COUNTY OF SAN MATEO

Burlingame Hills
Sewer Maintenance District

SEWER MASTER PLAN

Prepared by:
Brown and Caldwell
December 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 Burlingame Hills Sewer Maintenance District (BHSMD). 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 BHSMD. 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 90 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 28,300 linear feet of sewer lines. A total of 57 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 5,100 feet of the collection system was inspected. Over 430 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 sewers along Adeline Drive and Canyon Road was evaluated for this study. Results of the analysis indicate that approximately 1,800 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 seven capital improvement projects were developed for the BHSMD. Five of the projects are recommended to repair structural deficiencies. The remaining projects are recommended to provide additional hydraulic capacity to the Canyon Road trunk sewer. Estimated total construction costs for the projects range between $958,000 to $1,032,000 depending on the selected alternative improvement. The location of the improvement projects is listed below:

1. Canyon Road #4
2. Canyon Road #3
3. Hillside Drive
4. Canyon Road #2
5. Adeline Drive
6. Canyon Road #1
7. Fey Drive

SECTION 1

INTRODUCTION

This chapter introduces the sewer master planning process for the Burlingame Hills Sewer Maintenance District (BHSMD) 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 BHSMD is located on the San Francisco Peninsula in the area roughly bounded by Canyon Drive and Summit Drive in the south, Skyline Boulevard in the west, Hillside Drive and Adeline Drive in the north and Alvarado Avenue 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 BHSMD 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 BHSMD. 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 Burlingame Hills Sewer Maintenance District (BHSMD) 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.

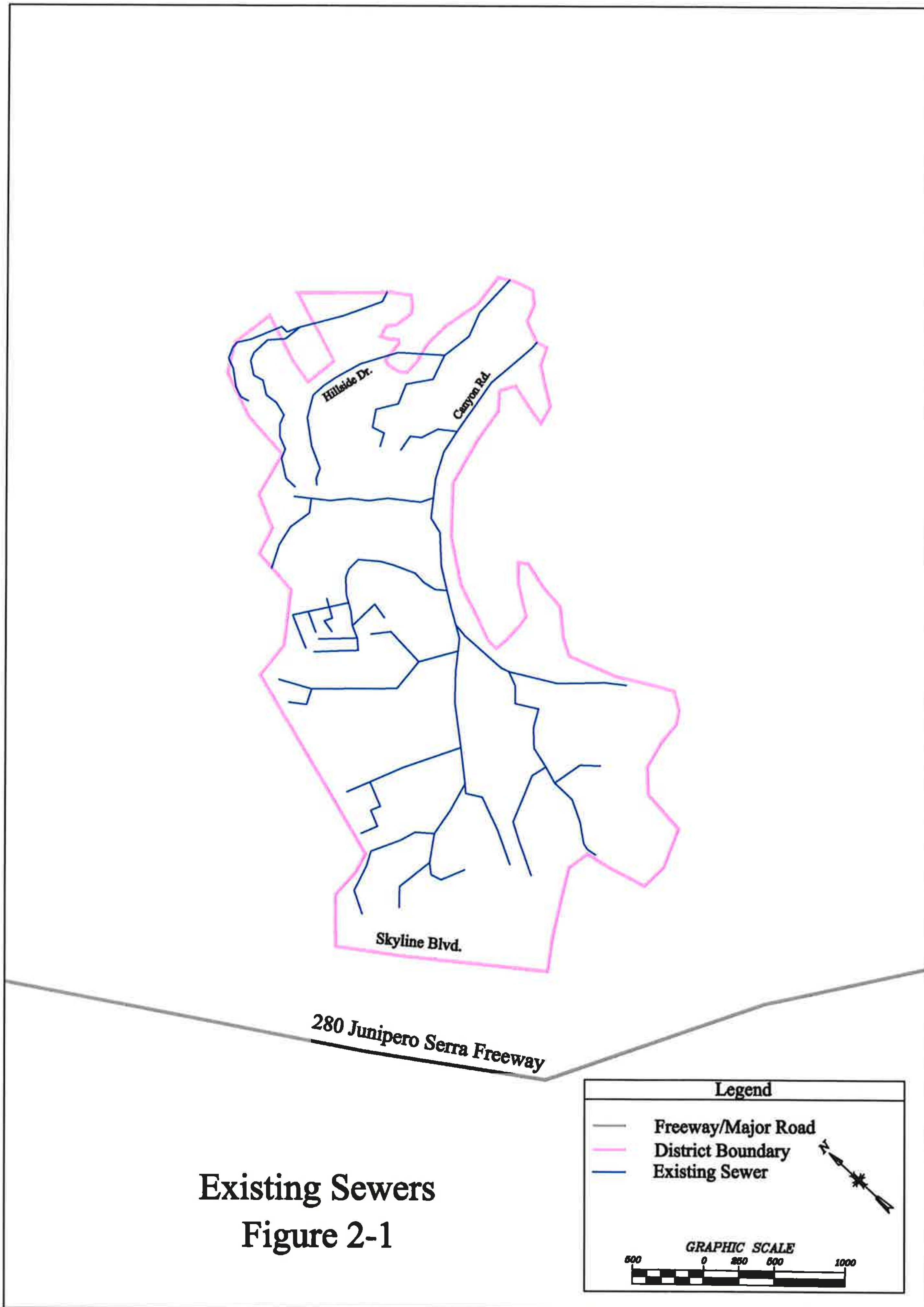
Description of Existing Facilities

The BHSMD'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 5 miles of 6-inch to 8-inch-diameter vitrified clay pipe. Most of the collection system has been constructed between the post World War II period and the present.

There are three main trunk sewers in the BHSMD. They are located on Adeline Drive, Canyon Road and Hillside Drive. These sewers roughly divide the BHSMD into three major drainage areas. All three of the trunk sewers discharge to the City of Burlingame at three different locations. The BHSMD has purchased capacity in the City of Burlingame sewer system. Figure 2-1 depicts the BHSMD 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 (B for BHSMD). The next four numbers identify the manhole within the BHSMD. 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

SECTION 3

SEWER OPERATION AND MAINTENANCE

Prior to beginning the physical inspection of the Burlingame Hills Sewer Maintenance District (BHSMD), 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 BHSMD 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 BHSMD 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	
2811	Adeline Dr	1978				x	Permit 0184
2831	Adeline Dr	1978					No cleanout, Lateral OK
2835	Adeline Dr	1977					No cleanout, Permit 0096
105	Alturas Dr	1990	xxx				
130	Alturas Dr	1996					Lateral OK, no cleanout
2874	Canyon Rd	1980				xx	
2875	Canyon Rd	1984					Lateral OK
3028	Canyon Rd	1987	x		x		
3035	Canyon Rd	1994	xx				
3040	Canyon Rd	1992					Cleanout too far back of P/L, No cleanout
3052	Canyon Rd	1995	xx				
3104	Canyon Rd	1995					Later & flushing inlet roots
3119	Canyon Rd	1986				x	Permit 0554
111	Fey Dr	1995	xx				Off-set
115	Fey Dr	1991	xx				
127	Fey Dr	1979				xx	Permit 0067
141	Glen Aulin Ln	1979	x				Lateral OK
170	Glen Aulin Ln	1984	x				Lateral OK
2817	Hillside Dr	1980	x				Lateral OK (2)
2895	Hillside Dr	1994	xxx				
2907	Hillside Dr	1992					Permit 2235
3015	Hillside Dr	1994					No cleanout
3041	Hillside Dr	1985	x				Lateral OK
3075	Hillside Dr	1986	xx				
3111	Hillside Dr	1992	x				Lateral OK
109	La Cuesta Dr	1987	xx				
114	Los Robles Dr	1996	xx				
170	Los Robles Dr	1980			x		Lateral OK
193	Los Robles Dr	1980	xxx				
201	Los Robles Dr	1990					Rotor Rooter snake in lateral, Rescue Rooter snake in lateral, Lateral OK
205	Los Robles Dr	1977	xx		x		
213	Los Robles Dr	1990	xx				
219	Los Robles Dr	1985	xx				
231	Los Robles Dr	1987	x				Cleanout OK
101	Newton Dr	1980	xxxxx				
108	Newton Dr	1987	xx		xxx		Lateral OK
112	Newton Dr	1993					No cleanout
134	Newton Dr	1987	x		x		
135	Newton Dr	1987	x			x	
2714	Summit Dr	1994	xx				
2730	Summit Dr	1990	xx				

Street number	Street name	Year	Reason for callout				Comment
			Roots	Grease	Paper	Inspection	
50	Tiptoe Ln	1986					No cleanout
140	Tiptoe Ln	1992					Lateral OK
155	Tiptoe Ln	1987				x	Permit 1118
110	Valdeflores Dr	1986	xxx				
120	Valdeflores Dr	1991					Permit 2177 & Permit 2127
15	Vista Ln	1986	x				No cleanout

Table 3-2. Callout Summary for Sewer Mains

Street number	Street name	Year	Reason for callout				Comment
			Roots	Grease	Paper	Inspection	
2999	Canyon Rd	1990	xx				
3030	Canyon Rd	1978	xx				
3030	Canyon Rd	1979	xx				
3030	Canyon Rd	1985	xx				
3030	Canyon Rd	1995	xx				
3035	Canyon Rd	1991	xx				
3053	Canyon Rd	1975	xx				
3059	Canyon Rd	1994	xx		x		
111	Fey Dr	1986			x		Broken main (2), Main repair
115	Fey Dr	1977	xx				
123	Fey Dr	1996	xxx				Main OK
127	Fey Dr	1985	xx				
3023	Hillside Dr	1975	xx				
120	La Mesa Dr	1992	xx				
176	Los Robles Dr	1976	xx				
176	Los Robles Dr	1979	xx				
219	Los Robles Dr	1979	xx				
219	Los Robles Dr	1987	xx				
108	Newton Dr	1978	xx				
96	TipToe Ln	1979	xx				
120	Tiptoe Ln	1994	xx		x		
140	Tiptoe Ln	1993	xx		x		
140	Tiptoe Ln	1994	xx				

SECTION 4

MANHOLE INSPECTION

The manhole inspection program was conducted during the winter and spring of 1997. Field crews documented the condition of 90 manholes in the Burlingame Hills Sewer Maintenance District (BHSMD). 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 BHSMD. Manholes were selected for inspection to provide a representative sample of the manholes in the BHSMD.

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	26
Roots	16
Grease	0
Frame and Cover Problems	14
Active or signs of Infiltration/Inflow	5
Major Debris in Channel	7
Manholes Inspected	90

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	1
Pipes with infiltration/inflow	0
Pipes with greater than light grease	17
Pipes with greater than light roots	45
Pipes with roots and grease	7
Pipes with cracks and fractures	3
Pipes with plugs and obstructions	15

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.

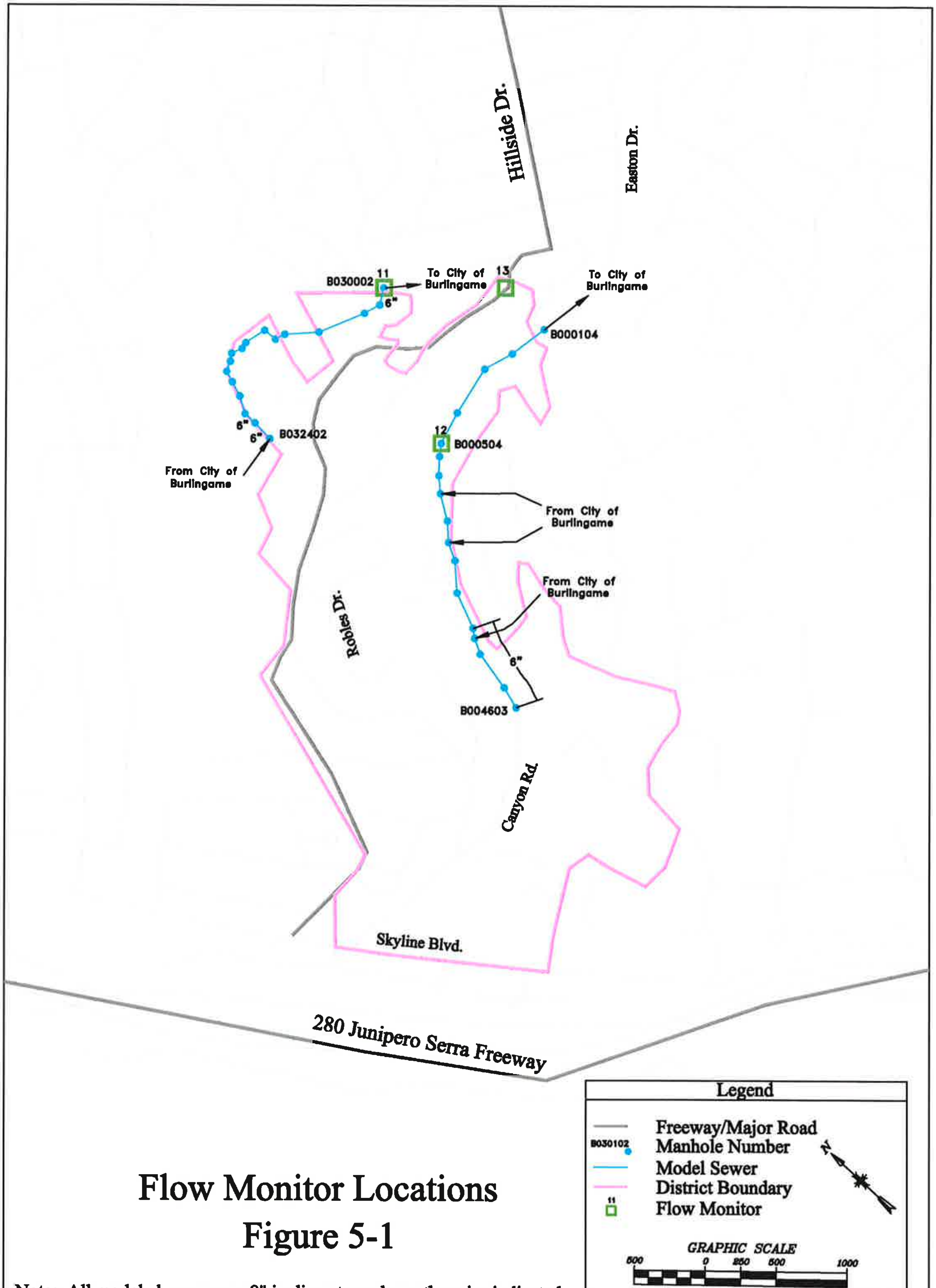
Purpose and Objective

The purpose of the flow monitoring program was to measure the existing collection system flows at various locations in the Burlingame Hills Sewer Maintenance District (BHSMD). 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 Fire Station Number 2, located at the intersection of Hillside Drive and Newton Drive, to determine how collection system flows reacted to various rainfall events.

Table 5-1 summarizes the measured flow rates for each monitoring station in the BHSMD 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
11	0.01	0.11	0.84
12	0.06	0.11	2.98
13	0.01	0.31	0.43



Flow Monitor Locations
Figure 5-1

Note: All modeled sewers are 8" in diameter unless otherwise indicated.

SECTION 6

SMOKE TESTING PROGRAM

The smoke testing program was conducted during the summer of 1998. Field crews tested approximately 28,300 linear feet of sewer lines in the Burlingame Hills Sewer Maintenance District (BHSMD). 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.

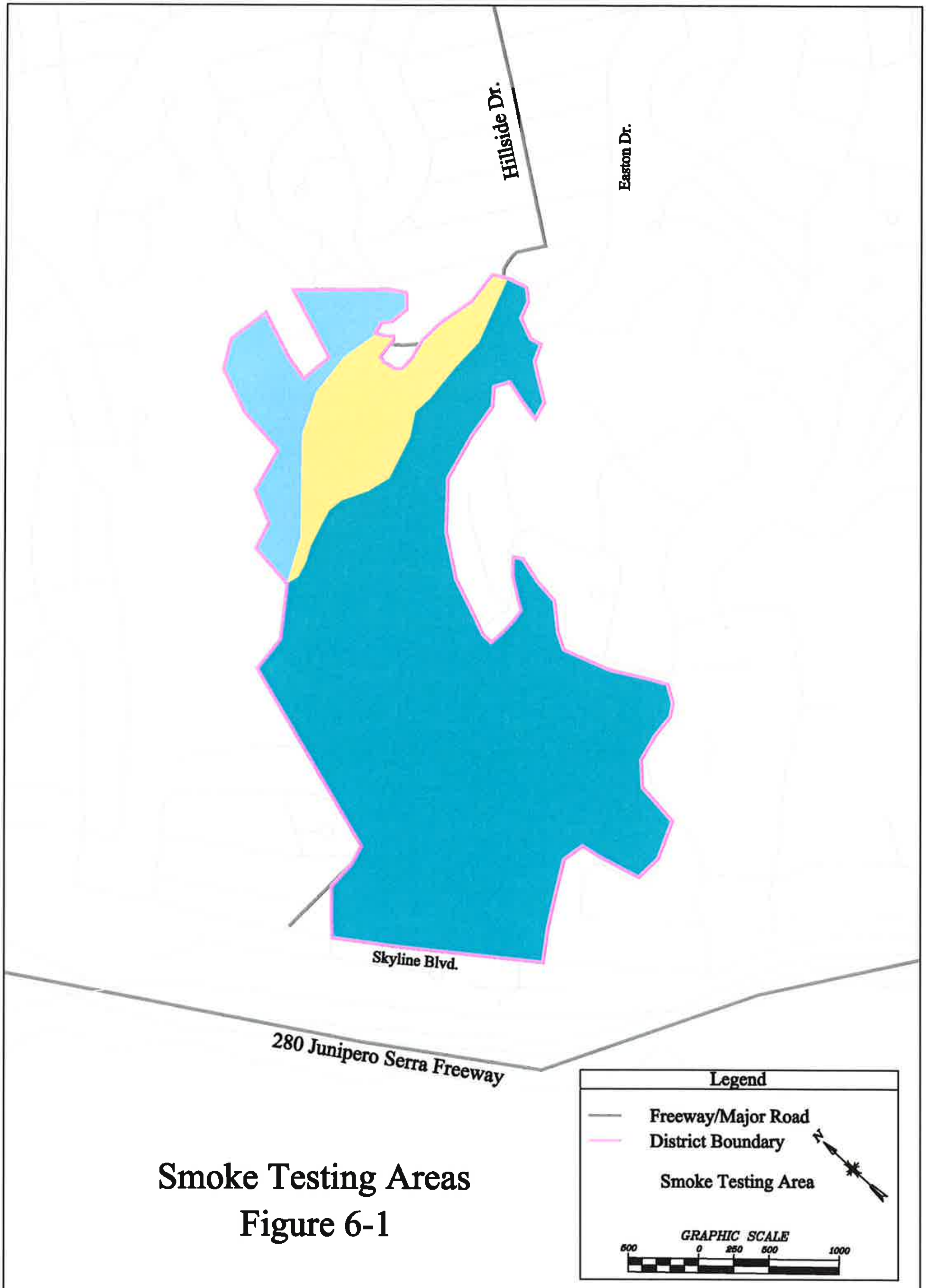
Smoke Testing Results

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 BHSMD 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 57 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.

Table 6-1. Smoke Testing Defect Summary

Defect type	Number of defects
Cleanout	38
Lateral	7
Illegal drain	1
Storm drain cross connection	0
Manhole leaks	4
Pavement cracks	3
Other	4
Total footage tested:	28,342



Smoke Testing Areas
Figure 6-1

SECTION 7

TELEVISION INSPECTION PROGRAM

The television inspection program was conducted during the winter of 1999. Field crews inspected approximately 5,100 linear feet of sewer lines in the Burlingame Hills Sewer Maintenance District (BHSMD). 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

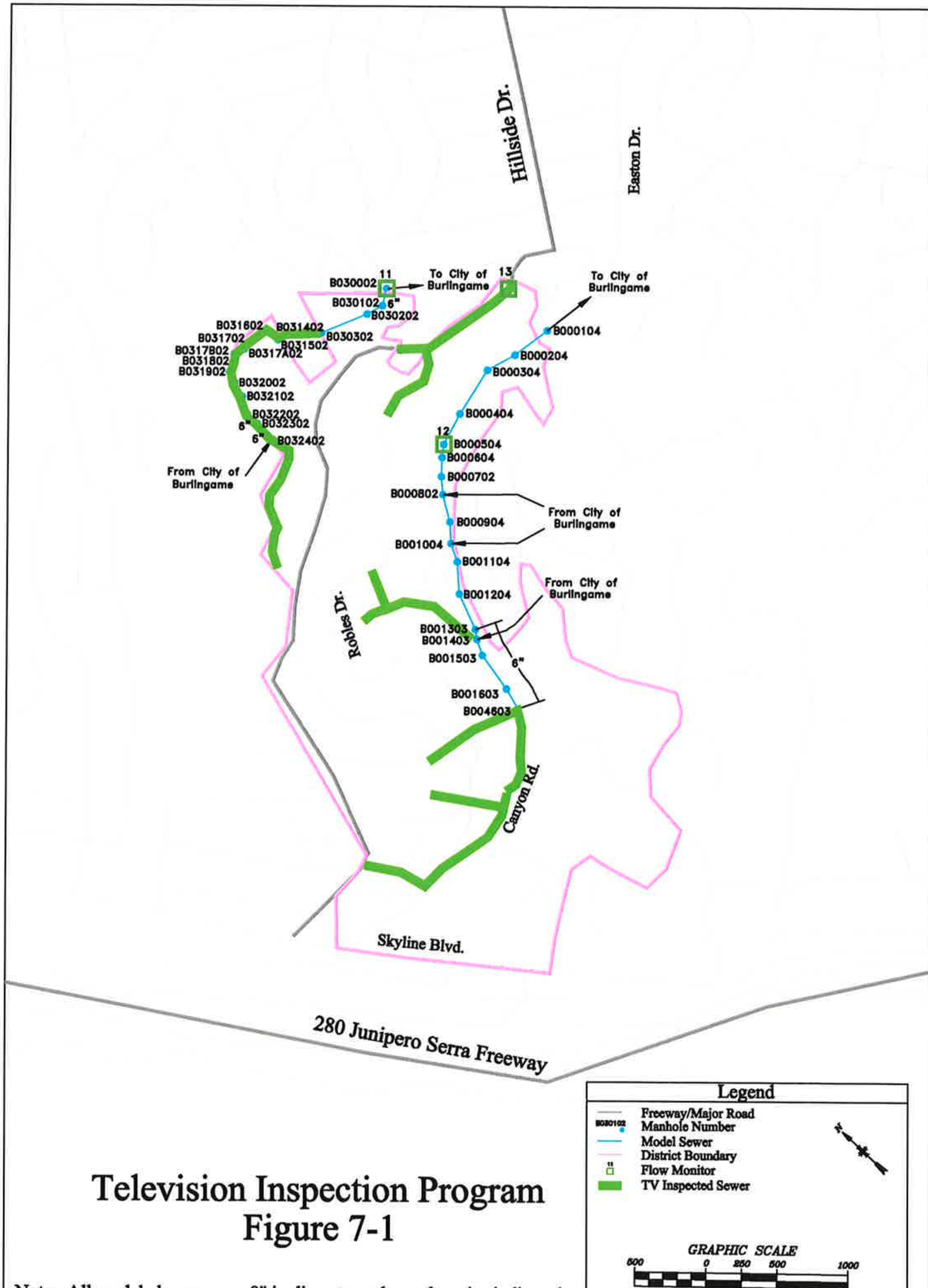
The areas scheduled for television inspection in the BHSMD area are shown on Figure 7-1. Sewers were selected for television inspection if they met one of the following four criteria:

- 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 3,100 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	8,200
Footage Completed	5,100
Cracks	
Radial	43
Longitudinal	2
Joints	
Minor offset joint	3
Major offset joint	4
Laterals	
Protruding lateral	0
Defect at connection	0
Dead connection	8
Roots	
Roots at joint	306
Roots at lateral	31
Infiltration/Inflow	
At joint	0
At crack	2
At roots	0
At inside lateral	0
At lateral connection	0
At inside lateral and at connection	0
Alignment	
Sag in line	6
Pipe out of round	0
Structural	
Piece missing	24
Shattered/broken	5
Crushed or collapsed	2
Mineral Stains	
At joint	0
At cracks	0
Sulfide Corrosion	
Minor	0



Television Inspection Program
Figure 7-1

Note: All modeled sewers are 8" in diameter unless otherwise indicated.

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 Burlingame Hills Sewer Maintenance District (BHSMD).

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 BHSMD 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.

Table 8-1. Base Sanitary Flow Rates

Flow monitor	Base sanitary flow, mgd
11	0.102
12	0.508
13	0.040

Typical Dry Weather Hydrograph
Figure 8-1

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 Burlingame Hills Sewer Maintenance District (BHSMD).

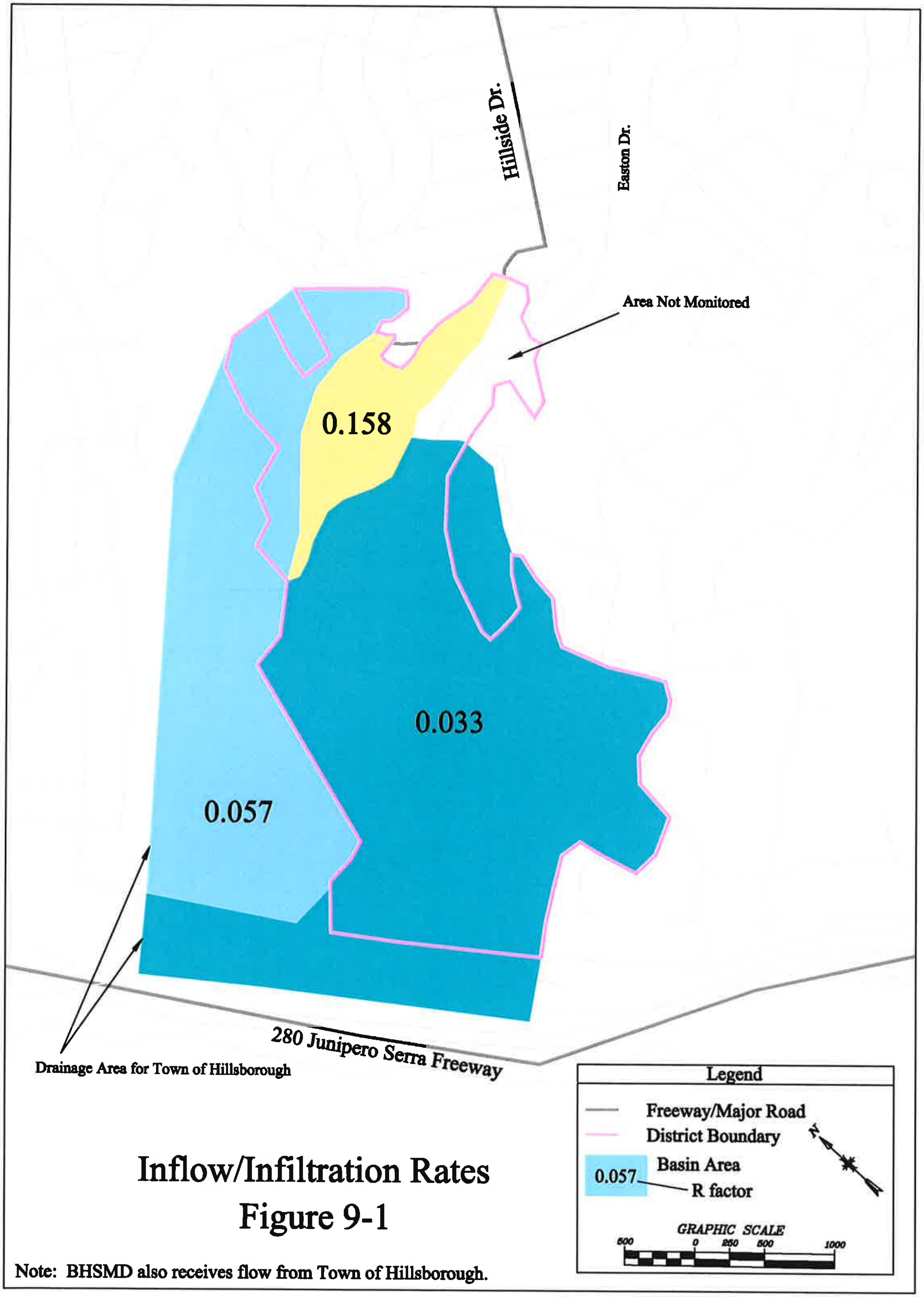
Wet Weather Flow

I/I consists of direct inflow of storm water runoff and rainfall-induced infiltration of storm water 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 of 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 monitor service areas and R factor used for the wet weather flow projections are shown on Figure 9-1. The flow monitor service area also includes portions of the Town of Hillsborough.

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.

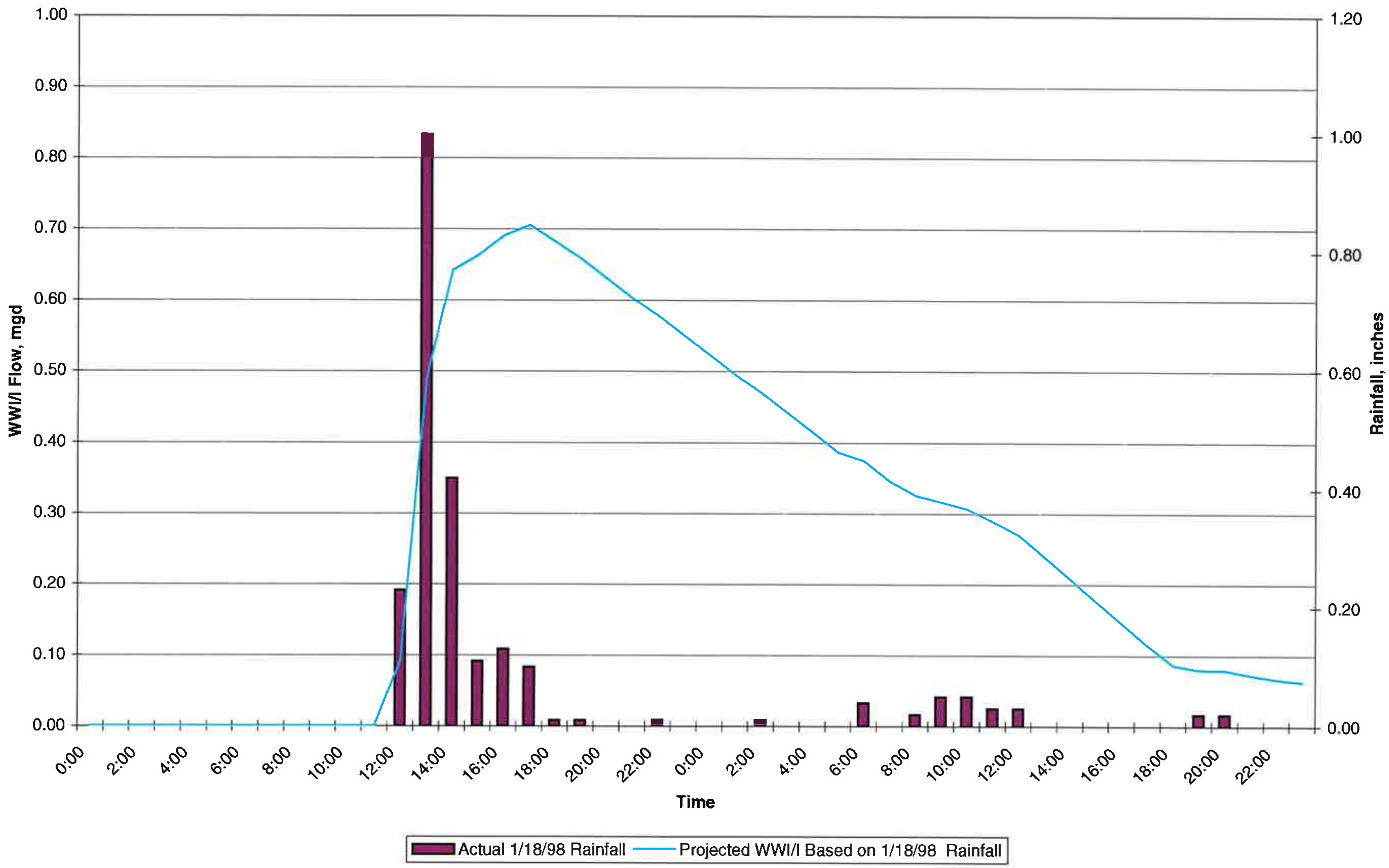
Unit hydrographs were developed for each basin to develop wet weather hydrographs for use in the model. Unit hydrographs are based on the "R" factor and the individual runoff characteristics for each basin. Synthetic hydrographs were added to the base flow hydrographs and the total flow hydrograph was 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.



Inflow/Infiltration Rates
Figure 9-1

Note: BHSMD also receives flow from Town of Hillsborough.

Typical Wet Weather Hydrograph
Figure 9-2



SECTION 10

HYDRAULIC MODEL DESCRIPTION

A hydraulic model was prepared of the Burlingame Hills Sewer Maintenance District's (BHSMD) 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

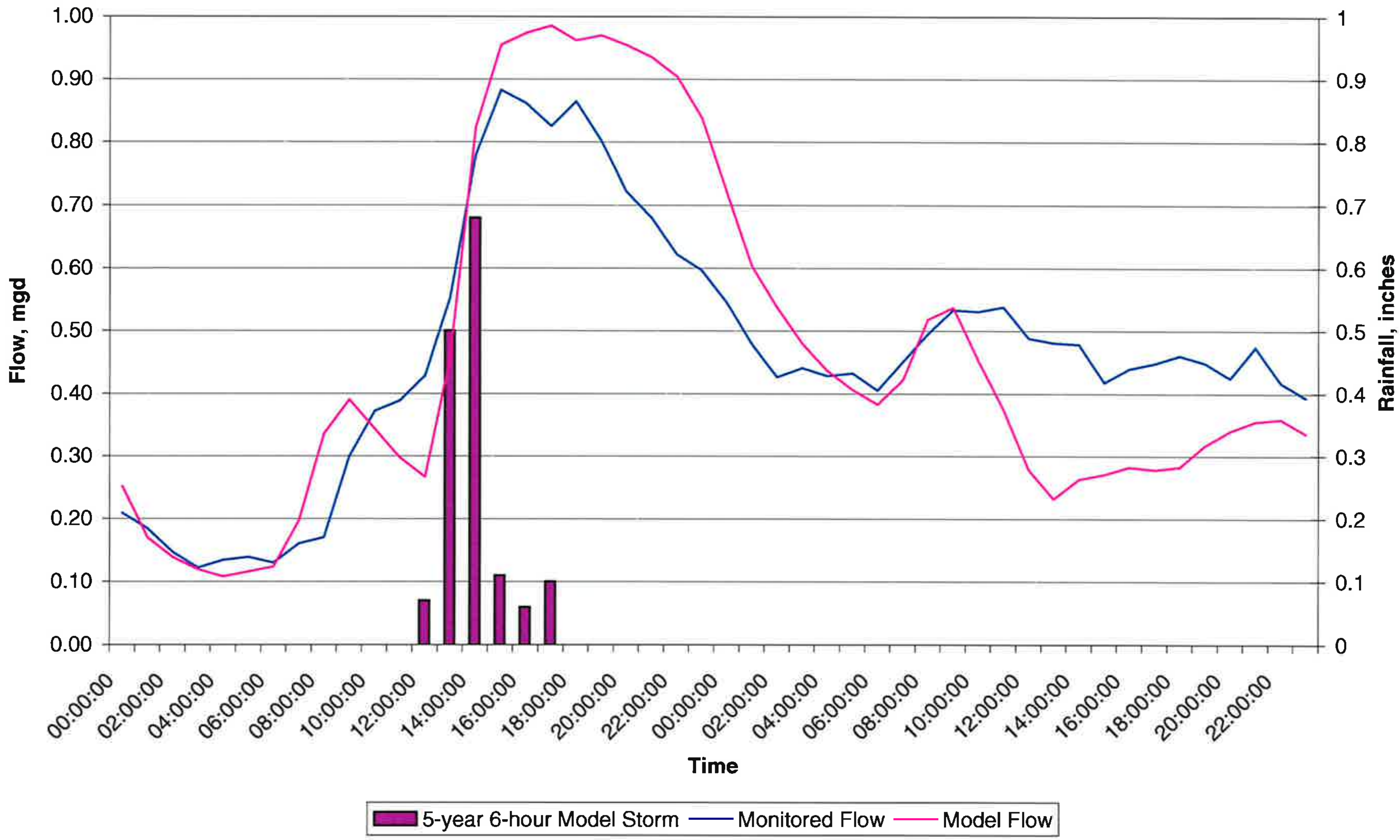
Major trunk sewers in each of the sewer Districts were modeled to determine where capacity deficiencies exist. The HYDRA model developed by PIZER, Inc., was used to simulate wastewater flows in the each of the Districts collection systems. HYDRA routes flow hydrographs (developed in Section 9) through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

For the BHSMD, Adeline Drive and Canyon Road trunk sewers were modeled. These sewers include all the pipelines 8 inches in diameter in the BHSMD.

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

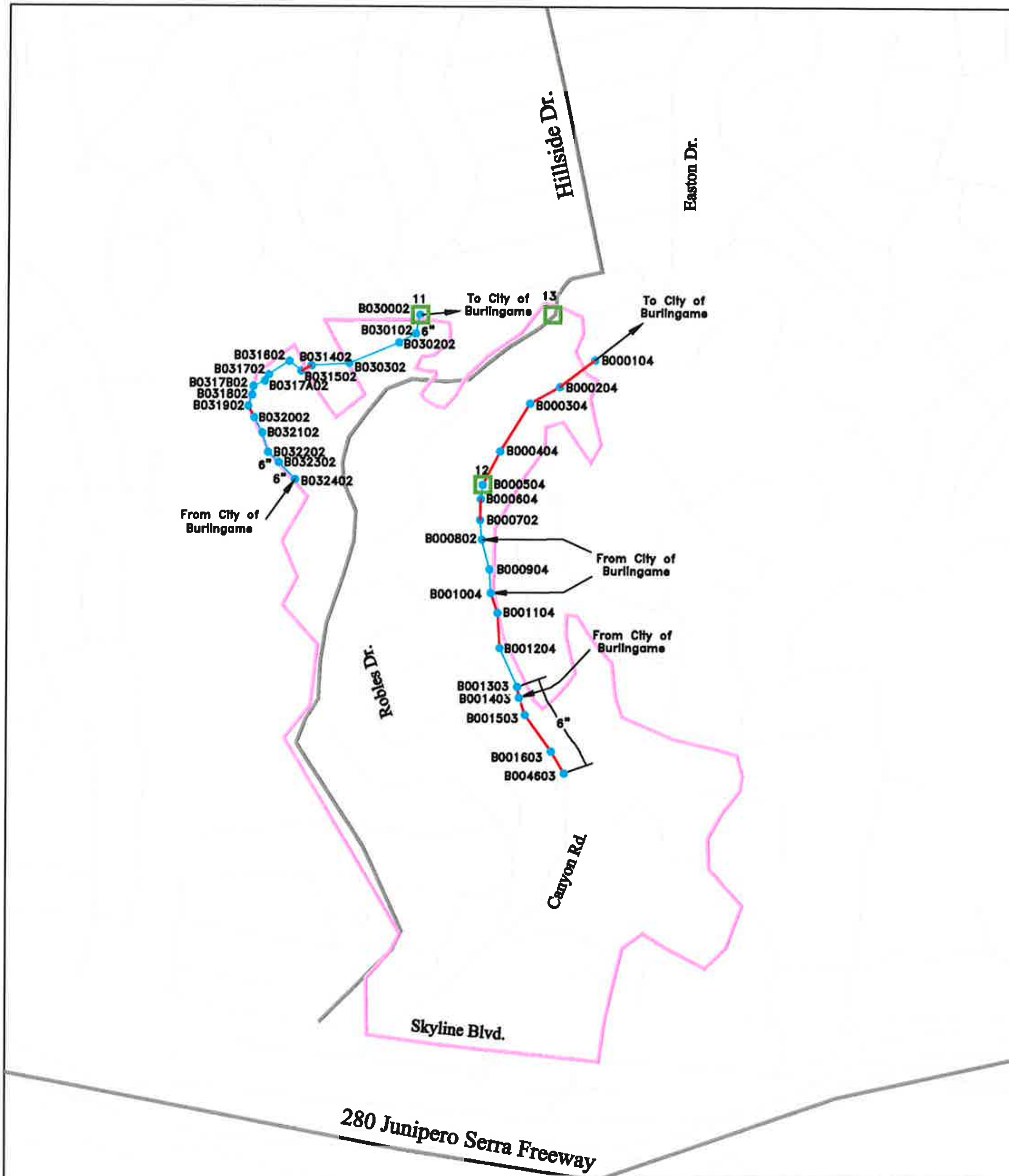
An evaluation of the pipeline capacities was performed using the flows developed in Sections 8 and 9 and the hydraulic model described in Section 10. This section describes the results of the capacity evaluation developed for the Burlingame Hills Sewer Maintenance District (BHSMD).

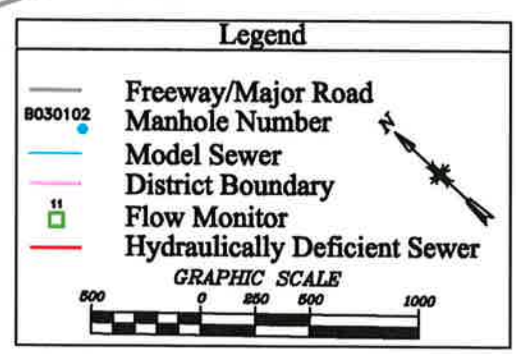
Capacity Analysis

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 that nearly all of the Canyon Road trunk sewer has insufficient capacity. This includes both the 6-inch and 8-inch diameter sections of the trunk sewer. Additionally, several localized sections of the trunk sewer on Adeline Drive are hydraulically inadequate. 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

Note: All modeled sewers are 8" in diameter unless otherwise indicated.

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 Burlingame Hills Sewer Maintenance District (BHSMD) collection system to adequately convey peak wet weather flows. This section presents the recommended improvements for correcting 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 and replacement pipes. For this report, alternatives and costs have been developed assuming the existing sewer will be replaced by a larger sewer. The main drawback to relief sewers is the increased amount of sewer pipe in the ground for the maintenance crews. 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 replacement sewer program. These reaches are not considered significant hydraulic problems because resulting backwater would be minor.

Nearly 1,800 linear feet of the Canyon Road trunk sewer was identified as hydraulically deficient. A 10-inch and 15-inch replacement sewer is recommended to relieve the existing trunk sewer. We do not recommend replacement or relief sewers for the limited hydraulic deficiencies on Adeline Drive. These deficiencies are very localized and will not create significant surcharging or backwatering. The location of the recommended replacement 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
B004603	B001004	6	545	10
B000702	B000104	8	1271	15
Total			1816	

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 demonstrating 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 Burlingame Hills Sewer Maintenance 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.

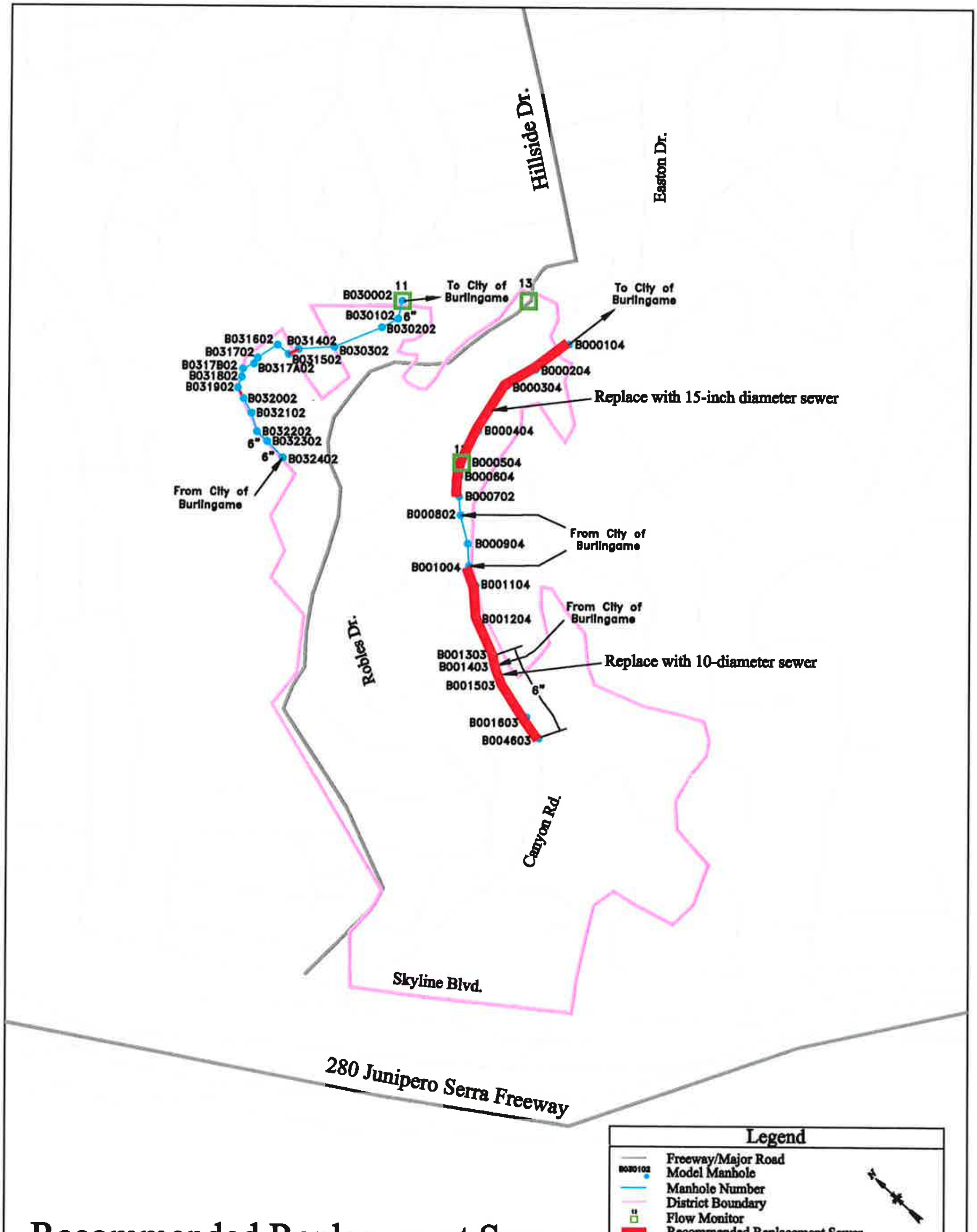
The capacity limitation of 0.67 mgd in the 6-inch to 8-inch-diameter sewer on Canyon Road requires a 1.61-mgd reduction in the projected PWWF of 2.28 mgd as shown in Appendix E. Reducing the flow by this amount will require complete removal of I/I from the Canyon Road trunk sewer tributary areas well as reducing the base sanitary flow. Neither of these reductions is practical.

The cost associated with complete collection system rehabilitation, using the unit costs provided in Table 12-1, equals $1.875 million for the nearly 5 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 nearly 4 miles. Therefore, the estimated construction cost for lateral rehabilitation is $0.96 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 $2.84 million. The estimated replacement construction cost for the increased capacity of sewer in Canyon Road is $207,000 as shown for the two Canyon 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 0.32 million gallons is equal to $400 per peak flow event. Given that this is a once in 5-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 City of Burlingame regarding the need for collection system capacity downstream 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

Note: All modeled sewers are 8" in diameter unless otherwise indicated.

SECTION 14

CAPITAL IMPROVEMENT PROGRAM

Capital improvement program (CIP) projects in the Burlingame Hills Sewer Maintenance District (BHSMD) are necessary to correct identified hydraulic and structural deficiencies. This section presents the recommended improvement for correction the hydraulic deficiencies presented in Section 13 and the structural problems identified in Section 7.

Capital Projects

A total of seven capital improvement projects were developed for the Burlingame Hills District. Five 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. Two projects were developed to provide increased hydraulic capacity to the Canyon Road trunk sewer. Alternatives have been developed for the following projects in the Burlingame Hills District:

1. Canyon Road #4
2. Canyon Road #3
3. Hillside Drive
4. Canyon Road #2
5. Adeline Drive
6. Canyon Road #1
7. Fey Drive

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 is 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. Recommend Capital Improvement Program

Project description	Priority	Minimum construction cost, dollars	Maximum construction cost, dollars
Canyon Road #4	1	152,500	152,500
Canyon Road #3	1	54,500	54,500
Hillside Drive	2	181,100	191,700
Canyon Road #2	2	163,700	179,100
Adeline Drive	3	179,600	195,300
Canyon Road #1	3	138,900	157,100
Fey Drive	3	88,100	100,900
Totals		958,400	1,031,100

Estimated construction costs for the projects range from $958,400 to $1,031,100 depending on the selected alternative. The Canyon Road replacement sewer project will require coordination with the City of Burlingame. The City of Burlingame trunk sewer that receives flow from the Canyon Road trunk sewer may also have capacity limitations. Correcting the capacity limitations on the Canyon Road trunk sewer may create a capacity problem in the City of Burlingame 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 two 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.

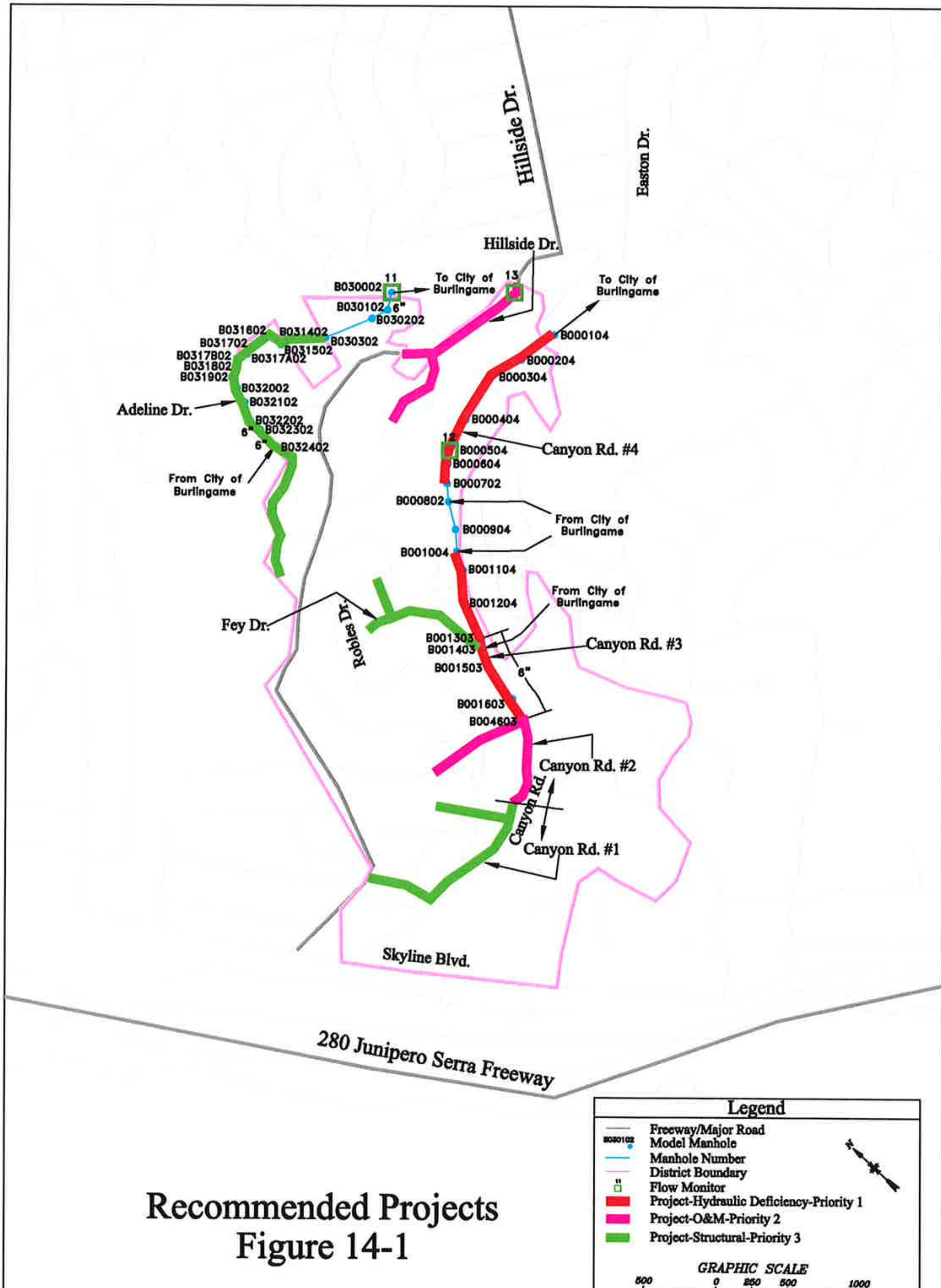
The mission of proactive collection system maintenance is to provide the longest possible life to the sewers without having to replace them with costly construction projects. The primary goal of providing the maximum capacity of the existing collection system network is what the maintenance program should 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 sewered 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

Note: All modeled sewers are 8" in diameter unless otherwise indicated.

SECTION 15

SANITARY SEWER RATES

The implementation of the capital improvement programs (CIP) developed for Burlingame Hills Sewer Maintenance District (BHSMD) 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 100 percent of all BHSMD 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 expenditure 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 periods 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 BHSMD 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 BHSMD choose to construct. Current rates are $451/residential unit equivalent. The Alternative 1 CIP necessitates a maximum rate increase of 128 percent to $1,029/residential unit equivalent in FY 2003/04. Alternative 2 sees a maximum rate increase of 134 percent to $1,056/residential unit equivalent in FY 2003/04. Alternative 3 sees a maximum rate increase of 129 percent to $1,031/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 BHSMD, the number of equivalent residential units used to calculate the rates is 406. 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. Burlingame Hills Alternative 1 Summary Rate Development

Item	Projected, dollars				
	1999/00	2000/01	2001/02	2002/03	2003/04
Gross expenses	402,107	414,170	426,595	439,393	452,574
Total offsetting revenue	32,998	33,477	33,970	34,478	35,001
Use of fund balance	-	-	-	-	-
Net revenue requirements	369,109	380,693	392,625	404,915	417,573
Annual rate assuming 406 connections	909	938	967	997	1,029

Table 15-2. Burlingame Hills Alternative 2 Summary Rate Development

Item	Projected, dollars				
	1999/00	2000/01	2001/02	2002/03	2003/04
Gross expenses	412,087	424,449	437,183	450,298	463,807
Total offsetting revenue	32,998	33,477	33,970	34,478	35,001
Use of fund balance	-	-	-	-	-
Net revenue requirements	379,089	390,972	403,213	415,820	428,806
Annual rate assuming 406 connections	934	963	993	1,024	1,056

Table 15-3. Burlingame Hills Alternative 3 Summary Rate Development

Item	Projected, dollars				
	1999/00	2000/01	2001/02	2002/03	2003/04
Gross expenses	402,947	415,035	427,486	440,311	453,520
Total offsetting revenue	32,998	33,477	33,970	34,478	35,001
Use of fund balance	-	-	-	-	-
Net revenue requirements	369,949	381,558	393,516	405,832	418,518
Annual rate assuming 406 connections	911	940	969	1,000	1,031

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 operating and maintenance costs as working capital reserves or about $40,000 in the case of Burlingame Hills along with emergency repair reserves. Assuming BHSMD has approximately 25,000 feet of equivalent 8-inch-diameter pipe (assuming 5,000 feet modeled length represents 20 percent of the system) and assuming $85/foot replacement cost yields an estimated minimum system replacement value of $2,125,000. Using the guideline above the County should thus maintain between $22,000 and $64,000 for emergency reserves. Thus, the total minimum recommended reserves would be between $62,000 and $104,000 for BHSMD. 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.

APPENDIX A

MANHOLE INSPECTION TECHNICAL MEMORANDUM

MEMORANDUM

To: Mark Welsh
County of San Mateo, DPW

From: Charlie Joyce
Brown & Caldwell

Date: October 12, 1998 File- 4692.01/10

Subject: Sanitary Sewer and Water System Evaluation Study
Manhole Inspection Memorandum of Field Work

INTRODUCTION

This memorandum presents a summary of the field investigations conducted during the winter and spring of 1997 on inspection of manholes in the nine sewer districts maintained by the San Mateo County Department of Public Works. A total of 873 manholes in the nine districts were inspected with the following in each district:

Table 1
Number of Manholes Inspected By District

District	Manholes Inspected
Burlingame Hills Sewer Maintenance District	90
Crystal Springs County Sanitation District	257
Devonshire County Sanitation District	37
Emerald Lake Heights Sewer Maintenance District	233
Fair Oaks Sewer Maintenance District	204
Harbor Industrial Sewer Maintenance District	22
Kensington Square Sewer Maintenance District	6
Oak Knoll Sewer Maintenance District	17
Scenic Heights County Sanitation District	7

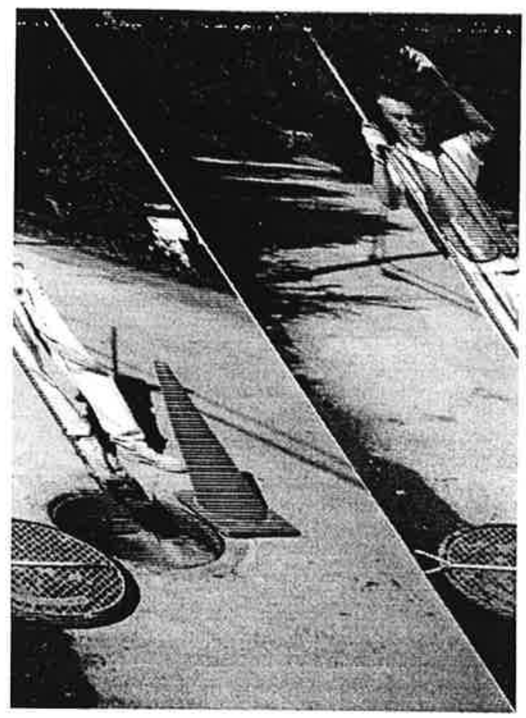
The purpose of this memorandum is to provide the background of how the manholes inspections were conducted, manhole numbering, interpretation of the manhole data, how the data will be used for other parts of the sanitary sewer collection system evaluation, and a summary of critical locations in the districts where repair work should take place. The memorandum also includes descriptions on how to locate photographs related to an inspected manhole in the 12 three ring binders provided at the completion of this project.

This memorandum does not provide the condition assessment of the sanitary collection system. That work effort will be completed as part of a later task in the project when the other parts of the field data, namely flow monitoring, television inspection, and smoke testing, are completed.

MANHOLE INSPECTION OVERVIEW

A key part of the data collection consisted of documenting the findings of the inspections for analysis. Two methods of documenting the manhole inspection were used for this project. The first was a field form set up to allow the field crew to collect data in an efficient manner on the condition of the manhole. The second method of documenting the manhole condition was to photograph defects found during the visual inspections. The manhole inspections were top side inspections where the condition of the manhole was observed from the surface.

In order to collect additional data on each manhole location a "Camera on a Stick" (Figure 1) was lowered into the manhole and a photograph of each pipe entering and leaving the manhole was taken. Where infiltration/inflow or other manholes conditions warranted a photograph was also taken from the "Camera on a Stick".



The view in the pipeline using the "Camera on a Stick" is dependent on the flow, debris, and channel benching in the manhole. Where the camera can be placed in the channel with a clear view of the pipeline the photograph typically shows approximately 20 feet of the sewer away from the manhole for an 8-inch diameter sewer. Larger sewer diameters typically show a longer distance and smaller sewer diameters show a shorter distance.

Pipes were photographed in a clockwise direction to avoid confusion and to allow for cataloging the photographs. Pipe A was always the first pipe in the clockwise direction from the primary outlet pipe(s). Drop manholes would have a photograph taken of both the top and bottom of the drop manhole and were noted as such in the comment field of that pipe. Each pipe in the drop manhole pipe was given a separate pipe identifier.

A copy of a blank field form used to document manhole conditions is included as Attachment A. Also in that attachment is a blank form for the pipe condition assessment that was completed for each pipe when the photographs were reviewed.

Manhole numbering modifications to the existing manholes numbering system for each basin were performed so that each manhole in the nine districts has a discrete unique label. The manhole number is an eight character alpha/numeric with the following definition:

B0001A04

B	Burlingame Hills, see Table 2.
0001	Manhole Number with zeros shown for place holders.
A	Several manholes were placed after initial numbering using a letter - A, B, etc. When not needed this part of field is left blank.
04	District Map Number as supplied by County.

Table 2
District Designators

District	Designator
Burlingame Hills Sewer Maintenance District	B
Crystal Springs County Sanitation District	C
Devonshire County Sanitation District	D
Emerald Lake Heights Sewer Maintenance District	E
Fair Oaks Sewer Maintenance District	F
Harbor Industrial Sewer Maintenance District	H
Kensington Square Sewer Maintenance District	K
Oak Knoll Sewer Maintenance District	O
Scenic Heights County Sanitation District	S

The manholes were numbered as the inspections were completed. Each completed form was then entered into a Microsoft Access v2.0 database that was programmed for manhole inspection analysis. Each item on the inspection form was input to the data base. The checks and boxes on the inspection form translate to a yes/no or numerical value in the database for future use in the condition assessment analysis. Data related to the pipe photographs were entered directly into the database after the photographs were developed and reviewed.

Manholes were selected for inspection to provide a representative random sample of the manholes in each of the nine districts. Manholes were identified for inspection from the collection system maps. The manholes selected normally met one of the following criteria:

- Connection of more than two sewers entering the manhole
- One of the sewers entered into or exited from an easement
- The sewer segment appeared typical to the area served
- A special flow connection or cross-connection was shown on the maps
- A manhole with many laterals entering, such as a cul-de-sac.

Manholes located in easements were also inspected, although access to many of these manholes was not possible due to obstructions, locked gates, or the occasional fence built over the manhole. Traffic control measures were used to route vehicles around the field crew and the crew followed safety precautions as outlined in the Field Health and Safety Plan required on all Brown and Caldwell field related projects.

MANHOLE INSPECTION BINDERS

A series of three-ring binders containing the print outs from the database with the accompanying photographs for each inspected manhole were assembled. The binders are numbered by an alpha/numeric format where the first letter corresponds to the district and the number corresponds to the binder number for that district. This format allows for future manhole inspections to be placed in successive binders. A field was added to the database so that the binder number could be attached to the manhole number.

A summary report is contained at the front of each binder to facilitate the location of a manhole. The summary report is provided in two orientations: 1) by film roll number, and 2) by manhole number. The contents of the binders area are arranged by film roll number for each District, rather than by manhole number.

The photographs for each manhole are arranged so the first photo (normally upper left) is the manhole number followed by the manhole cover, channel, or other defect photographs. The pipe photographs follow using the same convention as identified in the field inspection, beginning with Pipe A and proceeding through to Pipe X.

Locating a manhole in the binders is most easily accomplished by using the database query "BINDER/ROLL/MHID" to identify the binder number and the roll number of the associated photographs and then looking up the database print out and photographs in the appropriate binder.

Of the 873 manholes inspected a total of 2,480 pipes were photographed. The following tables provide summary information related to the manholes and pipes inspected. The tables are arranged by manhole number. Specific database reports for manholes and pipes, Attachments B and C, respectively, follow this memorandum.

Manholes
Manholes with Bench/Channel Defects Worse Than Moderate
Manholes with Roots
Manholes with Grease
Manholes with Frame and Cover Problems
Manholes with Infiltration/Inflow and Flow Caps
Manholes with Major Debris in Channel

Pipes

Pipes with Separated Joints Greater than Moderate and Deflections Greater than One Inch
Pipes with Greater than Minor Corrosion
Pipes with Infiltration/Inflow
Pipes with Greater than Light Grease
Pipes with Greater than Light Roots
Pipes with Roots and Grease
Pipes with Cracks and Fractures
Pipes with Plugs and Obstructions

APPENDIX B

1997 FLOW MONITORING PROGRAM TECHNICAL MEMORANDUM

MEMORANDUM 4692-02

November 19, 1997

TO: MARK WELCH, COUNTY OF SAN MATEO

FROM: BRIAN HAMMER, BROWN AND CALDWELL
CHARLIE JOYCE, BROWN AND CALDWELL

SUBJECT: COUNTY OF SAN MATEO MASTER PLAN
1997 FLOW MONITORING PROGRAM

This memorandum documents the flow monitoring program conducted for the County of San Mateo Master Plan during the winter of 1997. The purpose of the project was to measure the flow rate during dry weather and discrete rainfall events in the San Mateo County area. This memorandum discusses the flow monitoring program and subsequent data analysis. Results of the flow monitoring program are attached.

Flow Monitoring Locations

A flow monitoring plan was developed to determine dry weather flow rates and Inflow/Infiltration (I/I) rates in the County of San Mateo wastewater collection system. As part of the flow monitoring plan, specific locations within the County sanitary collection systems where temporary flow monitors and rain gauges could be installed were identified and evaluated. Potential monitoring site evaluations were conducted the week of January 16, 1997, by Brown and Caldwell staff.

During the field evaluation, manholes were inspected to determine their hydraulic suitability for flow monitoring and accessibility. Special safety considerations were also documented. Fifteen manholes were selected for temporary flow monitoring among the nine sewer district. Additionally, four rain gauge sites in the County collection system were also located and evaluated. The selected flow monitoring sites and rain gauge locations are listed in Table 1 and Table 2, respectively. Flow monitoring site reconnaissance forms for the selected manholes are included in Attachment A. Included in Attachment A are schematic diagrams of each sewer district showing the flow monitor locations.

Table 1 Flow Monitoring Locations

Flow monitor site	Location	Pipe diameter, in.
11	Burlingame Hills - 2815 Adeline near Alvarado	8
12	Burlingame Hills - 2872 Canyon Road	8
21	Crystal Springs - Polhemus Road near Ascension Street	10
22	Crystal Springs - Polhemus Road and Ticonderoga Road	8
31	Devonshire - Devonshire Road and Exeter Street	8
41	Emerald Lake - 1706 Cordilleras Road	8
42	Emerald Lake - Lake Boulevard and Oak Knoll Drive	8
43	Emerald Lake - Glenwood Drive at Garret Park	6
44	Emerald Lake - 1036 Lakeview Drive	6
51	Fair Oaks - Douglas Court. (end)	30
52	Fair Oaks - Bay Road at Willow Street.	30
53	Fair Oaks - 559 Oakside Drive	21
54	Fair Oaks - 343 Nimitz Avenue.	15
55	Fair Oaks - Woodside Road. near Churchhill	10

Table 2 Rain Gauge Locations

Rain gauge no.	Location
1	Burlingame Hills - Hillside at Newton, Fire Station #2
2	Crystal Springs - 2295 Cobble Hill at Ticonderoga Road (private residence)
3	Emerald Lake - California at Jefferson, Fire Station #19
4	Fair Oaks - Bay Road at 2nd Street., Fire Station #11

Flow Monitoring

Montedoro-Whitney WDFM-8 flow monitors were installed at the fifteen selected locations on January 22 and 23, 1997. These monitors are capable of measuring both depth and velocity of flow. The combined depth and velocity measurements make it possible to calculate flow rates for open channel conditions and during surcharge or backwater conditions.

Depth measurements were made by a differential pressure type strain gauge. One side of the sensing element is open to atmospheric pressure. This prevents errors due to changes in barometric pressure. Adjustments for temperature differences are made to further insure the accuracy of the measurements. The depth of flow sensing element is located on the bottom of the monitoring probe, which allows for depth measurements from zero to a maximum of 10 feet when the probe is centered exactly on the bottom of the pipe.

In field conditions, it is very difficult to center the probe exactly on the bottom of the pipe. The resultant difference between actual water surface level and monitored water surface level is called a depth offset. Corrections for the depth offset are discussed later in this memorandum. Depth measurements with these monitors are accurate to 0.01 of a foot under laboratory conditions. Accuracy of depth measurements in the field is dependent on the hydraulic characteristics of the flow stream at the monitoring site, proper installation techniques, and frequent maintenance procedures.

The monitors measure flow velocity using the ultrasonic Doppler shift method. The velocity sensor on the monitor sends an ultrasonic signal into the flow stream and measures velocities based on the Doppler shift. The flow monitoring velocity sensor is located approximately 1.5 inches from the bottom of the sensor and must be completely submerged to obtain accurate velocity measurements.

Velocity measurements are made at the bottom of the pipe near the wall and, therefore, are not actually measuring the average velocity of the flow stream. The difference between the monitored velocity and the average velocity is called a velocity offset and is also discussed later in this memorandum.

Precipitation intensity and duration were measured at four temporary locations in the County service area. The rain gauges were tipping bucket type gauges connected to portable electronic event recorders. The rain gauges are calibrated to tip after 0.01 inches of rainfall is received. The event recorder documents the time of each tip. Rain gauges 1 and 3 were installed on January 24, 1997. Rain gauges 2 and 4 were installed January 23, 1997. The flow monitors and rain gauges were removed on March 18, and March 24, 1997, respectively.

Flow Monitor Calibration

Calibration data was collected to verify both depth and velocity and to develop a depth-to-discharge relationship for the monitoring sites. Calibration data was obtained approximately once a week by manually measuring the depth and velocity of the flow stream with portable equipment. Field staff were responsible for maintaining the flow monitoring equipment and obtaining calibration information. The data was collected at various times in the diurnal cycle including early morning low flow periods and peak flow periods. Attachment B provides a listing of the calibration data for each flow monitoring location.

Data Analysis

Flow monitoring data analysis consisted of developing depth to discharge relationships for calculating flows, and determining depth and velocity offset values for the raw data. These tasks are described in the following paragraphs.

Depth-to-Discharge Relationship. The first step in the data analysis process was to develop a flow depth-to-discharge rating curve for each monitoring site. The rating curve was used to determine flows under open channel conditions. During the monitoring site calibration, the average velocity and corresponding depth of flow were measured approximately twice weekly at each of the flow monitoring sites. Average velocity measurements were made by field crews using portable velocity probes. The portable velocity probe is capable of continuously samples the velocity of the flow stream. Field crews move the portable velocity probe throughout the cross-sectional area of the flow stream for a period of 10 to 40 seconds and the average velocity was calculated automatically by the portable equipment.

These measurements were used to develop depth-to-discharge relationships. Calibration measurements were made at various times of the day and various days of the week to obtain information during the largest range of conditions experienced in the system during the monitoring period.

Actual flow rates were calculated from the calibration data using the continuity equation (flow = area x average velocity). The flow rate was then used to calculate the equivalent hydraulic slope at the site using Mannings equation. The average slope for all the manual measurements was then calculated and flow rates were plotted on a depth-versus-flow graph, and a Mannings curve was "fitted" to the data points. The curve utilizes the standard Mannings equation for open-channel flow, and use a depth-variable roughness coefficient or Mannings "n" value. The curves were then used to convert the flow monitoring depth measurements to flow rates during open channel flow conditions. When surcharging occurs, the depth and velocity measurements were used to calculate the flow rate using the continuity equation.

Offsets. The site calibration measurements were also used to develop depth and velocity offsets for the flow monitoring sites. Depths offsets occur when the flow monitoring probe was not installed exactly in the center of the pipe. Velocity offsets occur because the velocity sensor measures a point velocity near the pipe wall. In addition, each sensor has an inherent electronic offset. Manual calibration data was used to correct the monitored depth measurements and convert the point velocities to an average velocity. For this project, the combined electronic and physical offset remained constant at each of the flow monitoring sites during the flow monitoring period.

Results

Four storm events occurred during the flow monitoring program. The storm dates and their daily rainfall totals are summarized in Table 3.

Table 3 Rain Gauge Results, inches

Date	Rain Gauge 1 Burlingame Hills	Rain Gauge 2 Crystal Springs	Rain Gauge 3 Emerald Lake	Rain Gauge 4 Fair Oaks
01/24/97	0.63	0.56	0.71	0.59
01/25/97	1.20	1.15	1.64	1.02
01/26/97	0.53	0.43	0.52	0.25
02/17/97	0.21	0.13	0.13	0.07
03/02/97	0.23	0.11	0.21	0.02
03/16/97	0.34	0.13	0.40	0.10

The flow monitors at sites 12 and 44 either failed or became clogged with debris, for noted periods of time. For site 44, we do not recommend using the flow data from February 23, 1997, to March 16, 1997, as flow levels were too low to measure accurately. Also, flow monitoring at site 12 failed from February 20, 1997, to February 25, 1997. No additional monitoring problems were noted. Table 4 presents the dry weather and wet weather flow monitoring results of this analysis.

Table 4 Flow Monitoring Results, million gallons per day

Flow Monitoring Site	Minimum Flow	Average Flow	Peak Dry Weather Flow	Peak Wet Weather Flow
11	0.01	0.11	0.27	1.13
12	0.06	0.11	0.17	0.24
21	0.01	0.34	1.12	2.82
22	0.03	0.12	0.37	0.50
31	0.02	0.08	0.20	0.65
41	0.01	0.04	0.07	0.18
42	0.01	0.02	0.04	0.09
43	0.01	0.02	0.03	0.07
44	0.01	0.03	0.10	0.12
51	0.29	0.66	1.31	2.30
52	0.41	1.79	3.22	8.89
53	0.41	1.20	2.26	4.26
54	0.19	0.41	0.80	1.94
55	0.00	0.22	0.48	1.10

Listed below is a summary of the contents of the attachments:

Attachment A Flow Monitoring Site Reconnaissance Forms.

Attachment B. Flow Calibration Data

Attachment C Graphical Flow Summary. Graphical plots of minimum, daily, and peak flow rates.

BH:CJ:jm
Attachments

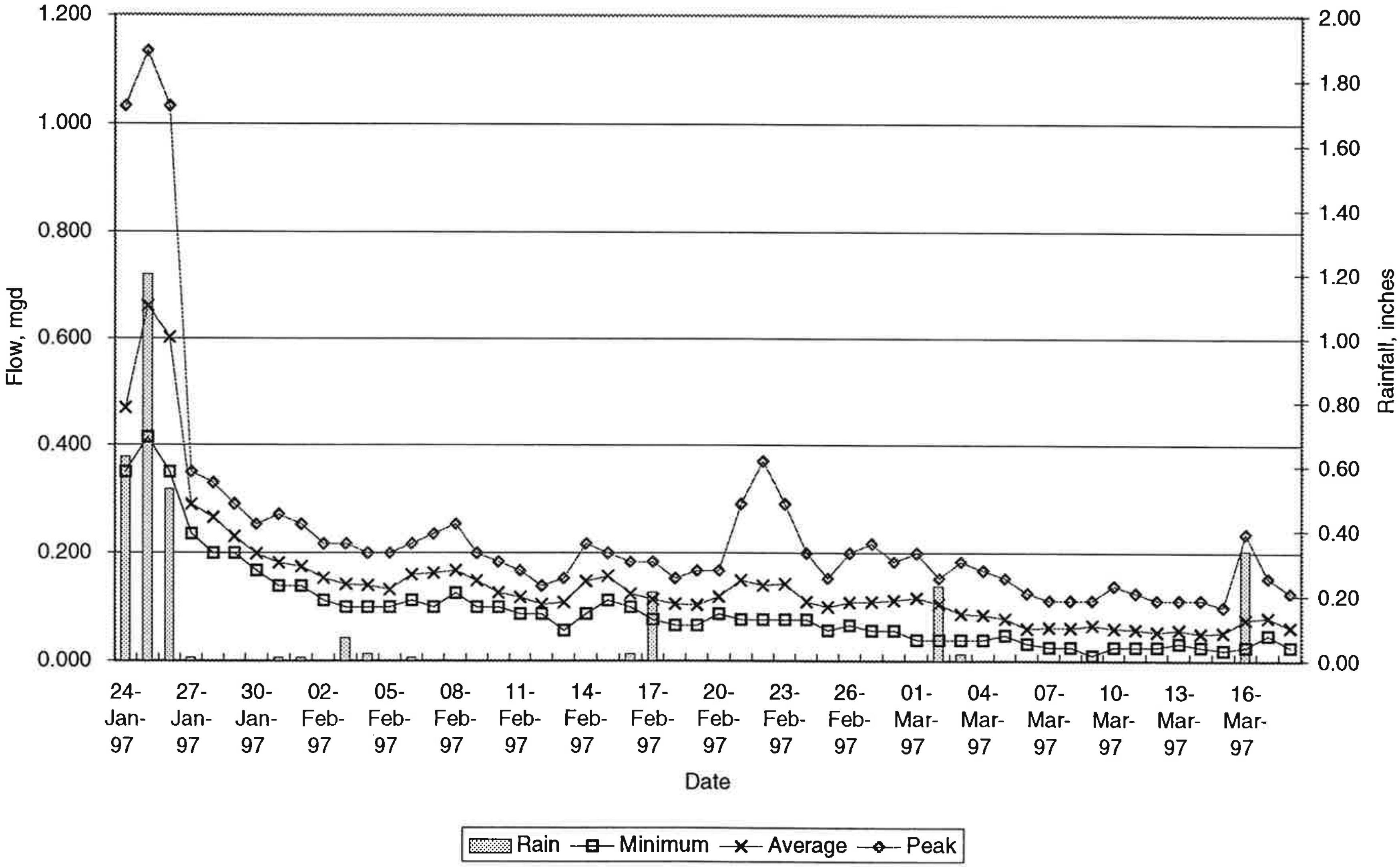
ATTACHMENT A

FLOW MONITORING SITE RECONNAISSANCE FORMS

ATTACHMENT C

GRAPHICAL FLOW SUMMARY
GRAPHICAL PLOTS OF MINIMUM, DAILY, AND PEAK FLOW RATES

County of San Mateo
Daily Flow Rates -- Site 11 -- 2815 Adeline, near Alvarado
8" Diameter



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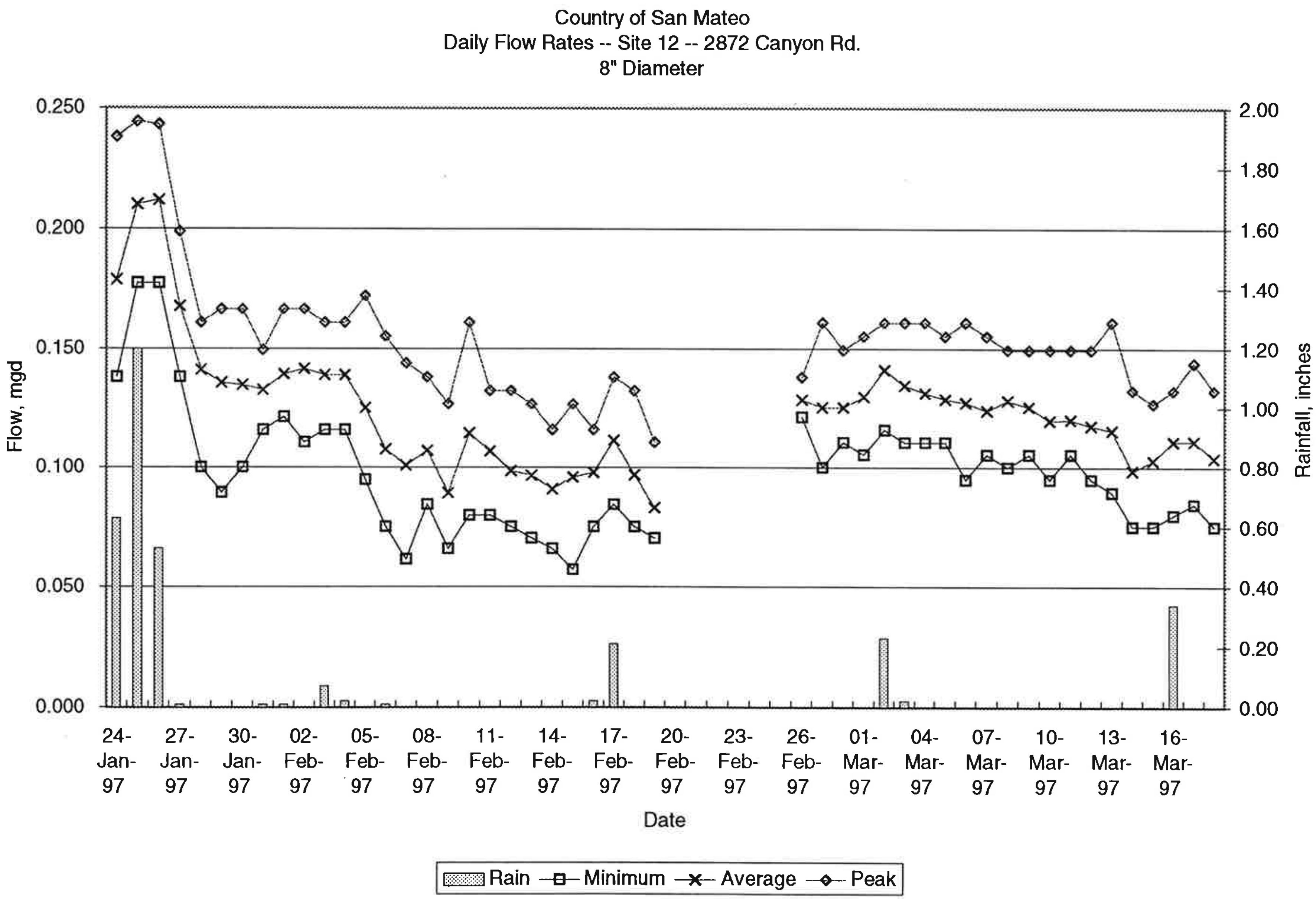

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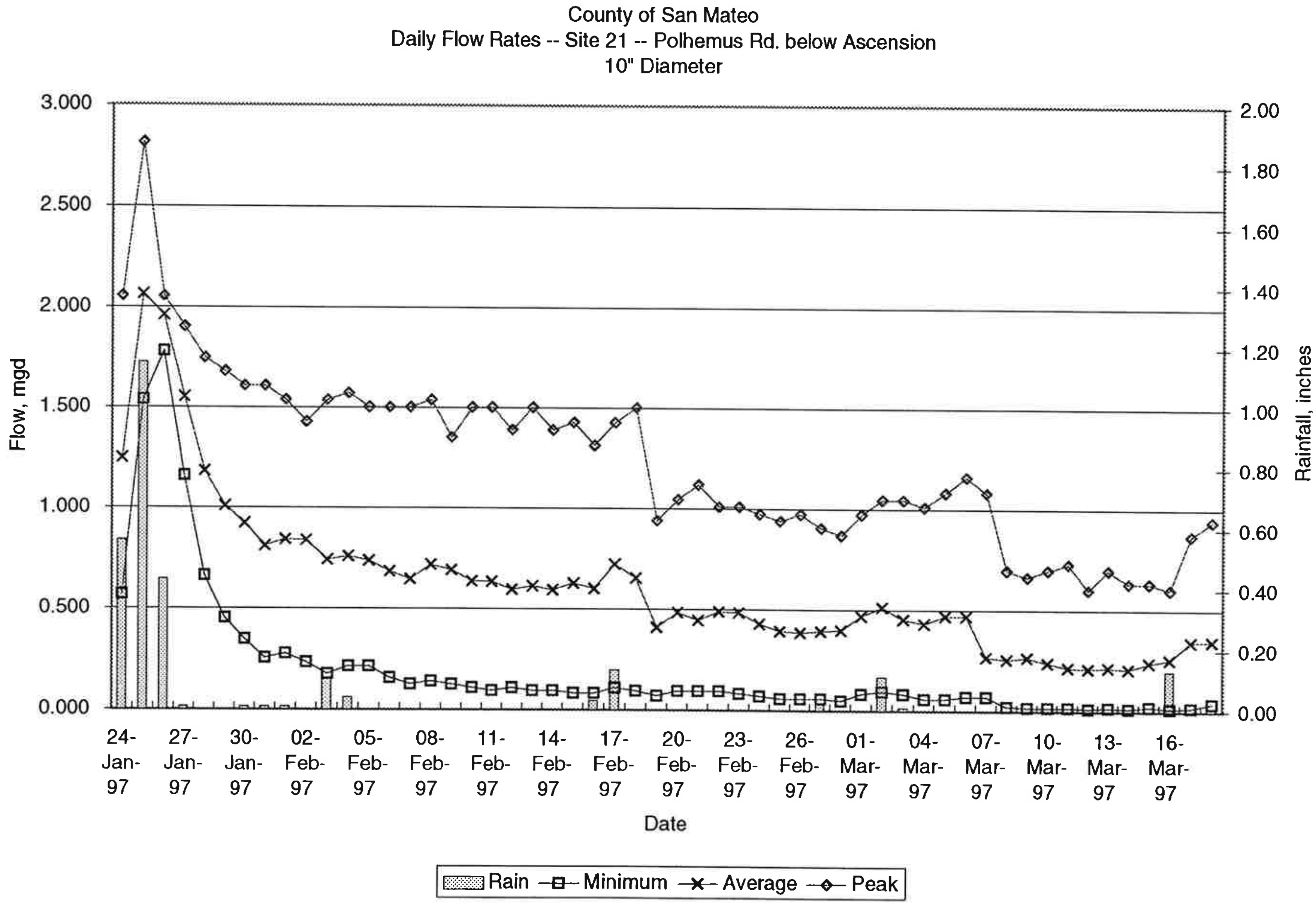

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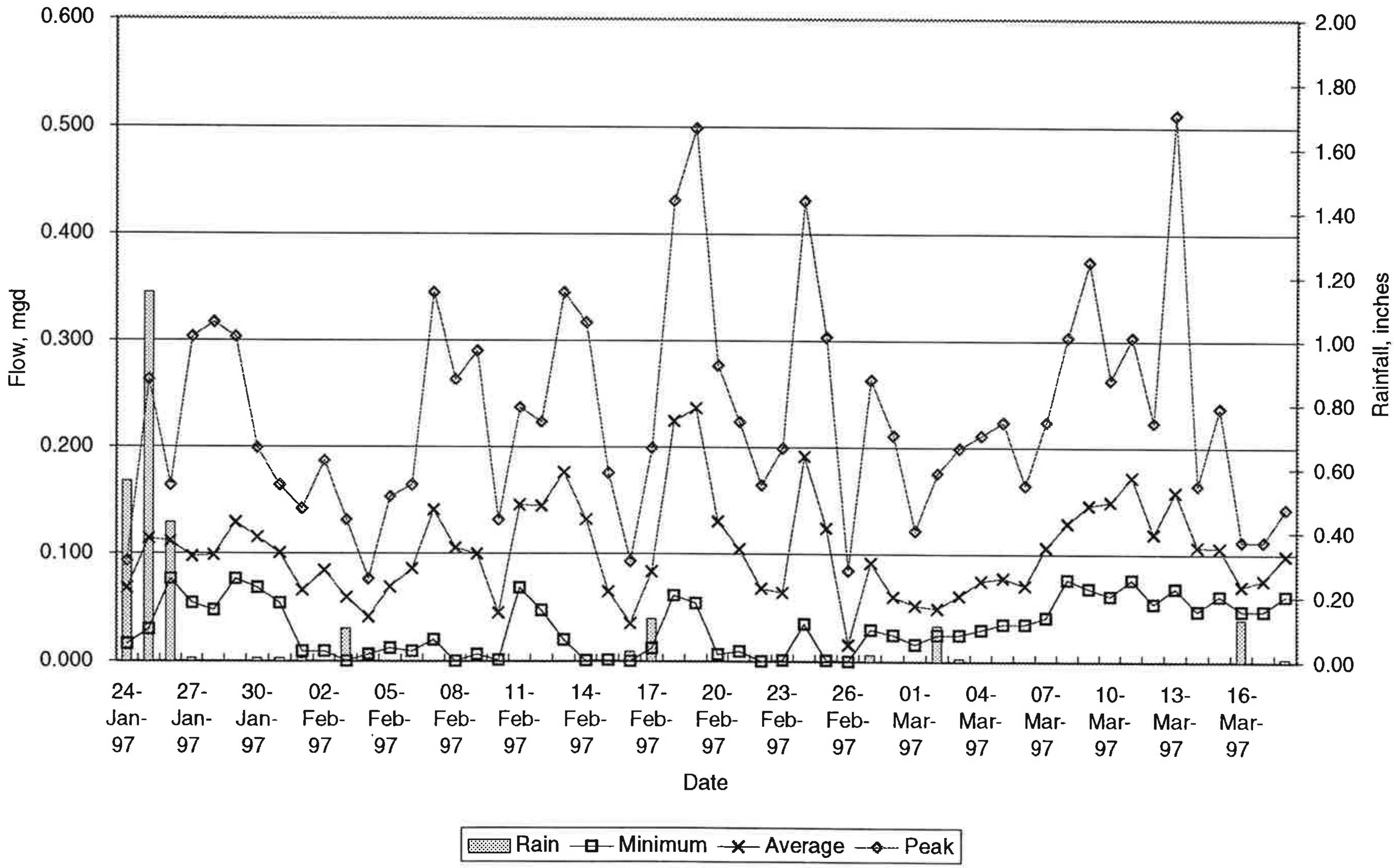
County of San Mateo
Daily Flow Rates -- Site 22 -- Polhemus Rd. at Ticonderoga
8" Diameter



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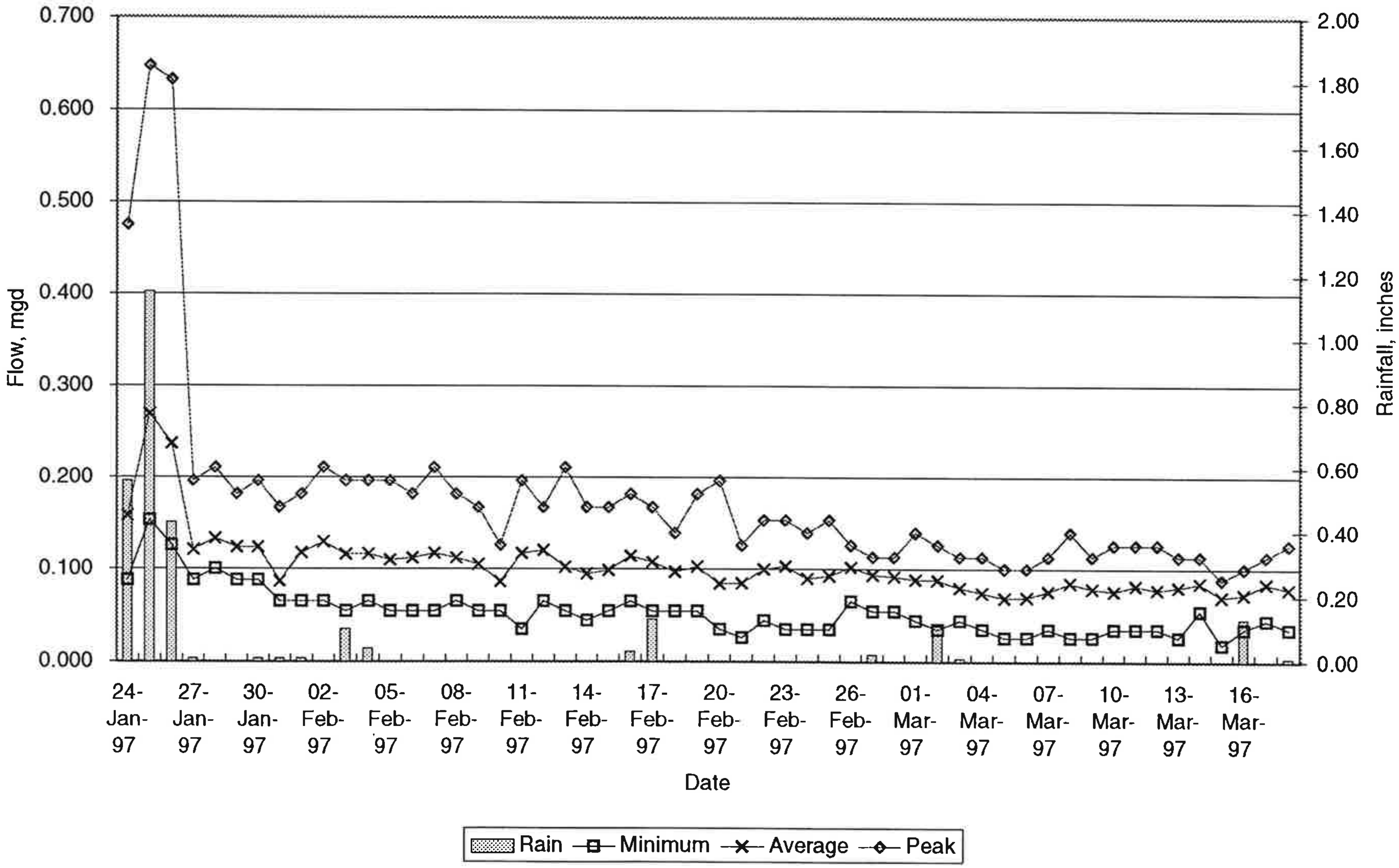
County of San Mateo
Daily Flow Rates -- Site 31 -- Devonshire and Exeter
8" Diameter



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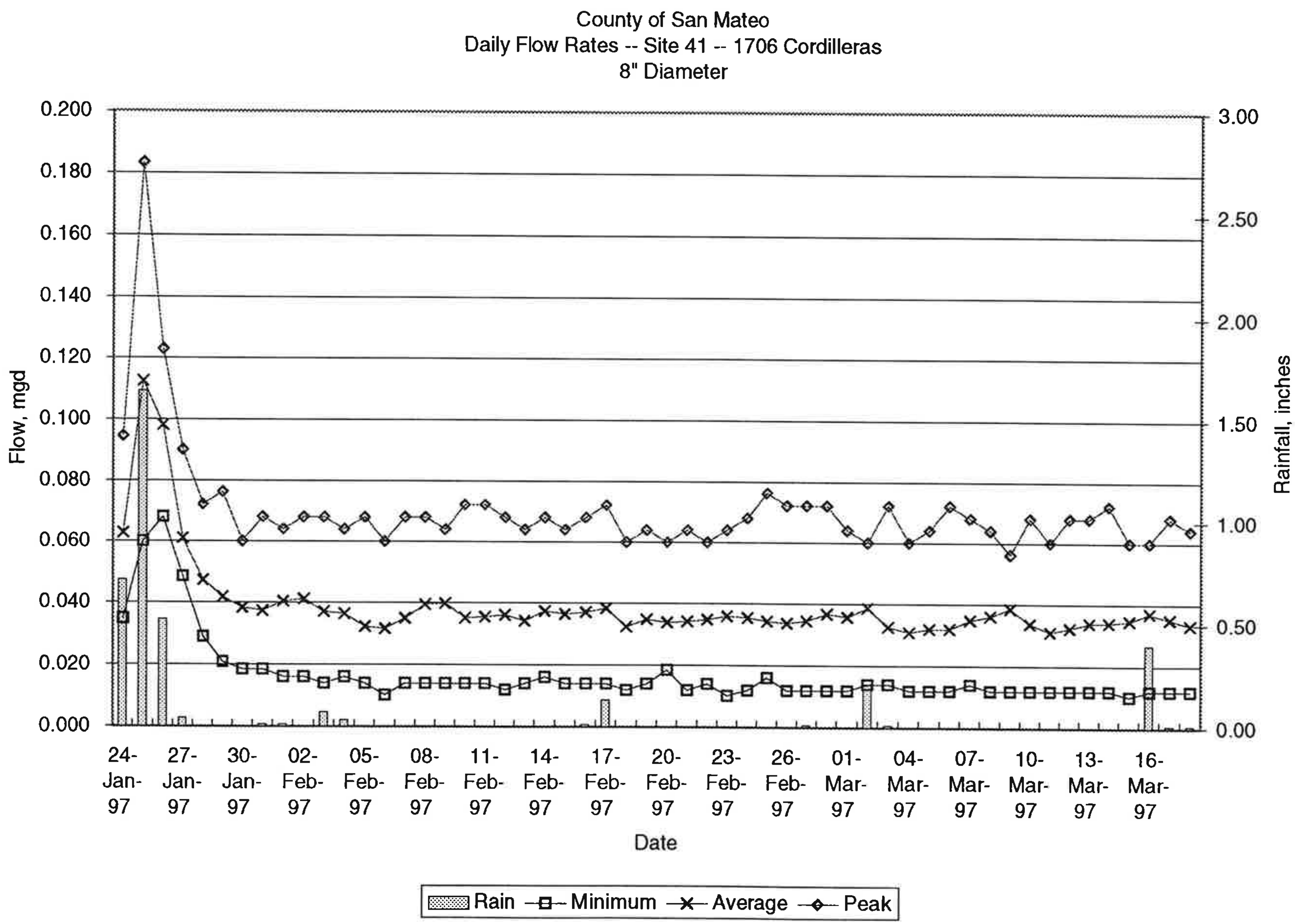

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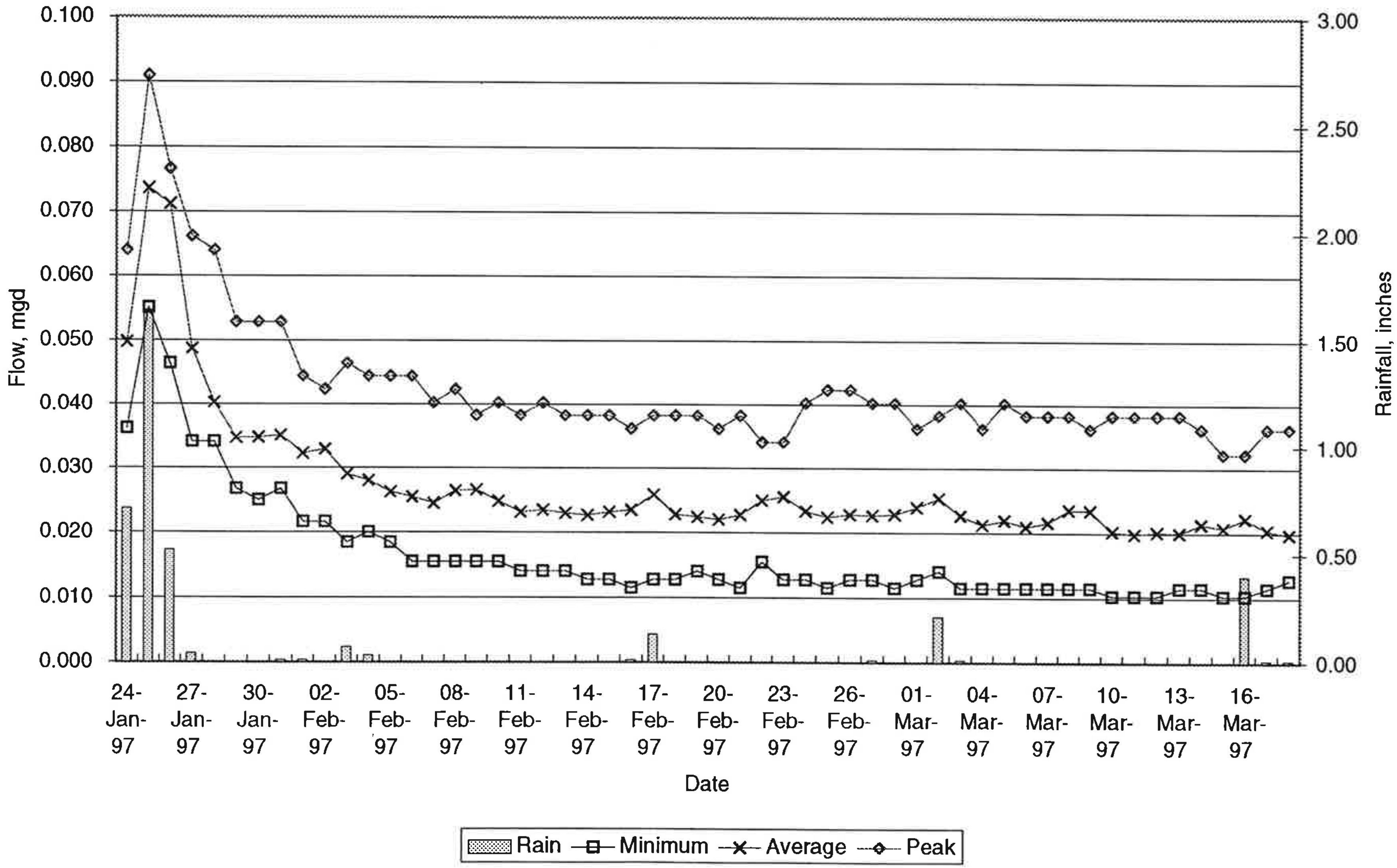
County of San Mateo
Daily Flow Rates -- Site 42 -- Lake Blvd. and Oak Knoll
8" Diameter



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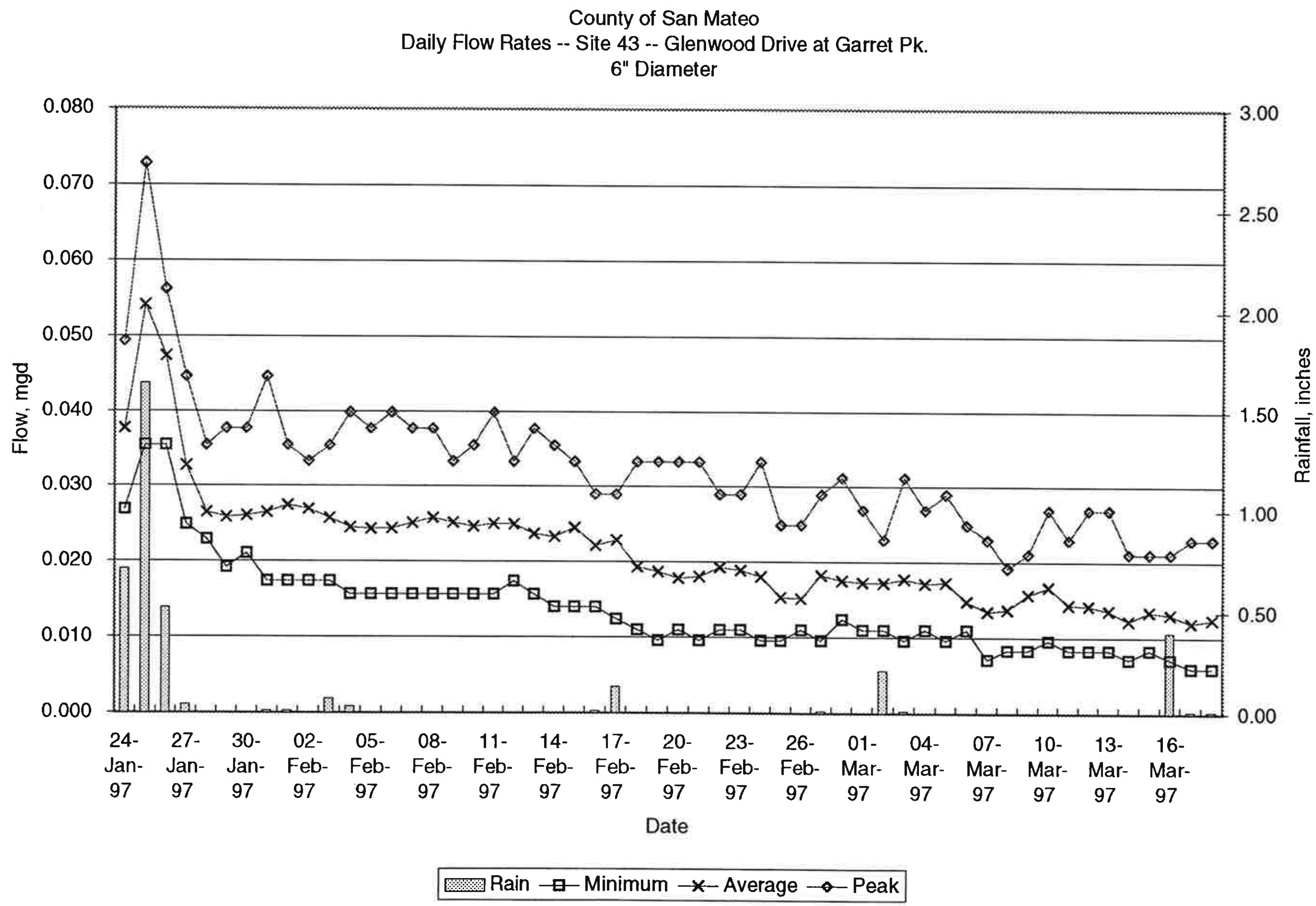

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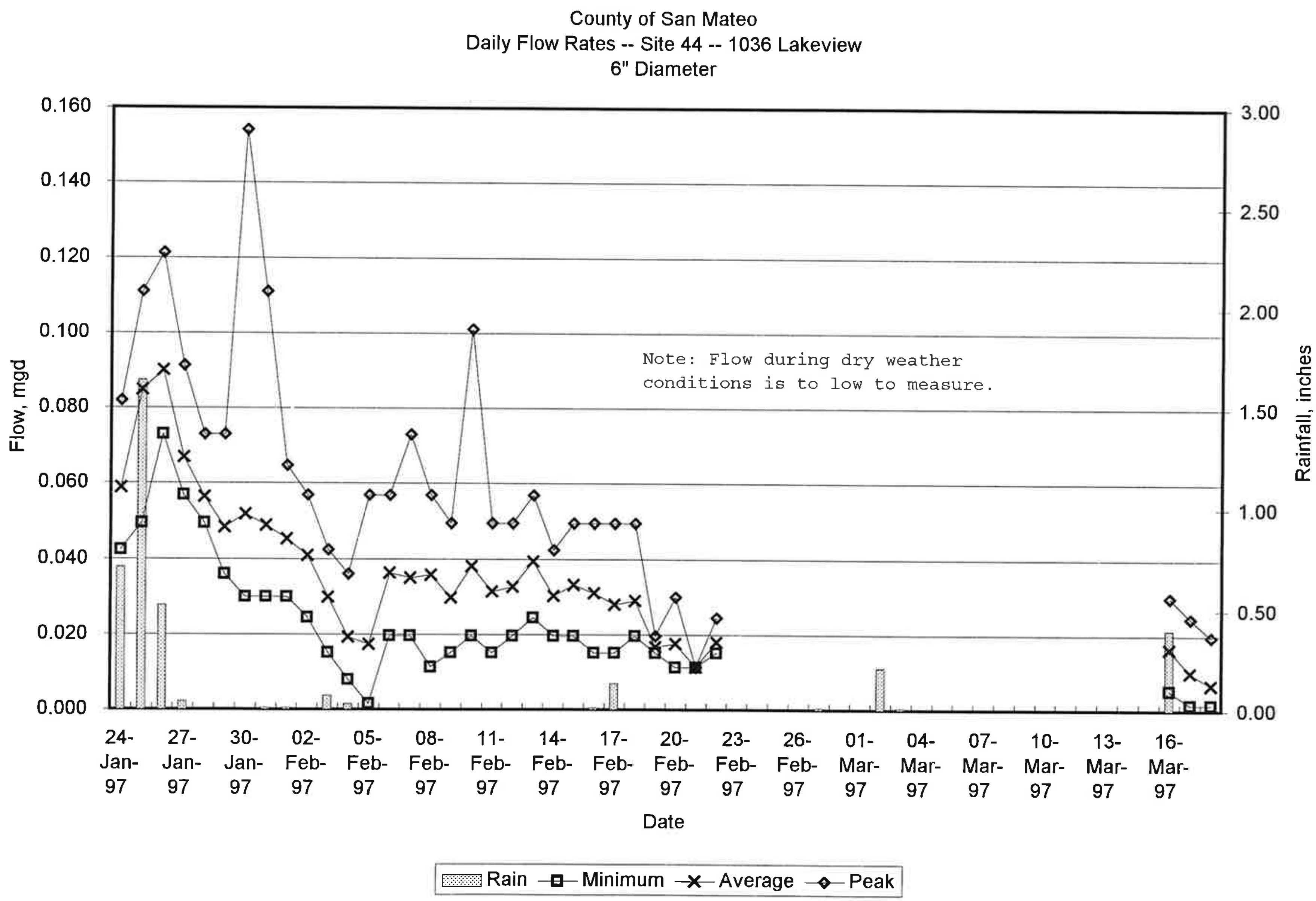

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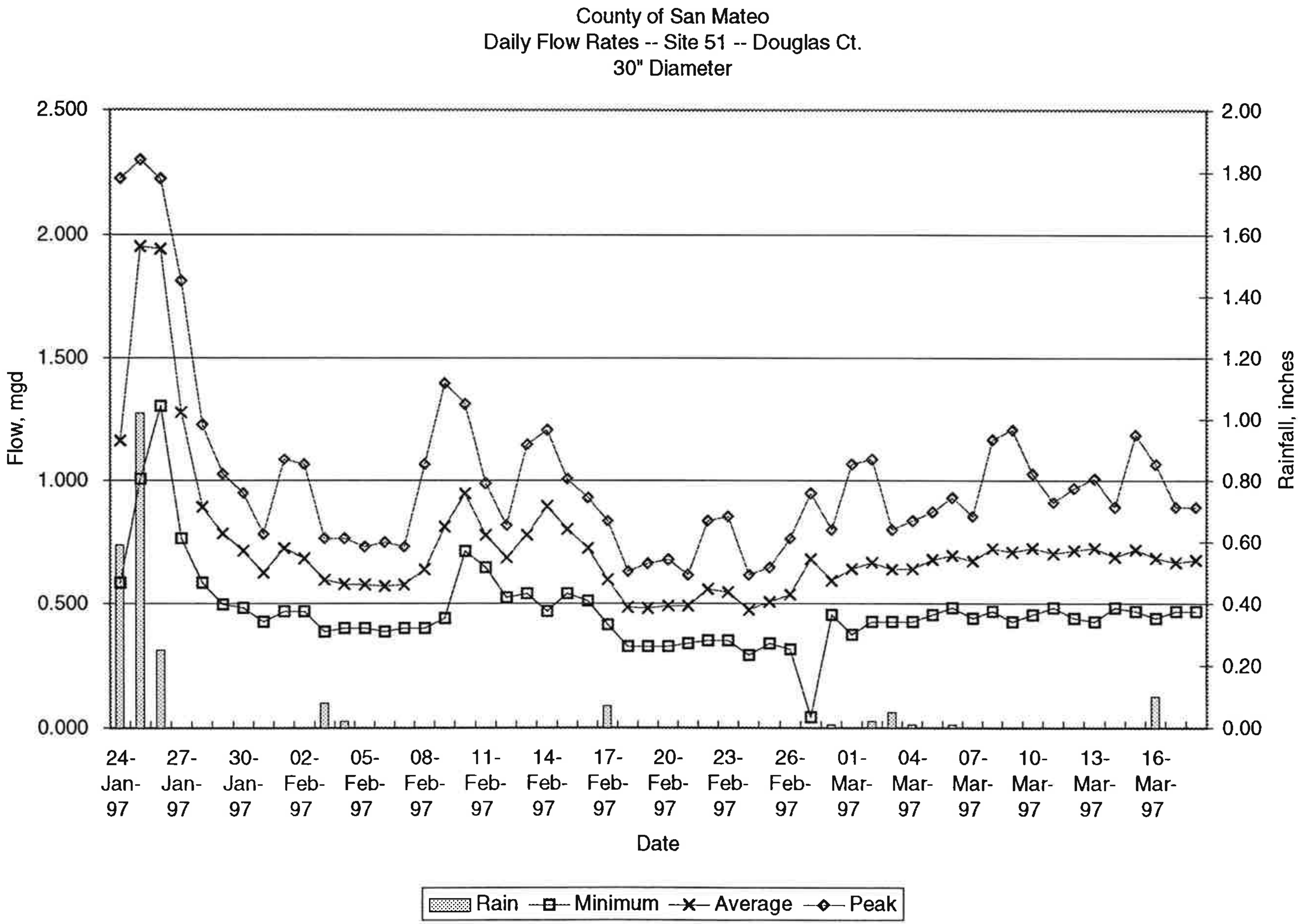

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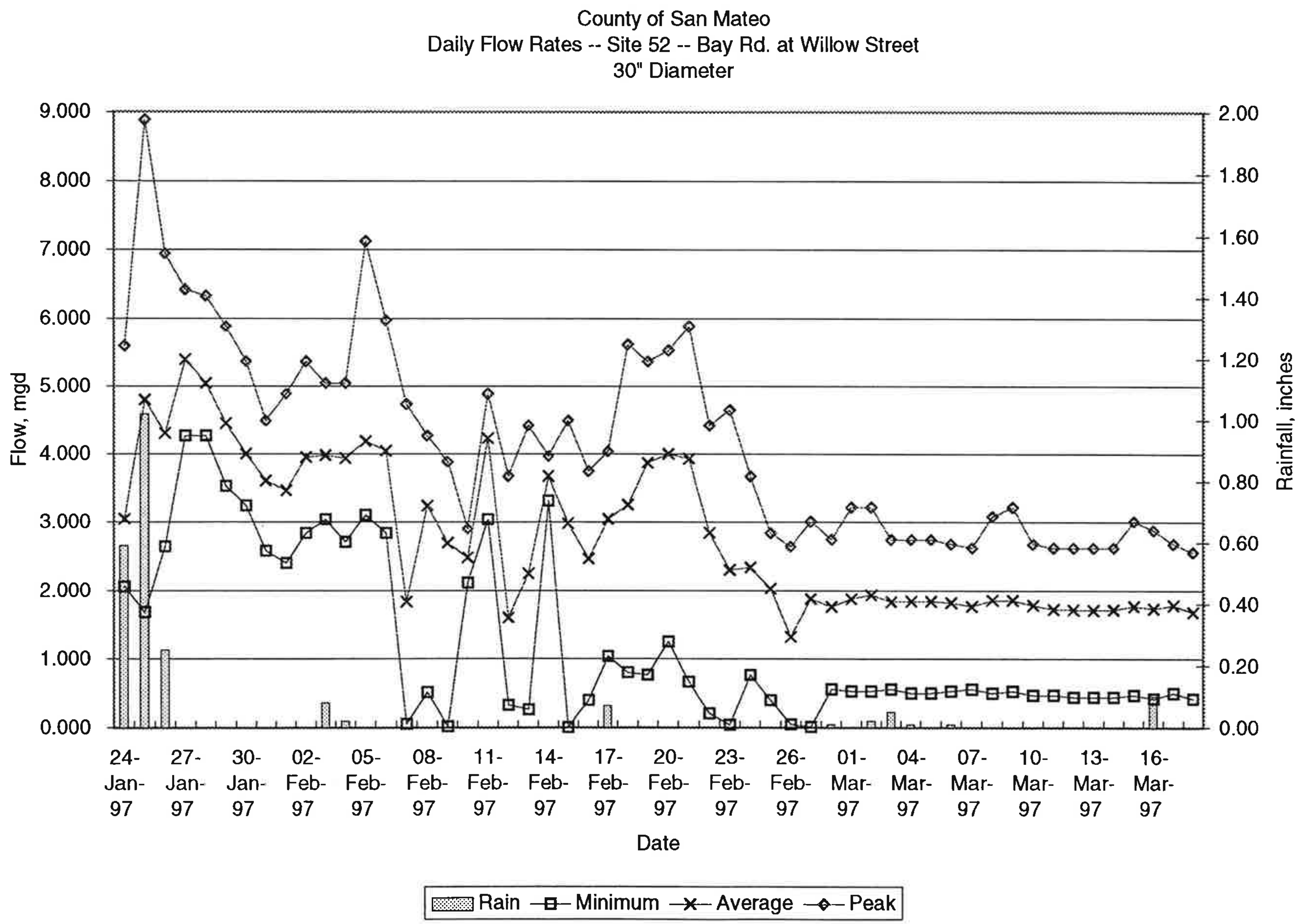

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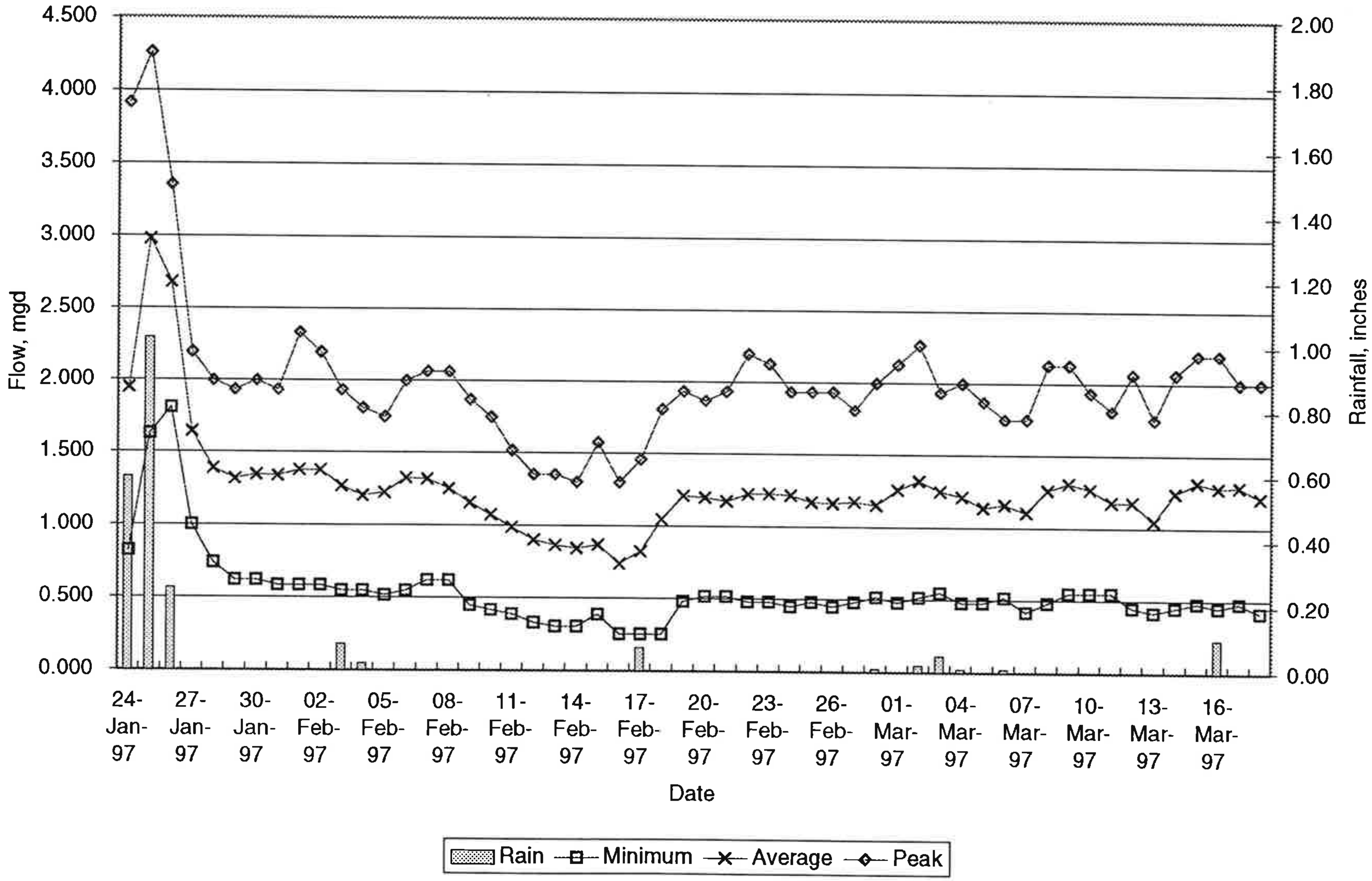
County of San Mateo
Daily Flow Rates -- Site 53 -- 559 Oakside
21" Diameter



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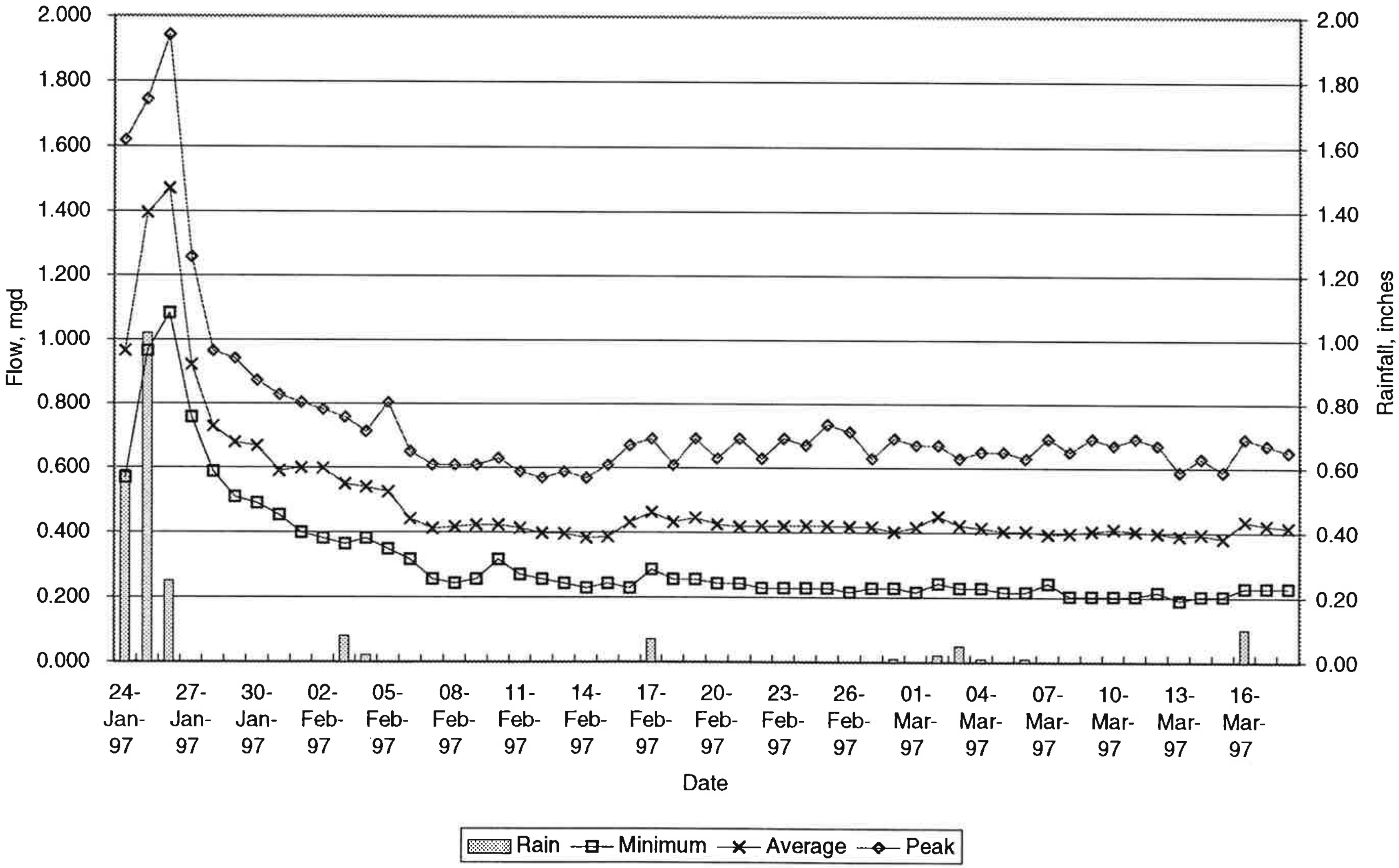
County of San Mateo
Daily Flow Rates -- Site 54 -- 343 Nimitz Ave.
15" Diameter



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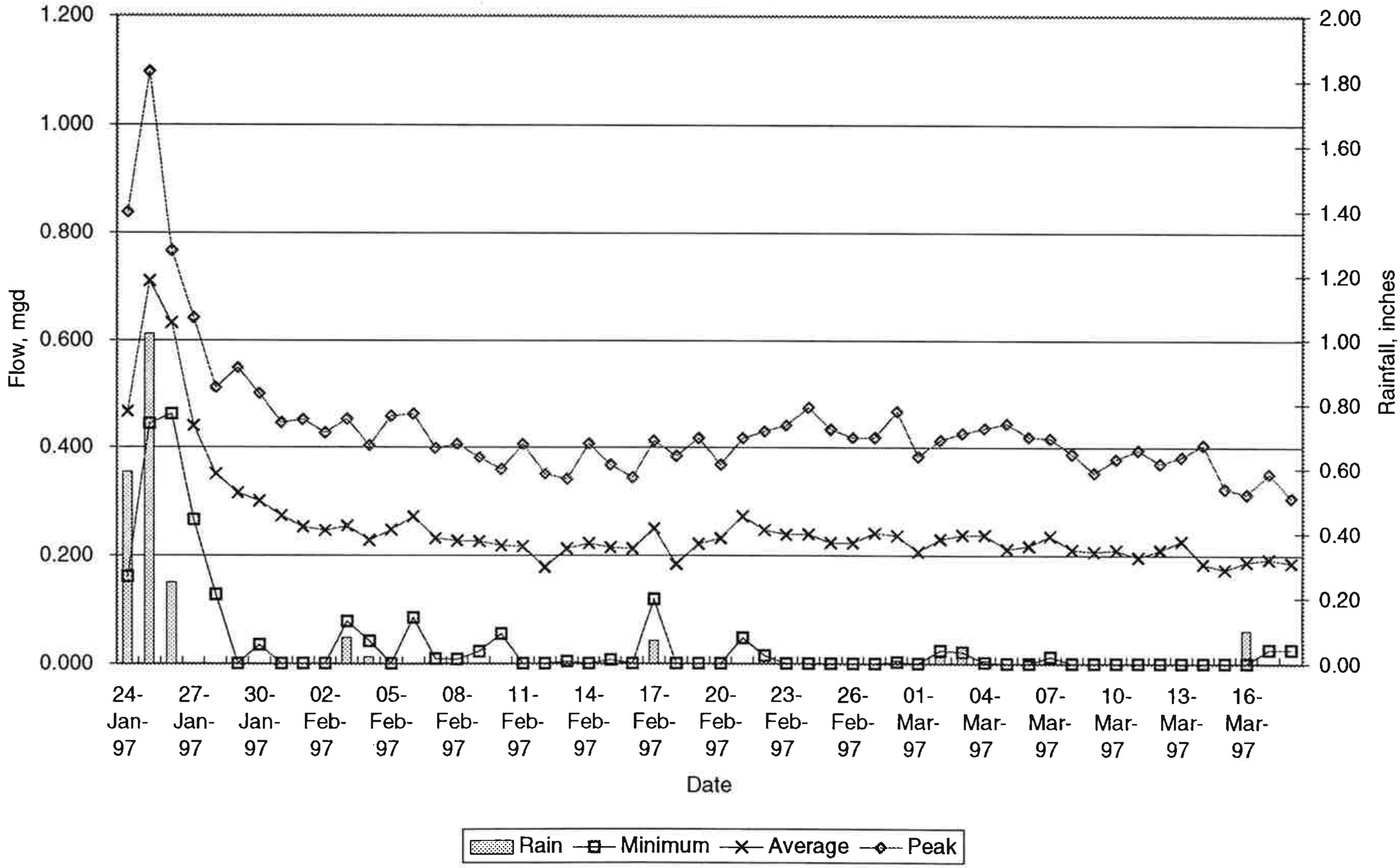
County of San Mateo
Daily Flow Rates -- Site 55 -- Woodside Rd. near Churchhill
10" Diameter



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APPENDIX C

SMOKE TESTING TECHNICAL MEMORANDUM AND RESULTS

MEMORANDUM 14692-003

October 13, 1998

TO: MARK WELSH
COUNTY OF SAN MATEO, DPW

FROM: BRIAN HAMMER
BROWN AND CALDWELL

SUBJECT: WASTEWATER MASTER PLAN
SMOKE TESTING FIELD INSPECTION

This technical memorandum presents the results of the smoke testing program performed during the summer of 1998 as part of the Wastewater Master Plan. Smoke testing was performed in sections of the Burlingame Hills, Crystal Springs, Devonshire, Emerald Lake, and Fair Oaks Sewer Districts.

Smoke Testing

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.
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.

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 defective laterals are detected by smoke testing.

Another limitation is that smoke cannot emerge through highly impervious surfaces such as concrete or asphalt, unless they are cracked. Additionally, smoke will not travel through saturated soil. Therefore, this fieldwork is most effectively conducted only during dry weather, when the soil is at its driest condition.

Smoke Testing Field Procedures

The smoke testing program consisted of public notification and actual smoke testing. Public notification was accomplished by means of two separate public notices prior to smoke testing: one distributed approximately 1 week followed by another 24-48 hours in advance of testing, to individual residences and businesses. These notices, shown in Figure 1, explained the reason smoke testing was being performed and gave a brief description of the procedures to be used by the smoke testing crew. The notices also advised persons with respiratory ailments or similar problems to contact the County Department of Public Works office so field crews could provide these people with special attention during the smoke testing operation.

The smoke testing field program consisted of circulating a nontoxic and nonstaining "smoke" through the sewer system. A specialized blower was used to circulate smoke through the sewer system at a rate of approximately 1,500 cubic feet per minute. Smoke traveled through the connecting mainlines and service laterals until it came out of defects or roof vents. Each defect found was photographed using digital cameras to document the defect. The crew maintained field logs in which they recorded the address, relative location, and type of defect found. Information from the field logs was input to a specialized ACCESS database for documentation and analysis. Inspection forms were then printed directly from the program along with the digital image of the defect.

Smoke Testing Results

Smoke testing was performed during the dry months of August and September 1998 to prevent smoke from being trapped in high groundwater and saturated soils. Smoke testing was performed in all subbasins in the Districts of Burlingame Hills and Devonshire, with the exception of those areas where the crew did not have access, and in selected subbasins of the Crystal Springs, Emerald Lakes, and Fair Oaks Districts. Those selected subbasins were 21line1, 21line2, 22line2, and SP in the Crystal Springs District, 45 in the Emerald Lake District, and 54 in the Fair Oaks Sewer Maintenance District. These subbasins are shown in Figure 2. Some sewer lines in these areas could not be accessed. Approximately 140,000 lineal feet of sewer line was tested during the 3-week inspection period.

A total of 201 defects was located and documented by field crews during the smoke testing period. Table 1 provides a summary of the defects for each of the Districts. The most prevalent defect noted was faulty cleanouts. Cross-connections between the sanitary sewer and the storm drain system were not noted during the testing period. Summary tables of the smoke testing results are provided in Attachments A1 and A2. Smoke testing forms and photographs of the defects are provided in Attachment B.

Potential health concern defects exist where direct physical contact with sewage or sewer gas is possible through open pipes, uncapped cleanouts, or poor plumbing connections. Whenever a resident reported smoke inside a building, a crew member inspected the location of the smoke to determine the source of the smoke. The smoke sources commonly found inside a home or commercial building were dried out or defective sink/bathtub traps, faulty plumbing, untrapped connections to the sewer, and area or floor drains. Area and floor drains were documented where applicable. Residents were provided with practical information regarding what could be done about the other problems to protect against the possibility of sewer gas or sewage entering the residence or business.

Uncapped cleanouts at ground or below ground level are both a public health concern and potential inflow source. The majority of defects noted were uncapped cleanouts where either the cap was loose, broken or deteriorated, or missing from the cleanout. We recommend the county consider having these cleanouts capped tightly to prevent sewage form spilling out into public areas and to eliminate cleanouts as a source of inflow.

APPENDIX D

TELEVISION INSPECTION RESULTS

County of San Mateo - Wastewater Master Plan
Mainline Sewer Internal Inspection
District: Burlingame Hills

RUN No.	STREET OR PARCEL No.	UPSTREAM MANHOLE No.	DOWNSTREAM MANHOLE No.	DEPTH	LENGTH BETWEEN MANHOLES, ft	COMPLETE FOOTAGE TAPED, ft	PIPE SIZE, in	PIPE MATERIAL TYPE	DATE OF INSPECTION	VIDEO TAPE No.	MAINLINE SEWER DEFECTS: CRACK		JTS		LATERALS			ROOTS		I/I						ALIGN		STRUC.			M.S.		S.C.		T	EST. I/I FLOW RATE, gpm	TOTAL No. of DEFECTS TO REHABILITATE	Total Score	COMMENTS
											CP1	CP2	OJ1	OJ2	PT1	PT2	PT3	RJ	RT	I1	I2	I3	I4	I5	I6	A1	A2	S1	S2	S3	M1	M2	C1	C2					
22	2819 Hillside Dr.	202	201			312	6	VCP	3/4/99	17-2	6							1	8									3							8		18	35	
15,16	3010 Canyon Rd.	15	14		140	94	6	VCP	3/3/99	16-15								3								1		1							1		5	32	Hole in pipe unable to get by. Reverse set up.
18	2811 Hillside Dr.	201	200-A	3		242	6	VCP	3/4/99	16-18								1										1							5		2	13	
13	123 Fey Dr.	123	122	3		157	6	VCP	3/3/99	16-13	1							11	1																2		13	11	
12	123 Fey Dr.	124	123	6		213	6	VCP	3/3/99	16-12								17																	1		17	8	
8	128 Fey Dr.	127	126			90	6	VCP	3/2/99	16-8								5	1																1		6	8	
1	3123 Hillside Dr.	87	86	3		208	6	VCP	3/1/99	16-1	1						1	8								1									3		11	7	
14	107 Fey Dr.	13	122	5		99	6	VCP	3/3/99	16-14								5	1																1		6	7	MH 13 is directly connected to MH 122.
7	128 Fey Dr.	128	127	5		140	6	VCP	3/2/99	16-7	1							3																	1		4	5	
11	127 Fey Dr.	126	124	6	110	20	6	VCP	3/3/99	16-11																1											1	5	Unable to get through. Full sag.
19,20	2800 Hillside Dr.	200-A	200			82	6	VCP	3/4/99	16-19				1				2																			3	5	Unable to get by . Will try reverse set up
6	100 La Messa Dr.	113	110	4		242	6	VCP	3/2/99	16-6							1	6								1									3		8	4	
9,10	143 Los Robles Dr.	147	126	4		90	6	VCP	3/2/99	16-9							1																		3		1	3	Unable to get by offset joint and possibly hole in the pipe. Will try reverse set up.
3	114 Los Montes Dr.	85	84			130	6	VCP	3/2/99	16-3								3																	1		3	3	
21	2825 Hillside Dr.	203	202	2,6		176	6	VCP	3/4/99	17-1								5																			5	3	
2	110 Los Montes Dr.	86	85			100	6	VCP	3/1/99	16-2								1																			1	1	
4	114 Los Montes Dr.	84	76			24	6	VCP	3/2/99	16-4																													
17	3004 Canyon Rd.	14	13	8		72	6	VCP	3/3/99	16-17																													
23, 24	2829 Hillside Dr.	204	203	3	300	93	6	VCP	3/23/99	17-3	1		1																						1		2	6	Reverse set up. Unable to get up line. Tractor keep rolling over. Hydro would not go trough line.
25	2829 Hillside Dr.	210	204	3	500	79	6	VCP	3/23/99	17-5																			1								1	63	Reverse set up cannot be done - not enough road space to close one traffic line.
26	120 Newton Dr.	206	205	3		230	6	VCP	3/23/99	17-6	7							8	1		1							1	1						4		19	48	
27, 28	108 Newton Dr.	205	204	3		207	6	VCP	3/23/99	17-7, 8	4	1		1				15	2									2	1						3		26	68	
29	2800 Alvorado Ave	218	217	4	190	5	6	VCP	3/24/99	17-9								1																			1	20	Reverse set up. Camera rolls over - cannot remove C/O cap end. End of line.
30	2800 Alvorado Ave	217	200			28	6	VCP	3/24/99	17-10								3																			3	11	reverse set up. Cannot get into MH 200. End of line.
31	2855 Adeline Dr.	306	304	3		134	6	VCP	3/24/99	17-11								11	1																1		12	10	
32	2848 Adeline Dr.	304	303	3		236	6	VCP	3/24/99	17-12								14	3							1									3		18	9	
33, 34	2880 Adeline Dr.	307	306	3		319	6	VCP	3/24/99	17-13, 14	2	1		1				15								1		5		1					2		26	81	
35	2886 Adeline Dr.	308	307	3		300	6	VCP	3/24/99	18-1	3							14	2																3		19	9	
36	2895 Adeline Dr.	309	308	3		284	6	VCP	3/24/99	18-2								11	4									1							5		16	16	
37	2917 Adeline Dr.	312	311	3		330	6	VCP	3/24/99	18-3							1	10	4									2	1						7		18	37	
38	2897 Adeline Dr.	311	309	3		94	6	VCP	3/24/99	18-4								2										1									3	29	
39	2933 Adeline Dr.	313	312	3		336	6	VCP	3/24/99	18-5							3				1							3	1						7		8	40	

40	2957 Adeline Dr.	162	161	4.4		205	6	VCP	3/25/99	18-6	1							10	2																3		13	9	
41	106 Los Robles Dr.	161	160			148	6	VCP	3/25/99	18-7								4																	1		4	3	
42, 43	106 Los Robles Dr.	160	159	4.5		198	6	VCP	3/25/99	18-8, 9								6																			6	3	Unable to get in line due to bent in line.
44	109 Los Robles Dr.	159	158	4.5		104	6	VCP	3/25/99	18-10								10	1																2		11	13	
45	109 Los Robles Dr.	158	157	5		134	6	VCP	3/25/99	18-11								6																	1		6	5	
46	2890 Canyon Rd.	153	152	3	165	6	6	VCP	3/25/99	18-12																													Reverse set up. Camera rolls over. Unable to go.
47	2890 Canyon Rd.	152	7	3		81	6	VCP	3/25/99	18-13																													
48	5 Tiara Ct.	20	19	4	110	3	6	VCP	3/29/99	19-1																													Unable to get camera by. Camera will not go upstream.
49	5 Tiara Ct.	19	18	4		60	6	VCP	3/29/99	19-2								1																			1	2	
50	Tiara Ct. (New House)	21	18	7		5	6	VCP	3/29/99	19-3																													Reverse set up. Unable to climb pipe. MH 21 is buried.
51	Tiara Ct. (New House)	18	17	7		135	6	VCP	3/29/99	19-4																									1			1	Removed 20 gal of sand, rock, and grease. From 120 to 135 feet pipe is full of water.
52	1 Tiara Ct.	17	16	11		160	6	VCP	3/29/99	19-5																													Remove 20 gal of sand and grease.
53, 54	3030 Canyon Rd.	49	48	4.9		109	6	VCP	3/29/99	19-6, 7	2		1					13																	1		16	20	Shattered pipe.
55	3028 Canyon Rd.	48	47	5		162	6	VCP	3/29/99	19-8	8							11										3									22	68	
56	3035 Canyon Rd.	50	49			151	6	VCP	3/30/99	19-9	2							10																			12	11	
57	3053 Canyon Rd.	51	50	5.7		170	6	VCP	3/30/99	19-10								5																			5	3	
58	3059 Canyon Rd.	62	52	4.7		138	6	VCP	3/30/99	19-11	1							10										1									12	28	
59	3059 Canyon Rd.	52	51	4		98	6	VCP	3/30/99	19-12	1							7																			8	10	
60	Canyon Rd.	70	62	5		158	6	VCP	3/30/99	19-13								7																			7	4	
61	175 Canyon Rd.	71	70	4		176	6	VCP	3/30/99	19-14	1							8																			9	6	
62	3111 Canyon Rd.	74	71	5		119	6	VCP	3/30/99	19-15								3																			3	3	
63	3119 Canyon Rd.	75	74	4		216	6	VCP	3/30/99	19-16	1							7																	3		8	6	
5, 64	3125 Canyon Rd.	76	75	4		63	6	VCP	3/30/99	19-17, 16-5			1					1																	1		2	6	
65, 66	176 Valdeflores Dr.	97	96	4		19	6	VCP	3/30/99	20-1, 2																				1							1	526	Reverse set up. Camera rolls over - too steep. Unable to get into back yard.
67	176 Valdeflores Dr.	96	95		260	1	6	VCP	3/30/99	20-3																													Reverse set up. Unable to get camera into MH - too much vegetation and roots.
68	3052 Canyon Rd.	95	51	5		2	6	VCP	3/30/99	20-4				1																							1	100	Unable to TV due to major off set.
69	139 La Mesa Dr.	106	108	4		101	6	VCP	3/30/99	20-5							1	6																	1		7	7	
70	161 Valdeflores Dr.	108	107	5	170	82	6	VCP	3/31/99	20-6								6																	1		6	9	Unable to hydro. Line rolls over at 82 feet.
	213 Los Robles Dr.	107	105		45																																		Too steep for TV
	213 Los Robles Dr.	105	103		180																																		Unable to hydro. Line full of roots. No TV.
	3028 Canyon Rd.	103	47		130																																		Unable to hydro. Line full of roots. No TV.
	Fern Path	157	155		150																																		No TV. Land slide. Line is on top of ground with many sharp turns. Photos are available.
	Fern Path	155	154		90																																		Same as above.
	Fern Path	154	153		130																																		Same as above.
	109 La Cuesta Dr.	149	10		140																																		Road to narrow. No TV.
TOTAL					2810	8170					43	2	3	4			8	306	31		2					6		24	5	2					81		436		

APPENDIX E

HYDRAULIC MODELING TECHNICAL MEMORANDUM

MEMORANDUM 14692-006

December 22, 1998

TO: MARK WELSH
COUNTY OF SAN MATEO, DPW

FROM: CHARLIE JOYCE
BROWN AND CALDWELL

SUBJECT: WASTEWATER MASTER PLAN
FLOW PROJECTIONS AND HYDRAULIC MODELING

This technical memorandum presents the results of the hydraulic modeling performed to determine the amount of available capacity in the County of San Mateo (County) trunk sewers. Modeling was performed on the major trunk sewers in Burlingame Hills (BH), Crystal Springs (CS), Devonshire (DS), Emerald Lake (EL), and Fair Oaks (FO), Oak Knoll (OK) and Scenic Heights (SH) sewer districts.

Design Flow Projections

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 Nino effects resulted in extensive rainfall during the January and February of 1998. Wet weather flow projections are based on flow monitoring results from second flow monitoring program.

BSF. 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.

BSF flow contributions to the hydraulic model are based on the flow monitoring data collected during dry weather periods. Actual dry weather hydrographs were extracted from the flow monitoring data and used in the model. Dry weather periods were used to minimize the amount of groundwater infiltration included in the calculation. Groundwater infiltration 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 date in each District would be needed to determine the amount of groundwater infiltration in each area.

Dry weather flow projections were prepared for current land use conditions only. Land use planners for the County and affected City agencies indicated that growth or significant in-filling was not expected in the future.

Flow monitoring was not performed in the OK and SH Districts. BSF calculations for these Districts are based on the number of parcels in the District and a per parcel water use rate of 220 gallons per day. A conservative sanitary peaking factor of 3.5 was used to determine the peak dry weather flow.

Wet Weather I/I Flow

I/I consists of direct inflow of storm water runoff and rainfall-induced infiltration of storm water percolating 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 of 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 that enters the collection system as I/I. The composite minimum and maximum "R" factor for each District is listed in Table 1.

Table 1, R Factors

District	Minimum R factor	Maximum R factor
Burlingame Hills	0.026	0.113
Crystal Springs	0.027	0.102
Devonshire	0.018	0.040
Emerald Lake	0.024	0.105
Fair Oaks	0.012	0.111

To determine the effects of I/I on the capacity of the wastewater conveyance system a wet weather design storm was developed. 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.

To develop wet weather hydrographs for use in the model, unit hydrographs were developed for each basin. 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 hydrograph was input to the model.

Due to the lack of flow monitoring data for the OK and SH areas, a conservative I/I rate of 2,400 gallons per acre per day was used. This rate is used by the Central Contra Costa Sanitary District and is the most conservative rate in use in the Bay Area.

Capacity Analysis

Major trunk sewers in each of the sewer Districts were modeled to determine if any 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 through the collection system and accounts for the time delays of peak flow from various tributary areas as the flows move downstream. A standard Manning's friction coeffcient of 0.0135 was used for the analysis.

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. Surveying was required in various areas to verify the pipeline slope. If capacity deficiencies were detected, the program was used to size the appropriate relief and/or replacement sewer size.

Hydraulic models of the Harbor Industrial and Kensington Square districts were not prepared due to their small size. Both districts are much less than 50 acres in size. An 8-inch diameter sewer with a slope of 0.1 percent has enough capacity to serve a tributary area greater than 50 acres in size using conservative flow factors for BSF and I/I. Therefore, it was assumed that trunk sewers in the Harbor Industrial and Kensington Square districts have adequate capacity.

Hydrographs produced by the model were compared to the actual wet weather hydrographs from the flow monitoring to verify model calibration. An example of a model calibration hydrograph for the Burlingame Hills District is shown in Figure 1.

The modeled sewers for each District and the results of the modeling are shown on Figure 2 through Figure 8. Relief sewer sizes for each District are summarized in Tables 2 through Table 5. Hydraulic capacity deficiencies were not found in the DS, OK or SH Districts. Complete model results are given in Attachment A.

Table 2, Hydraulic Modeling Results, Burlingame Hills

Upstream Manhole	Downstream Manhole	Existing Diameter, inches	Length, ft	Recommended Relief Sewer Sizes, inches
B004603	B000204	6-8	2,610	8
B000204	B000104	8	216	12
Total			2,826	

Table 3, Hydraulic Modeling Results, Crystal Springs

Upstream Manhole	Downstream Manhole	Existing Diameter, inches	Length, ft	Recommended Relief Sewer Sizes, inches
C019105	C014405	10	1,714	8
C014405	C000301	10	3,280	12
Total			4,994	

Table 4, Hydraulic Modeling Results, Emerald Lake

Upstream Manhole	Downstream Manhole	Existing Diameter, inches	Length, ft	Recommended Relief Sewer Sizes, inches
E115601	E115201	6	455	8
E102322	E101634	8	1,163	8
E101634	E101134	8	342	12
Total			1,960	

Table 5, Hydraulic Modeling Results, Fair Oaks

Upstream Manhole	Downstream Manhole	Existing Diameter, inches	Length, ft	Recommended Relief Sewer Sizes, inches
F198636	F198227	10	1,170	8
F197727	F193228	10	1,327	10
F193228	F191828	8-10	1,743	15
F190528	F183828	15	1,253	15
F183828	F170419	18	2,911	30
F170419	F169919	15-18	870	27
F169919	F168014	15	1,642	15
F157414	F156914	10	1,049	10
F156914	F156714	10	176	15
F120311	F117211	8-10	921	18
F117211	F116211	10-12	1,883	12
F116211	F115610	12-18	1,489	24
F156614	F145009	15-21	2,979	24
F143709	F115510	10-21	3,251	15
F115510	F114904	30	2,857	45
TOTAL			25,521	

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BURLINGAME HILLS SEWER DISTRICT 5 YEAR 6 HOUR

*** ADELINE

Analysis of Existing Pipes

Link	Long	Slope	Invert	San	Sto	Qdes	Qmax	GrUp	GrDn	SrCh/Dlt
		Diam	Up/Dn	Inf	Mis	Vel	%Cap	HGLUp	HGLDn	Parallel
						d/D	QRem	DiffUp	DiffDn	Replace
1	85	0.0802	216.04	0.1	0.4	0.49	0.89	221.54	214.12	***
		6	209.22	0.0	0.0	3.82	54.45	217.10	210.07	
B032402						0.55		4.44	4.05	
2	55	0.0242	209.22	0.1	0.4	0.49	0.49	214.12	212.70	***
		6	207.89	0.0	0.0	3.83	99.21	210.07	208.43	
B032302						0.80		4.05	4.27	
3	100	0.0050	207.89	0.1	0.4	0.49	0.48	212.70	211.50	
		8	207.39	0.0	0.0	2.15	101.30	208.43	207.93	4
B032202						0.81	0.01	4.27	3.57	10
4	219	0.0049	207.39	0.1	0.4	0.49	0.47	211.50	211.00	***
		8	206.32	0.0	0.0	2.15	102.48	208.00	207.03	4
B032102						0.82	0.01	3.50	3.97	10
5	94	0.0037	206.32	0.1	0.4	0.49	0.41	211.04	213.00	***
		8	205.97	0.0	0.0	2.15	117.39	207.03	206.64	6
B032002						1.00	0.07	4.01	6.36	10
6	123	0.0060	205.97	0.1	0.4	0.49	0.53	212.57	210.00	
		8	205.23	0.0	0.0	2.65	92.35	206.48	205.74	
B031902						0.76		6.09	4.26	
7	170	0.0051	205.23	0.1	0.4	0.49	0.48	210.00	209.00	
		8	204.36	0.0	0.0	2.15	100.13	205.76	204.89	4
B031802						0.80	0.00	4.24	4.11	10
8	137	0.0050	204.36	0.1	0.4	0.49	0.48	208.86	207.00	
		8	203.68	0.0	0.0	2.15	101.68	204.90	204.22	4
B031702						0.81	0.01	3.96	2.78	10
9	67	0.0051	203.68	0.1	0.4	0.49	0.48	207.30	212.00	***
		8	203.34	0.0	0.0	2.15	100.56	204.35	204.05	4
B031602						0.80	0.00	2.95	7.95	10
10	91	0.0037	203.34	0.1	0.4	0.49	0.41	212.00	207.00	***
		8	203.00	0.0	0.0	2.15	117.19	204.05	203.67	6
B031502						1.00	0.07	7.95	3.33	10
11	115	0.0062	203.01	0.1	0.4	0.49	0.53	207.00	208.00	***
		8	202.30	0.0	0.0	2.15	91.17	203.62	203.00	
B031402						0.75		3.38	5.00	
12	346	0.0058	202.41	0.1	0.5	0.58	0.52	207.82	210.20	
		8	200.40	0.0	0.0	2.58	112.82	203.00	200.99	4
B030302						0.89	0.07	4.82	9.21	10

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BURLINGAME HILLS SEWER DISTRICT 5 YEAR 6 HOUR

*** CANYON Analysis of Existing Pipes

Link	Long	Slope Diam	Invert Up/Dn	San Inf	Sto Mis	Qdes Vel d/D	Qmax %Cap QRem	GrUp HGLUp DiffUp	GrDn HGLDn DiffDn	SrCh/Dlt Parallel Replace
22	140	0.0930	240.00	0.8	1.6	2.05	2.07	243.80	231.38	***/***
		8	226.98	0.0	0.0	9.08	99.08	289.55	279.33	
B001004						0.80		-45.75	-47.95	
23	140	0.1224	226.98	0.8	1.6	2.05	2.37	231.38	220.00	***/***
		8	209.84	0.0	0.0	9.08	86.36	279.33	269.11	
B000904						0.73		-47.95	-49.11	
24	160	0.0700	209.84	0.8	1.6	2.05	1.79	220.00	203.84	***/***
		8	198.64	0.0	0.0	9.08	114.20	269.11	257.52	4
B000802						0.90	0.25	-49.11	-53.68	10
25	150	0.0547	198.64	0.9	1.8	2.28	1.58	203.84	194.89	***/***
		8	190.44	0.0	0.0	10.09	143.60	257.52	243.76	6
B000702						1.00	0.69	-53.68	-48.87	10
26	190	0.0303	190.44	0.9	1.8	2.28	1.18	194.89	189.04	***/***
		8	184.69	0.0	0.0	10.09	193.00	243.76	226.91	8
B000604						1.00	1.10	-48.87	-37.87	12
27	250	0.0540	184.69	0.9	1.8	2.28	1.58	189.04	175.69	***/***
		8	171.19	0.0	0.0	10.09	144.48	226.91	205.00	6
B000504						1.00	0.70	-37.87	-29.31	10
28	210	0.0723	171.19	0.9	1.8	2.28	1.82	175.69	163.41	***/***
		8	156.01	0.0	0.0	10.09	124.88	205.00	186.47	6
B000404						1.00	0.45	-29.31	-23.06	10
29	220	0.0298	156.01	0.9	1.8	2.28	1.17	163.41	157.08	***/***
		8	149.46	0.0	0.0	10.09	194.59	186.47	167.09	8
B000304						1.00	1.11	-23.06	-10.01	12
30	216	0.0096	149.46	0.9	1.8	2.28	0.67	157.08	151.68	***/***
		8	147.38	0.0	0.0	10.09	342.15	167.09	148.05	12
B000204						1.00	1.61	-10.01	3.63	15

Lateral length= 2826 Upstream length= 2826

BURLINGAME HILLS SEWER DISTRICT 5 YEAR 6 HOUR

*** ADELINE

Analysis of Existing Pipes

Link	Long	Slope Diam	Invert Up/Dn	San Inf	Sto Mis	Qdes Vel d/D	Qmax %Cap QRem	GrUp HGLUp DiffUp	GrDn HGLDn DiffDn	SrCh/Dlt Parallel Replace
13	236	0.0072	200.40	0.1	0.5	0.61	0.58	210.20	203.00	
		8	198.70	0.0	0.0	2.69	105.52	200.96	199.26	4
B030202						0.83	0.03	9.24	3.74	10
14	180	0.1134	198.70	0.1	0.5	0.61	1.06	203.00	181.53	
		6	178.28	0.0	0.0	8.22	57.27	198.98	178.56	
B030102						0.56		4.02	2.97	

Lateral length= 2018 Upstream length= 2018

*** CANYON

Analysis of Existing Pipes

Link	Long	Slope Diam	Invert Up/Dn	San Inf	Sto Mis	Qdes Vel d/D	Qmax %Cap QRem	GrUp HGLUp DiffUp	GrDn HGLDn DiffDn	SrCh/Dlt Parallel Replace
15	90	0.0660	318.36	0.5	0.9	1.14	0.81	323.94	317.67	***/***
		6	312.42	0.0	0.0	8.96	140.73	447.32	436.64	6
B004603						1.00	0.33	-123.38	-118.97	8
16	240	0.0662	312.42	0.7	1.3	1.71	0.81	317.67	303.69	***/***
		6	296.52	0.0	0.0	13.45	210.71	436.64	380.78	8
B001603						1.00	0.90	-118.97	-77.09	8
17	140	0.0334	296.52	0.7	1.3	1.71	0.58	303.69	300.17	***/***
		6	291.84	0.0	0.0	13.45	296.64	380.78	348.51	8
B001503						1.00	1.13	-77.09	-48.34	10
18	70	0.0344	291.84	0.7	1.3	1.71	0.58	300.17	296.43	***/***
		6	289.43	0.0	0.0	13.45	292.30	348.51	331.68	8
B001403						1.00	1.12	-48.34	-35.25	10
19	270	0.1132	289.43	0.8	1.6	2.05	2.28	296.43	265.92	***/***
		8	258.87	0.0	0.0	9.08	89.81	331.68	314.09	
B001303						0.75		-35.25	-48.17	
20	160	0.0554	258.87	0.8	1.6	2.05	1.59	265.92	254.51	***/***
		8	250.01	0.0	0.0	9.08	128.40	314.09	302.51	6
B001204						1.00	0.45	-48.17	-48.00	10
21	180	0.0556	250.01	0.8	1.6	2.05	1.60	254.51	243.80	***/***
		8	240.00	0.0	0.0	9.08	128.13	302.51	289.55	6
B001104						1.00	0.45	-48.00	-45.75	10

APPENDIX F

CAPITAL IMPROVEMENT PROJECTS

District: Burlingame Hills | Priority: 1

Project: Canyon Road #4

Project Purpose: Hydraulics

Project Location: Canyon Road near Summit Drive
MH 1-7

Existing Conditions:
Pipeline: 1271 feet of 8-inch diameter
Television Inspection: Not Inspected
Operation & Maintenance 3 callouts/year: Y / [N]
Manhole Inspection: [Roots] / [Pipe] / Grease
Hydraulics: Yes, needs 15-inch diameter replacement sewer

Alternative 1: Replace with 15-inch diameter sewer

Alternative 1 Cost: $152,500

Alternative 2: n/a

Alternative 2 Cost:

Alternative 3: n/a

Alternative 3 Cost:

Project Concerns:

Recommended Alternative:

District: Burlingame Hills

Priority: 1

Project: Canyon Road #3

Project Purpose: Hydraulics and Operations & Maintenace

Project Location: Canyon Road near El Prado Road
MH 46-10

Existing Conditions:
- Pipeline: 545 feet of 6-inch diameter
- Television Inspection: Not Inspected
- Operation & Maintenance 3 callouts/year: [Y] / N
- Manhole Inspection: [Roots] / [Pipe] / Grease
- Hydraulics: Yes, needs 10-inch diameter replacement sewer

Alternative 1: Replace with 10-inch diameter sewer

Alternative 1 Cost: $54,500

Alternative 2: n/a

Alternative 2 Cost:

Alternative 3: n/a

Alternative 3 Cost:

Project Concerns:

Recommended Alternative:

District: Burlingame Hills

Priority: 2

Project: Hillside Drive

Project Purpose: Operations & Maintenance

Project Location: Hillside Drive near Newton Drive
MH 210-204, MH 120-204, MH 204-200, MH 218-200

Existing Conditions:

Pipeline: 2130 feet of 6-inch diameter

Television Inspection: 8 crushed
1 sag
1 minor offset joint
cracks

Operation & Maintenance 3 callouts/year: [Y] / N

Manhole Inspection: [Roots] / Pipe / Grease

Hydraulics: No

Alternative 1: Increase Operations & Maintenance (rc)
Spot Repair (29)

Alternative 1 Cost: $183,000

Alternative 2: Pipe Bursting

Alternative 2 Cost: $191,700

Alternative 3: Remove and Replace

Alternative 3 Cost: $181,100

Project Concerns:

Recommended Alternative:

District: Burlingame Hills   Priority: 2

Project: Canyon Road #2

Project Purpose: Operations & Maintenance

Project Location: Canyon Road near Tiara Court
MH 51-47, MH 106-47, MH 20-16, MH 103-96, MH 113-110

Existing Conditions:

Pipeline: 1990 feet of 6-inch diameter
Television Inspection: 1 piece missing
1 minor offset
cracks
Operation & Maintenance 3 callouts/year: [Y] / N
Manhole Inspection: [Roots] / Pipe / Grease
Hydraulics: No

Alternative 1: Increase Operations & Maintenance (rc)
Spot Repair (18)

Alternative 1 Cost: $163,700

Alternative 2: Pipe Bursting

Alternative 2 Cost: $179,100

Alternative 3: Remove and Replace

Alternative 3 Cost: $169,200

Project Concerns:

Recommended Alternative:

District: Burlingame Hills　　　　Priority: 3

Project: Adeline Drive

Project Purpose: Structural

Project Location: Adeline Drive from Hillside Drive to Vista Lane
MH 313-303

Existing Conditions:
Pipeline: 2170 feet of 6-inch diameter
Television Inspection:
Operation & Maintenance 3 callouts/year: Y / [N]
Manhole Inspection: Roots / Pipe / Grease
Hydraulics:

Alternative 1: Increase Operations & Maintenance (rc)
Spot Repair (21)

Alternative 1 Cost: $179,600

Alternative 2: Pipe Bursting

Alternative 2 Cost:, $195,300

Alternative 3: Remove and Replace

Alternative 3 Cost: $184,500

Project Concerns:

Recommended Alternative:

District: Burlingame Hills Priority: 3

Project: Canyon Road #1

Project Purpose: Structural

Project Location: Canyon Road near Hillside Drive
MH 87-51, MH97-51

Existing Conditions:

Pipeline: 1745 feet of 6-inch diameter

Television Inspection: 1 sag
2 shattered
3 minor offset joints
cracks

Operation & Maintenance 3 callouts/year: Y / [N]

Manhole Inspection: Roots / Pipe / Grease

Hydraulics: No

Alternative 1: Increase Operations & Maintenance (rc)
Spot Repair (10)

Alternative 1 Cost: $138,900

Alternative 2: Pipe Bursting

Alternative 2 Cost: $157,100

Alternative 3: Remove and Replace

Alternative 3 Cost: $148,300

Project Concerns:

Recommended Alternative:

District: Burlingame Hills Priority: 3

Project: Fey Drive

Project Purpose: Structural

Project Location: Fey Drive near Canyon Road
MH 128-126, MH 147-126, MH 126-13

Existing Conditions:

Pipeline: 1121 feet of 6-inch diameter

Television Inspection: 1 minor structural
2 minor offset joints

Operation & Maintenance 3 callouts/year: Y / [N]

Manhole Inspection: Roots / Pipe / Grease

Hydraulics: No

Alternative 1: Increase Operations & Maintenance (rc)
Spot Repair (5)

Alternative 1 Cost: $88,100

Alternative 2: Pipe Bursting

Alternative 2 Cost: $100,900

Alternative 3: Remove and Replace

Alternative 3 Cost: $95,300

Project Concerns:

Recommended Alternative:

APPENDIX G

SANITARY SEWER RATE MODELS

Burlingame Hills Alternative 1 CIP Summary

Project	Priority	Alternative 1	Alt 1 Description
Canyon Road #4	1	$ 152,500	Replace sewer
Canyon Road #3	1	$ 54,500	Replace sewer
Hillside Drive	2	$ 183,000	Increase O & M, 29 Spot Repair
Canyon Road #2	2	$ 163,700	Increase O & M, 18 Spot Repair
Adeline Drive	3	$ 179,600	Increase O & M, 21 Spot Repair
Canyon Road #1	3	$ 138,900	Increase O & M, 10 Spot Repair
Fey Drive	3	$ 88,100	Increase O & M, 5 Spot Repair
Total		**$960,300**	

Burlingame Hills Alternative 1 Revenue Requirements

Item	1994/95	1995/96	1996/97	1997/98	Projected 1998/99 Budget	Projected 1999/00	2000/01	2001/02	2002/03	2003/04
Expenses										
Admin/Eng	$ 16,933	$ 17,568	$ 22,208	$ 26,318	$ 27,108	$ 27,921	$ 28,759	$ 29,621	$ 30,510	$ 31,425
Capital Projects*	$ -	$ -	$ 27,789	$ -	$ -	$ 192,060	$ 197,822	$ 203,756	$ 209,869	$ 216,165
Debt Service	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
O&M	$ 72,780	$ 101,300	$ 85,846	$ 66,084	$ 68,067	$ 70,109	$ 72,212	$ 74,379	$ 76,610	$ 78,908
Other	$ 1,091	$ -	$ 21,109	$ 501	$ 516	$ 531	$ 547	$ 564	$ 581	$ 598
Sewage Treatment	$ 125,401	$ 120,407	$ 114,083	$ 105,086	$ 108,238	$ 111,485	$ 114,830	$ 118,275	$ 121,823	$ 125,478
Source Control	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Gross Expenses	**$ 216,205**	**$ 239,275**	**$ 271,035**	**$ 197,989**	**$ 203,929**	**$ 402,107**	**$ 414,170**	**$ 426,595**	**$ 439,393**	**$ 452,574**
Offsetting Revenue										
Secure Property Taxes**	$ 13,329	$ 14,203	$ 15,204	$ 16,615	$ 15,500	$ 15,965	$ 16,444	$ 16,937	$ 17,445	$ 17,969
Unsecured Property Taxes	$ 1,829	$ 1,894	$ 1,936	$ 1,982	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000
Interest Earned***	$ 10,636	$ 19,148	$ 12,669	$ 15,173	$ 11,933	$ 11,933	$ 11,933	$ 11,933	$ 11,933	$ 11,933
HOPTR	$ 277	$ 278	$ 293	$ 303	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
Annexation Charges	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Connection Charges	$ 9,480	$ 2,510	$ 2,018	$ 10,216	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500
Miscellaneous Revenue	$ 227	$ 228	$ 314	$ 476	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
Total Offsetting Revenue	**$ 35,778**	**$ 38,261**	**$ 32,434**	**$ 44,765**	**$ 32,533**	**$ 32,998**	**$ 33,477**	**$ 33,970**	**$ 34,478**	**$ 35,001**
Use of Fund Balance	**$ (2,657)**	**$ (23,523)**	**$ (46,496)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Net Revenue Requirements	**$ 177,770**	**$ 177,491**	**$ 192,105**	**$ 153,224**	**$ 171,396**	**$ 369,109**	**$ 380,693**	**$ 392,625**	**$ 404,915**	**$ 417,573**
Annual Rate Assuming 406 Connections******					**$ 422**	**$ 909**	**$ 938**	**$ 967**	**$ 997**	**$ 1,029**

Note:

*Projected CIP is paid for over 5 years

**Secure Property Tax revenue is assumed to increase at 3% per year

***Interest Earned in projected years is calculated as 5% of Beginning Fund Balance

****Current Rate is $451

Burlingame Hills Alternative 1 Fund Balance

Item	1994/95	1995/96	1996/97	1997/98	Projected 1998/99 Budget	Projected 1999/00	2000/01	2001/02	2002/03	2003/04
Beginning Fund Balance	$ 311,330	$ 308,673	$ 285,150	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654
Additions to/(Use of) Balance	$ (2,657)	$ (23,523)	$ (46,496)	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ending Fund Balance	$ 308,673	$ 285,150	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654

Burlingame Hills Alternative 2 CIP Summary

Project	Priority	Alternative 2	Alt 2 Description
Canyon Road #4	1	$ 139,800	Replace sewer
Canyon Road #3	1	$ 46,300	Replace sewer
Hillside Drive	2	$ 191,700	Increase O & M, 29 Spot Repair
Canyon Road #2	2	$ 179,100	Increase O & M, 18 Spot Repair
Adeline Drive	3	$ 195,300	Increase O & M, 21 Spot Repair
Canyon Road #1	3	$ 157,100	Increase O & M, 10 Spot Repair
Fey Drive	3	$ 100,900	Increase O & M, 5 Spot Repair
Total		**$ 1,010,200**	

Burlingame Hills Alternative 2 Revenue Requirements

Item	1994/95	1995/96	1996/97	1997/98	Projected 1998/99 Budget	Projected 1999/00	2000/01	2001/02	2002/03	2003/04
Expenses										
Admin/Eng	$ 16,933	$ 17,568	$ 22,208	$ 26,318	$ 27,108	$ 27,921	$ 28,759	$ 29,621	$ 30,510	$ 31,425
Capital Projects*	$ -	$ -	$ 27,789	$ -	$ -	$ 202,040	$ 208,101	$ 214,344	$ 220,775	$ 227,398
Debt Service	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
O&M	$ 72,780	$ 101,300	$ 85,846	$ 66,084	$ 68,067	$ 70,109	$ 72,212	$ 74,379	$ 76,610	$ 78,908
Other	$ 1,091	$ -	$ 21,109	$ 501	$ 516	$ 531	$ 547	$ 564	$ 581	$ 598
Sewage Treatment	$ 125,401	$ 120,407	$ 114,083	$ 105,086	$ 108,238	$ 111,485	$ 114,830	$ 118,275	$ 121,823	$ 125,478
Source Control	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Gross Expenses	**$ 216,205**	**$ 239,275**	**$ 271,035**	**$ 197,989**	**$ 203,929**	**$ 412,087**	**$ 424,449**	**$ 437,183**	**$ 450,298**	**$ 463,807**
Offsetting Revenue										
Secure Property Taxes**	$ 13,329	$ 14,203	$ 15,204	$ 16,615	$ 15,500	$ 15,965	$ 16,444	$ 16,937	$ 17,445	$ 17,969
Unsecured Property Taxes	$ 1,829	$ 1,894	$ 1,936	$ 1,982	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000
Interest Earned***	$ 10,636	$ 19,148	$ 12,669	$ 15,173	$ 11,933	$ 11,933	$ 11,933	$ 11,933	$ 11,933	$ 11,933
HOPTR	$ 277	$ 278	$ 293	$ 303	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
Annexation Charges	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Connection Charges	$ 9,480	$ 2,510	$ 2,018	$ 10,216	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500
Miscellaneous Revenue	$ 227	$ 228	$ 314	$ 476	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
Total Offsetting Revenue	**$ 35,778**	**$ 38,261**	**$ 32,434**	**$ 44,765**	**$ 32,533**	**$ 32,998**	**$ 33,477**	**$ 33,970**	**$ 34,478**	**$ 35,001**
Use of Fund Balance	**$ (2,657)**	**$ (23,523)**	**$ (46,496)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Net Revenue Requirements	**$ 177,770**	**$ 177,491**	**$ 192,105**	**$ 153,224**	**$ 171,396**	**$ 379,089**	**$ 390,972**	**$ 403,213**	**$ 415,820**	**$ 428,806**
Annual Rate Assuming 406 Connections****					**$ 422**	**$ 934**	**$ 963**	**$ 993**	**$ 1,024**	**$ 1,056**

Note:

*Projected CIP is paid for over 5 years

**Secure Property Tax revenue is assumed to increase at 3% per year

***Interest Earned in projected years is calculated as 5% of Beginning Fund Balance

****Current Rate is $451

Burlingame Hills Alternative 2 Fund Balance

Item	1994/95	1995/96	1996/97	1997/98	Projected 1998/99 Budget	Projected 1999/00	2000/01	2001/02	2002/03	2003/04
Beginning Fund Balance	$ 311,330	$ 308,673	$ 285,150	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654
Additions to/(Use of) Balance	$ (2,657)	$ (23,523)	$ (46,496)	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ending Fund Balance	$ 308,673	$ 285,150	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654

Burlingame Hills Average Alternative CIP Summary

Project	Priority	Minimum Cost	Maximum Cost	Average
Canyon Road #4	1	$139,800	$152,500	$146,150
Canyon Road #3	1	$46,300	$54,500	$50,400
Hillside Drive	2	$181,100	$191,700	$186,400
Canyon Road #2	2	$163,700	$179,100	$171,400
Adeline Drive	3	$179,600	$195,300	$187,450
Canyon Road #1	3	$138,900	$157,100	$148,000
Fey Drive	3	$88,100	$100,900	$94,500
Total		$937,500	$1,031,100	$984,300

Burlingame Hills Average Alternative Revenue Requirements

Item	1994/95	1995/96	1996/97	1997/98	Projected 1998/99 Budget	Projected 1999/00	2000/01	2001/02	2002/03	2003/04
Expenses										
Admin/Eng	$ 16,933	$ 17,568	$ 22,208	$ 26,318	$ 27,108	$ 27,921	$ 28,759	$ 29,621	$ 30,510	$ 31,425
Capital Projects*	$ -	$ -	$ 27,789	$ -	$ -	$ 196,860	$ 202,766	$ 208,849	$ 215,114	$ 221,568
Debt Service	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
O&M	$ 72,780	$ 101,300	$ 85,846	$ 66,084	$ 68,067	$ 70,109	$ 72,212	$ 74,379	$ 76,610	$ 78,908
Other	$ 1,091	$ -	$ 21,109	$ 501	$ 516	$ 531	$ 547	$ 564	$ 581	$ 598
Sewage Treatment	$ 125,401	$ 120,407	$ 114,083	$ 105,086	$ 108,238	$ 111,485	$ 114,830	$ 118,275	$ 121,823	$ 125,478
Source Control	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Gross Expenses	**$ 216,205**	**$ 239,275**	**$ 271,035**	**$ 197,989**	**$ 203,929**	**$ 406,907**	**$ 419,114**	**$ 431,687**	**$ 444,638**	**$ 457,977**
Offsetting Revenue										
Secure Property Taxes**	$ 13,329	$ 14,203	$ 15,204	$ 16,615	$ 15,500	$ 15,965	$ 16,444	$ 16,937	$ 17,445	$ 17,969
Unsecured Property Taxes	$ 1,829	$ 1,894	$ 1,936	$ 1,982	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000	$ 2,000
Interest Earned***	$ 10,636	$ 19,148	$ 12,669	$ 15,173	$ 11,933	$ 11,933	$ 11,933	$ 11,933	$ 11,933	$ 11,933
HOPTR	$ 277	$ 278	$ 293	$ 303	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
Annexation Charges	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Connection Charges	$ 9,480	$ 2,510	$ 2,018	$ 10,216	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500	$ 2,500
Miscellaneous Revenue	$ 227	$ 228	$ 314	$ 476	$ 300	$ 300	$ 300	$ 300	$ 300	$ 300
Total Offsetting Revenue	**$ 35,778**	**$ 38,261**	**$ 32,434**	**$ 44,765**	**$ 32,533**	**$ 32,998**	**$ 33,477**	**$ 33,970**	**$ 34,478**	**$ 35,001**
Use of Fund Balance	**$ (2,657)**	**$ (23,523)**	**$ (46,496)**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**	**$ -**
Net Revenue Requirements	**$ 177,770**	**$ 177,491**	**$ 192,105**	**$ 153,224**	**$ 171,396**	**$ 373,909**	**$ 385,637**	**$ 397,717**	**$ 410,160**	**$ 422,975**
Annual Rate Assuming 406 Connections******					**$ 422**	**$ 921**	**$ 950**	**$ 980**	**$ 1,010**	**$ 1,042**

Note:

*Projected CIP is paid for over 5 years.

**Secure Property Tax revenue is assumed to increase at 3% per year

***Interest Earned in projected years is calculated as 5% of Beginning Fund Balance

****Current Rate is $451

Burlingame Hills Average Alternative Fund Balance

Item	1994/95	1995/96	1996/97	1997/98	Projected 1998/99 Budget	Projected 1999/00	2000/01	2001/02	2002/03	2003/04
Beginning Fund Balance	$ 311,330	$ 308,673	$ 285,150	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654
Additions to/(Use of) Balance	$ (2,657)	$ (23,523)	$ (46,496)	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Ending Fund Balance	$ 308,673	$ 285,150	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654	$ 238,654