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CITY OF VISTA AND BUENA SANITATION DISTRICT

SEWER MASTER PLAN UPDATE 2008

JANUARY 2008

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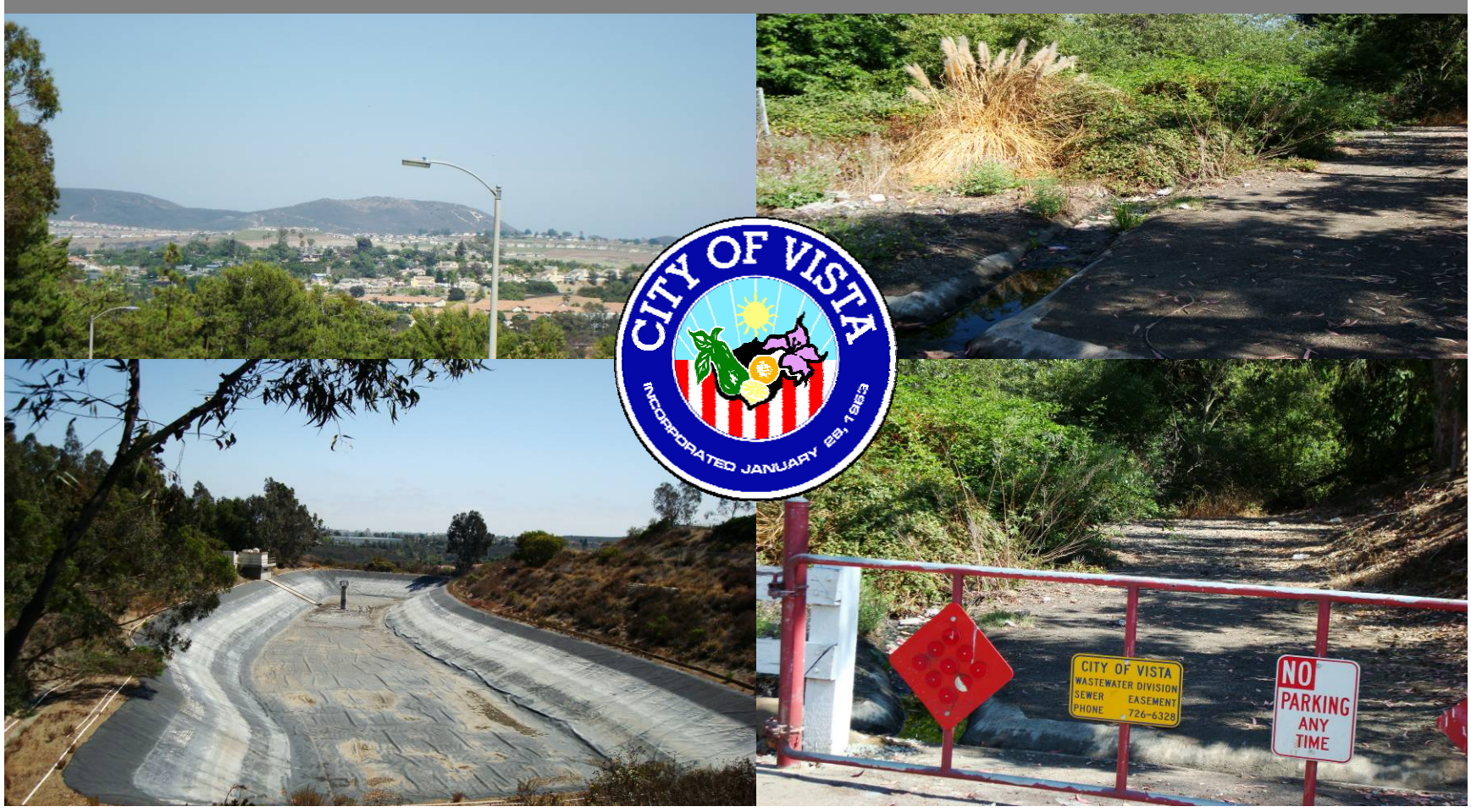

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SEWER MASTER PLAN UPDATE

JANUARY 2008

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- Morris B. Vance ..... City Mayor
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ANNOTATION

The following abbreviations and acronyms were used in the preparation of this Master Plan:

ACRONYM	DEFINITION
ABS	Acrylonitrile Butadiene Styrene
ABSP	Acrylonitrile Butadiene Styrene Pipe
ACP	Asbestos Cement Pipe
ADWF	Average Dry-Weather Flow
AWWF	Average Wet-Weather Flow
BII	Base Inflow and Infiltration
BSD	Buena Sanitation District
CCTV	Closed-Circuit Television
CIP	Cast Iron Pipe
CIP	Capital Improvement Program
City	City of Vista
CMMS	Computerized Maintenance Management System
COV	City of Vista
DIP	Ductile iron pipe
DIP/CL50	Ductile Iron Pipe Class 50
District	Buena Sanitation District
EDU	Equivalent Dwelling Unit
ENR CCI	Engineering News Record, Construction Cost Index
EPA	Environmental Protection Agency
ESVCP	Extra Strength Vitrified Clay Pipe
EWA	Encina Wastewater Authority
FOG	Fats, Oil and Grease
GIS	Geographical Information System
GPD	Gallons Per Day
HDPE	High Density Polyethylene
I&I, II	Inflow and Infiltration
JPA	Joint Powers Authority
MGD	Million Gallons per Day
MOU	Memorandum of Understanding
O&M	Operations and maintenance

ANNOTATION (CONTINUED)

ACRONYM	DEFINITION
PDWF	Peak Dry-Weather Flow
PF	Peaking Factor
PVC	Poly Vinyl Chloride
PVC/DIP	Poly Vinyl Chloride lined Ductile Iron Pipe
PVC/VCP	Poly Vinyl Chloride lined Vitrified Clay Pipe
PWWF	Peak Wet-Weather Flow
RCP	Reinforced concrete pipe
RDII	Rainfall-Derived Inflow and Infiltration
RPM	Reinforced Plastic Mortar
SANDAG	San Diego Association of Governments
SSF	South Santa Fe
SSMP	Sewer System Management Plan
SSO	Sanitary Sewer Overflows
SWMM	Storm Water Management Model
SWRF	Shadowridge Water Reclamation Facility
TFM	Temporary Flow Measurement
VCP	Vitrified Clay Pipe
VCP/DIP	Vitrified Clay Pipe/Ductile Iron Pipe
VCP/PVC	Poly Vinyl Chloride lined Vitrified Clay Pipe
VWD	Vallecitos Water District
WDR	Waste Discharge Requirements
WRF	Water Reclamation Facility

1.0 EXECUTIVE SUMMARY

This update is the product of greatly expanded hydraulic modeling detail prepared to address newly approved State regulations. The result is a program recommendation that optimizes replacement and rehabilitation projects. Starting with existing undersized pipelines in poor condition and located in streams and pipelines with poor access, the program schedules improvements over a 20-year period. The recommended program also includes a Complete Condition Assessment program composed of wet-weather flow measurement, televised inspections, smoke testing, and aboveground inspections. The televised inspection program is recommended on a 5-year program basis, reduced in frequency to a 10-year cycle following the initial assessments. All other components of this program will be completed within 1 year and will further optimize the Capital Improvement Program (CIP) and operations and maintenance (O&M) investment.

1.1 FINDINGS

The Master Plan preparation was based on significant analysis of the existing system through a combination of operations interviews, maintenance analysis and hydraulic analysis. The findings of this analysis is that the system is in need of significant investment to restore the system to acceptable physical condition and to provide adequate hydraulic capacity to minimize sanitary sewer overflows (SSOs). To address these needs, a list of prioritized Capital Improvements Program projects and their associated planning level costs has been prepared and is presented .

1.2 ANALYSIS

1.2.1 CAPACITY ANALYSIS

This Master Plan Update extends previous Master Plans by using a highly detailed hydraulic model that loads the flows in each pipe based on equivalent dwelling units (EDUs) in each adjacent parcel. (See Table 1-1) This level of detail was not available in previous planning efforts. Traditional master planning has relied on coarser analyses of trunk lines in the development of a Capital Improvement Program that addressed only capacity-related issues.

Capacity restoration may be provided by constructing larger replacement pipes or by reducing extraneous defect flows by pipeline rehabilitation. By estimating the rehabilitation costs associated with inflow and infiltration (I&I) reduction and the effects on pipeline capacity, this document identified a recommended set of CIP projects necessary to address identified capacity restrictions and condition related problems. Further, a Condition Assessment Program is recommended that will optimize the location of (I&I) reduction projects.

In addition to this Master Plan Update, the City of Vista (City)/Buena Sanitation District (District) engineering staff has been provided with the complete modeling data set to allow future changes in the system to be evaluated by the City. These management tools will allow the staff to accurately determine the level of development and required improvements in all parts of the collection system. The expanded modeling detail allows the City to analyze predicted flow versus measured flow to target I&I reduction and analyze EDU distribution and allocation. This additional analysis can be used to more efficiently manage O&M and CIP projects and more equitably assess rates and connection fees.

Table 1-1 shows the difference in modeled assets of the system for the past and current Master Plans.

Table 1-1 Modeled Pipes History

	Pipes Modeled		
Year	**Vista**	**Buena**	**Total**
1982	50	29	74
1993	89	32	121
2001	111	34	145
2007	5,537	2,326	7,863

1.2.2 OPERATIONAL ANALYSIS

During the course of the project, many meetings were held with the operation staff to identify non-capacity related deficiencies. The interviews included current and former field personnel that have been responsible for the CCTV inspection program since its' inception. The interviews also included detailed discussions of how past decisions for project development had occurred and the lessons learned from those experiences. Old maps and other documentation was reviewed to enhance the understanding of how the assets are currently being maintained. This included working with the CCTV crews, the Operations Staff Personnel and the IT Department. These discussion yielded a much better understanding of how the system is currently operated especially in the Priority Maintenance Areas.

Additionally the City's extensive database was used to determine areas that required additional attention through age, material and condition analysis. These conditions provided additional information that was used in the establishment of priorities for the projects identified.

1.3 REGULATORY CHANGES

Significant regulatory changes have occurred since the last Sewer Master Plan was prepared. The following discussion provides background on the dominant regulations that effect the management and operations of the sewer collection system.

In May 2006, the State Water Resources Control Board adopted Order 2006-003-DWQ, commonly known as the Waste Discharge Requirements (WDRs). The intent of the order is elimination of sanitary sewer overflows (SSOs). To achieve that goal, the State WDRs establish a uniform set of business requirements for the owners and operators of wastewater collection agencies. The documentation for the business process is embodied in a Sewer System Management Plan (SSMP). The primary elements of the SSMP are listed below.

(1) Restatement of the Goal ("To provide a plan and schedule to properly manage, operate and maintain all parts of the sanitary sewer system. This will help reduce and prevent SSOs, as well as mitigate any SSOs that do occur.")
(2) Organization – Describes the organization and designates the Responsible Party
(3) Legal Authority – Describes the legal authority to control sewer system connections
(4) Operations and Maintenance Program
(5) Design and Performance Provisions
(6) Overflow Emergency Response Plan
(7) Fats, Oil, and Grease (FOG) Control Program
(8) System Evaluation and Capacity Assurance Program
    a. Evaluate the system to determine capacity-related restrictions
    b. Design Criteria
    c. Capacity enhancement measures (Develop and fund CIP)
    d. Schedule the CIP
(9) Monitor, Measure, and Modify SSMP
(10) SSMP Program Audits
(11) Communication Program (Public Outreach).

These State requirements were modified by the San Diego Regional Board by retaining more stringent reporting aspects of the previously adopted local Board Order R9-96-04. The Vista/Buena Sanitation District Sewer Master Plan Update directly addresses the primary requirements of Item 8 of the WDRs.

The following discussion highlights the findings of the master planning process and presents the recommended CIP as required in Section 8 of the State WDRs.

This document identifies and outlines recommendations to address all known deficiencies. The estimated cost to do so is $123,400,612 over the next 5 years and $287,384,153 over the next 20 years. The components are (1) condition assessment needs, (2) capacity upsizes, and other projects necessary due to material (e.g., ductile iron pipe (DIP)), age, observed condition, and minimum diameter upsizes.

Table 1-2 Pipeline Inventory*

Items	Buena	Vista	Unknown	Total
Total Length of Sewer Pipeline (Miles)	95.7	215.1	0.6	311.4
Total Length of Force Main (Miles)	5.3	0	0	5.3

To establish the baseline hydraulic conditions of the piped system, extensive hydraulic modeling was used to determine the system capacity. The basis for the analysis was the City's existing collection system databases and Geographic Information System (GIS) data sets. Changes to the GIS data, identified by the project team were incorporated until May 17, 2007. As a result, the hydraulic model and associated information are considered current.

1.4 DEFICIENCIES

1.4.1 CAPACITY

Capacity analyses of the collection system were performed for the existing and future dry-weather and wet-weather conditions and for a variety of defect-flow reduction scenarios. The existing model was calibrated for both the average dry-weather and wet-weather events to properly represent the collection system's hydraulic characteristics.

The determination of capacity restrictions in the system under varying flow conditions provides the basis of determining capacity-related replacement projects. The findings from the model showed that the capacity of the system was adequate in all but 82,000 feet of pipelines 12 inches and larger. **Figure 1-1** Recommended Capacity CIP Projects, shows the projects recommended to address each deficiency.

Figure 1-1 Recommended Capacity CIP Projects

During wet-weather events, I&I volume was observed to be almost twice as much as in dry weather. This represents a significant cost to the City/District for pumping and treatment. The greatly increased flow rates also force costly upsizing of downstream facilities to handle the excessive peak flows.

In the early stages of the master planning process, a screening-level Flow Measurement Plan was prepared and submitted. The Flow Measurement Plan was not implemented due to the low total rainfall amount during the 2006/2007 wet season.

1.5 RECOMMENDATIONS

A total of $287,384,153 in improvements is recommended with $123,400,612 in Years 1 through 5. Since resources are limited, these recommendations have been prioritized and broken down to facilitate funding decisions. It should be emphasized that the implementation level will affect any I&I reduction potential. A wet-weather flow study and reexamination is therefore recommended after funding decisions are made.

1.5.1 INFLOW AND INFILTRATION REDUCTION

1.5.1.1 Condition Assessment Program

To comply with the System Evaluation portion of the WDR program, the recommended CIP includes funding for a system evaluation through a full condition assessment of the collection systems. This includes a Revised Flow Measurement Plan (2007/2008), a 5-year closed-circuit television (CCTV) inspection program, and other direct physical observations through smoke testing and manhole inspections. This aggressive program will allow the City/District to focus the proposed I&I reduction and rehabilitation programs in the areas of most need. The condition-assessment program has an estimated cost of $4.3 million. **Table 1-3** describes the components of this program in detail.

Table 1-3 Condition Assessment Programs

Component	Estimated Cost	Cost/Foot
Flow Measurement	$ 295,983	$ 0.18
Smoke Testing	$ 822,174	$ 0.50
Physical Inspection	$ 548,116	$ 0.33
CCTV	$ 2,055,435	$ 1.25
Program Mgmt	$ 558,256	$ 0.34
Total	$ 4,279,964	$ 2.60

1.5.2 CAPACITY RELATED RECOMMENDATIONS

As a result of identified capacity-related deficiencies, a recommended CIP project list has been identified. The estimated cost for these collection-system projects is approximately $40 million as shown in **Table 1-4**. This table does not include VC interceptor improvements for which Carlsbad is the lead agency.

Table 1-4 Capacity Replacement Project Summary

Scenario	Vista	Buena	Total
Existing	$8,863,134	$6,377,760	**$15,240,894**
Ultimate	$20,871,955	$18,625,090	**$39,497,045**

1.5.3 CONDITION RELATED RECOMMENDATIONS

By considering the pipe age, materials, location, and known conditions, a complete replacement/rehabilitation program was developed. Note that this program is conservative and the total estimated costs may be reduced based on the results of the complete Condition Assessment Program. The total estimated costs for non-capacity-related replacements and rehabilitation for the City/District is approximately $148 million as shown in **Table 1-5**. Condition-related projects also include prior CIPs identified during the 2001/2003 Master Plan Update.

Table 1-5 Other Rehabilitation or Replacement Projects

Project Type	Vista	Buena	Unknown	Total
Material-Related Force Main (DIP)	$0	$793,119	$0	$793,119
Material-Related Gravity Main (DIP)	$24,248,766	$2,399,813	$0	$26,648,579
Age-Related	$6,948,675	$0	$0	$6,948,675
Condition-Related	$68,267,080	$22,622,933	$11,198	$90,901,211
Minimum Size	$20,013,301	$2,393,598	$24,183	$22,431,082
Total	**$119,477,822**	**$28,209,463**	**$35,381**	**$147,722,666**

Based on the previous findings, the recommended CIP projects were prioritized and scheduled for funding. **Table 1-6** describes the project, agency, and cost estimates for the next 5 years.

Table 1-6 CIP/O&M Projects

Basin	Near-Term Cost	Long-Term Cost
Complete Condition Assessment		
Buena Subtotal	$ 1,333,989	$ 2,258,935
Vista Subtotal	$ 2,995,975	$ 5,154,181
Condition Assessment Subtotal	$ 4,329,964	$ 7,413,116
Prioritized Capacity-Related Replacements		
Buena Subtotal	$ 12,069,120	$ 18,625,090
Vista Subtotal	$ 33,210,695	$ 39,738,354
Capacity-Related Replacement Subtotal	$ 45,279,815	$ 58,363,444
Other Rehab or Replacements		
Buena Subtotal	$ 17,283,644	$ 52,649,539
Vista Subtotal	$ 56,507,189	$168,958,054
Other Rehab or Replacement Subtotal	$ 73,790,834	$221,607,593
Buena Total	**$ 30,686,753**	**$ 73,533,564**
Vista Total	**$ 92,713,859**	**$213,850,589**
Grand Total	**$123,400,612**	**$287,384,153**

1.6 CONCLUSION

In conclusion, a comprehensive plan of collection-system improvements necessary to address capacity, (I&I) reduction and condition related deficiencies has been prepared.

These recommended CIP projects will fulfill the City's/District's long-term need for a sustainable collection system. Further detail of the analyses that were performed to develop the program is discussed in subsequent chapters.

2.0 INTRODUCTION

To know where you are going, you need to know where you have been. This section discusses the City/District's history, authorization, and Scope of Work for this Sewer Master Plan Update.

2.1 BACKGROUND

The City of Vista and the Buena Sanitation District, shown in **Figure 2-1**, operate a sewer collection system to convey wastewater from homes and businesses to the Encina Wastewater Agency's treatment facilities. This Sewer Master Plan Update provides a set of recommended projects for inclusion in the City's overall Capital Improvements Program. These projects were identified through hydraulic modeling and capacity analysis, review of known conditions and through addressing new regulatory requirements. The identified complete condition assessment, replacements, and rehabilitation program will minimize the potential for system overflows and facilitate compliance with the State's newly adopted Waste Discharge Requirements (WDRs).

To provide sewer-system planning, the City of Vista and the Buena Sanitation District have contracted with Dudek to prepare a Sewer Master Plan Update. This 2007 report is an extensive update based on new analyses using the latest Geographic Information System (GIS) data sets. A complete hydraulic model of all facilities was prepared from and integrated with the GIS. These new analyses, combined with maintenance analysis and extensive review of the Master Plan of Sewerage prepared in July 2001 and 2003,[1] are the basis of the Sewer Master Plan Update. Historical references are also included for ease of access from the previous Master Plans of Sewerage prepared by Wilson and Associates in May 1993 and by Fraser, Wilson and Associates in March 1982. This Sewer Master Plan Update establishes a structured program of system improvements.

The complete collection system is shown with jurisdictional and maintenance boundaries in **Figure 2-1**.

[1] The 2003 Master Plan Update was an update of 2001 project costs by application of the 2003 ENR Construction Cost Index. No new analyses were performed in the 2003 Update.

Figure 2-1 Collection System

2.1.1 HISTORY

The following excerpts from previous Master Plans trace the early organizational history of the collection system.

2.1.1.1 City of Vista

"The collection system in the older areas of town near South Santa Fe was constructed prior to the formation of the Vista Sanitation District in 1947. The County Board of Supervisors was the governing body of the District until the incorporation of the City in 1963. At that time the Vista City Council became the ex officio Board of Directors of the District. The District is now operated and maintained by the City of Vista Department of Public Works."[2]

"The City of Vista provides sewer service to areas within the City which lie in the Buena Vista Creek Basin. The City also provides sewer service to portions of the San Luis Rey and Agua Hedionda Creek Basins within the City. The Buena Sanitation District provides sewer service to the majority of the Agua Hedionda Creek Basin within the City of Vista as well as areas within the Agua Hedionda Creek Basin east of the City."

"Some facilities presently owned by the City of Vista date back to the late 1920s and were constructed by the Vista Sanitary District. The Vista Sanitary District was formed in 1928 to provide sewer service to a small area of downtown Vista. In 1946, the Vista Sanitary District authorized an election for the dissolution of the District to initiate the transformation from a Sanitary District to a Sanitation District."

"The Sanitation District was formed in 1947 with the County Board of Supervisors acting as the governing body. When the City of Vista was incorporated in 1963, the control of the Vista Sanitation District was transferred from the County Board of Supervisors to the Vista City Council. This Vista Sanitation District entered into a Joint Powers Agreement [JPA] with the City of Carlsbad and subsequently connected to the Encina Water Pollution Control Facility in 1965."

"In 1983 the Vista Sanitation District was dissolved and all rights and obligations of the Vista Sanitation District were assumed by the City of Vista. All sanitation functions are now accomplished by the City of Vista staff and an enterprise fund has been set up to keep sanitation funds separate from general fund revenues."[3]

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[2] *Master Plan of Sewerage;* Fraser, Wilson and Associates, 1982.
[3] *Master Plan of Sewerage,* Dexter Wilson and Associates, 1993.

As the City and District have grown, pockets of adjacent communities that are best served through transfer agreements and participation in the JPA have been identified. To provide service to these areas, the City/District has entered into Service Agreements with the City of San Marcos, San Diego County, City of Carlsbad, City of Oceanside, Vallecitos Water District, Encina Wastewater Authority (EWA), Leucadia Wastewater District, and San Marcos County Water District. These agreements are listed and provided in the appendices to this Update. Almost all of the sewer flows that are generated in Vista and Buena are treated and discharged from the Encina Water Pollution Control Facility. This facility and the pump stations are owned jointly and administered by the Encina Wastewater Authority. This agency and its formation are discussed in Section **2.1.1.3.**

In April 2007, the City/District experienced two spills from ductile iron force mains that were approximately 20 years old. The cause of the failures is still under investigation. Initially, it appears that the ductile iron pipe was in contact with corrosive soils. This report has identified the costs associated with replacing all ductile iron pipes in the system.

In June 2007, the voters of the City approved changing the status of the City from a General Law City to a Charter City. A Charter City has greater flexibility in establishing business practices that offer a cost savings to the City. A dominant part of the approval process will be the savings anticipated from not being required by the State law to pay prevailing wages. Additional taxing and an aggressive municipal improvements program have also been approved by the voters.

2.1.1.2 Buena Sanitation District

"The Buena Sanitation District was organized in 1960 with the San Diego County Board of Supervisors acting as its governing body. The Buena Sanitation District connected to the Encina Water Pollution Control Facility in September of 1965. In 1983 the City of Vista requested to be represented on the Buena Sanitation District Board. In September 1983 the Board of Directors of the Buena Sanitation District was restructured in accordance with the Health and Safety Code to a three member board. Two of the members were from the San Diego County Board of Supervisors and one from the Vista City Council."

"In 1990, population changes in the Buena Sanitation District required a change of representation on the Board. The Board of Directors was changed to two representatives from the Vista City Council and one representative from the County of San Diego Board of Supervisors. Thus, the City of Vista obtained the controlling vote on the Buena Sanitation District Board."[4]

In October 1998, as a result of population changes in the District, the Board of Supervisors of the County of San Diego adopted Resolution No. 98-289, designating the City of Vista as the Board of Directors of the Buena Sanitation District. Today, the City of Vista continues to maintain the District in order to provide an effective form of funding, operations, and maintenance for the sewer collection system in portions of Vista, San Marcos, Carlsbad, and unincorporated areas of San Diego County.

2.1.1.3 Encina Wastewater Authority

In 1961 the Vista Sanitation District and the City of Carlsbad agreed to create a JPA for the purpose of acquiring and constructing a sub-regional sewer system. Through the years, additional agencies (including Buena Sanitation District) joined the JPA to achieve a collection and treatment system that offers economies of scale. **Table 2-1** shows the managing agency, member agencies, and achievements by year. The City/District has played an increasingly significant role in the provision of collection and treatment facilities for the area.

[4] *Master Plan of Sewerage,* Dexter Wilson and Associates, 1993.

Table 2-1 EWA Organizational History

Year	Manager	Member Agencies						Achievments
1961	San Diego County	Vista San. District	City of Carlsbad					JPA Initiated by Vista San and Carlsbad
1962								
1963								Original site acquired
1964				Buena Sanitation District				
1965					Vallecitos Water District			WPCF/EOO Complete 4.5 MGD
1966								
1967								
1968								
1969								
1970								
1971						City of Encinitas	Leucadia County Water District	Phase I Complete 6.75 MGD
1972								
1973								
1974								
1975								Phase 2 Complete 13.75 MGD,EOO Ext.
1976								COV performs service for BSD
1977								
1978								
1979	Leucadia CWD							
1980								
1981								
1982								
1983								VSD dissolved became City Enterprise
1984		City of Vista						
1985								
1986								
1987								
1988	Encina Admin. Agency							Phase 3 Complete 22.5 MGD Secondary
1989								
1990								
1991	Encina Wastewater Authority							
1992								Phase 4 Complete 36.0 MGD
1995								South Parcel Acquired
1996								
1997								
1998								
1999								
2000							Leucadia Wastewater District	
2001								
2002								
2003								
2004								
2005								
2006								
2007								Phase 5 In Process

As shown in the previous table, Vista and Buena have proactively engaged in planning and executing the sub-regional collection and treatment facilities operating under the auspices of the Encina Wastewater Authority. As the plant nears the final expansion phases, the costs for expansion will diminish and those for normal operating and maintenance expenses will likely increase. **Table 2-2** shows the near-term increase in EDUs, Operating Expenses, and flows for the City and District since 2002.

Table 2-2 Buena and Vista Flow and Cost History at Encina[5]

Vista						
Year	Operating Exp.	Avg MGD	Annual Flow	EDUs	$/MGD	OpExp/EDU
2002	$ 1,479,507	6.58	2,402	22,257	$ 616.02	$ 66.47
2003	$ 1,517,606	6.51	2,376	22,595	$ 638.68	$ 67.17
2004	$ 1,615,147	6.66	2,433	22,804	$ 664.42	$ 70.83
2005	$ 1,792,413	7.37	2,690	22,934	$ 666.31	$ 78.16
2006	$ 1,975,084	6.79	2,478	23,103	$ 796.94	$ 85.49
Buena						
Year	Operating Exp.	Avg MGD	Annual Flow	EDUs	$/MGD	OpExp/EDU
2002	$ 479,835	1.34	489	4,180	$ 981.06	$ 114.80
2003	$ 560,789	1.58	577	4,266	$ 972.41	$ 131.45
2004	$ 633,955	1.88	686	4,360	$ 923.86	$ 145.41
2005	$ 658,222	1.98	723	4,413	$ 910.78	$ 149.16
2006	$ 713,689	1.87	683	4,482	$ 1,045.62	$ 159.25
Totals					**Average**	
Year	Operating Exp.	Avg MGD	Annual Flow	EDUs	$/MGD	OpExp/EDU
2002	$ 1,959,342	7.92	2,891	26,437	$ 677.79	$ 74.11
2003	$ 2,078,395	8.09	2,953	26,861	$ 703.86	$ 77.38
2004	$ 2,249,102	8.54	3,119	27,164	$ 721.15	$ 82.80
2005*	$ 2,450,635	9.35	3,413	27,346	$ 718.08	$ 89.61
2006	$ 2,688,773	8.66	3,161	27,585	$ 850.64	$ 97.47

*2005 Experienced increased flow due to rainfall

The average cost for treatment at the Encina facility has increased from $616.02/million gallons per day (MGD) to $796.94/MGD in the last 5 years for the City of Vista. Average treatment costs for Buena Sanitation District have increased from $981.06/MGD to $1,045.62/MGD in the same period. These represent average annual increases of 6% for Vista and 1% for Buena Sanitation District. The increase in treatment costs may require a change in the user rates structure. A rate study will be performed based on final selection of recommended projects in the Sewer Master Plan Update.

[5] City of Vista, Agency Flow and EDU Counts, Memos to EWA June 2002–2006; Encina Wastewater Authority, Comprehensive Annual Financial Report, FY Ended June 30, 2006.

2.1.2 AUTHORIZATION

On March 26, 2006, the Vista City Council approved a contract with Dudek to prepare a Sewer Master Plan Update and a Stormwater GIS and Master Plan. The Sewer Master Plan Update authorized includes the following highlights from the Approved Scope of Work.

2.1.3 SCOPE OF WORK

The following items were specifically identified in the approved Scope of Work.

- Update the 2003 CIP
    - This task used the 2003 list of projects and prepared updated 2006 costs and modified projects to include logically located line segments. This update is superseded by the currently proposed program.
- Prepare a complete GIS integrated link-node model of the collection system
- Evaluate the capacity of the collection system under existing and future/wet and dry flow conditions
- Develop an I&I Reduction Program Plan
- Prepare a Sewer Master Plan Update
- Integrate Maintenance Management System (CMMS)
- Prepare a prioritized CIP recommendation
- Perform recommended CIP cost analyses
- Coordinate with IT staff

Each scope item was performed and is discussed in the following chapters.

3.0 STUDY AREA

Sewer collection systems are generally designed to flow downhill by gravity. As a result, the general topography of an area defines the layout of the collection system.

Sanitary sewer collection systems often contain defects and illicit connections that allow rainwater to enter. These flows are often termed “defect flows” or “Inflow and Infiltration” (I&I). Inflow is the result of a direct connection to the surface while infiltration occurs through groundwater. As a result, rainfall and its effect on the collection system drive the peak wet-weather flow (PWWF) that a system may accommodate without spilling.

This chapter describes the physical geography and the climate that influence the design of a collection system. It also delineates the study area.

3.1 PHYSICAL GEOGRAPHY

Drainage patterns within the District’s wastewater collection system are defined by the physical geography of its service area. The District is bounded on the northeast by the San Marcos Mountains and on the southwest by the Buena Vista and Agua Hedionda Lagoons. This results in a general flow direction from the northeast to the southwest. The overall area can be split into the two areas that flow towards each lagoon. Sewer service in each of these areas is also generally divided by the jurisdictional agency and by the original nature of development. The majority of the Vista Service Area is in the Buena Vista drainage basin, and the Buena Sanitation District Boundary dominates the Agua Hedionda drainage basin. Each of these collection systems is discussed more in Chapter 4. The dominant drainage features and jurisdictional boundaries are shown in **Figure 3-1**.

Physical geography influences jurisdictional boundaries quite naturally. The availability of sewer services induces increased density. These densified land uses require public services, and cities annex unincorporated areas to provide those services, to expand the revenue base, and to regulate development in accordance with the general plan.

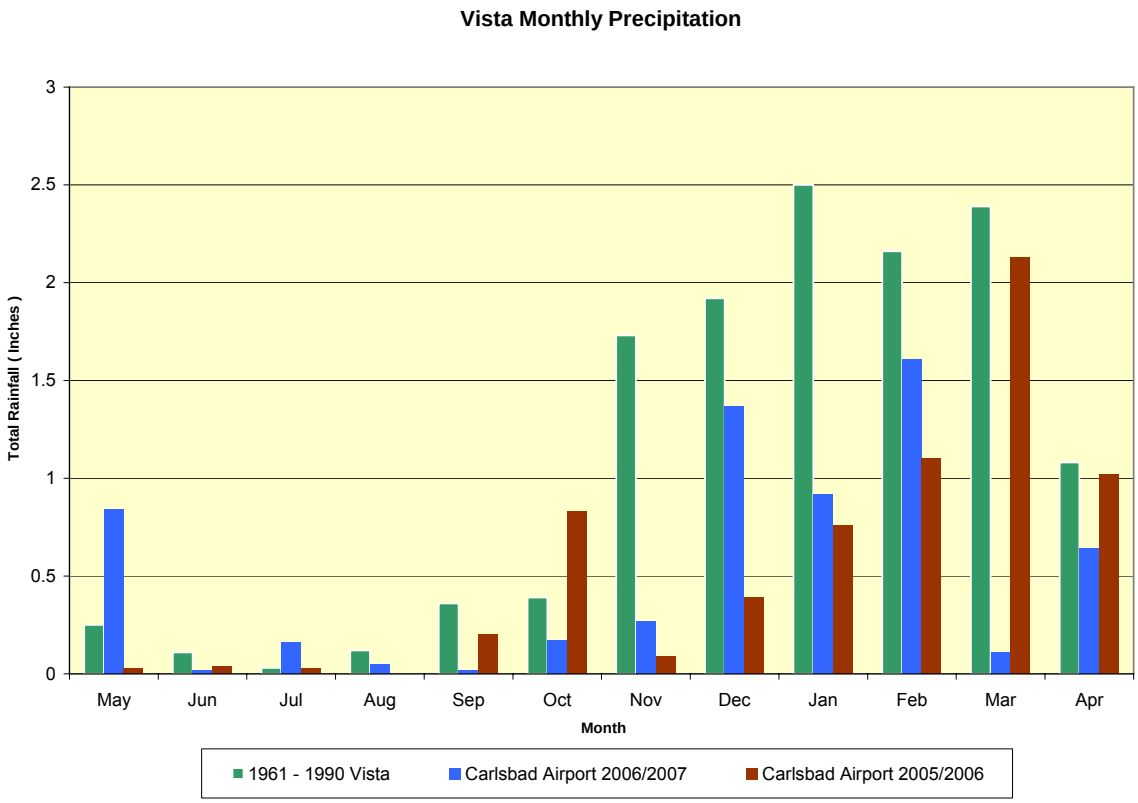
The flow of sewer across jurisdictional boundaries has led to joint ownership and flow transfer agreements involving the City of San Marcos, San Diego County, City of Carlsbad, City of Oceanside, Vallecitos Water District, Encina Wastewater Authority, Leucadia Wastewater District and San Marcos County Water District. These agreements require maintenance and revision as legal conditions change or as the agreements expire or become superseded.

Figure 3-1 Dominant Drainage Features

3.2 CLIMATE

As mentioned, the distribution of rainfall is an important consideration in planning a sewer system that is free from overflow. Wet-weather or defect flows represent the extreme event for consideration of capacity planning. This will be discussed fully in the development of Existing and Future Wet-Weather Flow Scenarios that were used as the basis of the capacity analysis. **Figure 3-2** shows the Historical Monthly Rainfall Totals in Vista.[6]

Figure 3-2 Vista Historical Monthly Rainfall Totals



3.3 STUDY AREA

The study area is defined by a combination of political and physical boundaries. The logical physical extents of the drainage include areas up to the ridgeline in the San Marcos Mountains. These areas are outside of the political boundaries of the City of Vista and the Buena Sanitation District. **Figure 3-3** shows the boundaries of the study area. The total area of the study area is

[6] NOAA, National Climatic Data Center, Climatography of the U.S. No. 81, Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Days 1961–1990, 2005–2007, Carlsbad Airport.

approximately 33 square miles or 21,120 acres. This includes all areas maintained by the City/District and areas that can flow by gravity into the system regardless of jurisdiction.

Figure 3-3 Study Area Boundary

4.0 WASTEWATER COLLECTION SYSTEM

A primary requirement of the WDRs and recommendation of the General Accounting Standards Board (GASB-34) is that the owner of the collection system prepares a complete inventory of the system. This chapter describes the collection-system pipelines owned by the City/District in terms of length, material, and age. A complete inventory would also contain remote and shared facilities. **Figure 2-1** shows the extent of the existing collection system.

4.1 EXISTING SEWER SYSTEM

To define the collection-system characteristics for the City and the Buena Sanitation District, the ownership category in the City of Vista Collection System GIS was used.

4.1.1 CITY OF VISTA

The City of Vista collection system is located primarily in the Buena Vista Drainage Area and is comprised of 35 sub-drainage areas. Three sub-drainage areas (V33, V34, and V35) are located in the Agua Hedionda Drainage Basin. The majority of sewer flows generated from the City drains to the Encina Wastewater Treatment plant via the Vista-Carlsbad Interceptor, with the exception of sewer flows generated in subsections V33, V34, and V35. These flows drain to the Encina Wastewater Treatment via the Buena Interceptor.

The City of Vista wastewater collection system includes approximately 215 miles of sanitary sewers ranging in size from 6 to 42 inches in diameter. **Table 4-1** summarizes the characteristic length of the Vista collection system based on the diameter of the pipelines.

Table 4-1 City of Vista's Pipeline Length

Diameter (Inches)	Length (Feet)	Length (Miles)
6	110,760	20.98
8	843,129	159.68
10	56,405	10.68
12	49,737	9.42
14	321	0.06
15	14,955	2.83
18	15,644	2.96
21	3,994	0.76
24	5,130	0.97
27	3,770	0.71
30	3,193	0.60
36	25,454	4.82
42	2,950	0.56
Total	**1,135,724**	**215.10**

Age spans of 10 years were calculated to determine the relationship between age and length of pipelines. **Table 4-2** summarizes the pipe age versus length relationship.

Table 4-2 City of Vista's Pipeline Age

Age Range (Years)	Length (Feet)	Length (Miles)
0 to 10	90,815	17.20
11 to 20	228,324	43.24
21 to 30	256,843	48.64
31 to 40	133,825	25.35
41 to 50	361,626	68.49
Greater Than 50	58,608	11.10
Unknown	5,683	1.08
Total	**1,135,724**	**215.10**

The City of Vista owns a total of 711,739 feet (approximately 135 miles) of pipeline made from vitrified clay pipe (VCP). This amounts to roughly 63% of the total collection system. Note that VCP lines installed prior to 1963 were regularly installed in short lengths with open joints and manholes 2 feet in diameter. Over half of the VCP lines (412,039 feet) are over 41 years old. Additionally, sewers were frequently located in very narrow easements centered on private-property lines. These factors make the older clay lines the most prone to root intrusion and offset joints. Those that are located in easements are extremely difficult (sometimes impossible) to maintain and should be relocated. The majority of remaining pipeline is constructed of plastic (PVC), for a total of 352,682 feet (approximately 67 miles). PVC pipeline accounts for 31% of the total collection system. **Table 4-3** presents the pipeline material and length relationship.

Table 4-3 City of Vista's Pipeline Material

Pipe Material	Length (Feet)	Length (Miles)
ABS	103	0.02
ABSP	5,133	0.97
ACP	385	0.07
CIP	487	0.09
DIP	41,117	7.79
DIP/CL50	162	0.03
ESVCP	416	0.08
HDPE	246	0.05
PVC	352,682	66.80
PVC/DIP	2,357	0.45
PVC/VCP	848	0.16
VCP	711,739	134.80
VCP/DIP	207	0.04
VCP/PVC	4,786	0.91
Unknown	15,055	2.85
Total	**1,135,724**	**215.10**

Table 4-4 shows the relationship between the City of Vista's pipeline age, material, and length for DIP, PVC, and VCP. Much of this is subject to the problems noted above.

Table 4-4 City of Vista's Combined Pipeline Age, Material, and Length (Ft)

Pipe Material	0 to 10 Years	11 to 20 Years	21 to 30 Years	31 to 40 Years	41 to 50 Years	Greater Than 50 Years	Unknown Age	Total Length
DIP	322	12,006	28,666		20		103	**41,117**
PVC	89,477	180,026	80,522	1,552	831		274	**352,682**
VCP	102	33,559	138,521	126,507	356,314	55,725	1,011	**711,739**

4.1.2 BUENA SANITATION DISTRICT

The Buena Sanitation District is located primarily in the Agua Hedionda Drainage Area. The first sewer pipelines were installed in 1964. The Buena Sewer Collection System comprises approximately 101 miles of sanitary sewers and force mains ranging in size from 4 to 30 inches in diameter. Sewer flows generated from the Buena Sanitation District drain to the Buena Pump Station and are conveyed to Encina Wastewater Treatment Plant via the Buena Force Main and the Buena Interceptor. **Table 4-5** summarizes the characteristic length of the collection system based on the diameter of the pipelines.

Table 4-5 Buena Sanitation District's Pipeline Length

Diameter (Inches)	Length (Feet)	Length (Miles)
4	46	0.01
6	12,850	2.43
8	408,614	77.39
10	13,794	2.61
12	25,551	4.84
14	15,947	3.02
15	9,946	1.88
16	5,623	1.06
18	20,211	3.83
21	7,232	1.37
24	10,275	1.95
30	2,602	0.49
Total	**532,691**	**100.89**

Table 4-6 summarizes the pipeline age versus length relationship. The entire collection system owned by the District is less than 50 years old.

Table 4-6 Buena Sanitation District's Pipeline Age

Age Range (Years)	Length (Feet)	Length (Miles)
0 to 10	39,009	7.39
11 to 20	95,212	18.03
21 to 30	187,206	35.46
31 to 40	35,726	6.77
41 to 50	171,250	32.43
Greater Than 50	0	0
Unknown	4,289	0.81
Total	**532,691**	**100.89**

VCP accounts for more than 50 miles of pipeline in the collection system. Another 23 miles of the collection system is composed of PVC. **Table 4-7** presents the pipeline material and length relationship.

Table 4-7 Buena Sanitation District's Pipeline Material

Pipe Material	Length (Feet)	Length (Miles)
ABS	5,152	0.98
ACP	6,403	1.21
CIP	816	0.15
DIP	13,625	2.58
HDPE	2,127	0.40
PE	498	0.09
PVC	120,286	22.78
RCP	996	0.19
RPVC	2,416	0.46
VCP	266,580	50.49
VCP/ PVC	190	0.04
VCP/PVC	229	0.04
XVCP	949	0.18
Minor Materials	777	0.15
Unknown	111,648	21.15
Total	**532,691**	**100.89**

Table 4-8 shows the relationship between the District's pipeline age, material, and length for DIP, PVC, and VCP. The majority of the District's collection system is comprised of VCP pipe that is less than 30 years old.

Table 4-8 Buena Sanitation District's Combined Pipeline Age, Material, and Length (Ft)

Pipe Material	0 to 10 Years	11 to 20 Years	21 to 30 Years	31 to 40 Years	41 to 50 Years	Unknown Age	Total Length
DIP	181	10,621	2,823				**13,625**
PVC	35,671	55,931	28,307		377		**120,286**
VCP	994	2,981	72,537	29,574	160,060	433	**266,580**

4.1.3 LIFT STATIONS

Lift stations convey tributary flow from low areas constrained by topographic elevations to higher elevations where the flows can be conveyed to the treatment plant by gravity. Lift stations typically require significant maintenance and attention by operations personnel and represent a significant risk point in the system for overflows or spills.

Flows tributary to lift stations are conveyed through pumps and pressure pipelines (force mains). The force-main flows discharge into the gravity collection system. The potential for odor at these discharge points is significant. As a result, lift stations and force mains are operated in such a manner to minimize the travel time in the force main and the turbulence at the discharge point. Lift stations are also constructed with redundant facilities and standby power to minimize the potential for spills and potential impact to the environment.

Recent force-main failures at the Buena and Buena Vista Lift Stations are currently under review. It is suspected that force-main installation techniques, pipeline materials, and age may have contributed to their failure. Further discussion of this issue is found in Chapter 7. There are four lift stations shared between the City of Vista and the Buena Sanitation District. These are:

- Raceway PS aka Melrose PS located at 2685 South Melrose Drive
- Buena PS aka Buena Creek PS located at 2080 South Melrose Drive
- Buena Vista PS aka Jefferson Street PS located at Buena Vista Lagoon at Jefferson
- Agua Hedionda PS located at Agua Hedionda Lagoon northeast of SDG&E power plant

All lift stations are operated by the Encina Wastewater Agency under various MOUs and agreements. The Buena Vista and Agua Hedionda Pump Stations are under shared ownership with Carlsbad as the lead agency.

The location of lift stations and force mains are shown in **Figure 4-1.**

Figure 4-1 Major Lift Stations and Force Mains

4.1.4 WATER RECLAMATION FACILITY

The Buena Sanitation District Shadowridge Water Reclamation Facility (SWRF) (**Figure 4-2**) was built in 1986 to add the required capacity to develop the Raceway Basin located just north of Palomar Airport Road and Melrose Drive. Since that time, Encina capacity and line upgrades have been sufficient to treat the flow at the Encina WRF. Without the need for additional treatment capacity and with rising O&M costs, the District decided to mothball the plant in February 2002. A restart is not anticipated until it becomes cost effective to expand the reclaimed water service area, upgrade the plant technology, and execute new agreements with State and local water resource agencies. A schedule for reevaluation and restarting has not been prepared. It is recommended that a schedule be considered for the economic evaluation of restarting this plant within the next 5 years. This will become especially relevant as funding is made available for evaluation of local water supplies to reduce the dependence on imported water.

Figure 4-2 Shadowridge Water Reclamation Facility

5.0 WASTEWATER FLOWS

5.1 INTRODUCTION

To assess the existing and future capacity of the collection system, determination of existing and future flows is required. Wastewater flows are greatly influenced by weather when there are a large number of defects in the system. This chapter discusses the development of existing and future flows under both dry and wet weather conditions. The impact of defect flow reduction is also analyzed and presented in this chapter.

5.2 HISTORICAL WASTEWATER FLOWS

The previous Sewer Master Plans, prepared in 1982, 1993, and 2001, each report flows from the flow meters at Vista and for the Buena Sanitation District. **Table 5-1** shows the past and existing sewer flows.

Table 5-1 Wastewater Flow

Average Measured Flow (MGD)			
Report Year	**Vista**	**Buena**	**Total**
1982	4.20	0.68	4.88
1993	5.14	2.03	7.17
2001	5.50	2.75	8.25
2007	5.57	3.17	8.74

5.3 EXISTING SEWER FLOWS

Existing sewer flows were measured by utilizing the 24-hour flow monitoring data in 15-minute intervals obtained from Encina Wastewater Agency. Flow measurement data at four meter locations (V1, V2, B2, and OV1) was obtained for the years 2003 to 2006. Meter locations B1, OS1, and BV1 were not analyzed since they include additional flows from other agencies and do not directly affect the capacity analysis of the existing collection system. **Table 5-2** Flow Measurement Locations, presents a summary of flow meter IDs used in this analysis. It includes the meter location and the agencies that flow into each meter.

Table 5-2 Flow Measurement Locations

Meter ID	Location*	Measured Flows
V1	Intersection of College Blvd. and SR-78	City of Vista + City of Oceanside
OS1	Near V1	City of Oceanside
V2	Upstream of the Raceway Pump Station	Subsections V34 and V35 of the City of Vista
B2	Downstream of the Buena Pump Station	Buena Sanitation District
BVPS	Intersection of Jefferson and SR-78	City of Vista + City of Oceanside + City of Carlsbad

**See Figure 7-1 Flow Measurement Locations*

5.3.1 AVERAGE DRY-WEATHER FLOW (ADWF)

Statistical analysis of the flow data was performed to define the existing average and peak dry-weather flow (ADWF and PDWF), average and peak wet-weather flows, and rainfall-derived I&I (defect flows) for each of the flow meters. ADWF was determined by analyzing the data for the dry days only. A dry day is defined as a day when no rainfall occurred 72 hours prior to that day and when there were no lingering effects from a previous rainfall. ADWF is important because it becomes the baseline for determining the amount of defect flows.

The average hourly dry-weather flow rate for each of the flow meters reflects the dominant land use that drains to each meter. The V1 meter is dominated by residential flow, while the V2 meter (basins V34 and V35) is dominated by industrial and commercial flows. V1 flows show increased wastewater production in the early morning and late evening associated with bathing and meals delayed by the travel time to the meter (**Figure 5-1**).

At V2, peak flows occur around noon due to activities in commercial and industrial areas with little delay due to the characteristically short, steep flow paths to the Raceway Pump Station (**Figure 5-2**).

The B2 meter is also dominated by residential flows, with peak flows occurring during morning and evening hours (**Figure 5-3).**

Figure 5-1 V1 Vista Average Dry-Weather Flow

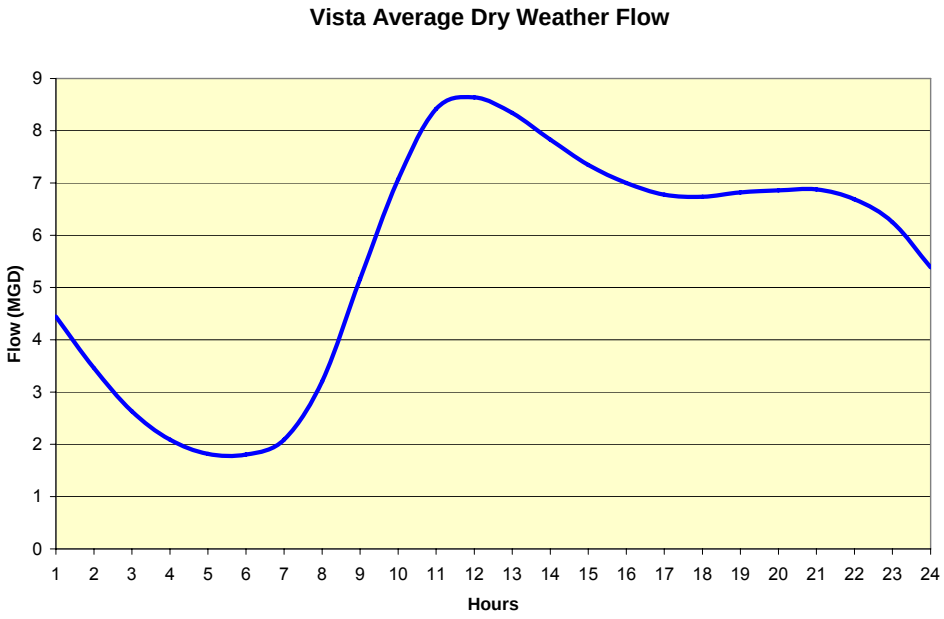


Figure 5-2 V34 V35 Average Dry-Weather Flow

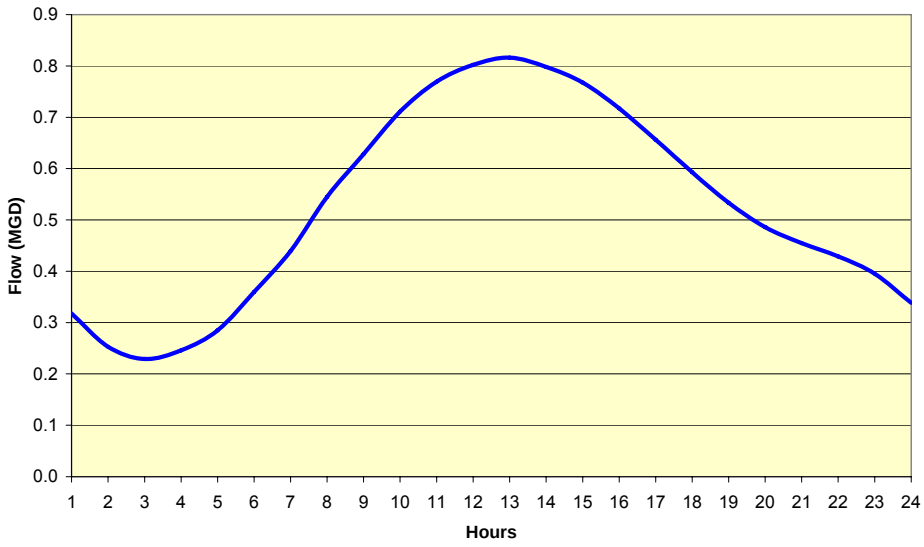
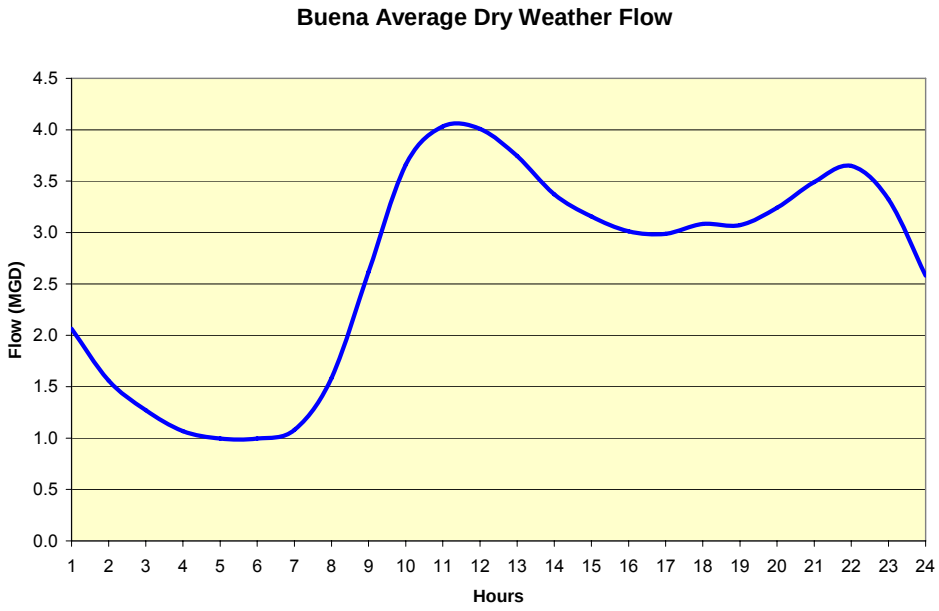


Figure 5-3 B2 Buena Sanitation District Average Dry-Weather Flow



The unit flow or average gallons per day (gpd) per EDU was calculated from the EDU records in the sewer billing database which tracks the EDUs to each parcel address. Each record is assigned a sewer tributary area and an estimated EDU. By calculating the total number of EDUs in each basin and the observed daily dry-weather flow volume, the unit flow per EDU was determined. **Table 5-3** shows the results of that calculation.

Table 5-3 Existing Unit Flow per EDU

Wastewater Basin	Tributary Flows by Type								TOTAL EDUs	Average Dry Weather Flow	Calculated Unit Flow per Basin gpd/EDU
	Residential [1]						Comm.	Gov/Sch/ Industrial			
	Single family		Multi-family		Mobile Home						
	Units	EDUs	Units	EDUs[2]	Units	EDUs[2]	EDUs[3]	EDUs[4]			
Vista	12,351	12,351	7,449	5,214	1,707	1,195	3,749	721	23,230	5.57 MGD	240
Raceway	455	455	-	-	-	-	1,239	-	1,694	0.52 MGD	307
Buena	6,659	6,659	3,941	2,759	480	336	2,409	161	12,323	2.65 MGD	215
Outside Vista	685	685	50	35	-	-	22	8	750	--	--
TOTALS:	20,150	20,150	11,440	8,008	2,187	1,531	7,418	890	37,997	8.74 MGD	
										Weighted average unit flow =	**236 gpd/EDU**

(1) Number of residential units and locations determined from 2005 water meter accounts
(2) Multi-family and mobile home EDUs calculated as 0.7 times a single family EDU
(3) Commercial EDUs calculated from 2005 water billings assuming a 90% return rate to the sewer system and a unit flow of 220 gpd/EDU
(4) EDUs obtained from water meter billing database (hand-billed accounts)

Table 5-4 indicates the estimated unit flows in previous master plans.

Table 5-4 Historic Unit Flows

Historic Unit Flow	
Report Year	**Gallons per day / EDU**
1982	248
1993	230
2001	226
2007	236

The decrease in unit flows between 2007 and1982, and increase in unit flows from 2001 to 2007, is considered to be too small to attribute to any single change in sewer ordinance EDU calculations or changes in the groundwater infiltration. The Wastewater unit flow has varied with time but has always been ±5.0% of 235 gpd per EDU. This is within the accuracy limits of the flow measurement devices. To assure that the capacity is assessed conservatively, the existing system was evaluated at an EDU loading of 250 gpd/EDU.

5.3.2 INFLOW AND INFILTRATION ANALYSIS

A wet-weather or I&I analysis was used to determine the impacts of defect flow. Flows originating from defects are generally known as defect flows or I&I. Defect flows that occur consistently regardless of precipitation are known as Base Inflow and Infiltration (BII). Defect flows that only occur as a result of a rainfall event are known as Rainfall-Derived Inflow and Infiltration (RDII). This section discusses the methodology used to estimate RDII.

I&I flows originate from defects in the collection system. Each is distinguished by the method by which it enters the collection system. Inflow comes from direct connections to the surface waters. Examples of inflow sources would include: missing clean-out covers; missing manhole covers; damaged manhole rings and cones in watercourses; manholes in street gutters; and roof, patio, refuse bin, storm and other drains that are connected to the sanitary sewer system. Inflow is characterized by a rapid response and diminishment closely following the pattern of the rainfall event. Inflow is most frequently located through the use of smoke testing during dry weather.

Infiltration flows enter the system from indirect connections through the soil/groundwater interface. Examples of infiltration source include cracked pipe, offset joints, manhole/pipe connections, and manhole chimney seals. Infiltration has a slow initial response to rainfall and infiltration defect flows may last for months after a rainfall event. Infiltration defects are best located through the use of CCTV inspections performed during periods of high groundwater.

BII is accounted for in the calculation of ADWF and not derived separately as in previous studies.

RDII flows into the sewer and temporarily elevates wastewater flows in the collection system. The nature of the RDII response is indicative of the type, magnitude, and distribution of the defects in the system. Defect flows were calculated by subtracting the ADWF from wet-weather flow on a selected storm event.

Table 7-2, Observed Defect Flows (by basin and event), describes the impact of several significant storm events that occurred during the flow data period. To consider the most conservative approach to wet-weather influences, the February 23, 2005 event was selected for wet-weather calibration. **Table 7-2** provides the basis of defect flow loading in the existing and future wet-weather models. Calibration of the wet-weather event was also performed using this data.

Table 5-5 indicates the magnitude of RDII during this event.

Table 5-5 Wet Flow Characteristics 2/23/2005

Basin	Dry Weather		Wet Event 2/23/2005			
	ADWF	PDWF	AWWF	AWWF PF	PWWF	PWW PF
Vista	5.57	8.64	10.90	1.96	13.33	2.39
Buena	2.65	4.03	4.45	1.68	5.26	1.98
Raceway	0.52	0.82	1.11	2.13	1.47	2.83
Total	8.74		16.46	1.88		2.40

ADWF = Average Dry-Weather Flow (2007)
PDWF = Peak Dry-Weather Flow
AWWF = Average Wet-Weather Flow (2/23/2005)
AWWF PF = AWWF/ADWF
PWWF = Peak Wet-Weather Flow
PWW PF = PWWF/ADWF
PF = Peak Rate Factor

It is notable that the average daily flow volumes were almost double (1.9 times) the ADWFs. This is an indication of widespread defects. The location of these defects will be narrowed by the implementation of a comprehensive flow-measurement program. The increase is significant and expensive, as these additional flows must be pumped and treated. The wet-weather peak flow rate to dry-weather average flows varied from 2.0 to 2.8.

Figure 5-4, **Figure 5-5,** and **Figure 5-6** graphically show wet-weather event flow, precipitation, RDII defect flow, and ADWF at each meter location.

Figure 5-4 Vista Wet-Weather Response 2/23/2005

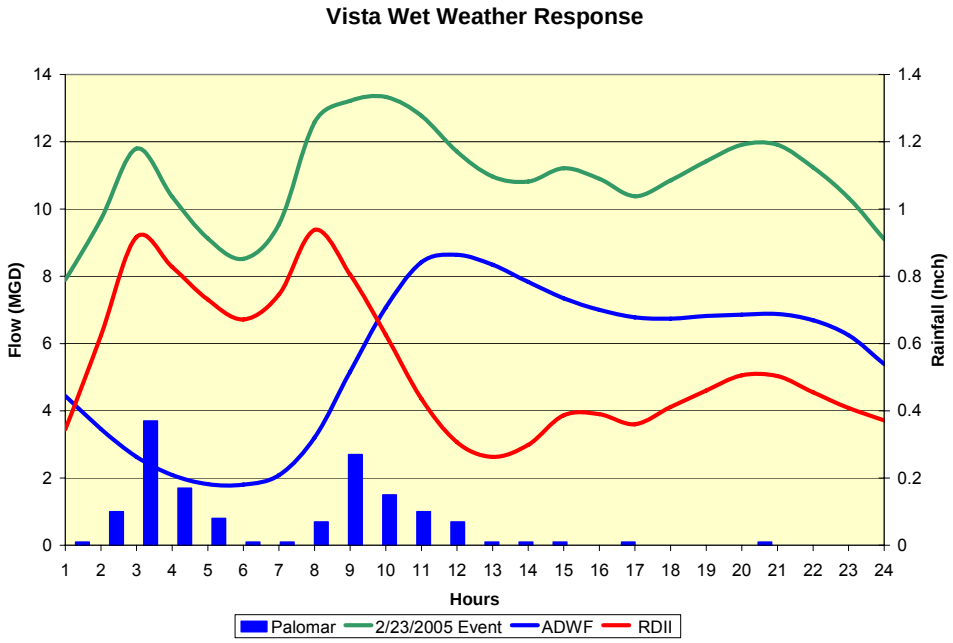


Figure 5-5 Buena Wet-Weather Response 2/23/2005

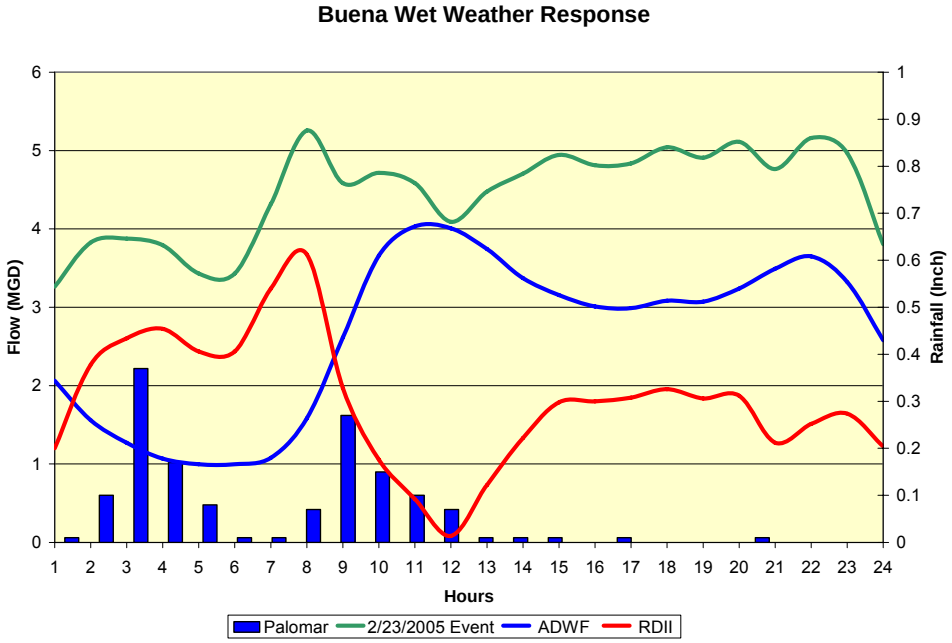
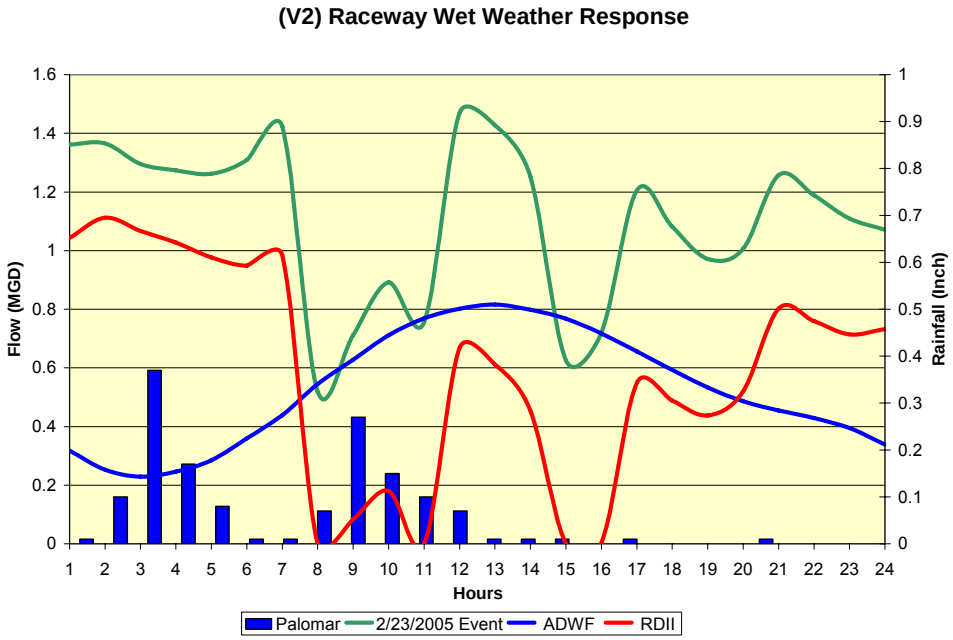


Figure 5-6 V2 Wet-Weather Response 2/23/2005



Note that the proximity of the pump station affects the shape of the curve at V2.

The numerical data associated with the RDII curve are used in the model as a pattern representing hourly changes of flow during a wet-weather event. The volume of defect flow in each basin was calculated separately and is shown in **Table 7-2, Observed Defect Flows.**

5.4 FUTURE SEWER FLOWS

In the development of this Master Plan Update, analyses were performed to determine the sewage-flow generation factors for representative land uses throughout the City's service area. Sewage-flow generation factors are presented as EDUs per acre for a particular land-use category. These values were used to generate the flow per loading unit for use in the sewer collection system model. Average dry-weather flow loads were generated for each parcel by multiplying the unit flows by the corresponding sewage-flow generation factor and the acreage of the parcel. Average dry-weather unit flow of 250 gpd per EDU was predicted for the land use during future sewage-flow generation. Future build-out flows were derived from all parcels as if they were developed to the highest zoning of the property. The source of the land-use categories used to develop sewage-flow generation factors was based on the City of Vista's Zoning and the SANDAG Designated Land Use. A summary of the sewage-flow generation factors developed in the study is presented in **Table 5-6**. Land use is shown in **Figure 5-7**.

Figure 5-7 Existing Land Use

Table 5-6 Land-Use Sewage-Flow Generation Factors

City of Vista Zoning	GPD/Acre	EDU/Ac
SSF Redev	10,000	40
Agriculture - 1	250	1
Commercial and Services	1,500	6
General Office	1,500	6
Industrial	1,000	4
Mobile Home and Trailer Park	1,000	4
Residential - Multi Family	2,625	10.5
Open Space - 0	-	0
Residential - Single Family R-1	1,000	4
Residential - Single Family R-1-B	1,750	7
Residential - Single Family - Low Density	500	2
SANDAG		
Residential - Spaced Rural - 1-10 acre lot	250	1
Residential - Spaced Residential	100	0.4
Residential - Single Family - 2	500	2
Residential - Multi Family - 10.5	2,625	10.5
Mobile Home	1,000	4
Jail/Other		150 gpd/bed
Hotels	13,750	55
Industrial	1,000	4
Transportation	-	0
Commercial	1,500	6
Government	1,500	6
Healthcare		150 gpd/bed
Schools	1,250	5
Golf Course/Recreation	500	2
Park/Open Space - 0	-	0

For future wet-weather flows, the wet-weather flows from 2005 were used and added to the future dry-weather flows. The defect flows were held constant as system deterioration and system rehabilitation were conservatively expected to balance. Consistent flow measurements for pre- and post-rehab will indicate whether this should change in the future. The following sections discuss the allocation of flows in the hydraulic model.

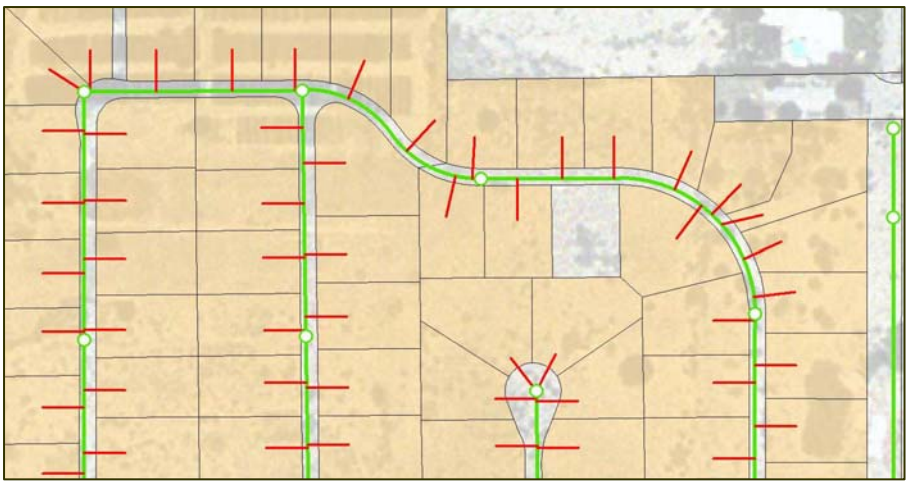
5.5 FLOW MODELING TECHNIQUES

In the previous models prepared for the City/District, many simplifications were made due to limitations of data availability or what hardware/software was available. The flow-modeling techniques employed in the model prepared for this report represent the state-of-the-art. The following sections discuss how the flow was allocated to each of the collection-system pipes.

ADWF is allocated in the model by assigning flow from each individual parcel to the nearest manhole (**Figure 5-8**). In the existing model, wastewater flows were calculated by apportionment based on the water billing information. In previous models, flows were allocated based on the sub-drainage area and then assigned to the connecting node on the trunk.

RDII or defect flows were calculated for each meter basin and were distributed over the nodes within the basin. There are 7,897 nodes in the current model. The previous models allocated flow by EDU or by loading based on pipe diameter. Further wet-weather flow monitoring would allow a more precise allocation of defect flows.

Figure 5-8 Parcel-Based Flow Allocation



5.6 MODEL CALIBRATION RESULTS

Model calibration is the process by which model flows are compared with the observed flows. Iterative adjustments are made to the sewage-flow generation factor volumes, the diurnal curves, or the physical model until the model's predicted hydrographs closely represent the observed flows. The primary purpose of a calibrated model is to provide an accurate representation of the hydraulic characteristics of the collection system.

A well-calibrated model is used as the basis of future modeling. In a calibrated model, the representations of the flow loading and allocation and the collection system facilities are representative of the characteristics in the system.

Figure 5-9 through **Figure 5-14**, and **Table 5-7**, show the comparison of the measured and modeled flows for the dry- and wet-weather conditions.

Table 5-7 Calibration Results

Scenario	Basin	Calibration Results					
		Measured		Modeled		Percent Difference	
		Average	Maximum	Average	Maximum	Average	Maximum
Dry	Vista	5.57	8.64	5.27	8.00	−5.39%	−7.36%
	Buena	2.65	4.03	2.55	3.85	−3.77%	−4.47%
	Raceway	0.52	0.82	0.52	0.81	0.00%	−1.22%
Wet	Vista	10.90	13.33	10.02	13.91	−8.07%	4.35%
	Buena	4.45	5.26	4.43	5.17	−0.45%	−1.71%
	Raceway	1.11	1.47	1.19	1.61	7.21%	9.52%

As shown in **Table 5-7,** all flows were modeled under wet and dry conditions to within less than 10% difference. This is considered an excellent calibration and is well within the accuracy of the flow-measurement data. This level of calibration is an indicator of the reliability and accuracy of the model. It is an indication that the data representing both the conveyance system and the flows injected closely represent the flow measurements.

Figure 5-9 Vista ADWF Calibration

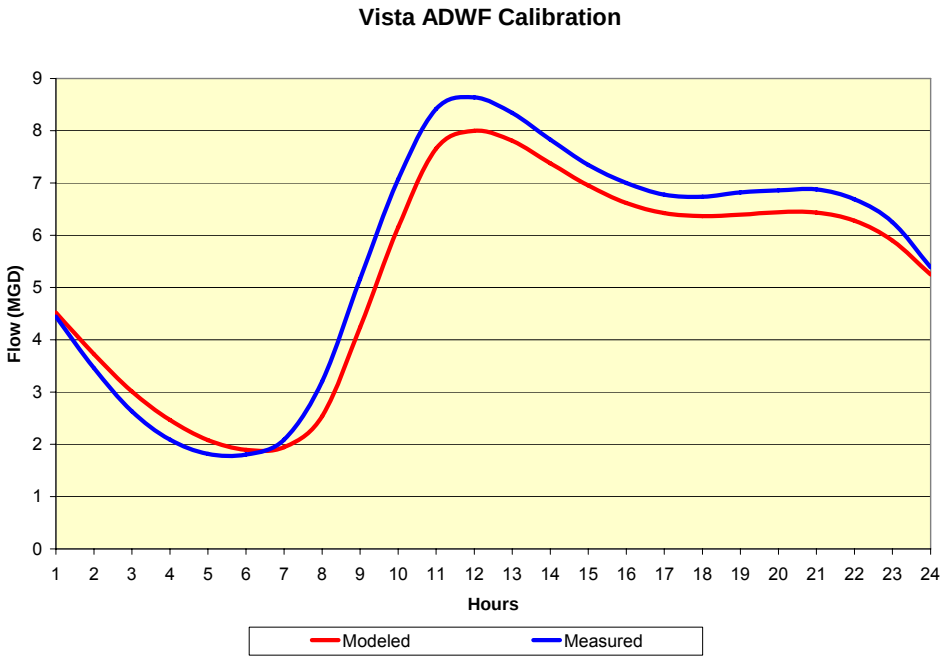


Figure 5-10 Buena ADWF Calibration

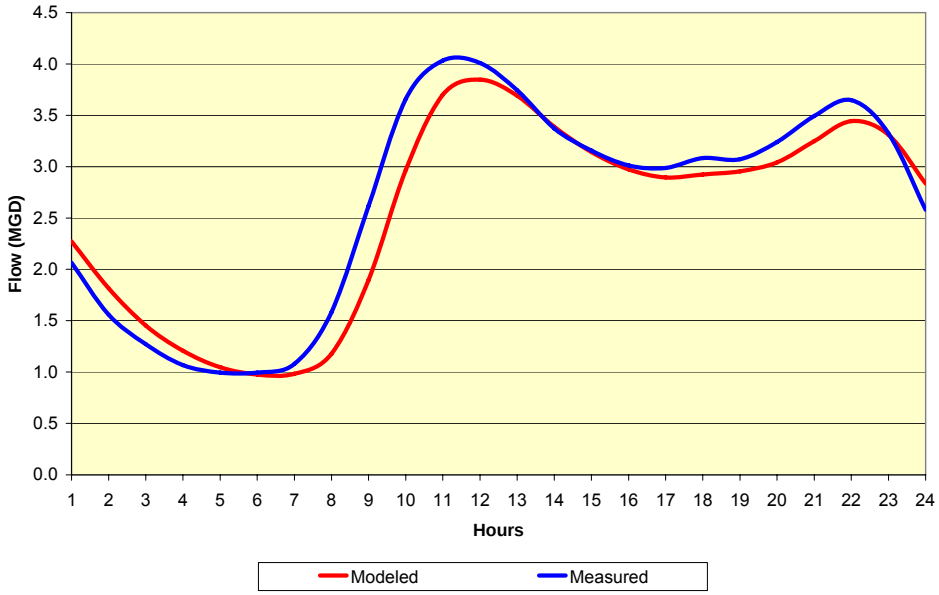


Figure 5-11 V2 ADWF Calibration

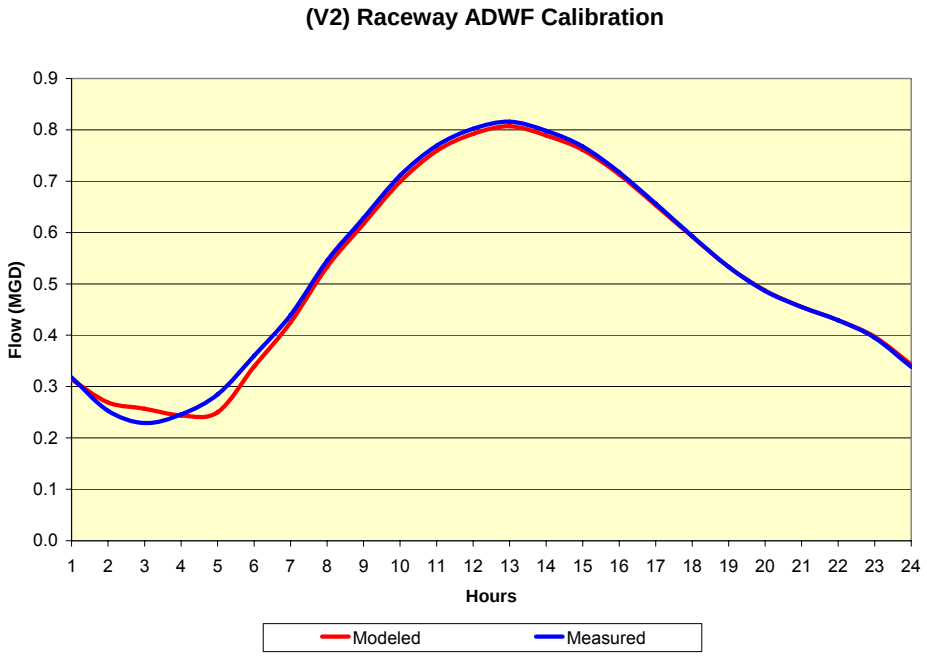


Figure 5-12 Vista Wet-Weather Calibration

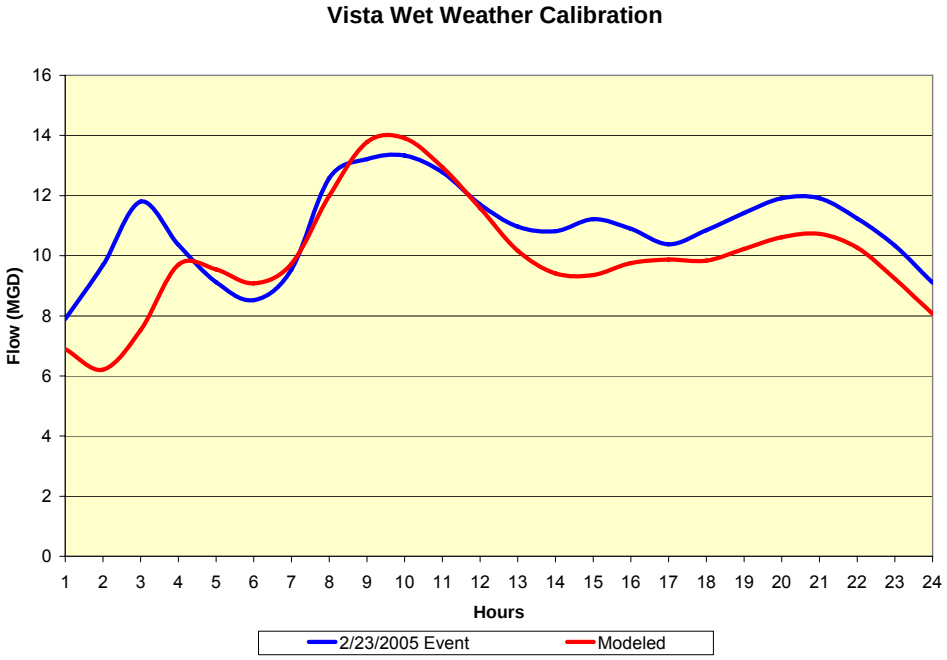


Figure 5-13 Buena Wet-Weather Calibration

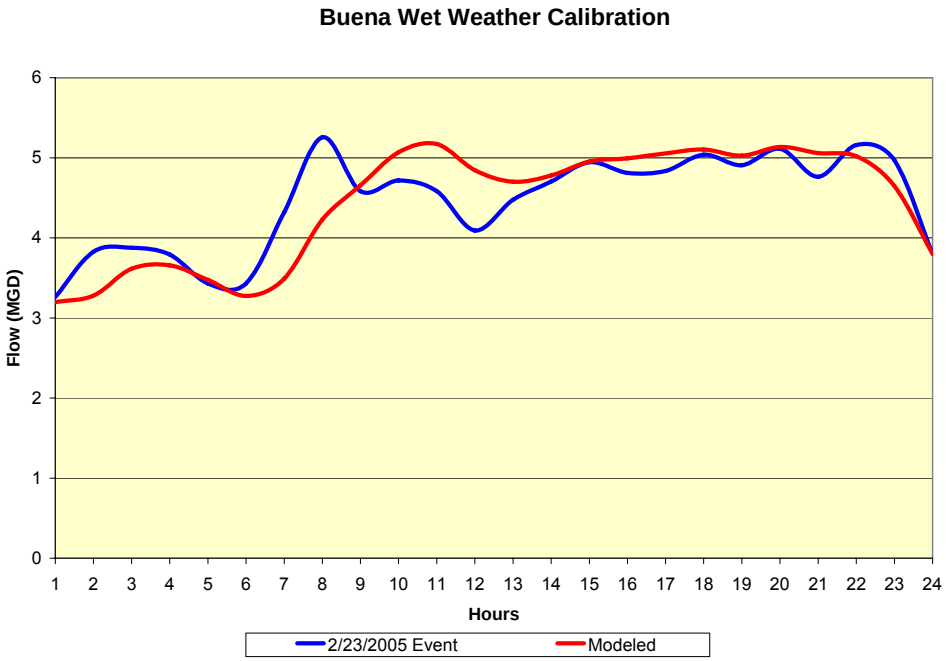
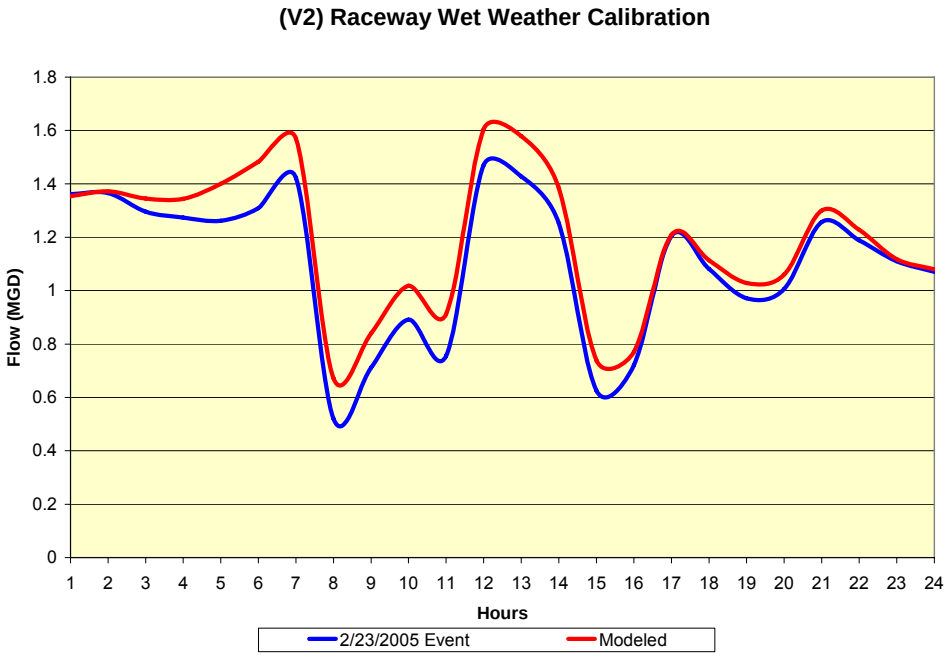


Figure 5-14 V2 Wet-Weather Calibration



In conclusion, the development of the collection-system model and the analysis of dry and wet flows have resulted in a well-calibrated model. The model is now used as the basis of capacity analysis and project development.

6.0 CAPACITY ANALYSIS

By modeling the sewer collection system under a variety of hydraulic conditions, the capacity deficient pipes are identified. These sections of pipe are then used as the basis of "projects" (logically collocated reaches of pipe). These projects are known as Capacity or Replacement projects. Operational projects related to material, minimum upsizing and relocation are discussed in Chapter 7.

6.1 COLLECTION SYSTEM MODELING

Using the information from the GIS (Chapter 4) and the flow measurement data (Chapter 5), a complete hydraulic model of the Vista sewer system was prepared. The hydraulic model calculates the characteristics of flow in each of 7,496 pipes in the system over a specified time period. Each pipe segment is represented by a link while each manhole is represented by a node. This is known as a link-node model.

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 InfoSWMM model was selected for the Vista model since its user interface is based on the City's GIS and its analytical engine is based on the Environmental Protection Agency's Storm Water Management Model (SWMM). The user interface is beneficial to the City since the end-user is already trained and oriented to ESRI's ArcGIS.

The SWMM model was originally created in 1975 to model combined sewer overflows that plagued the country. As a result the capabilities of EPA SWMM include the ability to model the hydraulics of sanitary or storm water conveyance systems. While not used for capacity analysis, SWMM has the ability to model the water quality throughout the collection system. As the regulations governing the operation of sanitary and storm sewers increase, this capability will allow the City/District to assess water quality impacts of various operating strategies. SWMM has recently been updated incorporating over 30 years of user feedback, direct project experience and the latest object oriented programming techniques.

Due to improvements in available input data, software and hardware, the hydraulic model of the collection system is vastly different than previous models prepared to support earlier master plans.

The earlier models represented groups of pipes, or reaches, as single pipes with the hydraulics being determined by the pipe with the least capacity. The collection system was "skeletonized" or simplified to include only large diameter pipes. In addition to the simplification of the conveyance system, flow representations were also simplified. The average dry weather flow (ADWF) volume was calculated and an empirical peaking factor equation was used to determine peak dry weather flow (PDWF) rate. The PDWF rate was used to assess the capacity of the simplified trunk system to accommodate the flow under dry weather conditions. To simulate the effects of rainfall and defect flows, the Peak Wet Weather Flow (PWWF) rates were calculated by applying empirical peaking factors to the peak dry weather flow (PDWF) rate. This rate was then applied at locations along the simplified trunk system to determine the capacity of the system during wet weather events. The representation of flows in this way is considered "static" and represents a conservative approach to determining the system's hydraulic capacity.

Table 1-1 shows the history of modeling detail by the number of pipes considered in each master plan update. The current model evaluates the capacity of all 7,496 pipes in the collection systems using the criteria described in Section 6.2. The comprehensive, up-to-date (May 2007) GIS dataset provided by the City was used as the basis of the conveyance system. Flows from each of the 23,581 parcels in the City of Vista, Buena Sanitation District, and OV basins were entered into one of 7,897 manhole nodes nearest the parcel. The flow from each parcel is represented as a hydrograph that presents a varying flow based on the time of day. The representation of the flow hydrograph for the ADWF/PDWF condition was based on the observed variation of flow rates from the flow measurement sites. Residential, industrial and commercial parcels have different flow patterns and are discussed in Chapter 5 – Wastewater Flows. Peak Wet Weather Flows were derived from observed conditions during the February 23, 2005 storm event. This representation of defect flow, RDII was used to assess the ability of the system to convey flows without overflow.

SWMM performs its analysis of flow routing using the St.Venants equation. Hydraulic calculations were performed for every 10 seconds. SWMM's analytical engine is fully dynamic and can accurately predict surcharge, backflow and overflow conditions. Through the use of improved data representing the collection system and flow variations, combined with the SWMM analytical engine, a more complete determination of hydraulic capacity has been performed for all flow scenarios. A complete description of the capacity analysis and cost estimation techniques follows.

6.2 PERFORMANCE CRITERIA

This section describes the technical basis of determining adequate pipeline operating capacity and design criteria for the capacity analysis. The capacity analysis defines minimum pipe sizing and project prioritization.

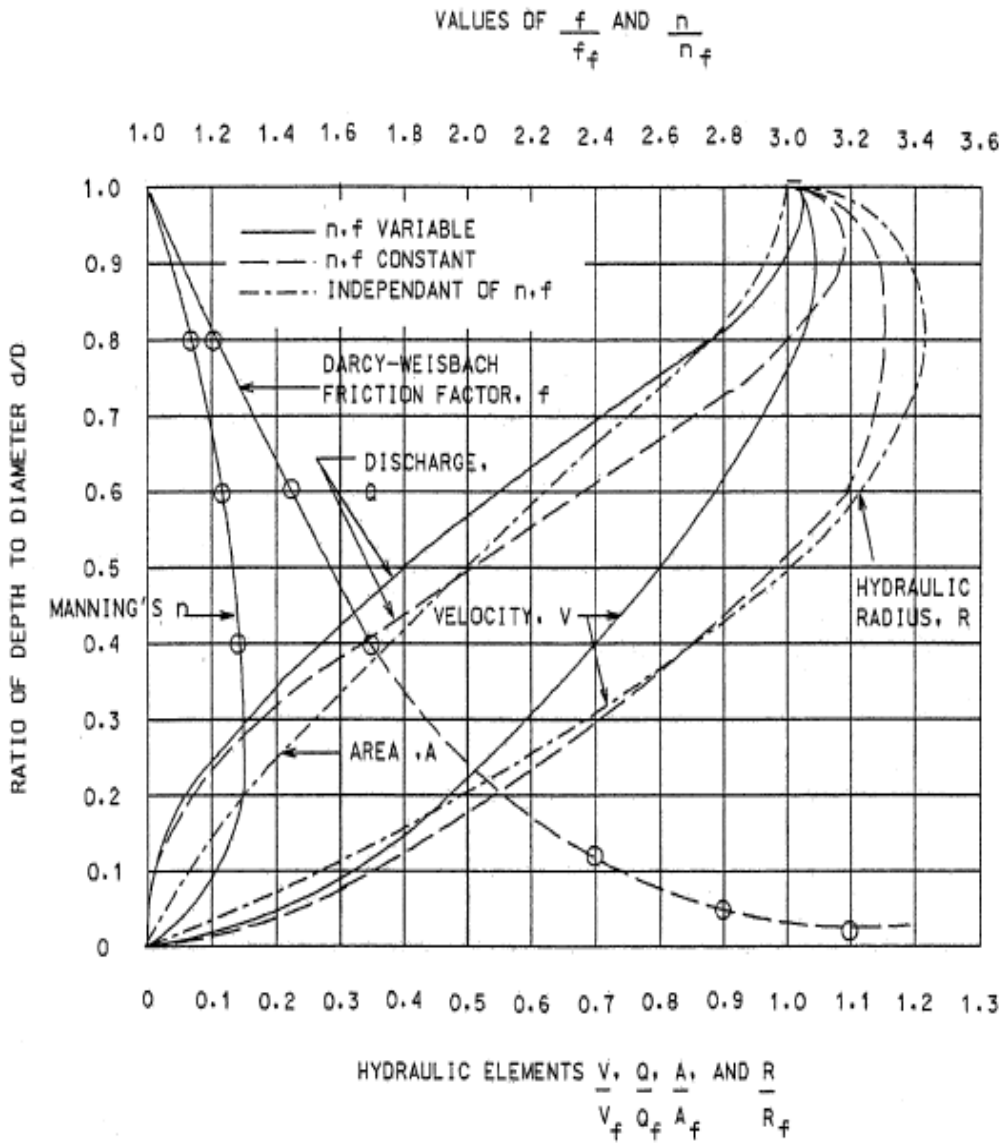
One purpose of a capacity analysis is to evaluate the hydraulic capacity of the collection system under current and future flow conditions. Criteria must be established to (1) Define the maximum allowable depth/Diameter ratio, (d/D), that is used as a threshold for further investigation and (2) the Design Criteria used for sizing future facilities. There are inherent allowances that are made to reflect the difference in installed or planned facilities.

The value used for the threshold or "trigger" value in 2001 was reduced from 0.85 in the 2001 report to 0.80 in the current report.

Figure 6-1 shows the depth/Diameter ratios and the corresponding Qpartial/Qfull values for circular pipes with a constant friction factor as used in the capacity analysis. As shown the pipe is flowing at 99% of its full pipe flow capacity when the depth is 80% of full pipe. In areas between 80% and 100% of depth the hydraulic regime is unstable. The use of the 0.80 value is considered more conservative than the 0.85 value. In addition, the InfoSWMM model reports the partial flow ratio of full flow in q/Q. In instances where the d/D is greater than 0.80 and the q/Q < 0.99 the line is surcharging because of a downstream restriction. The projects were reviewed and those with d/D >0.80 and q/Q <0.99 were removed from a recommended project.

Section 4.2.9 of the WAS suggests using a depth to diameter ratio of 0.5/0.75 depending on pipe diameter for Peak Dry Weather Flow (PDWF). We are using a depth to diameter ratio of 0.80 for conservative capacity evaluation of the system during Peak Wet Weather Flow (PWWF). The system has high levels of defect flow that may be reduced as rehabilitation continues. If the defect flow is reduced significantly in future years, the WAS standard may become appropriate.

Figure 6-1 Comparison Depth Flow Relationship



Constant n values were used in the capacity analysis. The remainder of the values for the Design Criteria are the same as they were in the 1993 and 2001 Master Plan Updates. These are presented in **Table 6-1**.

Table 6-1 Pipe Design Criteria

PIPE PARAMETER	VALUE
Minimum Velocity	**2 fps**
Manning's Roughness Coefficient	**0.013**
Force Main Velocity	**3 - 5 fps**
Minimum Pipe Size	**8-inch**
Threshold for Depth/Diameter in Peak Wet Weather Flow	**0.80**
Peak Wet Weather d/D: 12-inch and smaller	**0.5**
Peak Wet Weather d/D: larger than 12-inch	**0.75**

Water use and the corresponding sewer flows vary throughout the day. Pipelines are designed to convey the peak flow. Peak flows for the Vista and Buena System were derived from flow measurement information. A full discussion of the findings regarding the Dry and Wet Peak Flow Rates are discussed in Chapter 5 – Wastewater Flows.

It is further suggested that the City/District adopt more comprehensive design standards as required by the WDRs. We recommend the San Diego Water Agencies Standards as a comprehensive approach to promoting consistency in planning facilities throughout the County.

6.3 BASIS OF PIPE COSTS

To estimate the financial resources required for the replacement pipelines identified in this section, project cost estimates were made. The Engineering News Record, Construction Cost Index (ENR CCI) for Los Angeles in April 2006 is 8555. In the future all construction cost estimates should be adjusted using the current ENR CCI.

6.3.1 PIPELINE REPLACEMENT COSTS

Pipeline replacement costs were estimated from previous planning documents and from recent bid tabulations. Note that these are estimated costs for conceptual projects. The actual costs for design and construction may vary due to site specific requirements. The following table indicates the unit costs that were used as the basis of the project cost estimates.

Table 6-2 Replacement Pipe Unit Cost Estimates

Diameter (Inch)	Construction Costs ($15/In/LF)	Capital Costs[1] ($22.50/In/LF)	Capital Costs[2] ($29.25/In/LF)
8	$120	$180	$234
10	$150	$225	$293
12	$180	$270	$351
15	$225	$338	$439
18	$270	$405	$527
21	$315	$473	$614
24	$360	$540	$702
27	$405	$608	$790
30	$450	$675	$878
33	$495	$743	$965
36	$540	$810	$1,053
42	$630	$945	$1,229

[1]Includes 50% for technical services, field engineering and contingencies
[2]Includes additional 30% for easement contingencies

Technical services, field engineering and contingencies are estimated to equal 50% of the construction costs. These are described as follows:

Technical Services – 25%

- Preparation of environmental documentation
- Processing of approvals and permits
- Preliminary planning and design documents
- Final Design/Preparation of Plans, Specifications and Project Manuals
- Preparation of As-Builts
- Surveying

Field Engineering – 15%

- Contract Administration
- Coordination with other agencies
- Administration of geotechnical, archaeological, ROW and other outside services
- Construction Inspection

Contingencies – 10%

Easement Contingency [7]– 30%

- Permitting
- Special Construction
- Realignment

[7] Provided by staff and used only for projects located in potentially sensitive areas

An example of cost estimation is shown in **Table 6-3** below.

Table 6-3 Project Cost Calculation

Model Pipe Id	Vista Pipe Id	Length (ft)	Upsize Dia (in)	Easement Issues	Project Name	Unit Construction Cost ($15/In/LF)	Construction Cost ($)	Capital Cost[1] ($22.50/In/LF)	Capital Cost[2] ($29.25/In/LF)
1535	B10089.00-B10092.00	342	15	Yes	B4	$225	$76,950	$115,425	$150,053
4263	B10093.00-B10094.00	349	15	No	B4	$225	$78,525	$117,788	N/A

[1]Includes 50% for technical services, field engineering and contingencies
[2]Includes additional 30% for easement contingencies

Capital Cost[1] is the total project cost if there are no easement issues. Capital Cost[2] is the total project cost if there are easement issues.

6.4 EXISTING CAPACITY ANALYSIS

An understanding of the hydraulic condition of the existing system is essential to identify existing system related capacity deficiencies and to help prioritize recommended system improvements resulting from the ultimate system capacity analysis. The InfoSWMM hydraulic model developed as a part of this Master Plan was used to perform the capacity analysis of the existing collection system. Capacity analysis was performed for various flow scenarios including existing average and peak dry weather and wet weather flow scenarios. The existing flows were calibrated with the measured flows for all the scenarios before performing the existing system capacity analysis. **Table 6-4** presents the summary of existing average and peak dry weather and wet weather flows.

Table 6-4 Existing Wastewater Flows

Flow Scenarios	Dry Weather Flow		Wet Weather Flow	
	Average Flow (MGD)	Peak Flow (MGD)	Average Flow (MGD)	Peak Flow (MGD)
Vista	5.27	8.00	10.02	13.91
Buena	2.55	3.85	4.43	5.17
Raceway	0.52	0.81	1.19	1.61
OV Flow Transfer Obligations	2.15	2.5		5.375

Improvements were recommended based on the evaluation of the existing system during peak hours of wet weather conditions. Capacity analysis of open channel systems is generally based on the consideration of the depth of flow with respect to the diameter of the pipe. A capacity deficient section along a pipeline is recommended as a capacity related replacement project if depth-to-diameter ratio (d/D) exceeded the performance criteria established to define the projects during the wet weather flow scenario. A d/D ratio of 0.80 was used as a performance criteria threshold as discussed in Section 6.2.

Capacity deficient pipes were upsized in order to meet the design criteria of 50% full for the pipes with diameter less than or equal to 12-inch and 75% full for the pipes with diameter greater than 12-inch during peak wet weather flow. Capacity deficient pipes in close vicinity were grouped to define the potential projects and often include single pipe segments that do not have hydraulic restrictions. The pipes were grouped to create logically constructible projects. By doing this, material and age are consistent throughout an entire reach and there are fewer field coordination issues regarding protecting pipe in place.

6.5 FUTURE SYSTEM CAPACITY ANALYSIS

Methodology used during existing system capacity evaluation was adopted to identify and define capacity related replacement projects for the future collection system. InfoSWMM hydraulic model was used to perform the capacity analysis of the future collection system for various flow scenarios including ultimate average and peak dry weather and wet weather flow scenarios. **Table 6-5** presents the summary of ultimate average and peak dry weather and wet weather flows.

Table 6-5 Ultimate Wastewater Flows

Flow Scenarios	Dry Weather Flow		Wet Weather Flow	
	Average Flow (MGD)	Peak Flow (MGD)	Average Flow (MGD)	Peak Flow (MGD)
Vista	7.90	12.12	13.23	20.19
Buena	3.82	5.78	5.77	8.41
Raceway	0.91	1.42	1.59	2.57
OV Flow Transfer Obligations	2.15	2.5		5.375
OV1	0.23	0.35	0.34	0.55
OV2	0.15	0.23	0.22	0.35
OV3	0.003	0.005	0.007	0.011
OV4	0.06	0.09	0.10	0.16
OV5	0.32	0.50	0.54	0.86
OV6	0.23	0.36	0.27	0.43
OV TOTAL ADWF	0.99			2.36

Maximum anticipated peak flow factor is 1.60.

Improvements were recommended based on the evaluation of the future system during peak hours of wet weather conditions. A capacity deficient section along a pipeline is recommended as a capacity related replacement project if depth-to-diameter ratio (d/D) exceeded the threshold performance criteria of d/D greater than or equal to 0.80 and a q/Q ratio of 0.99.

Renegotiation of lower flows in the Oceanside flow agreement with has been recommended in the past and is supported by these findings. This may reduce overall future costs of downstream facilities.

7.0 OPERATIONAL ANALYSIS

Pipe capacity deficiencies may be restored by pipeline replacement (discussed in Chapter 6) or by pipeline rehabilitation to reduce the extraneous flows that enter the collection system through defects. These extraneous flows are known as inflow and infiltration (I&I), or defect flows. This chapter discusses recommended rehabilitation programs and their estimated costs. To further focus the rehabilitation efforts, additional operational processes were reviewed. This included the City's:

- Flow Measurement Plan
- Pipeline Relocation Program
- Pipeline material
- CCTV Sewer Inspection Program,
- Hot Spots (areas of frequent maintenance),
- Upsizing Minimum Pipe Sizes and
- Age or Useful Life Calculations.

7.1 INFLOW AND INFILTRATION PROGRAM

During the rainfall event that occurred on February 23, 2005, approximately 8.0 million gallons of inflow and infiltration was observed. Defect flows were added to the model as the basis for determining wet weather capacity requirements (Chapter 5 Wastewater Flows, Chapter 6 Capacity Analysis). This data provides an overview of the amount of inflow and infiltration in the three measured basins. These basins are the Vista, Buena and Raceway basins. Targeted wet weather flow measurement is proposed to more narrowly identify the defect flow distribution.

A cornerstone of the Master Plan Update is the Inflow and Infiltration Reduction Program. This program requires an overall approach to condition assessment, including flow measurement, CCTV Inspection, smoke testing and analysis of pipeline materials and age.

7.1.1 CONDITION ASSESSMENT PROGRAM

To focus limited resources on the most problematic areas, a full condition assessment program should be conducted. This would include an updated Temporary Flow Measurement Program, smoke testing, physical inspection and CCTV of the entire system. The maximum estimated costs associated with this program are shown in **Table 7-1**.

Table 7-1 Condition Assessment Costs

Component	Estimated Cost	Cost/Foot
Flow Measurement	$ 295,983	$ 0.18
Smoke Testing	$ 822,174	$ 0.50
Physical Inspection	$ 548,116	$ 0.33
CCTV	$ 2,055,435	$ 1.25
Program Mgmt	$ 558,256	$ 0.34
CA Total	$ 4,279,964	$ 2.60

7.1.2 PRELIMINARY VISTA FLOW MEASUREMENT PLAN

The foundation of inflow and infiltration reduction programs is the preparation of a Flow Measurement Plan. These plans provide specific locations for flow meters that allow future isolation of areas with high defect flows. These sub areas allow the City/District to focus resources in areas of observed high defect flows. Additionally, the wet weather flow measurements provide insight regarding the dominant defect type which tailors subsequent field investigations. In areas of observed high inflow, dry weather smoke testing identifies public and private defects and illicit connections. In areas of observed high rainfall derived inflow and infiltration (RDII), televised inspection during wet weather and high groundwater levels provides more specific pipe condition assessments. The scope of the Master Plan provided for the preparation of a Flow Measurement Plan.

The following text is excerpted from the Preliminary Flow Measurement Plan presented earlier to the City/District. Lack of rainfall has caused this plan to be superseded by the Full Flow Measurement Plan presented in Section 8.2.2

The purpose of the Flow Measurement Plan is to describe the location of temporary flow meters throughout the collection system based on:

a. The observed wet weather flows under existing conditions.
b. System characteristics.
c. Safety factors.
d. Available budget.

To further isolate RDII, a two phase flow measurement approach is recommended. The first phase involves selecting fewer flow measurement sites based on the available budget for preliminary flow measurement study. The second phase will involve a more detailed flow measurement study wherever necessary at a micro level. More flow meters will be installed as a part of the second phase.

Thirteen initial flow measurement sites are selected during the first phase. Each initial site is selected based on observed defect flows per unit inch of rainfall per unit foot of pipeline, upstream pipe length, safety factors (like traffic, depth of manhole, etc), and available budget for the task.

Defect flows per unit inch of rainfall per unit foot of pipeline were calculated during four highest storm events using the available Encina flow data for all three major basins (Vista, Buena, and Raceway). Defect flow calculations are presented in **Table 7-2**.

Table 7-2 Observed Defect Flows

Basin	Length of Pipeline (ft)	Storm Date	Rainfall (inch)	Defect Flow (MGD)	Defect Flow (gpd)/ inch of rainfall/ ft of pipeline
Vista	925,159	23-Feb-05	1.42	5.33	4.05
Vista	925,159	10-Jan-05	1.40	4.92	3.80
Vista	925,159	19-Feb-05	1.40	3.39	2.62
Vista	925,159	11-Jan-05	1.38	5.79	4.53
				Vista Max =	**4.53**
Buena	507,885	20-Oct-04	1.88	0.71	0.74
Buena	507,885	17-Oct-04	1.55	0.32	0.41
Buena	507,885	05-Apr-06	1.47	0.38	0.51
Buena	507,885	23-Feb-05	1.42	1.94	2.70
				Buena Max =	**2.70**
Raceway	82,365	05-Apr-06	1.47	0.08	0.64
Raceway	82,365	23-Feb-05	1.42	0.67	5.73
Raceway	82,365	10-Jan-05	1.40	0.58	5.03
Raceway	82,365	19-Feb-05	1.40	0.26	2.28
				Raceway Max =	**5.73**

Based on the defect flow calculations and the length of pipelines in each basin, eight sites in Vista basin and three sites in Buena basin are selected. Although defect flows in Raceway basin are comparatively higher, only two sites are selected because of the relatively smaller length. Higher defect flows in Raceway basin may also be occurring due to night time commercial and industrial flows.

These sites are selected at locations near the lower reach of the major trunks that are also capacity deficient under the existing conditions. Available budget and other safety factors like traffic and depth of the manhole were also considered while selecting the sites.

Pipelines upstream of the flow measurement sites were identified by using the upstream network trace tool in InfoSWMM modeling software. Upstream pipelines contributing flow to the flow measurement sites were used to generate flow basins for each meter location.

Table 7-3 presents summary information of thirteen primary meters that will be used to measure the collection system's response to wet weather events.

Table 7-3 Sub Basin Characteristics (Preliminary Flow Measurement Plan)

Model Id	Manhole Id / Location	Major Basin	Flow Meter	Upstream Pipe Length (ft)	Upstream Pipe Diameter (inch)
Temporary Flow Meters					
4727	V32T395	Vista	FM1	163,590	21
7384	V32T420	Vista	FM2	158,966	18
7385	V24101	Vista	FM3	182,460	27
3670	V05104	Vista	FM4	36,745	8
4710	V32T225	Vista	FM5	107,276	21
2495	V34109	Raceway	FM6	26,723	12
3300	V34110	Raceway	FM7	55,569	15
2840	V33174	Buena	FM8	118,879	18
2552	B01127	Buena	FM9	250,435	21
4220	V16042	Vista	FM10 (Optional)	86,050	15
1824	B08025.A	Buena	FM11 (Optional)	137,459	15
4747	V32T063	Vista	FM12 (Optional)	150,155	36
3672	V05046	Vista	FM13 (Optional)	28,005	12
Existing Flow Meters					
N/A	College/SR-78	Vista + Oceanside	V1	925,159	N/A
N/A	Near V1	Oceanside	OS1	N/A	N/A
N/A	Raceway PS	Raceway	V2	82,365	N/A
N/A	Buena PS	Buena	B2	507,885	N/A
N/A	Jefferson/SR-78	Vista + Oceanside + Carlsbad	BVPS	938,209	N/A

See section 8.4 for additional flows from Carlsbad.

Based on the preliminary wet weather analysis, upstream pipe lengths, safety factors, and available budget, Dudek recommended thirteen flow measurement sites to be selected in first phase of the flow measurement plan. Eight sites are in Vista basin, three sites in Buena, and two in Raceway basin.

To determine the distribution and magnitude of inflow and infiltration within the collection system, and further prioritize the rehabilitation programs, an intensive Sewer Flow Measurement Program has been defined. This program should be implemented as soon as the probability of rainfall increases.

7.1.3 REVISIONS TO THE PRELIMINARY FLOW MEASUREMENT PROGRAM

The Preliminary Flow Measurement Program was based on available funding for the budget year 2006/2007. The program as presented was limited to an initial screening of the system followed by more intensive flow measurements in the areas identified as having notable defect flows. **Figure 3-2**, **Vista Historical Monthly Rainfall Totals**, shows that the 2006/2007 budget year passed with significantly less rainfall than previously observed in the system.

To properly plan a Full Flow Measurement Program, we recommend that the number of flow meters be increased to 33 for a minimum period of 60 days. This number of meters is selected based on an average sub-basin size of 50,000 linear feet of pipe. This length improves data quality at the measurement location and provides a logical size of basin for further physical inspection techniques. The increased number of flow meters and the duration increases the costs to approximately $300,000 dollars. The advantage is that this additional investment potentially focuses the location of CCTV, smoke testing and additional physical inspection that would be required if adequate rainfall and measurable defect flow responses occur during the measurement period. If the program is not possible, or significant rainfall does not occur, the smoke testing and CCTV of the system will not be optimized through dominant defect determination. This will reduce the overall efficiency of the physical inspection program.

Table 7-4 presents summary information of the thirty-three (33) proposed temporary meters that will be used to measure the collection system's response to wet weather events. **Figure 7-1** shows meter locations for both the proposed temporary flow meters and the existing permanent flow meters.

Table 7-4 Sub Basin Characteristics
(Full Flow Measurement Plan)

Model Id	Manhole Id / Location	Major Basin	Flow Meter	Upstream Pipe Length (ft)	Upstream Pipe Diameter (inch)
Proposed Temporary Flow Meters					
4727	V32T395	Vista	FM1	45,598	21
7384	V32T420	Vista	FM2	41,929	18
7385	V24101	Vista	FM3	49,742	27
3670	V05104	Vista	FM4	36,745	8
4715	V32T220	Vista	FM5	59,589	21
2495	V34109	Raceway	FM6	26,723	12
3300	V34110	Raceway	FM7	55,569	15
2840	V33174	Buena	FM8	31,035	18
2552	B01127	Buena	FM9	57,598	21
4220	V16042	Vista	FM10	40,144	15
1824	B08025.A	Buena	FM11	45,509	15
4747	V32T063	Vista	FM12	57,287	36
3672	V05046	Vista	FM13	28,005	12
1532	B11062	Buena	FM14	38,123	8
1492	B13231	Buena	FM15	53,828	10
435	V33135	Buena	FM16	32,612	12
2330	V33140	Buena	FM17	55,232	12
662	B03183	Buena	FM18	41,996	8
1403	B02032	Buena	FM19	41,225	15
767	B14239	Buena	FM20	54,019	12
515	B07059	Buena	FM21	56,043	18
4602	V19110	Vista	FM22	45,906	12
6422	V02082	Vista	FM23	47,687	8
5257	V26237	Vista	FM24	54,617	8
6338	V24059	Vista	FM25	62,420	12
6302	V30059	Vista	FM26	51,835	10
6396	V32T083.A	Vista	FM27	41,033	36
6209	V23231	Vista	FM28	47,235	12
4693	V21191	Vista	FM29	44,851	12
4260	V16050	Vista	FM30	40,632	15
1747	V11123	Vista	FM31	30,662	12
1727	V10141.C	Vista	FM32	38,276	15
1744	V10142	Vista	FM33	49,054	18
Existing Permanent Flow Meters					
N/A	College/SR-78	Vista + Oceanside	V1	925,159	N/A
N/A	Near V1	Oceanside	OS1	N/A	N/A
N/A	Raceway PS	Raceway	V2	82,365	N/A
N/A	Buena PS	Buena	B2	507,885	N/A
N/A	Jefferson/SR-78	Vista + Oceanside + Carlsbad	BVPS	938,209	N/A

Figure 7-1 Flow Measurement Locations

7.1.4 CONTRACTUAL FLOW MEASUREMENT CONSIDERATIONS

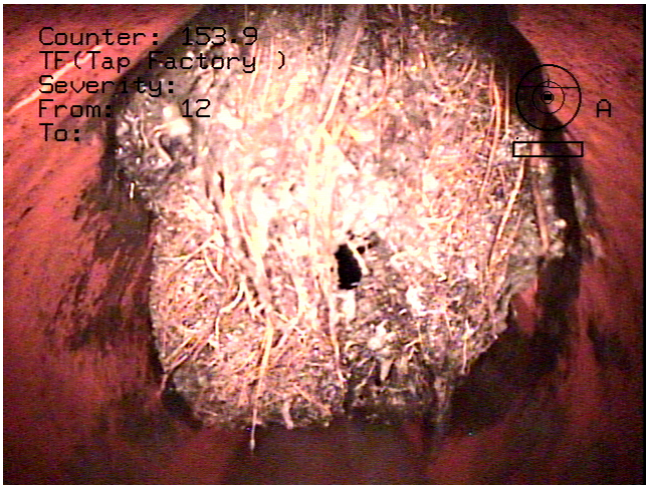
In addition to the use of flow measurement for the purposes of determining defect flows, flow measurement can also be used to remove uncertainty of flow based contractual limits. The Vallecitos Water District (VWD) Flow Transfer Agreement makes flow measurement optional. If the flow meters are installed, then the costs for installation and maintenance would be the responsibility of VWD. In the event that the flow meters are not installed, EDU based flows are used for billing purposes.

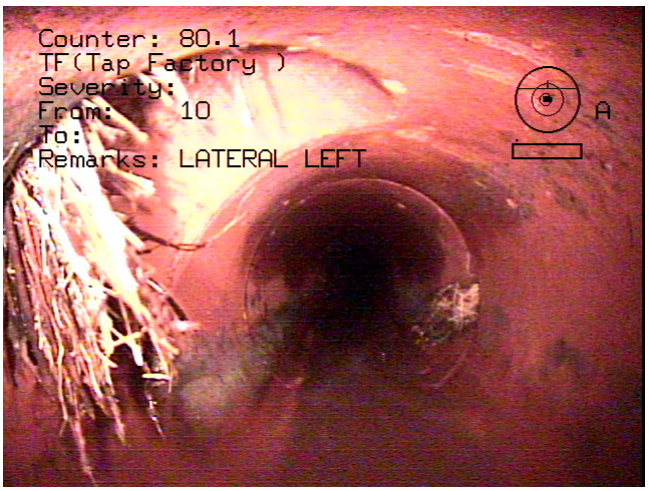
Another style of flow transfer agreement exists between Oceanside and Vista. In the current Oceanside/Vista agreement, flow measurement is again optional, but it is Vista's responsibility to install and maintain the OS1 flow meter. Oceanside is currently planning to install two flow meters in the OV5 basin. When no meters are installed, EDU based flow estimates are used.

7.1.5 CCTV SEWER INSPECTION PROGRAM

One of the primary tools in the investigation of operational considerations in the collection system is the closed circuit television (CCTV) inspection program. The City of Vista is aggressively pursuing updating its CCTV program to include connections between the Citywide GIS and the Accela Asset Management System. The City is implementing a modified PACP condition coding scheme that will allow accurate estimation of pipeline deterioration rates. This information will help prepare predictive maintenance scheduling. **Figure 7-2** shows a variety of problems that may be documented with the CCTV program.

Figure 7-2 Example Vista CCTV Captures





As shown, roots entering the pipe could potentially cause a blockage that may result in a spill. A CCTV program should be implemented that addresses the requirements of the WDR. Currently, the City's budget reports televising approximately 52,800 feet, or 10 miles, of sewer main per year. This includes acceptance reviews in newly installed mains (30 year review cycle). The CCTV database for the City reports that, since June 1992, over 217,791 feet, or 40 miles, of sewer main has been assessed for condition. In 15 years, this accounts for only 13% of the collection system. This would indicate that the actual CCTV program will inspect the entire system in about a hundred years.

Table 7-5 indicates the recorded results of the CCTV pipeline inspections.

Table 7-5 CCTV Pipe Inspection Results

Assessment Criteria	Length (Ft)	% of Inspected	% of Total
Bad	104,966	48%	6%
Good	112,825	52%	7%
Total CCTV	217,791	100%	13%
Unknown	1,454,444		87%
Total	1,672,235		100%

It is clear from this table that nearly 50% of inspected pipes are in bad condition. Furthermore, 85% of the system has not been inspected. Under the new WDRs, a complete condition assessment of the entire system is required.

Additionally, the CCTV database contains information on over 1,174 manhole inspections that were also conducted in the past 14 years. **Table 7-6** lists the findings of the manhole inspections.

Table 7-6 Manhole Inspection Results

Assessment Criteria	Number	% of Inspected	% of Total
Bad	419	35.7%	5%
Poor	3	0.3%	0%
Good	752	64.1%	10%
Total Inspected	1,174	100%	15%
Unknown	6,690		85%
Total	7,864		100%

Currently, the CCTV operations are being updated with the latest equipment, software and coding schemes. With these improvements, it is still likely that the City will need to contract CCTV inspections in order to complete a condition assessment of the entire system.

While not specifically stated in the WDR, many utilities are targeting a 10-year CCTV cycle for their systems, or 10% per year. Given the age and the observed condition of this collection system, Dudek recommends that the City/District implement a 5-year program for complete initial inspection of the system.

To review the system on a five year cycle would require video inspection of approximately 227,000 feet per year in Vista and 106,000 feet per year in Buena. **Table 7-7** shows the annual costs associated with the CCTV program.

Table 7-7 Estimated Annual CCTV Costs

	Vista	Buena	Total
Length of System (Ft)	1,135,724	532,691	1,668,415
CCTV Length/Year	227,145	106,538	333,683
CCTV Costs ($1.25/ft)	$ 283,931	$ 133,173	$ 417,104

7.2 SMOKE TESTING

Smoke testing of sewers is used to locate and identify inflow defects. Inflow defects are those that have a direct connection to the surface. When rainfall occurs, it quickly enters the collection system, taking up capacity that is needed to convey wastewater flows. Smoke testing involves the introduction of smoke into the collection system with low pressure blowers. Smoke then travels through the pipes and other openings to the surface. Smoke quickly identifies storm drain cross connections to the wastewater system, illegally connected roof, patio and area drains, broken lateral connections and other forms of direct connections. Defects are prioritized by reviewing photographs and observations taken during the course of the smoke testing.

Since smoke may enter the home through faulty plumbing, smoke testing requires significant public outreach. Affected homes and business are alerted during the smoke testing phase through the use of hand-bills or flyers. Additionally the fire, police and Public Works dispatchers are notified daily of the location of the smoke crews.

The photograph in **Figure 7-3** shows smoke coming from a roof drain and from the flower bed. These types of connections to the wastewater system create additional costs for pumping and treatment and should be eliminated.

Figure 7-3 Typical Smoke Testing

7.3 HOT SPOTS

As part of the Preventative Maintenance Program implemented by the City and District, certain pipelines have been identified as "Hot Spots". The total length of pipe in these high maintenance areas is 63,700 feet, or 3.8% of the system. These areas require maintenance more often to assure that the pipes flow freely. They are often associated with root intrusion and/or fats, oil and grease. The Hot Spot program is operationally separate from the remainder of the Preventative Maintenance Program. Separate processes identify, schedule and assign work associated with Hot Spots. Potential operational improvements could be made by consolidating work assignments through a single business process.

Figure 7-4 shows the locations of Hot Spots throughout the City/District.

Figure 7-4 Condition Assessment – CCTV / Hot Spots

7.4 PIPELINE RELOCATION PROGRAM

As part of the WDR, agencies must prioritize the relocation of pipes from watercourses and difficult-to-maintain easements to more accessible/maintainable areas. There are some existing pipelines in both the City and District that fall into this category, but maintenance or replacement would have a significant environmental impact. Often times, pipes located in these areas are subject to high groundwater and root intrusion. Furthermore, substandard maintenance of these lines raises concerns that blockages caused by material buildup could result in a sewer spill. As many of these facilities are located on or near private property or waterways, the environmental and political consequences of an overflow would be high. These areas represent a major liability for the City/District.

Recommended CIP projects in this category have additional costs associated with the difficulty of relocation and environmental costs. These have been included in the cost estimates prepared for these projects.

The City/District should embark on an aggressive program of relocation of these pipelines. This would include the establishment of utility easements and negotiations with developing properties to prevent where and when possible.

7.5 PIPELINE MATERIAL

The construction of sanitary sewer systems has changed little in the past four thousand years. The earliest collection systems in the Indus civilization were drained by terra cotta pipes. These are the early ancestors of our vitrified clay pipe (VCP). The primary change over the last 100 years has been the introduction of a number of modern materials. The materials in use closely reflect the dominant manufacturing materials of the day. Today almost all sewer pipe installed in the collection system is plastic, made of polyvinyl chloride (PVC). Both VCP and PVC are considered inert materials that are not affected by corrosion and most chemicals. As a result VCP and PVC are both considered reliable pipeline materials. VCP installed prior to 1963 was installed with short lengths, open joints and two foot manholes. It was thought that flow entering the pipe from groundwater would cleanse the pipe. These joints are highly susceptible to root intrusion and offset joints.

In the early 1980's vast experimentation was done in pipeline materials. The authorization of the Clean Water Act and the subsequent EPA Grant program provided much funding and innovations in the sewer business. Plastic pipes were introduced and several years passed before there were accepted standards for pipeline design. Many in-situ experiments were conducted with installation of a variety of pipe materials. Notable were the Asbestos Cement Pipes (ACP), Reinforced Concrete Pipes (RCP), Reinforced Plastic Mortar (RPM) and a variety

of composite material pipes. These pipes failed frequently due to internal corrosion from hydrogen sulfide or from material failure due to poor manufacturing processes. This opens the door for metal pipeline suppliers to fill the void. Metal had been used for some years in the gas and oil industry with few problems other than corrosion due to galvanic action between the soil and the pipe surface. Plastic wrap or lining was used to address the galvanic response with marginal success. Additionally, concerns over strength in both plastics and clay pipe led to the introduction of metal pipes.

Over 85% of the sewer pipes in the entire collection system are made of VCP or PVC. Recent failures of Ductile Iron Pipe (DIP) in force mains have raised questions regarding the integrity of metallic pipes. As a result this report recommends replacement of all sewer pipes not constructed of VCP or PVC. Based on the concerns over metal pipe failure the DIP should be replaced first. Ductile Iron Pipe comprises just over 3.2% of the collection system.

Table 7-8 shows the distribution of pipe material and ownership by length of pipe. **Figure 7-5** shows the map of the collection system by material.

Table 7-8 Pipe Length by Material and Owner

Pipe Material	Vista	Buena	Unknown	Private	Total
ABS	103	5,152			5,255
ABSP	5,133				5,133
ACP	385	6,403			6,788
CIP	487	816			1,303
DIP	41,117	13,625			54,742
DIP/VCP		62			62
DIP/CL50	162				162
DIP/PVC		75			75
ESVCP	416				416
FM		159			159
HDPE	246	2,127			2,373
PE		498			498
PVC	352,682	120,286	1,567	124	474,659
PVC/DIP	2,357				2,357
PVC/VCP	848				848
RCP		996			996
RPVC		2,416			2,416
S4-5		320			320
S4-1		125			125
Steel		36			36
VCP	711,739	266,580	428		978,747
VCP/PVC		190			190
VCP/DIP	207		357		564
VCP/PVC	4,786	229			5,015
XVCP		949			949
Unknown	15,055	111,648	1,344		128,048
Total	**1,135,724**	**532,691**	**3,696**	**124**	**1,672,235**

While not specifically listed, there are materials that are of concern in the sewer system. These include Techite (a composite pipe with notable failure history), Spirolite, Asbestos Cement Pipe (ACP), and any form of metallic pipe subject to corrosion failure.

In addition to considerations regarding the materials in place, Section 7.6 discusses the age and useful life for sewer pipes.

Figure 7-5 Pipeline Materials

7.6 PIPE AGE

Research into the useful life of sewer collection systems has revealed a broad range of opinions and techniques to evaluate the useful life of sewers. Some agencies use a 30 year pipe life as this coincides with the construction bond life. Many agencies use 50 years as a planning estimate even though they may have collection system pipes that are over 200 years old.

For the purposes of this discussion we will assume that the useful life for the sewer pipeline is 50 years. The EPA has accepted this estimate as a part of its discussions with the City of San Diego. The City of Vista and the Buena Sanitation District vary widely in the age distribution of pipe. In the City of Vista, approximately 37% of the collection system is over 40 years old. In the Buena Sanitation District, over 35% of the system is between 20 and 30 years old. **Table 7-8** shows the distribution of pipe age by Agency, and a graphical representation of pipeline age is shown in **Figure 7-6**.

Table 7-9 Pipe Age by Agency

Age Range	Vista	Buena	Unknown	Private	Total
0 to 10	90,815	39,009	796		130,620
11 to 20	228,324	95,212	772	124	324,431
21 to 30	256,843	187,206	210		444,259
31 to 40	133,825	35,726			169,551
41 to 50	361,626	171,250	575		533,451
Greater Than 50	58,608				58,608
Unknown	5,683	4,289	1,344		11,316
Total	**1,135,724**	**532,691**	**3,696**	**124**	**1,672,235**

Based on the assumption that useful pipe life may be successfully extended well beyond fifty years with rehabilitation, **Table 7-10** shows the length of pipe that should be rehabilitated each decade and each year. The final row shows an average rate that smoothes the investment requirements. On average, the City/District should plan to rehabilitate over 40,000 feet per year at an estimated annual cost of $3.45 Million.

Table 7-10 Rehabilitation Schedule and Cost Estimate

	10 Year		Annual		Annual Rehab. Cost Est.		
Year	Vista	Buena	Vista	Buena	Vista	Buena	Total
2040	319,139	134,220	31,914	13,422	$ 2,655,130	$1,116,669	$3,771,800
2030	256,843	187,206	25,684	18,721	$ 2,136,846	1,557,492	$3,694,339
2020	133,825	35,726	13,382	3,573	$ 1,113,379	$ 297,230	$1,410,610
2010	420,234	171,250	42,023	17,125	$ 3,496,209	$1,424,741	$4,920,950
Average	**282,510**	**132,101**	**28,251**	**13,210**	**$ 2,350,391**	**1,099,033**	**$3,449,424**

Figure 7-6 Pipeline Age

7.7 UPSIZING MINIMUM PIPE DIAMETERS

In many of the older parts of the City and in areas of high relief, six-inch sewer lines were installed. Current construction standards require a minimum diameter of eight inches. The large diameter is to increase the accessibility of the pipe to Closed Circuit TV inspection and other maintenance operations. The replacement of these pipes represents a lower priority unless they are associated with capacity, hot spots, and material or age considerations. **Figure 7-7** shows the full extent of all Minimum Size pipelines.

7.8 CONCLUSIONS

The City/District is currently transitioning from capacity expansion projects required for sustained growth to asset management projects. The key to successfully operate and maintain the collection system is to establish (1) A full condition assessment program and (2) schedule and plan the O&M program based on the findings of the program. The full condition assessment program will consist of (1) Revised Temporary Flow Measurement (TFM) Program (2) Field Investigations (CCTV, Smoke Testing and Field Reconnaissance) targeted based on Findings of the TFM (3) Expansion of the City's CCTV program into areas of older non-PVC/VCP pipe to prioritize the replacement program.

Figure 7-7 Minimum Size Pipelines

8.0 RECOMMENDED CIP PROJECTS

A goal of the Sewer Master Plan Update is to define a financial program that provides a sustainable collection system with adequate capacity for current and future customers. This chapter describes the recommended CIP projects and their cost estimates. This constitutes a set of prioritized financial estimates for the City/District consideration.

8.1 PRIORITIZATION

Establishing the priority for projects identified in Chapter 6 and 7 provides the basis of timing for the Capital Improvements Program. The establishment of priorities is discussed in the following paragraphs.

The following table shows the matrix used to establish the priority for each replacement project. Since the overall intent of the program is to convey wastewater and defect flows without overflow, a project has a high priority if it addresses an existing capacity restriction. These projects would be constructed first, but would be constructed at the size required to handle anticipated future flows. Other factors that were considered in the assignment of priority were the material, age, relocation, known hot spot, CCTV Condition Assessment and pressure pipes. In other words if a replacement project additionally addresses other concerns, it is ranked higher for consideration. Priorities were established individually for the City and District.

Note that the scoring system allows the ranking to be “tied”. Ties were broken by assigning a priority based on peak flow rate. For example, a score of 0.789 resulted in a rank of 6 for several projects. The project with the highest peak flow rate would be assigned the Priority of 6, the second highest would be assigned a priority of 7, etc. In this way, projects with equal factors in all other categories are biased so that the largest potential problems are handled soonest.

Table 8-1 Priority Assignment

	Capacity Restriction											
Parameter	**Existing**	**Future**	**Material**	**Age**	**Relocation**	**Hot Spot**	**CCTV**	**FM**				
Weight	10	10	5	5	2	5	5	15				
Project	18%	18%	9%	9%	4%	9%	9%	26%	**Score**	**Flow Rate**	**Rank***	**Priority**
B1	1	1	1	3	1	0	0	0	0.737	6.74	4	4
B2	1	1	1	3	0	0	1	0	0.789	3.69	3	3
B3	0	1	1	3	0	0	1	0	0.614	0.789	6	7
B4	0	1	1	3	1	0	1	0	0.649	1.734	5	5
B5	1	1	1	3	1	1	1	0	0.912	4.989	2	2
OV2	0	1	1	3	0	0	1	0	0.614	11.215	6	6
Buena Outfall FM Ph3	1	1	1	3	1	0	1	1	1.088	11.215	1	1
V1	1	1	1	5	0	1	1	0	1.053	1.911	1	1
V2	1	1	4	1	0	0	0	0	0.789	16.709	4	4
V3	1	1	1	3	0	0	1	0	0.789	0.964	4	7
V4	1	1	1	3	0	0	0	0	0.702	6.459	8	8
V5	1	1	1	3	0	0	0	0	0.702	1.707	8	11
V6	0	1	4	3	0	0	0	0	0.789	1.063	4	6
V7	1	1	1	3	0	0	1	0	0.789	3.054	4	5
V8	1	1	1	3	1	0	1	0	0.825	1.337	3	3
V9	1	1	1	3	0	0	0	0	0.702	2.819	8	10
V10	1	1	1	3	1	1	1	0	0.912	0.757	2	2
V11	1	1	1	3	0	0	0	0	0.702	4.655	8	9
R1	0	1	0	0	0	0	0	0	0.175	0.729	13	13
OV1	0	1	4	1	0	0	0	0	0.614	20.444	12	12
	Yes = 1	Yes = 1	VCP = 1	<20=0	Yes = 1	Yes =1	Good = 0	Yes =1	* Ranked by Owner			
	No = 0	No = 0	PVC = 0	20-30=1	No = 0	No = 0	Bad = 1	No = 0				
			DIP = 4	30-40=2			Unk = 0					
			Other = 2	40-50=3								
				>50 = 5								

The lower portion of the matrix shows the values used for the specific parameter under consideration. These priorities become the basis of the scheduling of the projects. **Table 8-6** shows the project sorted by priority with estimated project costs.

Table 8-2 and **Table 8-3** summarize capacity deficient projects and estimated improvement costs for the existing system in the Buena Sanitation District and the City of Vista, respectively.

Table 8-2 Existing Capacity Deficient Projects in Buena Sanitation District

Project Name	Length (ft)	Cost ($)	Description
B1-Green Oak to BVPS Upsize	1,262	$755,528	Upsize existing 18" and 12" sewer lines along Green Oak and between the Buena lift station and Grand to 21" and 15".
B2-Thibodo to Watson Upsize and Realignment	709	$287,145	Upsize existing 15" sewer line along Watson to 18".
B5-Watson to Green Oak Upsize and Realignment	1,041	$548,287	Upsize existing 8" sewer line along Watson to 18".
B6 Buena Outfall Force Main Phase III	7,200	$4,786,800	Construct 24" of Force main and 18" and 15" of Gravity Sewer in Palomar Airport Rd and west of EL Camino Real to divert flows to Vallecitos Interceptor.
Total	**10,212**	**$6,377,760**	

Table 8-3 Existing Capacity Deficient Projects in the City of Vista

Project Name	Length (ft)	Cost ($)	Description
V1-West Vista Way Replacement and Upsize	5,249	$1,658,966	Upsize existing 12", 10", and 8" sewer lines along Sunset, Vista, and Huff between Via Centre, Nettleton, and Durian to 15" and 12".
V2-Hacienda / Vista Village Upsize	2,180	$1,760,657	Upsize existing 30" and 12" sewer lines along Hacienda to 36" and 18".
V3-North Melrose Upsize	2,737	$786,454	Upsize existing 10", and 8" sewer lines along Melrose between Hacienda and Ascot to 15" and 12".
V4- Main / Broadway / Santa Fe Upsize	2,916	$1,377,679	Upsize existing 18" along Santa Fe, Broadway, Citrus, Main and Vista Village between Santa Fe and Intersection of Vista Village/Escondido/Hillside/Vista to 21".
V5-Eucalyptus / Citrus Upsize	2,737	$905,514	Upsize existing 12" and 10" and 8" sewer lines along Citrus, Eucalyptus, and Escondido15" and 12".
V7-Mercantile Upsize	940	$358,203	Upsize existing 12", 8", and 6" sewer lines along Santa Fe and north-west of Guajome to 18", 15", and 12".
V8- MonteVista / South Santa Fe Realignment & Upsize	1,294	$383,616	Upsize existing 8" sewer line along Santa Fe between Escondido and Santa Anita to 15" and 12".
V9-North Santa Fe Upsize	1,801	$850,973	Upsize existing 18" sewer lines along Santa Fe between Orange and Nevada to 21".
V10-North Santa Fe / Cananea / Calera Upsize	2,190	$656,197	Upsize existing 10" and 8"sewer lines along Cananea and Calera to 12".
V11-East Vista Way / Vale Terrace Upsize	370	$124,875	Upsize 8" sewer line along Vale Terrace to 15".
Total	**22,414**	**$8,863,134**	

The total length of all the existing capacity related projects is 34,139 feet. The total estimated improvement cost of all the existing capacity related projects is $12,693,569. The existing recommended capacity deficient projects are shown in **Figure 8-1**.

Figure 8-1 Existing Recommended Capacity Deficient Projects

Table 8-4 and **Table 8-5** summarize capacity deficient projects and estimated improvement costs for the future system in the Buena Sanitation District and the City of Vista respectively. The future recommended capacity deficient projects are shown in **Figure 8-2**.

Table 8-4 Future Capacity Deficient Projects in Buena Sanitation District

Project Name	Length (ft)	Cost ($)	Description
B1- Green Oak to BVPS Upsize	4,944	$3,595,899	Upsize existing 21", 18", and 12" sewer lines along Green Oak and between the Buena lift station and Grand to 27", 24", and 15".
B2- Thibodo to Watson Upsize and Realignment	3,019	$1,304,335	Upsize existing 15" and 8" sewer lines along Watson and Sycamore and between Watson and intersection of Thibodo/Plumosa to 21", 18", and 15".
B3-El Valle Opulento Upsize	918	$309,855	Upsize existing 10" sewer line along El Valle Opulento and between El Valle Opulento and El Copa to 15".
B4-Buena Creek / Robelini Upsize	4,724	$1,685,475	Upsize existing 12" sewer line along Robelini and Buena Creek and between intersection of Sycamore/Robelini and Lakeside to 15".
B5-Watson to Green Oak Upsize and Realignment	3,795	$2,382,086	Upsize and realign existing 18" and 8" sewer lines along Oleander and Watson between Green Oak and Lupine Hills to 24", 21", and 18".
OV2-Buena Outfall Phase IV	8,847	$4,560,640	Upsize existing 24", 21", and 18" Buena Interceptor to 27", 24", and 21".
B6-Buena Outfall Force Main Phase III	7,200	$4,786,800	Construct 24" of Force main and 18" and 15" of Gravity Sewer in Palomar Airport Rd and west of El Camino Real to divert flows to Vallecitos Interceptor.
Total	**33,447**	**$18,625,090**	

The hydraulic model of the collection system has been prepared and used to evaluate the capacity of the system. Additionally capacity related projects have been identified to overcome these restrictions. These projects are summarized in this chapter. Detailed project sheets have been prepared for each project (replacement and rehabilitation) and are included in the appendices. Detailed information related to project location are in Appendix 1.

Table 8-5 Future Capacity Deficient Projects in the City of Vista

Project Name	Length (ft)	Cost ($)	Description
V1-West Vista Way Replacement and Upsize	6,344	$1,954,616	Upsize existing 12", 10", and 8" sewer lines along Sunset, Vista, Huff, and Durian and between intersection of Via Centre/Sunset and Cedar and Hill to 15" and 12".
V2-Hacienda / Vista Village Upsize	4,026	$3,356,869	Upsize existing 33", 30", 24", 21", and 12" sewer lines along Hacienda and Vista Village and between La Tortuga and Lado De Loma to 42", 36", 30", 27", 21", 18" and 15".
V3-North Melrose Upsize	5,500	$1,615,217	Upsize existing 10" and 8" sewer lines along Melrose between Hacienda and Olive to 15" and 12".
V4- Main / Broadway / Santa Fe Upsize	3,347	$1,620,884	Upsize existing 18" along Santa Fe, Broadway, Citrus, Main and Vista Village between Santa Fe and Intersection of Escondido/Hillside to 24" and 21".
V5-Eucalyptus/ Citrus Upsize	3,037	$1,034,641	Upsize existing 12", 10", and 8" sewer lines along Citrus, Eucalyptus, and Escondido and between Broadway and Avalon to 18", 15", and 12".
V6-South Melrose Upsize	1,910	$644,623	Upsize existing 10" sewer line along Melrose between Hacienda and County Complex to 15".
V7-Mercantile Upsize	3,171	$960,556	Upsize existing 12", 8", and 6" sewer lines along Santa Fe, Mercantile, and Pala Vista and between Main and Rincon to 18", 15", and 12".
V8-MonteVista / South Santa Fe Realignment and Upsize	8,358	$2,794,418	Upsize existing 8" sewer line along Santa Fe, Service, and Monte Vista and between Escondido and Service to 15" and 12".
V9-North Santa Fe Upsize	3,979	$2,093,580	Upsize existing 18" and 15" sewer lines along Santa Fe and between Orange and intersection of Los Angeles/Townsite to 24" and 18".
V10- Cananea / Calera Upsize	2,830	$862,825	Upsize existing 10" and 8" sewer lines along Cananea and Calera, between Santa Fe and Bobier to 15" and 12".
V11-East Vista Way / Vale Terrace Upsize	1,853	$769,770	Upsize 18" and 8" sewer line along Vista and Vale Terrace and between Townsite and intersection of Bel Air/Williamston to 21", 18", and 15".
R1-Faraday Easement Sewer Upsize	1,431	$482,811	Upsize existing 12" sewer line west of Melrose and between the Raceway Pump Station and Faraday to 15".
OV1-VC3 Relief Sewer	2,837	$2,681,145	Upsize existing 36" Vista-Carlsbad Interceptor to 42".
Total	**48,621**	**$20,871,955**	

Figure 8-2 Future Recommended Capacity Deficient Projects

Table 8-6 Replacement Projects By Priority with Estimates

Priority	Buena	Est. Cost
1*	B6 Buena Outfall FM Ph3	$4,786,800
2*	B5	$2,382,086
3*	B2	$1,304,335
4*	B1	$3,595,899
5	B4	$1,685,475
6	OV2	$4,560,640
7	B3	$309,855
	Subtotal	$18,625,090
Priority	**Vista**	**Est. Cost**
1*	V1	$1,954,616
2*	V10	$862,825
3*	V8	$2,794,418
4*	V2	$3,356,869
5*	V7	$960,556
6*	V6	$644,623
7*	V3	$1,615,217
8*	V4	$1,620,884
9*	V11	$769,770
10*	V9	$2,093,580
11*	V5	$1,034,641
12	OV1	$2,681,145
13	R1	$482,811
	Subtotal	$20,871,955
	Total	**$39,497,045**

* Projects found to have Existing Wet Weather Capacity Restrictions. It is important to facilitate construction on these projects as soon as possible.

In addition to the Capacity Related Replacement Projects, the City/District must address looming age, material, minimum size and condition related replacements or rehabilitation. The following sections discuss the scheduling of these improvements and additional Operations and Maintenance related activities that will insure compliance with the WDR through a well managed collection system. **Table 8-7** shows the estimated costs for addressing all noted areas of concern. It should be noted that a complete Condition Assessment program may limit these cost estimates. For instance, there may be a number of non-VCP/PVC pipes that do not need immediate rehabilitation. These estimated costs may be refined and/or deferred to some future date.

Table 8-7 Non-Capacity CIP Projects

Project Type	Vista	Buena	Unknown	Total
Material Related Force Main (DIP)	$0	$793,119	$0	$793,119
Material Related Gravity Main (DIP)	$24,248,766	$2,399,813	$0	$26,648,579
Age Related	$6,948,675	$0	$0	$6,948,675
Condition Related	$68,267,080	$22,622,933	$11,198	$90,901,211
Minimum Size	$20,013,301	$2,393,598	$24,183	$22,431,082
Total	**$119,477,822**	**$28,209,463**	**$35,381**	**$147,722,666**

Condition related projects also include prior capital improvement projects identified during the 2003 Master Plan Update. These projects should be scheduled for completion based in the listed order based on the funding made available through bonding and rates.

8.2 CONDITION ASSESSMENT PROGRAM

As noted in the previous discussion and in Chapter 7, the total extent and costs associated with the Non-Capacity Projects will be modified by a complete condition assessment program. The complete condition assessment program elements and associated costs are shown in **Table 8-8**. It is recommended that these projects be completed within the next five years of the CIP. The costs for flow measurement, physical inspection, CCTV and smoke testing are for the entire system. It is likely, based on the flow measurement program, that these amounts will be reduced. For that reason, the flow measurement program should be commenced as soon as rainfall is likely in the 2007/2008 wet season. Note that the 2007/2008 Flow Measurement Program has been increased over the previously prepared 2006/2007 Flow Measurement Plan. The Flow Measurement Plan was based on budget constraints in the 2006/2007 budget and had fewer flow measurement devices installed in the system. The 2006/2007 Flow Measurement Plan was not implemented due to unseasonably low rainfall amounts.

Table 8-8 Condition Assessment Costs

Component	Estimated Cost	Cost/Foot
Flow Measurement	$ 295,983	$ 0.18
Smoke Testing	$ 822,174	$ 0.50
Physical Inspection	$ 548,116	$ 0.33
CCTV	$ 2,055,435	$ 1.25
Program Mgmt	$ 558,256	$ 0.34
Total	**$ 4,279,964**	**$ 2.60**

8.3 PHASED CAPITAL IMPROVEMENT PROGRAM

Based on the considerations discussed in the previous section, a phased schedule of system condition assessment, capacity and non-capacity replacements has been developed. To develop the maximum estimated costs, this program combines the Condition Assessment Program, Capacity and Non-Capacity Replacement Projects. It is likely that as the results of the Condition Assessment Program are analyzed that some of the non-capacity replacement projects will be reduced.

The schedule for the CIP was developed to have full funding in the first year of the project. This approach is simplified but provides assured funding for the projects prior to their construction. In addition to the capacity replacement projects, there are periodic inspection and replacement projects included. For example the CCTV inspection program of the entire program is shown to be completed within the first five years, but costs continue at a reduced schedule (10% per year) throughout 2027. Other programs, such as DIP replacement and capacity related replacements, show completion with no expected returns. As a result, the overall annual spending declines on the average from $17 million dollars in the first five years to around $4 million in 2027. This is driven by ongoing age related replacements and the CCTV inspection program.

The developed CIP is based on priorities established on the need and impacts of the given project. The Condition Assessment Program is fundamental to determining the current “State of the System”. Replacement projects were developed on the criteria discussed in the previous section. Finally the maximum costs for material, age and non-capacity related replacements were derived but may be affected by the findings of the condition assessment program.

Table 8-9 describes the proposed scheduling of the CIP.

Table 8-9 Proposed CIP

Basin	Near Term CIP						Near Term Total	Long Term CIP			Total
	Year	1	2	3	4	5		10	15	20	
	Budget	2007/2008	2008/2009	2009/2010	2010/2011	2011/2012		2017	2022	2027	
Complete Condition Assessment											
Buena	Flow measurement	$ 46,265	$ 46,265	$ 46,265			$ 138,795				$ 138,795
	Smoke Testing	$ 246,652					$ 246,652				$ 246,652
	Physical Inspection	$ 164,435					$ 164,435				$ 164,435
	CCTV Inspection	$ 123,326	$ 123,326	$ 123,326	$ 123,326	$ 123,326	$ 616,631	$ 308,315	$ 308,315	$ 308,315	$ 1,541,576
	Program Management	$ 93,481	$ 18,499	$ 18,499	$ 18,499	$ 18,499	$ 167,477				$ 167,477
	Buena SubTotal	$ 674,159	$ 188,090	$ 188,090	$ 141,825	$ 141,825	$ 1,333,989	$ 308,315	$ 308,315	$ 308,315	$ 2,258,935
Vista	Flow measurement	$ 207,188					$ 207,188				$ 207,188
	Smoke Testing	$ 575,522					$ 575,522				$ 575,522
	Physical Inspection	$ 383,681					$ 383,681				$ 383,681
	CCTV Inspection	$ 287,761	$ 287,761	$ 287,761	$ 287,761	$ 287,761	$ 1,438,805	$ 719,402	$ 719,402	$ 719,402	$ 3,597,011
	Program Management	$ 218,123	$ 43,164	$ 43,164	$ 43,164	$ 43,164	$ 390,779				$ 390,779
	Vista SubTotal	$ 1,672,275	$ 330,925	$ 330,925	$ 330,925	$ 330,925	$ 2,995,975	$ 719,402	$ 719,402	$ 719,402	$ 5,154,181
Condition Assessment SubTotal		$ 2,346,434	$ 519,015	$ 519,015	$ 472,750	$ 472,750	$ 4,329,964	$ 1,027,718	$ 1,027,718	$ 1,027,718	$ 7,413,116
Prioritized Capacity Related Replacements											
Buena	Buena Outfall FM Ph3	$ 4,786,800					$ 4,786,800				$ 4,786,800
	B5		$ 2,382,086				$ 2,382,086				$ 2,382,086
	B2			$ 1,304,335			$ 1,304,335				$ 1,304,335
	B1				$ 3,595,899		$ 3,595,899				$ 3,595,899
	B4						$ -	$ 1,685,475			$ 1,685,475
	OV2						$ -	$ 4,560,640			$ 4,560,640
	B3						$ -		$ 309,855		$ 309,855
	Buena SubTotal	$ 4,786,800	$ 2,382,086	$ 1,304,335	$ 3,595,899	$ -	$ 12,069,120	$ 6,246,115	$ 309,855	$ -	$ 18,625,090
Vista	V1	$ 1,954,616					$ 1,954,616				$ 1,954,616
	V10		$ 862,825				$ 862,825				$ 862,825
	V8		$ 2,794,418				$ 2,794,418				$ 2,794,418
	V2			$ 3,356,869			$ 3,356,869				$ 3,356,869
	V7			$ 960,556			$ 960,556				$ 960,556
	V3				$ 1,615,217		$ 1,615,217				$ 1,615,217
	V6				$ 644,623		$ 644,623				$ 644,623
	V4					$ 1,620,884	$ 1,620,884				$ 1,620,884
	V11					$ 769,770	$ 769,770				$ 769,770
	V9					$ 2,093,580	$ 2,093,580				$ 2,093,580
	V5					$ 1,034,641	$ 1,034,641				$ 1,034,641
	OV1						$ -	$ 2,681,145			$ 2,681,145
	R1						$ -		$ 482,811		$ 482,811
	Carlsbad	$ 11,115,884	$ 3,050,000	$ 1,336,812			$ 15,502,696				$ 18,866,399
	Vista SubTotal	$ 13,070,500	$ 6,707,243	$ 5,654,237	$ 2,259,840	$ 5,518,875	$ 33,210,695	$ 2,681,145	$ 482,811	$ -	$ 39,738,354
Capacity Related Replacement SubTotal		$ 17,857,300	$ 9,089,329	$ 6,958,572	$ 5,855,739	$ 5,518,875	$ 45,279,815	$ 8,927,260	$ 792,666	$ -	$ 58,363,444
Other Rehab or Replacements											
Buena	DIP FM	$ 793,119					$ 793,119				$ 793,119
	DIP Gravity - 10	$ 239,981	$ 239,981	$ 239,981	$ 239,981	$ 239,981	$ 1,199,906	$ 1,199,906	$ -	$ -	$ 2,399,813
	Age Related*	$ 1,424,741	$ 1,424,741	$ 1,424,741	$ 1,424,741	$ 1,424,741	$ 7,123,703	$ 1,486,152	$ 1,486,152	$ 7,787,461	$ 17,883,468
	Condition Related - 20**	$ 1,131,147	$ 1,131,147	$ 1,131,147	$ 1,131,147	$ 1,131,147	$ 5,655,733	$ 5,655,733	$ 5,655,733	$ 5,655,733	$ 22,622,933
	Upsize Minimum - 20	$ 119,680	$ 119,680	$ 119,680	$ 119,680	$ 119,680	$ 598,399	$ 598,399	$ 598,399	$ 598,399	$ 2,393,598
	Encina WA	$ 235,182	$ 876,338	$ 222,467	$ 352,427	$ 226,368	$ 1,912,782	$ 1,434,427	$ 1,456,574	$ 1,752,825	$ 6,556,608
	Buena SubTotal	$ 3,943,850	$ 3,791,887	$ 3,138,016	$ 3,267,975	$ 3,141,917	$ 17,283,644	$ 10,374,618	$ 9,196,858	$ 15,794,418	$ 52,649,539
Vista	DIP FM	$ -					$ -				$ -
	DIP Gravity - 10	$ 2,424,877	$ 2,424,877	$ 2,424,877	$ 2,424,877	$ 2,424,877	$ 12,124,383	$ 12,124,383	$ -	$ -	$ 24,248,766
	Age Related*	$ 3,449,424	$ 3,449,424	$ 3,449,424	$ 3,449,424	$ 3,449,424	$ 17,247,120	$ 5,566,897	$ 5,566,897	$ 10,684,232	$ 39,065,145
	Condition Related - 20**	$ 3,413,354	$ 3,413,354	$ 3,413,354	$ 3,413,354	$ 3,413,354	$ 17,066,770	$ 17,066,770	$ 17,066,770	$ 17,066,770	$ 68,267,080
	Upsize Minimum - 20	$ 1,000,665	$ 1,000,665	$ 1,000,665	$ 1,000,665	$ 1,000,665	$ 5,003,325	$ 5,003,325	$ 5,003,325	$ 5,003,325	$ 20,013,301
	Encina WA	$ 622,828	$ 2,320,793	$ 589,157	$ 933,326	$ 599,487	$ 5,065,591	$ 3,798,770	$ 3,857,422	$ 4,641,979	$ 17,363,761
	Vista SubTotal	$ 10,911,148	$ 12,609,113	$ 10,877,476	$ 11,221,645	$ 10,887,807	$ 56,507,189	$ 43,560,145	$ 31,494,414	$ 37,396,306	$ 168,958,054
Other Rehab or Replacement SubTotal		$ 14,854,998	$ 16,401,000	$ 14,015,492	$ 14,489,620	$ 14,029,724	$ 73,790,834	$ 53,934,763	$ 40,691,272	$ 53,190,724	$ 221,607,593
Buena Total		**$ 9,404,809**	**$ 6,362,063**	**$ 4,630,441**	**$ 7,005,699**	**$ 3,283,742**	**$ 30,686,753**	**$ 16,929,048**	**$ 9,815,029**	**$ 16,102,734**	**$ 73,533,564**
Vista Total		**$ 25,653,922**	**$ 19,647,281**	**$ 16,862,638**	**$ 13,812,410**	**$ 16,737,607**	**$ 92,713,859**	**$ 46,960,692**	**$ 32,696,627**	**$ 38,115,708**	**$ 213,850,589**
Grand Total		**$ 35,058,731**	**$ 26,009,344**	**$ 21,493,079**	**$ 20,818,110**	**$ 20,021,349**	**$ 123,400,612**	**$ 63,889,740**	**$ 42,511,656**	**$ 54,218,442**	**$ 287,384,153**
Carry Forward Amount Total		**$ 20,025,008**					***Avg. Annual***	***$ 12,777,948***	***$ 8,502,331***	***$ 10,843,688***	

* Average Annual Cost Chapter 8
** Includes previously identified condition, will be lowered with Complete Condition Assessment
Cost Note: All estimated costs are in 2007 dollars ENR CCI = 8555.3

Historically, the City/District has on average spent $3.5 million per year on CIP projects and an additional $1.7 million on projects managed by Encina. **Table 8-10** shows the recent CIP expenditures for the City/District. Additional resources will be required to accelerate to the level of spending recommended. This will likely include addition of staff and outsourcing of necessary functions.

Table 8-10 Historical CIP Spending

	Vista		Buena				
FY end	CIP Projects	Encina Projects	CIP Projects	Encina Projects	V+B	Encina Total	Grand Total
1999	$1,831,760	$715,000	$170,280	$285,000	$2,002,041	$1,000,000	$3,002,041
2000	$3,513,896	$900,933	$283,143	$349,356	$3,797,039	$1,250,289	$5,047,327
2001	$1,898,338	$404,266	$220,399	$147,756	$2,118,737	$552,022	$2,670,759
2002	$7,119,417	$713,882	$3,049,017	$220,741	$10,168,434	$934,624	$11,103,057
2003	$641,201	$489,330	$1,818,619	$188,779	$2,459,820	$678,109	$3,137,929
2004	$539,881	$1,628,028	$326,524	$656,945	$866,405	$2,284,973	$3,151,378
2005	$518,561	$4,270,558	$650,052	$592,302	$1,168,614	$4,862,861	$6,031,474
2006	$3,326,635	$1,098,161	$2,693,303	$962,372	$6,019,938	$2,060,533	$8,080,471
Average	***$2,423,711***	***$1,277,520***	***$1,151,417***	***$425,406***	***$3,575,128***	***$1,702,926***	***$5,278,055***
Totals	$19,389,689	$10,220,159	$9,211,338	$3,403,251	$28,601,027	$13,623,410	$42,224,437

In addition to the projects that are native to Vista or to Buena Sanitary District, there are long term shared projects in both Carlsbad and the Encina Wastewater Authority plans. **Table 8-11** from the Carlsbad Sewer Master Plan (2003) shows the Carlsbad projects with the Vista share based on percent capacity and their 2007 escalated estimated costs.

Table 8-11 Sub-Regional CIP Projects

Project	Vista CIP	Description	Category	Project Cost
Vista/Carlsbad Interceptor Reach VC3 - capacity upgrade upstream of the Buena Vista Lift Station		3,350' of 42" Pipeline	Interceptor Replacement	$2,615,648
Buena Vista Lift Station - capacity increase, control system upgrade, new back-up generator		Lift Station Capacity = 26 MGD	L.S. Rehab	$748,055
Buena Vista Lift Station Force Main (VC4) - replace existing 16" pipeline with 24" pipeline to provide dual 24" FMs & increase capacity		3,840' of 24" Force Main	New Force Main	$1,336,812
Vista/Carlsbad Interceptor Reach VC11B - upgrade capacity and construct new bridge crossing over the Agua Hedionda Lagoon	8129	915' of 54" Pipeline	Interceptor Replacement & New Bridge	$1,602,359
Agua Hedionda Lift Station and Force Main VC12 - rehab lift station and construct new force main	8125	Lift station capacity = 36 MGD 200' of 36" force main	L.S. Rehab & New Force Main	$5,513,525
V/C Interceptor Reaches VC13, VC14 & VC15 - Increase interceptor capacity from the AH Lift Station to Encina WPCF	8130	3510' of 54" Pipeline 6,831' of 60" Pipeline	Interceptor Replacement	$7,050,000
Total				**$18,866,399**

8.4 OTHER PROJECTS AND ANALYSES

8.4.1 BUENA OUTFALL FM PHASE III

Buena Interceptor is identified as capacity deficient during existing and future flow scenarios. **Table 8-12** summarizes the flows carried by the Buena Interceptor during various scenarios. These flows include the flows generated by the Buena Sanitation District, sub drainage basins V34 and V35 of the City of Vista and additional flows from the City of Carlsbad.

Table 8-12 Buena Interceptor Flows

Flow Scenarios	Exiting		Ultimate	
	Average Flow (MGD)	Peak Flow (MGD)	Average Flow (MGD)	Peak Flow (MGD)
Dry Weather Flow	3.67	5.32	5.54	7.89
Wet Weather Flow	6.44	8.78	8.46	11.54

The City of Vista owns 3.75 MGD capacity in the Vallecitos Interceptor which runs parallel to the Buena Interceptor. Special analysis was performed to determine the hydraulic restrictions in the Buena Interceptor by diverting 3.75 MGD to the Vallecitos Interceptor. The analysis was performed during existing and future wet weather conditions. Option C, recommended in the March 2002 Buena Interceptor Upgrade Route Selection and Flow Splitting Study, was utilized for diverting the flow to the Vallecitos Interceptor. Option C includes 3,200 feet of 24-inch force main, 3,200 feet of 18-inch gravity main, and 800 feet of 15-inch gravity main. It is referred to as *Buena Outfall Force Main Phase III Project* in this Master Plan. The force main would divert the flow at manhole V36T055 and follow the existing alignment of the Buena Interceptor, southwest across El Camino Real on Palomar Airport Road. It would transition from force main to gravity main at the intersection of Palomar Airport Road and Yarrow Drive.

Construction of Buena Outfall Force Main Phase III Project will provide sufficient capacity in the Buena Interceptor to handle the existing wet weather flows; however, it will still have hydraulic restrictions to deliver the ultimate wet weather flows. The results and recommendations of this analysis are summarized in **Table 8-13**.

Table 8-13 Buena Interceptor Analysis Recommendations

Flow Scenarios	Project Name	Project Description
Existing	**B6 - Buena Outfall Force Main Phase III**	Construct 24" of Force main and 18" and 15" of Gravity Sewer in Palomar Airport Rd and west of EL Camino Real to divert flows to Vallecitos Interceptor.
Ultimate	**OV2-Buena Outfall Phase IV**	Upsize existing 24", 21", 18" Buena Interceptor to 27", 24", and 21".

8.4.2 FUTURE OCEANSIDE FLOWS

Ultimate average dry weather and wet weather flows were calculated as a part or special analysis. The same methodology was followed to calculate and allocate the average dry weather flows in the hydraulic model as described in Chapter 5.

Defect flows and corresponding wet weather hydrographs calculated for the City of Vista using flow monitoring data at meters V1 and OV1 was applied in conjunction to ADWF at each manhole in the OV basins to account for the wet weather flows. Defect flows per manhole were calculated by dividing the total defect flows with the number of manholes. **Table 8-14** presents the flows determined by the hydraulic model for all the OV basins.

Table 8-14 Ultimate Oceanside Flows

Basins	Dry Weather Flow		Wet Weather Flow	
	Average Flow (MGD)	Peak Flow (MGD)	Average Flow (MGD)	Peak Flow (MGD)
OV1	0.23	0.35	0.34	0.55
OV2	0.15	0.23	0.22	0.35
OV3	0.003	0.005	0.007	0.011
OV4	0.06	0.09	0.10	0.16
OV5	0.32	0.50	0.54	0.86
OV6	0.23	0.36	0.27	0.43

8.4.3 BUENA PUMP STATION INFLUENT GRAVITY MAIN

There was a spill in the existing 18-inch Spirolite gravity main approximately 1,000 feet upstream of the Buena Pump Station and south of the intersection of Melrose Drive and Green Oak Road. As per the City staff, this gravity main is in bad condition and is identified as a condition related-rehabilitation project in the CIP. Generally, relining a pipeline reduces its diameter. Hydraulic analysis was performed to verify whether the gravity main will have sufficient capacity with reduced diameter during future wet weather conditions. The diameter of the existing gravity main was reduced to 16-inch and the pipeline capacity was analyzed during ultimate peak wet weather flow. The results of this analysis show that the gravity main will have enough capacity after relining. The results are presented in **Table 8-15**. It is recommended that this line be included in the near term CIP as a condition related rehabilitation project.

Table 8-15 Peak Ultimate Wet Weather Analysis

Condition	Diameter	Peak Flow (MGD)	(d/D)
Existing	18-Inch	1.64	0.55
After Relining	16-Inch	1.64	0.67

8.5 CONCLUSIONS

In this chapter, we have combined the results of the hydraulic model and the observations from the various pipe and condition databases to provide a set of projects necessary to improve and maintain the collection system. The priorities include addressing capacity based replacement projects that are existing deficiencies, and commencing with a multi-mode condition assessment program to update and verify conditions within the system. The condition assessment program will include a comprehensive wet-weather flow measurement plan and a fast track CCTV inspection program. The goal of the CCTV program is to evaluate the entire collection system within 5 years. The CCTV program will initially begin based on pipe age but may be redirected as results from the flow measurements indicate areas of high infiltration.