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

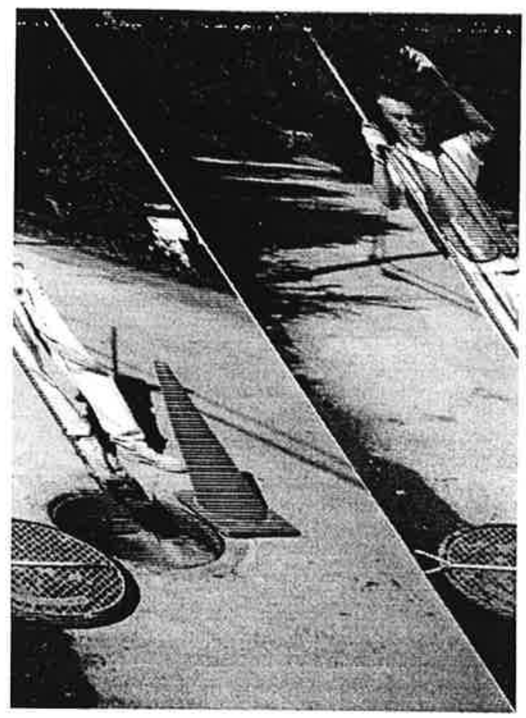
The purpose of this memorandum is to provide the background of how the manholes inspections were conducted, manhole numbering, interpretation of the manhole data, how the data will be used for other parts of the sanitary sewer collection system evaluation, and a summary of critical locations in the districts 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

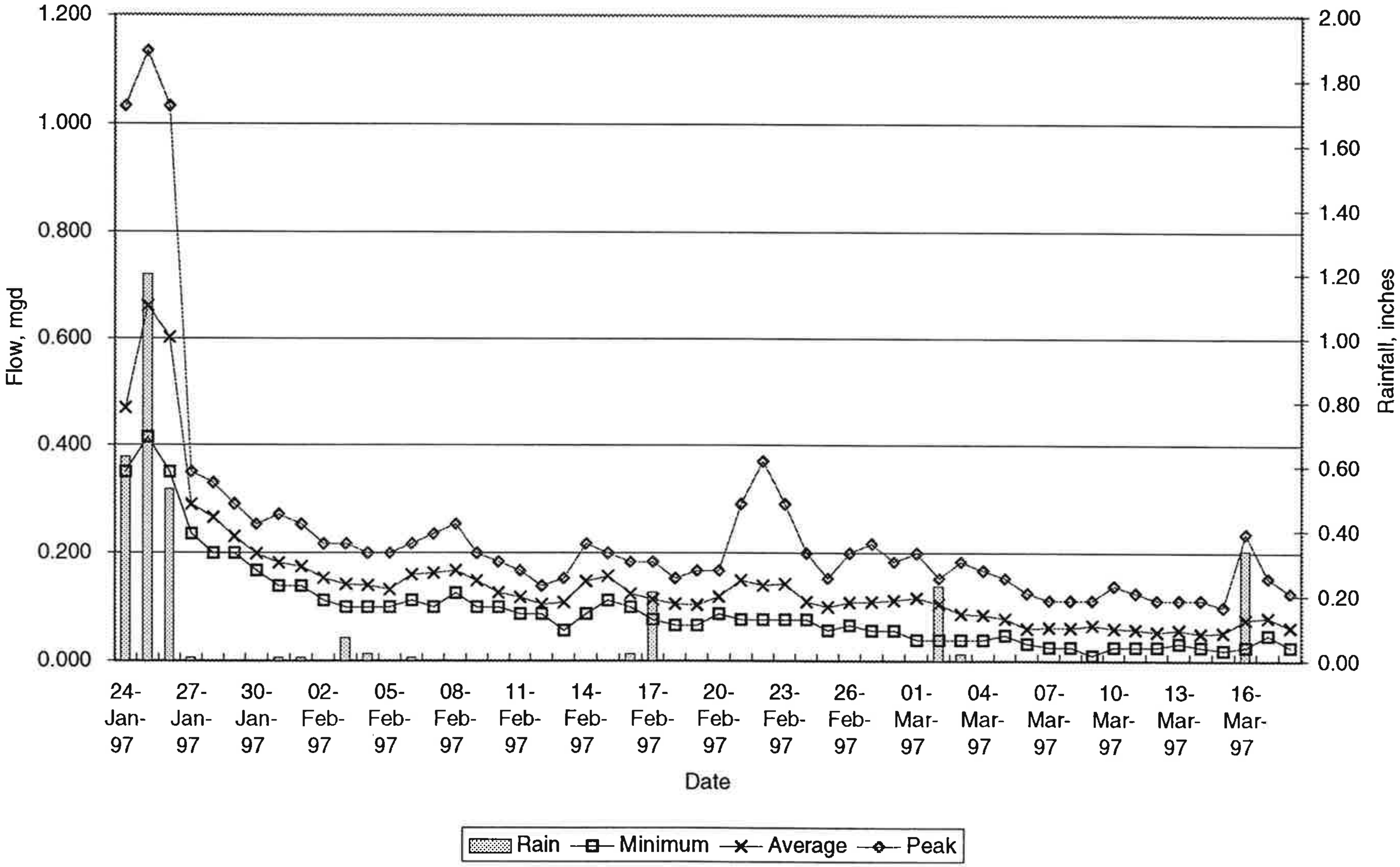
ATTACHMENT A

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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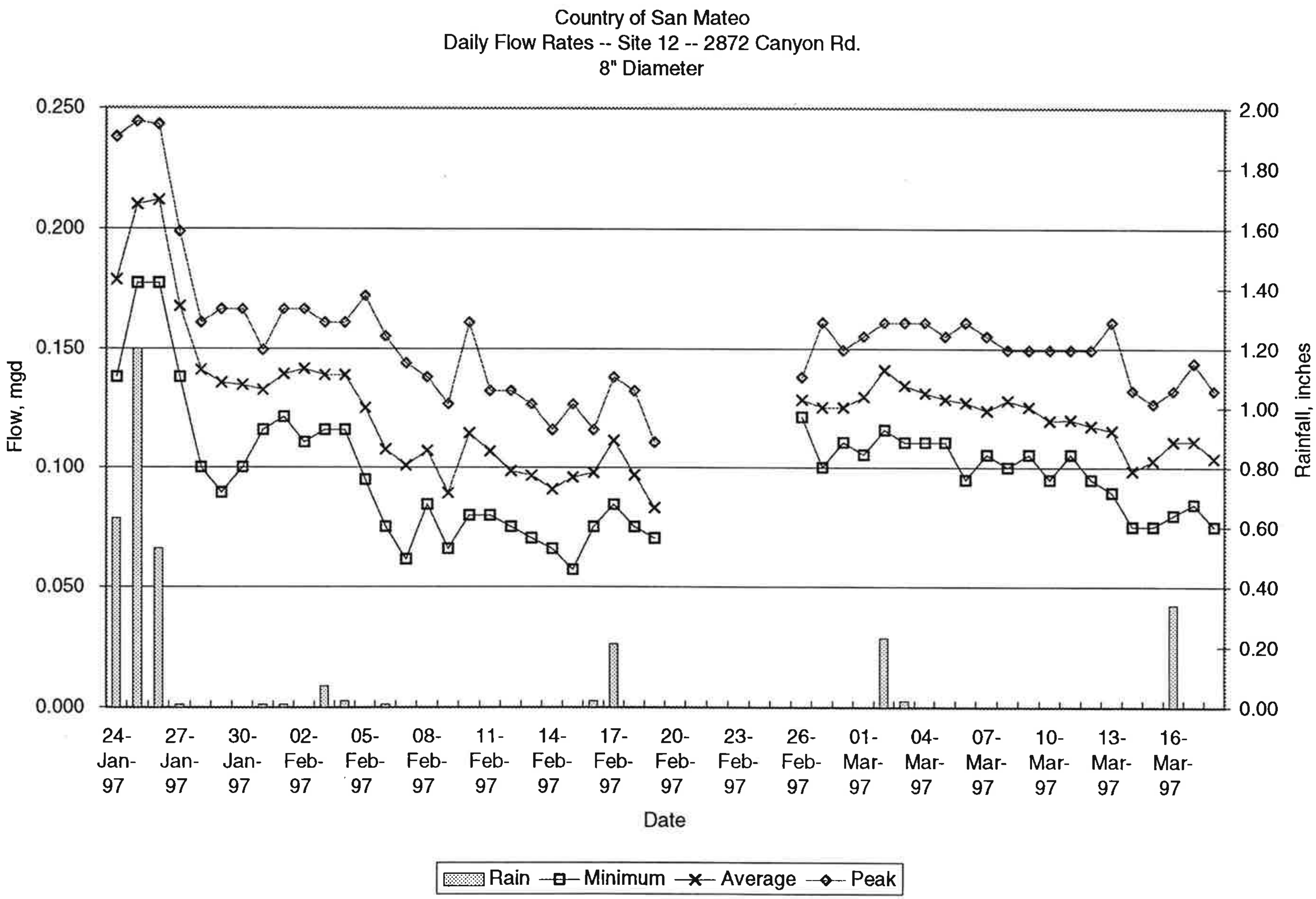

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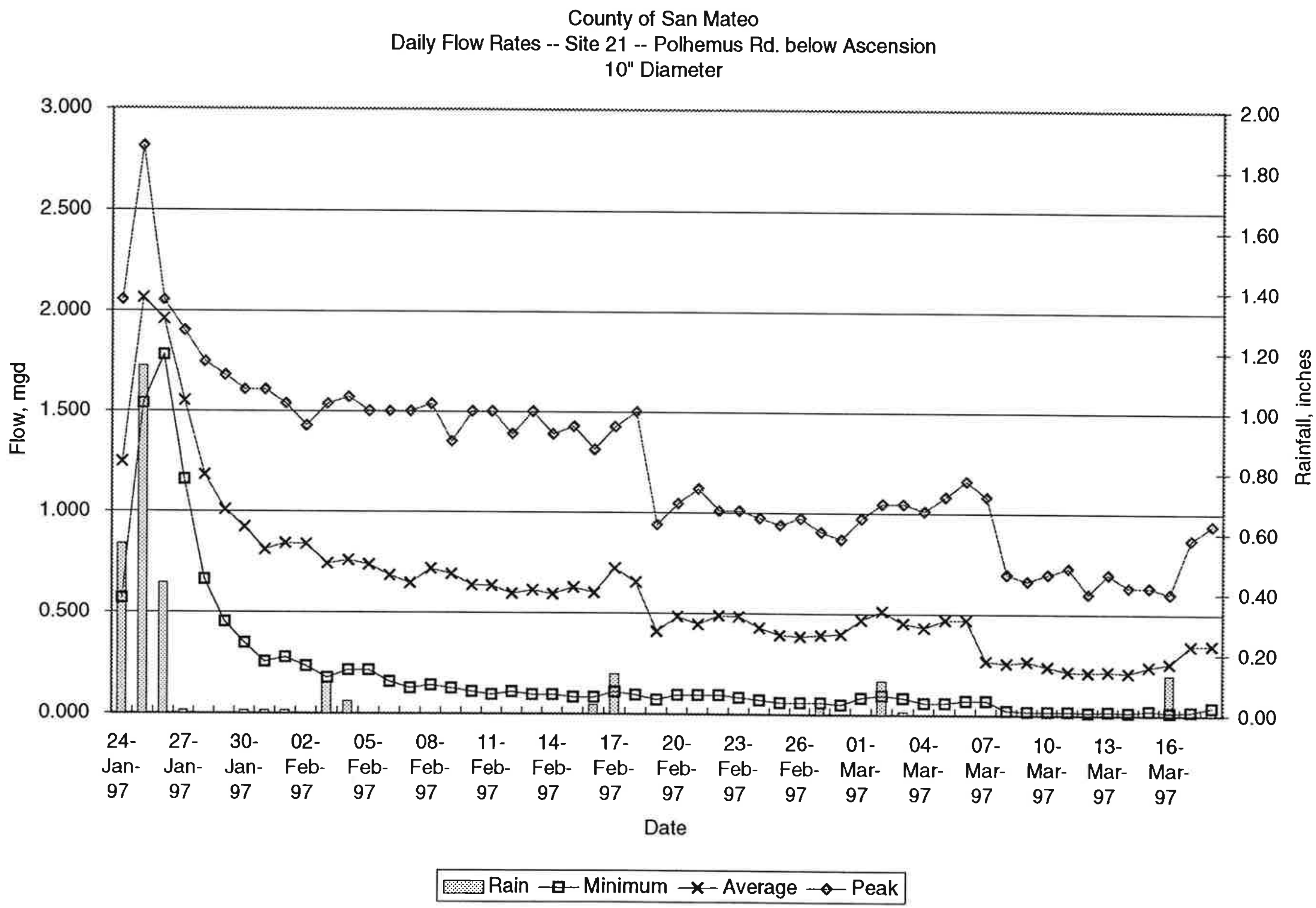

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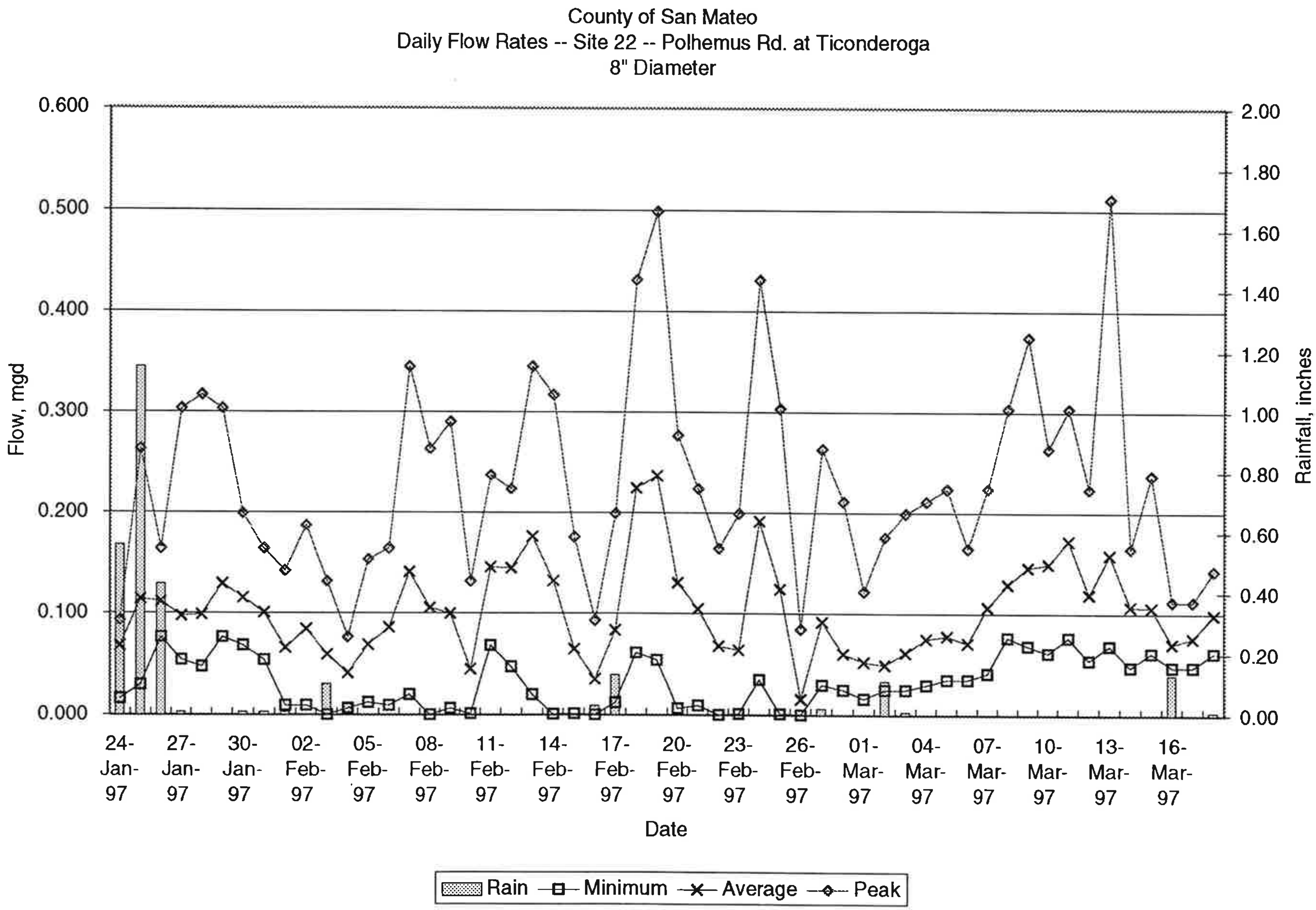

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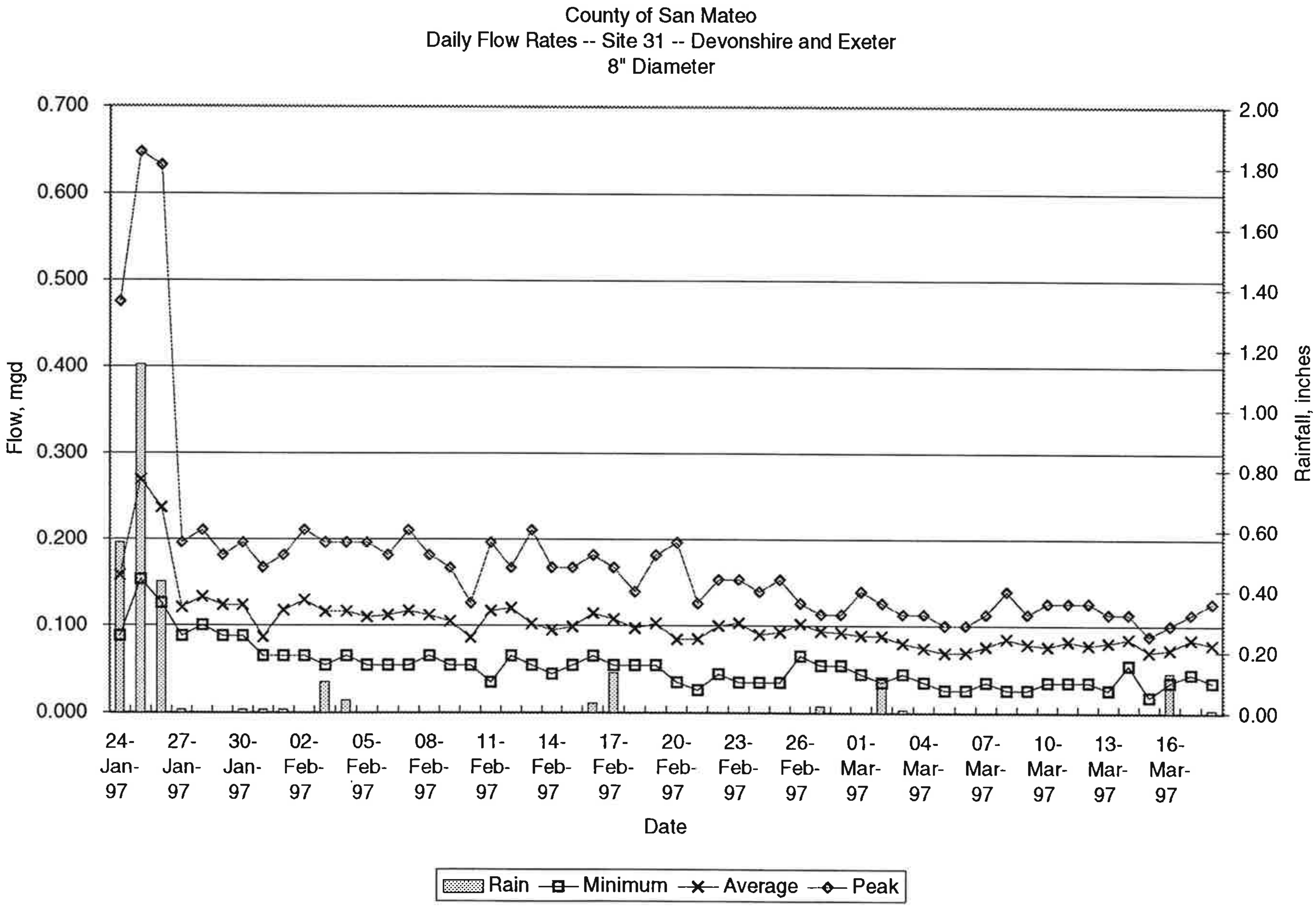

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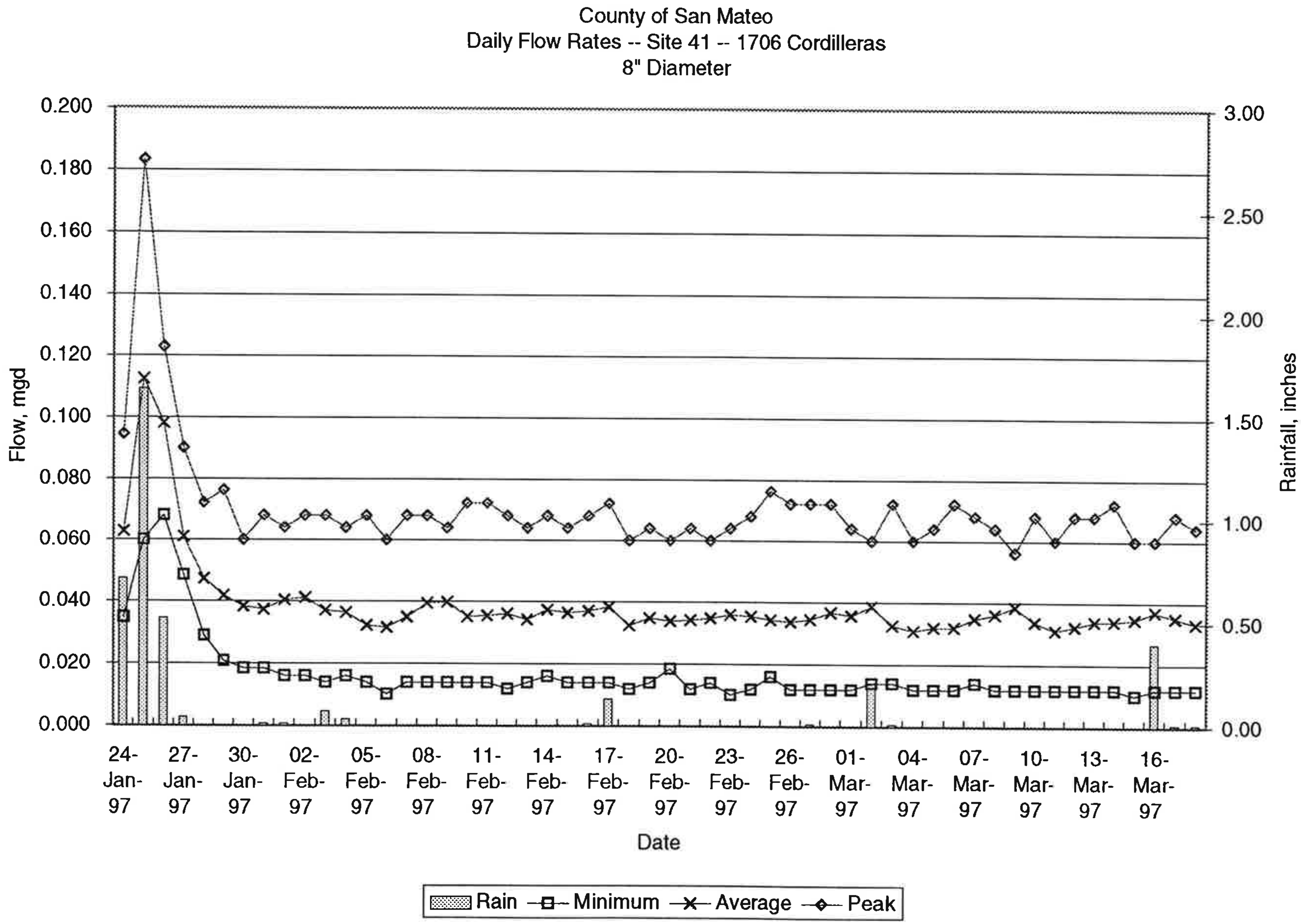

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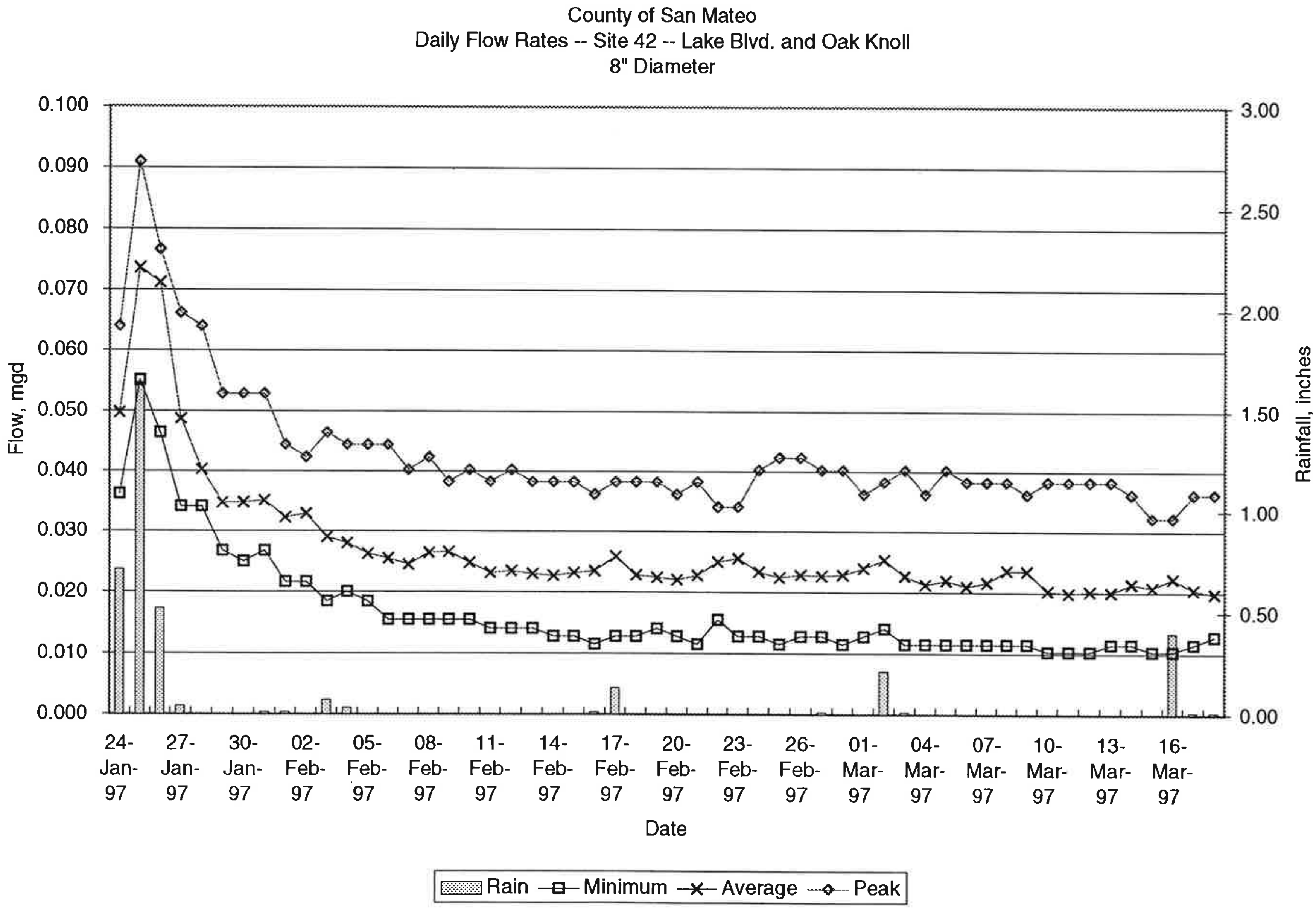

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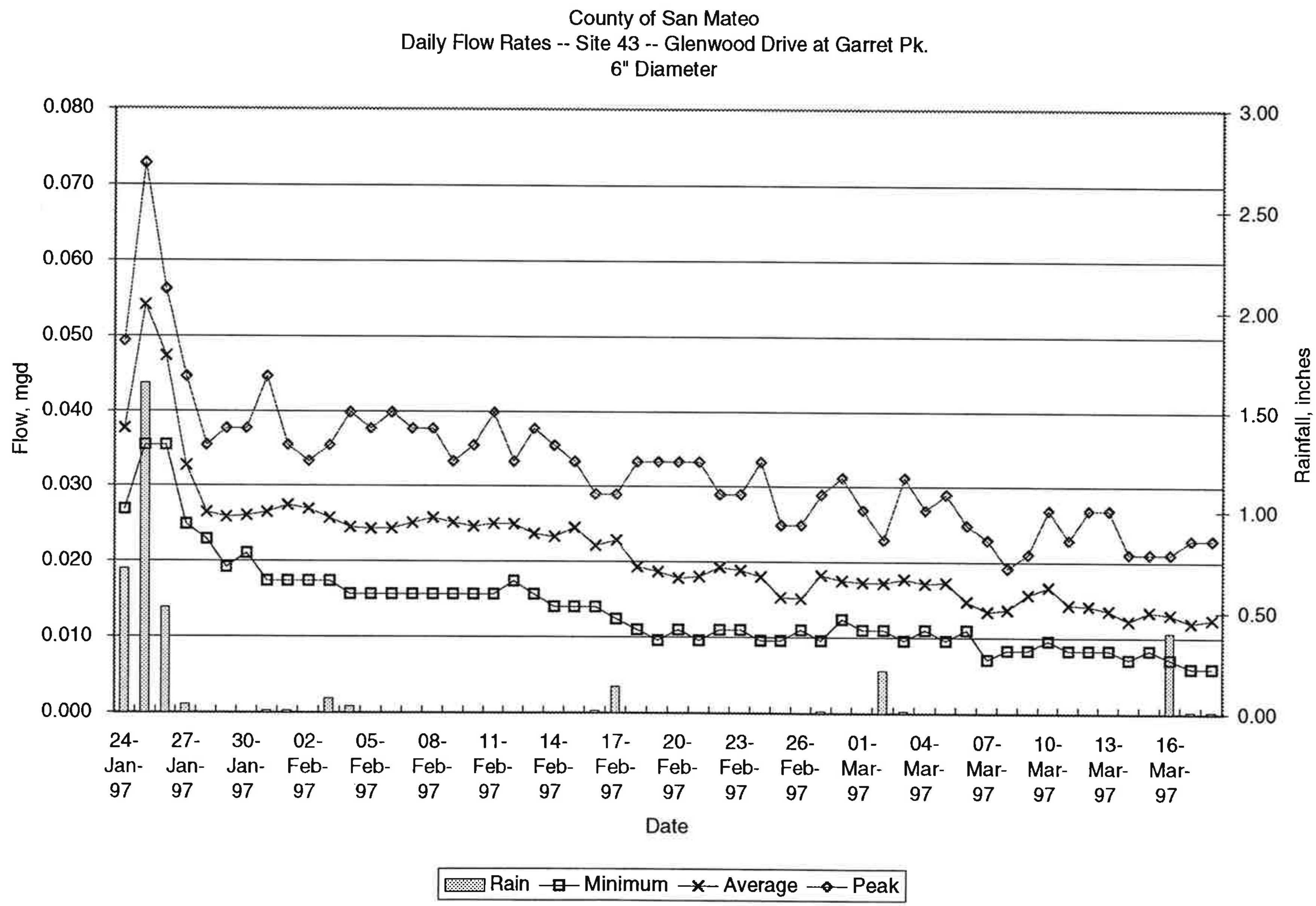

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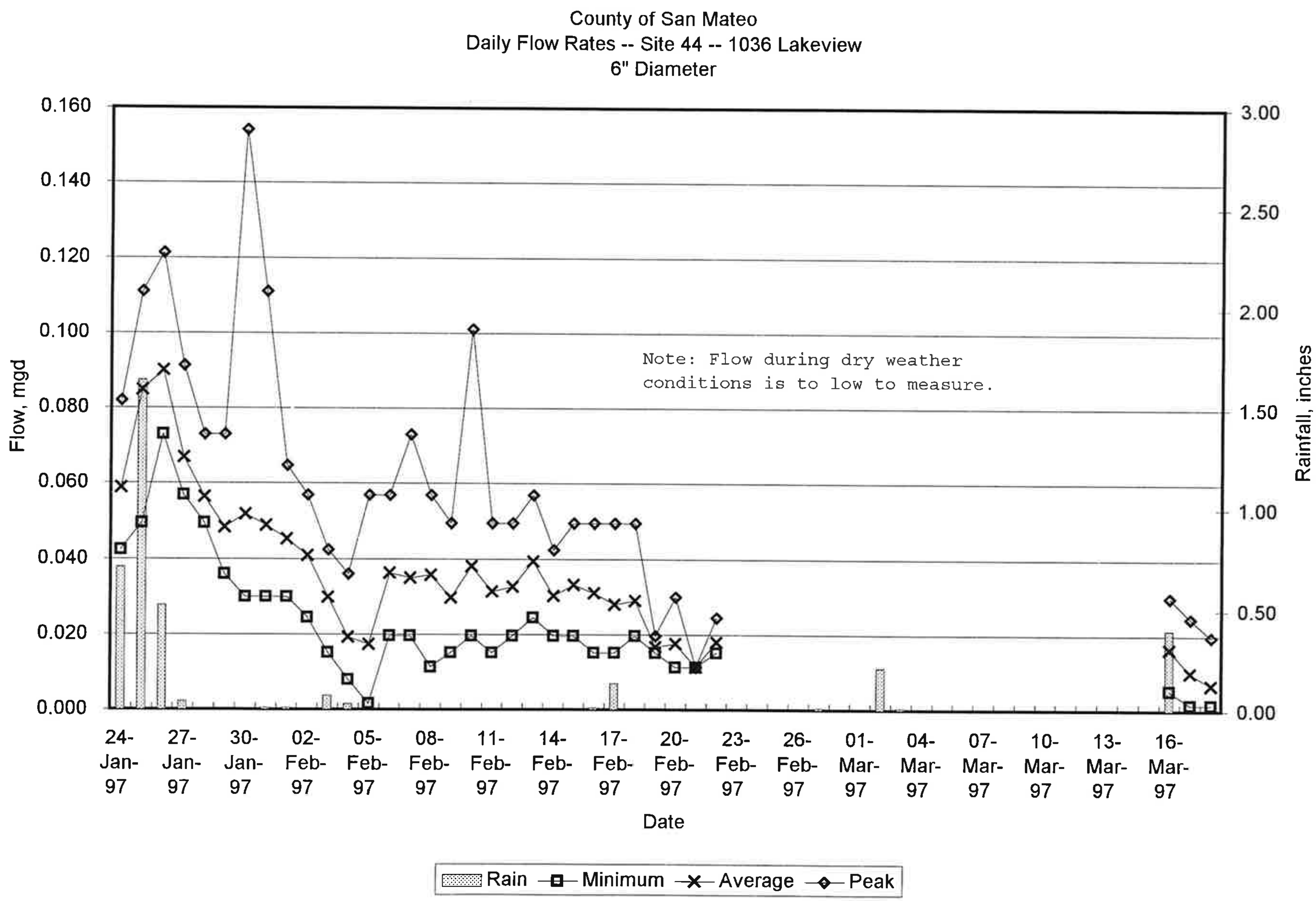

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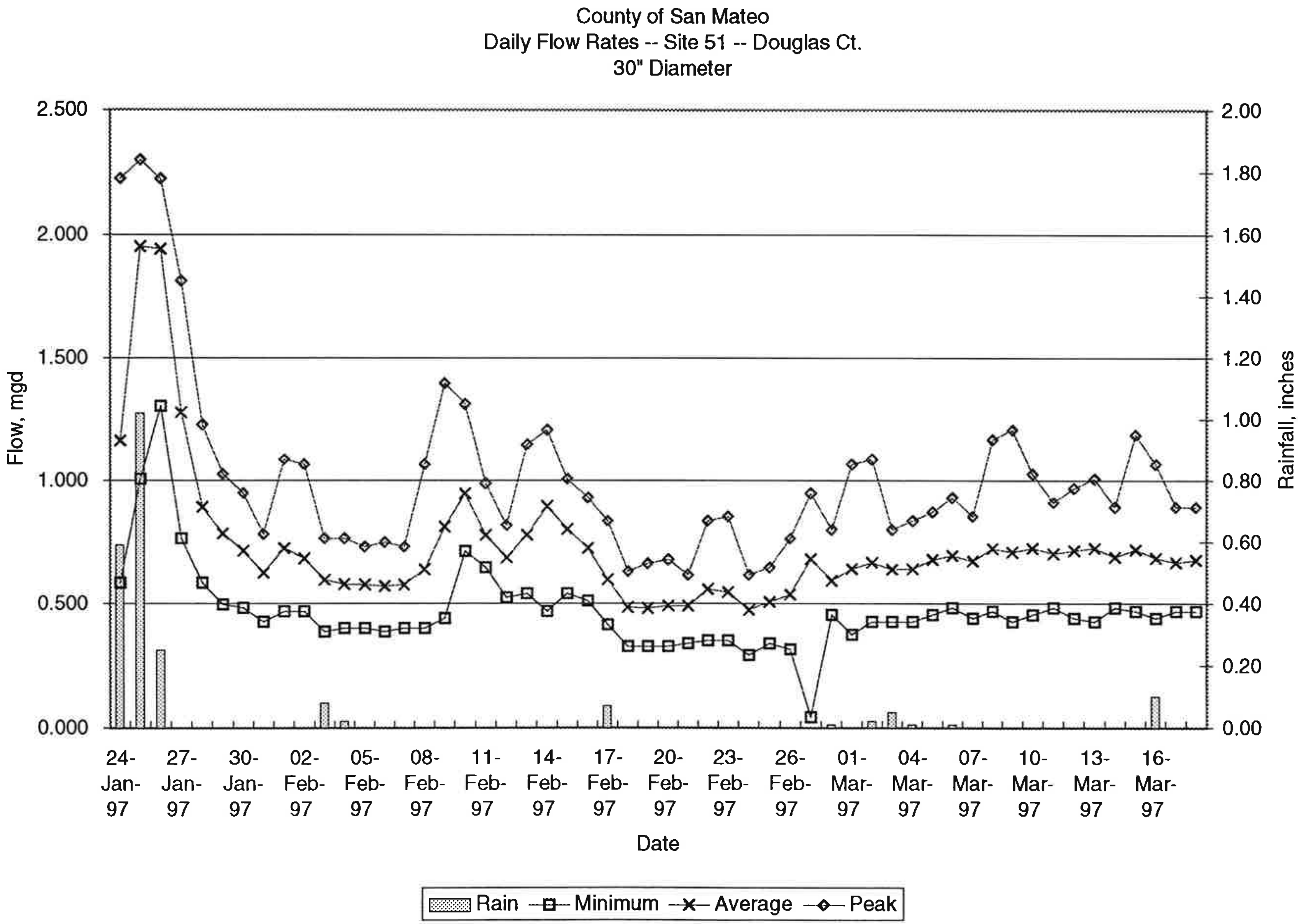

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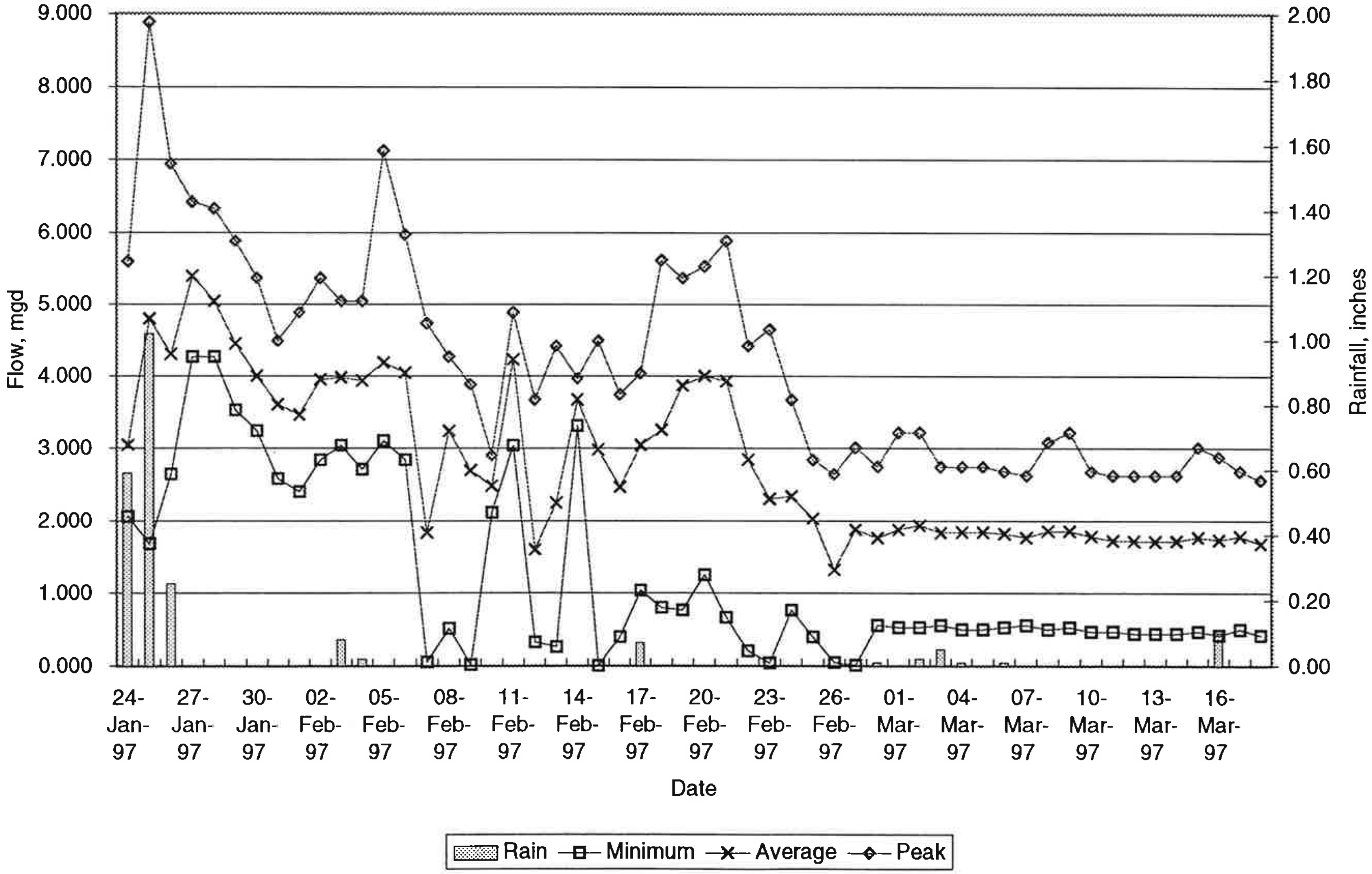
County of San Mateo
Daily Flow Rates -- Site 52 -- Bay Rd. at Willow Street
30" Diameter



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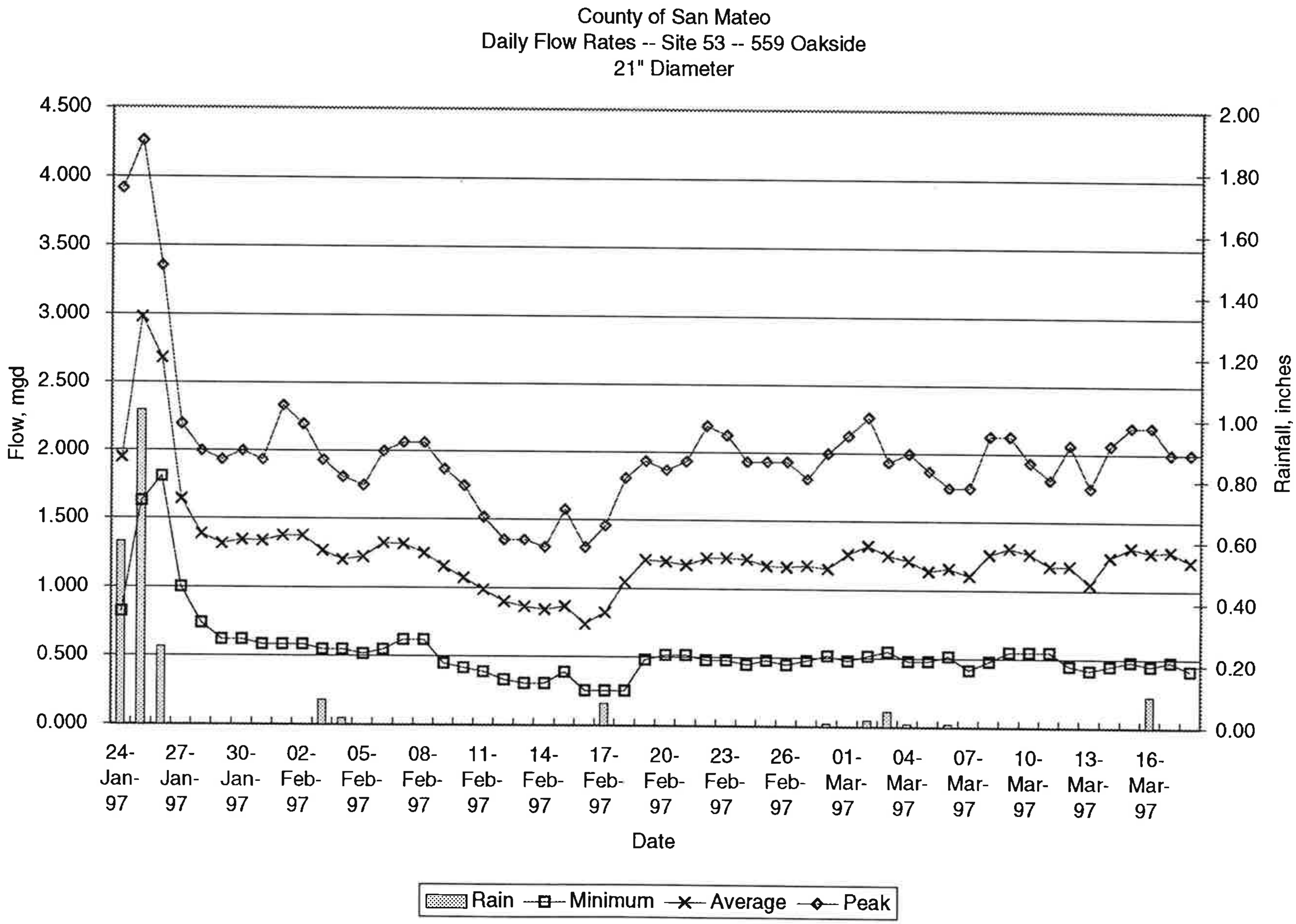

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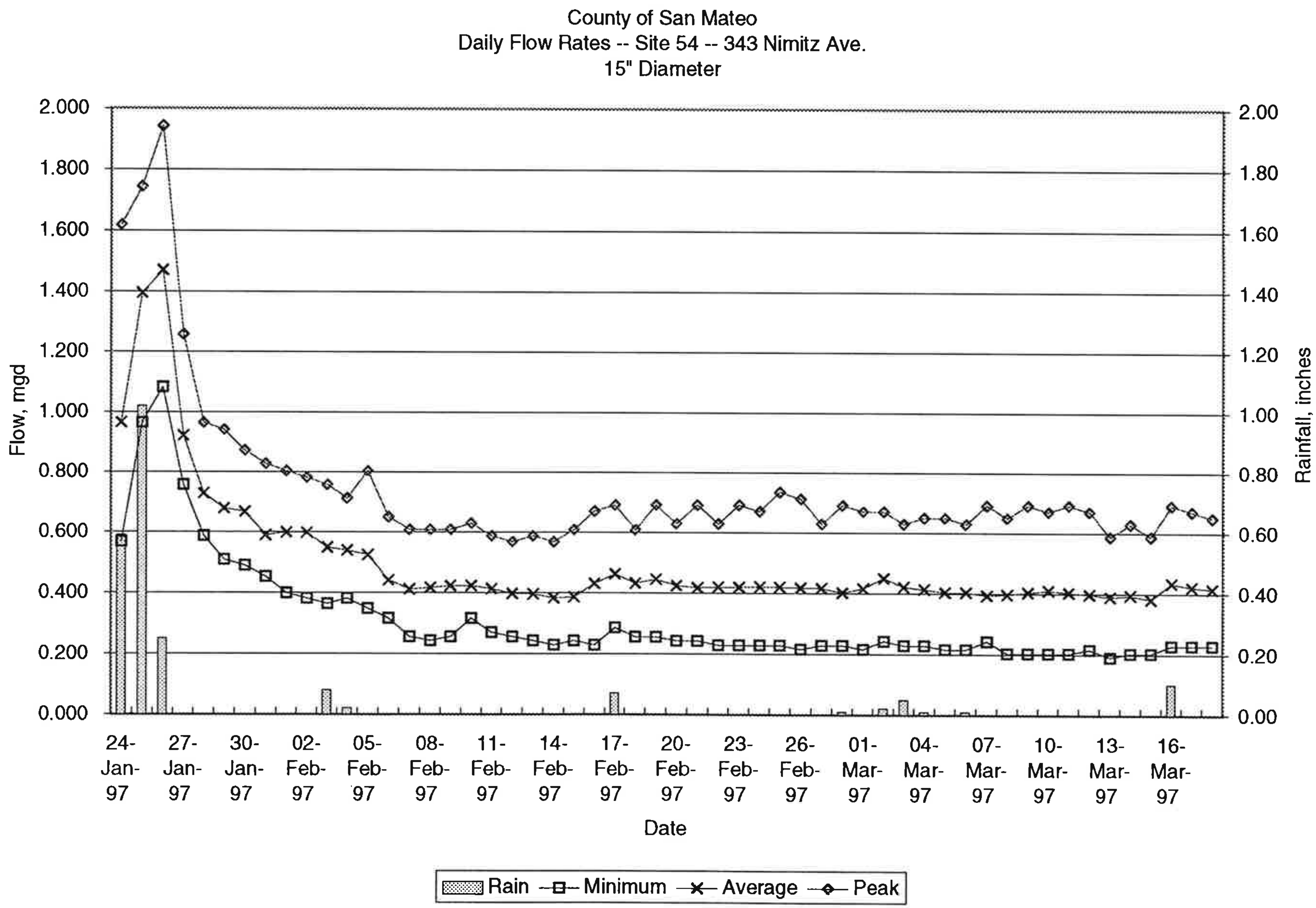

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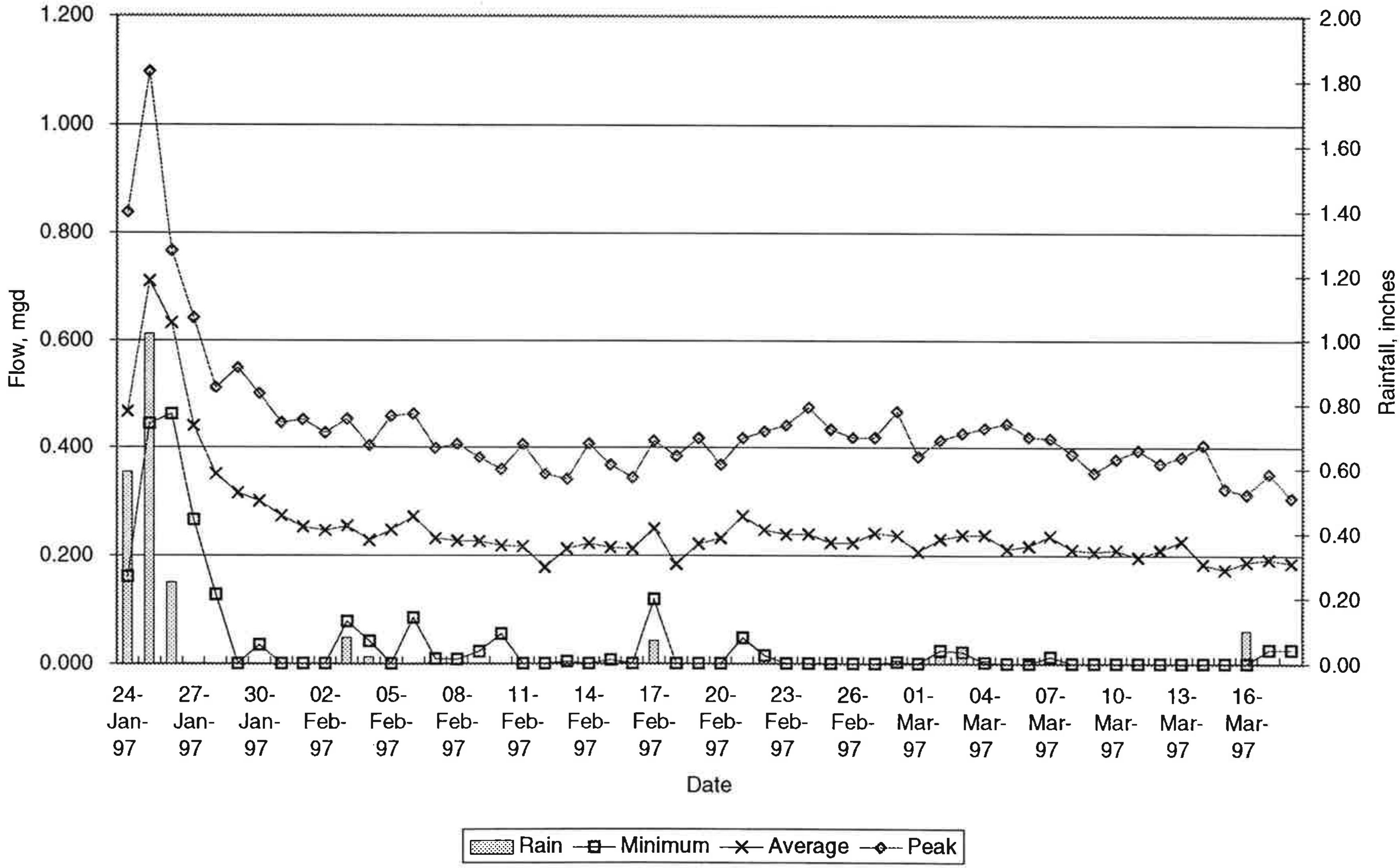
County of San Mateo
Daily Flow Rates -- Site 55 -- Woodside Rd. near Churchhill
10" Diameter



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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	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
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	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
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