City of Santa Paula Wastewater System Master Plan

City of Santa Paula

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Chapter 1 - Executive Summary

Overview

This study provides recommendations and an implementation plan for improvements to Santa Paula's sanitary sewer system. This plan addresses the current sanitary sewer needs as well as the future needs of the City.

Purpose

The City of Santa Paula provides wastewater collection and treatment for local residents. The existing facilities are aging and improvements are needed to maintain the integrity of the system. Other improvements are needed to accommodate the planned growth of the City. Consequently, the City needs to evaluate the hydraulic capacity and the condition of the existing sewer system, and plan for infrastructure replacement and improvement projects. In addition, the City needs to develop a long-term maintenance plan to continue to provide adequate collection and transportation of local wastewater.

The focus of this report is on the collection system (pipelines, manholes, lift stations). Improvements to the treatment system are addressed as a separate project.

Analysis

For this study, the collection system flows were estimated based on data acquired from various sources. In addition, an analysis of the daily pattern of flow (Diurnal Flow) was conducted since wastewater flow in a sewer system is not uniform, but varies throughout the day. The daily peak flow is a critical flow for analysis of the collection system. This is because the peak (highest) flow in the sewer will have the highest depth. If the flow line (depth) is too great, the free discharge of laterals may occur, creating backups. For purposes of this study, a peaking factor of 2.0 times the average daily flow was used to estimate the peak day flow. The present peak to average flow ratio is 1.8 (2.4 MGD to 4.3 MGD).

The diurnal flow patterns, both weekday and weekend, are not expected to change in the future. However the flows, average and peak, are expected to increase in relation to the total population that is

served. The estimated future average dry-weather flow is 4.0 MGD at build-out. Using the peaking factor of 2.0, the expected future peak flow is 8.0 MGD. These figures were used for modeling future flow in the collection system.

Gravity sewer systems are subject to migration of clear water, *Infiltration and Inflow* (I/I) from the outside. The volume of clear water that enters a sewer system has an adverse effect on the hydraulic capacity of the sewers. Consequently, an I/I evaluation was conducted for a portion of the City. The nature of the wet weather flow patterns validated an assumption that most of the clear water in the Santa Paula sewer system can be attributed to inflow. The sum of the maximum I/I plus the peak hourly flow is 7.0 MGD, which approximately 2.6 times the average day flow. For analysis purposes in this report, the peak wet weather flow rate of 3.0 times the average flow was used.

Sources of inflow should be eliminated where practical, since inflow utilizes sewer capacity and is costly to treat. The City should repair broken pipes, leaking pipe joints, offset manhole castings, below grade manhole covers subject to ponding, and any other potential sources of inflow in a timely manner. Of particular importance is diligent observation of the system for surcharge and backflow during wet weather. Regulations regarding spillage of sewage are becoming increasing strict. In accordance with CMOM,[1] in the event of a spill, the City may be required to prove that its system was adequately designed and maintained.

The collection system was modeled in order to determine the hydraulic capacity of the main sewer lines. Modeling is a tool used to evaluate the capacity of pipes in a sewer system. The model is a mathematical analysis. For this study, the model consists of an Excel spreadsheet that was created utilizing Manning's equation to calculate the sewer capacity in terms of percent full pipe. The spreadsheet approach was used because it can be readily used by City staff and other engineers without the need for special software or training. This model was run using for existing and future peak flow, under dry and wet-weather conditions.

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[1] Capacity, Management, Operations, and Maintenance (CMOM) regulations of the U.S. Environmental Protection Agency.

Results

Prior to this study, the City had no standard criteria for the design, analysis, and construction of sewer systems. Such criteria were established and included in this report. Based on the adopted criteria , only two segments of sewer were determined to be undersized for existing conditions. A 10-inch segment is located at Main Street near Blanchard School between manholes 2D43 and 2E05. The other sewer is a 20-inch segment located in Harvard Boulevard between manholes 4D06 and 4D09.

The future flow data input in the Model showed future capacity problems in the following sewer segments:

- 12-inch sewer, east along Harvard Blvd. and north along Garcia and Thirteenth Streets
- 36, and 24-inch sewers from the Wastewater Treatment Plant east to Acacia Road, north to Harvard Blvd. east to Steckel Drive
- 8-inch sewer along Steckel Drive north to Main Street
- 8-inch sewer east along Santa Paula Street to Walden Street, south along Walden and Elm Streets to Harvard Blvd.

Condition Assessment

For this report, a preliminary assessment of the system was performed, based on a review of existing video tapes, video tape logs, observation of select manholes, and interviews with operational staff. Because much of the City system dates to the 1920s and 1930s, deterioration is evident.

Sewer repair and rehabilitation is an ongoing process, as sewers will continue to deteriorate and fail over time. The City, therefore, must be vigilant in their efforts to maintain the system. To this end, this report recommends a plan for immediate sewer rehabilitation as well as a plan for continual observance and corrections within the system.

Based on the review of videotapes, it is apparent that the central or older portion of the City has more problem areas than other areas within the collection system. The City's two lift stations were inspected and both lift stations are at the end of their useful service

lives and in need of replacement. The City should conduct a more detailed hydraulic investigation prior to replacement of both lift stations.

Summary of Recommendations

Based on the information in this report, the following improvement program is recommended:

1. **System Condition Assessment and Cleaning Program**

   - Currently the City inspects about 2.5 percent of their pipeline each year using closed circuit television. This goal should be raised to 10 percent each year, with priority given to the areas shown in **Figure 7-3**. This higher rate should continue until 100 percent of the City has been evaluated, at which time the goal should be re-evaluated.

   - Likewise, 10 percent of all manholes should be inspected annually in addition to inspections conducted while crews are cleaning and/or videotaping the pipelines.

   - Currently, the City cleans about 25 percent of their pipelines each year. Because this goal was established more than 4 years ago, virtually all pipelines have been cleaned. The benefit of continuing to clean at this rate is not clear. It is recommended that this goal be scaled back to 15 percent for two years, then re-evaluated. In general, the amount of cleaning performed should be tailored to the conditions of the system. Some pipes may need several cleanings each year, while others may virtually never need cleaning. Those pipelines which need frequent cleaning should be evaluated regarding the cause, and perhaps targeted for rehabilitation.

2. **Pipeline and Manhole Replacement and Rehabilitation Program**. Much of the existing system dates to the 1920s and 1930s. Very little of it is less than 40 years old. A routine program of pipeline replacement and rehabilitation is needed to keep abreast of deteriorating infrastructure, and avoid the sewage spills and sinkholes that may occur when pipelines and manholes fail. A goal of replacing/rehabilitating 2 percent of this

infrastructure each year is appropriate given the overall age of the system. With such a goal, it will take 50 years to completely replace the current system—at which point the pipelines being replaced will be approximately 100 years old on average.

- Priorities for replacement/rehabilitation are shown in **Figure 8-1**.
- Priorities should be re-evaluated annually, based on the results of the System Condition Assessment Program.

3. **Lift Station Replacements**. As noted earlier, the two existing lift stations should be budgeted for replacement.

4. **Capacity Improvements**. As discussed earlier, only two pipelines were determined to be undersized based on *current* flows; one in Main Street near Blanchard School, and the other at the west end of Harvard Boulevard. On the other hand, the Fagan and East Area developments will require significant upgrades to the existing system, along Harvard Boulevard in particular. As a result, capacity upgrades, in general, should be scheduled based on development schedules. The exception is the upgrade in Main Street which is independent of development activity, and should receive a high priority.

Table 1-1 provides an overview of a recommended capital improvement program, based on the above recommendations.

Conclusion

The City of Santa Paula has been able to provide adequate collection of wastewater from its residents for more than 50 years. To this end, the City must continue to be diligent in operating and maintaining its system including, assessment of capacity and condition on an regular basis. The projects identified in this report are limited to known conditions. An estimated $25 M must be expended to replace sewers based on projects identified in this study. The money should be spent based on project priorities. However, there are still portions of the sewer system for which no information was reviewed. As new information is gathered, the priority of projects should be dynamic such that critical projects, projects that could affect the health and well being of residents, receive top priority.

Table 1-1
Recommended Program of Capital Expenditures (2005 dollars)
Santa Paula Wastewater System Master Plan

Project Description	Unit Cost	Units	City Total Cost	Developer Total Cost	2005/6	2006/7	2007/8	2008/9	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
1 CCTV 10% per of the system per year with first priority given to the pipe shown in Figure 7-3	$1.10	313060 [2]	$344,000		$34,400	$34,400	$34,400	$34,400	$34,400	$34,400	$34,400	$34,400	$34,400	$34,400
2 Inspect 10% of the Manholes per year	$150	1130	$170,000		$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000	$17,000
3 Cleaning of 15% of the system per year for 2 years then re-evaluate[6]	$0.75	47000 [3]	$353,000		$35,300	$35,300	$35,300	$35,300	$35,300	$35,300	$35,300	$35,300	$35,300	$35,300
4 Pipeline Replacement/Rehabilitation Program to replace 2% of the system per year	$110	6300 [4]	$6,930,000		$693,000	$693,000	$693,000	$693,000	$693,000	$693,000	$693,000	$693,000	$693,000	$693,000
5 Manhole Rehabilitation	$2,500	280 [5]	$700,000		$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000	$70,000
6 Lift Station Rehabilitation	$20,000	2			$10,000	$10,000								
7 Pipeline replacement due to future capacity issues per Figure 6-4 [6]														
Fagan Canyon Segment	$650	6600		$4,290,000			$4,290,000							
Adams Canyon Segment	$250	3300		$825,000							$825,000			
East Area 1 Segment	$375	7700		$2,887,500						$2,887,500				
8 Collection System Known Capacity Deficiencies	$8,485,000	1 [9]	$8,485,000		$1,697,000	$1,697,000	$1,697,000	$1,697,000	$1,697,000					
9 Collection System Known Condition Deficiencies	$1,589,000	1 [10]	$1,589,000		$317,800	$317,800	$317,800	$317,800	$317,800					
Total Construction Costs [8]			$ 18,571,000	$ 8,003,000	$ 2,875,000	$ 2,875,000	$ 2,865,000	$ 2,865,000	$ 2,865,000	$ 850,000	$ 850,000	$ 850,000	$ 850,000	$ 850,000
Add 20% for Engineering and Administration			$ 3,714,000	$ 1,601,000	$ 575,000	$ 575,000	$ 573,000	$ 573,000	$ 573,000	$ 170,000	$ 170,000	$ 170,000	$ 170,000	$ 170,000
Add 15% Construction Contingency			$ 2,786,000	$ 1,200,000	$ 431,000	$ 431,000	$ 430,000	$ 430,000	$ 430,000	$ 128,000	$ 128,000	$ 128,000	$ 128,000	$ 128,000
Total Cost			$ 25,071,000	$ 10,804,000	$ 3,881,000	$ 3,881,000	$ 3,868,000	$ 3,868,000	$ 3,868,000	$ 1,148,000	$ 1,148,000	$ 1,148,000	$ 1,148,000	$ 1,148,000

Notes

1. Costs are based on current (2005) dollars.

2. Total system length is 313,060 lineal feet.

3. 15% of system length.

4. 2% of system length.

5. Assumed 25% of the manholes need rehabilitation over the next 10 years.

6. Costs include $50 per lineal foot to account for manholes ($15,000 placed every 300 feet).

7. City currently cleans 25% of the collection system per year. Costs for cleaning should be re-distributed to all for increased televising and benefit should be re-evaluated after 2 years.

8. Costs borne by developers are not included in the annual costs.

9. From Table 8-1, cost distributed over 5 years.

10. From Table 8-2, cost distributed over 5 years.

Chapter 2 - Introduction

This section provides an overview of the Santa Paula area and wastewater collection.

Background

The City of Santa Paula provides wastewater collection and treatment for local residents. The existing facilities are aging and improvements are needed to maintain the integrity of the system. An evaluation of the hydraulic capacity and condition assessment will allow the City to plan for infrastructure replacement and improvement projects. In addition, the City needs to develop a long-term maintenance plan to continue to provide adequate collection and transportation of local wastewater.

Study Objectives and Scope

This study provides recommendations and an implementation plan for improvements to Santa Paula's sanitary sewer system. The plan addresses the current situation and sanitary sewer needs as well as the future needs of the City. The following is a list of activities used to define present and future wastewater projects.

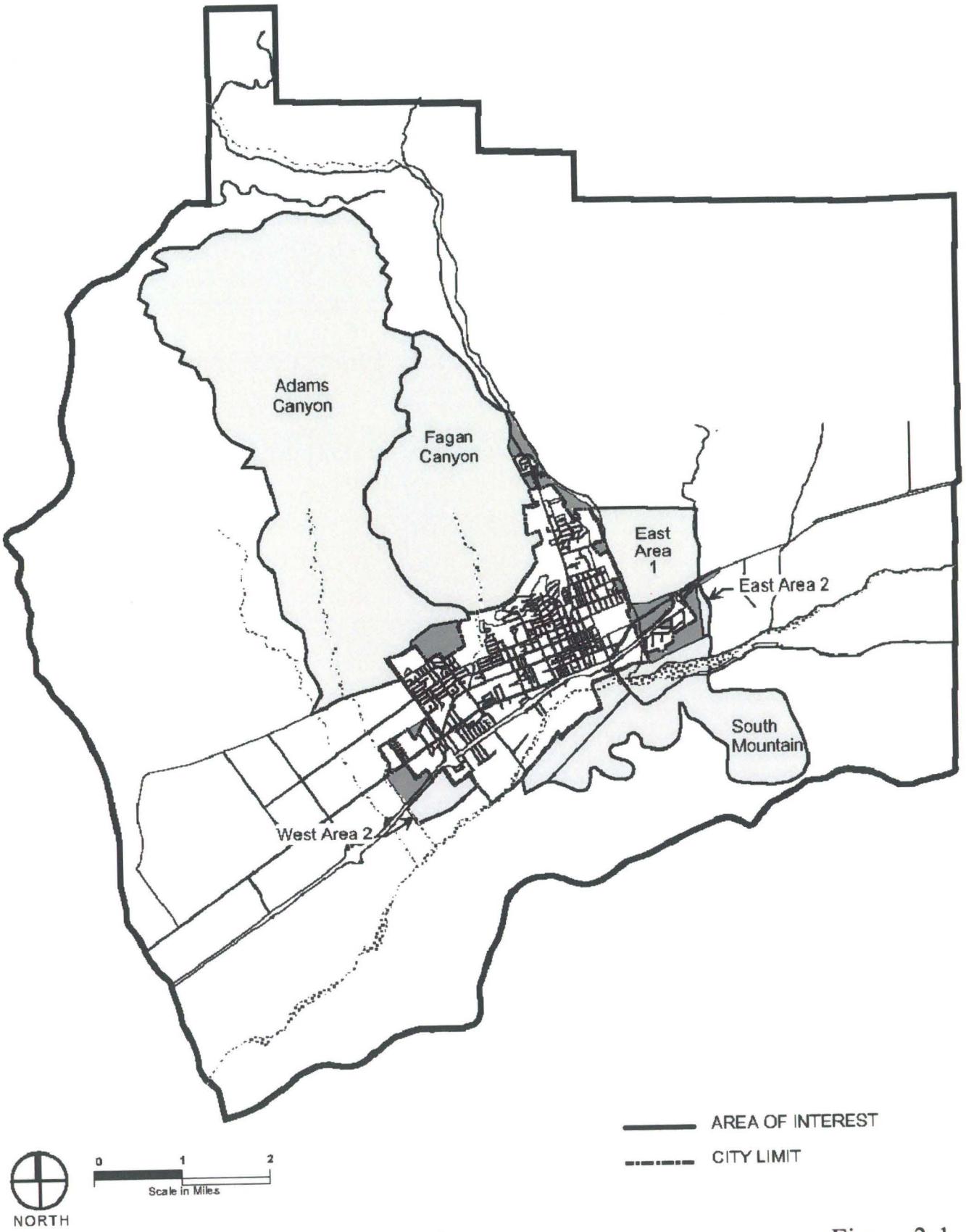
- Data on the existing collection system were gathered.
- Data on present and future land use were gathered.
- Present and future flows in relation to Equivalent Residential Units (ERU) were defined.
- The existing system was broken down into collection basins for analysis purposes.
- Interviews with City staff were conducted to confirm or clarify assumptions on sewage flow rates.
- A limited site investigation was conducted to confirm or clarify some flow assumptions and to assess the condition of selected sewer manholes from various representative areas within the City.

- A review of existing diurnal flow curves and past wastewater treatment plant flow records was conducted to assess peak flow rates and Infiltration and Inflow (I/I) in the sewer system.
- Existing videotape logs and portions of videotapes of the sewer system were reviewed to assess the condition of existing sewers.
- Recommendations for additional videotaping and flow monitoring in specific areas were made to confirm condition assessment and flow assumptions respectively.
- A sewer model of the existing collection system main trunk sewers was developed to assess present and future flow impact on the system capacity.
- A sewer model of the existing collection system with reinforcements to the main trunk sewers was developed to define projects to meet present and future capacity needs.
- Sewer project recommendations were developed based on present capacity needs, future capacity needs and limited condition assessment.
- A plan for implementation of projects was developed.

Study Area Description

The City of Santa Paula is located in Ventura County between the mountain foothills and the Santa Clara River. It is one of the oldest cities in Ventura County. Incorporated in 1902, land use within the City reflects 100 years of building and development. The City owns, operates and maintains over 50 miles of sanitary sewers and a wastewater treatment facility. The majority of the sanitary sewer system was built within the last 50 years however; portions of the sanitary sewer system were built earlier.

The City is surrounded by agricultural land and has experienced steady growth in recent years. **Figure 2-1** shows the sphere of influence of the City and proposed expansion areas within the sphere of influence. The proposed expansion areas are primarily residential.



Expansion Areas

Figure 2-1

Existing Collection System Description

The City of Santa Paula has a network of sanitary sewers ranging in size from 4 inch to 36 inch. Most of the flow in the system is by gravity to the Wastewater Treatment Facility (WWTF), which is located in the southwest corner of the City. The City owns and maintains two small sewer lift stations. The two main trunk sewers follow Harvard Blvd. and SR126 along the south edge of town. The main trunk sewers range in diameter from 10 inch to 36 inch. The majority of the collection system sewer diameters are 6 and 8 inches and serve primarily residential users. **Figure 2-2** is a map of the collection system. Flow are predominantly from north to south and from east to west.

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CITY OF SANTA PAULA
WASTEWATER SYSTEM
MASTER PLAN

EXISTING SANITARY SEWER SYSTEM

VT-S27-105-01	SEPT 2005	FIGURE 2-2

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Chapter 3 - System Database

The analysis of the current sewer system is dependent upon review of existing data. The sources of data are also used as a basis for projecting future conditions. This section describes the data sources used and their relevance for this study.

Database Sources

Several sources of information were collected and used to establish a database for the Santa Paula Sewer System. The sources included:

- Local land use and zoning maps
- Parcel maps
- Selected local development plans
- City General Plan
- Available collection system maps detailing sewer sizes and slopes
- Potable water records (September 2003 to September 2004 and Total Water Use 2002)
- Number of water connections
- Number of sewer connections
- Wastewater treatment plant flow records for selected periods within the years 1998 to 2004
- Other relevant planning studies

The main objective for the data base review was to determine the volume of flow and how the flow is collected throughout the sewer system. Once a database was established a model of the system was created (see Chapter 4).

Current Flow Conditions

The analysis of a sewer system is reliant upon information from the aforementioned sources. Proper evaluation of data is essential to make correct engineering judgment. One of the most important sources of data is the land use plans and zoning information for the City.

Presently, the City has defined geographic boundaries in which residential, commercial, public and industrial areas are defined. Each group generates wastewater, which enters the sewer system and is ultimately treated at the wastewater treatment plant. **Figure 3-1** displays the current zoning for the City of Santa Paula. The zoning map further defines the areas in terms such as single-family residential, high density residential, light industrial, etc. The map shows the location of the various sewer customers. Location is essential for determination of the flow associated with specific segments of the collection system.

Individual pipes (laterals) carry wastewater flow from homes or buildings to the sewer main pipe. The sewer pipe must be adequately sized to carry the flow that accumulates from each lateral. As flow moves through the sewer segments, the flow increases with other lateral connections as well as other sewer pipe connections. The location and type of sewer user e.g. single family residential, commercial, industrial, etc., is used to estimate the flow and accumulation of flow in specific sewer segments.

Typical dry-weather wastewater flow for 2003 was approximately 2.4 million gallons per day (MGD) based on WWTF flow data. This total flow needs to be allocated to wastewater customers in order to establish a reasonable model of the collection system. Since the majority of the flow in Santa Paula is residential, the simplest way to break down the wastewater flow is in equivalent residential units (ERUs). Based on City data, there are 6,621 residential customers, 678 commercial customers and nine industrial customers. For modeling purposes, flow is presented in terms of ERU.

The following is a description of the methodology used to determine ERU values. For this report, an ERU is defined as one residence with 3.5 people and an average wastewater flow rate of 85[2] gallons per person per day[3] (297.5 gallons per day per ERU). **Table 3-1** lists the existing water customers in Santa Paula and the existing potable water demand based on water billing records from September 2003 to September 2004.

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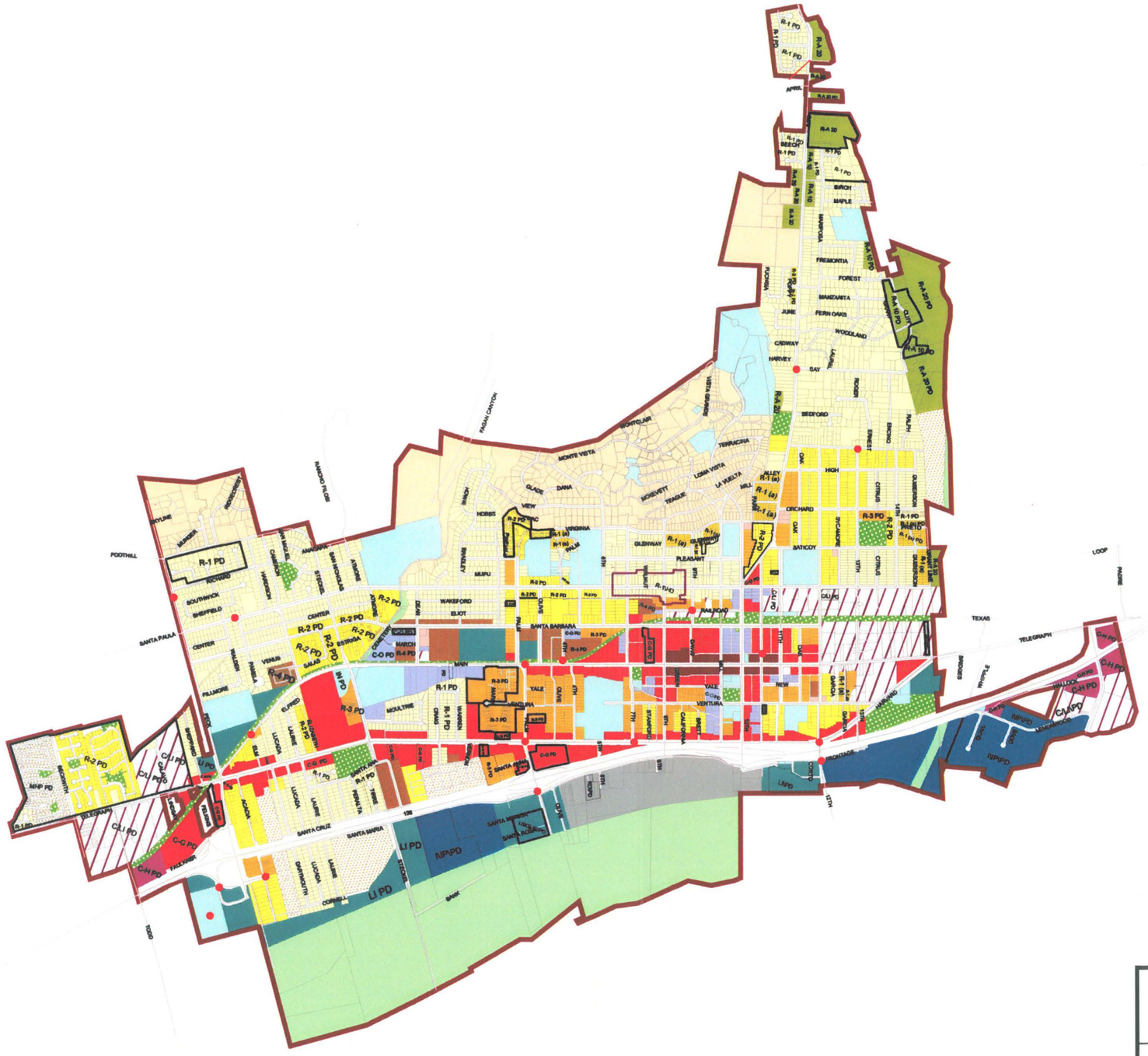
[2] Based on plant meter data for May 2 through May 9, 2004.

[3] Based on 2.4 mgd and 29,000 people.



LEGEND

Zoning

- O Open Space-Passive
- OPR Open Space-Parks & Recreation
- R-A Rural Residential
- HR2-PD Hillside Res. 2-PD (0-3 du/acre)
- R-1 Single Family Residential
- R-1(a) Small Lot Single Family Res.
- R-2 Medium Density Residential
- R-3 Medium-High Density Res.
- R-4 High Density Residential
- MHP Mobile Home Park
- C-N Commerial Neighborhood
- C-O Commercial Office
- C-G General Commercial
- C-H Highway Commercial
- CBD Central Business District
- C/LI Commercial/Light Industrial
- LI Light Industrial
- I Industrial
- IP Industrial Park Overlay
- IN Institutional/Civic
- KO Airport Operational
- KS-IS Airport Safety Zonr Overlay - Inner Safety Subzone
- KS-OS Airport Safety Zone Overlay-Outer Safety Subzone
- KI Airport-Influenced Area Overlay
- RR Railroad Overlay
- PD Planned Development Overlay
- SP Specific Plan
- HD Historica Overlay

City Limits

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CITY OF SANTA PAULA
WASTEWATER SYSTEM
MASTER PLAN

ZONING MAP

VT-S27-105-01 SEPT 2005 FIGURE 3-1

Table 3-1
Existing Customers and Estimated Average Flows
Wastewater System

		Potable Water Demand (AF/yr)	Potable Water Demand (MGD)	ERUs	Wastewater Flow (MGD)
City Center	Small Customers	4,693	4.19002	7294	2.170
1144 Ventura St	Grace Thille School	5.63	0.00503	2	0.001
141 Steckle Dr	Glen City Elementary School	2.21	0.00197	1	0.000
736 Ojai Rd	City of Santa Paula - Mill Park	1.94	0.00173	0	0.000
City Center	City of Santa Paula - Vet Memorial I	4.99	0.00446	0	0.000
1330 Harvard Blvd (E)	City of Santa Paula -DMV	10.96	0.00979	8	0.002
1360 Harvard Blvd (E)	City of Santa Paula - Harding Park	8.95	0.00799	0	0.000
332 San Clemente St	City of Santa Paula - Obregon Park	5.95	0.00531	0	0.000
1430 Santa Clara St	City Concrete/TDI SOUTHDO	10.94	0.00977	25	0.007
City Center	Las Piedras Park	12.87	0.01149	0	0.000
City Center	Teague Park	10.96	0.00979	0	0.000
115 Peck Rd (N)	Blanchard School	13.47	0.01203	4	0.001
1305 Laurel Rd #A	Thelma Bedell School	11.37	0.01015	3	0.001
7680 Pine Grove Rd	Far West Resort	12.75	0.01138	29	0.009
7400 Pine Grove Rd	Far West Resorts Tent Park	6.52	0.00582	15	0.004
430 10th St (N)	McKevett School	6.90	0.00616	2	0.001
145 4th St (N)	Santa Paula SR Apt Assoc	5.74	0.00513	13	0.004
135 4th St	Santa Paula SR Apt Assoc	5.18	0.00463	12	0.003
309 Olive St (N)	Santa Paula Union High School Disti	10.58	0.00945	3	0.001
798 Harvard Blvd (E)	Caltrans	8.60	0.00768	0	0.000
1198 Harvard Blvd (E)	Caltrans	13.62	0.01216	0	0.000
342 Palm Ave (S)	Caltrans	10.87	0.00971	0	0.000
602 Ventura St	Isbell School	17.67	0.01578	5	0.002
1149 Santa Paula (E)	Barbara Webster School	11.25	0.01004	3	0.001
299 Santa Cruz St	Mountain View Mobile Home	11.81	0.01054	27	0.008
710 Harvard Blvd	Mountain View Mobile Home	11.67	0.01042	26	0.008
400 Craig Dr	400 Mobile Home Estates	27.36	0.02443	62	0.018
15245 Telegraph (W)	Twyford Plant Laboratories Inc	16.03	0.01431	48	0.014

Table 3-1
Existing Customers and Estimated Average Flows
Wastewater System

		Potable Water Demand (AF/yr)	Potable Water Demand (MGD)	ERUs	Wastewater Flow (MGD)
103 Peck Rd	Saticoy Lemon Association	23.59	0.02106	53	0.016
825 10th St (N)	Santa Paula Memorial Hospital	11.53	0.01029	35	0.010
1500 Richmond Rd	Oak Mobile Home Estates	25.17	0.02247	57	0.017
500 Santa Maria (W)	Rancho Santa Paula Mobile Home -	15.73	0.01404	35	0.011
501 Santa Maria (W)	Rancho Santa Paula Mobile Home -	15.98	0.01427	36	0.011
720 Santa Maria	Anacapa Mobile Home	16.93	0.01512	38	0.011
273 Santa Paula (W)	Santa Paula Cemetery	24.27	0.02167	0	0.000
801 Santa Paula (W)	Middle Road Mutual - 4" Meter	15.54	0.01388	0	0.000
801 Santa Paula (W)	Middle Road Mutual - 6" Meter	40.12	0.03582	0	0.000
1141 Cummings Rd #2	Limonera Co - 6" Meter	42.86	0.03827	0	0.000
1142 Cummings Rd #1	Limonera Co - 8" Meter	91.51	0.08171	0	0.000
15433 Telegraph (W)	West Santa Paula Mobile Home Park	74.37	0.06640	167	0.050
600 Todd Rd	County Jail	32.89	0.02937	74	0.022
	TOTALS	5400		8076	2.4

ERUs from City	6,621	residential
Flow (based on 85 gal/cap/day)	1,969,748	Gallons per day
Flow from commercial and industrial	433,008	Gallons per day
Industrial and commercial ERUs	1,455	Commercal/Ind
Total present ERUs	8,076	

The table also lists the estimated wastewater flow and ERU values for the various customers. The existing wastewater flows were estimated in the following manner:

> The "small customers" were defined as single-family residences and small businesses. This was determined based on water meter sizes as small customers have water meters of 2 inches or smaller. Since the City records indicate approximately 6,621 customers are residential, a wastewater flow of 1.97 MGD was estimated based on the ERU definition. An additional 0.2 mgd was estimated for the 600 or so other small customers, based on the assumption that the average small business is roughly equal to one ERU. The difference between the potable water demand and the estimated wastewater flow is assumed to be water that is used for landscape irrigation etc.
>
> Wastewater flow for the other water users with meters larger than 2 inches was estimated on a case-by-case basis. For example, zero wastewater flow was attributed to local parks. Although parks may have rest rooms, the flow was assumed to be intermittent and negligible, and therefore, disregarded. Likewise, most water used by schools is for landscape irrigation, so the wastewater percent was estimated at only 20% of the total potable water used. Other users such as apartments and mobile home parks had wastewater flow estimated based on 75% of the water use, assuming 25 % of the water was used for irrigation.

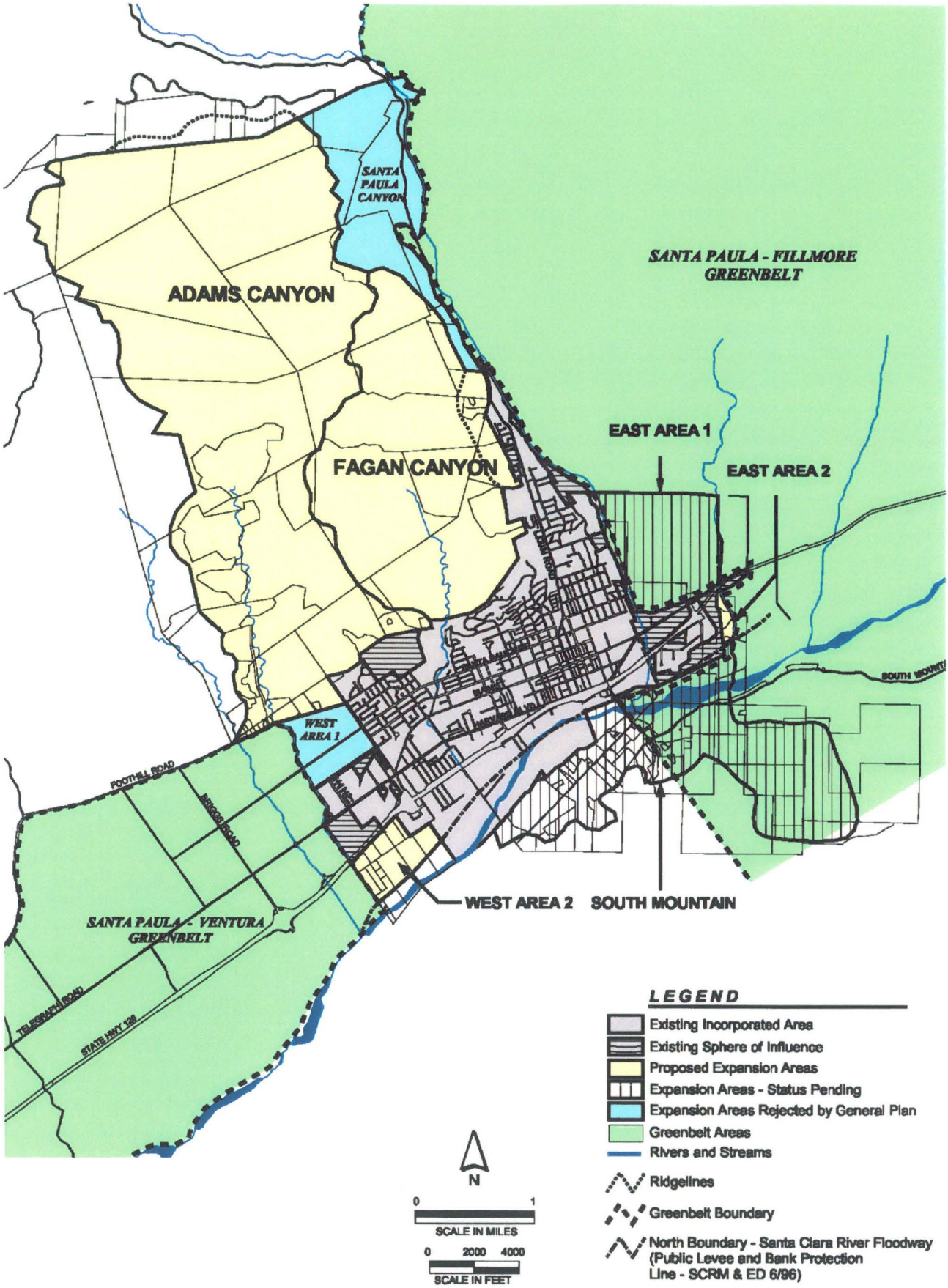
The total existing wastewater flow predicted by the model is 2.4 MGD. The estimated wastewater flow based on our assumptions and technique matched favorably with the reported flow at the wastewater treatment plant. In addition, ADS Environmental Services prepared a "Temporary Flow Monitoring Report" for the period of September 1, 2004 through September 14, 2004 as part of a different City project. The flow monitors located at the influent and effluent to the WWTP recorded an average daily flow of 2.40 MGD and 2.47 MGD respectively. Consequently, this database was used as a snapshot calibration for the model development.

Future Flow Conditions

The City of Santa Paula has a general plan for growth of the community within their Sphere of Influence. **Figure 3-2** is a map showing the expansion areas surrounding the City. Based on information provided by the City Planning Department, the specific plan for the Fagan Canyon development and the City's General plan, **Table 3-2** was developed. The table is similar to **Table 3-1**, however, anticipated future flows are included.

Future ERUs were calculated based on the anticipated water use. On Table 3-2, the potable water demand and number of residential units are noted. The wastewater was calculated based on the assumption that 75% of potable water sold to the residential customers would enter the collection system as wastewater. The remaining 25% would be water used for lawn maintenance and would not enter the sanitary sewer system. The estimated wastewater flow was used to determine future ERUs based on the definition of one ERU equivalent to 3.5 people and 85 gallons per person per day of projected flow. Wastewater from other users such as commercial, schools, etc., was estimated on a case-by-case basis.

Using the aforementioned method to estimate future wastewater flow in the collection system results in an estimated future wastewater flow of 3.7 MGD. This suggests that approximately 57% of the total potable water sold will enter the collection system. Currently about 50% of the water sold enters the sanitary sewer system. The assumption that more than 50% of the potable water sold will enter the sanitary sewer system provides a conservative estimate for flow in the sewer model. The importance of conservative design for the sewer system cannot be understated. Generally, the sewer system will provide a useful service life for the community above that of the wastewater treatment plant. This is evidenced by the fact that many of the existing sewers are more than 30-years old.



CITY OF SANTA PAULA
FUTURE GROWTH AREAS

Figure 3-2

Table 3-2
Future Customers and Average Flows
Wastewater System

Location	Customer Type	Units	Water Demand (AF/yr)	Water Demand (gpm)	ERUs	Wastewater Average Dry Weather Flow (MGD)
City Center	Small Customers		4,693	2,909	7294	2.1700
City Center	Allowance for Fill-in		235	145	365	0.1085
1144 Ventura St	Grace Thille School		2.25	1.4	1	0.0004
141 Steckle Dr	Glen City Elementary School		0.88	0.5	1	0.0002
736 Ojai Rd	City of Santa Paula - Mill Park		1.94	1.2	0	0.0000
City Center	City of Santa Paula - Vet Memorial Park		1.00	0.6	0	0.0000
1330 Harvard Blvd (E)	City of Santa Paula -DMV		10.96	6.8	8	0.0024
1360 Harvard Blvd (E)	City of Santa Paula - Harding Park		1.79	1.1	0	0.0000
332 San Clemente St	City of Santa Paula - Obregon Park		1.19	0.7	0	0.0000
1430 Santa Clara St	City Concrete/TDI SOUTHDO		10.94	6.8	25	0.0073
City Center	Las Piedras Park		2.57	1.6	0	0.0000
City Center	Teague Park		4.38	2.7	0	0.0000
115 Peck Rd (N)	Blanchard School		5.39	3.3	3	0.0010
1305 Laurel Rd #A	Thelma Bedell School		11.37	7.0	7	0.0020
7680 Pine Grove Rd	Far West Resort		12.75	7.9	29	0.0085
7400 Pine Grove Rd	Far West Resorts Tent Park		6.52	4.0	15	0.0044
430 10th St (N)	McKevett School		2.76	1.7	2	0.0005
145 4th St (N)	Santa Paula SR Apt Assoc		5.74	3.6	13	0.0038
135 4th St	Santa Paula SR Apt Assoc		5.18	3.2	12	0.0035
309 Olive St (N)	Santa Paula Union High School District		4.23	2.6	3	0.0008
798 Harvard Blvd (E)	Caltrans		0.00	0.0	0	0.0000
1198 Harvard Blvd (E)	Caltrans		0.00	0.0	0	0.0000
342 Palm Ave (S)	Caltrans		0.00	0.0	0	0.0000
602 Ventura St	Isbell School		7.07	4.4	4	0.0013
1149 Santa Paula (E)	Barbara Webster School		4.50	2.8	3	0.0008
299 Santa Cruz St	Mountain View Mobile Home		11.81	7.3	27	0.0079

Table 3-2
Future Customers and Average Flows
Wastewater System

Location	Customer Type	Units	Water Demand (AF/yr)	Water Demand (gpm)	ERUs	Wastewater Average Dry Weather Flow (MGD)
710 Harvard Blvd	Mountain View Mobile Home		11.67	7.2	26	0.0078
400 Craig Dr	400 Mobile Home Estates		27.36	17.0	62	0.0183
15245 Telegraph (W)	Twyford Plant Laboratories Inc		16.03	9.9	48	0.0143
103 Peck Rd	Saticoy Lemon Association		4.72	2.9	11	0.0032
825 10th St (N)	Santa Paula Memorial Hospital		11.53	7.1	35	0.0103
1500 Richmond Rd	Oak Mobile Home Estates		25.17	15.6	57	0.0169
500 Santa Maria (W)	Rancho Santa Paula Mobile Home		15.73	9.8	35	0.0105
501 Santa Maria (W)	Rancho Santa Paula Mobile Home		15.98	9.9	36	0.0107
720 Santa Maria	Anacapa Mobile Home		16.93	10.5	38	0.0113
273 Santa Paula (W)	Santa Paula Cemetery		4.85	3.0	0	0.0000
801 Santa Paula (W)	Middle Road Mutual - 4" Meter		3.11	1.9	7	0.0021
801 Santa Paula (W)	Middle Road Mutual - 6" Meter		8.02	5.0	18	0.0054
1141 Cummings Rd #2	Limonera Co - 6" Meter		42.86	26.6	96	0.0287
1142 Cummings Rd #1	Limonera Co - 8" Meter		91.51	56.7	206	0.0613
15433 Telegraph (W)	West Santa Paula Mobile Home Park		74.37	46.1	167	0.0498
600 Todd Rd	County Jail		32.89	20.4	74	0.0220
City Center Total			5,445	3376	8725	2.5958
Fagan	SF Residences	1862 units	1,022	633.6	1862	0.5539
Fagan	MF Residences	638 units	161	99.7	638	0.1356
Fagan	Commercial	0.5 acres	1	0.6	2	0.0007
Fagan	Schools	10 acres	4	2.2	2	0.0006
Fagan	Golf course/parks/landscaped commons	324 acres	143	88.4	0	0.0000
Fagan Total			1,330	825	2504	0.6908
Adams	SF Residential	41 units	14	8.5	41	0.0122
Adams	MF Residential	0 units	0	0.0	0	0.0000
Adams	Commercial	- SF	0	0.0	0	0.0000

Table 3-2
Future Customers and Average Flows
Wastewater System

Location	Customer Type	Units	Water Demand (AF/yr)	Water Demand (gpm)	ERUs	Wastewater Average Dry Weather Flow (MGD)
Adams	Schools	0 acres	0	0.0	0	0.0000
Adams	Golf course/parks/landscaped commons	0 acres	0	0.0	0	0.0000
Adams Total			14	8	41	0.0122
East Area 1	SF Residential	742 units	609	377.3	1370	0.4075
East Area 1	MF Residential	158 units	111	68.9	250	0.0744
East Area 1	Commercial	0 SF	0	0.0	0	0.0000
East Area 1	Schools	10 acres	4	2.2	8	0.0024
East Area 1	Golf course/parks/landscaped commons	163.5 acres	72	44.6	162	0.0482
East Area 1 Total			795	493	1790	0.5325
East Area 2	Commercial/Industrial	1,600,830 SF	74	45.7	221	0.0658
East Area 2 Total			74	46	221	0.0658
So. Mtn	Golf course/parks	15 acres	33	20.5	0	0.0000
So. Mtn Total			33	20	0	0.0000
West Area 2	Commercial	2,646,270 acres	122	75.5	366	0.1088
West Area 2 Total			122	76	366	0.1088
Grand Total			7,813	4,843	13647	4.0

Chapter 4 – Diurnal Flow Curves

Wastewater flow in a sewer system is not uniform, but varies throughout the day. For example, late night and early morning flows in the collection system are low. As businesses open and people get ready for work, school or other daily activities, the flow in the collection system rises. An analysis of the daily pattern of flow (Diurnal Flow) is necessary to correctly model Santa Paula's sewer system.

Development of Existing Diurnal Flow Curves

The Santa Paula Wastewater Treatment Facility has a chart recorder that records flow to the plant throughout the day. Several weeks of daily flow charts were reviewed to determine an average diurnal curve. Data from May 2, 2004 through May 10, 2004 was used to develop the diurnal flow curves **Figure 4-1** and **Figure 4-2**. **Figure 4-1** shows the typical pattern of flow through the wastewater treatment facility on weekdays. **Figure 4-2** depicts flow to the wastewater treatment plant on weekends. The same diurnal flow patterns are noted in the "Temporary Flow Monitoring Report", prepared by ADS Environmental Services for the period of September 1 through September 14, 2004. Flow monitoring at various points within the collection system was conducted as part of this study (details of the flow monitoring are discussed in Chapters 6 and 7). The monitoring was conducted between November 30, 2004 and December 13, 2004. The typical diurnal curves generated at four of the five monitoring locations were consistent with the diurnal flow curve having late night and early morning low flow and peak flow at mid morning followed by a second peak occurring in the early evening.

All of the reviewed flow monitoring data were consistent in relation to the shape of the diurnal curve. During weekdays, as noted on **Figure 4-1**, the flow rate begins to increase after 4:00 AM and peaks at approximately 10:00 AM. Weekend flow peaks at approximately 12:00 PM. The daily peak flow is a critical flow for analysis of the collection system. This is because the peak (highest) flow in the sewer will have the highest depth. The depth of flow in a sewer is critical. If the flow line (depth) is higher than lateral or other sewer connections, thereby preventing free discharge of flow, back-ups could occur. Back-up of sanitary sewage in homes and business is a public health concern. As noted on **Figure 4-2** the peak daily flow (during dry weather) is approximately 4.3 MGD.

The relationship between peak flow and average flow was used to establish a peaking factor. Based on a peak flow of 4.3 MGD and an

average daily flow of 2.4 MGD, the ratio of peak to average flow is 1.8. For purposes of this study, a factor of 2.0 times the average daily flow will be used to define the peak weather flow.

FIG 4-1

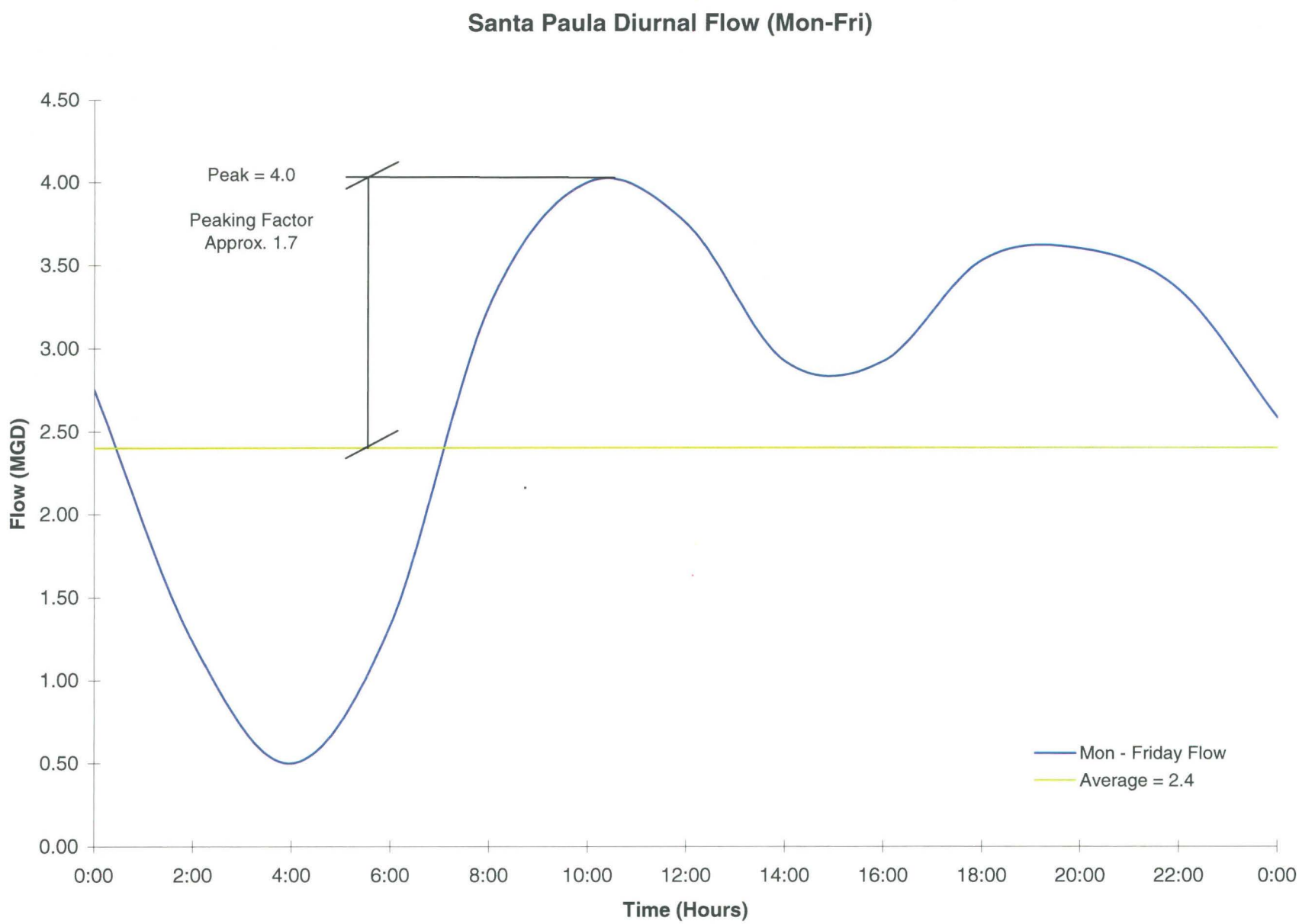
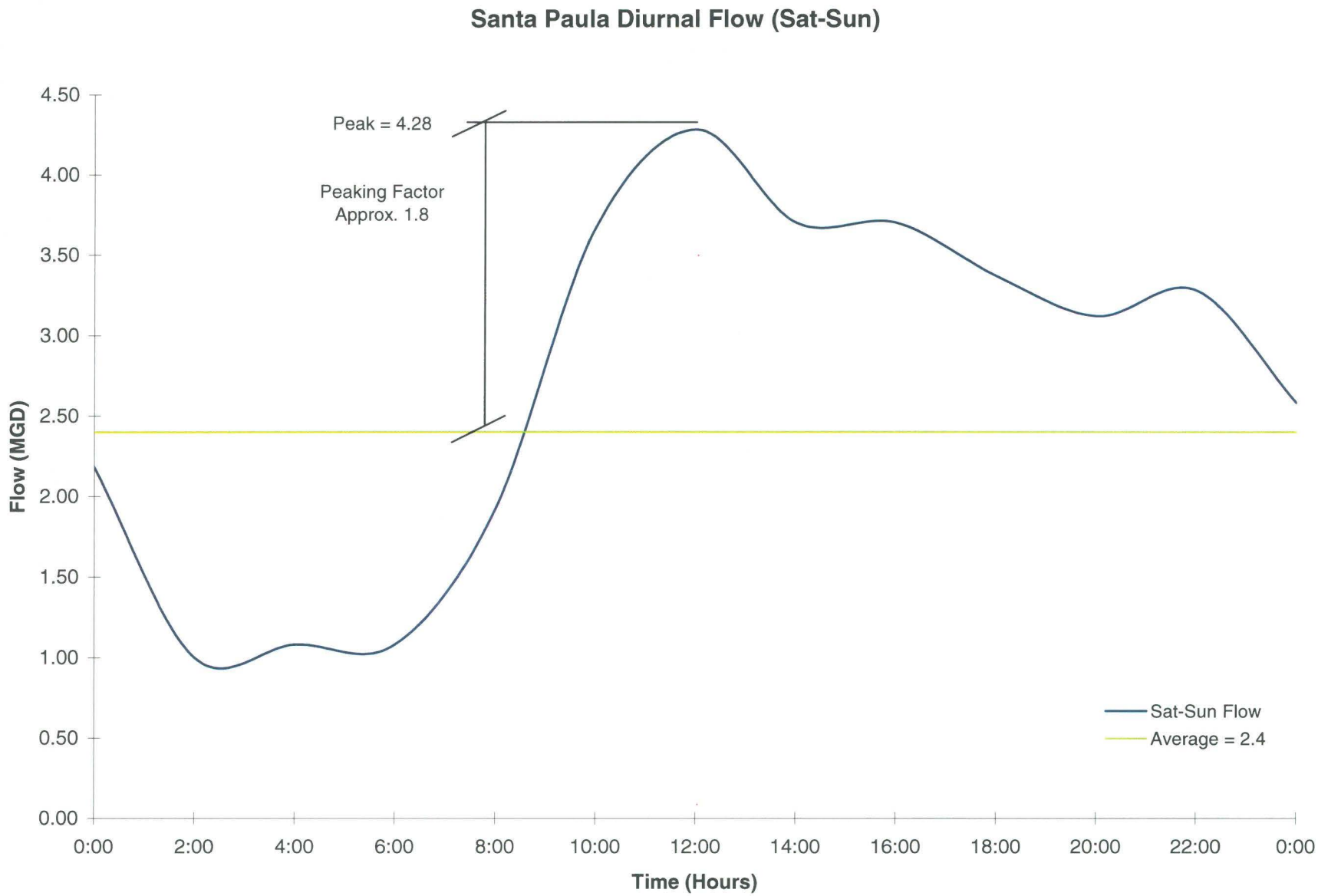

Santa Paula Diurnal Flow (Mon-Fri)
Peak = 4.0
Peaking Factor
Approx. 1.7
Flow (MGD)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time (Hours)
Mon - Friday Flow
Average = 2.4

FIG 4-2


Santa Paula Diurnal Flow (Sat-Sun)
Peak = 4.28
Peaking Factor
Approx. 1.8
Flow (MGD)
4.50
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time (Hours)
Sat-Sun Flow
Average = 2.4

Development of Future Flow

The diurnal flow patterns, both weekday and weekend, are not expected to change in the future. However the flows, average and peak, are expected to increase. As noted in Section 3, **Table 3-2**, the total number of ERUs is expected to increase, resulting in an average flow of 4.0 MGD at build-out. Using the peaking factor of 2.0, the expected future peak flow is 8.0 MGD. These figures will be used for modeling future flow in the collection system.

Chapter 5 - Infiltration and Inflow Analysis

Gravity sewer systems are subject to migration of clear water from the outside. The volume of clear water that enters a sewer system has an adverse effect on the hydraulic capacity of the sewers. Understanding the existing sewer conditions includes an evaluation of the additional clear water component of the wastewater flow.

Review of Past Documentation

Infiltration and Inflow (I/I) is clear water that enters the sewer system. Ground water that enters sewer pipes through cracks and weak joints is termed infiltration. Infiltration is usually present when the groundwater table is high and/ or when rain saturates the soil surrounding the sewer pipes, manholes and laterals. Inflow is clear water that enters the sewer system during rain events. Pick holes in manhole covers, off set manhole rims, cross connections from storm water catch basins, roof and foundation drains and illegal sump pump connections are all sources of inflow. Large quantities of I/I in a sewer system reduce the capacity of the sewers and adversely affect the hydraulic capacity of the wastewater treatment plant. Communities that experience flow rates in excess of 120 gallons per capita per day (gpcd) are required by EPA to perform a Sewer System Evaluation Survey (SSES) to define clear water sources and identify a plan for I/I removal.

Based on the Santa Paula's wastewater treatment plant records, the average daily flow is approximately 85 gpcd. Consequently, excessive I/I are not present in the sewer system. Because of the link between I/I and rainfall, the average monthly rainfall totals in Ventura County for the past 10 years were reviewed (January 1994-September 2004, see Appendix). The wettest month in the 10-year period was February 1998. The most recent wet month was February 2004. Daily wastewater treatment plant flow records for February 1998 and February 20 through 28, 2004 were reviewed. **Table 5-1** shows the average day wastewater rate and recorded precipitation. The data shown in **Table 5-1** indicates that average wet weather daily flow is about 2.0 times the average dry weather daily flow. The table also shows that peaking occurs quickly and dissipates quickly. This is indicative of inflow rather than infiltration since infiltration usually dissipates gradually over time. The reason infiltration dissipates over time is because the clear water entering the sewer is due to high ground water or saturated soil conditions which can linger weeks beyond a rain event. Inflow, however, flows directly into the sewer

during the rain event. When the rain stops the inflow of clear water also stops.

Table 5-1
WWTP Flow and Precipitation

Date	WWTF Flow (MGD)	Precipitation (in)			
		Station 97 Port Hueneme	Station 101 Piru	Station 152 Camarillo	Station 156 Oxnard
2/20/98	2.56	0.00	0.00		
2/21/98	2.59	0.17	0.35		
2/22/98	3.32	0.61	1.97		
2/23/98	4.62	1.76	3.94		
2/24/98	3.24	0.01	0.08		
2/25/98	2.74	0.00	0.00		
2/26/98	2.65	0.00	0.00		
2/27/98	2.54	0.00	0.00		
2/28/98	2.61	0.00	0.00		
2/20/04	2.32		0.00	0.00	0.00
2/21/04	2.48		0.00	0.50	0.52
2/22/04	2.63		0.20	0.36	0.82
2/23/04	2.65		0.20	0.01	0.00
2/24/04	2.28		0.00	0.00	0.00
2/25/04	3.50		0.04	1.46	3.05
2/26/04	3.23		0.00	0.41	0.09
2/27/04	ND		0.00	0.00	0.00
2/28/04	2.25		0.00	0.00	0.00

Indicates high WWTF flow and local precipitation

Precipitation from CIMIS data base, Ventura daily reports

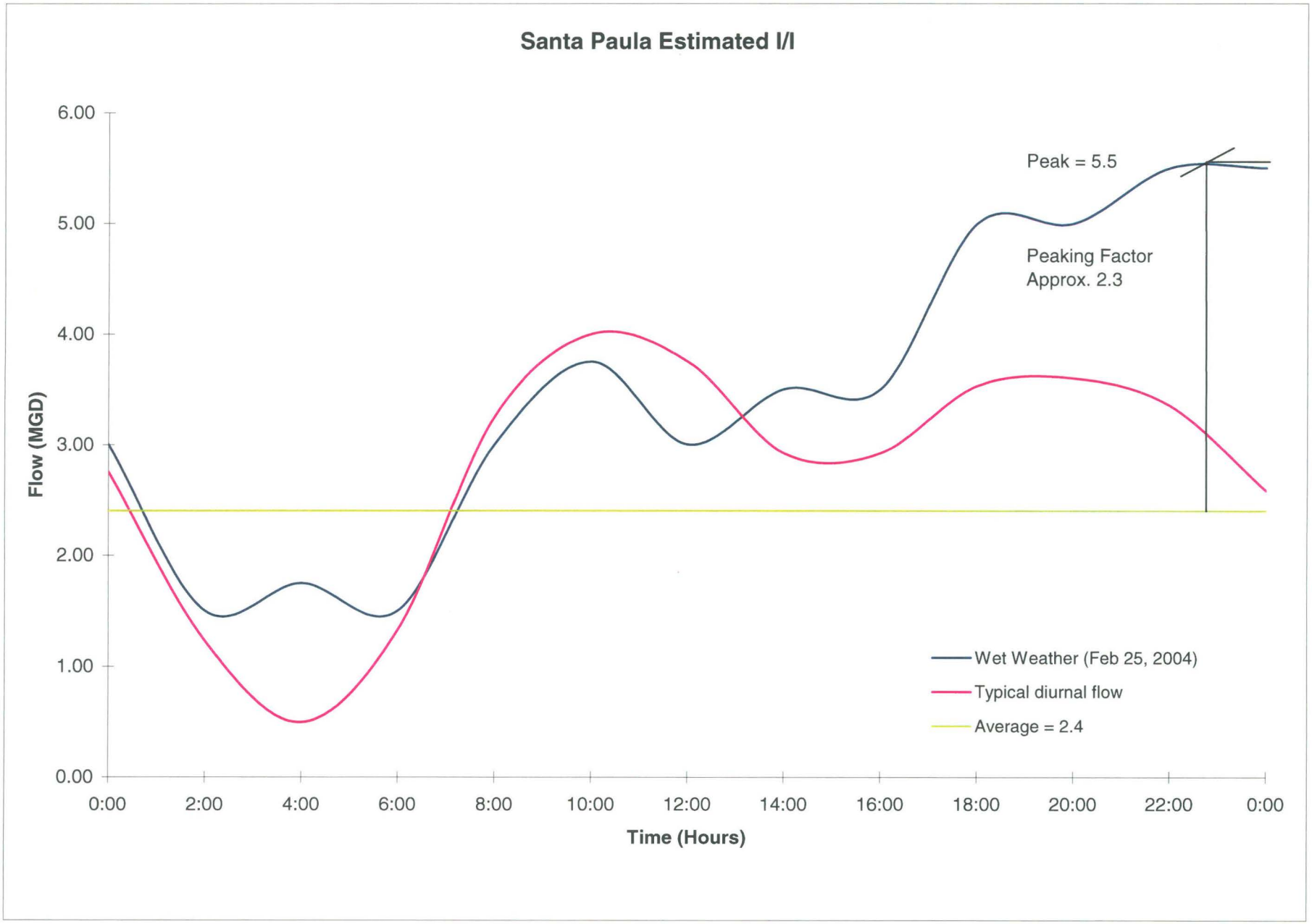
Review of Wet Weather Flow Information

The most recent significant rainfall occurred on February 25 and 26, 2004. Daily flow curves for the aforementioned dates were compared to the typical diurnal flow curve. **Figure 5-1** and **Figure 5-2** show the relationship between the flow curves. As noted, during the afternoon of February 25th through the early morning hours of February 26th, the flow rate was much larger than usual. The difference in flow between the curves is most probably I/I. The nature of the flow pattern validates the assumption that most of the clearwater in the Santa Paula sewer system can be attributed to inflow.

Because the rainfall occurred in the evening and early morning, the flow to the wastewater treatment plant peaked at approximately 5.5 MGD. If the rainfall had occurred during midday, the peak flow would have been greater. Consequently, the following assumptions were made. As noted on **Figure 5-1** the maximum I/I rate is 2.75 MGD. The peak hourly flow (see diurnal flow curve **Figure 4-2**) is 4.28 MGD. The sum of the maximum I/I plus the peak hourly flow is 7.03 MGD, which approximately 2.6 times the average day flow. For analysis purposes in this report, the peak wet weather flow rate of 3.0 times the average flow was used.

Sources of inflow should be eliminated if possible, since inflow utilizes sewer capacity and is costly to treat.

The City must repair any broken pipes, offset manhole castings, below grade manholes subject to ponding and any other potential sources of inflow in a *timely manner*. And, they must be diligent in observing surcharge and backflow in sewer pipes during wet weather. Inflow sources may be more easily identified through observation of high flow in pipe segments during wet weather.



I/I = 5.5-2.4=3.1 MGD
Worst Case (Sat-Sun Peak)
I/I = 4.28+3.1 = 7.38
Peaking Factor
7.38/2.4=3.08

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Figure 5.1

BOYLE Engineering Corp

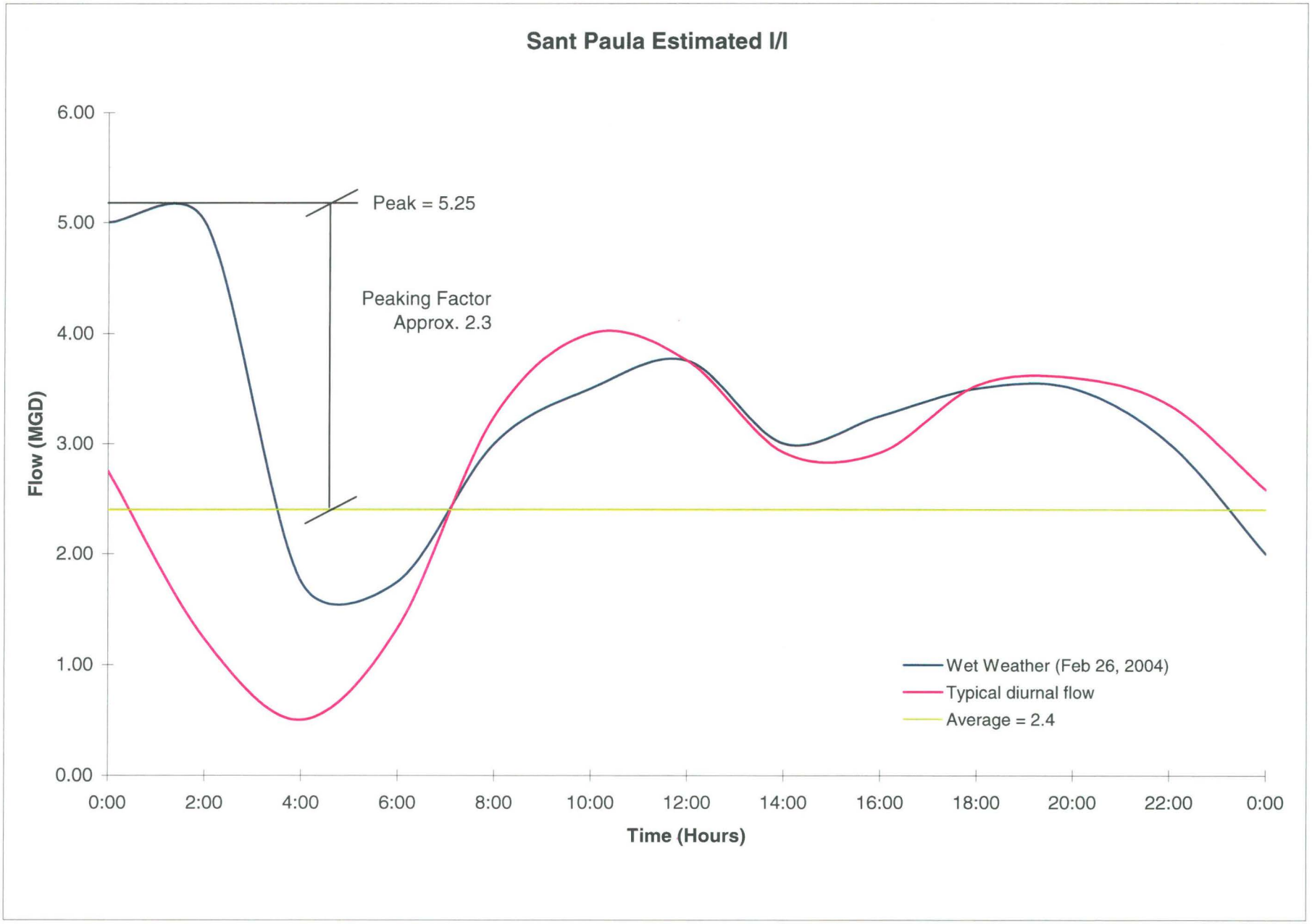

Figure 5-2

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BOYLE Engineering Corp

Chapter 6 – Sewer Flow Model

Sewer modeling is a tool used to evaluate the capacity of pipes in a sewer system. The model is a mathematical analysis. Features of the sewer system such as, the pipe diameter, the slope of the pipe, the material of construction, and the maximum depth of flow are defined and put into the computer model. The model then uses mathematical equations to calculate the capacity of the sewer segment.

The collection system was modeled in order to determine the hydraulic capacity of the main sewer lines. The model is an Excel program that utilizes Manning's equation to calculate the sewer capacity in terms of percent full pipe.

Model Criteria

The sewer model was developed based on the criteria noted on **Table 6-1**. The peaking factors an ERU flow components were developed based on actual flow data as discussed in previous chapters of this report.

The model formulas were based on the Manning Equation:

$$V=(1.486/n)r^{2/3}s^{1/2}$$

Where:

V=velocity
n=roughness coefficient
r=hydraulic radius
s=slope

This criteria for pipe noted in **Table 6.1** indicates n equal to 0.013 for clay or concrete pipe and 0.011 for PVC. A roughness coefficient of 0.012 was used in the equation since existing pipe materials were not readily known.

Table 6-1
Wastewater System Criteria

Criterion	Value	Comment
Average Dry Weather Flow (ADWF)	Measured quantity of flow over a dry weather period / time period	Should be equal to flow generation
Peak Dry Weather Flow (PDWF) Avg flow < 2 cfs Avg flow between 2 and 8 cfs Avg flow over 8 cfs	 2.5 x ADWF 2.25 x ADWF 2.0 x ADWF	Peak flow measured over a period of dry weather
Peak Wet Weather Flow (PWWF)	3 x ADWF	Based on Parsons Preliminary Design Report for the Wastewater Treatment Facility
Wastewater Generation	Residential Units x Persons per Household x Per Capita Generation	For commercial/industrial users, use Equivalent Residential Units
Equivalent Residential Units (ERUs) for commercial and industrial customers	1 for services up to 2-inch Large services based on water use and estimated wastewater flow as described in Chapter 3	Based on water service size
Persons per household	Apts: 2.5 Existing Houses: 3.5 New Houses: 3.5	Estimates based on Downtown Improvement Plan Report, to be verified with City General Plan

Table 6-1
Wastewater System Criteria (cont.)

Criterion	Value	Comment
Per Capita Generation	85 gallons/person/day	Based on average treatment plant flows and 2004 population estimates
Manning "n"	0.013 for VCP and concrete 0.011 for PVC and HDPE	
Maximum Depth of Flow	d/D = 0.5 for PDWF, 12 inch pipes and smaller d/D = 0.67 for PDWF, 15-inch pipes and larger d/D = 0.75 for PWWF	
Minimum Velocity	At least 2 fps when flowing half full	
Maximum Velocity	Not more than 8 fps	
Minimum sewer size	8 inch	6-inch can be used where the following conditions are met: • slope of 0.0080 or greater • length of 200 feet or less • serves 10 units or less
Minimum slopes	0.0080 for 6-inch 0.0044 for 8-inch 0.0036 for 10-inch 0.0024 for 12-inch 0.0016 for 15-inch 0.0014 for 18-inch 0.0010 for 21-inch and larger	

Table 6-1
Wastewater System Criteria

Criterion	Value	Comment
Substandard slope	To be reviewed and approved on case-by-case basis	
Location of Manholes	Maximum 350 ft spacing At changes is slope At changes in alignment At points of reverse curvature At junctions in mains At upstream ends of all mains longer than 200 ft	
Standard Depth	Pipe invert to be 8-ft below curb invert	

Model Input

The collection system was broken into sewer basins. **Figure 6-1** shows the collection system and the basin designations. **Figure 6-1** also shows the relationship between the basins as the flow combines in the main trunk sewers. Use of the basin approach allows the model to define flow for a specific region or regions.

Two weeks of flow monitoring was conducted November 30 through December 13, 2004, in order to verify the flow assumptions from particular basins.

Five flow meters were installed throughout the collection system. The locations are noted on **Figure 6-2**. The flow meters recorded flow at 15-minute intervals throughout the two-week period. The data collected from the meters was reviewed and compared to assumptions used in the flow model development. Unfortunately, the collected data and the model assumptions could not be related in three of the five locations for the following reasons:

- The flow data collected from the meter located in MH 7E04 showed significant spikes or peak flow occurring routinely in the morning hours. The peak flow was recorded as high as 30 times the average flow. The City was made aware of this phenomenon and will be investigating.

- The flow data collected from MH 7D28 was about 40% less that predicted, however, the video logs for the same segment of sewer indicate that the line was plugged and equipment could not get through the section. Thus, the recorded flow data is suspect.

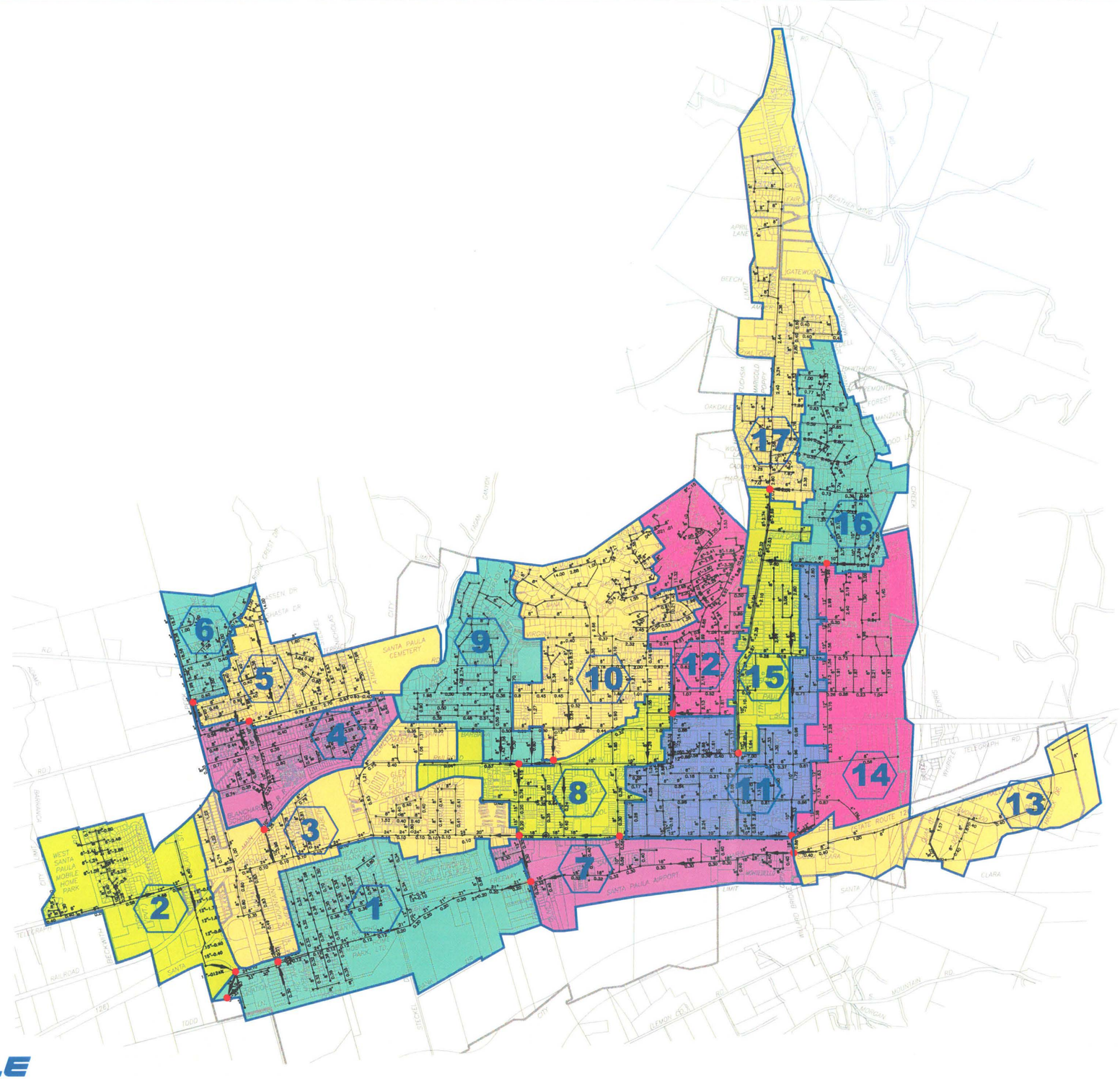
- The flow data from 8G05 is suspect due to prolonged periods of no flow measurement.

Flow data collected from MH 2E04 and MH 7E02 did correlate with the model and the measured flow was within 3% and 19% respectively of the modeled flows.

Figure 6-2 shows the concentration points for flow input into the model and pipes analyzed. Also noted on the figure is the ERU count

for each specific basin. The ERU count was based on the number of parcels, the zoning designation and the large customers as defined in Chapter 3. **Table 6-2** and **Table 6-3** are the Excel spreadsheets that make up the model of the existing conditions.

The sewer segment, diameter and slope were input to the model. The manning equation was then used to calculate the flow at 50% and 67% full. Based on the size of the sewer, the maximum flow depth criteria noted in **Table 6-1** (50% for 12-inch pipes and smaller, 67% for 15-inch pipes and larger and 75% for peak wet weather flow all pipe sizes) and the ERU criteria, the maximum flow in terms of ERU was calculated. The calculated ERU was then compared to the estimated ERU and a determination was made regarding the flow rate as less than capacity, at capacity or above capacity. Sewer segments that were determined to be at or above capacity were analyzed further; see **Table 6-4** through **Table 6-8**, to determine the actual flow rate and depth of flow. Additionally, the upstream sewer segments were modeled to determine the limits of the capacity problem



ZONE ID	ERU COUNT	CONTRIBUTING ZONES
ZONE 1	530	1+2+3+7
ZONE 2	598	2
ZONE 3	891	3+4+8
ZONE 4	623	4+5+6
ZONE 5	391	5
ZONE 6	215	6
ZONE 7	106	7+13+14
ZONE 8	358	8+9+11
ZONE 9	416	9+10
ZONE 10	546	10
ZONE 11	639	11+12+15
ZONE 12	431	12
ZONE 13	57	13
ZONE 14	375	14+16
ZONE 15	336	15+17
ZONE 16	298	16
ZONE 17	492	17

LEGEND

- CONCENTRATION POINT
- FLOW DIRECTION
- 13 ZONE ID

1000' 500' 0 1000' 2000'

SCALE IN FEET

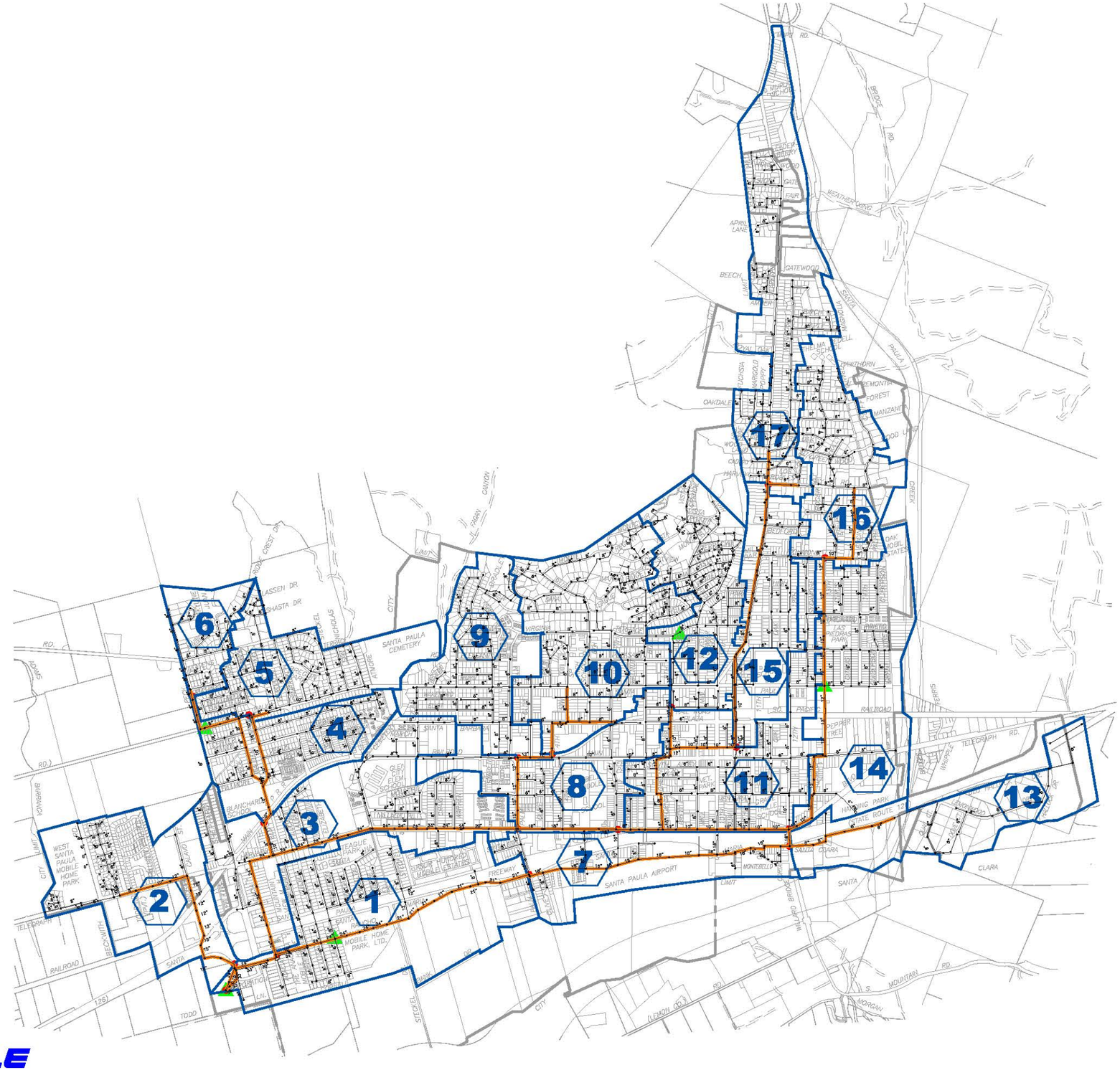
BOYLE

CITY OF SANTA PAULA WASTEWATER SYSTEM MASTER PLAN

SEWER BASINS

VT-S27-105-01 SEPT 2005 FIGURE 6-1

DWG: F:\ellison\S2710501 - Santa Paula MPA\CAD\ADDITIONAL DWGS\Figures\Figure 6-1.dwg USER: kmartin
DATE: Sep 27, 2005 8:39am XREFS: Santa Paula Lots Sewer Pipes Color 0 Width



ZONE ID	ERU COUNT	CONTRIBUTING ZONES
ZONE 1	530	1+2+3+7
ZONE 2	598	2
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ZONE 4	623	4+5+6
ZONE 5	391	5
ZONE 6	215	6
ZONE 7	106	7+13+14
ZONE 8	358	8+9+11
ZONE 9	416	9+10
ZONE 10	546	10
ZONE 11	639	11+12+15
ZONE 12	431	12
ZONE 13	57	13
ZONE 14	375	14+16
ZONE 15	336	15+17
ZONE 16	298	16
ZONE 17	492	17

LEGEND

- PIPES ANALYZED
- CONCENTRATION POINT
- FLOW METER LOCATIONS
- ZONE ID

1000' 500' 0 1000' 2000'

SCALE IN FEET

BOYLE

CITY OF SANTA PAULA
WASTEWATER SYSTEM
MASTER PLAN

PIPELINE ANALYZED IN THE MODEL

VT-S27-105-01 | SEPT 2005 | FIGURE 6-2

DWG: F:\94171 PAULA\S27105\01 - Santa Paula MP\CAD\ADDITIONAL DWGS\Figures\Figure 6-2.dwg USER: kmorin
DATE: Feb 21, 2006 1:17pm XREFS: Santa Paula.dwg Sewer Pipes Color/ 0 Width

Table 6-2
Existing Conditions- Dry Weather

Flow Calculation Data		
Persons Per Household =	3.5	
Per Capita Generation =	85	gpd
Generation Per Household =	297.5	gpd
=	0.00046	cfs
Peaking Factor =	2	
Peaked Generation =	0.000921	cfs
Manning's "n" =	0.012	

ERU Count	
Zone 1	530
Zone 2	598
Zone 3	891
Zone 4	623
Zone 5	391
Zone 6	215
Zone 7	106
Zone 8	358
Zone 9	416
Zone 10	546
Zone 11	639
Zone 12	431
Zone 13	57
Zone 14	375
Zone 15	336
Zone 16	298
Zone 17	492
Total =	**7302**

Collection Zone	FROM MH#	TO MH#	Pipe Dia. (in)	Slope (ft/ft)	1/2 Full Capacity - (dia. <= 12") (cfs)	2/3 Full Capacity - (dia. > 12") (cfs)	ERU's Served at Capacity	ERU's Currently Served	Contributing Zones	Peaked Flow Rate (cfs)	Percent Full
17	7H10	7H09	8	0.0202	0.930	1.458	1010	492	17	0.453	< 50%
17	7I01	7H10	8	0.0260	1.055	1.655	1146	465		0.428	< 50%
17	7H22	7H10	6	0.0084	0.279	0.437	302	27		0.025	< 50%
17	7I17	7I16	8	0.0253	1.041	1.632	1130	465		0.428	< 50%
16	8G05	8G03	12	0.0198	2.716	4.257	2949	298	16	0.274	< 50%
16	8G24	8G05	10	0.0029	0.639	1.002	694	283	.95*16	0.261	< 50%
16	8H11	8H09	10	0.0039	0.741	1.162	805	179	.6*16	0.165	< 50%
15	7E11	7E04	8	0.0220	0.971	1.522	1054				< 50%
15	7E09	7E03	8	0.0193	0.909	1.425	987				< 50%
15	**Parallel Pipes**		8				2041	828	15+17	0.762	< 50%
14	7D28	7D26	12	0.0032	1.092	1.711	1185	673	14+16	0.620	< 50%
13	7C15	7C14	8	0.0040	0.414	0.649	449	57	13	0.052	< 50%
12	6E11	6E12	10	0.0171	1.552	2.433	1685	431	12	0.397	< 50%
11	5D30	5D29	18	0.0020	2.545	3.989	4332	1898	11+12+15	1.747	< 67%
11	6D20	6D19	18	0.0012	1.971	3.090	3356	1738	.75*11+12+15	1.600	< 67%
11	6D29	6D20	12	0.0015	0.747	1.172	811	479	.75*11	0.441	< 50%
11	7D25	7D24	10	0.0040	0.751	1.177	815	575	.90*11	0.529	< 50%
10	5E19	5E14	8	0.0028	0.346	0.543	376	191	.35*10	0.176	< 50%
10	5E10	5E14	8	0.0084	0.600	0.940	651	246	.45*10	0.226	< 50%
10	5E16	5E17	8	0.0116	0.705	1.105	765	546	10	0.503	< 50%
9	4D34	4D33	8	0.0200	0.926	1.451	1005	962	9+10	0.886	< 50%
9	4D36	4D34	8	0.0134	0.758	1.188	823	374	.9*9	0.345	< 50%
9	4E01	4D36	8	0.0143	0.783	1.227	850	374	.9*9	0.345	< 50%
9	4E05	4E01	8	0.0156	0.818	1.282	888	374	.9*9	0.345	< 50%
9	4E06	4E05	8	0.0050	0.463	0.726	502	354	.85*9	0.326	< 50%
8	4D06	4D09	20	0.0008	2.131	3.341	3629	3218	8+9+11	2.962	**67%**
8	4D26	4D27	15	0.0020	1.565	2.453	2664	1016	.15*8+9	0.935	< 67%
8	4D27	4D06	15	0.0020	1.565	2.453	2664	1016	.15*8+9	0.935	< 67%
8	4D31	4D31	12	0.0076	1.682	2.637	1827	998	.1*8+9	0.919	< 50%
8	5D04	4D07	18	0.0009	1.707	2.676	2906	890	.7*8+11	0.819	< 67%
8	5D22	5D05	18	0.0008	1.609	2.523	2740	872	.65*8+11	0.802	< 67%
7	5C07	5C05	18	0.0032	3.219	5.046	5480	836	7+13+14	0.770	< 67%
7	7C14	7C13	18	0.0056	4.258	6.675	7250	673	14	0.620	< 67%
7	7C13	7C07	18	0.0030	3.116	4.885	5306	730	13+14	0.672	< 67%
6	2F01	2E48	8	0.0103	0.664	1.041	721	215	6	0.198	< 50%
5	2E42	2E34	10	0.0200	1.678	2.631	1823	391	5	0.360	< 50%
5	2E45	2E43	8	0.0040	0.414	0.649	449	91		0.084	< 50%
5	2E40	2E42	8	0.0035	0.387	0.607	420	276		0.254	< 50%
4	2D43	2D44	10	0.0025	0.593	0.930	644	1229	4+5+6	1.131	**90%**
4	2D42	2D43	10	0.0025	0.593	0.930	644	1229		1.131	**90%**
4	2E04	2D42	10	0.0025	0.593	0.930	644	1229		1.131	**90%**
4	2E05	2E04	10	0.0025	0.593	0.930	644	1229		1.131	**90%**
4	2E06	2E05	8	0.0094	0.635	0.995	689	578	.3*4+5	0.532	< 50%
4	2E12	2E06	8	0.0086	0.607	0.952	659	578		0.532	< 50%
4	2E08	2E05	10	0.0025	0.593	0.930	644	651	.7*4+6	0.599	**50%**
4	2E17	2E08	10	0.0025	0.593	0.930	644	589	.6*4+6	0.542	< 50%
3	2C14	2C15	24	0.0021	5.615	8.803	9562	5338	3+4+8	4.914	< 67%
3	3D19	3D20	24	0.0010	3.875	6.074	6598	3664	.5*3+8	3.373	< 67%
3	2D09	2D51	24	0.0010	3.875	6.074	6598	4893	.5*3+4+8	4.504	< 67%
3	3D21	3D18	8	0.0060	0.507	0.795	550	134	.15*3+FC	0.123	< 50%
3	2D45	2D46	10	0.0096	1.163	1.823	1263	1229	4	1.131	< 50%
2	1C04	1C08	15	0.0124	3.896	6.108	6634	598	2	0.551	< 67%
2	1D08	1D17	12	0.0066	1.568	2.458	1703	449	.75*2	0.413	< 50%
2	1D09	1D08	8	0.0058	0.498	0.781	541	389	.65*2	0.358	< 50%
2	1D10	1D09	8	0.0058	0.498	0.781	541	389	.65*2	0.358	< 50%
1	2C01	Plant	36	0.0010	11.425	17.910	19454	7302	1+2+3+7	6.722	< 67%
1	3C04	3C03	21	0.0020	3.838	6.017	6535	1048	.4*1+7	0.965	< 67%
1	3C05	3C04	21	0.0013	3.095	4.851	5269	1048	.4*1+7	0.965	< 67%
1	3C06	3C05	21	0.0020	3.838	6.017	6535	916	.15*1+7	0.843	< 67%

Table 6-3
Existing Conditions- Wet Weather

Flow Calculation Data	
Persons Per Household =	3.5
Per Capita Generation =	85 gpd
Generation Per Household =	297.5 gpd
=	0.00046 cfs
Peaking Factor =	3
Peaked Generation =	0.001381 cfs
Manning's "n" =	0.012

ERU Count	
Zone 1	530
Zone 2	598
Zone 3	891
Zone 4	623
Zone 5	391
Zone 6	215
Zone 7	106
Zone 8	358
Zone 9	416
Zone 10	546
Zone 11	639
Zone 12	431
Zone 13	57
Zone 14	375
Zone 15	336
Zone 16	298
Zone 17	492
Total =	**7302**

Collection Zone	FROM MH#	TO MH#	Pipe Dia. (in)	Slope (ft/ft)	3/4 Full Capacity (cfs)	ERU's Served at Capacity	ERU's Currently Served	Contributing Zones	Peaked Flow Rate (cfs)	Percent Full
17	7H10	7H09	8	0.0202	1.697	1228	492	17	0.679	< 75%
17	7I01	7H10	8	0.0260	1.925	1393	465		0.642	< 75%
17	7H22	7H10	6	0.0084	0.508	367	27		0.037	< 75%
17	7I17	7I16	8	0.0253	1.899	1375	465		0.642	< 75%
16	8G05	8G03	12	0.0198	4.953	3586	298	16	0.412	< 75%
16	8G24	8G05	10	0.0029	1.166	844	283	.95*16	0.391	< 75%
16	8H11	8H09	10	0.0039	1.352	978	179	.6*16	0.247	< 75%
15	7E11	7E04	8	0.0220	1.771	1282				< 75%
15	7E09	7E03	8	0.0193	1.658	1200				< 75%
15	**Parallel Pipes**		8			2482	828	15+17	1.143	< 75%
14	7D28	7D26	12	0.0032	1.991	1441	673	14+16	0.929	< 75%
13	7C15	7C14	8	0.0040	0.755	546	57	13	0.079	< 75%
12	6E11	6E12	10	0.0171	2.830	2049	431	12	0.595	< 75%
11	5D30	5D29	18	0.0020	4.641	3360	1898	11+12+15	2.621	< 75%
11	6D20	6D19	18	0.0012	3.595	2603	1738	.75*11+12+15	2.400	< 75%
11	6D29	6D20	12	0.0015	1.363	987	479	.75*11	0.662	< 75%
11	7D25	7D24	10	0.0040	1.369	991	575	.90*11	0.794	< 75%
10	5E19	5E14	8	0.0028	0.632	457	191	.35*10	0.264	< 75%
10	5E10	5E14	8	0.0084	1.094	792	246	.45*10	0.339	< 75%
10	5E16	5E17	8	0.0116	1.286	931	546	10	0.754	< 75%
9	4D34	4D33	8	0.0200	1.688	1222	962	9+10	1.328	< 75%
9	4D36	4D34	8	0.0134	1.382	1000	374	.9*9	0.517	< 75%
9	4E01	4D36	8	0.0143	1.428	1033	374	.9*9	0.517	< 75%
9	4E05	4E01	8	0.0156	1.491	1079	374	.9*9	0.517	< 75%
9	4E06	4E05	8	0.0050	0.844	611	354	.85*9	0.488	< 75%
8	4D06	4D09	20	0.0008	3.887	2815	3218	8+9+11	4.444	**86%**
8	4D26	4D27	15	0.0020	2.854	2066	1016	.15*8+9	1.403	< 75%
8	4D27	4D06	15	0.0020	2.854	2066	1016	.15*8+9	1.403	< 75%
8	4D31	4D31	12	0.0076	3.068	2222	998	.1*8+9	1.378	< 75%
8	5D04	4D07	18	0.0009	3.113	2254	890	.7*8+11	1.228	< 75%
8	5D22	5D05	18	0.0008	2.935	2125	872	.65*8+11	1.204	< 75%
7	5C07	5C05	18	0.0032	5.870	4251	836	7+13+14	1.154	< 75%
7	7C14	7C13	18	0.0056	7.766	5623	673	14	0.929	< 75%
7	7C13	7C07	18	0.0030	5.684	4116	730	13+14	1.008	< 75%
6	2F01	2E48	8	0.0103	1.212	877	215	6	0.297	< 75%
5	2E42	2E34	10	0.0200	3.061	2216	391	5	0.540	< 75%
5	2E45	2E43	8	0.0040	0.755	546	91		0.126	< 75%
5	2E40	2E42	8	0.0035	0.706	511	276		0.381	< 75%
4	2D43	2D44	10	0.0025	1.082	783	1229	4+5+6	1.697	**100% +**
4	2D42	2D43	10	0.0025	1.082	783	1229		1.697	**100% +**
4	2E04	2D42	10	0.0025	1.082	783	1229		1.697	**100% +**
4	2E05	2E04	10	0.0025	1.082	783	1229		1.697	**100% +**
4	2E06	2E05	8	0.0094	1.157	838	578	.3*4+5	0.798	< 75%
4	2E12	2E06	8	0.0086	1.107	801	578		0.798	< 75%
4	2E08	2E05	10	0.0025	1.082	783	651	.7*4+6	0.899	< 75%
4	2E17	2E08	10	0.0025	1.082	783	589	.6*4+6	0.813	< 75%
3	2C14	2C15	24	0.0021	10.241	7416	5338	3+4+8	7.371	< 75%
3	3D19	3D20	24	0.0010	7.067	5117	3664	.5*3+8	5.059	< 75%
3	2D09	2D51	24	0.0010	7.067	5117	4893	.5*3+4+8	6.756	< 75%
3	3D21	3D18	8	0.0060	0.925	669	134	.15*3	0.185	< 75%
3	2D45	2D46	10	0.0096	2.121	1535	1229	4	1.697	< 75%
2	1C04	1C08	15	0.0124	7.106	5146	598	2	0.826	< 75%
2	1D08	1D17	12	0.0066	2.859	2070	449	.75*2	0.619	< 75%
2	1D09	1D08	8	0.0058	0.909	658	389	.65*2	0.537	< 75%
2	1D10	1D09	8	0.0058	0.909	658	389	.65*2	0.537	< 75%
1	2C01	Plant	36	0.0010	20.837	15089	7302	1+2+3+7	10.083	< 75%
1	3C04	3C03	21	0.0020	7.000	5069	1048	.4*1+7	1.447	< 75%
1	3C05	3C04	21	0.0013	5.644	4087	1048	.4*1+7	1.447	< 75%
1	3C06	3C05	21	0.0020	7.000	5069	916	.15*1+7	1.264	< 75%

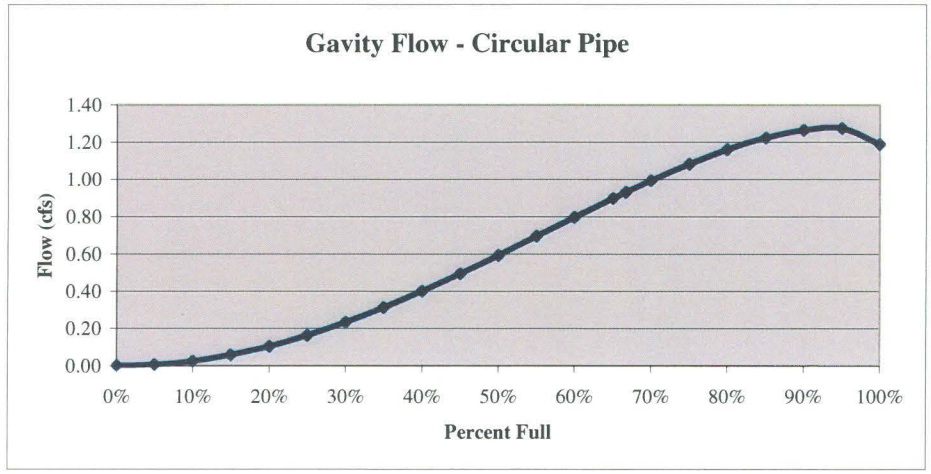
Table 6-4
Zone 4 MH 2E08 - 2E05 PDWF

Circular Channel Hydraulics

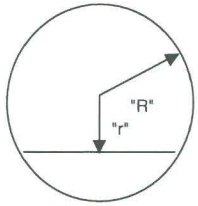
Manning's Equation

Channel Data

Q =	0.5990	cfs	0.39	MGD
dia =	10	inches	0.83	feet
n =	0.012		50.2%	% Full
s =	0.0025	feet/foot		
Normal Depth =	0.42	feet		
v =	2.19	fps		
Velocity Head $h_{v1} = v^2/2g$	0.07	feet		
Area =	0.27	ft^2		
Wetted Perimeter =	1.31	feet		
Hydraulic Radius =	0.21	feet		
Top Width =	4.00	feet		
Froude Number =	1.47			



Working Cells
Solves Manning's Eqn for all depths then uses vlookup to find the solution. Use caution when pipe is in the range of 95% full, there can be more than one flow depth for a given flow rate.



	dia		s	n	"R"			
	0.833		0.00250	0.012	0.417			
Diameter Factor (divides diameter in 1/1000ths)	**Flow Q**	**Depth d**	**Hydraulic Radius R_h**	**Velocity v**	**"r"**	**Area A**	**Wetted Perimeter Wp**	**Hydraulic Radius R_h**
0.000	0.00	0.000	0	0	0.417	0.000	0	0
0.050	0.01	0.042	0.027	0.56	0.375	0.010	0.376	0.027
0.100	0.02	0.083	0.053	0.87	0.333	0.028	0.536	0.053
0.150	0.06	0.125	0.077	1.12	0.292	0.051	0.663	0.077
0.200	0.10	0.167	0.100	1.34	0.250	0.078	0.773	0.100
0.250	0.16	0.208	0.122	1.52	0.208	0.107	0.873	0.122
0.300	0.23	0.250	0.142	1.69	0.167	0.138	0.966	0.142
0.350	0.31	0.292	0.161	1.83	0.125	0.170	1.055	0.161
0.400	0.40	0.333	0.179	1.96	0.083	0.204	1.141	0.179
0.450	0.49	0.375	0.194	2.08	0.042	0.238	1.226	0.194
0.500	**0.59**	**0.417**	**0.208**	**2.18**	**0.000**	**0.273**	1.309	0.208
0.550	0.70	0.458	0.221	2.26	0.042	0.307	1.392	0.221
0.600	0.80	0.500	0.231	2.33	0.083	0.342	1.477	0.231
0.650	0.90	0.542	0.240	2.39	0.125	0.375	1.563	0.240
0.667	0.93	0.556	0.243	2.41	0.139	0.386	1.593	0.243
0.700	0.99	0.583	0.247	2.44	0.167	0.408	1.652	0.247
0.750	1.08	0.625	0.251	2.47	0.208	0.439	1.745	0.251
0.800	1.16	0.667	0.253	2.48	0.250	0.468	1.845	0.253
0.850	1.22	0.708	0.253	2.47	0.292	0.494	1.955	0.253
0.900	1.26	0.750	0.248	2.45	0.333	0.517	2.082	0.248
0.950	1.28	0.792	0.239	2.38	0.375	0.535	2.242	0.239
1.000	1.19	0.833	0.208	2.18	0.417	0.545	2.618	0.208

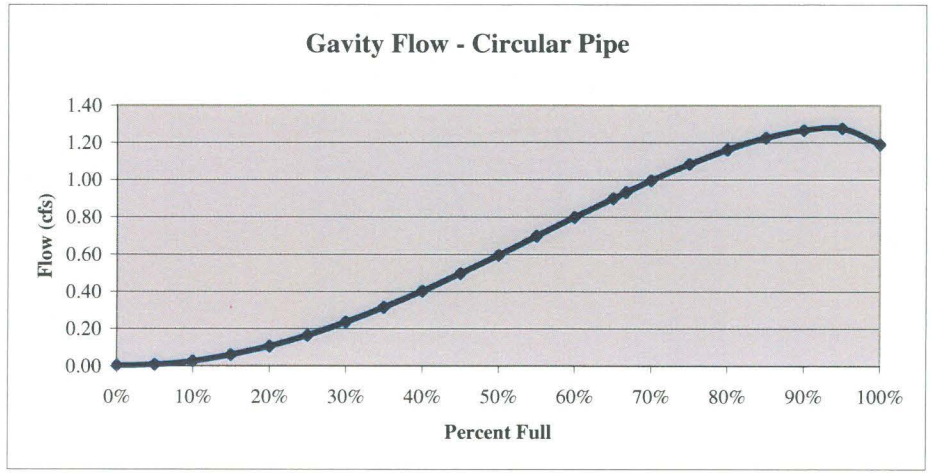
Table 6-5
Zone 4 MH 2E04 - 2D42 PDWF

Circular Channel Hydraulics

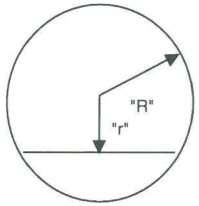
Manning's Equation

Channel Data

Q =	1.2660	cfs	0.82	MGD
dia =	10	inches	0.83	feet
n =	0.012		90.1%	% Full
s =	0.0025	feet/foot		
Normal Depth =	0.75	feet		
v =	2.45	fps		
Velocity Head $h_{v1} = v^2/2g$	0.09	feet		
Area =	0.52	ft^2		
Wetted Perimeter =	2.08	feet		
Hydraulic Radius =	0.25	feet		
Top Width =	5.27	feet		
Froude Number =	1.38			



Working Cells
Solves Manning's Eqn for all depths then uses vlookup to find the solution. Use caution when pipe is in the range of 95% full, there can be more than one flow depth for a given flow rate.



	dia		s	n	"R"			
	0.833		0.00250	0.012	0.417			
Diameter Factor (divides diameter in 1/1000ths)	**Flow Q**	**Depth d**	**Hydraulic Radius R_h**	**Velocity v**	**"r"**	**Area A**	**Wetted Perimeter Wp**	**Hydraulic Radius R_h**
0.000	0.00	0.000	0	0	0.417	0.000	0	0
0.050	0.01	0.042	0.027	0.56	0.375	0.010	0.376	0.027
0.100	0.02	0.083	0.053	0.87	0.333	0.028	0.536	0.053
0.150	0.06	0.125	0.077	1.12	0.292	0.051	0.663	0.077
0.200	0.10	0.167	0.100	1.34	0.250	0.078	0.773	0.100
0.250	0.16	0.208	0.122	1.52	0.208	0.107	0.873	0.122
0.300	0.23	0.250	0.142	1.69	0.167	0.138	0.966	0.142
0.350	0.31	0.292	0.161	1.83	0.125	0.170	1.055	0.161
0.400	0.40	0.333	0.179	1.96	0.083	0.204	1.141	0.179
0.450	0.49	0.375	0.194	2.08	0.042	0.238	1.226	0.194
0.500	**0.59**	**0.417**	**0.208**	**2.18**	**0.000**	**0.273**	1.309	0.208
0.550	0.70	0.458	0.221	2.26	0.042	0.307	1.392	0.221
0.600	0.80	0.500	0.231	2.33	0.083	0.342	1.477	0.231
0.650	0.90	0.542	0.240	2.39	0.125	0.375	1.563	0.240
0.667	0.93	0.556	0.243	2.41	0.139	0.386	1.593	0.243
0.700	0.99	0.583	0.247	2.44	0.167	0.408	1.652	0.247
0.750	1.08	0.625	0.251	2.47	0.208	0.439	1.745	0.251
0.800	1.16	0.667	0.253	2.48	0.250	0.468	1.845	0.253
0.850	1.22	0.708	0.253	2.47	0.292	0.494	1.955	0.253
0.900	1.26	0.750	0.248	2.45	0.333	0.517	2.082	0.248
0.950	1.28	0.792	0.239	2.38	0.375	0.535	2.242	0.239
1.000	1.19	0.833	0.208	2.18	0.417	0.545	2.618	0.208

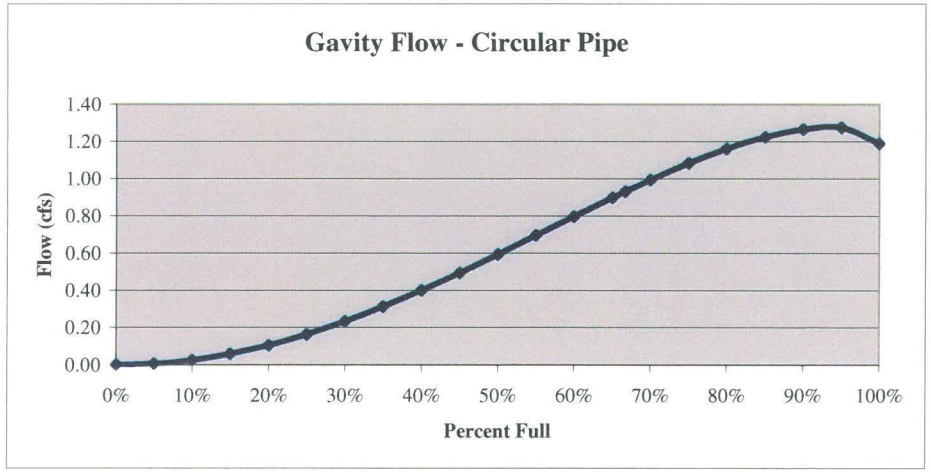
Table 6-6
Zone 4 MH 2E04 - 2D42 PWWF

Circular Channel Hydraulics

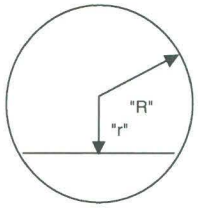
Manning's Equation

Channel Data

Q =	1.6970	cfs	1.10	MGD
dia =	10	inches	0.83	feet
n =	0.012		100.0%	% Full
s =	0.0025	feet/foot		
Normal Depth =	0.83	feet		
v =	3.11	fps		
Velocity Head $h_{v1} = v^2/2g$	0.15	feet		
Area =	0.55	ft^2		
Wetted Perimeter =	2.62	feet		
Hydraulic Radius =	0.21	feet		
Top Width =	5.53	feet		
Froude Number =	1.75			



Working Cells
Solves Manning's Eqn for all depths then uses vlookup to find the solution. Use caution when pipe is in the range of 95% full, there can be more than one flow depth for a given flow rate.



	dia		s	n	"R"			
	0.833		0.00250	0.012	0.417			
Diameter Factor (divides diameter in 1/1000ths)	Flow Q	Depth d	Hydraulic Radius R_h	Velocity v	"r"	Area A	Wetted Perimeter Wp	Hydraulic Radius R_h
0.000	0.00	0.000	0	0	0.417	0.000	0	0
0.050	0.01	0.042	0.027	0.56	0.375	0.010	0.376	0.027
0.100	0.02	0.083	0.053	0.87	0.333	0.028	0.536	0.053
0.150	0.06	0.125	0.077	1.12	0.292	0.051	0.663	0.077
0.200	0.10	0.167	0.100	1.34	0.250	0.078	0.773	0.100
0.250	0.16	0.208	0.122	1.52	0.208	0.107	0.873	0.122
0.300	0.23	0.250	0.142	1.69	0.167	0.138	0.966	0.142
0.350	0.31	0.292	0.161	1.83	0.125	0.170	1.055	0.161
0.400	0.40	0.333	0.179	1.96	0.083	0.204	1.141	0.179
0.450	0.49	0.375	0.194	2.08	0.042	0.238	1.226	0.194
0.500	**0.59**	**0.417**	**0.208**	**2.18**	**0.000**	**0.273**	1.309	0.208
0.550	0.70	0.458	0.221	2.26	0.042	0.307	1.392	0.221
0.600	0.80	0.500	0.231	2.33	0.083	0.342	1.477	0.231
0.650	0.90	0.542	0.240	2.39	0.125	0.375	1.563	0.240
0.667	0.93	0.556	0.243	2.41	0.139	0.386	1.593	0.243
0.700	0.99	0.583	0.247	2.44	0.167	0.408	1.652	0.247
0.750	1.08	0.625	0.251	2.47	0.208	0.439	1.745	0.251
0.800	1.16	0.667	0.253	2.48	0.250	0.468	1.845	0.253
0.850	1.22	0.708	0.253	2.47	0.292	0.494	1.955	0.253
0.900	1.26	0.750	0.248	2.45	0.333	0.517	2.082	0.248
0.950	1.28	0.792	0.239	2.38	0.375	0.535	2.242	0.239
1.000	1.19	0.833	0.208	2.18	0.417	0.545	2.618	0.208

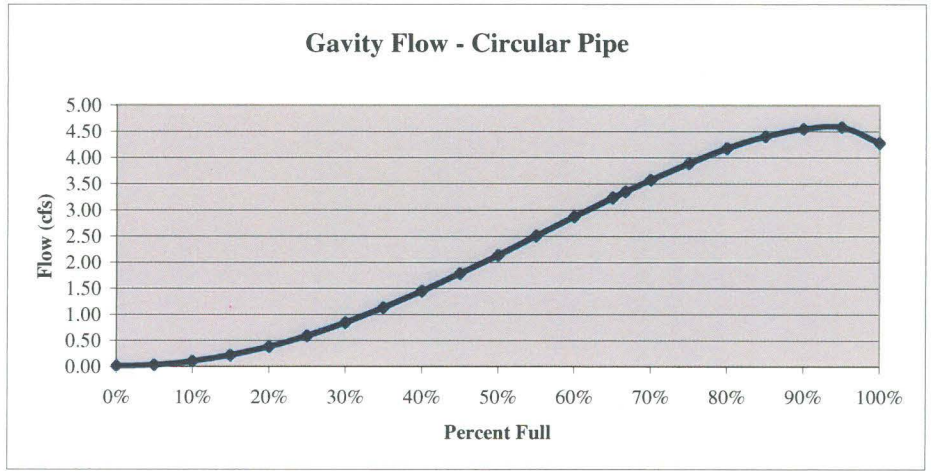
Table 6-7
Zone 8 MH 4D06 - 4D09 PDWF

Circular Channel Hydraulics

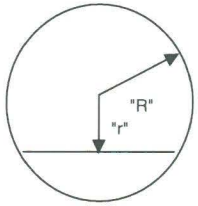
Manning's Equation

Channel Data

Q =	3.3730	cfs	2.18	MGD
dia =	20	inches	1.67	feet
n =	0.012		67.1%	% Full
s =	0.0008	feet/foot		
Normal Depth =	1.12	feet		
v =	2.17	fps		
Velocity Head $h_{v1} = v^2/2g$	0.07	feet		
Area =	1.56	ft^2		
Wetted Perimeter =	3.20	feet		
Hydraulic Radius =	0.49	feet		
Top Width =	9.19	feet		
Froude Number =	0.93			



Working Cells
Solves Manning's Eqn for all depths then uses vlookup to find the solution. Use caution when pipe is in the range of 95% full, there can be more than one flow depth for a given flow rate.



	dia		s	n	"R"			
	1.667		0.00080	0.012	0.833			
Diameter Factor (divides diameter in 1/1000ths)	Flow Q	Depth d	Hydraulic Radius R_h	Velocity v	"r"	Area A	Wetted Perimeter Wp	Hydraulic Radius R_h
0.000	0.00	0.000	0	0	0.833	0.000	0	0
0.050	0.02	0.083	0.054	0.50	0.750	0.041	0.752	0.054
0.100	0.09	0.167	0.106	0.78	0.667	0.114	1.073	0.106
0.150	0.21	0.250	0.155	1.01	0.583	0.205	1.326	0.155
0.200	0.37	0.333	0.201	1.20	0.500	0.311	1.545	0.201
0.250	0.58	0.417	0.244	1.37	0.417	0.427	1.745	0.244
0.300	0.83	0.500	0.285	1.52	0.333	0.550	1.932	0.285
0.350	1.12	0.583	0.322	1.65	0.250	0.681	2.110	0.322
0.400	1.44	0.667	0.357	1.76	0.167	0.815	2.282	0.357
0.450	1.78	0.750	0.388	1.86	0.083	0.952	2.451	0.388
0.500	**2.13**	**0.833**	**0.417**	**1.95**	**0.000**	**1.091**	2.618	0.417
0.550	2.50	0.917	0.441	2.03	0.083	1.229	2.785	0.441
0.600	2.86	1.000	0.463	2.10	0.167	1.367	2.954	0.463
0.650	3.22	1.083	0.480	2.15	0.250	1.501	3.126	0.480
0.667	3.34	1.112	0.485	2.16	0.278	1.546	3.186	0.485
0.700	3.57	1.167	0.494	2.19	0.333	1.631	3.304	0.494
0.750	3.89	1.250	0.503	2.21	0.417	1.755	3.491	0.503
0.800	4.17	1.333	0.507	2.23	0.500	1.871	3.690	0.507
0.850	4.39	1.417	0.505	2.22	0.583	1.976	3.910	0.505
0.900	4.54	1.500	0.497	2.20	0.667	2.068	4.163	0.497
0.950	4.58	1.583	0.477	2.14	0.750	2.141	4.484	0.477
1.000	4.26	1.667	0.417	1.95	0.833	2.182	5.236	0.417

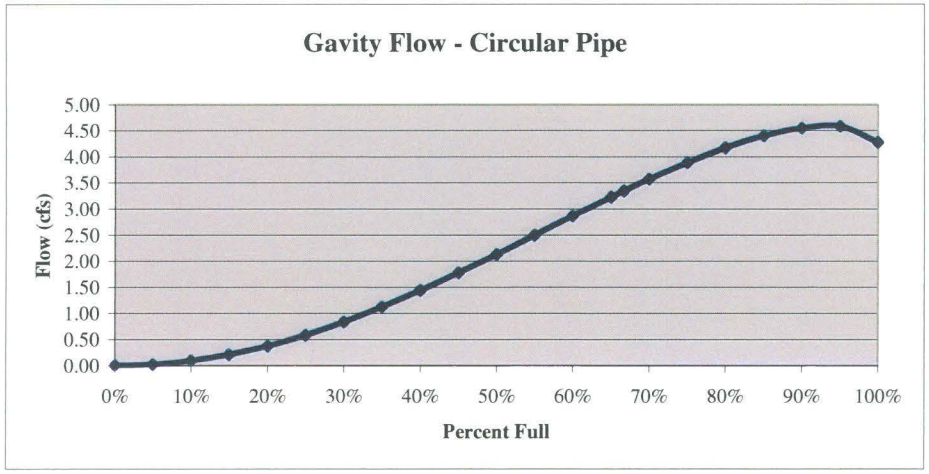
Table 6-8
Zone 8 MH 4D06 - 4D09 PWWF

Circular Channel Hydraulics

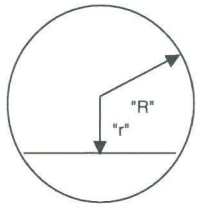
Manning's Equation

Channel Data

Q =	4.4440	cfs	2.87	MGD
dia =	20	inches	1.67	feet
n =	0.012		86.4%	% Full
s =	0.0008	feet/foot		
Normal Depth =	1.44	feet		
v =	2.22	fps		
Velocity Head $h_{v1} = v^2/2g$	0.08	feet		
Area =	2.00	ft^2		
Wetted Perimeter =	3.98	feet		
Hydraulic Radius =	0.50	feet		
Top Width =	10.34	feet		
Froude Number =	0.89			



Working Cells
Solves Manning's Eqn for all depths then uses vlookup to find the solution. Use caution when pipe is in the range of 95% full, there can be more than one flow depth for a given flow rate.



	dia		s	n	"R"			
	1.667		0.00080	0.012	0.833			
Diameter Factor (divides diameter in 1/1000ths)	**Flow Q**	**Depth d**	**Hydraulic Radius R_h**	**Velocity v**	**"r"**	**Area A**	**Wetted Perimeter Wp**	**Hydraulic Radius R_h**
0.000	0.00	0.000	0	0	0.833	0.000	0	0
0.050	0.02	0.083	0.054	0.50	0.750	0.041	0.752	0.054
0.100	0.09	0.167	0.106	0.78	0.667	0.114	1.073	0.106
0.150	0.21	0.250	0.155	1.01	0.583	0.205	1.326	0.155
0.200	0.37	0.333	0.201	1.20	0.500	0.311	1.545	0.201
0.250	0.58	0.417	0.244	1.37	0.417	0.427	1.745	0.244
0.300	0.83	0.500	0.285	1.52	0.333	0.550	1.932	0.285
0.350	1.12	0.583	0.322	1.65	0.250	0.681	2.110	0.322
0.400	1.44	0.667	0.357	1.76	0.167	0.815	2.282	0.357
0.450	1.78	0.750	0.388	1.86	0.083	0.952	2.451	0.388
0.500	**2.13**	**0.833**	**0.417**	**1.95**	**0.000**	**1.091**	2.618	0.417
0.550	2.50	0.917	0.441	2.03	0.083	1.229	2.785	0.441
0.600	2.86	1.000	0.463	2.10	0.167	1.367	2.954	0.463
0.650	3.22	1.083	0.480	2.15	0.250	1.501	3.126	0.480
0.667	3.34	1.112	0.485	2.16	0.278	1.546	3.186	0.485
0.700	3.57	1.167	0.494	2.19	0.333	1.631	3.304	0.494
0.750	3.89	1.250	0.503	2.21	0.417	1.755	3.491	0.503
0.800	4.17	1.333	0.507	2.23	0.500	1.871	3.690	0.507
0.850	4.39	1.417	0.505	2.22	0.583	1.976	3.910	0.505
0.900	4.54	1.500	0.497	2.20	0.667	2.068	4.163	0.497
0.950	4.58	1.583	0.477	2.14	0.750	2.141	4.484	0.477
1.000	4.26	1.667	0.417	1.95	0.833	2.182	5.236	0.417

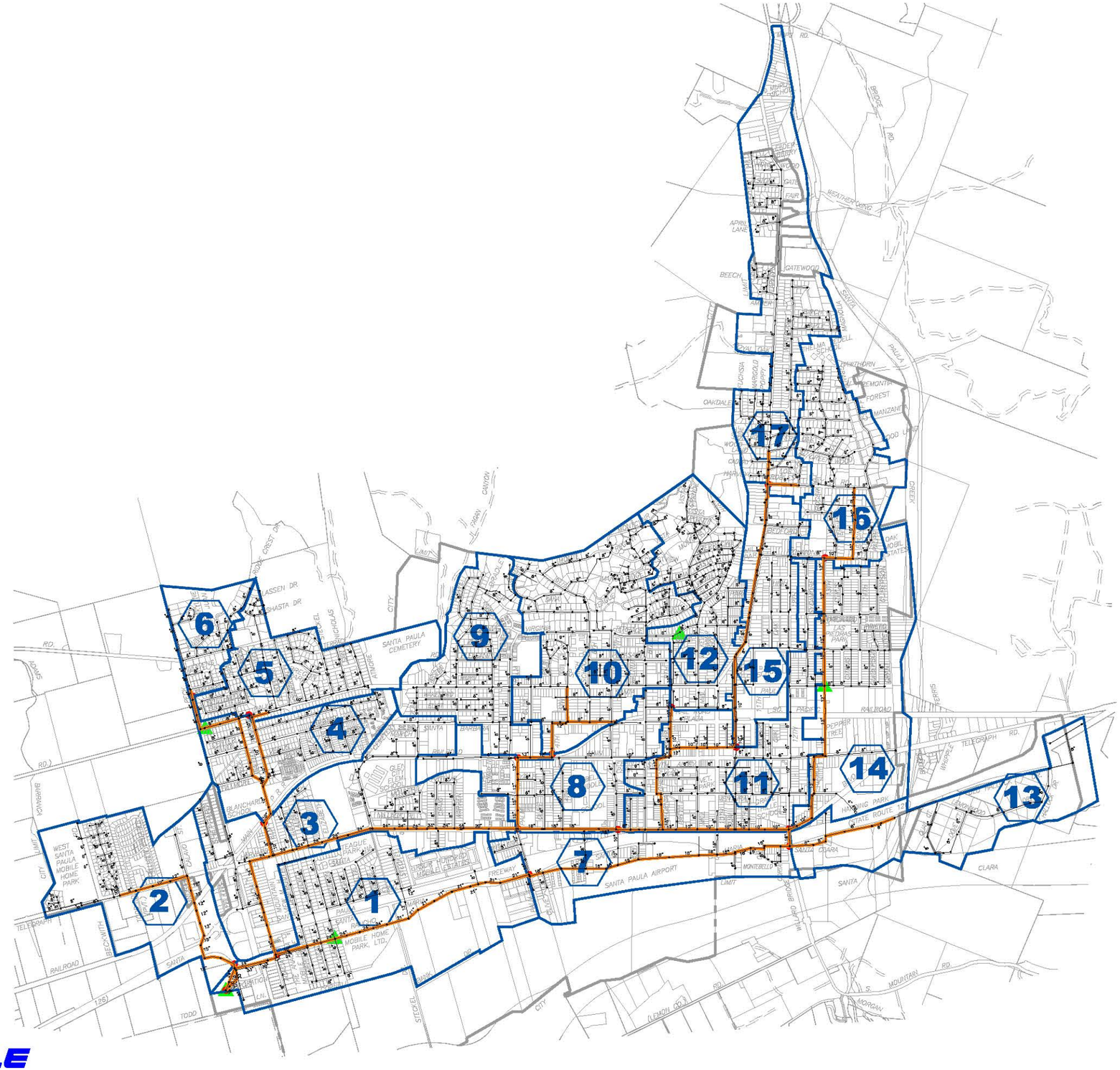
Model Results

The model was run using the existing daily peak flow conditions. Based on the percent full criteria, only two segments of sewer were determined to be above capacity. A 10-inch segment is located at Main Street near Blanchard School between manholes 2D43 and 2E05. The other sewer is a 20-inch segment located in Harvard Blvd. between manholes 4D06 and 4D09. **Figure 6-3** shows the system deficiencies.

The model was also run using wet weather flow conditions. The results showed deficiencies in the same sewer segments.

The City must note that the wet weather peak flow was assumed to be spread evenly throughout the basins. Since the analysis indicates that high wet weather flow is inflow related (See Chapter 5), the clear water entering the collection system may not be evenly distributed throughout the basins as the model suggests. However, without a detailed survey of the entire sewer system, the actual locations of inflow cannot be determined. A detailed survey would involve test procedures such as smoke testing of sanitary sewers and dye testing of storm sewers to locate leaks and cross connections in the sewer system. Additionally, a field inspection of all manholes within the system would need to be performed. Exfiltration tests and a cost comparison for rehabilitation verses treatment of the wastewater would be necessary.

The future wastewater flow conditions were modeled. Based on information from the local developers, the point of flow tie into the existing systemwas determined. **Figure 6-4** shows how the new developments could be connected to the system. **Figure 6-4** also shows deficiencies within the existing system based on the future flows. **Table 6-9** and **Table 6-10** show the results of future flow in the model.



ZONE ID	ERU COUNT	CONTRIBUTING ZONES
ZONE 1	530	1+2+3+7
ZONE 2	598	2
ZONE 3	891	3+4+8
ZONE 4	623	4+5+6
ZONE 5	391	5
ZONE 6	215	6
ZONE 7	106	7+13+14
ZONE 8	358	8+9+11
ZONE 9	416	9+10
ZONE 10	546	10
ZONE 11	639	11+12+15
ZONE 12	431	12
ZONE 13	57	13
ZONE 14	375	14+16
ZONE 15	336	15+17
ZONE 16	298	16
ZONE 17	492	17

LEGEND

- PIPES ANALYZED
- CONCENTRATION POINT
- FLOW METER LOCATIONS
- ZONE ID

1000' 500' 0 1000' 2000'

SCALE IN FEET

BOYLE

CITY OF SANTA PAULA
WASTEWATER SYSTEM
MASTER PLAN

PIPELINE ANALYZED IN THE MODEL

VT-S27-105-01 | SEPT 2005 | FIGURE 6-2

DWG: F:\94171 PAULA\S27105\01 - Santa Paula MP\CAD\ADDITIONAL DWGS\Figures\Figure 6-2.dwg USER: kmorin
DATE: Feb 21, 2006 1:17pm XREFS: Santa Paula.dwg Sewer Pipes Color/ 0 Width

LEGEND

AT CAPACITY

ABOVE CAPACITY

800' 400'0 0 800' 1600'

SCALE IN FEET

BOYLE

CITY OF SANTA PAULA WASTEWATER SYSTEM MASTER PLAN

SYSTEM CAPACITY DEFICIENCIES (EXISTING)

VT-S27-105-01 SEPT 2005 FIGURE 6-3

DWG: F:\SANTA PAULA\S27\105\01 – Santa Paula MPI\CAD\ADDITIONAL DWGS\Figures\Figure 6-3.dwg USER: kmartin
DATE: Feb 21, 2006 11:19pm XREFS: Santa Paula data Sewer Pipes Color 0 Width

Table 6-9
Future Conditions - Dry Weather

Flow Calculation Data

Persons Per Household =	3.5
Per Capita Generation =	85 gpd
Generation Per Household =	297.5 gpd
=	0.00046 cfs
Peaking Factor =	2
Peaked Generation =	0.000921 cfs
Manning's "n" =	0.012

ERU Count

Zone 1	530
Zone 2	873
Zone 3	3927
Zone 4	650
Zone 5	391
Zone 6	215
Zone 7	106
Zone 8	358
Zone 9	416
Zone 10	546
Zone 11	2095
Zone 12	431
Zone 13	224
Zone 14	375
Zone 15	336
Zone 16	298
Zone 17	492
Total =	**12263**

(includes expansion)

ERU Count Expansion

Fagan Canyon	3036
Adams Canyon	27
East Area 1	1456
East Area 2	167
West Area 2	275
Total =	**4961**

Collection Zone	FROM MH#	TO MH#	Pipe Dia. (in)	Slope (ft/ft)	1/2 Full Capacity - (dia. <= 12") (cfs)	2/3 Full Capacity - (dia. > 12") (cfs)	ERU's Served at Capacity	ERU's Served	Contributing Zones	Peaked Flow Rate (cfs)	Percent Full
17	7H10	7H09	8	0.0202	0.930	1.458	1010	492	17	0.453	< 50%
17	7I01	7H10	8	0.0260	1.055	1.655	1146	465		0.428	< 50%
17	7H22	7H10	6	0.0084	0.279	0.437	302	27		0.025	< 50%
17	7I17	7I16	8	0.0253	1.041	1.632	1130	465		0.428	< 50%
16	8G05	8G03	12	0.0198	2.716	4.257	2949	298	16	0.274	< 50%
16	8G24	8G05	10	0.0029	0.639	1.002	694	283	.95*16	0.261	< 50%
16	8H11	8H09	10	0.0039	0.741	1.162	805	179	.6*16	0.165	< 50%
15	7E11	7E04	8	0.0220	0.971	1.522	1054				< 50%
15	7E09	7E03	8	0.0193	0.909	1.425	987				< 50%
15	**Parallel Pipes**		8				2041	828	15+17	0.762	< 50%
14	7D28	7D26	12	0.0032	1.092	1.711	1185	673	14+16	0.620	< 50%
13	7C15	7C14	8	0.0040	0.414	0.649	449	224	(13+EA2)	0.206	< 50%
12	6E11	6E12	10	0.0171	1.552	2.433	1685	431	12	0.397	< 50%
11	5D30	5D29	18	0.0020	2.545	3.989	4332	3354	(11+EA1)+12+15	3.088	< 67%
11	6D20	6D19	18	0.0012	1.971	3.090	3356	3249	.95*(11+EA1)+12+15	2.991	< 67%
11	6D29	6D20	12	0.0015	0.747	1.172	811	1990	.95*11	1.832	**100%+**
11	7D25	7D24	10	0.0040	0.751	1.177	815	1886	.90*11	1.736	**100%+**
10	5E19	5E14	8	0.0028	0.346	0.543	376	191	.35*10	0.176	< 50%
10	5E10	5E14	8	0.0084	0.600	0.940	651	246	.45*10	0.226	< 50%
10	5E16	5E17	8	0.0116	0.705	1.105	765	546	10	0.503	< 50%
9	4D34	4D33	8	0.0200	0.926	1.451	1005	962	9+10	0.886	< 50%
9	4D36	4D34	8	0.0134	0.758	1.188	823	374	.9*9	0.345	< 50%
9	4E01	4D36	8	0.0143	0.783	1.227	850	374	.9*9	0.345	< 50%
9	4E05	4E01	8	0.0156	0.818	1.282	888	374	.9*9	0.345	< 50%
9	4E06	4E05	8	0.0050	0.463	0.726	502	354	.85*9	0.326	< 50%
8	4D06	4D09	20	0.0008	2.131	3.341	3629	4674	8+9+11	4.303	**83%**
8	4D26	4D27	15	0.0020	1.565	2.453	2664	1016	.15*8+9	0.935	< 67%
8	4D27	4D06	15	0.0020	1.565	2.453	2664	1016	.15*8+9	0.935	< 67%
8	4D31	4D31	12	0.0076	1.682	2.637	1827	230	.1*8+9	0.212	< 50%
8	5D04	4D07	18	0.0009	1.707	2.676	2906	2346	.7*8+11	2.159	< 67%
8	5D22	5D05	18	0.0008	1.609	2.523	2740	2328	.65*8+11	2.143	< 67%
7	5C07	5C05	18	0.0032	3.219	5.046	5480	1003	7+13+14	0.923	< 67%
7	7C14	7C13	18	0.0056	4.258	6.675	7250	673	14	0.620	< 67%
7	7C13	7C07	18	0.0030	3.116	4.885	5306	897	13+14	0.826	< 67%
6	2F01	2E48	8	0.0103	0.664	1.041	721	215	6	0.198	< 50%
5	2E42	2E34	10	0.0200	1.678	2.631	1823	391	5	0.360	< 50%
5	2E45	2E43	8	0.0040	0.414	0.649	449	91		0.084	< 50%
5	2E40	2E42	8	0.0035	0.387	0.607	420	276		0.254	< 50%
4	2D43	2D44	10	0.0025	0.593	0.930	644	1256	(4+AC)+5+6	1.156	**80%**
4	2D42	2D43	10	0.0025	0.593	0.930	644	1256		1.156	**80%**
4	2E04	2D42	10	0.0025	0.593	0.930	644	1256		1.156	**80%**
4	2E05	2E04	10	0.0025	0.593	0.930	644	1256		1.156	**80%**
4	2E06	2E05	8	0.0094	0.635	0.995	689	996	.93*(4+AC)+5	0.916	**63%**
4	2E12	2E06	8	0.0086	0.607	0.952	659	996		0.916	**65%**
4	2E08	2E05	10	0.0025	0.593	0.930	644	800	.90*(4+AC)+6	0.736	**57%**
4	2E17	2E08	10	0.0025	0.593	0.930	644	781	.87*(4+AC)+6	0.719	**56%**
3	2C14	2C15	24	0.0021	5.615	8.803	9562	9857	(3+FC)+4+8	9.074	**57%**
3	3D19	3D20	24	0.0010	3.875	6.074	6598	8405	.95*3+8	7.737	**56%**
3	2D09	2D51	24	0.0010	3.875	6.074	6598	9661	.95*3+4+9	8.894	**100%+**
3	3D21	3D18	8	0.0060	0.507	0.795	550	3142	.8*3	2.892	**100%+**
3	2D45	2D46	10	0.0096	1.163	1.823	1263	1256	4	1.156	< 50%
2	1C04	1C08	15	0.0124	3.896	6.108	6634	873	(2+WA2)	0.804	< 67%
2	1D08	1D17	12	0.0066	1.568	2.458	1703	349	.40*2	0.321	< 50%
2	1D09	1D08	8	0.0058	0.498	0.781	541	262	.30*2	0.241	< 50%
2	1D10	1D09	8	0.0058	0.498	0.781	541	262	.30*2	0.241	< 50%
1	2C01	Plant	36	0.0010	11.425	17.910	19454	12263	1+2+3+7	11.289	< 67%
1	3C04	3C03	21	0.0020	3.838	6.017	6535	1215	.4*1+7	1.119	< 67%
1	3C05	3C04	21	0.0013	3.095	4.851	5269	1215	.4*1+7	1.119	< 67%
1	3C06	3C05	21	0.0020	3.838	6.017	6535	1083	.15*1+7	0.997	< 67%

Table 6-10
Future Conditions - Wet Weather

Flow Calculation Data

Persons Per Household =	3.5
Per Capita Generation =	85 gpd
Generation Per Household =	297.5 gpd
=	0.00046 cfs
Peaking Factor =	3
Peaked Generation =	0.001381 cfs
Manning's "n" =	0.012

ERU Count

Zone 1	530
Zone 2	873
Zone 3	3927
Zone 4	650
Zone 5	391
Zone 6	215
Zone 7	106
Zone 8	358
Zone 9	416
Zone 10	546
Zone 11	2095
Zone 12	431
Zone 13	224
Zone 14	375
Zone 15	336
Zone 16	298
Zone 17	492
Total =	**12263**

(includes expansion)

ERU Count Expansion

Fagan Canyon	3036
Adams Canyon	27
East Area 1	1456
East Area 2	167
West Area 2	275
Total =	**4961**

Collection Zone	FROM MH#	TO MH#	Pipe Dia. (in)	Slope (ft/ft)	3/4 Full Capacity (cfs)	ERU's Served at Capacity	ERU's Served	Contributing Zones	Peaked Flow Rate (cfs)	Percent Full
17	7H10	7H09	8	0.0202	1.697	1228	492	17	0.679	< 75%
17	7I01	7H10	8	0.0260	1.925	1393	465		0.642	< 75%
17	7H22	7H10	6	0.0084	0.508	367	27		0.037	< 75%
17	7I17	7I16	8	0.0253	1.899	1375	465		0.642	< 75%
16	8G05	8G03	12	0.0198	4.953	3586	298	16	0.412	< 75%
16	8G24	8G05	10	0.0029	1.166	844	283	.95*16	0.391	< 75%
16	8H11	8H09	10	0.0039	1.352	978	179	.6*16	0.247	< 75%
15	7E11	7E04	8	0.0220	1.771	1282				< 75%
15	7E09	7E03	8	0.0193	1.658	1200				< 75%
15	**Parallel Pipes**		8			2482	828	15+17	1.143	< 75%
14	7D28	7D26	12	0.0032	1.991	1441	673	14+16	0.929	< 75%
13	7C15	7C14	8	0.0040	0.755	546	224	(13+EA2)	0.309	< 75%
12	6E11	6E12	10	0.0171	2.830	2049	431	12	0.595	< 75%
11	5D30	5D29	18	0.0020	4.641	3360	3354	(11+EA1)+12+15	4.632	< 75%
11	6D20	6D19	18	0.0012	3.595	2603	3249	.95*(11+EA1)+12+	4.487	100%+
11	6D29	6D20	12	0.0015	1.363	987	1990	.95*11	2.748	100%+
11	7D25	7D24	10	0.0040	1.369	991	1886	.90*11	2.604	100%+
10	5E19	5E14	8	0.0028	0.632	457	191	.35*10	0.264	< 75%
10	5E10	5E14	8	0.0084	1.094	792	246	.45*10	0.339	< 75%
10	5E16	5E17	8	0.0116	1.286	931	546	10	0.754	< 75%
9	4D34	4D33	8	0.0200	1.688	1222	962	9+10	1.328	< 75%
9	4D36	4D34	8	0.0134	1.382	1000	374	.9*9	0.517	< 75%
9	4E01	4D36	8	0.0143	1.428	1033	374	.9*9	0.517	< 75%
9	4E05	4E01	8	0.0156	1.491	1079	374	.9*9	0.517	< 75%
9	4E06	4E05	8	0.0050	0.844	611	354	.85*9	0.488	< 75%
8	4D06	4D09	20	0.0008	3.887	2815	4674	8+9+11	6.454	100%+
8	4D26	4D27	15	0.0020	2.854	2066	1016	.15*8+9	1.403	< 75%
8	4D27	4D06	15	0.0020	2.854	2066	1016	.15*8+9	1.403	< 75%
8	4D31	4D31	12	0.0076	3.068	2222	230	.1*8+9	0.318	< 75%
8	5D04	4D07	18	0.0009	3.113	2254	2346	.7*8+11	3.239	78%
8	5D22	5D05	18	0.0008	2.935	2125	2328	.65*8+11	3.214	82%
7	5C07	5C05	18	0.0032	5.870	4251	1003	7+13+14	1.385	< 75%
7	7C14	7C13	18	0.0056	7.766	5623	673	14	0.929	< 75%
7	7C13	7C07	18	0.0030	5.684	4116	897	13+14	1.239	< 75%
6	2F01	2E48	8	0.0103	1.212	877	215	6	0.297	< 75%
5	2E42	2E34	10	0.0200	3.061	2216	391	5	0.540	< 75%
5	2E45	2E43	8	0.0040	0.755	546	91		0.126	< 75%
5	2E40	2E42	8	0.0035	0.706	511	276		0.381	< 75%
4	2D43	2D44	10	0.0025	1.082	783	1256	(4+AC)+5+6	1.734	100%+
4	2D42	2D43	10	0.0025	1.082	783	1256		1.734	100%+
4	2E04	2D42	10	0.0025	1.082	783	1256		1.734	100%+
4	2E05	2E04	10	0.0025	1.082	783	1256		1.734	100%+
4	2E06	2E05	8	0.0094	1.157	838	996	.93*(4+AC)+5	1.375	100%+
4	2E12	2E06	8	0.0086	1.107	801	996		1.375	100%+
4	2E08	2E05	10	0.0025	1.082	783	800	.90*(4+AC)+6	1.105	76%
4	2E17	2E08	10	0.0025	1.082	783	781	.87*(4+AC)+6	1.078	< 75%
3	2C14	2C15	24	0.0021	10.241	7416	9857	(3+FC)+4+8	13.611	100%+
3	3D19	3D20	24	0.0010	7.067	5117	8405	.95*3+8	11.606	100%+
3	2D09	2D51	24	0.0010	7.067	5117	9661	.95*3+4+9	13.340	100%+
3	3D21	3D18	8	0.0060	0.925	669	3142	.15*3+FC	4.338	100%+
3	2D45	2D46	10	0.0096	2.121	1535	1256	4	1.734	< 75%
2	1C04	1C08	15	0.0124	7.106	5146	873	(2+WA2)	1.206	< 75%
2	1D08	1D17	12	0.0066	2.859	2070	349	.40*2	0.482	< 75%
2	1D09	1D08	8	0.0058	0.909	658	262	.30*2	0.362	< 75%
2	1D10	1D09	8	0.0058	0.909	658	262	.30*2	0.362	< 75%
1	2C01	Plant	36	0.0010	20.837	15089	12263	1+2+3+7	16.934	< 75%
1	3C04	3C03	21	0.0020	7.000	5069	1215	.4*1+7	1.678	< 75%
1	3C05	3C04	21	0.0013	5.644	4087	1215	.4*1+7	1.678	< 75%
1	3C06	3C05	21	0.0020	7.000	5069	1083	.15*1+7	1.495	< 75%

The future flow data input in the model showed future capacity problems in the following sewer segments:

- 12-inch sewer, east along Harvard Blvd. and north along Garcia and Thirteenth Streets
- 36, and 24-inch sewers from the Wastewater Treatment Plant east to Acacia Road, north to Harvard Blvd. east to Steckel Drive
- 8-inch sewer along Steckel Drive north to Main Street
- 8-inch sewer east along Santa Paula Street to Walden Street, south along Walden and Elm Streets to Harvard Blvd.

The connection point for the future flow from East Area 2 is assumed to be the main trunk sewer that is south of the Santa Paula Freeway (SR 126). This sewer presently acts as a relief sewer for the main trunk sewer along Harvard Blvd. East Area 2 utilizes a small amount (221 ERUs) of capacity in the sewer south of SR 126 and this would eliminate some of the overflow/relief capability for the Harvard Blvd. sewer. However, the lemonwood lift station capacity will need to be analyzed. The connection point for East Area 1 is in the Harvard Blvd main trunk sewer.. Based on the anticipated build-out flow, replacement of the Harvard Blvd main trunk sewer would be required. The replacement sewer in Harvard Blvd would be sized to convey all of the existing and East Area 1 build-out flow, consequently, overflow relief in the replaced Harvard Blvd. trunk sewer to the existing trunk sewer south of SR126 will not be critical. **Table 6-11** and **Table 6-12** show model results with modifications to sewer segments that were at capacity.

Recommendations

Figure 6-5 shows the sewer improvements based on the model results. The immediate improvements are based on the existing capacity needs. The future improvements are based on development needs.

Table 6-11
Future Reinforcements - Dry Weather

Flow Calculation Data

Persons Per Household =	3.5	
Per Capita Generation =	85	gpd
Generation Per Household =	297.5	gpd
=	0.00046	cfs
Peaking Factor =	2	
Peaked Generation =	0.000921	cfs
Manning's "n" =	0.012	

ERU Count

Zone 1	530
Zone 2	873
Zone 3	3927
Zone 4	650
Zone 5	391
Zone 6	215
Zone 7	106
Zone 8	358
Zone 9	416
Zone 10	546
Zone 11	2095
Zone 12	431
Zone 13	224
Zone 14	375
Zone 15	336
Zone 16	298
Zone 17	492
Total =	**12263**

(includes expansion)

ERU Count Expansion

Fagan Canyon	3036
Adams Canyon	27
East Area 1	1456
East Area 2	167
West Area 2	275
Total =	**4961**

- required pipe size

Collection Zone	FROM MH#	TO MH#	Pipe Dia. (in)	Slope (ft/ft)	1/2 Full Capacity - (dia. <= 12") (cfs)	2/3 Full Capacity - (dia. > 12") (cfs)	ERU's Served at Capacity	ERU's Served	Contributing Zones	Peaked Flow Rate (cfs)	Percent Full
17	7H10	7H09	8	0.0202	0.930	1.458	1010	492	17	0.453	< 50%
17	7I01	7H10	8	0.0260	1.055	1.655	1146	465		0.428	< 50%
17	7H22	7H10	6	0.0084	0.279	0.437	302	27		0.025	< 50%
17	7I17	7I16	8	0.0253	1.041	1.632	1130	465		0.428	< 50%
16	8G05	8G03	12	0.0198	2.716	4.257	2949	298	16	0.274	< 50%
16	8G24	8G05	10	0.0029	0.639	1.002	694	283	.95*16	0.261	< 50%
16	8H11	8H09	10	0.0039	0.741	1.162	805	179	.6*16	0.165	< 50%
15	7E11	7E04	8	0.0220	0.971	1.522	1054				< 50%
15	7E09	7E03	8	0.0193	0.909	1.425	987				< 50%
15	**Parallel Pipes**		8				2041	828	15+17	0.762	< 50%
14	7D28	7D26	12	0.0032	1.092	1.711	1185	673	14+16	0.620	< 50%
13	7C15	7C14	8	0.0040	0.414	0.649	449	224	(13+EA2)	0.206	< 50%
12	6E11	6E12	10	0.0171	1.552	2.433	1685	431	12	0.397	< 50%
11	5D30	5D29	18	0.0020	2.545	3.989	4332	3354	(11+EA1)+12+15	3.088	< 67%
11	6D20	6D19	18	0.0012	1.971	3.090	3356	3249	.95*(11+EA1)+12+	2.991	< 67%
11	6D29	6D20	15	0.0015	1.355	2.124	2307	1990	.95*11	1.832	< 67%
11	7D25	7D24	15	0.0040	2.213	3.469	3768	1886	.90*11	1.736	< 67%
10	5E19	5E14	8	0.0028	0.346	0.543	376	191	.35*10	0.176	< 50%
10	5E10	5E14	8	0.0084	0.600	0.940	651	246	.45*10	0.226	< 50%
10	5E16	5E17	8	0.0116	0.705	1.105	765	546	10	0.503	< 50%
9	4D34	4D33	8	0.0200	0.926	1.451	1005	962	9+10	0.886	< 50%
9	4D36	4D34	8	0.0134	0.758	1.188	823	374	.9*9	0.345	< 50%
9	4E01	4D36	8	0.0143	0.783	1.227	850	374	.9*9	0.345	< 50%
9	4E05	4E01	8	0.0156	0.818	1.282	888	374	.9*9	0.345	< 50%
9	4E06	4E05	8	0.0050	0.463	0.726	502	354	.85*9	0.326	< 50%
8	4D06	4D09	24	0.0008	3.466	5.433	5901	4674	8+9+11	4.303	< 67%
8	4D26	4D27	15	0.0020	1.565	2.453	2664	1016	.15*8+9	0.935	< 67%
8	4D27	4D06	15	0.0020	1.565	2.453	2664	1016	.15*8+9	0.935	< 67%
8	4D31	4D31	12	0.0076	1.682	2.637	1827	230	.1*8+9	0.212	< 50%
8	5D04	4D07	18	0.0009	1.707	2.676	2906	2346	.7*8+11	2.159	< 67%
8	5D22	5D05	18	0.0008	1.609	2.523	2740	2328	.65*8+11	2.143	< 67%
7	5C07	5C05	18	0.0032	3.219	5.046	5480	1003	7+13+14	0.923	< 67%
7	7C14	7C13	18	0.0056	4.258	6.675	7250	673	14	0.620	< 67%
7	7C13	7C07	18	0.0030	3.116	4.885	5306	897	13+14	0.826	< 67%
6	2F01	2E48	8	0.0103	0.664	1.041	721	215	6	0.198	< 50%
5	2E42	2E34	10	0.0200	1.678	2.631	1823	391	5	0.360	< 50%
5	2E45	2E43	8	0.0040	0.414	0.649	449	91		0.084	< 50%
5	2E40	2E42	8	0.0035	0.387	0.607	420	276		0.254	< 50%
4	2D43	2D44	15	0.0025	1.750	2.743	2979	1256	(4+AC)+5+6	1.156	< 67%
4	2D42	2D43	15	0.0025	1.750	2.743	2979	1256		1.156	< 67%
4	2E04	2D42	15	0.0025	1.750	2.743	2979	1256		1.156	< 67%
4	2E05	2E04	15	0.0025	1.750	2.743	2979	1256		1.156	< 67%
4	2E06	2E05	10	0.0094	1.151	1.804	1249	996	.93*(4+AC)+5	0.916	< 50%
4	2E12	2E06	10	0.0086	1.101	1.725	1195	996		0.916	< 50%
4	2E08	2E05	12	0.0025	0.965	1.513	1048	800	.90*(4+AC)+6	0.736	< 50%
4	2E17	2E08	12	0.0025	0.965	1.513	1048	781	.87*(4+AC)+6	0.719	< 50%
3	2C14	2C15	30	0.0021	10.181	15.960	17337	9857	(3+FC)+4+8	9.074	< 67%
3	3D19	3D20	30	0.0010	7.026	11.014	11963	8405	.95*3+8	7.737	< 67%
3	2D09	2D51	30	0.0010	7.026	11.014	11963	9661	.95*3+4+9	8.894	< 67%
3	3D21	3D18	15	0.0060	2.710	4.249	4615	3625	.15*3+FC	3.337	< 67%
3	2D45	2D46	10	0.0096	1.163	1.823	1263	1256	4	1.156	< 50%
2	1C04	1C08	15	0.0124	3.896	6.108	6634	873	(2+WA2)	0.804	< 67%
2	1D08	1D17	12	0.0066	1.568	2.458	1703	349	.40*2	0.321	< 50%
2	1D09	1D08	8	0.0058	0.498	0.781	541	262	.30*2	0.241	< 50%
2	1D10	1D09	8	0.0058	0.498	0.781	541	262	.30*2	0.241	< 50%
1	2C01	Plant	36	0.0010	11.425	17.910	19454	12263	1+2+3+7	11.289	< 67%
1	3C04	3C03	21	0.0020	3.838	6.017	6535	1215	.4*1+7	1.119	< 67%
1	3C05	3C04	21	0.0013	3.095	4.851	5269	1215	.4*1+7	1.119	< 67%
1	3C06	3C05	21	0.0020	3.838	6.017	6535	1083	.15*1+7	0.997	< 67%

Table 6-12
Future Reinforcements - Wet Weather

Flow Calculation Data

Persons Per Household =	3.5
Per Capita Generation =	85 gpd
Generation Per Household =	297.5 gpd
=	0.00046 cfs
Peaking Factor =	3
Peaked Generation =	0.001381 cfs
Manning's "n" =	0.012

ERU Count

Zone 1	530
Zone 2	873
Zone 3	3927
Zone 4	650
Zone 5	391
Zone 6	215
Zone 7	106
Zone 8	358
Zone 9	416
Zone 10	546
Zone 11	2095
Zone 12	431
Zone 13	224
Zone 14	375
Zone 15	336
Zone 16	298
Zone 17	492
Total =	**12263**

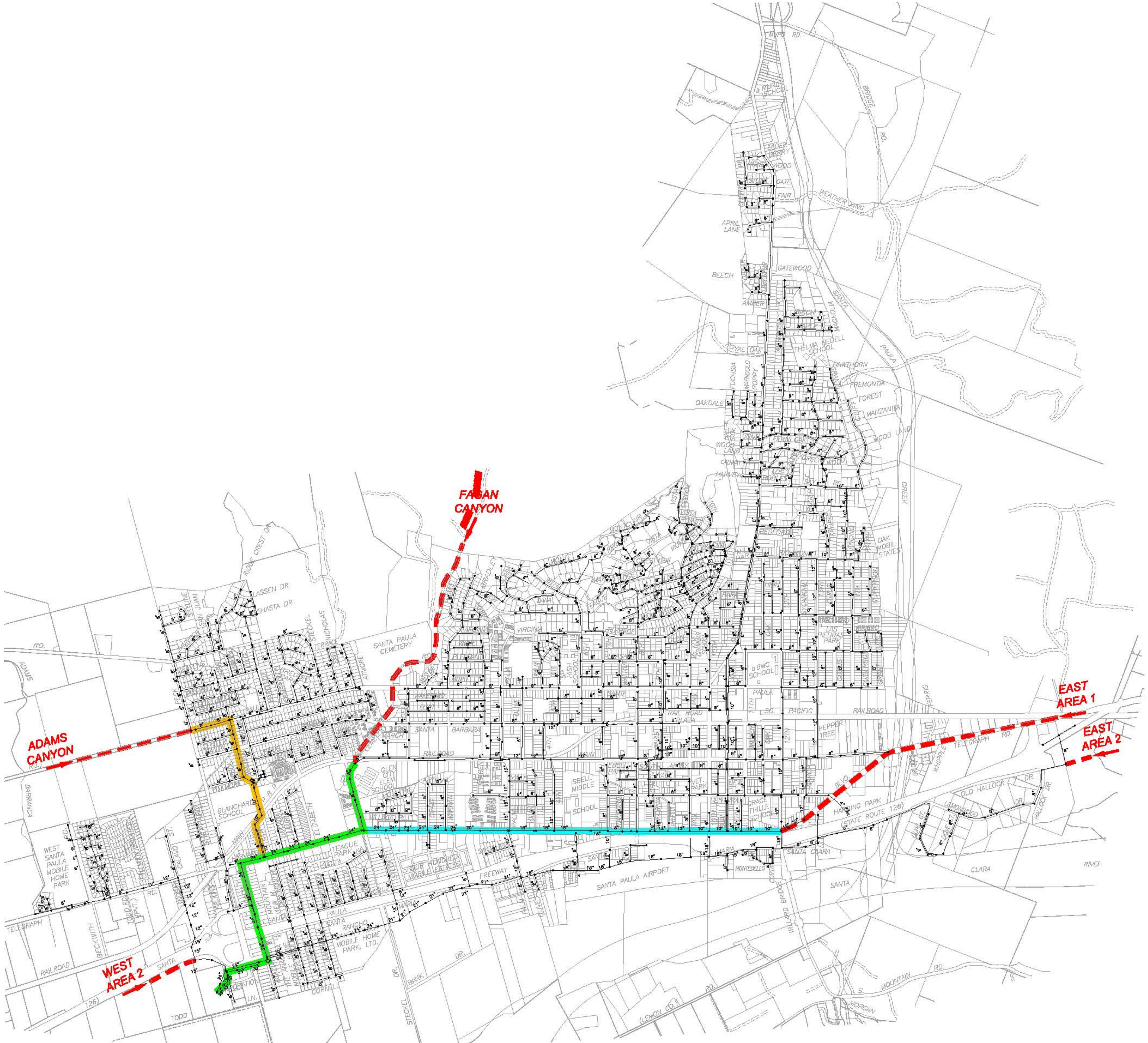
(includes expansion)

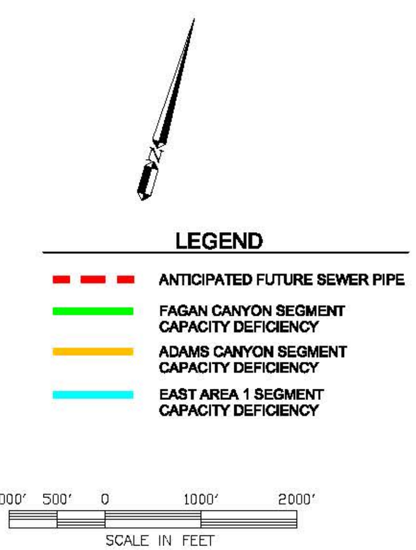
ERU Count Expansion

Fagan Canyon	3036
Adams Canyon	27
East Area 1	1456
East Area 2	167
West Area 2	275
Total =	**4961**

- required pipe size

Collection Zone	FROM MH#	TO MH#	Pipe Dia. (in)	Slope (ft/ft)	3/4 Full Capacity (cfs)	ERU's Served at Capacity	ERU's Served	Contributing Zones	Peaked Flow Rate (cfs)	Percent Full
17	7H10	7H09	8	0.0202	1.697	1228	492	17	0.679	< 75%
17	7I01	7H10	8	0.0260	1.925	1393	465		0.642	< 75%
17	7H22	7H10	6	0.0084	0.508	367	27		0.037	< 75%
17	7I17	7I16	8	0.0253	1.899	1375	465		0.642	< 75%
16	8G05	8G03	12	0.0198	4.953	3586	298	16	0.412	< 75%
16	8G24	8G05	10	0.0029	1.166	844	283	.95*16	0.391	< 75%
16	8H11	8H09	10	0.0039	1.352	978	179	.6*16	0.247	< 75%
15	7E11	7E04	8	0.0220	1.771	1282				< 75%
15	7E09	7E03	8	0.0193	1.658	1200				< 75%
15	**Parallel Pipes**		8			2482	828	15+17	1.143	< 75%
14	7D28	7D26	12	0.0032	1.991	1441	673	14+16	0.929	< 75%
13	7C15	7C14	8	0.0040	0.755	546	224	(13+EA2)	0.309	< 75%
12	6E11	6E12	10	0.0171	2.830	2049	431	12	0.595	< 75%
11	5D30	5D29	18	0.0020	4.641	3360	3354	(11+EA1)+12+15	4.632	< 75%
11	6D20	6D19	21	0.0012	5.422	3926	3249	.95*(11+EA1)+12	4.487	< 75%
11	6D29	6D20	18	0.0015	4.019	2910	1990	.95*11	2.748	< 75%
11	7D25	7D24	15	0.0040	4.036	2922	1886	.90*11	2.604	< 75%
10	5E19	5E14	8	0.0028	0.632	457	191	.35*10	0.264	< 75%
10	5E10	5E14	8	0.0084	1.094	792	246	.45*10	0.339	< 75%
10	5E16	5E17	8	0.0116	1.286	931	546	10	0.754	< 75%
9	4D34	4D33	8	0.0200	1.688	1222	962	9+10	1.328	< 75%
9	4D36	4D34	8	0.0134	1.382	1000	374	.9*9	0.517	< 75%
9	4E01	4D36	8	0.0143	1.428	1033	374	.9*9	0.517	< 75%
9	4E05	4E01	8	0.0156	1.491	1079	374	.9*9	0.517	< 75%
9	4E06	4E05	8	0.0050	0.844	611	354	.85*9	0.488	< 75%
8	4D06	4D09	30	0.0008	11.461	8299	4674	8+9+11	6.454	< 75%
8	4D26	4D27	15	0.0020	2.854	2066	1016	.15*8+9	1.403	< 75%
8	4D27	4D06	15	0.0020	2.854	2066	1016	.15*8+9	1.403	< 75%
8	4D31	4D31	12	0.0076	3.068	2222	230	.1*8+9	0.318	< 75%
8	5D04	4D07	21	0.0009	4.696	3400	2346	.7*8+11	3.239	< 75%
8	5D22	5D05	21	0.0008	4.427	3206	2328	.65*8+11	3.214	< 75%
7	5C07	5C05	18	0.0032	5.870	4251	1003	7+13+14	1.385	< 75%
7	7C14	7C13	18	0.0056	7.766	5623	673	14	0.929	< 75%
7	7C13	7C07	18	0.0030	5.684	4116	897	13+14	1.239	< 75%
6	2F01	2E48	8	0.0103	1.212	877	215	6	0.297	< 75%
5	2E42	2E34	10	0.0200	3.061	2216	391	5	0.540	< 75%
5	2E45	2E43	8	0.0040	0.755	546	91		0.126	< 75%
5	2E40	2E42	8	0.0035	0.706	511	276		0.381	< 75%
4	2D43	2D44	12	0.0025	1.760	1274	1256	(4+AC)+5+6	1.734	< 75%
4	2D42	2D43	12	0.0025	1.760	1274	1256		1.734	< 75%
4	2E04	2D42	12	0.0025	1.760	1274	1256		1.734	< 75%
4	2E05	2E04	12	0.0025	1.760	1274	1256		1.734	< 75%
4	2E06	2E05	10	0.0094	2.099	1519	996	.93*(4+AC)+5	1.375	< 75%
4	2E12	2E06	10	0.0086	2.007	1453	996		1.375	< 75%
4	2E08	2E05	12	0.0025	1.760	1274	800	.90*(4+AC)+6	1.105	< 75%
4	2E17	2E08	10	0.0025	1.082	783	781	.87*(4+AC)+6	1.078	< 75%
3	2C14	2C15	30	0.0021	18.569	13446	9857	(3+FC)+4+8	13.611	< 75%
3	3D19	3D20	30	0.0010	12.814	9279	8405	.95*3+8	11.606	< 75%
3	2D09	2D51	33	0.0010	16.522	11964	9661	.95*3+4+9	13.340	< 75%
3	3D21	3D18	18	0.0060	8.038	5820	3625	.15*3+FC	5.006	< 75%
3	2D45	2D46	10	0.0096	2.121	1535	1256	4	1.734	< 75%
2	1C04	1C08	15	0.0124	7.106	5146	873	(2+WA2)	1.206	< 75%
2	1D08	1D17	12	0.0066	2.859	2070	349	.40*2	0.482	< 75%
2	1D09	1D08	8	0.0058	0.909	658	262	.30*2	0.362	< 75%
2	1D10	1D09	8	0.0058	0.909	658	262	.30*2	0.362	< 75%
1	2C01	Plant	36	0.0010	20.837	15089	12263	1+2+3+7	16.934	< 75%
1	3C04	3C03	21	0.0020	7.000	5069	1215	.4*1+7	1.678	< 75%
1	3C05	3C04	21	0.0013	5.644	4087	1215	.4*1+7	1.678	< 75%
1	3C06	3C05	21	0.0020	7.000	5069	1083	.15*1+7	1.495	< 75%





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BOYLE

CITY OF SANTA PAULA
WASTEWATER SYSTEM
MASTER PLAN

SYSTEM CAPACITY
DEFICIENCIES-FUTURE

VT-S27-105-01	SEPT 2005	FIGURE 6-4

Chapter 7 – Interceptor Physical Condition

The City of Santa Paula's wastewater collection system is comprised of sewer pipes over 30 years old as well as newer pipes. As the condition of the pipes deteriorates, obstructions from broken pieces and roots can cause hydraulic restrictions in the system. This section discusses the condition of the existing collection system. The discussion, however, is limited to sections of the collection system that have been video taped and cleaned since 2002. Additionally, known deficiencies identified by operations and City Staff are included.

Condition Assessment Objectives

The main objective of the condition assessment is to identify segments of the sewer system that are in need of replacement or repair. The sources for the condition assessment include video of internal television inspections, a field inspection of representative manholes and interviews with City Staff and others.

Sewer repair and rehabilitation is an ongoing process. Although repair or replacement of sewer segments is recommended in this chapter, sewers will continue to deteriorate and fail over time. The City, therefore, must be vigilant in their efforts to maintain the system. To this end, this section recommends a plan for immediate sewer rehabilitation as well as a plan for continual observance and corrections within the system.

Internal Television Inspections

Figure 7-1 shows the collection system and high lights the areas that have been televised since 2002. The logs and videotapes were reviewed and sewer segments in need of rehabilitation and repair were noted. **Figure 7-2** identifies the sewer segments in poor condition. **Table 7-1** identifies the segment by manhole numbers and describes the condition.

Based the review of videotapes, it is apparent that the central or older portion of the City has more problem areas within the collection system. **Figure 7-3** identifies areas targeted for further investigations. Information gathered from subsequent videotaping will need to be prioritized and included in the City's annual budget for sewer maintenance and repair.

CITY OF SANTA PAULA WASTEWATER SYSTEM MASTER PLAN

TELEVISED SEWERS

VT-S27-105-01	SEPT 2005	FIGURE 7-1

BOYLE

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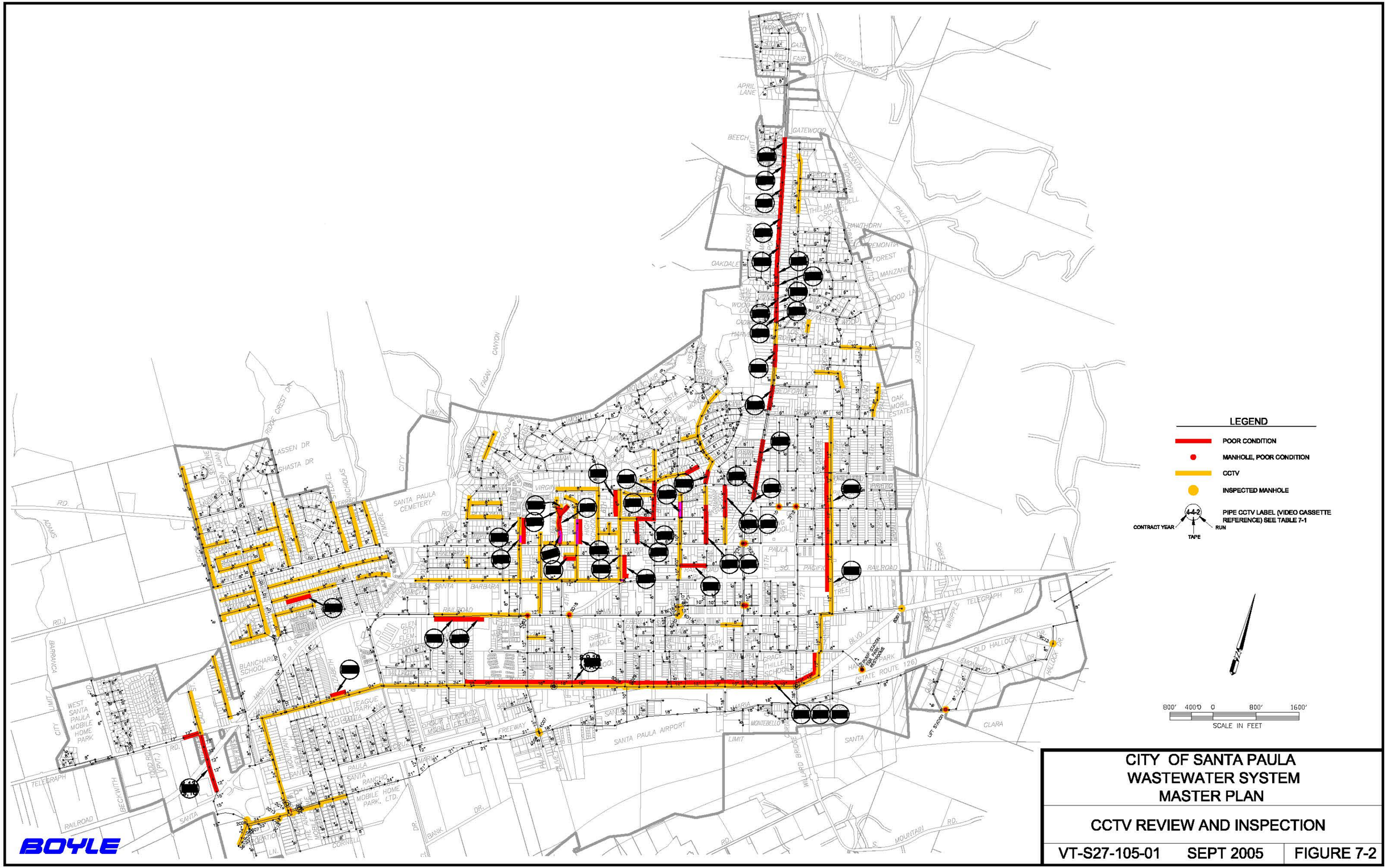
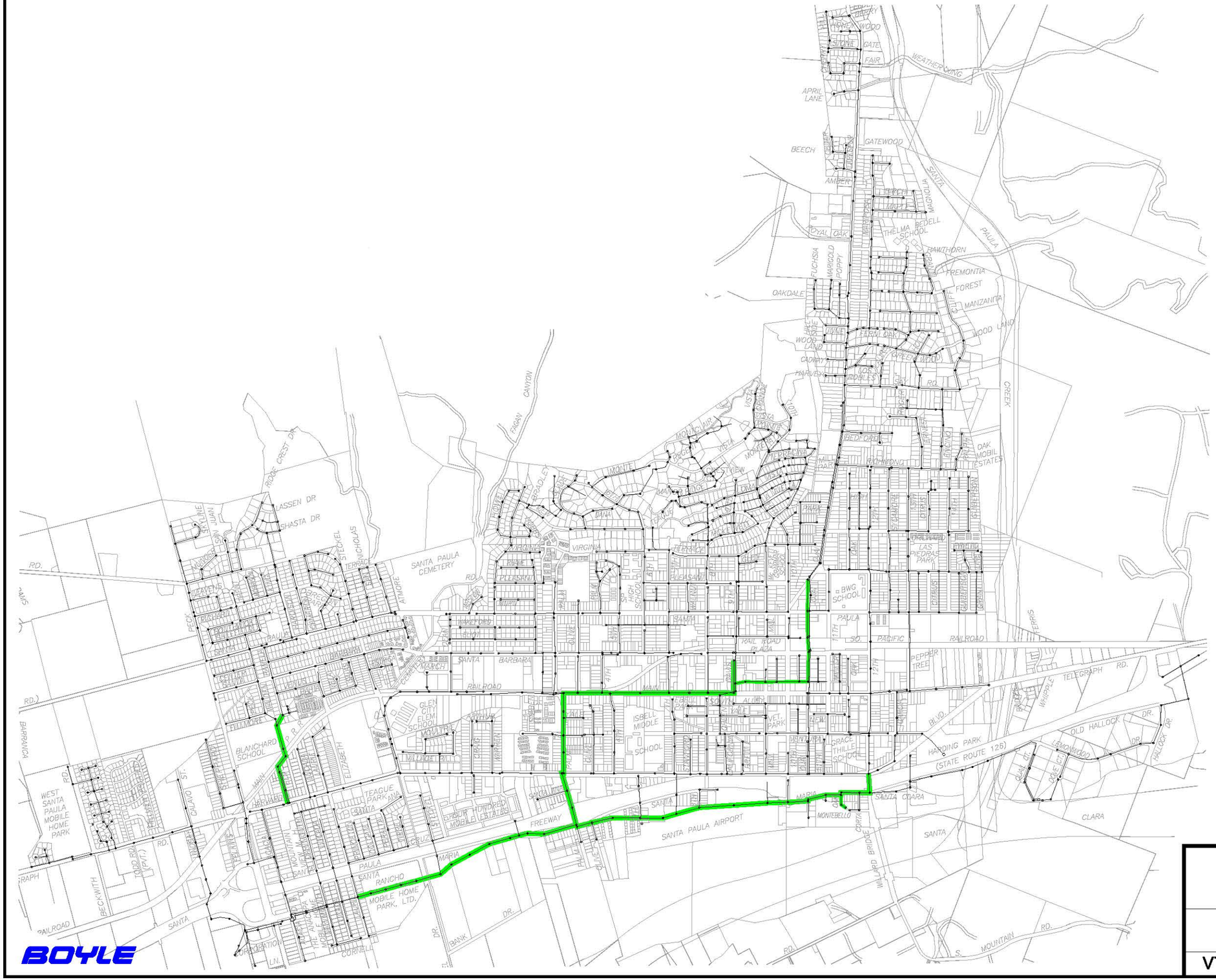

LEGEND
POOR CONDITION
MANHOLE, POOR CONDITION
CCTV
INSPECTED MANHOLE
PIPE CCTV LABEL (VIDEO CASSETTE REFERENCE) SEE TABLE 7-1
CONTRACT YEAR
TAPE
RUN
800' 400' 0 800' 1600'
SCALE IN FEET
BOYLE
CITY OF SANTA PAULA
WASTEWATER SYSTEM
MASTER PLAN
CCTV REVIEW AND INSPECTION
VT-S27-105-01
SEPT 2005
FIGURE 7-2



LEGEND

- RECOMMENDED FUTURE CCTV
- SEWER MANHOLE

BOYLE

CITY OF SANTA PAULA WASTEWATER SYSTEM MASTER PLAN

RECOMMENDED PRIORITY CCTV

VT-S27-105-01	SEPT 2005	FIGURE 7-3

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DATE: Feb 21, 2006 12:6pm XREFS: Santa Paula Late Sewer Pipes Color 0 Width

Video Tapes Reviewed
-Selection based on the CCTV inspection logs

TABLE 7-1

9/27/2005
Rev. 1

Year	Tape	Run	Label	Location	MH to	MH	Action	Comment
Contract Year 4								
	Tape 1	Run 1	4-1-1	Seventh Street	5F25	5F29	Replacement	Broken joint, cracked lateral
		Run 5	4-1-5	Seventh Street	5E25	5E27		Cracked lateral
		Run 6	4-1-6	Santa Barbara Street	5E28	5E27	Replacement	Broken pipe near collapse
	Tape 4	Run 2	4-4-2	Santa Barbara Street	2E23	2E24		Several small sags
Contract Year 5								
	Tape 1	Run 2	5-1-2	Ninth Street	6F14	6F05	Replacement	Several pipe segment have small "alligatored" cracks
	Tape 2	Run 1	5-2-1	Ojai Road/Hwy 150	7J01	7I17		Small cracks, broken joint
		Run 2	5-2-2	Ojai Road/Hwy 150	7I17	7I16	Spot Repair	Broken and offset joint
		Run 3	5-2-3	Ojai Road/Hwy 150	7I16	7I10		Small spiral crack
		Run 4	5-2-4	Ojai Road/Hwy 150	7I10	7I09		Cracked joint
		Run 5	5-2-5	Ojai Road/Hwy 150	7I09	7I06		Cracked joints
		Run 6	5-2-6	Ojai Road/Hwy 150	7I06	7I29	Replacement	Many small cracks at most joints
	Tape 3	Run 1	5-3-1	Ojai Road/Hwy 150	7K04	7K02	Spot Repair	Cracked, severe offset and blockage - also recommend cleaning
		Run 2	5-3-2	Ojai Road/Hwy 150	7K02	7J04	Replacement	Hole in side of pipe, severe sag in pipe just before MH, Heavy roots
		Run 3	5-3-3	Ojai Road/Hwy 150	7J04	7J02	Mech. Clean	Heavy roots backing up flow - clear the pipe
	Tape 4	Run 4	5-4-4	Ojai Road/Hwy 150	7L08	7L09	Mech. Clean	Clear pipe- Roots blocking flow
		Run 8	5-4-8	Ojai Road/Hwy 150	7L07	7K04	Mech. Clean	Clear pipe- Roots blocking flow
Contract Year 6								
	Tape 1	Run 1	6-1-1	Ojai Road/Hwy 150	7H10	7H09		Not Viewed
		Run 4	6-1-4	Ojai Road/Hwy 150	7H05	7H01		
		Run 7	6-1-7	Ojai Road/Hwy 150	7G05	7G01	Spot Repair	Large hole in top of pipe (this run is actually at the beginning of tape 2)
	Tape 2	Run 1	6-2-1	Ojai Road/Hwy 150	7G01	7F04		Cracked lateral, offset joints
	Tape 3	Run 4	6-3-4	Ojai Road/Hwy 150	7F07	7F05		Crack around pipe
Contract Year 7								
	Tape 1	Run 1	7-1-1	Main Street	4D41	4D39	Replacement	Hole in pipe, severe sag and offset joint
		Run 2	7-1-2	Main Street	4D39	4D37	Replacement	2 Holes in pipe
		Run11	7-1-11	Fifth Street	5F16	5E09	Replacement	Crushed pipe at lateral, several holes and severe cracks
	Tape 2	Run 4	7-2-4	Palm Court	5F05	5F06	Spot Repair	Hole in Pipe
		Run 5	7-2-5	Palm Court	5F06	5F03	Spot Repair	Hole in invert of pipe
		Run 6	7-2-6	Alley	5E11	5E10	Replacement	Broken pipe with void
		Run 7	7-2-7	Palm Court	5F04	5F03	Replacement	Several pipe segment have small "alligatored" cracks
		Run 8	7-2-8	Palm Court	5F03	5E07	Spot Repair	Holes in pipe, severe cracks and partial collapse
	Tape 3	Run 5	7-3-5	Palm Avenue	4E31	4E32	Spot Repair	Hole in pipe
		Run 7	7-3-7	Palm Avenue	4F08	4E30	Replacement	Severe cracks, hole in invert
Contract Boyle								
	Tape 1	Run 1		McKevett Easement	6G12	6G09	Clean	Small cracks and roots
	Tape 1	Run 2		McKevett Easement	6G09	6G05	Spot Repair/clean	Crack. At joint. Very old pipe with lots of residue.
	Tape 1	Run 3		McKevett Easement	6G05	6G02	Replacement	Broken and collapsed pipe
	Tape 1	Run 5		McKevett Easement	6G20	6G19	Replacement	Broken pipe and offset joints

Video Tapes Reviewed
-Selection based on the CCTV inspection logs

TABLE 7-1

9/27/2005
Rev. 1

Year	Tape	Run	Label	Location	MH to	MH	Action	Comment
	Tape 1	Run 6		McKevett Rd.	6G19	6G18	Spot Repair	Hole in top. Hole looks drilled. Medium sized.
	Tape 1	Run 6A		McKevett Rd.	6G18	6G04		Begin sag..
	Tape 1	Run 7		McKevett Rd.	6G04	6G03		Begin sag
	Tape 1	Run 9		Eighth St.	6G01	6F16	Replacement	Large Crack
	Tape 2	Run 1		Eighth St.	6F15A	6F02	Replacement	Hole in top.
	Tape 2	Run 2		Virginia Terrace	5F26	6F16	Mech. Clean	Plugged lateral left. Rocks and concrete.
	Tape 2	Run 3		Pleasant St.	6F02	5F31	Replacement	Broken pipe with roots.
	Tape 2	Run 4		Pleasant St	5F31	5F29	Mech. Clean	Grease and sag
	Tape 2	Run 7		Tenth St	6H03	6H02		Crack. Small.
	Tape 2	Run 10		Tenth St.	6G26	6G27	Spot repair	Broken Pipe. Hole in top.
	Tape 3	Run 1		Walnut St.	5F31	5E23	Replacement	Hole in top. Large/ Roots
	Tape 3	Run 5		Tenth St.	6G33	6G34	Spot Repair	Hole in side with patch. Huge hole with plastic like patch. Patch partially caved in.
	Tape 4	Run 1		Mill St.	6G34	6G35		Pipe deflects down sharply
	Tape 4	Run 2		Virginia Terrace	6F22	6F20	Mech Clean	Sag with debris in invert
	Tape 4	Run 5		Mill St.	6G35	6F22	Replacement	Broken Pipe
	Tape 4	Run 7		Mill St	6F10	6F08	Replacement	Broken pipe. Partial collapse. Cracks along entire pipe.
	Tape 4	Run 8		Tenth St	6F24	6F12	Replacement	Hole in right side. Large hole
	Tape 4	Run 9		Tenth St.	6F12	6F11	Replacement	Lateral left. Broken Pipe.
	Tape 4	Run 10		Tenth St.	6F11	7E20	Mech. Clean	Heavy roots. Grease.
	Tape 5	Run 1		Mill St	6F08	6E26	Replacement	Broken Pipe, Entire segment Cracked
	Tape 5	Run 2		Santa Paula St	6E05	5E23		Lateral right Protruding, not affecting flow
	Tape 5	Run 3		Santa Paula St	5E23	5E22		Camera flipped, will not pass. High flow through area
	Tape 5	Run 5		Railroad Ave	6E24	6E10	Replacement	Broken Pipe. Hole in top.
	Tape 6	Run 1		13th St.	8G05	8G03	Line Segment	Small cracks at all joints throughout pipe
	Tape 6	Run 2		13th St.	8G03	8G02	Spot Repairs	Spot repairs necessary at 3 locations, several small cracks throughout segment
	Tape 6	Run 3		13th St.	8G02	8F15	Spot Repairs	Spot repairs necessary at 2 locations. Small cracks throughout pipe at joints
	Tape 6	Run 4		13th St.	8F15	8F14	Line/Spot Repair	Small cracks at joints throughout pipe segment. One spot repair necessary.

Video Tapes Reviewed
-Selection based on the CCTV inspection logs

TABLE 7-1

9/27/2005
Rev. 1

Year	Tape	Run	Label	Location	MH to	MH	Action	Comment
	Tape 6	Run 5		13th St.	8F14	8F10	Line/Spot Repair	Small cracks at all joints throughout pipe. One spot repair necessary
	Tape 6	Run 6		13th St.	8F10	8F01	Line/Spot Repair	Small cracks at most joints throughout pipe segment. Two spot repairs necessary
	Tape 6	Run 7		13th St.	8F01	8E03	Line Segment	Small cracks at most joints throughout pipe segment. No spot repairs necessary.
	Tape 6	Run 8		13th St.	8E03	8E02	Line/Spot Repair	Small cracks at most joints throughout pipe segment. 2 possible spot repairs.
	Tape 7	Run 4		13th St.	8E02	8E01	Line/Spot Repair	Small cracks at most joints throughout pipe segment. One spot repair necessary. Replace cast iron section??
	Tape 7	Run 6		Garcia St	7D45	7D47	Line Segment	Small cracks at most joints throughout pipe segment. Additional cracks at laterals.
	Tape 7	Run7		Garcia St	7D47	7D46	Line Segment	Small cracks at most joints throughout pipe segments.
	Tape 8	Run 1		Garcia St	7D48	7D49	Line Segment	Small cracks throughout pipe segmen. No spot repairs necessary.
	Tape 8	Run 2		Garcia St.	7D49	7D51A	Replace	Several breaks and cracks throughout.
	Tape 8	Run 3		Garcia St.	7D50	7D51	Line Segment	Small cracks throughout pipe segment at all joints. No spot repairs necessary.
	Tape 8	Run 4		Harvard Blvd.	7D51	7D28	Replace	Small cracks throughout pipe segment at all joints. Several spot repairs and cleaning are necessary if not replaced
	Tape 8	Run 5		Harvard Blvd.	7D28	7D26	Clean	Camera would not pass. Cannot specify if repairs are necessary.
	Tape 8	Run 7		Harvard Blvd.	7D25	7D24	Replace	VERY old pipe. Cracks not visible due to buildup on piping. At the very least should clean the pipe segment.
	Tape 8	Run 8		Harvard Blvd.	7D24	7D23	Replace	VERY old pipe. Cracks not visible due to buildup on piping. At the very least should clean the pipe segment.
	Tape 8	Run 9		Harvard Blvd.	7D23	7D05	Replace	VERY old pipe. Cracks not visible due to buildup on piping. At the very least should clean the pipe segment.
	Tape 9	Run 1		Harvard Blvd.	7D04	7D02	Spot Repair	VERY old pipe. Spot repair necessary in 1 location.
	Tape 9	Run 3		Harvard Blvd.	6D30	6D29	Spot Repairs	VERY old pipe. Spot repairs necessary at several locations
	Tape 9	Run 4		Harvard Blvd.	6D29	6D20	Spot Repairs	VERY old pipe. Spot repair necessary in 1 location.
	Tape 9	Run 8		Harvard Blvd.	5D31	5D30	Spot Repair	VERY old pipe. Spot repair necessary in 1 location.
	Tape 10	Run 2		Harvard Blvd.	5D26	5D22		VERY old pipe.
	Tape 10	Run 4		Harvard Blvd.	5D04	4D07	Spot Repair	VERY old pipe.Large area needs spot repairs
	Tape 11	Run1		Harvard Blvd.	4D06	4D09		VERY old pipe.
	Tape 11	Run2		Harvard Blvd.	4D09	4D11	Spot Repair	VERY old pipe with heavy erosion. Lateral needs spot repair.
	Tape 11	Run 4		Harvard Blvd.	4D12	4D13	Spot Repair	Spot repair necessary at one location.
	Tape 12	Run 2		Hrvard Blvd.	3D35	3D15	Cleaning	Cleaning necessary
	Tape 12	Run 4		Harvard Blvd.	3D16	3D17	Cleaning	Cleaning necessary
	Tape 12	Run 5		Harvard Blvd.	3D17	3D18	Cleaning	Cleaning necessary

Video Tapes Reviewed
-Selection based on the CCTV inspection logs

TABLE 7-1

9/27/2005
Rev. 1

Year	Tape	Run	Label	Location	MH to	MH	Action	Comment
	Tape 12	Run 6		Harvard Blvd.	3D18	3D19	Cleaning	Cleaning of debris and mineral buildup necessary.
	Tape 12	Run 9		Harvard Blvd.	3D24	2D28	Spot Repair	Spot repair necessary in one location.
	Tape 12	Run 13		Harvard Blvd.	2D37	2D49	Cleaning	Cleaning of debris and mineral buildup necessary.
	Tape 12	Run 15		Harvard Blvd.	2D48	2D51	Cleaning	Cleaning of debris and mineral buildup necessary.
	Tape 12	Run 16		Harvard Blvd.	2D51	2D09	Cleaning	Cleaning of debris and mineral buildup necessary.
	Tape 13	Run 1		Acacia Rd.	2D09	2D11	Cleaning	Cleaning of debris and mineral buildup necessary.
	Tape 13	Run 2		Acacia Rd.	2D11	2D02	Cleaning	Cleaninig necessary
	Tape 13	Run 3		Acacia Rd.	2D02	2D01	Cleaning	Cleaning of mineral deposits necessary
	Tape 13	Run 4		Acacia Rd.	2D01	2C15	Cleaning	Cleaning of mineral deposits necessary
	Tape 13	Run 6		Telegraph Rd.	1D17	1D07	Spot Repair/MH clean	Spot repair necessary in one location. MH number 1D07 needs to be cleaned.
	Tape 13	Run 9		Easement	1D05	1D04	Spot Repair	Spot repair necessary in one majorly offset location
	Tape 13	Run 10		Easement	21D04	1D03	Spot Repairs	Spot repair necessary in two locations.

Interceptor Field Inspections

An inspection of selected manholes and the City's two lift stations was conducted as part of this study. Because of the onerous task of inspecting all City manholes, only a representative portion was inspected. The inspection found nine manholes in poor condition our of 31 observed. The manholes inspected are noted in **Figure 7-2**. A summary of the condition of each manhole is located in the Appendix. Field notes and photographs of the inspected manholes are also included in the Appendix. It would be prudent for the City to inspect manholes in the vicinity of those noted in poor condition. As a long-term goal, the City should set an annual plan for sewer and manhole inspections and rehabilitation.

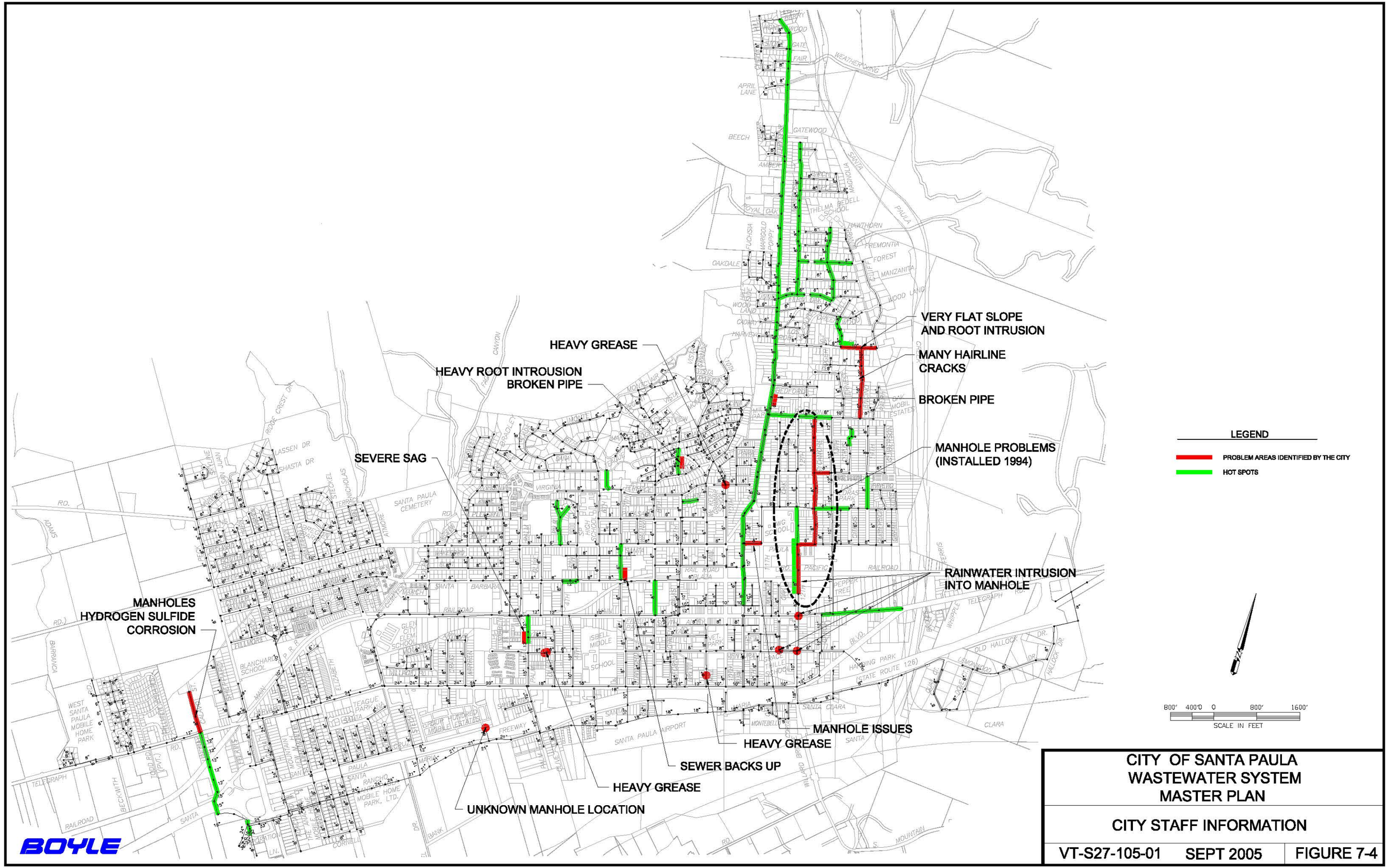
The City's two lift stations were inspected. Both lift stations were in poor condition. The older of the two lift stations is located in G. Harding Park and provides service for the public rest rooms. The station includes a four-foot diameter wet well with two submersible pumps. Access to the pump station and valve chamber is through a cast plate cover set at or below grade. The pump station is subject to flooding because the access cover is not sealed and structural settlement and/or design has caused the station to be located below finished grade and subject to ponding. This station is over 20 years old and has reached the end of its useful service life. The City should consider replacement of this station. A new station would eliminate the possibility of clear water, associated with flooding, into the sewer system.

Lemonwood Industrial Park, south of SR126, is the site for the City's other lift station. This lift station consists of a six-foot diameter wet well with two dry-pit centrifugal pumps. The pump station is over 10-years old and the design and/or layout of the station is in need of further investigation. Of particular concern is the location of the inlet pipes relating to the overall depth of the wet well. Very limited capacity appears to be available without backing up flow into incoming pipes. In light of the condition of installation and potential future development in the area, an upgrade to this station would be in the City's best interest.

Public Works Concerns

City staff and contract operators routinely inspect and address issues with the sewer system. Public works employees and others were asked to provide input regarding areas within the sewer system that are troublesome. **Figure 7-4** is a map of the sewer system with trouble areas, as identified by staff, noted. The "Hot Spots" identified by City Staff and contractors are noted on the Figure and included in the Appendix. "Hot spots" are locations within the collection system that require frequent or regularly scheduled maintenance activities.

Figure 7-5 includes all of the areas in need of attention as identified in this condition assessment.



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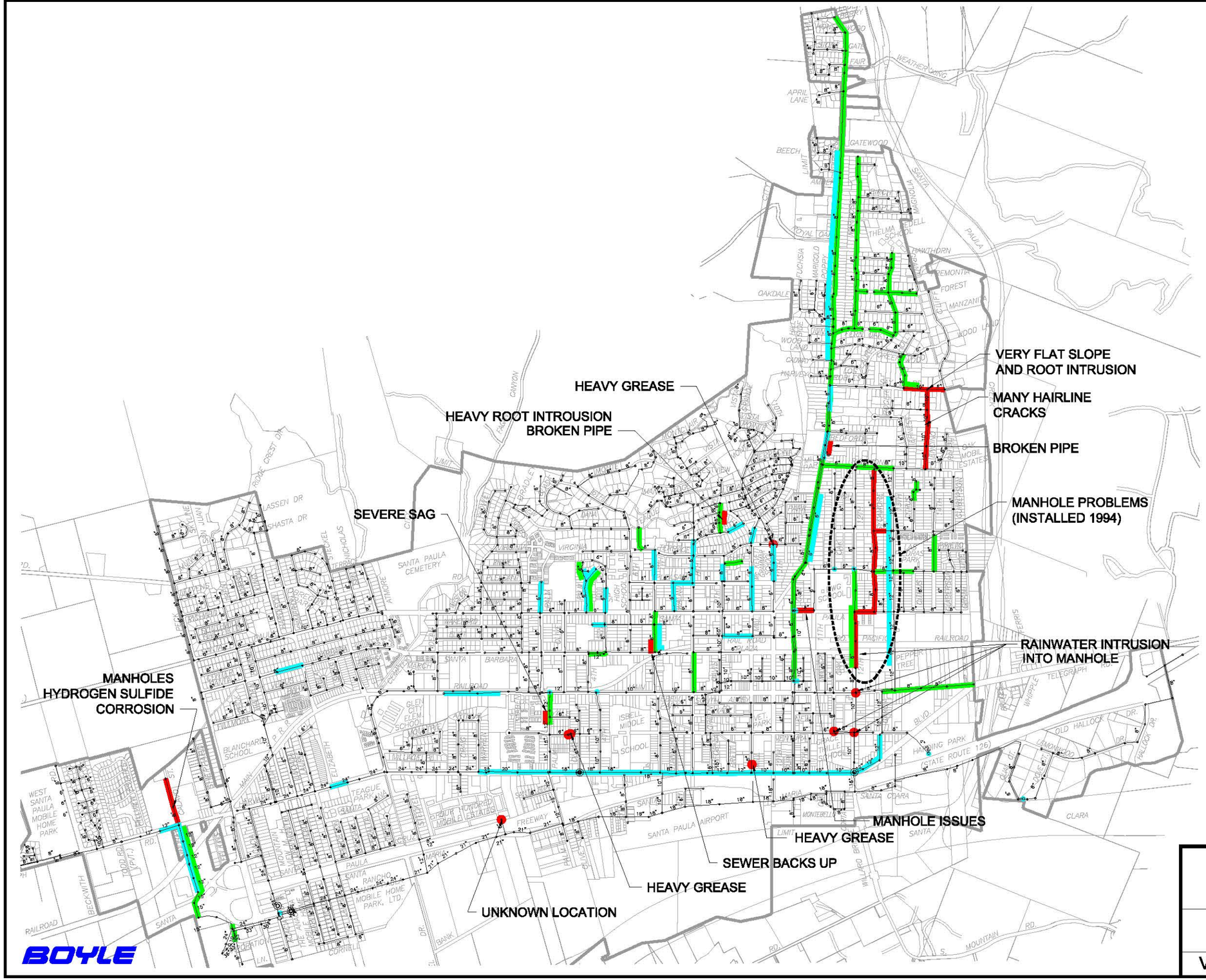

LEGEND

- HOT SPOTS
- PROBLEM AREAS IDENTIFIED BY THE CITY
- POOR CONDITION

800' 400'0 0 800' 1600'

SCALE IN FEET

BOYLE

CITY OF SANTA PAULA
WASTEWATER

SUMMARY OF CONDITION
ASSESSMENT

VT-S27-105-01 JULY 2005 FIGURE 7-5

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Chapter 8 – Recommended Capital Improvement Program

Based on the Sewer Capacity Model results and the condition assessment, this chapter identifies capital improvement projects that the City must undertake in order to continue to provide adequate collection facilities for the City's wastewater. It must be noted, however, that maintenance of sewers is ongoing because as the system ages segments will continually need repair and replacement. This report can only address needs based on existing system database, thus the City must be vigilant in their efforts to televise, inspect, clean, repair and replace deficiencies within the sewer system.

Project Identification

Based on the Model results, the following replacement projects are recommended and noted on **Table 8-1**:

- Replace 12-inch sewer with 18-inch sewer, east along Harvard Blvd. and north along Garcia and Thirteenth Streets.
- Replace 36, and 24-inch sewers with 42, 33 and 30-inch sewers from the Wastewater Treatment Plant east to Acacia Road, north to Harvard Blvd. east to Steckel Drive.
- Replace 8-inch sewer with 15-inch sewer along Steckel Drive north to Main Street.
- Replace 8 and 10-inch sewers with 15 and 18-inch sewers east along Santa Paula Street to Walden Street, south along Walden and Elm Streets to Harvard Blvd.

Based on the Field investigation and condition assessment the following projects are recommended:

- Replace Harding Park lift station in its entirety.
- Replace pumps and ancillary equipment in Lemonwood lift station and increase capacity based on future flow.
- Replacement of sewer segments throughout the televised area as noted on **Table 8-2**.
- Spot repair of sewer segments throughout televised area as noted on **Table 8-3**.
- Spot cleaning of sewer segments throughout televised area as noted on **Table 8-3**.
- Repair of sewer segments based on areas identified by the City. "Hot Spots" are noted on **Table 8-4**.

Table 8-1
City of Santa Paula
Collection System Known Deficiencies

Capacity Pipe Replacement							
Description	**Orientation**	**From**	**To**	**LF**	**Diam**	**Raw Cost**	**Total Cost**
Walden and Elm St	NS	2E45	2E06	1400	15	$ 245,000	$ 338,100
Walden and Elm St	NS	2E06	2D48	1400	18	$ 315,000	$ 434,700
Acacia Rd.	NS	2D09	2C20	1900	36	$ 950,000	$ 1,311,000
Steckel Ave.	NS	3D33	3D19	1300	15	$ 227,500	$ 313,950
Garcia St.	NS	7D45	7D26	2100	18	$ 472,500	$ 652,050
13 th St.	NS	8E03	8D04	1300	18	$ 292,500	$ 403,650
W. Santa Paula St.	EW	2E48	2E45	750	15	$ 131,250	$ 181,125
Harvard Blvd.	EW	7D25	6D30	850	15	$ 148,750	$ 205,275
Harvard Blvd.	EW	6D30	6D20	300	18	$ 67,500	$ 93,150
Harvard Blvd.	EW	6D20	4D06	1350	24	$ 438,750	$ 605,475
Harvard Blvd.	EW	4D06	3D19	1350	30	$ 675,000	$ 931,500
Harvard Blvd.	EW	2D09	2D48	500	36	$ 250,000	$ 345,000
Harvard Blvd.	EW	2D48	3D19	1900	36	$ 950,000	$ 1,311,000
Main St.	EW	7D45	8D04	200	18	$ 45,000	$ 62,100
Peck Rd. Eastbound Offramp	EW	2C20	2C08	800	33	$ 400,000	$ 552,000
800' E of Peck Rd. Eastbound Offramp	SW	2C08	430' SW	430	33	$ 215,000	$ 296,700
To WWTP	EW/NS	2C20	2C01	650	42	$ 325,000	$ 448,500
TOTAL							**$ 8,485,000**

Table 8-2
City of Santa Paula
Collection System Known Deficiencies

Poor Condition Pipe Replacement							
Description	**Orientation**	**From**	**To**	**LF**	**Diam**	**Raw Cost**	**Total Cost**
Ojai Rd.	NS	7K04	7F04	4000	8	$ 480,000	$ 662,400
7 th St.	NS	5F25	5F29	600	8	$ 72,000	$ 99,360
5 th St.	NS	5F16	5E09	400	8	$ 48,000	$ 66,240
Palm Ct.	NS	5F04	5E07	800	8	$ 96,000	$ 132,480
E Palm Ct.	NS	5F04	5F03	200	8	$ 24,000	$ 33,120
N Palm Ave.	NS	4F08	4E30	500	8	$ 60,000	$ 82,800
Main St.	EW	4D41	4D37	1100	8	$ 132,000	$ 182,160
Mc Kevett Easement	EW	6G05	6G02	200	6	$ 20,000	$ 27,600
Mc Kevett Easement	NS	6G20	6G19	100	6	$ 10,000	$ 13,800
Eighth St.	NS	6G01	6F16	100	6	$ 10,000	$ 13,800
Eighth St.	NS	6F15A	6F02	150	6	$ 15,000	$ 20,700
Pleasant St.	EW	6F02	5F31	180	6	$ 18,000	$ 24,840
Walnut St.	NS	5F31	5E23	220	6	$ 22,000	$ 30,360
Mill St	NS	6G35	6F22	110	8	$ 13,200	$ 18,216
Mill St	NS	6F10	6F08	150	6	$ 15,000	$ 20,700
Tenth St.	NS	6F24	6F12	150	6	$ 15,000	$ 20,700
Mill St	NS	6F08	6E26	200	6	$ 20,000	$ 27,600
5tH St- 200' S/O Santa Paula St.	EW	5E10	5E11	200	8	$ 24,000	$ 33,120
Tenth St.	NS	6F11	6F12	150	6	$ 15,000	$ 20,700
Railroad Ave.	EW	6E10	6E24	250	8	$ 30,000	$ 41,400
Santa Barbara St.	EW	5E27	5E28	100	8	$ 12,000	$ 16,560
TOTAL							**$ 1,589,000**

Table 8-3
City of Santa Paula
Collection System Known Deficiencies

Spot Repair & Cleaning			
Location	**From**	**To**	**Description**
Seventh Street	5E25	5E27	Watch
Santa Barbara Street	2E23	2E24	Watch
Ojai Road/Hwy 150	7J01	7I17	Watch
Ojai Road/Hwy 150	7I17	7I16	Spot Repair
Ojai Road/Hwy 150	7I16	7I10	Watch
Ojai Road/Hwy 150	7I10	7I09	Watch
Ojai Road/Hwy 150	7I09	7I06	Watch
Ojai Road/Hwy 150	7K04	7K02	Spot Repair
Ojai Road/Hwy 150	7J04	7J02	Mech. Clean
Ojai Road/Hwy 150	7L08	7L09	Mech. Clean
Ojai Road/Hwy 150	7L07	7K04	Mech. Clean
Ojai Road/Hwy 150	7H10	7H09	Watch
Ojai Road/Hwy 150	7H05	7H01	Watch
Ojai Road/Hwy 150	7G05	7G01	Spot Repair
Ojai Road/Hwy 150	7G01	7F04	Watch
Ojai Road/Hwy 150	7F07	7F05	Watch
Palm Court	5F05	5F06	Spot Repair
Palm Court	5F06	5F03	Spot Repair
Palm Court	5F03	5E07	Spot Repair
Palm Avenue	4E31	4E32	Spot Repair
McKevett Easement	6G12	6G09	Clean
McKevett Easement	6G09	6G05	Spot Repair/clean
McKevett Rd.	6G19	6G18	Spot Repair
McKevett Rd.	6G18	6G04	Watch
McKevett Rd.	6G04	6G03	Watch
Virginia Terrace	5F26	6F16	Mech. Clean
Pleasant St	5F31	5F29	Mech. Clean
Tenth St	6H03	6H02	Watch
Tenth St.	6G26	6G27	Spot repair
Tenth St.	6G33	6G34	Spot Repair
Mill St.	6G34	6G35	Watch
Virginia Terrace	6F22	6F20	Mech Clean
Tenth St.	6F11	7E20	Mech. Clean
Santa Paula St	6E05	5E23	Watch
Santa Paula St	5E23	5E22	Watch
13th St.	8G05	8G03	Line Segment
13th St.	8G03	8G02	Spot Repairs
13th St.	8G02	8F15	Spot Repairs
13th St.	8F15	8F14	Line/Spot Repair
13th St.	8F14	8F10	Line/Spot Repair
13th St.	8F10	8F01	Line/Spot Repair
13th St.	8F01	8E03	Line Segment

Table 8-3
City of Santa Paula
Collection System Known Deficiencies

Spot Repair & Cleaning			
Location	**From**	**To**	**Description**
13th St.	8E03	8E02	Line/Spot Repair
13th St.	8E02	8E01	Line/Spot Repair
Garcia St	7D45	7D47	Line Segment
Garcia St	7D47	7D46	Line Segment
Garcia St	7D48	7D49	Line Segment
Garcia St.	7D50	7D51	Line Segment
Harvard Blvd.	7D51	7D28	Replace
Harvard Blvd.	7D28	7D26	Clean
Hrvard Blvd.	3D35	3D15	Cleaning
Harvard Blvd.	3D16	3D17	Cleaning
Harvard Blvd.	3D17	3D18	Cleaning
Harvard Blvd.	3D18	3D19	Cleaning
Harvard Blvd.	3D24	2D28	Spot Repair
Harvard Blvd.	2D37	2D49	Cleaning
Harvard Blvd.	2D48	2D51	Cleaning
Harvard Blvd.	2D51	2D09	Cleaning
Acacia Rd.	2D09	2D11	Cleaning
Acacia Rd.	2D11	2D02	Cleaning
Acacia Rd.	2D02	2D01	Cleaning
Acacia Rd.	2D01	2C15	Cleaning
Telegraph Rd.	1D17	1D07	Spot Repair/MH clean
Easement	1D05	1D04	Spot Repair
Easement	21D04	1D03	Spot Repairs

Table 8-4
City of Santa Paula
Collection System Known Deficiencies

Problem Areas Identified by the City

Description	Orientation	From	To	LF
Calavo St.	NS	1E03	1D07	800
Palm Ave.	NS	4D32	4D27	400
Encino St.	NS	8H09	8G23	1300
SycamorE St.	NS	7G27	7E31	2400
12 th St.	NS	7E30	7E27	900
Santa Paula St.	EW	7E24	7E26	300
Santa Paula St.	EW	7E30	7E31	300
Orchard St.	EW	7G24	8G01	300
Say Rd.	EW	8H11	8H12	700

Project Prioritization

The model of the existing system identified capacity problems within the stretch of sewer located along Harvard Boulevard between Palmer and Warren and the sewer south along Pamela to Maui. These projects should be completed immediately as it is related to the existing conditions. Likewise projects identified through the condition assessment must also be prioritized since they effect the current situation. The larger projects associated with capacity for future growth may be completed within the next ten to twenty years based on the rate of growth and future development locations.

The model defines the existing capacity of the sewers in terms of ERU's. In addition, the maximum capacity of the sewer is defined in ERU's. The difference between the sewer capacity ERU's and the ERU's based on current flow is excess ERU capacity. The excess ERU capacity can be used as a trigger for prioritizing sewer replacement. The ERU's are noted on the model spreadsheets (**Tables 6-2, 6-3, 6-9** and **6-10**). **Table 8-1** identifies sewer pipeline lengths that will reach capacity based on "build out" estimates. Since the City of Santa Paula has control to limit the number of ERU's per year, this should be considered when scheduling or prioritizing projects.

Table 8-5 is the priority system used to assess projects.

The following figure, **Figure 8-1** is a summary of the projects and estimated priority for each.

Capital Cost Estimates

The replacement projects as noted on **Tables 8-1 and 8-2** must be scheduled and budgets for the projects must be identified. **Table 8-6** is the construction cost criteria used for estimating replacement costs. The estimated costs are based on replacement of sewers. Prior to initiation of the project, however, a more detailed assessment of replacement alternatives such as parallel relief sewers, slip lining, etc. should be conducted. Alternative evaluation is outside the scope of this study but is recommended prior to construction as cost savings may be realized.

Other projects identified for spot repair and cleaning are noted on **Table 8-3**. The cost estimates for these activities will very depending on the degree of cleaning required and the location and condition of the spot repair. The City should annually budget for spot repair and cleaning. The initial sum may be larger than subsequent years due to the present condition.

Project Implementation

Based sewer modeling and the assessment of known sewer conditions, the City must:

- Initiate an alternative study for existing capacity replacement projects identified as priority one
- Work with local developers to define a schedule for future development and further prioritize future capacity projects
- Initiate an alternative study for condition replacement projects identified as priority one
- Establish a program and schedule for spot repair projects, focusing of sewer segments that were found to be in poor condition based on CCTV and also identified by the City as "hot spots"
- Establish a cleaning program for sewer segments that were not properly cleaned as part of the sewer CCTV program
- Establish a program to clean and video additional sewers, focusing on the southern trunk sewer.

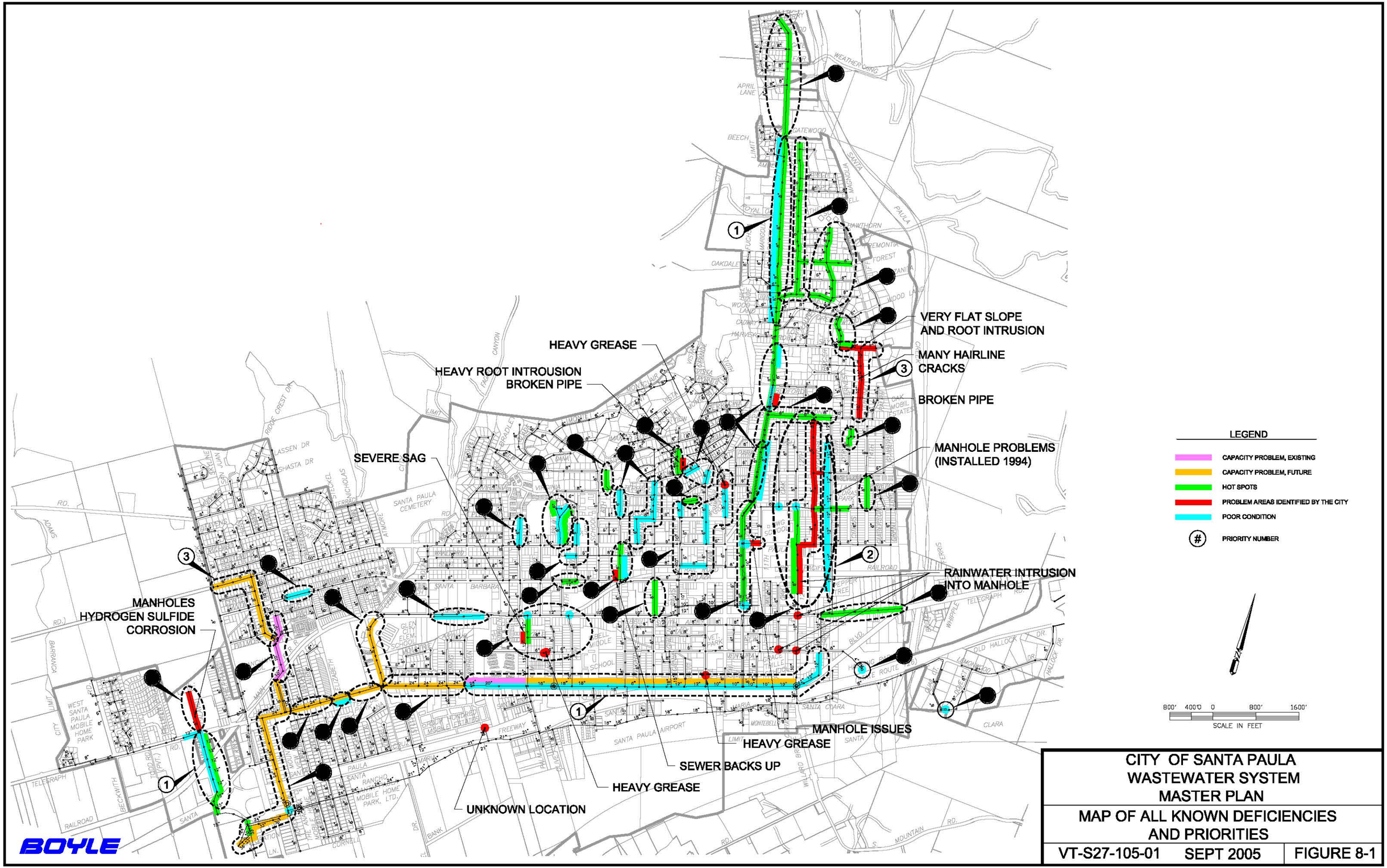
The City of Santa Paula has been able to provide adequate collection of wastewater from its residents for the more than 50 years. To this end, the City must be diligent in operating and maintaining its system including, assessment of capacity and condition on an annual basis. The projects identified in this report are limited to known conditions. There are still portions of the sewer system for which no information was reviewed. As new information is gathered, the priority of projects should be dynamic such that critical projects, projects that could effect the health and well being of residents, receive top priority.

Table 8-5
City of Santa Paula
Project Prioritization

Project Type	*Reason*	*Priority Number*
Replacement	Existing Capacity	1
	Future Capacity	3
	Field Assessment	
	CCTV	2
	Hot Spot	2
	CCTV and Hot Spot	1
	Capacity and Field	1
Spot Repair	CCTV	3
	Hot Spot	3
	CCTV and Hot Spot	2
Cleaning	CCTV	3
	Hot Spot	3
	CCTV and Hot Spot	2

Table 8-6 Wastewater System Construction Cost Criteria	
Item Description	**Budgetary Cost**
6-inch pipeline	$100/LF
8-inch pipeline	$120/LF
12-inch pipeline	$145/LF
15-inch pipeline	$175/LF
18-inch pipeline	$225/LF
21-inch pipeline	$275/LF
24-inch pipeline	$325/LF
27-inch pipeline	$400/LF
30-inch pipeline	$500/LF
Lift Stations	$500,000 for 50 HP or less
Engineering, Administration, and Construction Mgmt	• 25 percent of construction for pump stations and tanks • 20 percent of construction for pipelines
Project Contingency	• 15 percent of construction

Pipeline costs based on work in existing streets and includes excavation, installation, backfill, pavement repair, and manholes.



CITY OF SANTA PAULA
WASTEWATER SYSTEM
MASTER PLAN

MAP OF ALL KNOWN DEFICIENCIES
AND PRIORITIES

VT-S27-105-01 SEPT 2005 FIGURE 8-1

DWG: F:\SANTA PAULA\S27\105\01 – Santa Paula MPI\CAD\ADDITIONAL DWGS\Figures\Figure 8-1.dwg USER: kmerlin
DATE: Feb 21, 2006 12:26pm AREFS: Santa Paula Lists Sewer Pipes Solid 0 Width

Appendices