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COUNTY OF SAN MATEO

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Crystal Springs County  
Sanitation District

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SEWER MASTER PLAN

Prepared by:  
Brown and Caldwell  
August 1999

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## EXECUTIVE SUMMARY

In December 1996, the County of San Mateo engaged Brown and Caldwell to prepare a sewer system master plan for the Crystal Springs County Sanitation District (CSCSD). This executive summary presents the findings, conclusion, and recommendations regarding this system. It also proposes a capital improvement plan (CIP) and summarizes recommended rates and a revenue plan to finance proposed improvements.

### Background

The overall master planning process used for the sewer system master plan consisted of identifying capacity limitations along with structural deficiencies of the sewer system and developing an ongoing improvement program to correct the limitations. Part of the overall improvement program is the consideration for changing current maintenance activities to more appropriately match the needs of the sewer system. The improvement plan's goal is to develop a balance between capital projects and system maintenance to achieve a highly reliable collection system for the lowest overall cost.

A series of field inspections were performed to collect information on the collection system. Limited source detection methods (including smoke testing, manhole inspections, maintenance calls, television inspection and topographic surveying) were used to identify collection system structural deficiencies. Wet weather flow monitoring and hydraulic modeling were performed to develop a listing of hydraulic deficiencies. Projects were developed and prioritized based on the deficiencies and capital costs that were prepared. Methods for financing the recommended improvements are also included in the study.

### Findings

Review of known problem areas and interviews with County maintenance crews was used to prioritize field inspections in the CSCSD. Flow monitoring was also performed to evaluate the amount of remaining capacity in the wastewater collection system. This section presents the results of the field inspection and capacity analysis.

A manhole inspection program was performed in the winter and spring of 1997. Field crews documented the condition of 257 manholes. No serious defects were noted during the inspection. Results of the inspections were used to prioritize the television inspection program.

The smoke testing program was conducted during the summer of 1998. Areas with suspected high Inflow/Infiltration (I/I) were scheduled for testing. Field crews tested approximately 50,800 linear feet of sewer lines. A total of 59 collection system defects were documented during the program. No serious defects were noted.

The television inspection program was conducted during the winter of 1999. A total of 9,271 feet of the collection system was inspected. Over 210 structural defects were documented during the inspection. Results of the television inspection program were used to develop the CIP.

Flow monitoring was performed during the winters of 1997 and 1998. The purpose of the flow monitoring was to develop peak wastewater flow rates for use in the hydraulic model of the collection system. The capacity of the major trunk sewer along Polhemus Road was evaluated for this study. Results of the analysis indicate that approximately 5,000 linear feet of the trunk sewer has inadequate capacity.

### **Recommendations**

A CIP was developed based on the results of the field work and capacity analysis. A total of nine capital improvement projects were developed for the CSCSD. Eight of the projects are recommended to repair structural deficiencies. The remaining project is recommended to provide additional hydraulic capacity to the Polhemus Road trunk sewer. Estimated total construction costs for the projects range between \$1,570,000 and 1,850,000 depending on the selected alternative improvement. The location of the improvement projects is listed below:

1. Timberlane Way
2. South Ascension Drive
3. Polhemus Road (north)
4. Polhemus Road (south)
5. Rainbow Drive
6. Enchanted Way
7. Parrot Drive
8. Lexington Avenue
9. Randall Road

## SECTION 1

### INTRODUCTION

This chapter introduces the sewer master planning process for the Crystal Springs County Sanitation District (CSCSD) of San Mateo County (County), including background, authorization, scope of work and report organization.

#### **Background and Purpose of Work**

The overall master planning process used for the sewer system master plan consisted of identifying capacity limitations along with structural deficiencies of the sewer system and developing an ongoing improvement program to correct the limitations. Part of the overall improvement program is the consideration for changing current maintenance activities to more appropriately match the needs of the sewer system. The improvement plan's goal is to develop a balance between capital projects and system maintenance to achieve a highly reliable collection system for the lowest overall cost.

A series of field inspections were performed to collect information on the collection system. Limited source detection methods (including smoke testing, manhole inspections, maintenance calls, television inspection and topographic surveying) were used to identify collection system structural deficiencies. Wet weather flow monitoring and hydraulic modeling were performed to develop a listing of hydraulic deficiencies. Projects were developed and prioritized based on the deficiencies and capital costs that were prepared. Methods for financing the recommended improvements are also included in the study.

The County maintains and operates nine noncontiguous sewer districts containing approximately 130 miles of sewer mains. The sewer districts are:

1. Burlingame Hills Sewer Maintenance District
2. Crystal Springs County Sanitation District
3. Devonshire County Sanitation District
4. Emerald Lake Heights Sewer Maintenance District
5. Fair Oaks Sewer Maintenance District
6. Harbor Industrial Sewer Maintenance District
7. Kensington Square Sewer Maintenance District
8. Oak Knoll Sewer Maintenance District
9. Scenic Heights County Sanitation District

The CSCSD is located on the San Francisco Peninsula in the area roughly bounded by the Arthur Younger Freeway (Highway 92) in the south, the Junipero Serra Freeway (I-280) in the west, Crystal Springs Road in the north and Parrot Drive in the east.

Though the County has maintained and upgraded the collection system in the past, this work has been done without the benefit of master planning. This report provides a prioritized capital



improvement program along with recommended follow-up field investigations and potential funding mechanisms.

### **Authorization**

The County authorized this work through an agreement with Brown and Caldwell dated December 17, 1996.

### **Scope of Work**

The scope of work includes the following activities:

**Assessment of Existing Sewer Systems.** To develop a meaningful capital improvement program, it was necessary to determine the structural and hydraulic condition of the CSCSD collection system. Methods used to complete the evaluation included reviewing existing maps and records drawings, interviewing County maintenance workers and checking maintenance records, manhole inspections, wet weather flow monitoring, smoke testing and television inspection. Results from the flow monitoring program were used to develop wet weather hydrographs for use in the hydraulic model and determine which areas in the system had the highest infiltration/inflow rates.

**Development of Sewer System Capital Improvement Plans.** A listing of sewer system deficiencies were developed based on the sewer system assessment task. Capital projects were developed to correct each identified system deficiency. Capital projects were prioritized and estimated capital costs for each project were determined. Project priorities were reviewed with County staff and an annual schedule of required capital improvements were developed. A financial plan was developed to support the recommend projects. The financial plan includes financial alternatives and recommended sewer charges and revised connection fees, if any.

**Data Management.** Data generated during the study was entered into a series of Access databases for future use by the County. The databases will be submitted under separate cover to the County with the Master Plans.

**Master Plan Report.** Prepare a sewer system master plan report for the Crystal Springs District. The master plan report is supported by a series of technical memoranda prepared as part of the previous tasks. The master plan provides completed documentation of the recommended capital improvement projects as well as financing alternatives.

### **Report Format**

This Master Plan report has been organized as a reference report, to the extent possible. Each section in the report consists of one to two pages of descriptive text followed by a data table, graphical figure, or both. This report has 15 sections roughly divided as follows:

- Sections 1 through 3 describe the current County system and operating procedures.
- Sections 4 through 9 describe the field work programs.
- Sections 10 and 11 summarize the hydraulic modeling work.
- Sections 12 through 15 describe the capital improvement program and funding mechanisms.

Technical memoranda and backup material are also provided in the appendices following the main body of the report as identified in the Table of Contents.

## SECTION 2

### EXISTING SEWERS

The general physical characteristics of the Crystal Springs County Sanitation District (CSCSD) sewer collection system are described in this section. These characteristics provide the basis for physical evaluation of the collection system and determine the system's ability to convey current and projected wastewater flows.

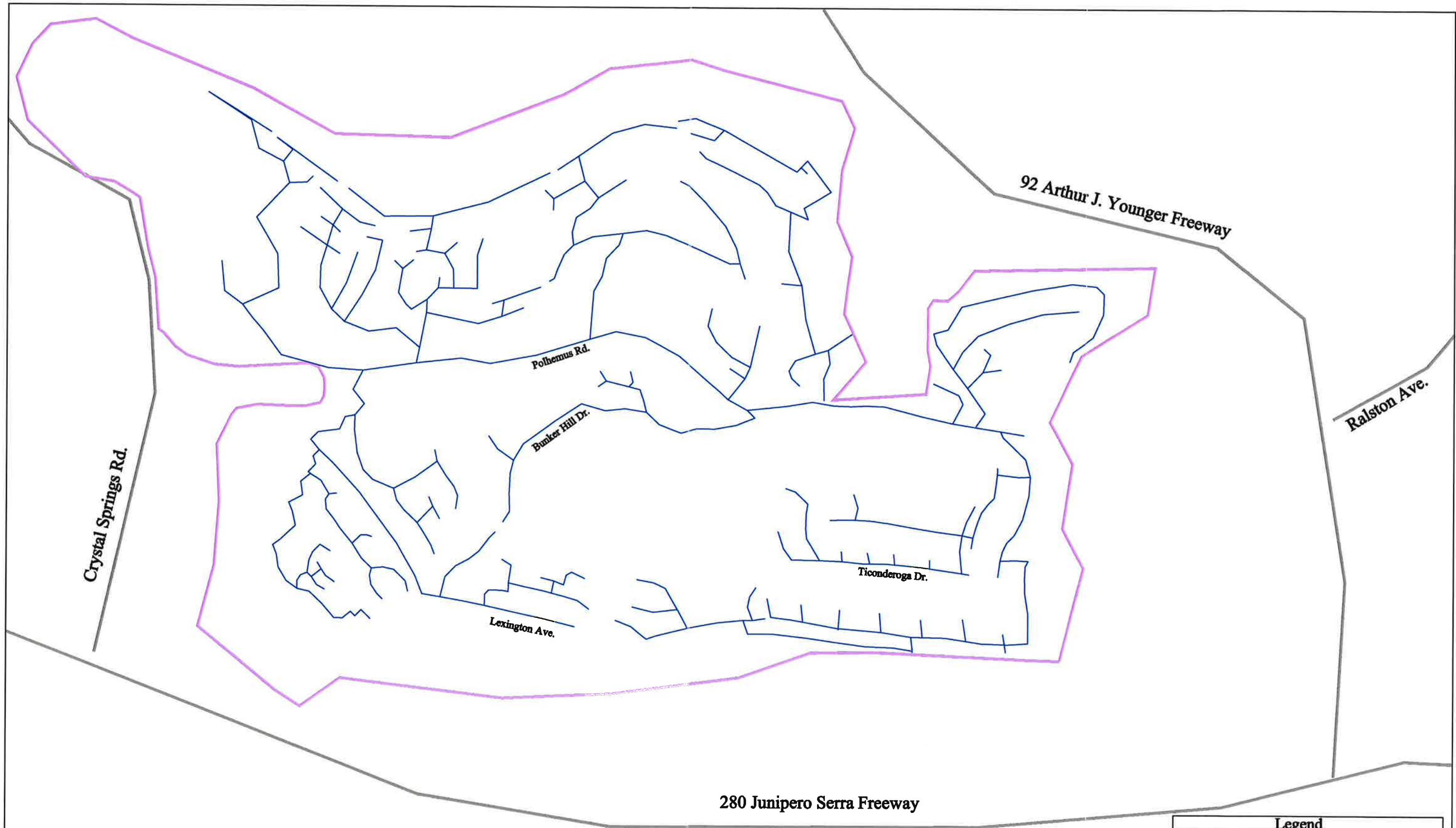
#### **Description of Existing Facilities**

The CSCSD's sewer collection system is characterized as a gravity system. Sewage pumping stations are not required due to the topography in the service area. The collection system consists of approximately 13 miles of 6-inch to 15-inch-diameter vitrified clay pipe. Most of the collection system has been constructed between the post World War II period and the present.

The main trunk sewer in the CSCSD is a 10-inch to 15-inch-diameter sewer located in the valley along Polhemus Road. This sewer roughly divides the CSCSD into two major drainage areas. The trunk sewer begins by collecting wastewater flows from County and State facilities located on Tower Road and Polhemus Road and then flows to the north and ultimately discharges wastewater flow to the Town of Hillsborough. The point of connection to the Town of Hillsborough is at the intersection of Polhemus Road and Crystal Springs Road. The CSCSD purchased capacity in the Town of Hillsborough and City of San Mateo sewer systems. Figure 2-1 depicts the CSCSD boundaries and collection system.




#### **Manhole Number System**

A manhole numbering scheme was developed to aid in data management. The manhole numbering system consists of an eight-digit alphanumeric code. The first letter identifies the District within the County (C for CSCSD). The next four numbers identify the manhole within the CSCSD. A single letter code follows and is used for manholes with duplicate numbers (typically infill manholes constructed by the County). The last two numbers in the code describe the County map number.




**Existing Sewers**  
**Figure 2-1**

**Legend**

-  Existing Sewers
-  Freeway/Major Road
-  District Boundary

**GRAPHIC SCALE**

500 0 250 500 1000



## SECTION 3

### SEWER OPERATION AND MAINTENANCE

Prior to beginning the physical inspection of the Crystal Springs County Sanitation District (CSCSD), the current operation and maintenance procedures were reviewed. This section documents the results of that review.

#### **Known Problem Areas**

Areas of known problems within the sewer collection system were identified through discussions with County personnel and review of the CSCSD maintenance records. Problem areas were identified by line blockages from roots and grease accumulations or sewer sags. The collection systems are on a cleaning frequency of once per year minimum and can range up to four times per year based on collection system call outs. Problems associated with flat sewers are not found in the CSCSD due to the relatively steep topography in the service area. There are no known manholes or pipelines with hydrogen sulfide corrosion problems.

Several approaches are available for addressing sewer maintenance problems. Grease problems are addressed by controlling grease discharges from commercial establishments by requiring grease traps and having an enforcement program to ensure that they function properly. Grease can accumulate at sags, areas with flat slopes, roots, and offset joints in sewers. Grease problems in residential areas are addressed by increased maintenance (hydroflushing of the sewer to flush the grease accumulation downstream).

Root problems are typically addressed by using an undersized root cutter, typically a 4-inch-diameter cutter for a 6-inch sewer. The County maintenance crews prefer to use an undersized cutter to prevent damage to the pipeline. Roots can also be addressed by chemical foam application to kill the roots. Application and reapplication is typically required on a 1- to 3-year cycle. The County has recently started using chemical root treatment in the Burlingame Hills Sewer Maintenance District.

Accumulations of rocks and gravel in the sewer line can be an indicator of broken pipe in the system. Television inspection should be performed in these areas to look for pipes in bad condition. A listing of the maintenance “hot-spots” for sewer laterals in the system requiring callouts more than twice a year is provided in Table 3-1. Sewer mains requiring two or more callouts per year are summarized in Table 3-2. A description of the problem is also provided. This listing was used to develop the collection system physical inspection programs described in the following sections.

Table 3-1. Callout Summary for Sewer Laterals

Street number	Street name	Year	Reason for callout				Comment
			Roots	Grease	Paper	Inspection	
2267	Allegheny Wy	1992	x				Lateral OK
2275	Allegheny Wy	1995					No cleanout, Permit 2539
1506	Ascension Dr	1996	x				
1542	Ascension Dr	1990	x				
1548	Ascension Dr	1987	x				
1624	Ascension Dr	1993					Bad spot; lateral needs repair
1630	Ascension Dr	1987		x			No cleanout
1312	Bel Aire Rd	1994					Permit 2477 Lateral OK
1327	Bel Aire Rd	1978	x				"T"-Cleanout
1330	Bel Aire Rd	1995	x				
1366	Bel Aire Rd	1979				x	
1456	Bel Aire Rd	1978					No cleanout
1480	Bel Aire Rd	1985					No cleanout
20	Bennington Dr	1976					Lateral OK
1520	Brandywine Rd	1980	x				Lateral OK
1547	Brandywine Rd	1993					VOID Permit 2386. Owner taking responsibility of uninspected work.
2193	Bunker Hill Dr	1990	x				
2220	Bunker Hill Dr	1992			x		Permit 2219 & Lateral OK
5	Crown Ct	1986				x	Permit 0945
20	Crown Ct	1986					Permit 0946
45	Crown Ct	1987				x	Permit 1475
1341	Enchanted Wy	1986	x				Off-set
1354	Enchanted Wy	1993					No cleanout
1515	Forge Rd	1996	x		x		
2011	Kings Ln	1996	x				Off-set, Lateral OK
2034	Kings Ln	1979				x	Permit 0164
2041	Kings Ln	1984	x				Lateral OK
1261	Laurel Hill Dr	1993					No cleanout
1263	Laurel Hill Dr	1992	x				Permit 1549 (1987), Hair
1263	Laurel Hill Dr	1993	x		x		
1479	Laurel Hill Dr	1996					Permit 2706 Voided - Owner decided not to reconstruct cleanout. "T"-cleanout
1415	Lexington Ave	1992					No cleanout
1607	Lexington Ave	1980					No cleanout
1628	Lexington Ave	1992					No cleanout
1659	Lexington Ave	1987	x				
1660	Lexington Ave	1985					Cleanout OK

Street number	Street name	Year	Reason for callout				
			Roots	Grease	Paper	Inspection	Comment
1690	Lexington Ave	1979	x				No cleanout
1719	Lexington Ave	1977					Rocks in Cleanout
1723	Lexington Ave	1995			x		Dirt, Permit 2597
1784	Lexington Ave	1994					Lateral OK
1880	Lexington Ave	1978	x				Lateral OK
1912	Lexington Ave	1995					Permit 2552, Non-standard cleanout
2036	Lexington Ave	1995					No cleanout, Lateral OK
2136	Lexington Ave	1980					Lateral OK
1786	Los Altos Dr	1993					No cleanout
1805	Los Altos Dr	1979	x		x		No cleanout
1812	Los Altos Dr	1988	x				Off-set
1936	Los Altos Dr	1996					Lateral OK
1983	Los Altos Dr	1979	x				
15	Lundys Ln	1987	x				Improper cleanout
1707	Monticello Rd	1994	x				
1708	Monticello Rd	1987	x				
1759	Monticello Rd	1986					Repair lateral (Off-Set)
30	Mountain View Pl	1995					No cleanout
1136	Parrott Dr	1985				x	Repair Main
1151	Parrott Dr	1985	x				
1163	Parrott Dr	1991	x		x		
1203	Parrott Dr	1993					Lateral OK
1230	Parrott Dr	1979	x				Lateral OK
1311	Parrott Dr	1992					Mud & Needs Repair
1399	Parrott Dr	1991					Permit 2170 & Broken Pipe
1426	Parrott Dr	1980					Broken Lateral
1475	Parrott Dr	1993					Lateral OK
1499	Parrott Dr	1985		x			Combo & mud
1563	Parrott Dr	1977					Broken lateral
1615	Parrott Dr	1979	x				Lateral OK
1615	Parrott Dr	1980	x				Lateral OK
1616	Parrott Dr	1992	x				Grass
1636	Parrott Dr	1975				x	Lateral OK
1684	Parrott Dr	1975					No cleanout
1691	Parrott Dr	1996	x		x		
1699	Parrott Dr	1985	x				
1798	Parrott Dr	1975	x				No cleanout
1819	Parrott Dr	1978	x				Lateral OK
1835	Parrott Dr	1991	x				Lateral OK
1883	Parrott Dr	1993					No cleanout
15	Powhatan Pl	1993	x				Lateral OK
2024	Queens Ln	1990	x				
2029	Queens Ln	1996			x		

Street number	Street name	Year	Reason for callout				
			Roots	Grease	Paper	Inspection	Comment
2030	Queens Ln	1992	x				
2072	Queens Ln	1994	x		x		
2083	Queens Ln	1984	x				
2154	Queens Ln	1996	x				
2177	Queens Ln	1994	x				
2184	Queens Ln	1991					No cleanout; too far back of property line
1427	Rainbow Dr	1991					Permit 2143, No cleanout
1844	Randall Rd	1994	x				Lateral OK
1876	Randall Rd	1991	x				
1884	Randall Rd	1995					Permit 2207
30	Roxbury Ln	1994	x				
35	Roxbury Ln	1982					Permit 0407
1510	Seneca Ln	1995	x				"T"-cleanout connects to manhole. Letter sent.
25	Shelburne Pl	1993	x		x		
2224	Sheraton Pl	1985	x		x		
2230	Sheraton Pl	1992	x				Lateral OK
139	Starlite Dr	1985	x				Lateral OK
148	Starlite Dr	1993					No cleanout
163	Starlite Dr	1976			x		No cleanout
1456	Tarrytown Rd	1995					Rocks, Permit 2637
1911	Ticonderoga Dr	1978					No cleanout
1992	Ticonderoga Dr	1991			x		Lateral OK
2012	Ticonderoga Dr	1980					No cleanout
2043	Ticonderoga Dr	1980					No cleanout
2059	Ticonderoga Dr	1994					No cleanout
2096	Ticonderoga Dr	1990	x				
2124	Ticonderoga Dr	1987				x	Permit 1460
2062	Timberlane Wy	1980					Permit 0253
2083	Timberlane Wy	1986				x	Permit 1073
2087	Timberlane Wy	1986				x	Permit 1075
2095	Timberlane Wy	1986				x	Permit 1074
5	White Plains Ct	1980	x				Lateral OK
35	White Plains Ct	1977					Cleanout repair
1615	Yorktown Rd	1985	x				Off-set
1644	Yorktown Rd	1992		x			No cleanout
1712	Yorktown Rd	1978	x				Lateral OK



Table 3-2. Callout Summary for Sewer Mains

Street number	Street name	Year	Reason for callout				Comment
			Roots	Grease	Paper	Inspection	
10	Burgoyne Ct	1977	x				Main OK
1359	Enchanted Wy	1978	x				Main OK (3)
1405	Enchanted Wy	1978					
1835	Parrott Dr	1980	x				
1835	Randall Rd	1980		x	x		
1624	Ascension Dr	1985	x	x			
1136	Parrott Dr	1985				xx	
1835	Parrott Dr	1985	xxx				
1306	Bel Aire Rd	1986				xxxx	Main OK, Off-Set (Bel Aire Rd & Parrot Dr)
1405	Enchanted Wy	1986	x				Main OK (2)
1250	Parrott Dr	1986					Broken Main, Main Ok
2029	Queens Ln	1987	xxx				

## SECTION 4

### MANHOLE INSPECTION

The manhole inspection program was conducted during the winter and spring of 1997. Field crews documented the condition of 257 manholes in the Crystal Springs County Sanitation District (CSCSD). This section presents the results of the manhole inspection program.

#### **Purpose and Objective**

Manhole inspection was performed to evaluate manholes as potential infiltration/inflow (I/I) sources and document their physical condition. Additionally, the manhole inspection results were used to prioritize the smoke testing and television inspection programs. The manhole inspection program did not include all the manholes in the CSCSD. Manholes were selected for inspection to provide a representative sample of the manholes in the CSCSD.

During the inspection, the general condition of the manhole and incoming/outgoing pipelines was determined. Photographs of the incoming/outgoing pipelines were taken to determine their condition. The following conditions were documented during the inspection:

- Manhole bench/channel condition
- Roots in the manhole or pipeline
- Grease in the manhole or pipeline
- Manhole frame/cover condition
- Presence of I/I in the manhole or pipeline
- Major debris in the manhole or pipeline
- General physical condition of the pipeline.

#### **Findings**

The major manhole defects noted during the manhole inspection program are listed in Table 4-1. The major pipeline defects observed from the photographs are listed in Table 4-2. A technical memorandum, dated October 12, 1998, describing the manhole inspection in more detail is provided in Appendix A. Attachments A, B and C for the technical memorandum were provided in the original submittal. Manhole inspection forms and photographs are provided under separate cover in a series of three-ring binders.

**Table 4-1. Manhole Defects**

Defect type	Number
Bench/Channel Defects	10
Roots	5
Grease	23
Frame and Cover Problems	12
Active or signs of Infiltration/Inflow	7
Major Debris in Channel	12
Manholes Inspected	257

**Table 4-2. Pipeline Defects Noted from Manhole Inspection Program**

Pipes with separated joints greater than moderate and deflections greater than 1 inch	12
Pipes with greater than minor corrosion	0
Pipes with infiltration/inflow	0
Pipes with greater than light grease	25
Pipes with greater than light roots	38
Pipes with roots and grease	3
Pipes with cracks and fractures	22
Pipes with plugs and obstructions	0

## SECTION 5

### FLOW MONITORING PROGRAM

A flow monitoring program was implemented to measure flow rates during dry weather and discrete rainfall events. This section describes the flow monitoring program. Flows and flow rates developed from the flow monitoring efforts are described in Sections 8 and 9.

Wastewater flows were divided into base sanitary flow (BSF) and wet weather infiltration/inflow (I/I) components for this study. Base sanitary flow factors are based on dry weather flow monitoring performed during the winter of 1997. Due to limited rainfall during the winter of 1997, additional wet weather flow monitoring was performed during the following season. El Niño effects resulted in extensive rainfall during the months of January and February of 1998. Wet weather flow projections are based on flow monitoring results from the second flow monitoring program in 1998. Results of the 1997 flow monitoring program are provided in Appendix B. Results of the 1997-1998 flow monitoring program are provided in the County of San Mateo 1997 – 1998 flow monitoring program dated January 14, 1998, and March 4, 1998.

#### Purpose and Objective

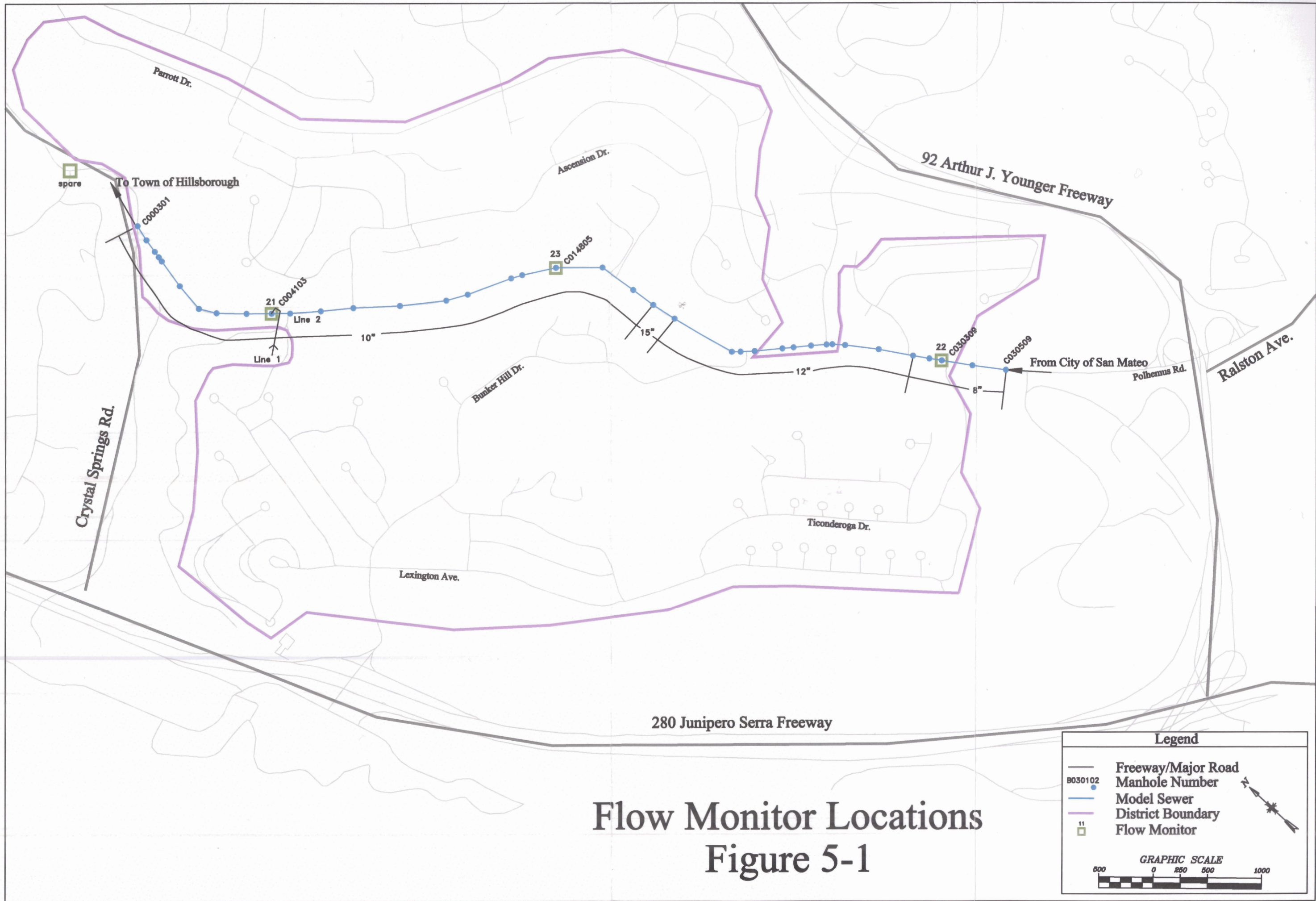
The purpose of the flow monitoring program was to measure the existing collection system flows at various locations in the Crystal Springs County Sanitation District (CSCSD). Wet weather and dry weather flow rates were measured to develop design flows for use in a hydraulic model of the collection system. Additionally, a rain gauge was installed at 2295 Cobblehill Place to determine how collection system flows reacted to various rainfall events. The rain gauge was moved to a County facility located at the 1551 Tartan Trail Road Pump House.

Table 5-1 summarizes the measured flow rates for each monitoring station in the CSCSD for the 1997/1998 flow monitoring period. The location of the flow monitors and rain gauges is shown on Figure 5-1. The technical memorandum describing the 1997 flow monitoring program is provided in Appendix B. Attachments A and B for the technical memorandum were provided in the original submittal. This memorandum describes the location of the flow monitors and rain gauges, and the complete results of the flow monitoring program.

**Table 5-1. Flow Monitoring Results, million gallons per day  
1997/1998**

Flow monitoring site	Minimum dry weather flow	Average dry weather flow	Peak wet weather flow
21 Line 1*	0.07	0.11	0.89
21 Line 2*	0.01	0.61	4.60
22 Line 2	0.03	0.12	0.95
23	0.12	0.44	2.31

\*Flow monitors located in same manhole measuring two lines.



**Flow Monitor Locations**  
**Figure 5-1**

## SECTION 6

### SMOKE TESTING PROGRAM

The smoke testing program was conducted during the summer of 1998. Field crews tested approximately 50,800 linear feet of sewer lines in the Crystal Springs County Sanitation District (CSCSD). This section presents the results of the smoke testing program.

#### Purpose and Objective

Smoke testing is a quick and effective method for identifying many types of wastewater collection system deficiencies. Typical defects encountered during a smoke testing program include the following:

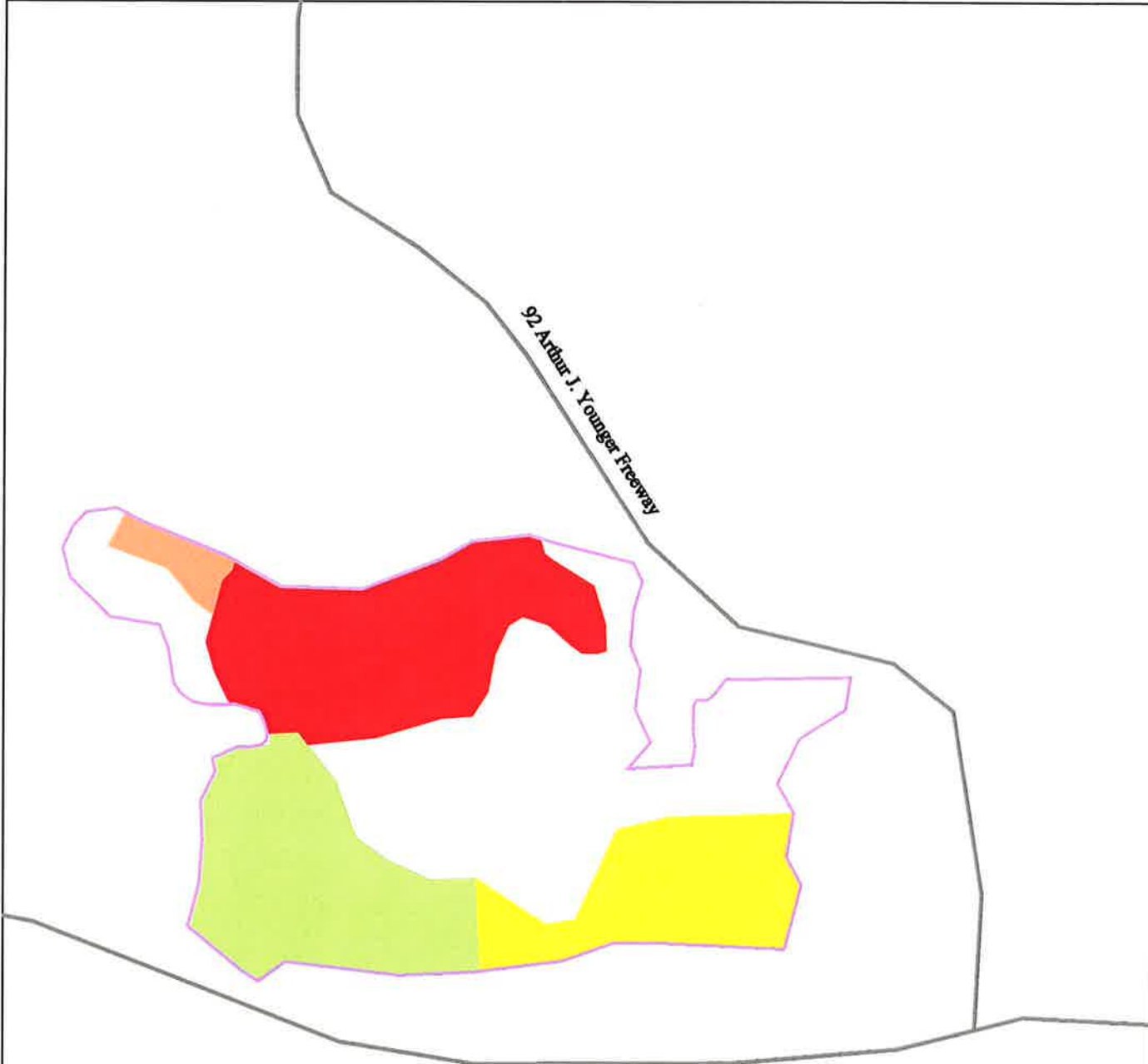
1. Broken or deteriorated building laterals.
2. Improperly capped cleanouts.
3. Broken or deteriorated sewer mains in unpaved areas.
4. Unsealed or damaged manholes.
5. Sags and/or obstructions in the mains.
6. Direct and indirect connections between storm and sanitary sewer systems.
7. Untrapped or improper building plumbing.
8. Illegal sewer connections from/to storm drain systems

Although smoke testing is an efficient method of identifying collection system inadequacies, certain conditions affect the interpretation and effectiveness of the test. One factor that affects smoke testing results is the extent and porosity of the cover over the sewer main or service lateral. For instance, pilot studies have indicated that only one-third or less of lateral defects are detected by smoke testing.

#### Smoke Testing Results




Smoke testing was performed during the dry months of August and September 1998 to ensure that smoke was not trapped in high groundwater. The areas tested in the CSCSD area are shown on Figure 6-1. Smoke testing areas were selected based on the results of the flow monitoring program. Areas with suspected high I/I rates were selected for smoke testing.


No major defects were noted during the smoke testing program. A total of 59 defects were located and documented during the program. The most prevalent defect was missing or damaged cleanout covers. The majority of these defects are located on the private side of the property line. A summary of the smoke testing defects is provided in Table 6-1. A technical memorandum, dated October 13, 1998, describing the smoke testing program in more detail is provided in Appendix C. Smoke testing reports and photographs are also provided in Appendix C.




280 Juniperos Serra Freeway

**Smoke Testing Areas**  
**Figure 6-1**

Legend	
	Freeway/Major Road
	District Boundary
	Smoke Testing Area



**GRAPHIC SCALE**  


**Table 6-1. Smoke Testing Defect Summary**

Defect type	Number of defects
Cleanout	52
Lateral	2
Illegal drain	2
Storm drain cross connection	1
Manhole leaks	1
Pavement cracks	1
Other	0
Total footage tested:	50,794



## SECTION 7

### TELEVISION INSPECTION PROGRAM

The television inspection program was conducted during the winter of 1999. Field crews inspected approximately 9,271 linear feet of sewer lines in the Crystal Springs County Sanitation District (CSCSD). This section presents the results of the television inspection program.

#### Purpose and Objective

The purpose of the television inspection program of mainline sewers was to observe and document the internal condition of the pipeline in reference to infiltration/inflow (I/I) and structural deterioration. Results of the television inspection were then used to develop capital improvement programs described in Sections 13 and 14. The following conditions were observed and documented:

1. Structural Integrity—the number, type and extent of cracks and/or broken, crushed, shattered or collapsed pipe.
2. Root Intrusion—the amount and severity of the roots were documented.
3. I/I—the location of I/I sources were documented.
4. Protruding Laterals—a lateral's protrusion into the pipeline was estimated to judge if it will interfere with rehabilitation or routine maintenance.
5. Defective lateral connections—defective lateral connections such as broken pipe at the connections, broken saddles, cracks and the connections, pieces missing from the connection, and structural defects in the lateral were documented.
6. Offset or Open Joints—offset or open joints were visually estimated from the inspection to determine if they would require spot repairs prior to rehabilitation.
7. Pipe Sags—the extent of sags or misalignment was judged to help determine the structural integrity of the pipeline and their suitability for rehabilitation.
8. Corrosion—hydrogen sulfide corrosion of concrete sewers was identified and documented.

#### Television Inspection Results

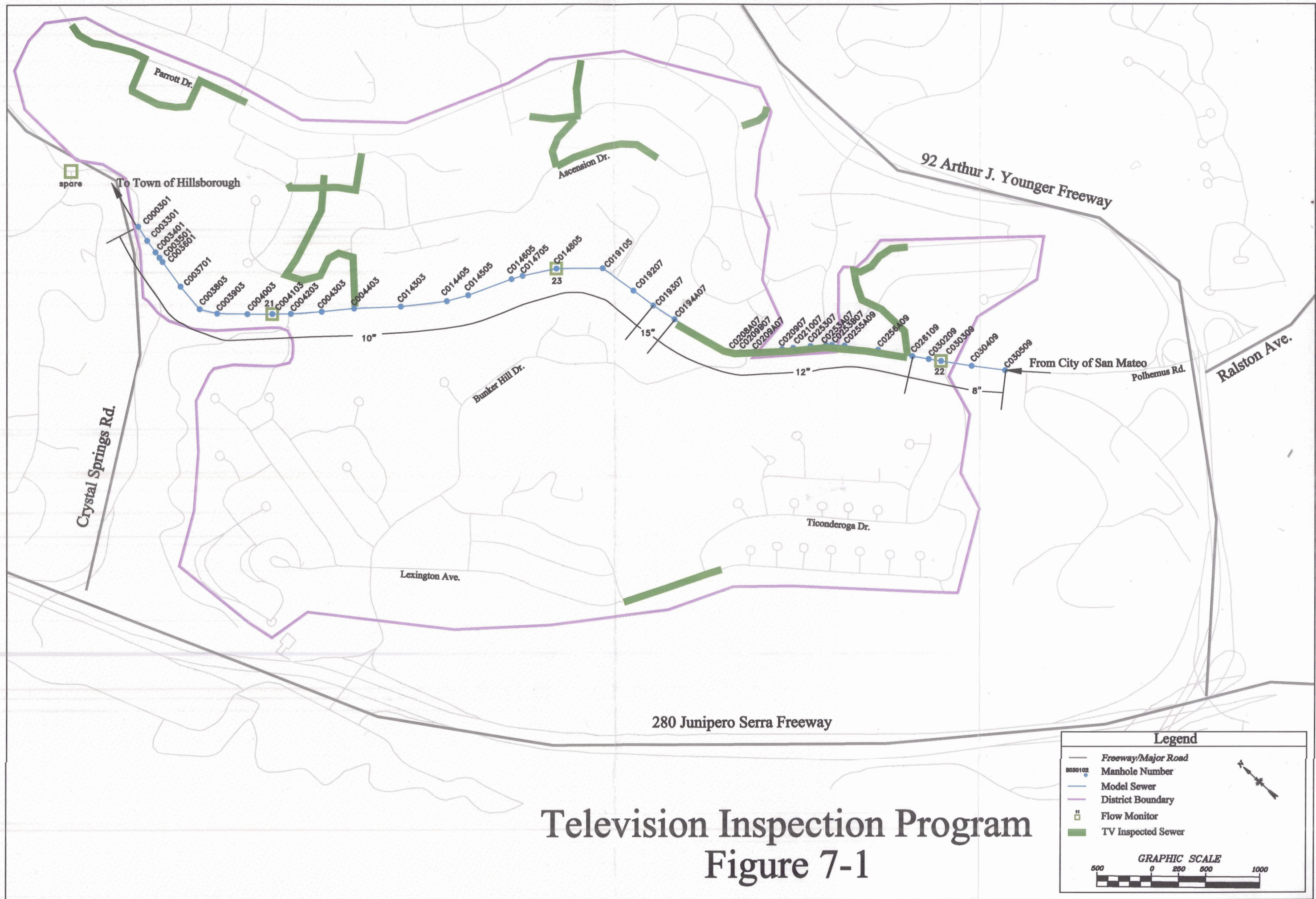
The areas scheduled for television inspection in the CSCSD area are shown on Figure 7-1. Sewers were selected for television inspection if they met one of the following four criteria:

- Excessive maintenance callouts
- Manhole inspection program noted a pipeline defect
- Special request from the County maintenance personnel
- A mainline defect was noted during the smoke testing program.

Sewers scheduled for television inspection were cleaned or flushed prior to inspection to allow for a better structural inspection. Approximately 2,000 linear feet of mainline sewer could not be inspected due to severe defects in the line, which blocked the path of the camera, or lack of access to the sewer. When a severe defect was encountered, the camera setup was reversed to attempt an inspection of the sewer whenever possible. Results of the television inspection program are summarized in Table 7-1. Complete results of the program are provided in Appendix D.

**Table 7-1. Television Inspection Summary**

Description	Total
Footage attempted	9,947
Footage completed	9,355
Cracks	
Radial	21
Longitudinal	2
Joints	
Minor offset joint	0
Major offset joint	5
Laterals	
Protruding lateral	4
Defect at connection	2
Dead connection	6
Roots	
Roots at joint	148
Roots at lateral	14
Infiltration/Inflow	
At joint	0
At crack	0
At roots	0
At inside lateral	0
At lateral connection	0
At inside lateral and at connection	0
Alignment	
Sag in line	5
Pipe out of round	0
Structural	
Piece missing	6
Shattered/broken	2
Crushed or collapsed	2
Mineral Stains	
At joint	0
At cracks	0
Sulfide Corrosion	
Minor	0



Television Inspection Program  
Figure 7-1

## SECTION 8

### BASE SANITARY FLOWS

The results of the flow monitoring program described in Section 5 were used to establish base sanitary flow (BSF) rates. Base sanitary flow rates are used with wet weather flow rates and the hydraulic model to determine the amount of available capacity in the collection system. Wet weather flow rates and the hydraulic modeling are discussed in subsequent sections of the report. This section describes the methodology used to develop base sanitary flow rates for the Crystal Springs County Sanitation District (CSCSD).

#### Dry Weather Flow

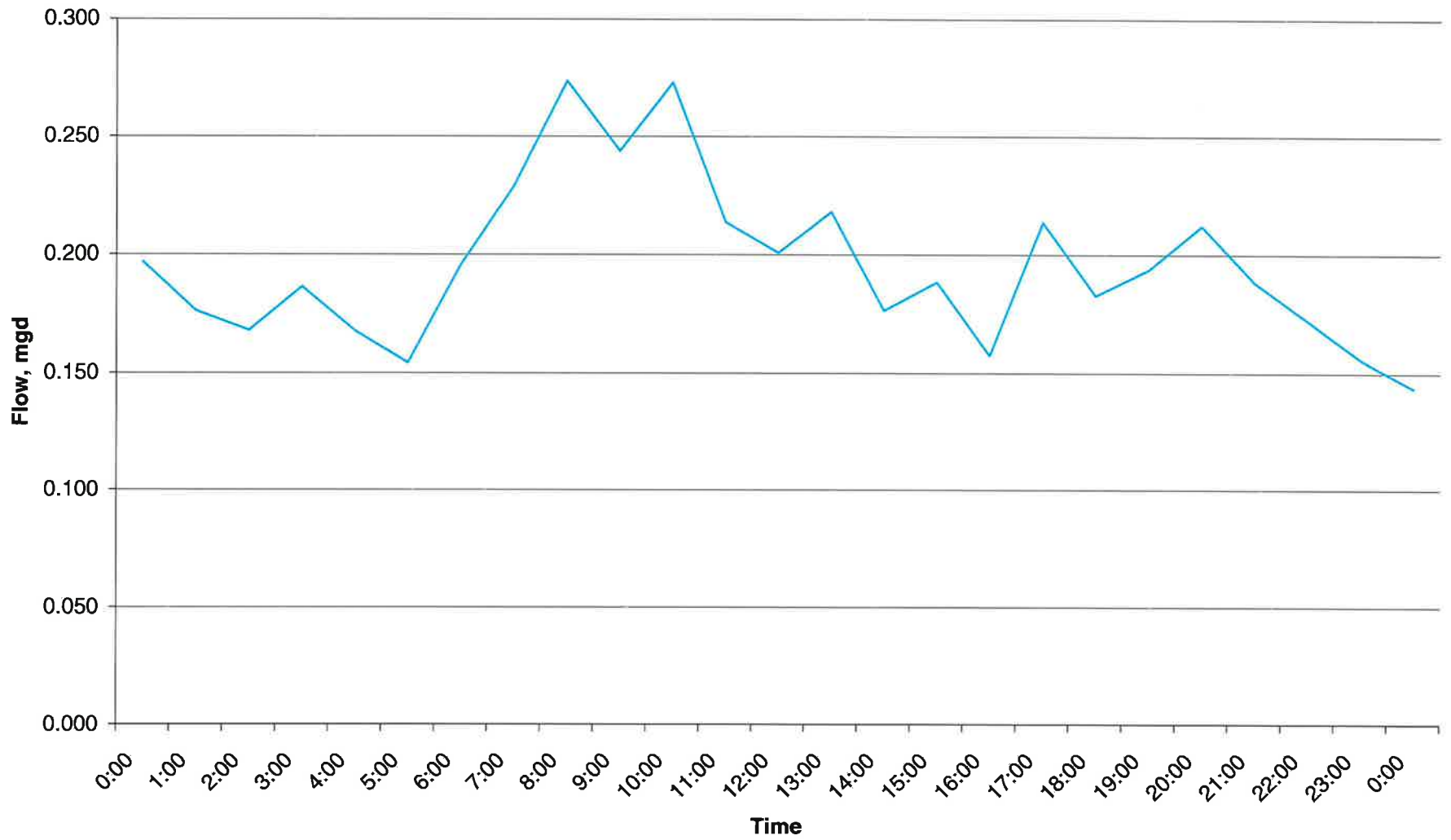
BSF is wastewater contributed by residential, commercial, industrial and public users. Base flow is directly related to land use and varies throughout the day and between weekdays and weekends. BSF from residential areas has a typical diurnal pattern with peak flows occurring in the morning after 7:00 a.m. and a second smaller peak occurring in the evening. A typical dry weather hydrograph is shown on Figure 8-1.

BSF flow contributions to the hydraulic model are based on the flow monitoring data collected during dry weather periods. Actual dry weather flow hydrographs were extracted from the flow monitoring data and used in the model. Peaking factors normally estimated for subsequent use in the hydraulic analysis were not needed since the actual diurnal flow pattern from the flow monitoring could be used directly in the hydraulic model.

Dry weather periods were used to minimize the amount of groundwater infiltration (GWI) included in the calculation. GWI occurs when groundwater levels are above the sewer pipes and the pipes have defects that allow infiltration. Some groundwater infiltration is undoubtedly included in the BSF rates. However, extensive review of accurate water use data in each District would be needed to determine the amount of groundwater infiltration in each area. Based on our review of the flow monitoring, GWI is not a significant factor in the total wastewater flow in the CSCSD area. BSF projections were not prepared for future land use conditions. Land use planners for the County and affected City agencies indicated that growth or significant infilling were not expected in the future.

BSF rates used for the service area for each of the flow monitoring sites are presented in Table 8-1. A complete description of the flow monitoring program is given in Appendix B. Additionally, the technical memorandum describing the flow projections and hydraulic modeling in more detail is provided in Appendix E.

**Typical Dry Weather Hydrograph**  
**Figure 8-1**



**Table 8-1. Base Sanitary Flow Rates**

Flow monitor	Base sanitary flow, mgd
21 Line 1*	0.195
21 Line 2*	0.286
22 Line 2	0.150
23	0.320

\*Flow monitor located in same manhole measuring two lines.

## SECTION 9

### INFLOW/INFILTRATION RATES

The flow monitoring program described in Section 5 was performed to establish inflow/infiltration (I/I) rates. I/I rates are used in conjunction with base sanitary flow (BSF) rates (established in Section 8) and the hydraulic model to determine the amount of available capacity in the collection system. This section describes the methodology used to develop I/I rates for the Crystal Springs County Sanitation District (CSCSD).

#### **Wet Weather Flow**

I/I consists of direct inflow of stormwater runoff and rainfall-induced infiltration of stormwater percolating through the soil into the collection system. Inflow occurs when storm water enters the collection system through illegally connected catch basins, area drains or home roof gutter downspouts, or through manhole covers or cleanout lids. Inflow can become severe if surface flooding occurs and manholes and cleanouts are submerged or used to drain low-lying areas.

I/I accounts for the large increase in peak flows that occur during rainfall events. In areas with older sewers, I/I is typically the largest component of the total wastewater flow. I/I was evaluated by calculating the “R” factor for each of the monitored basins for each storm. An “R” factor is the percentage of rainfall volume falling on an area that enters the collection system as I/I. The composite minimum and maximum “R” factor, based on the flow monitoring data, for each flow monitoring location is listed in Table 9-1. The flow monitors service areas and R factor used for the wet weather flow projections are shown on Figure 9-1.

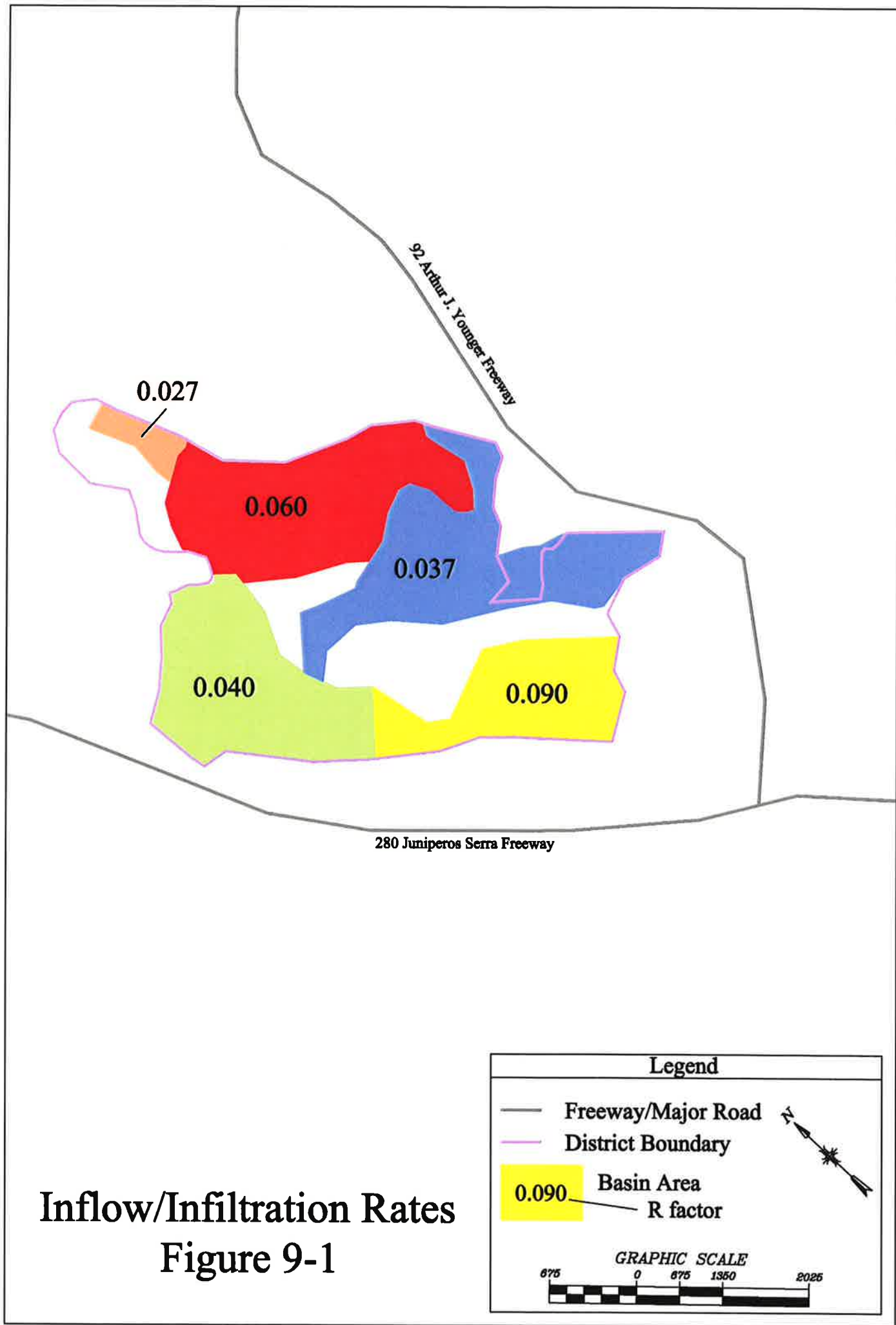
A wet weather design storm was developed to determine the effects of I/I on the capacity of the wastewater conveyance system. The January 18, 1998, rainfall event was very similar to a 5-year design storm in terms of intensity, duration, and volume. Therefore, this storm was selected as the design event. Minor adjustments were made to the rainfall hydrograph to account for differences in the volume between the actual storm and the 5-year design rainfall.

Unit hydrographs were developed for each basin to develop wet weather hydrographs for use in the model. Unit hydrographs are based on the “R” factor and the individual runoff characteristics for each basin. Synthetic hydrographs were added to the base flow hydrographs and the total flow hydrograph was then input to the hydraulic model. A typical wet weather synthetic hydrograph is shown on Figure 9-2. A complete description of the I/I flow projections is provided in the Technical Memorandum provided in Appendix E.

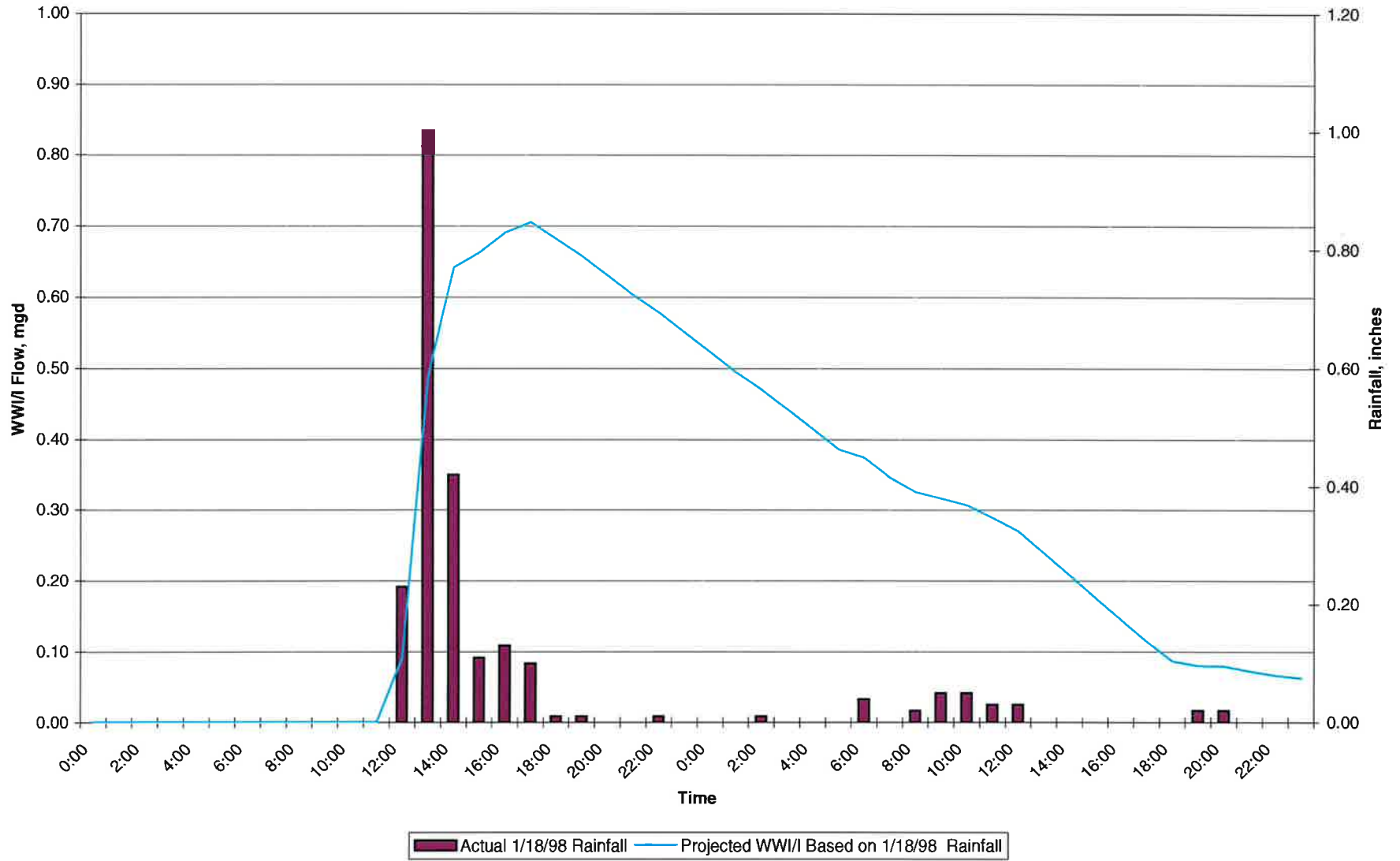


**Table 9-1. R Factor**

Flow Monitoring Site	Minimum	Maximum
21 Line 1	0.031	0.044
21 Line 2	0.054	0.091
22 Line 2	0.047	0.102
23	0.037	0.097



Typical Wet Weather Hydrograph  
Figure 9-2



## SECTION 10

### HYDRAULIC MODEL DESCRIPTION

A hydraulic model was prepared of the Crystal Springs County Sanitation District's (CSCSD) wastewater collection system trunk sewer. The model was used to evaluate the capacity of the pipelines to carry existing peak wet weather flows. This section presents a description of the model and the model development.

#### Computer Model

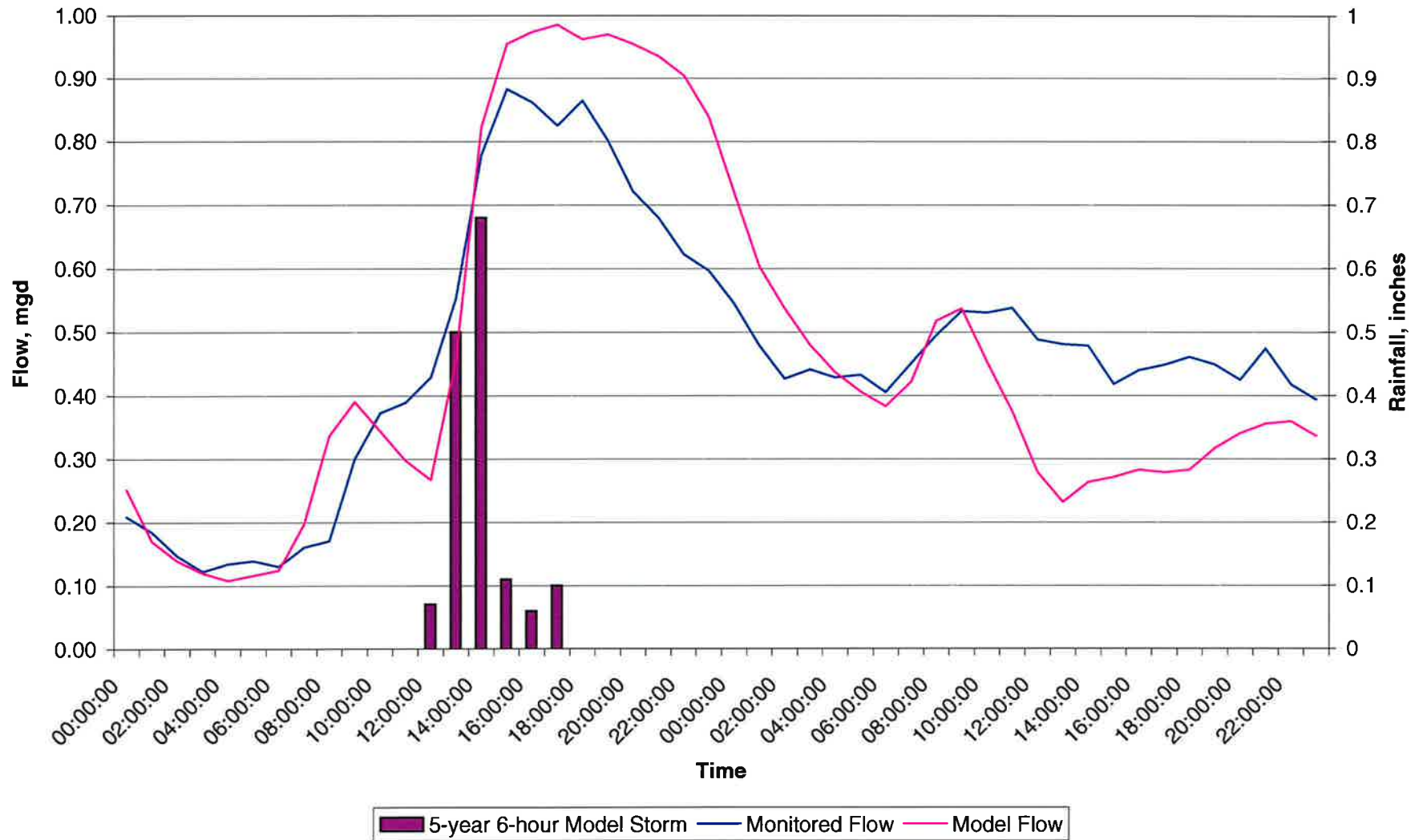
Major trunk sewers in each of the sewer Districts were modeled to determine where capacity deficiencies exist. The HYDRA model developed by PIZER, Inc., was used to simulate wastewater flows in the each of the Districts collection systems. HYDRA routes flow hydrographs (developed in Section 9) through the collection system and accounts for the time delays of peak flow from various tributary areas as the flows move downstream.

For the CSCSD, the Polhemus Road trunk sewer was modeled. This sewer includes nearly all the pipelines 8 inches in diameter or larger in the CSCSD. This trunk sewer is composed of 8-inch- and 15-inch-diameter gravity sewers in the upstream portion. Near the downstream end of the trunk sewer, the diameter decreases to 10 inches.

Most of the pipeline data used in the model was taken from the existing County collection system maps. Pipeline data required by the model includes upstream and downstream inverts and pipeline length and diameter. Surveying was completed to fill in gaps in the data or questionable data.

Modeled flow is compared to the theoretical capacity of each pipe segment. The capacity of each pipeline is a function of the pipeline slope and diameter. If capacity deficiencies were detected, then the program was used to size the appropriate relief and/or replacement sewer size. A typical example hydrograph comparing the model hydrograph to actual flow monitoring is shown on Figure 10-1. The technical memorandum describing the flow development and modeling is provided in Appendix E.

Typical Monitored to Model Flow Calibration  
Figure 10-1



## SECTION 11

### MODEL RESULTS

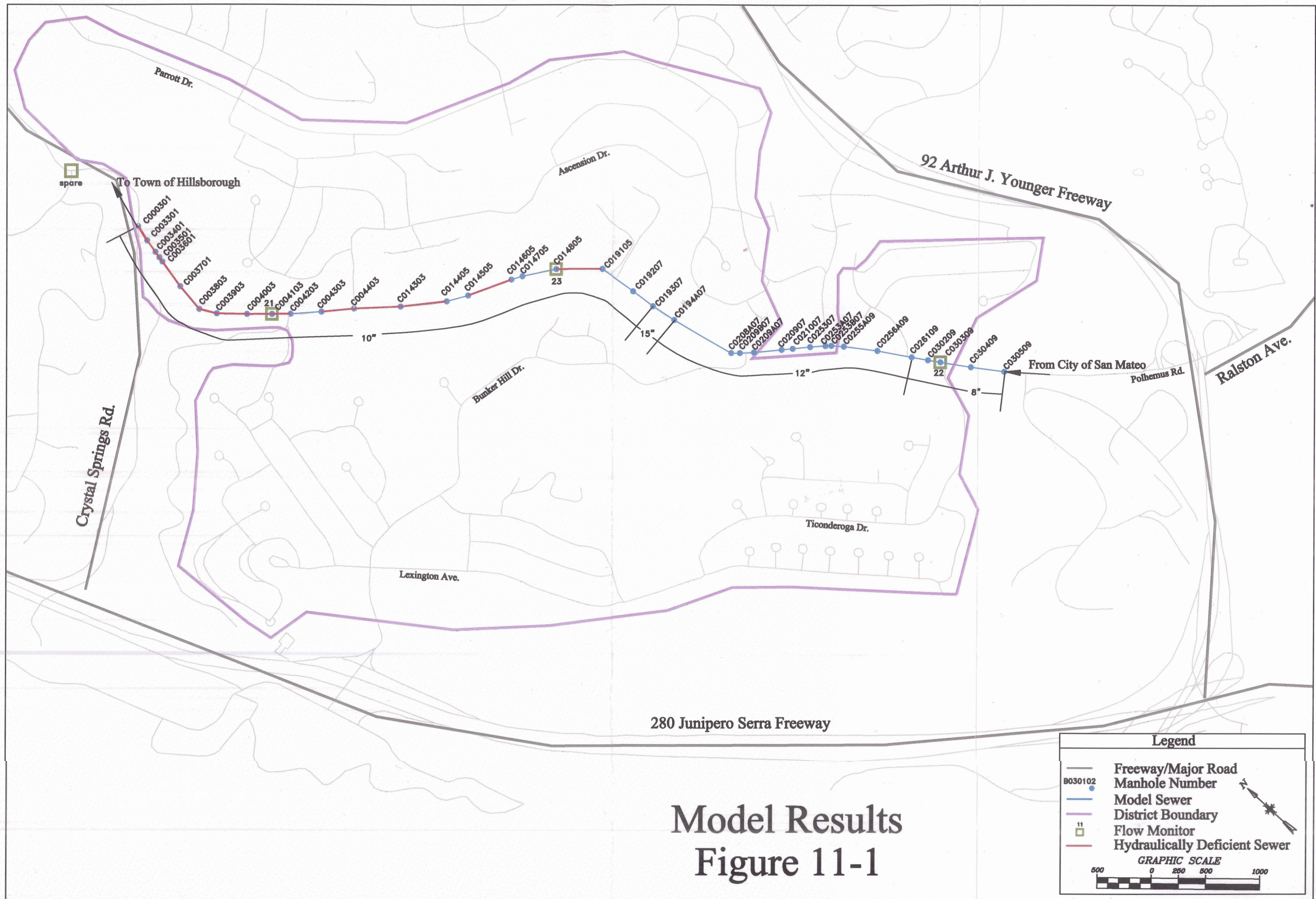
An evaluation of the pipeline capacities was performed using the flows developed in Sections 8 and 9 and the hydraulic model described in Section 10. This section describes the results of the capacity evaluation developed for the Crystal Springs County Sanitation District (CSCSD).

#### Capacity Analysis

The capacity of the existing system was evaluated using peak wet weather flows. This flow condition is generated by existing development in the service area (Section 8) under design storm conditions (Section 9).

The model routes the flow through the pipe network, calculates the capacities of the pipes, and compares the routed flows to the pipe capacities to identify inadequate pipes. The pipe capacity calculations are based on a Manning's roughness coefficient of 0.013. Pipes were defined to be hydraulically inadequate if the depth of flow is 100 percent or greater of the pipe diameter. The model sized relief and replacement sewer sizes for all inadequate sewers.

The results of the model indicate a severe bottleneck where the Polhemus Road trunk sewer changes to 10 inches in diameter. Nearly all the 10-inch-diameter sewer is unable to convey peak wet weather flow without surcharging. Model results are shown on Figure 11-1. The technical memorandum describing the flow development and modeling is provided in Appendix E. Additionally, the complete HYDRA modeling results are provided in Appendix E.



Model Results  
Figure 11-1

**Legend**

- Freeway/Major Road
- Manhole Number
- Model Sewer
- District Boundary
- Flow Monitor
- Hydraulically Deficient Sewer

GRAPHIC SCALE  
0 250 500 1000

## SECTION 12

### UNIT COSTS

This section presents the basis for the estimated unit costs that were developed for estimating the construction costs and the capital costs of recommended capital improvements. The cost index and the development of the capital costs of gravity sewer pipeline construction and rehabilitation are presented.

#### Capital Costs

The total capital investment necessary to complete a project consists of expenditures for construction, engineering services, contingencies, and such overhead items as legal and administrative services and financing. The various components of capital costs are described below. Unit construction costs were developed for the following construction and rehabilitation methods:

- Remove and Replace—recommended for pipelines with serious structural or hydraulic capacity deficiencies where trenchless construction is typically more expensive or not practical.
- Sliplining—recommended for pipelines with minor structural deficiencies or root intrusion and minimal sags.
- Pipe Bursting—recommended method for increasing capacity of structurally deficient 6-inch-diameter lines to 8-inch-diameter lines and provides minimal disruption to the community.
- Chemical Root Treatment—recommended for lines with root intrusion.
- Do Nothing—no capital project is recommended for lines with minor structural deficiencies and light root intrusion. For this option, television re-inspection in a maximum of 10 years is recommended.
- Increase O& M—recommended for lines with minor root intrusion and grease buildup.
- Spot Repair—recommended for lines with severe defects that create maintenance problems or where required prior to implementing other rehabilitation methods.

**Cost Index.** A good indicator of changes over time in construction costs is the Engineering News Record (ENR) 20-city Construction Cost Index (CCI), which is computed from prices of construction materials and labor, and based on a value of 100 in 1913. Cost data in this report are based on an ENR CCI of 6000, representing costs in March 1999.

**Construction Costs.** Construction costs presented in the master plan represent preliminary cost estimates of the materials, labor and services necessary to build the proposed projects. The cost estimates are prepared to be indicative of the cost of construction in the study area. In considering cost estimates, it is important to realize that changes during final design, as well as future changes in



the cost of material, labor and equipment, will cause comparable changes in the estimated costs. Unit costs used in this study were obtained from a review of pertinent sources of reliable construction cost information. Construction cost data given in this report are not intended to represent the lowest prices that can be achieved for each type of work, but rather are intended to represent planning-level estimates for budgeting purposes. The following assumptions were made in the development of the unit costs:

- **Remove and Replace**—Costs include excavation, backfill, compaction, haul off and asphalt repair. Material costs for 8-inch- to 21-inch-diameter sewers are for PVC or VCP. Material costs for 24-inch-diameter or larger sewers are for RCP. Replacement costs for 6-inch-diameter lines include cost for 8-inch-diameter replacement materials. The costs have been developed based on average trench depth not exceeding 15 feet.
- **Sliplining**—Costs include the use of HDPE as the liner material, construction of access pits and an average service lateral reconnection fee. Sewage bypass pumping is only needed on a localized basis and, therefore, is not included in the costs.
- **Pipe Bursting**—Costs include the use of HDPE as the liner material, construction of access pits and an average service lateral reconnection fee. Costs include the bypassing of sewage.
- **Chemical Root Treatment**—Costs include application and removal with hydroflush equipment. Costs also include reapplication every 2 years.
- **Do nothing**—Costs for this option are for television re-inspection in 10 years at a rate of \$1.50/foot for the data collection and data review.
- **Spot Repair**—A cost of \$800 has been included in the estimates for each spot repair occurrence.

Table 12-1 presents the unit construction costs for construction and rehabilitation of gravity sewer pipelines.

### **Contingencies, Engineering, and Overhead**

Construction contingencies, engineering and overhead are assumed to be 40 percent of the construction cost. It is appropriate to allow for the uncertainties unavoidably associated with planning-level layout of projects. Such factors as unexpected geotechnical conditions, extraordinary utility relocation and alignment changes are a few of the items that can increase project cost for which it is wise to make allowance in preliminary estimates.

Engineering services associated with projects include preliminary investigations and reports, site and route surveys, geotechnical explorations, preparation of drawings and specifications, construction services, surveying and staking, and sampling and testing of materials. Overhead charges cover such items as legal fees, financing expenses, administrative costs, and interest during construction.

**Table 12-1. Gravity Sewer Pipe Unit Construction Costs**

Pipe diameter, inches	Relief and replacement sewer cost, \$/foot	Sliplining, \$/foot	Root treatment, \$/foot	Pipe bursting, l.f.
6	85	n/a	3	90
8	85	55	3	90
10	100	70	4	115
12	110	90	5	145
15	120	110	6	175
18	140	n/a	n/a	n/a
21	180	n/a	n/a	n/a
24	195	n/a	n/a	n/a
27	220	n/a	n/a	n/a
30	230	n/a	n/a	n/a
33	255	n/a	n/a	n/a
36	285	n/a	n/a	n/a
42	305	n/a	n/a	n/a
48	355	n/a	n/a	n/a

Other Costs:

\$800/spot repair

Reinspect in 10 years = \$1.50/foot

## SECTION 13

### RECOMMENDED COLLECTION SYSTEM IMPROVEMENTS

Improvements will be necessary to the Crystal Springs County Sanitation District (CSCSD) collection system to adequately convey peak wet weather flows (PWWF). This section presents the recommended improvements for accommodating the hydraulic capacity problems identified in Section 11. Capital improvement projects for correcting structural deficiencies as well as the hydraulic deficiencies are provided in Section 14.

#### Collection System Sewer Sizing

The improvements recommended for correcting the hydraulic capacity problems are based on the model results for peak wet weather flow. The model selects pipe sizes for parallel relief pipes and replacement pipes. The main drawback to relief sewers is the increased amount of sewer pipe in the ground for the maintenance crews. For this report, alternatives and costs have been developed assuming a larger sewer will replace the existing sewer. However, the County will have to decide on a case-by-case basis during the design of each project as to whether to construct replacement or parallel relief sewers.

Sewer sizes developed by the computer model were verified and modified where necessary to reduce potential maintenance problems. Maintenance problems can arise when a larger sewer discharges into a smaller sewer. The diameters of the smaller sewers are modified to be no smaller than the upstream pipe. In some cases, a sewer is extended for several reaches to connect two portions of the collection system with hydraulic problems.

Short lengths and isolated reaches of over-capacity pipe have, in some cases, not been included with the recommended relief/replacement sewer program. These reaches are not considered significant hydraulic problems because resulting backwater would be minor.

Nearly 5,000 linear feet of the Polhemus Road trunk sewer was identified as hydraulically deficient. A 10-inch and 12-inch relief sewer is recommended to relieve the existing trunk sewer. The location of the recommended relief sewer is shown on Figure 13-1. Table 13-1 summarizes the modeling results.

**Table 13-1. Recommended Replacement Sewers**

Upstream manhole	Downstream manhole	Existing diameter, inches	Length, ft	Recommended replacement sewer sizes, inches
C019105	C014405	10	1,714	8
C014405	C000301	10	3,280	12
Total			4,994	

### Infiltration/Inflow Reduction

The use of collection system rehabilitation to reduce the overall PWWF within the basin was considered as an option prior to developing the recommendations listed in Table 13-1 for pipe replacement. Collection system rehabilitation is used to accomplish two main objectives:

1. Provide a continuing level of service with regard to the structural integrity of the collection system.
2. Reduce the overall level of I/I entering the collection system for either peak flow rates or for total I/I flow into the system.

I/I studies nationwide have demonstrated that effective removal of I/I from the collection system requires a comprehensive implementation of collection system rehabilitation of both the sanitary sewer and the private building lateral. Agencies, such as, East Bay Municipal utilities District, Vallejo Sanitation and Flood Control District, and the City and County of Honolulu have performed pilot rehabilitation programs documenting the need for comprehensive rehabilitation for effective I/I removal. The effective amount of I/I reduction possible, even with comprehensive rehabilitation, is a subject of some debate within the sewer industry. Claims range from over 90 percent removal to less than 40 percent removal of the I/I from the collection system. Many things impact the ability of the rehabilitation effectiveness in removing I/I for a long period of time (50 years is considered a reasonable time measure for effectiveness of rehabilitation program). An average long-term effectiveness of 75 percent was assumed for I/I removal from the collection system for this study, based on the results of similar work in the Bay Area.

This type of area-wide rehabilitation approach is critical for collection systems where field data from condition assessment programs show no one area of the collection system as having a significantly higher level of sewer defects that contribute to I/I in the collection system. The Crystal Springs County Sanitation District condition assessment data indicates that the entire district will require comprehensive rehabilitation to provide the required reduction in I/I related flows to avoid the capacity limitations within the existing collection system configuration.

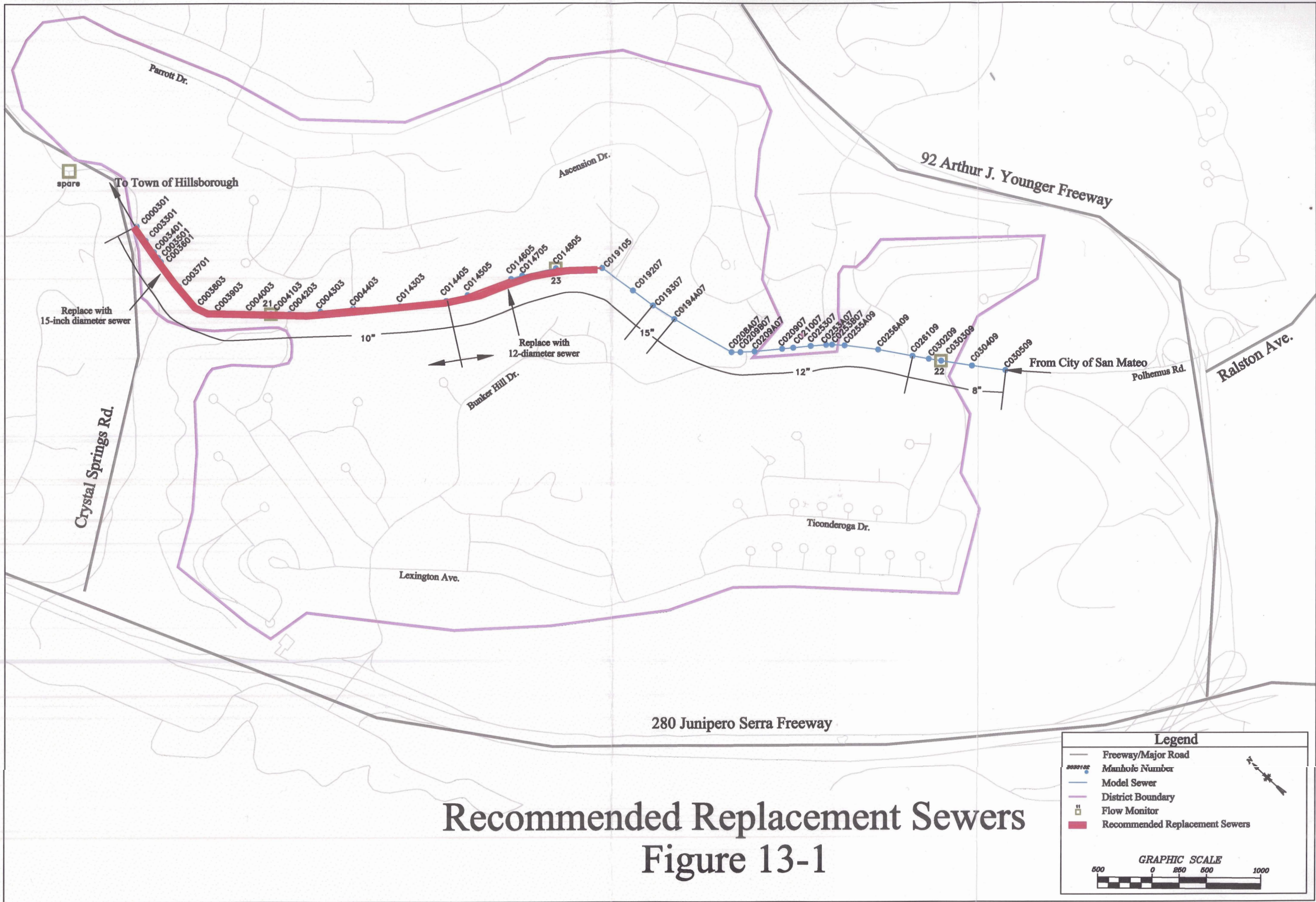
The capacity limitation of 1.74 mgd in the 10-inch sewer in Polhemus requires a 1.86 mgd reduction in the projected PWWF of 3.60 mgd as shown in Appendix E. Effectively, 52 percent of the PWWF will need to be eliminated from the system through a comprehensive rehabilitation program of the district. Using the 75 percent effectiveness criteria, which could be considered optimistic, then the entire collection system in the district will require comprehensive rehabilitation.

The cost associated with complete collection system rehabilitation, using the unit costs provided in Table 12-1, equals \$5.15 million for the 13 miles of collection system approximated as 8-inch rehabilitated sewer at \$75/lf (assumes approximately a 50/50 split between slip lining and pipe bursting of equivalent 8-inch-diameter pipe). The rehabilitation of the sewer laterals will cost approximately \$50/ft when considering landscaping replacement or the use of trenchless construction methods. The estimated total length of sewer laterals in the district is about 10 miles. Therefore, the estimated construction cost for lateral rehabilitation is \$2.64 million. The total estimated construction cost for a rehabilitation program that is effective enough to eliminate the requirement for a new larger capacity sewer is approximately \$7.79 million. The estimated replacement construction cost for the increased capacity of sewer in Polhemus Road is \$655,300 as shown for the two Polhemus Road projects listed in Table 14-1.

### **Wastewater Cost of Treatment**

The cost of treating the increased PWWF will have to be borne by the rate payers of the district. The current cost of treatment charged by the City of San Mateo is approximately \$0.00125/gallon treated. Using this rate the cost of treating the PWWF storm event total flow of approximately 10.5 million gallons, as shown in Figure 9-2 as the area under the projected wet weather flow line, equals \$13,125 per peak flow event. Given that this is a once in five-year condition, the overall cost impact to eliminate the wet weather flows is not practical based on the cost analysis shown above. Planning and negotiation should begin with the Town of Hillsborough and the City of San Mateo regarding the need for collection system capacity down stream of the district.

The County needs to carefully review the terms of the operating agreements for accommodating wastewater flow with each of these agencies to determine who is responsible for the cost of any potential downstream improvements required as the result of construction of a new larger-capacity sewer for the district. The operating agreements should provide a basis of negotiation and planning for developing the recommended projects so that no agency is overly burdened with the cost of the new facilities and that the potential for overflows is prevented.



**Recommended Replacement Sewers**  
**Figure 13-1**

**Legend**

- Freeway/Major Road
- Manhole Number
- Model Sewer
- District Boundary
- Flow Monitor
- Recommended Replacement Sewers

**GRAPHIC SCALE**

500 0 250 500 1000

## SECTION 14

### CAPITAL IMPROVEMENT PROGRAM

Capital improvement program (CIP) projects in the Crystal Springs County Sanitation District (CSCSD) are necessary to correct identified hydraulic and structural deficiencies. This section presents the recommended improvements for correction of the hydraulic deficiencies presented in Section 13 and the structural problems identified in Section 7.

#### Capital Projects

A total of nine capital improvement projects were developed for the Crystal Springs District. Eight of the projects are required to correct structural deficiencies that create increased maintenance costs or where the sewer is deteriorated to the point where failure may occur in the near future. One project was developed to provide increased hydraulic capacity to the Polhemus Road trunk sewer. Alternatives have been developed for the following projects in the Crystal Springs District:

1. Timberlane Way
2. South Ascension Drive
3. Polhemus Road (north)
4. Polhemus Road (south)
5. Rainbow Drive
6. Enchanted Way
7. Parrot Drive
8. Lexington Avenue
9. Randall Road

A priority ranking of 1 to 3 was applied to each of the projects to aid in the scheduling of the recommended CIP projects. The ranking was done according to the following:

- Priority 1—Required to correct hydraulic deficiencies. The only mitigation alternative available for this option is construction of relief or replacement sewers.
- Priority 2—Sewer lines with excessive maintenance requirements. Improvements to Priority 2 lines are required to prevent dry weather overflows that may be associated with blockages created by roots or other structural problems.
- Priority 3—Sewer lines with minor to major structural deficiencies. Corrective action may or may not be required on these lines depending on the severity of defects.

Table 14-1 presents the recommended projects, priority rating and minimum and maximum mitigation construction costs. Each of the recommended projects are shown on Figure 14-1. A project summary sheet is provided for each project in Appendix F. The summary sheet describes the project location, description of the deficiency, the three corrective alternatives, estimated

construction costs for each alternative and any specific project concerns ( i.e., easement work, coordination with neighboring cities, etc.).

**Table 14-1. Recommended Capital Improvement Program**

Project Description	Priority	Minimum construction cost, dollars	Maximum construction cost, dollars
Polhemus Road (north)	1	N/A	582,100
Randall Road	2	61,300	73,200
Timberlane Way	2	208,115	238,900
Parrot Drive	3	180,000	180,000
Lexington Avenue	3	2,500	127,000
Enchanted Way	3	30,100	35,900
Rainbow Drive	3	271,400	325,600
South Ascension Drive	3	233,200	279,700
Polhemus Road (south)	3	4,000	4,000
Totals		\$1,572,700	\$1,846,400

Estimated construction costs for the projects range from \$1,572,700 to \$1,846,400 depending on the selected alternative. The Polhemus Road replacement sewer project will require coordination with the Town of Hillsborough. The Town of Hillsborough trunk sewer that receives flow from the Polhemus Road trunk sewer also has capacity limitations. Correcting the capacity limitations on the Polhemus Road trunk sewer may aggravate the capacity problem in the Town of Hillsborough trunk sewer.

**Operation and Maintenance Program**

A crucial part of the successful ongoing performance of the collection system is the operation and maintenance (O&M) program used by the agency. Current maintenance guidelines for the collection system are to clean all sewers in easements annually, and all sewers in roadways every 6 months. In addition, some sewers are cleaned more frequently where they have been identified as being prone to blockages. The purpose of this section is to provide an overview of an O&M approach for the district. It is beyond the scope of work for this project to develop a reach by reach O&M program for the district.

County staff provided a long-term history of emergency call outs to respond to potential spills and blockages. Analysis of these data confirmed that some portions of the system require more frequent cleaning than other segments, which is typical of all collection systems. Also typical cleaning practice is to clean enough material from the pipe to keep the flow moving, rather than completely clean the pipe. An example of this practice is the use of a 4-inch root cutter head to open the flow on the 6-inch-diameter sewer. This cleaning method provides only 44 percent of the available pipe cross sectional area to convey sewer flows. Cleaning to the full diameter of the sewer (use of a 6-inch root cutter in a 6-inch sewer, etc.) and removing the debris from the immediate downstream manhole, while more time consuming, will provide the maximum available sewer system capacity



without pipe replacement. The priority of the field crew should be placed on providing a clean sewer rather than the more typical production rate performance criteria.

Overall collection system maintenance should be on a regular schedule that balances the need to provide maximum available sewer capacity with the cost of maintenance. Typical cleaning frequencies in other agencies in the Bay Area range from once every 6 to 10 years, with segments of sewer cleaned more frequently (up to monthly) where needed. Adopting a program with a fixed cleaning frequency should be instituted for the district. The County has maintenance management software that is capable of establishing schedules for the maintenance crews. Initial cleaning frequencies should be extended to once every 2 years (except for known trouble spots) and then to longer return periods as the condition of the collection system relative to debris, grease, and roots build up is determined throughout the collection system. Known trouble spots that require more frequent maintenance should be placed on a 2-month cleaning schedule, or more frequent if warranted, and tracked to determine whether the cleaning frequency can be increased.

Establishing a cleaning program that relies on continuous schedule/frequency refinement will provide the district with an optimum cleaning program that provides a high level of service and reliability to the community. An added benefit to a responsive cleaning program is the ability of the maintenance crews to shift their focus to accommodate changes in the collection system as changes occur.

When the cleaning of the collection system is performed by a maintenance crew that has other assigned duties in addition to O&M on the collection system, it becomes very important to prioritize with justification, the time requirements of the maintenance crews. Other collection system activities, such as spot repairs, main line rehabilitation, manhole rehabilitation/reconstruction, and lateral rehabilitation could all be added to the duties of the maintenance crew. The impact of this type of increased work load would likely require the maintenance crews to become completely assigned to collection system O&M. This approach would allow the County to maintain the structural integrity of the collection system with a minimum amount of outside construction contracting. Larger projects where several sewers are rehabilitated at the same time should be constructed with a contractor that specializes in the rehabilitation method being used for that portion of the collection system.

The upcoming EPA regulations on sanitary sewer overflows (SSO) will likely require that each district within the County apply for and secure a National Pollutant Discharge Elimination System (NPDES) permit for the operation of the collection system. One of the key aspects proposed for the SSO regulations is the tracking and elimination of dry weather overflows. The SSO regulations will likely allow for limited overflows to occur that are related to acts of nature (severe wet weather events) and for acts of vandalism (illegal dumping of debris into a manhole). It will not allow for repeat overflow locations and will require a database/geographic information system to track the operation and maintenance and the performance of the collection system.

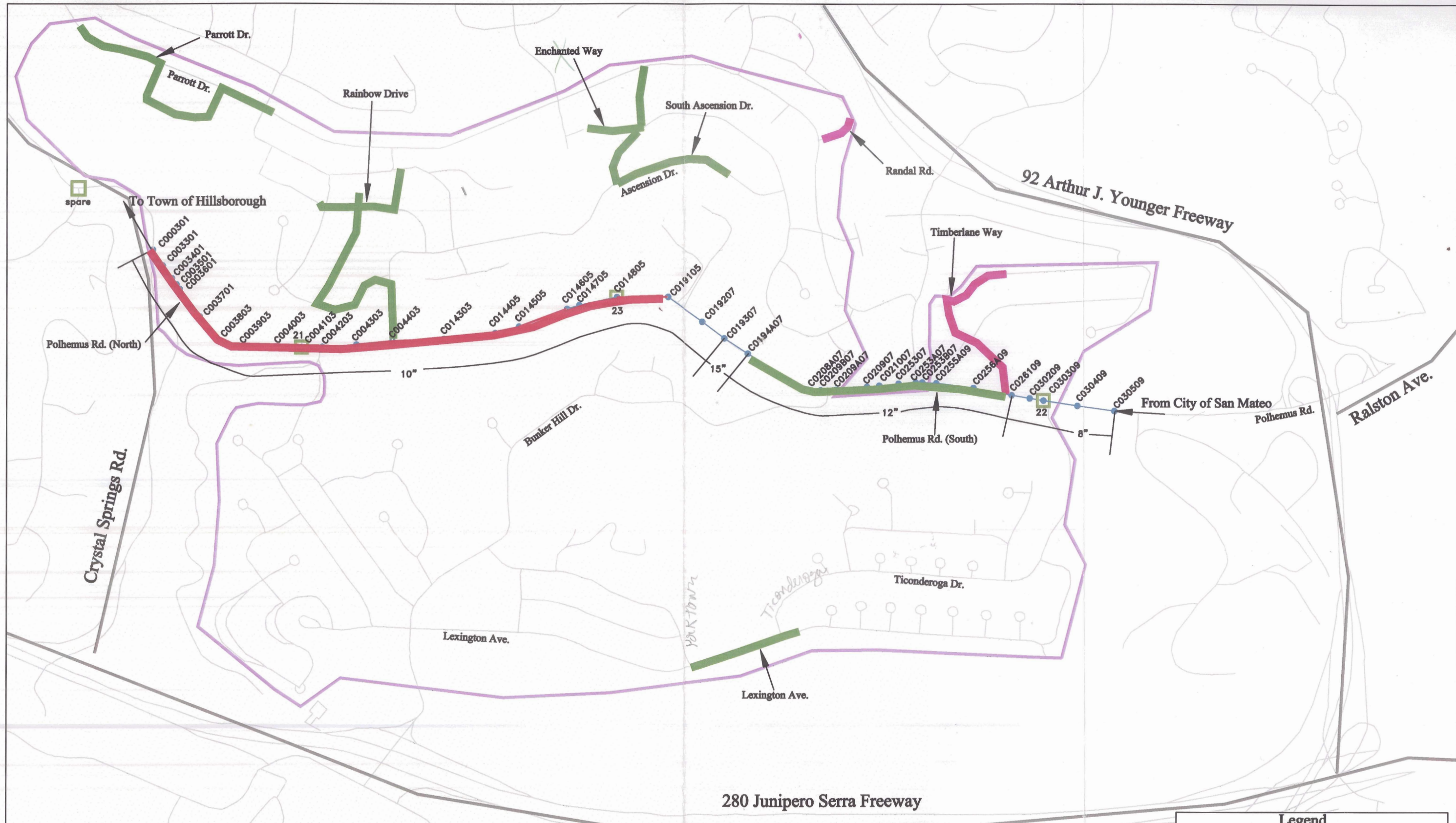
The mission of proactive collection system maintenance is to provide the longest possible life to the sewers without having to replace them with costly construction projects. The primary goal of providing the maximum capacity of the existing collection system network is what the maintenance program should achieve. Unfortunately, an aggressive O&M program will not have any effect on the amount of I/I that enters the collection system as the repairs that are completed by the

maintenance crews are selective, structurally oriented, and spread over the entire collection system, rather than a comprehensive focused rehabilitation program.

### **Other Collection System Options**

The County could consider the impacts/benefits of other collection system options, in addition to construction and modifications of the O&M program recommendations made from this study. Two main options are presented below:

1. Require lateral inspection testing and repair as a condition of ownership transfer of a sewer parcel. The benefit is that the new property owner will acquire the property with a sound sewer lateral and the County will, over a long time period, have the sewer lateral located on the private property rehabilitated at no direct cost to the County. Statistically, home ownership changes an average of every 7 to 10 years. A downside to this approach is that many properties do not change ownership in this time frame and consequently the County will end up with a mix of tested and untested laterals within a neighborhood, thereby limiting the effectiveness of the rehabilitation for reducing the I/I contribution to PWWF. This type of inspection has been implemented in several communities in California and in all cases meet with considerable political resistance for impacted jurisdictions and the local real estate organizations. Where implemented, the program is now considered a minor cost of doing business within the community.
2. Begin a long-term sewer replacement program of the collection system. At this time, the cost of a cyclic replacement program based on the design life of the collection system is both impractical and cost prohibitive. The cost comparison of providing system capacity versus total system rehabilitation (see Section 13) to reduce I/I contribution demonstrates the economic burden on the rate payer. A key benefit of a scheduled cyclic replacement program would be establishing a reasonable expected cap to I/I related flows by establishing a schedule of replacement combined with ongoing O&M to effectively limit the amount of I/I entering the collection system.



Recommended Projects  
Figure 14-1

**Legend**

- Freeway/Major Road
- Manhole Number
- Model Sewer
- District Boundary
- Flow Monitor
- Project-Hydraulic Deficiency-Priority 1
- Project-O&M-Priority 2
- Project-Structural-Priority 3

**GRAPHIC SCALE**

500 0 250 500 1000

## SECTION 15

### SANITARY SEWER RATES

The implementation of the capital improvement programs (CIP) developed for Crystal Springs County Sanitation District (CSCSD) in Section 14 will require that the District invest considerably in its sanitary sewer collection system. As a consequence, the District will need to charge higher rates to its customers. The impact of the various alternative levels of CIP expenditures on District finances and a projection of this impact on the equivalent single-family residences (SFR) rate is presented in this section. SFRs currently make up approximately 98 percent of all CSCSD residential unit equivalents. The impact of various levels of CIP expenditures on the rates assessed SFRs was determined by (1) determining the various alternative levels of the CIP expenditures considered over a 5-year period, adjusted for inflation, and (2) determining current revenue requirements.

The sanitary sewer rates necessary to pay for the recommended improvements at each alternative level considered for the 5-year study period FY 1999/00 through 2003/04 were estimated. This section presents the methodology used to determine the likely impacts.

The rates derived assume no use of reserves to lower revenue requirements necessary to be recovered from rates. As such, this section contains guidelines for the County's use in determining an appropriate reserve level for the District. All supporting documentation of the development of revenue requirements and rates is contained in Appendix G.

### RATE IMPACTS

Determining the impact of the CIP on the sanitary sewer rates requires that the cost of the CIP be combined with existing annual revenue requirements to estimate the increase in the rates required to meet the new level of revenue requirements. Essentially, revenue requirements are developed based on historical expenditures, offsetting revenues, and alternative levels of CIP-related expenditures for each fiscal year in the study period. This total net revenue requirement is divided by the total number of equivalent residential connections (ERC) in the District to obtain the rate per ERC.

#### Development of CIP

The three priority levels of capital improvements currently under consideration are discussed in detail in Section 14. The recommended financing alternative for the District for the CIP developed is pay-as-you-go financing. Although debt (e.g., Certificates of Participation [COPs] or revenue bonds) could possibly be issued by combining projects from several Districts to create a larger single issue, pay-as-you-go financing is the recommended alternative at this time.

## **Development of Annual Revenue Requirements**

Revenue requirements for the CSCSD system were estimated from accounting information provided by County staff. For each alternative, historical and projected revenue requirements were developed. Projected expenses were developed by inflating the FY 1997/98 expenses by 3 percent per year. The capital projects expenditures (CIP) in any given year is the level of CIP divided by 5 years (assuming the projects will be paid evenly over the 5-year period) and inflated by 3 percent in each subsequent year. Offsetting revenue in the form of secure property taxes was also inflated by 3 percent per year. Other projected offsetting revenues were based on historical levels of receipts and were not inflated. It was assumed that the District does not plan to either add to or subtract from their existing reserve fund balance. This assumption may change if the County conducts a reserve study, the results of which may indicate that the reserve balance can either be used or added to. Tables 15-1, 15-2 and 15-3 contain a summary of the revenue requirements and rate development.

## **Impact of Revised Revenue Requirements**

The impact on rates of the proposed CIP is significant regardless of what level of capital projects CSCSD choose to construct. Current rates are \$352/residential unit equivalent. The Alternative 1 CIP necessitates a maximum rate increase of 104 percent to \$718/residential unit equivalent in FY 2003/04. Alternatives 2 and 3 cause maximum rate increases of 101 percent and 96 percent to \$708/residential unit equivalent and \$690/residential unit equivalent in FY 2003/04, respectively. This analysis assumes that the increased costs, both as a result of the CIP and increases in general expenses, are absorbed equally by all customers. The tables provided in Appendix G summarize the revenue requirements including CIP levels for each alternative along with the calculated rates. As no significant growth is expected in CSCSD, the number of equivalent residential units used to calculate the rates is 1,499. The full development of the rates for the three alternatives and the average of the three alternatives is contained in Appendix G. Tables 15-1, 15-2 and 15-3 also contain a summary of the rate development.

**Table 15-1. Crystal Springs Alternative 1 Summary Rate Development**

Item	Projected, dollars				
	1999/00	2000/01	2001/02	2002/03	2003/04
Gross expenses	1,051,519	1,079,105	1,107,519	1,136,786	1,166,930
Total offsetting revenue	87,462	88,080	88,717	89,373	90,048
Use of fund balance	-	-	-	-	-
Net revenue requirements	964,056	991,025	1,018,802	1,047,413	1,076,882
Annual rate assuming 1,499 connections	643	661	680	699	718

**Table 15-2. Crystal Springs Alternative 2 Summary Rate Development**

Item	Projected, dollars				
	1999/00	2000/01	2001/02	2002/03	2003/04
Gross expenses	1,037,882	1,065,059	1,093,052	1,121,884	1,151,582
Total offsetting revenue	87,462	88,080	88,717	89,373	90,048
Use of fund balance	-	-	-	-	-
Net revenue requirements	950,419	976,979	1,004,335	1,032,512	1,061,534
Annual rate assuming 1,499 connections	634	652	670	689	708

**Table 15-3. Crystal Springs Alternative 3 Summary Rate Development**

Item	Projected, dollars				
	1999/00	2000/01	2001/02	2002/03	2003/04
Gross expenses	1,013,586	1,040,034	1,067,276	1,095,335	1,124,236
Total offsetting revenue	87,462	88,080	88,717	89,373	90,048
Use of fund balance	-	-	-	-	-
Net revenue requirements	926,123	951,954	978,559	1,005,963	1,034,188
Annual rate assuming 1,499 connections	618	635	653	671	690

**RESERVE RECOMMENDATION**

The following list of general recommendations are for the County’s use in determining the appropriate amount of reserve funds to maintain for the District.

1. **Working Capital Reserve**—This generally constitutes 1/6 to 1/12 (as appropriate for a utility’s billing cycle) of annual operations and maintenance expenses. This is intended to cover the gap created by the need to pay for expenses incurred prior to the receipt of fees for services rendered.
2. **Emergency Repair Reserve**—Between 1 percent and 3 percent of the current replacement value of a system’s assets can be held in reserve for use in the case of main breaks or other necessary emergency repairs.
3. **Self Insurance Reserve**—Between 1 percent and 3 percent of the current replacement value of a system’s assets can be held in reserve as self insurance in the case of damages a system might sustain from natural or other disaster.
4. **Debt Service Reserve**—Generally, debt holders require that a utility maintain a minimum reserve equal to 1 year’s debt service payments.

It is recommended that at a minimum, the County maintain 10 percent of annual operations and maintenance expenses as working capital reserves, or about \$100,000 in the case of Crystal Springs, along with emergency repair reserves. Assuming CSCSD has approximately 45,000 feet of equivalent 10-inch-diameter pipe (assuming 9,000 feet modeled length represents 20 percent of the system) and assuming \$100/foot replacement cost yields an estimated minimum system replacement value of \$4,500,000. Using the guideline stated above the County should thus maintain between \$45,000 and \$135,000 for emergency repair reserves. Thus the total minimum recommended reserves would be between \$145,000 and \$235,000 for CSCSD. It should be noted that this minimum level of reserves is based on the District’s current O&M expenses, the above guidelines, and a rough estimate of the value of the District’s assets and should be updated if better information becomes available. Current and projected fund balance levels are shown on the tables in Appendix G.