtained from the City's current CIP using the remaining balance value. For projects not in the City's current CIP, estimates were developed by City staff. Cost Estimates include engineering, administrative, environmental and legal costs, and a construction contingency. It is noted that costs identified for V/C Interceptor capacity improvements represent the total cost, although a portion of these costs will be shared by the City of Vista. The costs shown for the EWPCF line items represent the City's pro-rated share or the actual payments on debt service.

Table 6-3 Recommended Capital Improvement Projects

Project ID	Description/Location	Project Type	Size/Quantity	Probable Project Cost***
Rehabilitation Projects:				
SR-1	5514 Leucadia Trunk Sewer Rehabilitation	Rehabilitation	670 LF of 21" Cured-in-Place Pipeline	$150,000
SR-2	5517 North Batiquitos Lift Station Pump Replacement	Replacement	Replace 3 Existing Pumps	250,000
SR-3	5501 Buena Interceptor Sewer and Manhole Rehabilitation	Rehabilitation	65 Manholes and 4600 LF of Pipe	3,618,000
SR-4	5513 Condition Assessment of Sewer Pipelines Greater than 12" Dia.**	Rehabilitation	Asses Condition of Pipes Larger than 12" in Dia.	627,000
SR-5	5519 Flow Meter Replacement**	Replacement	Flow Meter Replacement	95,000
SR-6	Gateshead Sewer Lift Station Removal	Removal	Removal of Existing Lift Station	74,000
SR-7	5520 Odor and Corrosion Prevention Assessment**	Rehabilitation	Odor and Corrosion Prevention Assessment at Various Locations in the City	100,000
SR-8	3840 Sewer Lift Station Repairs and Upgrades	Rehabilitation	Misc. Lift Station Improvements	1,689,000
SR-9	3927/5503 Sewer Line Refurbishments/Replacements and Manholes**	Rehabilitation	Refurbish/Replace Various Sewer Lines throughout the City	6,468,000
SR-10	5502 Terramar Lift Station and Forcemain Replacement	Replacement	553 LF of 8" Pipeline	548,000
SR-11	Simsbury Sewer LS Removal	Removal	Remove Lift Station	161,000
SR-12	5523 Summerwind Place Sewer Relocation;	New	3,060 LF of 8" Pipeline	580,000
SR-13	5524 Tamarack Sewer Rehabilitation at Railroad Right-of-Way;	Rehabilitation	200 LF of 10" Pipeline	252,000
SR-14	5515 Vancouver St. HDD Sewer Extension	New	1,310 LF of 8", 1,700 LF of 10" & 1,500 LF of 12" Pipeline	883,000
SR-15	Foxes Landing Lift Station Wet Well and Pump Replacement	Replacement	Replace Wetwell and Pumps at Lift Station	1,750,000
SR-16	Foxes Landing Lift Station Forcemain Rehabilitation;	Rehabilitation	920 LF of 12" Cured-in Place Pipeline	225,000
SR-17	Vista/Carlsbad Interceptor Sewer Rehabilitation (VC1 & VC2);	Rehabilitation	Install CIPP Lining in 36" & 42" Sewer	141,000
SR-18	Terramar Collector Sewer Replacement in El Arbol Dr. & Los Robles Dr.	Replacement	5,395 LF of 8" Pipeline	1,250,000
SR-19	North Batiquitos Sewer Access Road Improvements	Restoration	Access Road Improvements	250,000
SR-20	North Batiquitos Lift Station Forcemain Rehabilitation;	Rehabilitation	1,826 Lf of 14" Cured-in-Place Pipeline	554,000
SR-21	Crest Drive Sewer Extension	New	Extend 8" Pipeline 570 LF along Crest Dr.	350,000
SR-22	Sewer Easement Access Program	Restoration	Restore Access to Manholes	400,000
SR-23	Buena Interceptor Sewer Access Road Improvements (East of Costco)	Restoration	Build Access Road for Buena Interceptor along Encinas Creek	150,000
SR-24	Buena Interceptor Sewer Realignment (East End);	Replacement	2,710 LF of 18" Pipeline	1,987,000
SR-25	5509 Home Plant Sewer Lift Station and Forcemain Replacement	Replacement	2,308 LF of 8" Pipeline	3,518,000
			Subtotal	**23,070,000**

Project ID	Description/Location	Project Type	Size/Quantity	Probable Project Cost***
Collection System Capacity Projects:				
C-1	Poinsettia Lane Sewer Replacement;	Capacity	53 LF of 8" Pipeline	100,000
C-2	Marron Road Sewer Replacement	Capacity	276 LF of 8" Pipeline	350,000
C-3	Las Palmas Trunk Sewer;	Capacity	3,901 LF of 15" Pipeline	2,420,000
C-4	Faraday and El Camino Real Sewer Replacement (Orion to PAR);	Capacity	3,323 LF of 12" Pipeline	1,540,000
C-5	5504 Sewer Monitoring Program**	Capacity	Measure Flows in System to Verify Capacity	491,000
			Subtotal	**4,901,000**
New Sewer Collection Pipeline Projects				
N-1	Holly Springs Property	New Sewer	1,809 ' LF of 8" Pipeline	Developer Funded
N-2	Cantarini Property	New Sewer	5,180 ' LF of 8" & 10" Pipeline	Developer Funded
N-3	Mandana Property	New Sewer	6,823 ' LF of 8" & 10" Pipeline	Developer Funded
N-4	Las Flores Sewer Extension	New Sewer	1,087 ' LF of 8" Pipeline	Developer Funded
N-5	Robertson Ranch East	New Sewer	17,019 ' LF of 8" & 10" Pipeline	Developer Funded
N-6	Terramar Sewer Extension	New Sewer	1,207 ' LF of 10" Pipeline	Developer Funded
N-7	Dos Colinas	New Sewer	3,390 ' LF of 8" Pipeline	Developer Funded
N-8	Robertson Ranch West	New Sewer	17,995 ' LF of 8" & 10" Pipeline	Developer Funded
N-9	Quarry Creek (Simsbury) Sewer Extension	New Sewer	6,030 ' LF of 10" Pipeline	Developer Funded
N-10	Ponto Sewer Extension	New Sewer	2,872 ' LF of 10" & 12" Pipeline	Developer Funded
N-11	College Ave Trunk Sewer	New Sewer	2,882 ' LF of 10" Pipeline	Developer Funded
N-12	Palomar Commons/Buena Sewer Realignment	New Sewer	857 ' LF of 8" Pipeline	Developer Funded
			Subtotal	Developer Funded
Interceptor Capacity Projects				
I-1	3950 Vista/Carlsbad Interceptor Replacement (VC-3)	Interceptor	3,483 LF of 42" Pipeline	2,688,000
I-2	Vista/Carlsbad Interceptor Sewer - Buena Vista Lift Station Improvements	Interceptor	Install Additional 300 HP Pump	1,075,000
I-3	3886 Vista/Carlsbad Interceptor Reach (VC-11B)	Interceptor	1,400 LF of 54" Pipeline & Bridge Crossing Lagoon	6,168,000
I-4	3492 Vista/Carlsbad Interceptor - Agua Hedionda LS and FM (VC12-VC13)	Interceptor	33 mgd Lift Station and 3,492 LF of 30" Dia. Sewer Force Main	21,745,000
I-5	3949 Vista/Carlsbad Interceptor Reach (VC14-VC15)	Interceptor	7,122 LF of 54" Dia. Sewer Pipeline	14,490,000
I-6	5508 Vista/Carlsbad Interceptor-Buena Vista L.S. Forcemain (VC4)	Interceptor	3,700 LF of 21" Dia. Sewer Force Main	630,000
			Subtotal	**46,796,000**
Encina Water Pollution Control Facility Projects				
E-1	5801 Capital acquisitions/Replacement/Rehabilitation	EWPCF		51,414,000
E-2	Phase IV Expansion-Debt Service	EWPCF		2,785,000
			Subtotal	**54,199,000**

* *Costs for the V/C Interceptor capacity improvements include Vista's cost share.*

** *Projects are at various locations through the City.*

*** *Project cost shown for active projects is the amount of funding remaining as of March 31, 2012*

CHAPTER 7 - SEWER CONNECTION FEE UPDATE

The City of Carlsbad has historically charged connection fees to provide sewer service to its new customers. The fees pay for the planning, design and construction of capacity improvements and/or new facilities required for the conveyance and treatment of sewage. Under California State law, connection fees must be based on relevant capital costs. This chapter provides an updated basis for sewer connection fees based on growth projections and capital improvement projects identified to serve future development.

7.1 BACKGROUND

Sewer connection fees are used to generate revenue to construct sewer infrastructure needed to support new development. Assembly Bill 1600 was incorporated into the California Government Code under Title 7, Division 1, Chapter 5: "Fees for Development Projects", effective 1989. Chapter 5 states that any fee imposed by a local agency must show that the fee will be used only for purposes related to the service for which the fee is assessed. The law requires that the City of Carlsbad: 1) identify the purpose of the fee, 2) identify the use for which the fee is to be put, 3) show a relationship between the fee's use and the type of development project on which the fee is imposed, and 4) show a relationship between the need for the facility and the type of development project on which the fee is imposed. This chapter provides the basis for connection fees needed to satisfy California law.

The current sewer connection fee was developed in 1990 as part of the "Capacity Fee Update to the 1987 Master Plan of Sewerage". The fee is based on the Equivalent Dwelling Unit (EDU) method. An EDU is a unit of measure for the sewage generated from particular buildings, structures or uses. One EDU is equal to an approximation of the amount of sewage generated by an average single-family residence. The City uses a formula to determine the EDU's for other residential, commercial and industrial users. The sewer connection fee is adjusted annually using the Engineering News Record Los Angeles Construction Cost Index. The 2011-2012 sewer connection fee is $1,096 per EDU.

In the City of Carlsbad, some sewer projects are paid for by Sewer Benefit Area (SBA) Fees. These developer-paid fees provide direct funding for specific projects. The sewer benefit area fee program was originally approved by the City Council on January 15, 1991. The SBA fee is collected with the issuance of building permits within defined sewer benefit areas. Some developments are conditioned to construct specific facilities prior to or concurrent with the issuance of building permits. In these cases, reimbursement is given for actual costs through the SBA fee. Projects constructed with SBA fees are not included in the connection fee calculations.

7.2 GROWTH PROJECTIONS

The total number of future users must be estimated to calculate connection fees. The City of Carlsbad Growth Database is used in this Master Plan Update to determine the number of future users and project the ultimate sewer flow for the capacity analysis (documented in Chapter 6, Section 6.3). Parcels in the Growth Database are assigned to one of 25 Local Facility Management Zones (LFMZ), illustrated previously on Figure 1-3. For the connection fee update, an updated version of the Growth Database is

used to determine the number of future users. In the updated Growth Database, future users are based on development that is projected to occur after January 1, 2012.

Growth data in the updated Growth Database consists of the number of projected residential units and the estimated building area for commercial and industrial parcels at build-out. Sewer connection fees are currently assessed based on Equivalent Dwelling Units (EDUs). By definition, one EDU will generate the equivalent amount of sewage as an average single-family residence, which is estimated to be 220 gallons per day (gpd). EDU conversions for other types of development are defined in Table 13.10.020-c of the Carlsbad Municipal Code. For commercial developments, the gross floor area of the building in square feet (sqft) is divided by 1,800 to obtain the number of EDUs. This is equivalent to a sewage generation rate of 1,225 gpd per 10,000 sqft of building area or 5.6 EDUs/10,000 sqft. For industrial developments the building area is divided by 5,000, which is equivalent to a sewage generation rate of 440 gpd per 10,000 sqft of building area, or 2 EDUs/10,000 sqft. The projected future EDUs within the City of Carlsbad Sewer Service Area after January 1, 2012 are summarized in Table 7-1.

Table 7-1 Projected Future EDUs within the Sewer Service Area

LFMZ	Future Development			Total EDUs*	LFMZ	Future Development			Total EDUs*
	Residential	Commercial	Industrial			Residential	Commercial	Industrial	
1	545	176	0	721	15	539	414	0	953
2	5	5	0	10	16	0	0	322	322
3	7	13	50	70	17	0	57	239	296
4	18	0	0	18	18	0	14	169	183
5	0	0	221	221	19	67	160	0	227
7	1	17	0	18	20	137	84	0	221
8	34	0	0	34	21	294	0	0	294
9	161	80	0	241	22	7	124	0	131
10	12	1	0	13	24	26	0	0	26
13	0	523	40	563	25	655	1	0	656
14	960	124	0	1084					
Residential Total = 3468		**Commercial Total = 1793**			**Industrial Total = 1041**			**Total = 6302**	

**Non-residential EDU conversions are: commercial = building area/1800, industrial = building area/5000*

7.3 CAPITAL COSTS FOR CAPACITY IMPROVEMENTS

The purpose of the sewer connection fee is to pay for growth related capacity improvements. All of the wastewater generated within the City of Carlsbad Sewer Service Area is treated at the Encina WPCF. The connection fee therefore recovers the cost of capital improvements and expansions to the Encina Water Pollution Control Facility (EWPCF). In the City of Carlsbad, developers provide direct funding for many specific projects through Sewer Area Benefit Fees. These projects are not included in the sewer connection fees.

The basis of improvement projects for the connection fee is the Capital Improvement Program (CIP) previously identified in Table 6-3 of this Master Plan Update. The CIP recommends improvements to the sewer collection and conveyance system and the Encina WPCF that will be needed to support the build-out population of the Sewer Service Area, including replacement of existing facilities and maintenance–

related projects. However, only the capacity-related projects identified to accommodate future growth are included in the connection fee calculations.

The capacity related capital improvement projects required for future development and an estimate of probable costs are summarized in Table 7-2 for the connection fee update. Table 7-2 lists only those connection fee projects that require funding in the future. Therefore, some of the projects shown in Table 6-3 as being funded by connection fees are not included in Table 7-2 because funds have already been fully appropriated for those projects and need not be included in the new connection fee calculation. Project costs reflect future planned expenditures based on the City of Carlsbad 2012-2013 Capital Improvement Program.

Project costs listed in Table 7-2 are shown as total project costs, although Carlsbad is only responsible for their cost share of the improvements to the Vista/Carlsbad Interceptor projects (project IDs I-1 thru I-3). Carlsbad's actual cost share will be based on their capacity rights defined in an agreement with the City of Vista dated February 26, 2002 titled "Agreement for Ownership, Operation and Maintenance of the Vista Carlsbad Interceptor Sewer" (provided in Appendix "D" of this Master Plan Update). For the purpose of the connection fee calculation, Vista's share of the project cost is considered to be future revenue for Carlsbad and is included in the calculation of the available cash balance shown in Table 7-3. Encina WPCF project costs are based on the City of Carlsbad's current capacity ownership of the Encina WPCF, as documented in the February 2000 Revised Basic Agreement. The EWPCF costs also include a line item for Carlsbad's share of the remaining payments to be made toward the debt service of the Phase IV plant expansion. The total cost of Carlsbad's future projects to be funded from connection fees is estimated at approximately $12,622,279.

7.4 CONNECTION FEE CALCULATIONS

A cost per EDU for sewer service can be determined from the CIP costs and the projected number of future users, which has been estimated from available planning data. Because the actual number of units eventually constructed may vary, the estimate of future sewer EDUs is reduced by 10 percent in the calculation of sewer connection fees. This unit reduction is considered a "safety factor" to ensure that the necessary fees will be collected even if the Sewer Services Area is not completely built out as planned.

Table 7-2 Capital Improvement Projects for the Connection Fee Update

Project ID	Project Title	Project Type	Estimated Cost
I-1	Vista/Carlsbad Interceptor Sewer, Reach VC3	Replace with Larger Pipe	$ 2,688,200
I-2	Vista/Carlsbad Interceptor Sewer - Buena Vista LS Improvements	Increase Lift Station Capacity	$ 1,175,000
I-3	Vista/Carlsbad Interceptor Sewer, Reach VC11B	Replace with Larger Pipe	$ 500,000
C-1	Poinsettia Lane Sewer Replacement (new)	Replace with Larger Pipe	$ 100,000
C-2	Marron Road Sewer Replacement (new)	Replace with Larger Pipe	$ 350,000
C-3	Las Palmas Trunk Sewer (new)	New Trunk Sewer	$ 2,420,000
C-4	Faraday and ECR Sewer Replacement (new)	Replace with Larger Pipe	$ 1,540,000
C-5	Sewer Capacity Monitoring	Monitoring Flows	$ 414,000
SR-3	Buena Interceptor Capacity Purchase (new)	Capacity Purchase	$ 500,000
N-9	Vista/Carlsbad Interceptor Sewer, Reach VC1 Capacity Purchase (new)	Capacity Purchase	$ 150,000
E-2	Encina Phase IV Expansion Debt Service	Debt Service	$ 2,785,079
		Total	**$ 12,622,279**

The calculations for the updated connection fee are shown in Table 7-3. The "Total Cost" in Table 7-3 is the budget estimate for Future Capital Expenditures minus the Available Cash Balance in the sewer connection fee account. City Staff have projected the available cash balance on March 1, 2012 to be $7,844,000. The new connection fee is calculated to be $842 per EDU.

Table 7-3 Sewer Connection Fee Calculation

Future Capital Expenditures	Available Cash Balance	Total Cost	Future EDUs Less 10%	Cost per EDU
$12,622,279	**$7,844,000**	**$4,778,179**	**5,672**	**$842**