Technical Report Documentation Page

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Water Pollution Aspects of Particles Which Collect on Highway Surfaces

5. REPORT DATE
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7. AUTHOR(S)
Richard B. Howell , P.E.

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Sacramento, California 95819

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This research was performed under the Federal Highway Administration Project A--8-20.

16. ABSTRACT
Caltrans studied the nature of constituents in pavement runoff waters at three sites during the winter of 1975 through winter of 1977. Sample sites were located at I-405 Los Angeles, I-680 Walnut Creek, and Route 50 Placerville. Discrete samples were obtained at various times during storm runoff and tested at the Transportation Laboratory in Sacramento. Some 34 different physical, chemical, and biological parameters were measured. This report presents the findings of this study. This information can be used in assessing environmental effects of transportation systems on water quality.

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Water pollution, highway runoff, constituents in pavement runoff.

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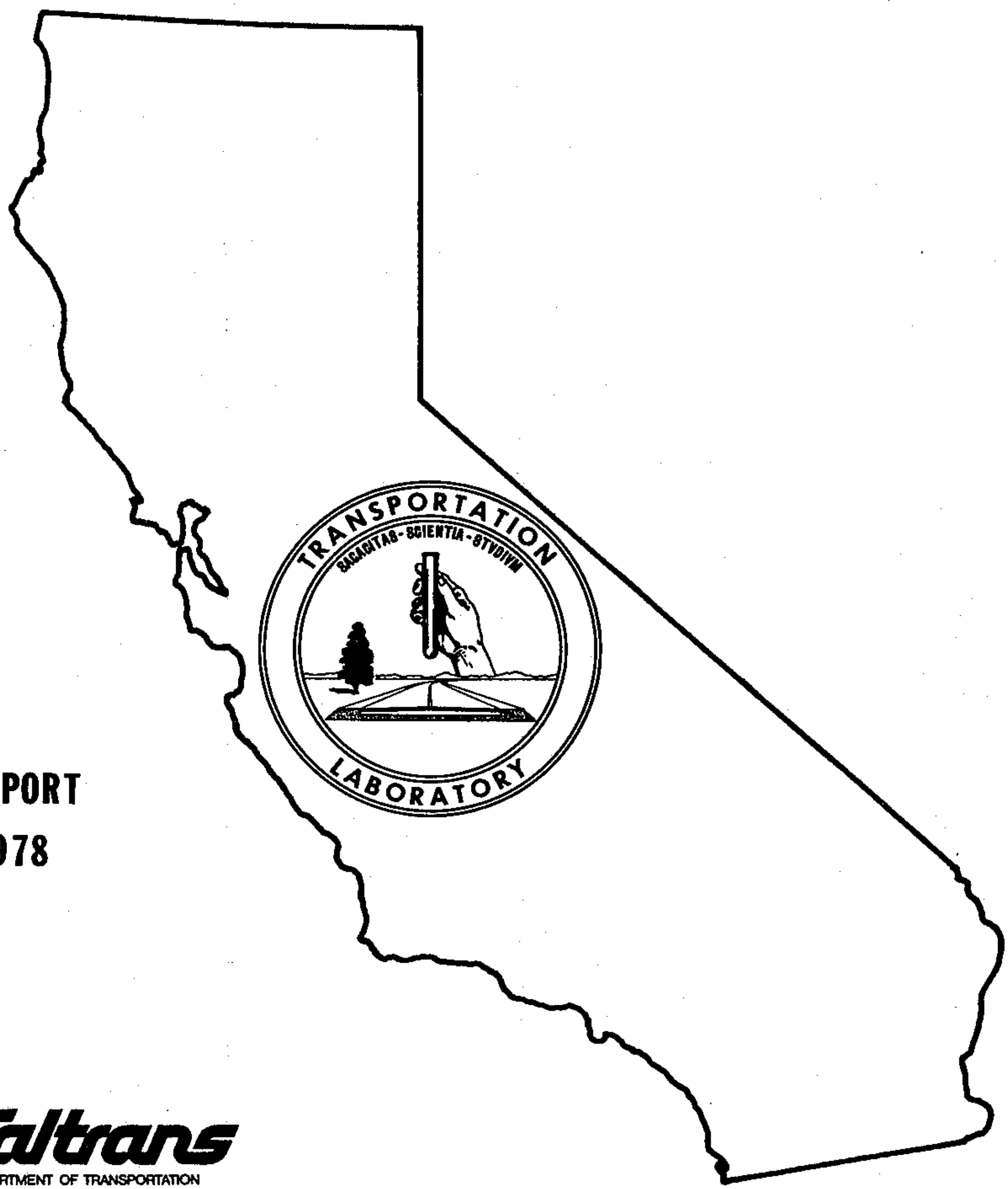
REPORT NO. FHWA-CA-TL-78-22

WATER POLLUTION ASPECTS OF PARTICLES WHICH COLLECT ON HIGHWAY SURFACES



FINAL REPORT

JULY 1978

Caltrans

CALIFORNIA DEPARTMENT OF TRANSPORTATION

NOTICE

The contents of this report reflect the views of the Office of Transportation Laboratory which is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views or policies of the State of California or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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TECHNICAL REPORT STANDARD TITLE PAGE

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17. KEY WORDS	18. DISTRIBUTION STATEMENT
Water pollution, highway runoff, constituents in pavement runoff.	No restrictions. This document is available to the public through the National Technical Information Service, Springfield, VA 22161

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STATE OF CALIFORNIA
DEPARTMENT OF TRANSPORTATION
DIVISION OF CONSTRUCTION
OFFICE OF TRANSPORTATION LABORATORY

July 1978

FHWA No. A-8-20
TL No. 657117

Mr. C. E. Forbes
Chief Engineer

Dear Sir:

I have approved and now submit for your information this final research project report titled:

WATER POLLUTION ASPECTS OF PARTICLES WHICH COLLECT ON HIGHWAY SURFACES

Study made by . . . . Enviro-Chemical Branch

Under the Supervision of . . . . Earl C. Shirley, P.E.

Principal Investigator . . . . . . Richard B. Howell, P.E.

Co-Investigator . . . . Richard J. Spring, P.E.

Report Prepared by . . . . Richard B. Howell, P.E.

Assisted by . . . . James A. Racin, Donald I. Nakao, and Martin E. Nolan

Very truly yours,

GEORGE A. HILL
Chief, Office of Transportation Laboratory

Attachment
RBH:cj

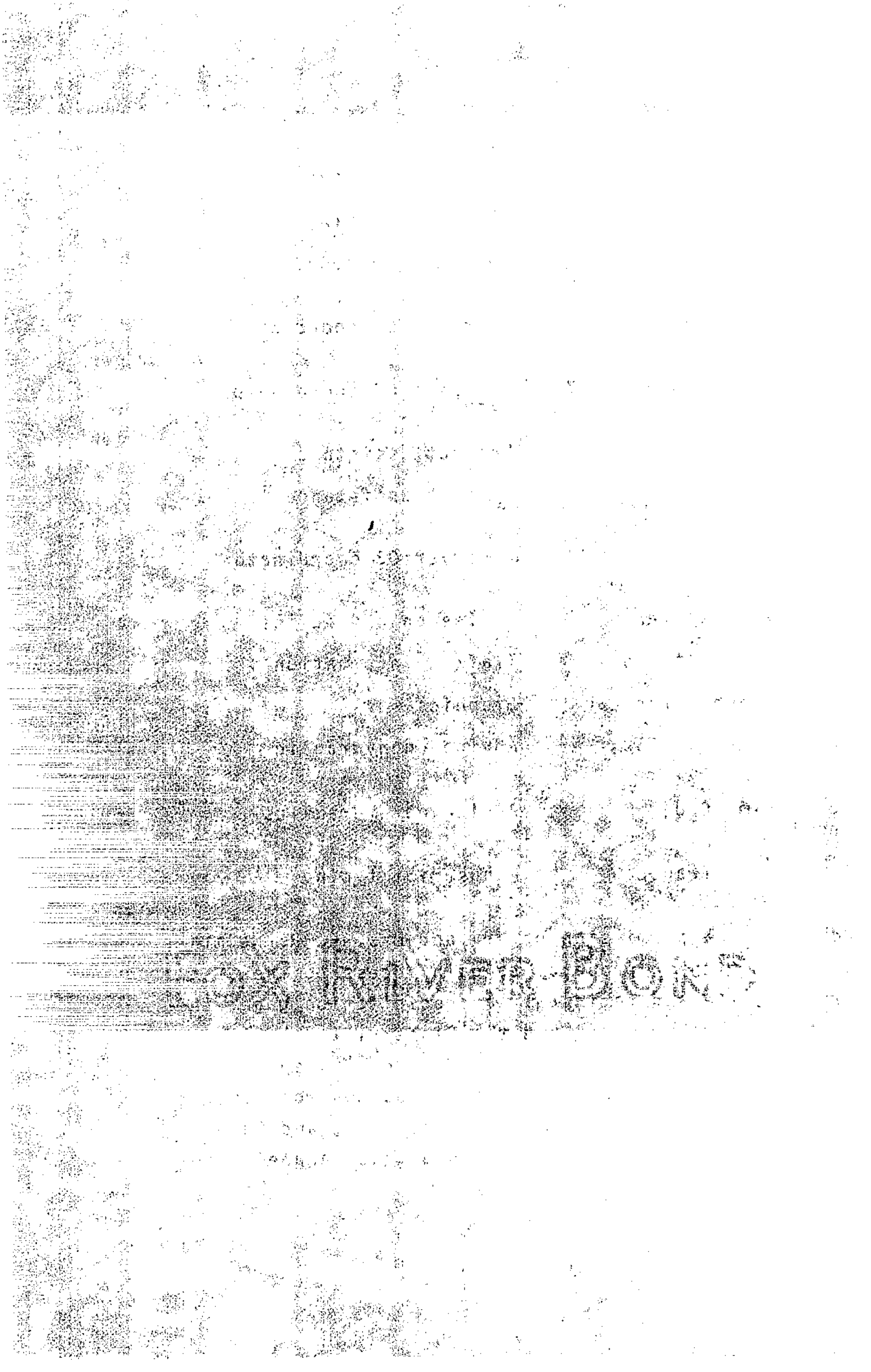
ACKNOWLEDGEMENTS

Many individuals were involved in various phases of the project and at different times. The valuable contribution of these people is deeply appreciated. Some have since left Caltrans or changed assignments. For those who have left the organization, their current agency is listed.

Earl Shirley, TransLab	Study guidance and advice
Byron Lord, FHWA W.O.	Advice and Coordination with other similar research projects
Herb Gregory, FHWA Reg. IX	Advice on hydraulics and sampling
Richard Wasser, WRCB	Project study engineer 1974-75
John Adams, WRCB	Project study engineer 1975 and project assistance
Joe Pantalone, ARB	Project study engineer 1976, sampling and chemical testing
Don Nakao, TransLab	Project study engineer 1976 and project assistance
Richard Spring, TransLab	Project study engineer 1977-78
Gary Winters, TransLab	Project assistance, sampling, chemical testing and biology
Martin Nolan, TransLab	Project assistance
Patrick Monahan, TransLab	Project assistance
Phil Caruso, TransLab	Project assistance and chemical testing
Jeff Gidley, TransLab	Project assistance
James Racin, TransLab	Project assistance

Joe Halterman, Energy Commission	Project assistance
David Smith, TransLab	Chemical testing
Bill Chapman, TransLab	Chemical testing
Tom Tanton, Energy Commission	Chemical testing
Jean Smart, District 07	District 07 coordinator 1975-76
Eli Greengard, District 07	District 07 coordinator 1977-78
Jim Ito, District 07	Project assistance
Dorothy Uyehara, District 07	Project assistance
Robert Skidmore, District 03	District 03 coordinator
Roy Chalmers, Caltrans	Advice on hydraulics
Emery Stoker, Caltrans	Traffic information
Elmer Wigginton, TransLab	Graphics
Dr. Kenneth Kerri, CSU, Sacramento	Advice on hydraulics
Dr. Young Kim, CSU, Los Angeles	Advice on hydraulics
Carol Johnson, TransLab	Manuscript typing

In addition, the permission of Mr. and Mrs. E. R. Helmrich for the use of their property to gain access to the Placerville site and to install a precipitation gage; the cooperation of Dale Tourne and the Placerville maintenance crew in the culvert modification and street sweeping information; the Los Angeles County Flood Control District for permission to use their maintenance road, and to construct a foot bridge over their drainage channel; the



maintenance crew at the Caldecott Tunnel who provided information on weather; Nick Bakaldin, Bill Travis, and Earl Smitten of District 04 for their assistance in obtaining site approval, access and drainage modifications for Walnut Creek; the TransLab Shop personnel who built the flow monitoring flume for Placerville; students Don Hansen and Geary Long of California State University, Sacramento, for flume calibration; and many others who individually provided help, appreciation is extended.

And finally, several people in other states shared ideas, information on their in-state work, and responded to requests. Among these were:

Dave Pederson	Minnesota Department of Highways
Bob Aye	Washington State Highway Commission
Larry Barfield	Florida Department of Transportation
George Cramer	Louisiana Department of Transportation
Joe Armijo	Montana State University
Mahendra Gupta	Envirex, Inc.

To these people, I sincerely express my thanks.

CONVERSION FACTORS

English to Metric System of Measurement

Quantity	English unit	Multiply by	To get metric equivalent
Length	inches (in)	25.4	millimetres (mm)
		.0254	metres (m)
	feet (ft)	.3048	metres (m)
	miles (mi)	1.6093	kilometres (km)
Area	square inches (in^2)	6.4516×10^{-4}	square metres (m^2)
	square feet (ft^2)	.092903	square metres (m^2)
	acres	4046.9	square metres (m^2)
		.40469	hectares (ha)
		.40469	square hectometres (hm^2)
		.0040469	square kilometres (km^2)
	square miles (mi^2)	2.590	square kilometres (km^2)
Volume	gallons (gal)	3.7854	litres (l)
		.0037854	cubic metres (m^3)
	million gallons (10^6 gal)	3785.4	cubic metres (m^3)
	cubic feet (ft^3)	.028317	cubic metres (m^3)
	cubic yards (yd^3)	.76455	cubic metres (m^3)
	acre-feet (ac-ft)	1233.5	cubic metres (m^3)
		.0012335	cubic hectometres (hm^3)
		1.233×10^{-6}	cubic kilometres (km^3)
Volume/Time (Flow)	cubic feet per second (ft^3/s)	28.317	litres per second (l/s)
		.028317	cubic metres per second (m^3/s)
	gallons per minute (gal/min)	.06309	litres per second (l/s)
		6.309×10^{-5}	cubic metres per second (m^3/s)
	million gallons per day (mgd)	.043813	cubic metres per second (m^3/s)
Mass	pounds (lb)	.45359	kilograms (kg)
	tons (short, 2,000 lb)	.90718	tonne (t)
		907.18	kilograms (kg)
Power	horsepower (hp)	0.7460	kilowatts (kW)
Pressure	pounds per square inch (psi)	6894.8	pascal (Pa)
Temperature	Degrees Fahrenheit (°F)	$\frac{tF - 32}{1.8} = tC$	Degrees Celsius (°C)

[illegible]

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CONCLUSIONS AND RECOMMENDATIONS

The following conclusions are made as a result of this study:

1. Results from this study show that there is an apparent peak concentration of metals and nutrients (nitrate, ammonia, Kjeldahl nitrogen, total phosphate and orthophosphates) and high conductivity at the beginning of storm runoff. The concentrations of these materials and conductivity decrease significantly with continuing storm water runoff.

2. Total solids and total suspended solids concentrations appear to follow the variation in the runoff hydrograph. The volatile portion of the solids (indicative of the organic material that is combustible) varied from 20-40% to 60-90%. There does appear to be a significant relationship between solids buildup and dry weather (period between storms). The peak total solids recorded during this study occurred at 45 days between storms.

3. Chemical Oxygen Demand and Oil and Grease also showed concentrations that tended to vary with the magnitude of the runoff hydrograph although not proportionately. There does appear to be a peak concentration that is reached at some point during the storm runoff.

4. The parameters, related to highways, that appear to be most important in terms of water quality standards were:

Boron	Iron
Chemical Oxygen Demand	Lead
Conductivity	Zinc
Nitrate	Oil and Grease
Kjeldahl Nitrogen	pH
Ammonia	Sulfate
Total Phosphate	Total Solids
Orthophosphate	Total Suspended Solids

In all cases, except for Total Suspended Solids and pH, the storm runoff that produced the highest concentrations occurred after a significant dry spell between storms. Further analysis of the data will be performed under a new research study A-8-50 "Modeling Transportation Pavement Runoff".

5. The parameters showing lower levels of concentration, similar to concentrations in non-highway drainages, were:

Bicarbonate	Chromium
Carbonate	Copper
Silica	Magnesium
Chloride	Manganese
Sodium	Mercury
Potassium	Molybdenum
Calcium	Nickel
Cadmium	

Additional analysis of the data will be performed under a new research study A-8-50 "Modeling Transportation Pavement Runoff".

6. One sample was taken at the Los Angeles site and tested for asbestos and Biochemical Oxygen Demand (BOD). The asbestos test results did not show a significant contribution from the roadway. These tests were expensive and required use of the electron microscope. Since a significant amount of asbestos fiber was not found in the initial sample and adequate funds for running this test were not included in the research, no further testing was performed. Further testing for asbestos needs to be performed (See Recommendation 4). BOD test results also did not show a high oxygen demand. Since field samples could not be delivered to the laboratory for testing within a period of 6-24 hours, this test was deleted and Chemical Oxygen Demand was run instead.

7. Dustfall analyses were performed during two 30-day test periods at the Los Angeles I-405 site. Results showed that there was an increase in dustfall in the downwind direction of the freeway compared with upwind dustfall. The origin of the particulate matter and the transport mechanism were not investigated.

8. It was concluded that the data derived in this study are suitable for use in developing a predictive model for highway runoff.

Based on these conclusions and other aspects of the project, the following recommendations are made:

1. Results from this study should be analyzed in terms of correlations with traffic, precipitation, maintenance practices, and land use. This analysis will be accomplished under a new research project A-8-50 "Modeling Transportation Pavement Runoff".

2. The data should be used to develop a predictive model for forecasting possible concentrations of various constituents in pavement runoff water for environmental assessment documents.

3. Future sampling at field sites should include the use of automatic sampling equipment to capture the first significant runoff and also to reduce field time by sampling personnel.

4. Additional sampling should be performed for asbestos and dustfall, particularly at the Walnut Creek and Placerville sites since this data was only acquired at the Los Angeles site.

5. An alarm system and floodlight should be installed at field sampling sheds to reduce vandalism and thievery.

6. Additional studies should be performed to examine the variables of pavement type, age, and service.

7. Studies should be conducted to ascertain the effectiveness of current street sweeping practices for reducing concentrations of various constituents in pavement runoff water.

8. The three sites used in this study should be used on future pavement runoff studies by Caltrans.

IMPLEMENTATION

Copies of this report will be distributed to FHWA and Caltrans Districts and appropriate Headquarters Offices for their use. The information in the report should be used by the Districts in discussing environmental aspects of proposed transportation projects. A research proposal will be submitted to FHWA requesting approval to proceed with development of a pavement runoff prediction model based on the data developed in this study beginning in F.Y. 1978-79.

INTRODUCTION

Research began in earnest in the late 1960's and early 1970's to determine the nature of constituents in pavement runoff waters. Initial work was performed by URS and the Washington State Highway Commission. The URS work studied concentrations of heavy metals and nutrients resulting from flushing a pavement with a water truck(1). The Washington State Highway Commission work measured pollutant concentrations in runoff water from Route 520 near Seattle(2) during actual rainstorms.

The Transportation Laboratory (TransLab) became interested in the identification of pavement runoff constituents in the early 1970's when the U. S. Environmental Protection Agency solicited State interest in demonstrating the use of a vortex separator to remove solids contained in urban runoff. In reviewing the request for proposals, the question was raised as to what exactly was in pavement runoff water. A literature search showed most information pertained to urban runoff from city streets and very little information was available for highways. Consequently, Caltrans initiated a study with the Federal Highway Administration in the Fall of 1973 to describe and quantify pollutants in highway runoff during storm periods. The study was conducted in the urbanized area of Los Angeles (I-405), the San Francisco Bay Area at Walnut Creek (I-680), and a rural area east of Sacramento near Placerville (Route 50). These locations are shown in Figure 1. Field samples were taken over the winters of 1975-76 through 1977-78, a period of 3 years.

The subject of this report is to present the findings and data from the Caltrans study. Included is information on chemical constituents, flow, precipitation, and traffic.

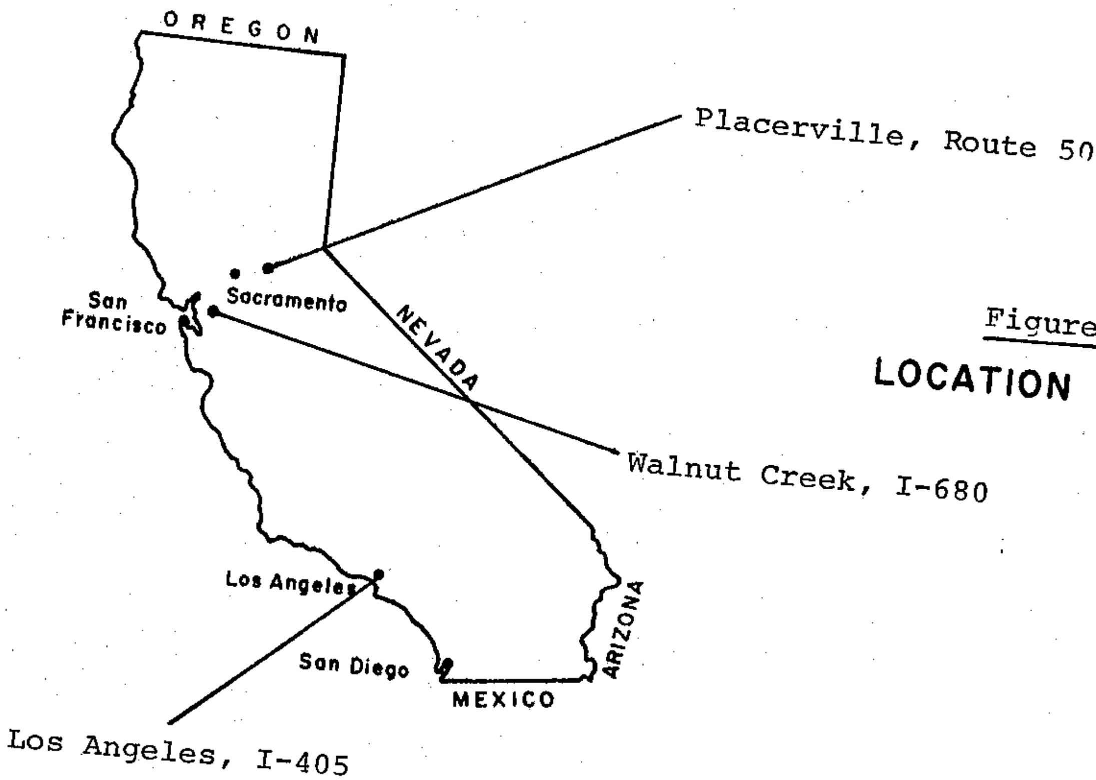


Figure 1

LOCATION MAP

In addition, dustfall was measured over two 30-day periods at the Los Angeles site and was published as an Interim Report entitled "Dustfall Analysis for the Pavement Storm Runoff Study (I-405 Los Angeles)"(3). A summary of the data from the dustfall study is presented in this report.

TransLab also conducted a concurrent study on the effects of pavement runoff on biological systems using the 5-day algal bioassay test. The biological work was performed under an FHWA sponsored research project called "Influence of Highway Erosion Sediments and Water Borne Materials from Roadway Surfaces on Aquatic Biota" (A-8-25). A final report on this work will be published in June 1978(4).

Research on constituents in pavement runoff is also being conducted for FHWA by the Environmental Sciences Division of Envirex. The study is being conducted at highway locations in Pennslyvania, Tennessee, Louisiana, Colorado, and Wisconsin. More recent work was begun in the Fall of 1977 in Washington by the Washington State Highway Commission. The FHWA sponsored research is being carried out by the University of Washington.

In the interim, the U.S. Environmental Protection Agency developed information for estimating concentrations of pollutants in urban and street runoff water. Models have been developed from this information to predict pollutant loadings on receiving waters(5). The model has application for urban stormwater runoff but limited use for highway surfaces.

FHWA is in the process of providing guidance in the development of pavement runoff models for highways. The Caltrans information will provide the basis for developing a model for use in the more arid western states.

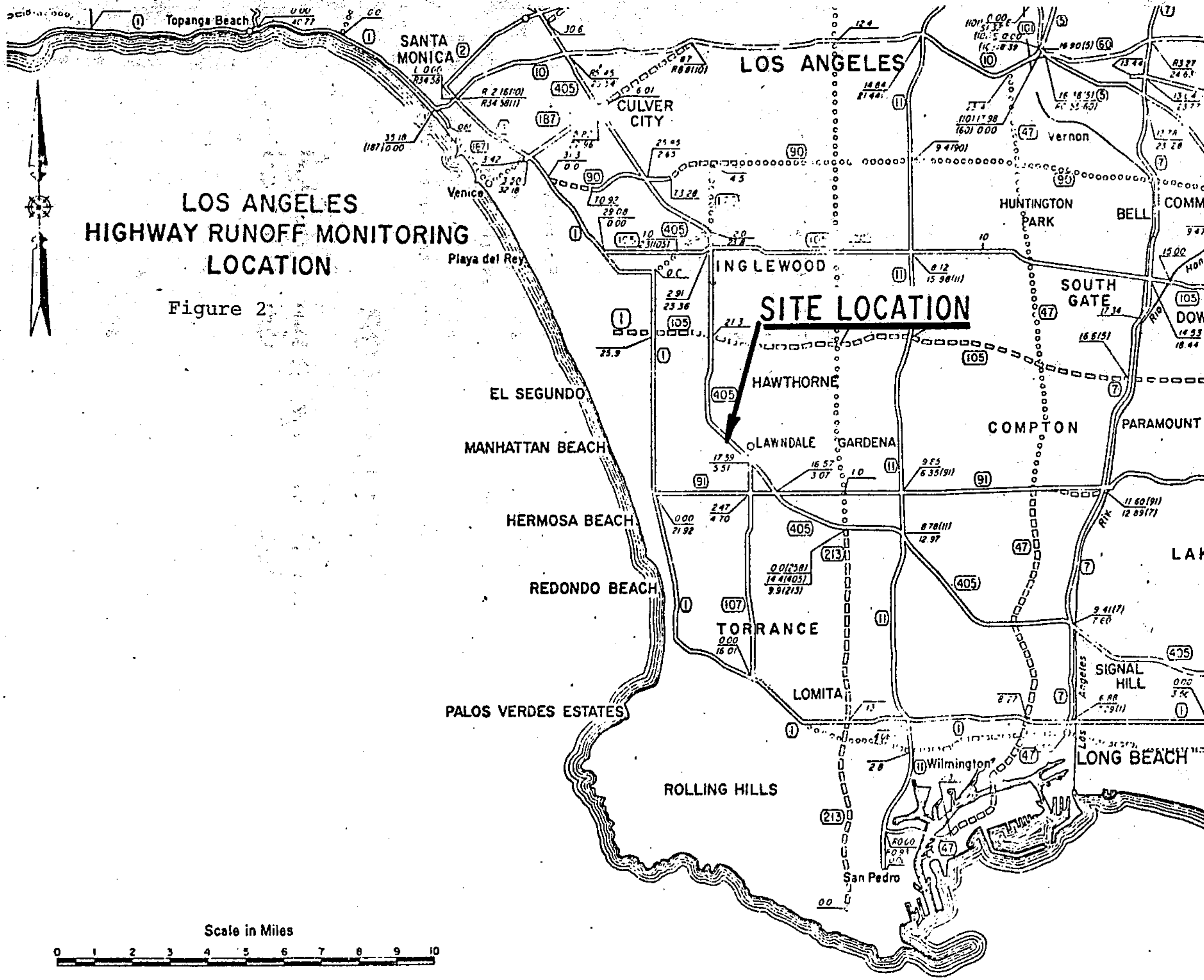
DESCRIPTION OF SITES

Three field sites were selected throughout the state to represent high (185,000), medium (66,000), and low (23,000) average daily traffic (ADT) usage. The sites were selected in regards to safety of field personnel, runoff from paved surface areas only, and a drainage collection network that could be sampled at one convenient point. The search for sites that met these requirements was time consuming and at times frustrating. All of the research time during the first year and a half after approval of the research proposal was taken up in locating good field sampling sites that included only pavement runoff. The sites were selected and equipped in time to sample storm runoff beginning in the Fall of 1975.

Los Angeles, I-405

The first site selected was on the San Diego Freeway (I-405) near P.M. 18 located about 4 miles south of the Los Angeles International Airport. Figure 2 shows the site location and Figure 3 shows the site details. The San Diego Freeway is a major carrier of traffic through the west side of the Los Angeles area.

I-405 is an eight lane freeway with Portland Cement Concrete (PCC) pavement and has a chain link type median barrier. The freeway is on a fill section at this location. Drainage is from about 3.2 acres of freeway. Surface water enters a series of drain inlets and is piped to the west side of the freeway. The drainage water then discharges through a 36" reinforced concrete pipe (RCP) to the Los Angeles Flood Control District (FCD) concrete channel that parallels the freeway at this location.

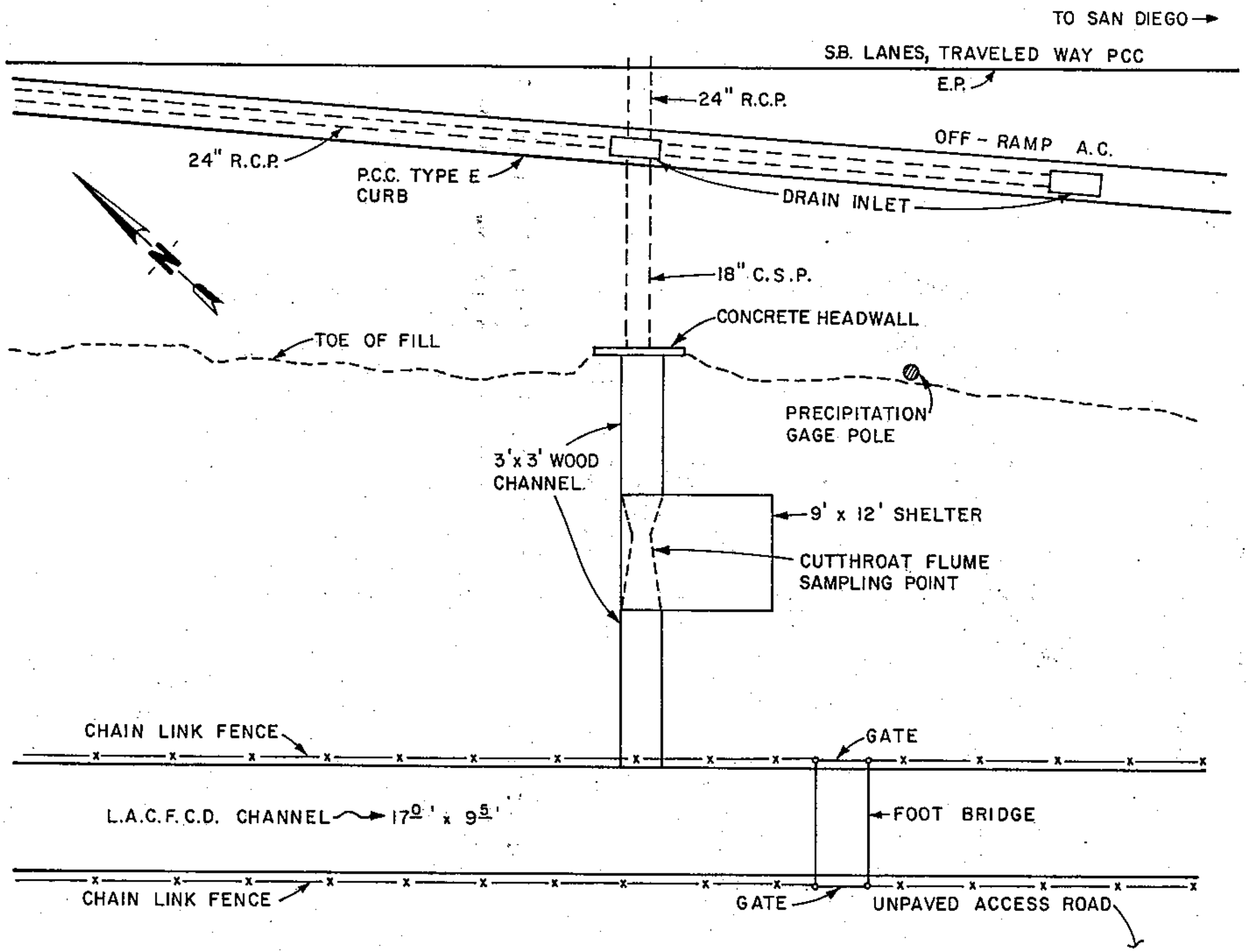


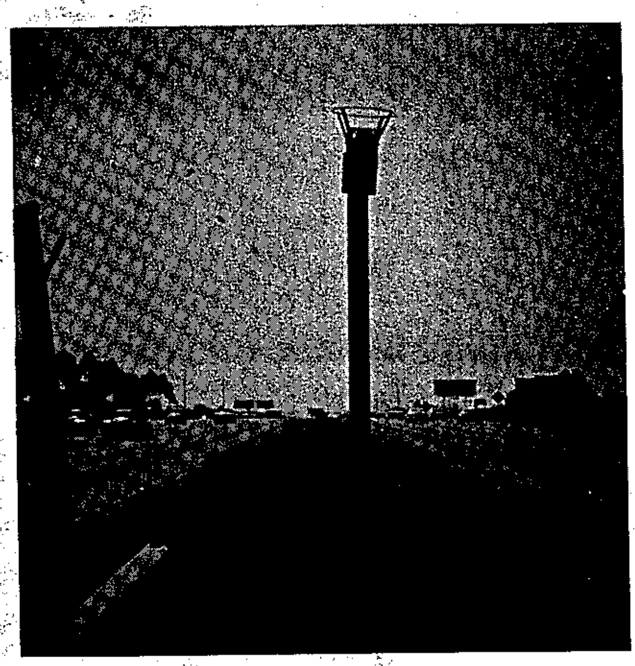
LOS ANGELES
HIGHWAY RUNOFF MONITORING
LOCATION

Figure 2

FIGURE 3

PLAN VIEW
LOS ANGELES RUN-OFF SAMPLE SITE
NOT DRAWN TO SCALE



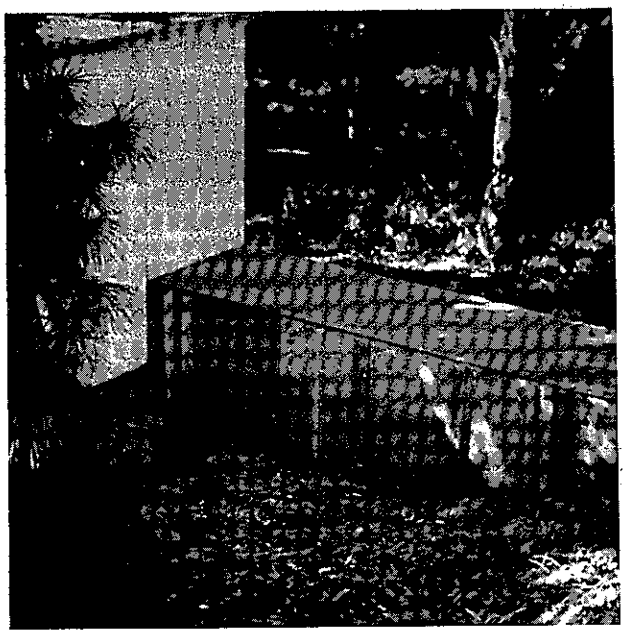


Dustfall collection apparatus in median
I-405, Los Angeles

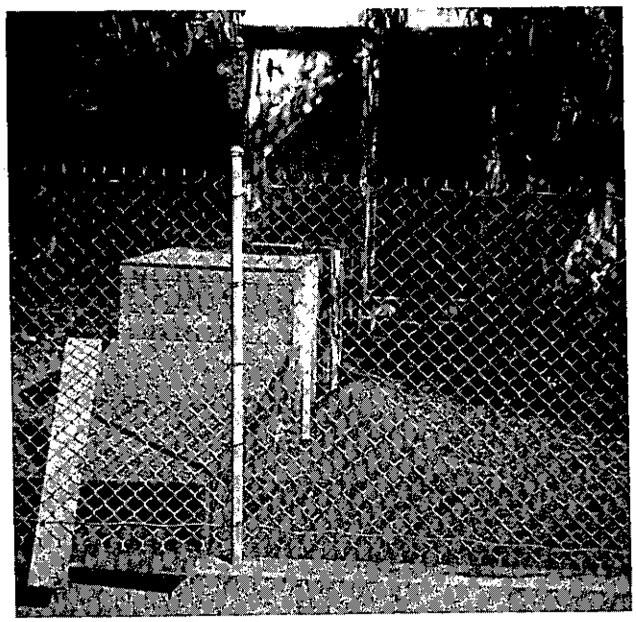
Average daily traffic is around 185,000 vehicles (both directions). Land use consists of light industrial and residential on the east side of the freeway and an open field, a nursery, a minature golf course, and residential on the west side. The Pacific Ocean is located approximately five miles to the west.

Eucalyptus trees and shrubs are located along the fill slopes. Some ice plant (mesembryanthemum) is also growing.

Access to the site is via the unpaved FCD maintenance road. The FCD provided Caltrans with a key to the gate and unlimited access for the study. It was necessary to construct a foot bridge over the flood control channel to reach the highway right-of-way. The Caltrans Distrct 07 Materials Department constructed the foot bridge and installed gates in the fence.



Highway drain inside wooden
flume leading to sampling shed
I-405 Los Angeles



Outlet flume from sampling shed

A used wooden construction shed was erected at the site. A rectangular flume constructed of plywood was designed by TransLab and installed by District 07 personnel. A baffle and energy dissipator were placed in the entrance to produce a subcritical flow. A cut throat section was designed into the flume for flow determination. The flume discharged directly into the flood control channel.

A used power pole was installed at the site in order to locate the precipitation gage above the tree tops. The recorder and all instruments were placed inside the shed.

Electric power was brought in from existing power lines located along a residential street about 1/4 mile away. The power cable was buried in conduit under the FCD maintenance road and then brought across on the foot bridge to the shed.

<u>Walnut Creek, I-680</u>

The Walnut Creek site is located on I-680 near P.M. 12.70 which is just south of the Route 24 turnoff to Bay Area points such as Berkeley, Oakland and San Francisco. Figure 4 shows the site location and Figure 5 shows the site details.

I-680 is a six lane PCC pavement with a New Jersey median barrier that was constructed in 1975 just prior to the sampling. The freeway is located on a fill section. Drainage is from about 2.1 acres of freeway. Surface drainage enters a series of drain inlets and is piped through an 18" RCP to the west side of the freeway. The drainage water then flows through a 24" RCP under an adjacent frontage road to a storm drain.

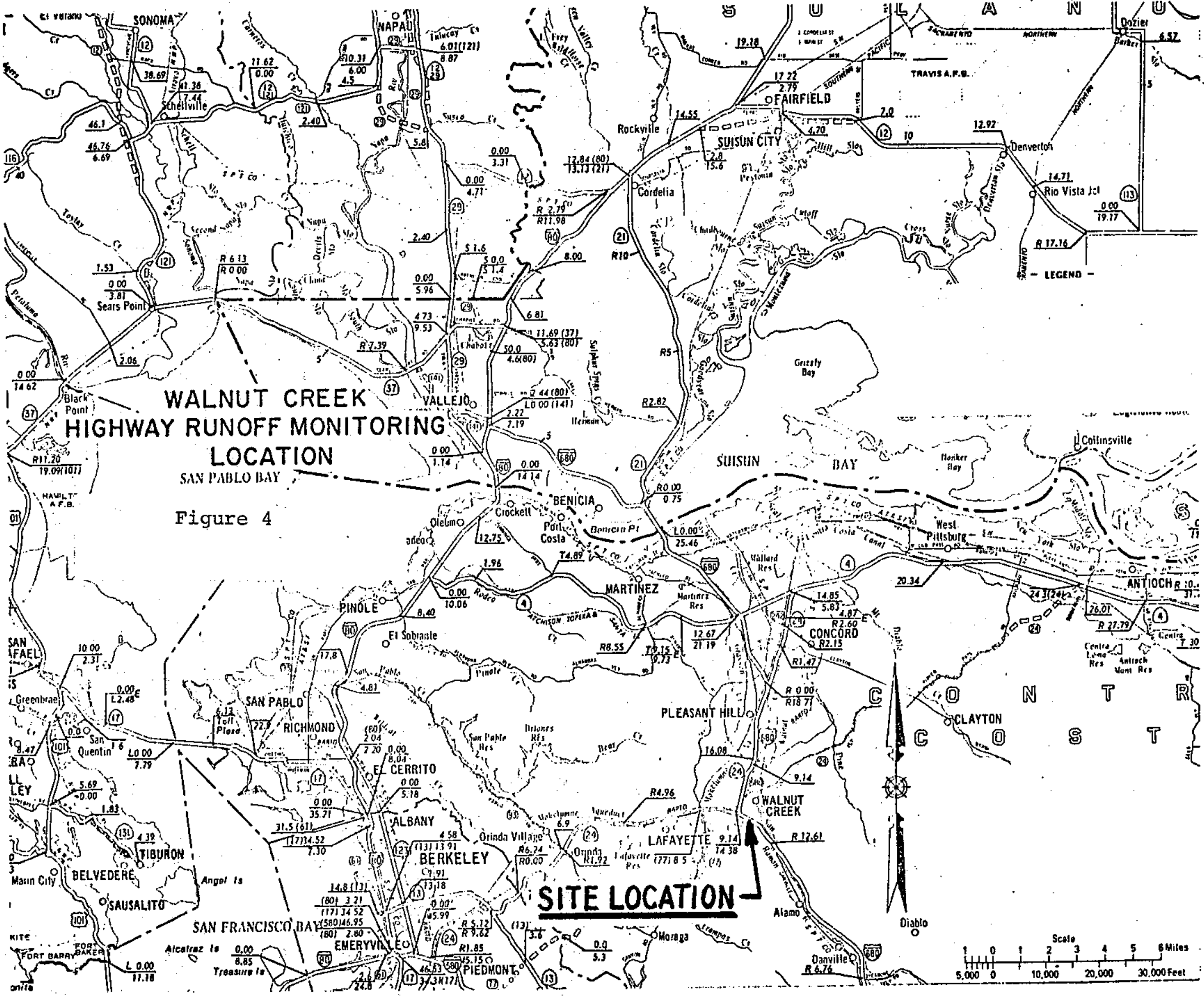
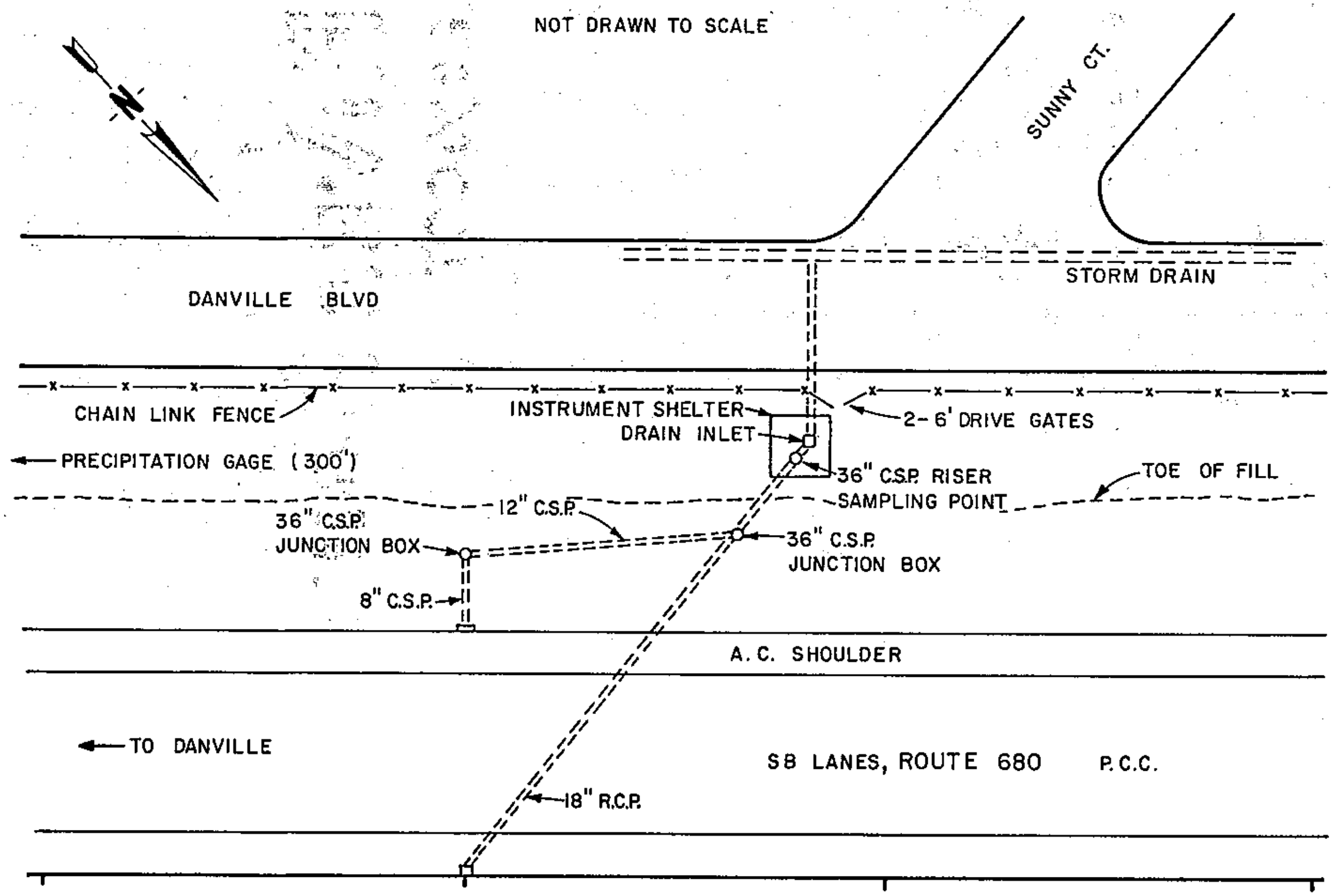
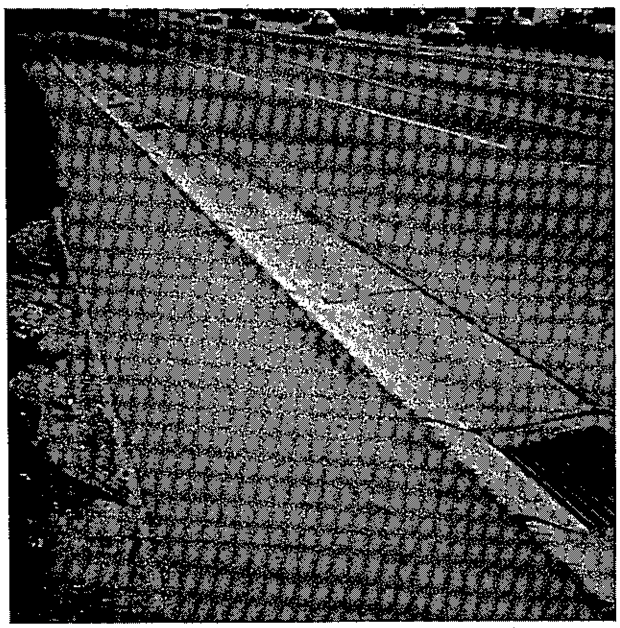

WALNUT CREEK
HIGHWAY RUNOFF MONITORING
LOCATION
SITE LOCATION
SAN PABLO BAY
SUISUN BAY
SAN FRANCISCO BAY
SONOMA
NAPA
FAIRFIELD
SUISUN CITY
Rockville
Cordelia
Denverton
Rio Vista Jct
VALLEJO
BENICIA
Crockett
Port Costa
MARTINEZ
PINOLE
El Sobrante
SAN PABLO
RICHMOND
EL CERRITO
ALBANY
BERKELEY
EMERYVILLE
PIEDMONT
Orinda Village
LAFAYETTE
WALNUT CREEK
PLEASANT HILL
CONCORD
CLAYTON
West Pittsburg
ANTIOCH
Collinsville
Alamo
Danville
Moraga
Diablo
TIBURON
BELVEDERE
SAUSALITO
Sears Point
Black Point
Grizzly Bay
Honker Bay
TRAVIS A.F.B.
LEGEND
Scale
5,000 0 10,000 20,000 30,000 Feet
0 1 2 3 4 5 6 Miles

Figure 4

FIGURE 5

PLAN VIEW
WALNUT CREEK RUN-OFF SAMPLE SITE
NOT DRAWN TO SCALE



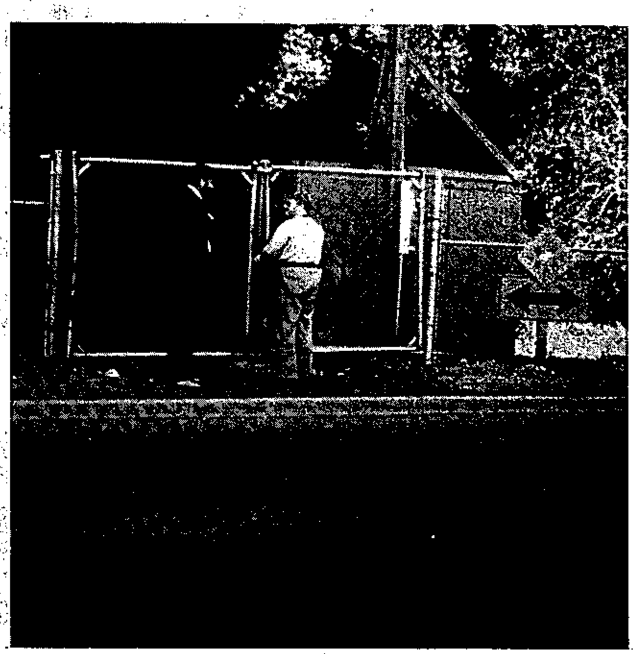


Drain inlets on I-680, Walnut Creek

Average daily traffic is around 66,000 vehicles (both directions). Land use is practically all residential although the town of Walnut Creek (shopping, etc.) is located just north of the site.

Vegetation, which lines the freeway and adjacent land, consists of trees, brush and ice plant.

Access to the site is available off the frontage road called Danville Blvd. A double car gate was constructed in the chain link fence to provide access. A hole was cut into the 18" RCP to gain access to storm flows. A wooden shed was procured for use as the sampling shed. It was placed over the RCP. Maintenance personnel had to add one section of 12" corrugated steel pipe (CSP) to a downdrain in order to direct a small amount of surface runoff into the RCP. They also placed some asphalt concrete (AC) around the shed entrance to reduce the muddy working conditions.



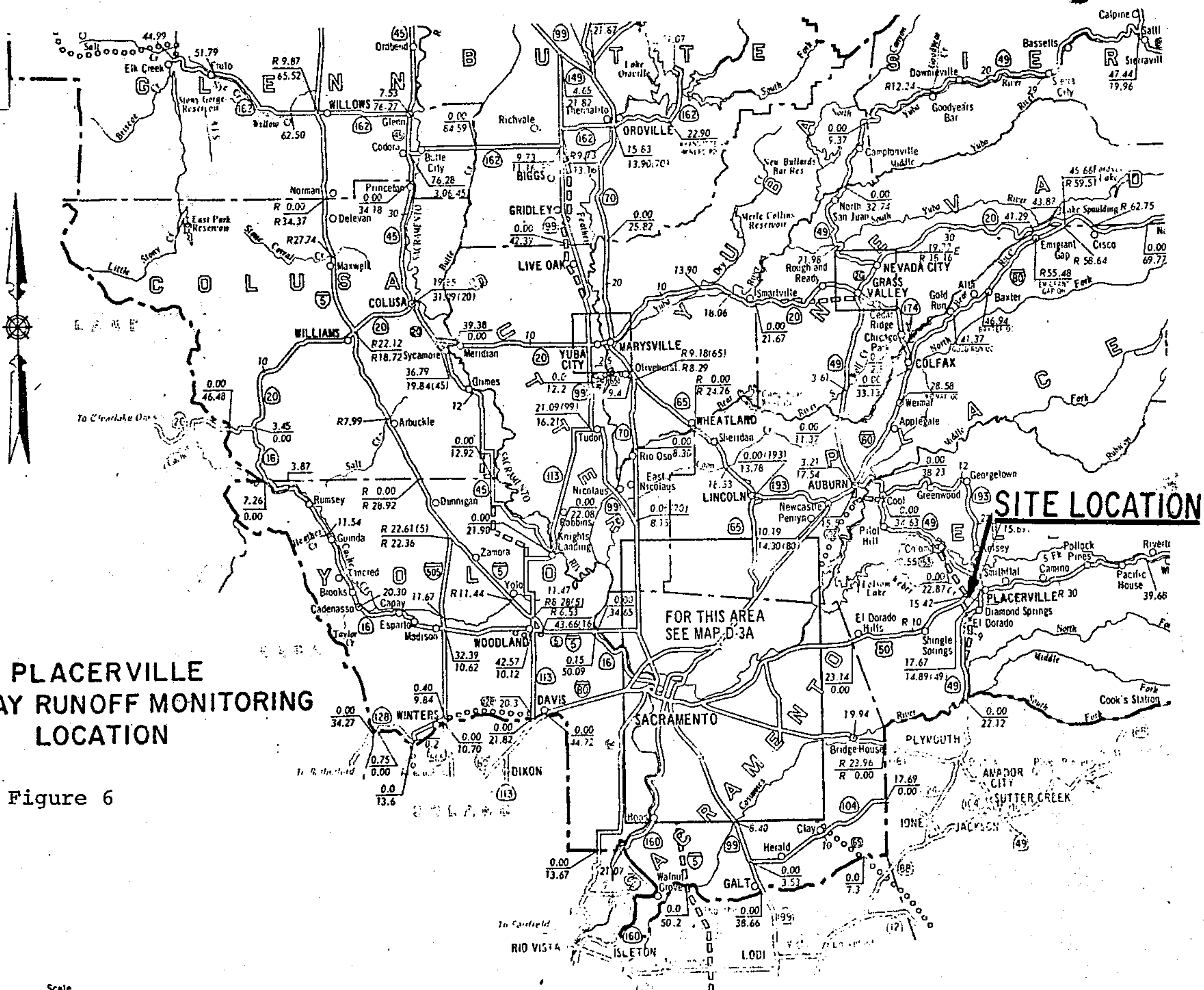
Sampling Shed, Walnut Creek I-680

Power was brought to the site from nearby power lines. A 4"x4" post was installed as a power drop pole. All monitoring equipment was placed inside the shed.

The precipitation gage was located in a clearing about 300 feet south of the shed. This appeared to be the best location since the sample site was surrounded by heavy vegetation.

Placerville, Route 50

The rural site choosen for this study was on Route 50 just west of Placerville near P.M. 15.5. This site is in the foothills about 35 miles east of Sacramento along one of two major trans-Sierra routes in northern California. Figure 6 shows the site location and Figure 7 shows the site details.

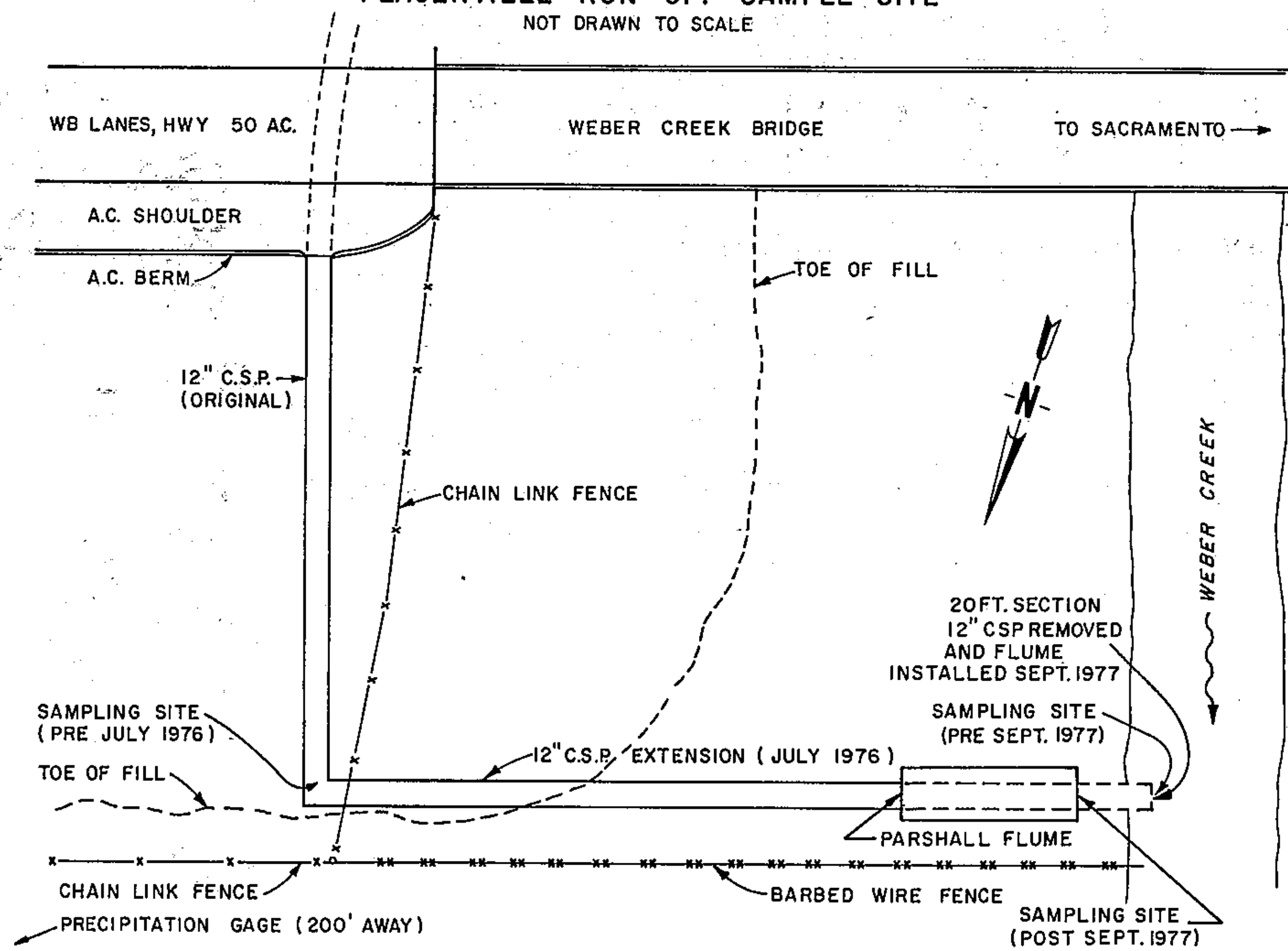


PLACERVILLE HIGHWAY RUNOFF MONITORING LOCATION

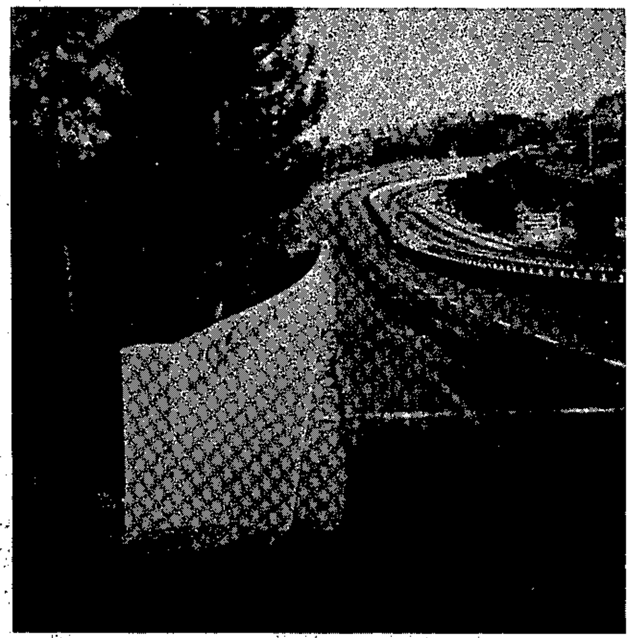
Figure 6

FIGURE 7

PLAN VIEW
PLACERVILLE RUN-OFF SAMPLE SITE
NOT DRAWN TO SCALE



Route 50 is a four lane AC paved highway with a New Jersey median barrier. The eastern section of the highway is in a partial cut and the central section of the road is on fill. The western end of the section connects with the Weber Creek Bridge. Surface waters enter a series of drain inlets and ditches and discharge down a CSP downdrain.

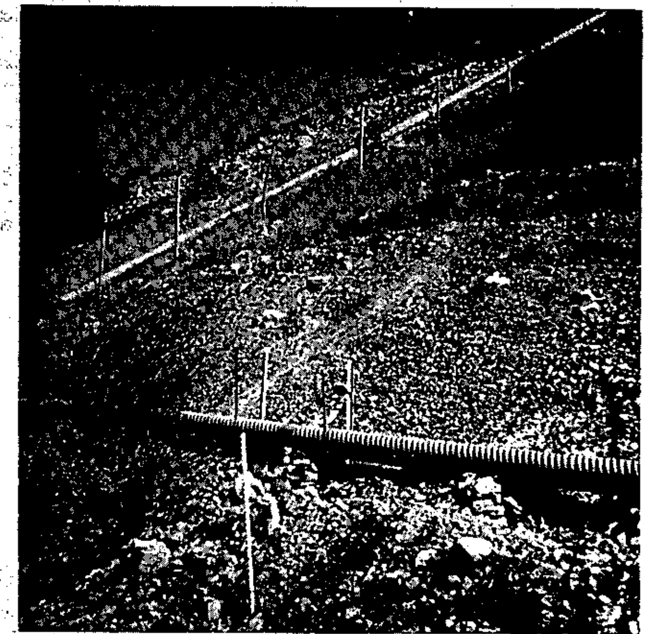


Weber Creek Bridge westbound lanes Highway 50, Placerville

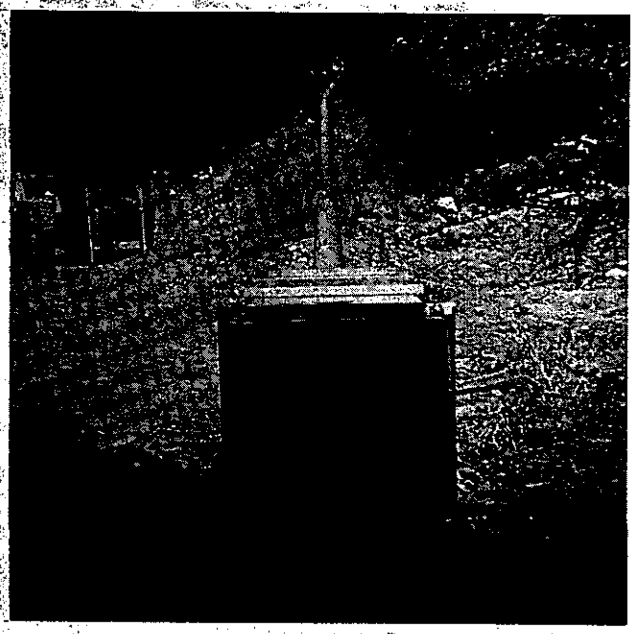
Average daily traffic is around 23,000 vehicles (both directions). Land use is light residential and rolling foothills consisting of open grazing for cattle.

Native vegetation surrounds the area and consists of grasses, brush, and trees.

Access to the site is through private property. Permission was obtained from the landowner to drive through their field to within walking distance of the highway right-of-way.



Pipe downdrain system for Placerville site



Energy dissipator and flume
located on outlet of downdrain
Placerville site

Prior to July 1976, field samples were collected at the outlet of the CSP downdrain which discharged at the base of the fill. Maintenance personnel installed a CSP extension along the highway fence line to discharge the highway storm runoff directly into Weber Creek after the homeowner complained about scouring on their property from culvert discharges.

TransLab moved the sample site to the end of the CSP and had a portable wooden Parshall flume built and installed in September 1977. The flume was calibrated at the Hydraulics Lab at California State University, Sacramento.

The Placerville site was manually operated. The precipitation gage was located on the private landowners field about 200 feet from the sample site. A wire fence was placed around the precipitation gage after it was discovered that donkeys were in the area and were molesting the equipment.

The following is a summary of the physical features of the sites:

TABLE 1

Summary of Site Features

Location	ADT	Type Pavement	Year Constructed	No. Lanes	Width			Drainage Area
					Lane	Median	Outside Shldr.	
Los Angeles I-405	185,000	PCC	1963	8	12'	22'	10'	3.2 acres
Walnut Creek I-680	66,000	PCC	1960	6	12'	22'	10'	2.1 acres
Placerville Rte 50	23,000	AC	1963	4	12'	22'	10'	2.0 acres

All shoulders were constructed of asphalt concrete.

SAMPLING AND FIELD MONITORING

Selection of field sites and installation of sampling equipment were completed in time to begin sampling storm runoff in the Winter of 1975-76. The winter season normally includes the mid-October through March period with the most intense storms occurring from November to February.

Precipitation at all the sites is in the form of rain. At Placerville, there are infrequent storms that may result in small amounts of snow. However, when it does snow, it melts within a short time.

Storm Prediction and Sampling

It was determined that four to five storms would be sampled at each site. An attempt was made to sample storms that represented varying time intervals between storms. Although several storms occurred, not all produced significant runoff. The following table shows the number of storms sampled at each site:

TABLE 2

Storms Sampled

	1975-76	1976-77	1977-78	Total for Site
Los Angeles I-405	2	3	5	10
Walnut Creek I-680	4	3	4	11
Placerville Rte 50	3	2	4	9
	9	8	13	

The 1975-76 and 1976-77 winters were during the California drought. During the winter of 1977-78, significant storms brought an end to the record-breaking drought.

The following is a tabulation of the storms sampled:

Location	Date	No. of Samples	No. of Days Since Last Storm
	1975-76 Winter		
Los Angeles, I-405	February 4, 1976	6	54
	March 1	3	21
Walnut Creek, I-680	October 9-10, 1975	5	86
	December 21	5	8
	January 9, 1976	1	19
	February 5	3	27
Placerville, Rte 50	October 9-10, 1975	8	3
	October 30	5	4
	November 15	2	5
	1976-77 Winter		
Los Angeles, I-405	December 30, 1976	12	48
	January 5, 1977	8	2
	January 20	8	13
Walnut Creek, I-680	October 1, 1976	5	3
	November 11	10	41
	December 29	14	45
Placerville, Rte 50	February 8, 1977	12	27
	March 16	11	3
	1977-78 Winter		
Los Angeles, I-405	December 21, 1977	6	2
	January 3, 1978	9	5
	January 4	8	0
	January 6	8	1
	January 14	10	3
Walnut Creek, I-680	October 28, 1977	5	29
	November 21	13	15
	December 14	10	2
	December 21	5	3
Placerville, Rte 50	September 19, 1977	4	2
	November 21	6	15
	December 11	5	19
	December 14-15	10	2

Sampling was ended during mid-winter of 1977-78 in order to allow sufficient time to test the samples in the laboratory and analyze the data for inclusion in this report.

Samples were procured at various intervals during a storm in order to describe the variation in concentration with time and flow. Since this study was oriented to describing what was in pavement runoff water, some 34 different parameters were either measured in the field or determined in the laboratory as follows:

Temperature*	Cadmium
pH*	Calcium
Specific Conductance*	Chromium
Total Solids	Copper
Volatile Portion of Total Solids	Iron
Total Suspended Solids	Lead
Volatile Portion of Total Suspended Solids	Magnesium
Chemical Oxygen Demand	Manganese
Nitrogen, Kjeldahl	Mercury
Nitrogen, Ammonia	Molybdenum
Nitrogen, Nitrate	Nickel
Phosphate, Total	Potasimum
Orthophosphate	Sodium
Oil and Grease	Zinc
Chloride	Carbonate
Sulfate	Boron
Bicarbonate	Silica

*Field Measurement

Some of these parameters were measured in the field since they had a very short holding time. For other parameters, samples were obtained and returned to TransLab in Sacramento.

The Placerville and Walnut Creek sites were monitored by TransLab personnel. The Los Angeles site was monitored by District 07 personnel.

Field Equipment

The Los Angeles and Walnut Creek sites had a shed in which to work. Also, electric power was brought in which resulted in good sampling and testing conditions. The Placerville site, however, did not have a protective shed or electric power. This made sampling and testing very difficult, particularly during night time hours.

Most equipment was stored inside the sampling sheds in preparation for sampling the next storm. For the Placerville site, all equipment had to be brought to the site for each trip. A check list was used to insure that the necessary equipment and materials were on hand and in working order. A copy of the check list is shown in the Appendix on page 88.

The Los Angeles field site was equipped with a sonic water level recorder, a Martek Mark V Water Quality Analyzer and recorder, and a Weather Measure precipitation gage.

The Walnut Creek field site was equipped with an ISCO Model 1391 Automatic Water Sampler. After several malfunctions of the instrument, however, it was not used in procuring samples. Field testing of pH, conductivity, and temperature was accomplished with portable field instruments. Precipitation was recorded with an MRI rain gage and recorder.

All equipment was calibrated at the beginning of each winter sampling period and maintained throughout the course of the winter. At the conclusion of the sampling period, the sites were deactivated for the summer and all equipment was properly stored until the following winter.

Three incidents occurred at the Los Angeles site during the course of the study. In October, 1976, a contractor was building a minature golf course in a field adjacent to the Flood Control District maintenance road. During the excavation of a trench, the 110 volt buried power line was cut. Repairs were made within a few days and the site was again operational. Then on December 30, 1976, the District 07 field crew arrived at the site in preparation for sampling a storm and discovered that sometime during the night, a tire must have come off a passing truck and hit the precipitation gage pole, and then landed on top of the sampling shed. The pole was tilted slightly from the impact and a roof beam was cracked. The precipitation gage clock stopped, evidently from the jolt. The time on the clock was 4:00 a.m. The precipitation gage and sonic flow recorder were repaired, calibrated and placed back into operation by January 5, 1977. Then during the period of January 26 to February 8, 1978, vandals broke into the Los Angeles sampling shed and took several thousand dollars worth of equipment. A police report was filed with the California State Police and Redondo Beach Police Department.

One incident occurred at the Placerville sampling site that resulted in some slight damage. Sometime during January, 1977, a large rock rolled down the fill slope and hit the 12" CSP extension about 60' from the elbow at the base. Maintenance personnel had to replace the damaged section of culvert.

Monitoring Procedures

It was decided to sample storm runoff by taking grab samples. The decision for this rested largely with the fact that rapid variability in pipe flow at Walnut Creek required on-site observation to collect samples correctly, Placerville was not equipped with a protective shelter for field sampling, and frequent automatic sampler equipment malfunctions necessitated grab sampling.

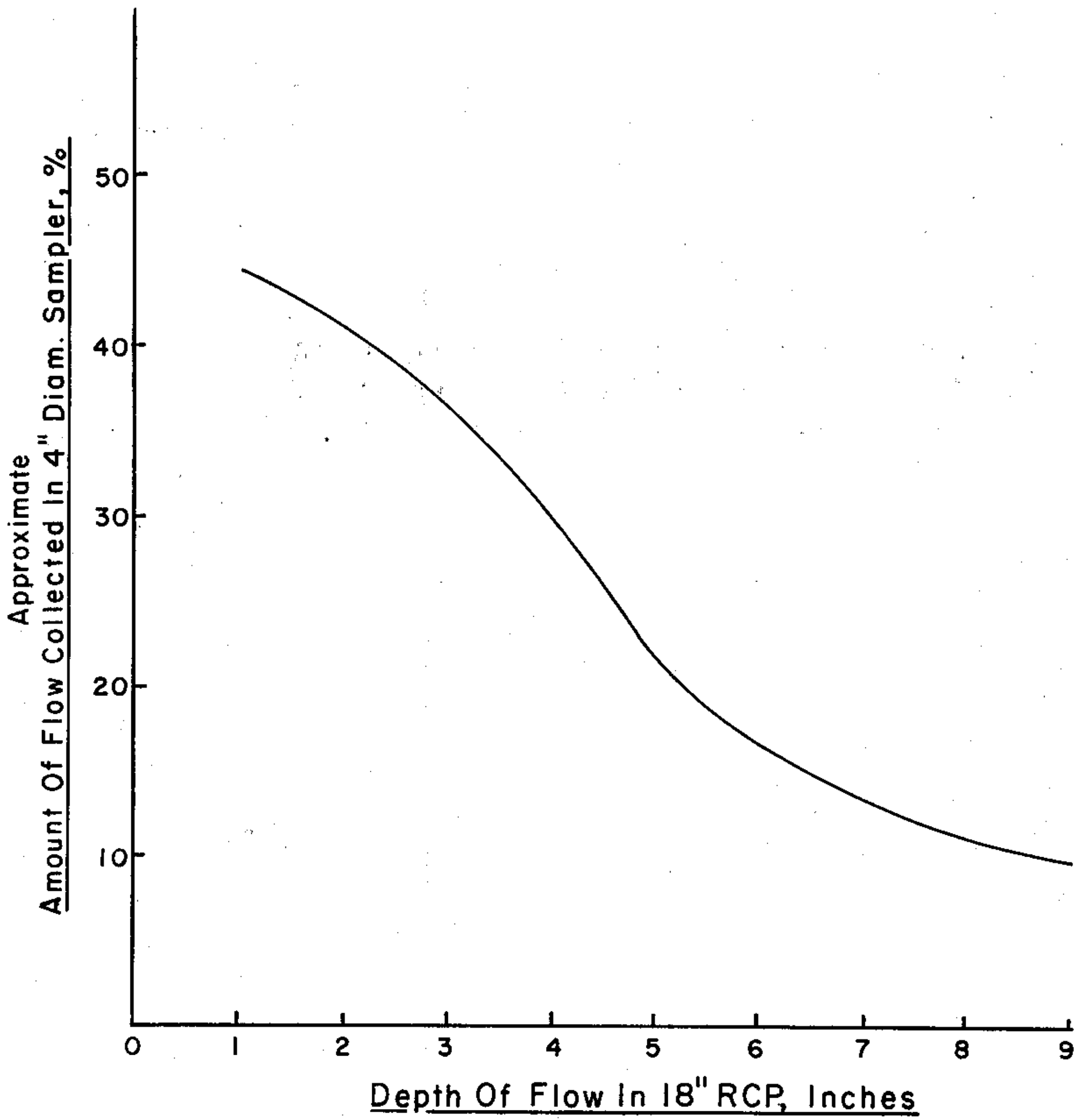
Flows in the flumes at Los Angeles and Placerville were usually small and, consequently, the depth of flow was shallow enough so that a grab sample represented practically the total flow. At Walnut Creek, a 4" diameter sample bottle was attached to a rod. The sampler was lowered into the 18" RCP to obtain a sample. The collected sample was then transferred to a sample bottle. Figure 8 shows the approximate relative percent of flow cross sectional area that was sampled for various flow depths. The curve was developed using a ratio of the area for the 4" diameter bottle and cross sectional area of flow at different flow depths. Most flows in the RCP were under 4" depth.

TransLab receives a daily teletype of weather forecasts. During the winter rainy season, the forecasts were reviewed for potential incoming storms. Telephone contact was maintained with the National Weather Service for incoming storms that appeared to have a high probability of rainfall.

As a storm approached the Walnut Creek site, maintenance personnel at the Caldecott Tunnel on Route 24 were called. They notified TransLab of the first indication of rain. A field crew was then dispatched. Travel time to the site was about 1.5 hours.

FIGURE 8

APPROXIMATE
AMOUNT OF FLOW COLLECTED IN SAMPLER
Walnut Creek



For Placerville, the California Highway Patrol or U.S. Forest Service Office, located 1/4 mile from the site, was called. Usually rainstorms moved across California from a northwesterly direction so that if rain started falling in Sacramento it would rain in Placerville about one hour later. In these instances, a field crew was dispatched without calling Placerville. Travel time to Placerville was about 45 minutes.

The District 07 field monitoring crews also reviewed daily NWS forecasts for the Los Angeles area. For predicted storms, telephone contact was maintained with the NWS. During non-working hours, an employee who lived near the site served as the key person in notifying the field crew.

In sampling storms, it was very difficult to arrive at a field site just prior to storm runoff. For many forecasted storms, no significant runoff occurred although minor amounts of rain fell. Many storms also occurred after normal working hours including weekends, which necessitated working overtime.

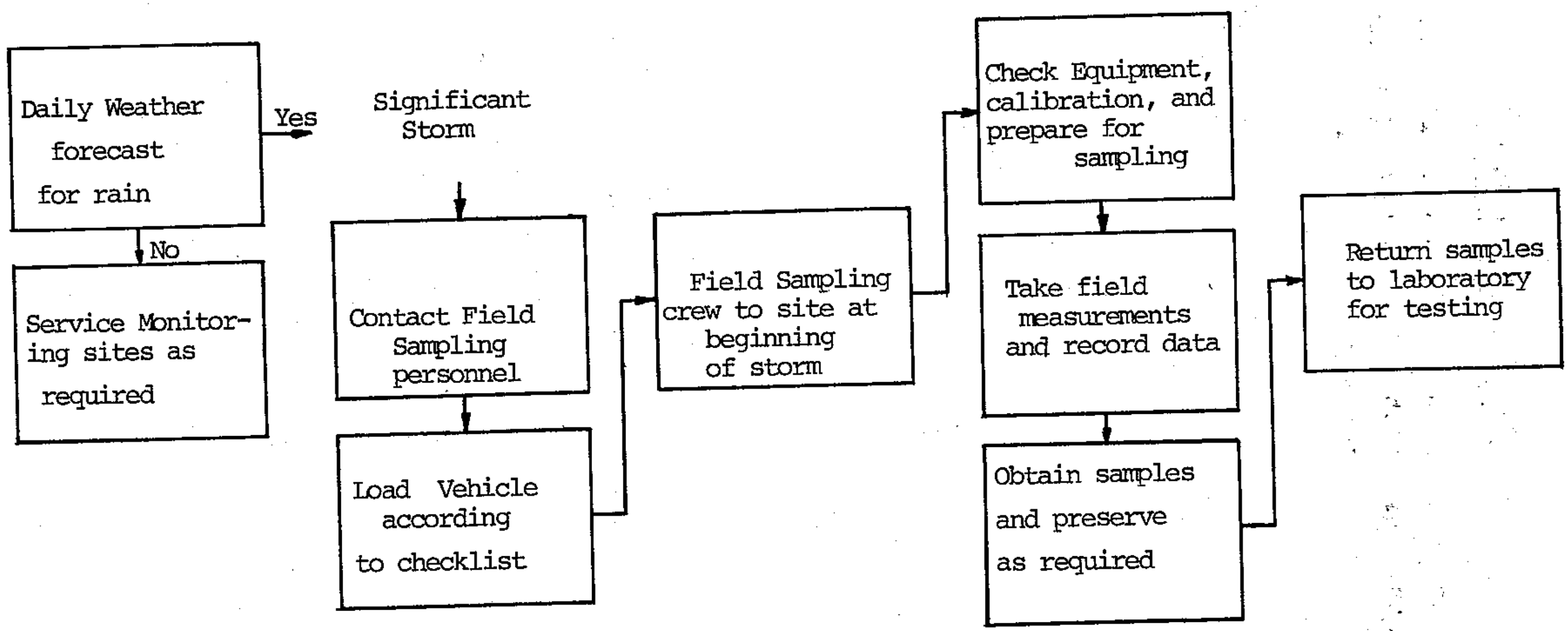
Figure 9 shows the flow chart for the field data collection procedure.

When field crews arrived at the site, they followed pre-established guidelines for sampling as follows:

> Grab samples were taken at the beginning of a storm or immediately upon arriving at the sampling site. Samples were taken every 15 minutes thereafter for the following 1-1/2 to 2 hours. After 6 to 8 samples had been taken, frequency of sampling was reduced to 1 sample

FIGURE 9

Flow Chart For Highway Runoff Monitoring



every half hour for the next 2 hours and again reduced to 1 sample every hour for the remainder of the storm. Judgment had to be exercised for exceptions to the above sampling schedule. The following parameters were monitored in the field, according to the above time schedule whether or not a sample was taken:

Flow Level
Temperature
pH
Conductivity
Dissolved Oxygen (except Placerville)

If runoff stopped due to rain ceasing and only 2 to 3 samples were taken, and no more rain was forecast for the immediate future, then all samples were discarded except for the 1975-76 winter.

Sample bottles were properly labeled prior to sample collection. Proper labeling insured that identification remained on the sample bottles which were placed in ice water. Sample identification was also referenced on the Data Sheet. The following table describes the sample collection container labeling.

TABLE 3

Container Labeling

Containers & Sizes	Sample Designation	Parameters to be Tested	Preservative
Two 1/2 Gal. Polyethylene Jugs	P	Bioassays, Major Ions	Cool to 4°C
1/2 Gal. Polyethylene Jug	M	Heavy Metals	10 ml HNO_3
1 Liter Glass Bottle	O	Oil & Grease	5 ml H_2SO_4(1+1) & Cool to 4°C
1/2 Gal. Polyethylene Bottle	N	Residues, COD, Nitrogen & Phosphate fractions	1 ml H_2SO_4(1+1) & Cool to 4°C

All sample containers were properly labeled with runoff site and sample number. The 1/2 gallon polyethylene jug sample that was tested for metals had metals written on the label along with site and number. Each sample consisted of 5 containers.

All samples were sent to the TransLab Chemical Section, attention Dave Smith.

Field data were entered on a form for each sample as shown in the Appendix on page 89.

LABORATORY TESTING

Samples were returned to TransLab with the field crews. The samples were preserved in the field as delineated in Table 3, page 35. The chemist met the crew and took charge of setting up the samples for analysis. In the case of samples from Los Angeles, the District 07 sampling crew took the samples to the Western Air Freight office at the Los Angeles International Airport and the samples were sent out on the next Sacramento bound flight. A TransLab employee met the incoming flight and brought the samples to TransLab where testing or additional preservation was performed immediately except in cases where testing immediately was not critical, i.e., metals. Figure 10 shows the flow chart for testing water samples at TransLab.

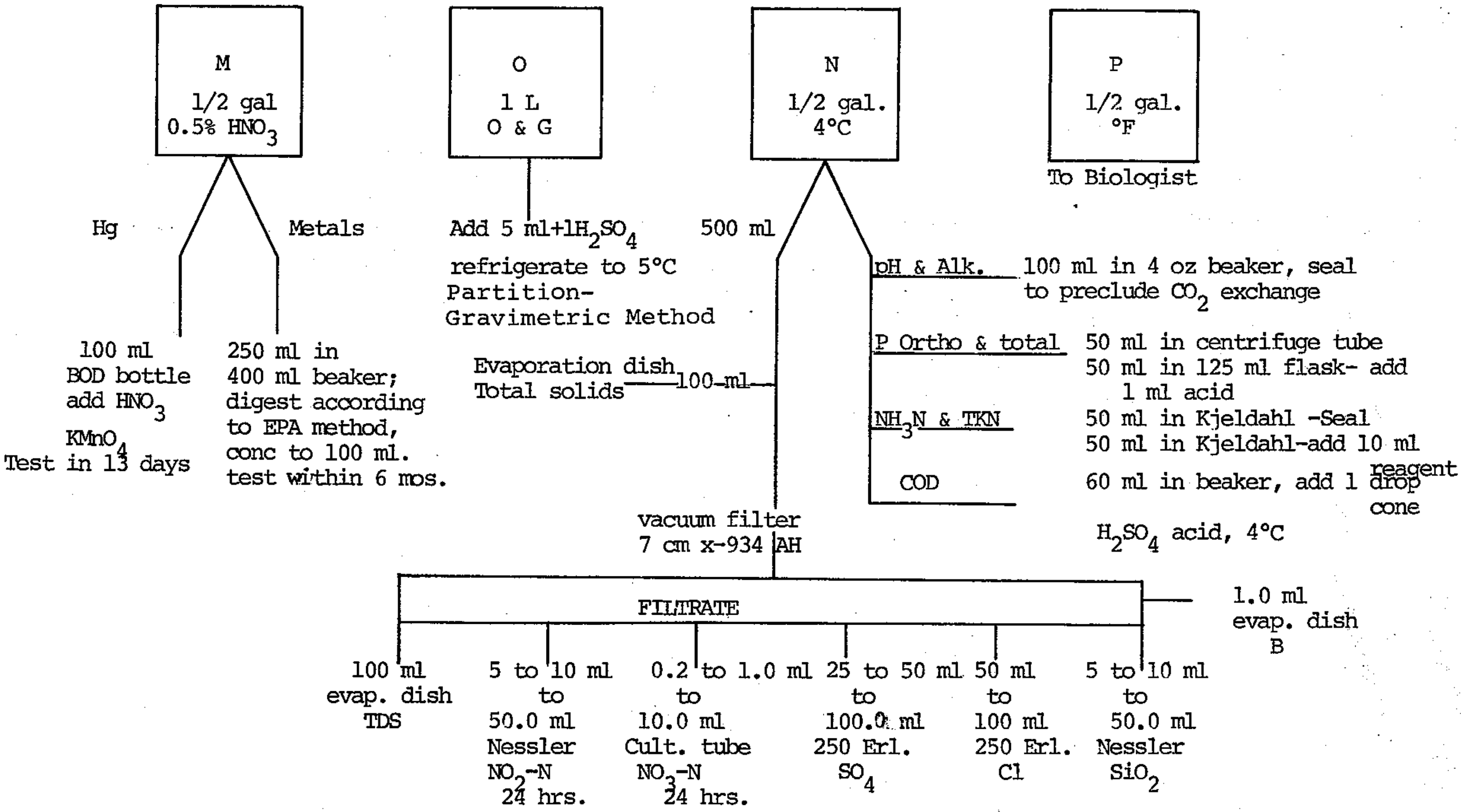
The water sample for biological assay testing was given to the TransLab Biology Unit. The bioassay work was performed under the FHWA sponsored research project A-8-25 and is reported under that research report(4).

All tests were performed in accordance with the approved test methods as delineated in "Standard Methods for the Examination of Water and Wastewater"(6). TransLab is an Approved Laboratory (noncommercial) by the California Department of Health as required under the regulations of the U.S. Environmental Protection Agency.

Testing was delayed for many samples taken during various stages of the study because of the loss of chemical testing personnel and other high priority work that took precedence. The samples collected during the 1977-78 Winter season were given top priority and consequently were tested within a shorter time frame.

FIGURE 10

FLOW CHART FOR TESTING WATER SAMPLES



ANALYSIS OF WATER QUALITY DATA

The results of the field monitoring and laboratory testing for all samples taken during various storms at the three test sites for the winters of 1975-76 through 1977-78 are shown in the Appendix.

For the data collected, the most significant concentrations recorded for selected parameters were as follows:

TABLE 4

Significant Concentrations

Parameter	Highest Concentration	Site	Date	No. of Days Since Last Storm
Boron (B)	4.6 mg/l	Los Angeles	12/30/76	48
Sulfate (SO_4)	440 mg/l	Walnut Creek	12/29/76	45
Iron (Fe)	76 mg/l	Placerville	2/8/77	27
Lead (Pb)	9.8 mg/l	Los Angeles	12/30/76	48
Zinc (Zn)	22 mg/l	Placerville	2/8/77	27
Nitrate (NO_3-N)	50 mg/l	Los Angeles	2/4/76	54
Kjeldahl (N)	36 mg/l	Walnut Creek	12/29/76	45
Ammonia (N)	26 mg/l	Los Angeles	2/4/76	54
Total Phosphate	1.39 mg/l	Walnut Creek	12/29/76	45
Ortho Phosphate	0.81 mg/l	Walnut Creek	12/29/76	45
Oil & Grease	174 mg/l	Walnut Creek	10/28/77	29
Total Solids	2,340 mg/l	Walnut Creek	12/29/76	45
Total Suspended Solids	1,970 mg/l	Placerville	10/9-10/75	3
Chemical Oxygen Demand	806 mg/l	Walnut Creek	12/29/76	45
Conductivity	2,105 umhos/cm	Walnut Creek	12/29/76	45

The highest concentrations shown above only occurred at a specific time during the storm runoff and do not represent the time averaged concentration in the flow. Refer to Figures 11 to 20 for a more detailed display of the concentrations during runoff.

The maximum pH recorded was 11.5 (basic) at Placerville on March 16, 1977. The minimum pH recorded was 5.8 (acidic) at Los Angeles on January 6 and 14, 1978. The normal range of pH that is specified in water quality criteria is 6.5-8.0.

It is interesting to note that in all cases, except for Total Suspended Solids, the maximum concentrations occurred after a significant period of dry weather. For the Total Suspended Solids recorded at Placerville on October 9-10, 1975, the rainfall recorded three days prior was not an intensive storm. However, the October 9-10 storm was one of the most intense recorded at this site (0.30 in/hr maximum intensity and 2" total rainfall). The October 9-10, 1975 storm was the third storm of the 1975-76 winter, which followed after a long dry summer, and was the first storm of major intensity that winter. Thus, it is suspected that the pavement was thoroughly flushed and this resulted in the high Total Suspended Solids reading as compared to lower readings for the two previous storms.

Parameters that do not appear to have significant concentrations in pavement runoff waters based on this study include the following:

- Bicarbonate (HCO_3)
- Carbonate (CO_3)
- Silica (SiO_2)
- Chloride (Cl)
- Sodium (Na)
- Potassium (K)
- Calcium (Ca)
- Magnesium (Mg)
- Cadmium (Cd)
- Chromium (Cr)
- Copper (Cu)
- Manganese (Mn)
- Mercury (Hg)
- Molybdenum (Mo)
- Nickel (Ni)

Figures 11 through 20 show the varying concentrations of selected parameters with time during stormwater runoff at the various sites. The plots show a general pattern of initial high concentrations for metals at the beginning of storm runoff which decreases as the storm continues on.

Conductivity and nutrients (nitrate, Kjeldahl nitrogen, ammonia, total phosphate and ortho phosphate) show a similar relationship to the metals. Chemical Oxygen Demand, Oil & Grease, Total Solids, and Total Suspended Solids appear to vary directly with storm runoff volume.

No attempt was made to analyze the data in terms of correlations with traffic, time between storms (dry days), precipitation, or maintenance practices as this is beyond the scope of the research.

The data do show that the dry summer-early fall period apparently results in the accumulation of particles and other material that is flushed from the pavement during the first significant rains. After several good flushing rains, the concentrations remain at lower levels.

A runoff sample taken at the Los Angeles site on December 4, 1974, was tested at Truesdail Lab (a commercial laboratory in Los Angeles) for Biochemical Oxygen Demand (BOD). The following results were obtained:

Sample Size(ml)	Sample + Dilution(ml)	Dilution (%)	Depletion (mg/l)	BOD (mg/l)
100	300	33	4.4	13
50	300	17	4.3	25.6
20	300	7	1.3	18.6

"Standard Methods" recommends using results of dilutions between 5 and 25% for oxidized effluents(6).

Figure 11

RUNOFF CONCENTRATIONS FOR BORON AND LEAD

Los Angeles, Dec. 30, 1976

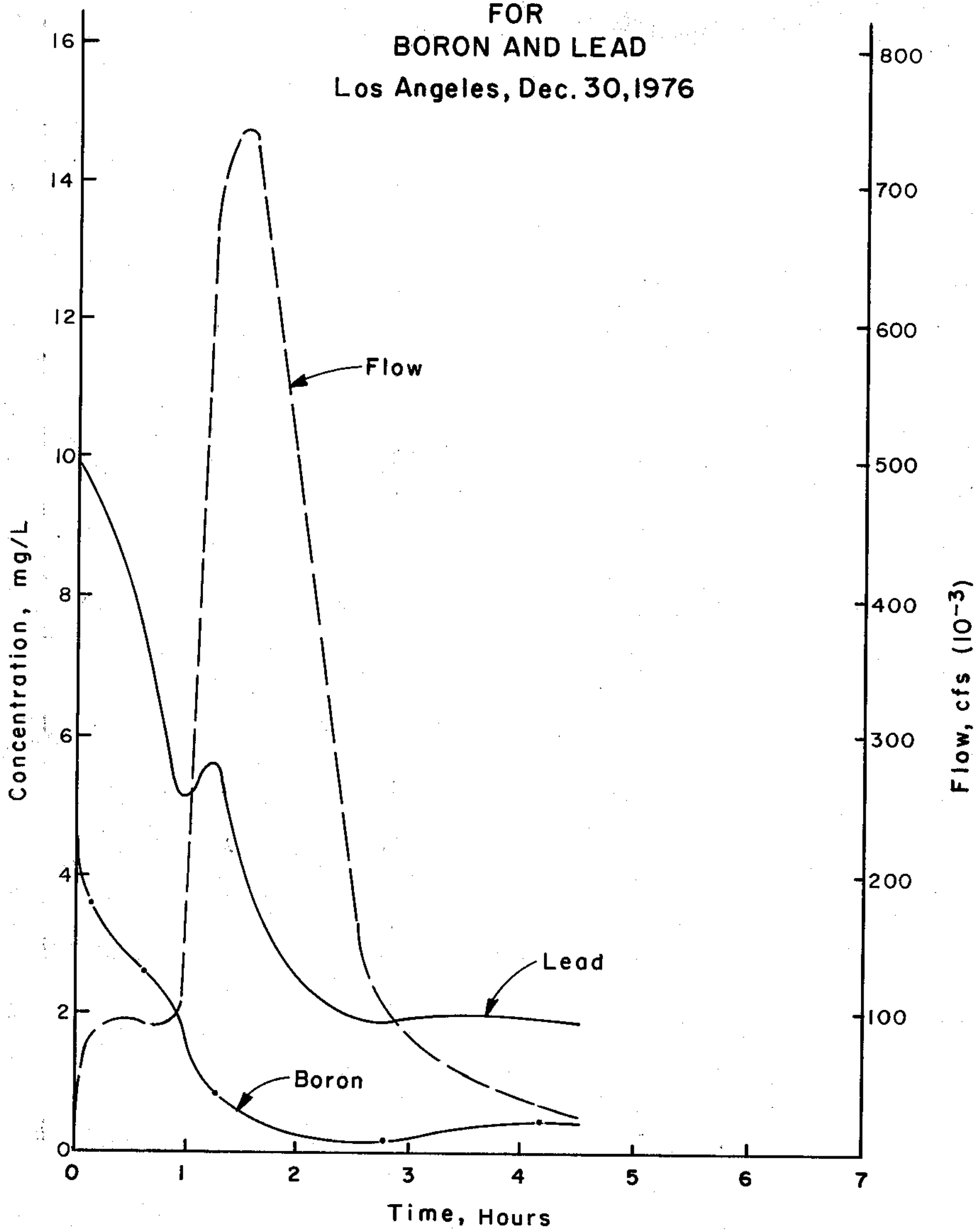


Figure 12

RUNOFF CONCENTRATIONS FOR IRON AND ZINC Placerville, Feb. 8, 1977

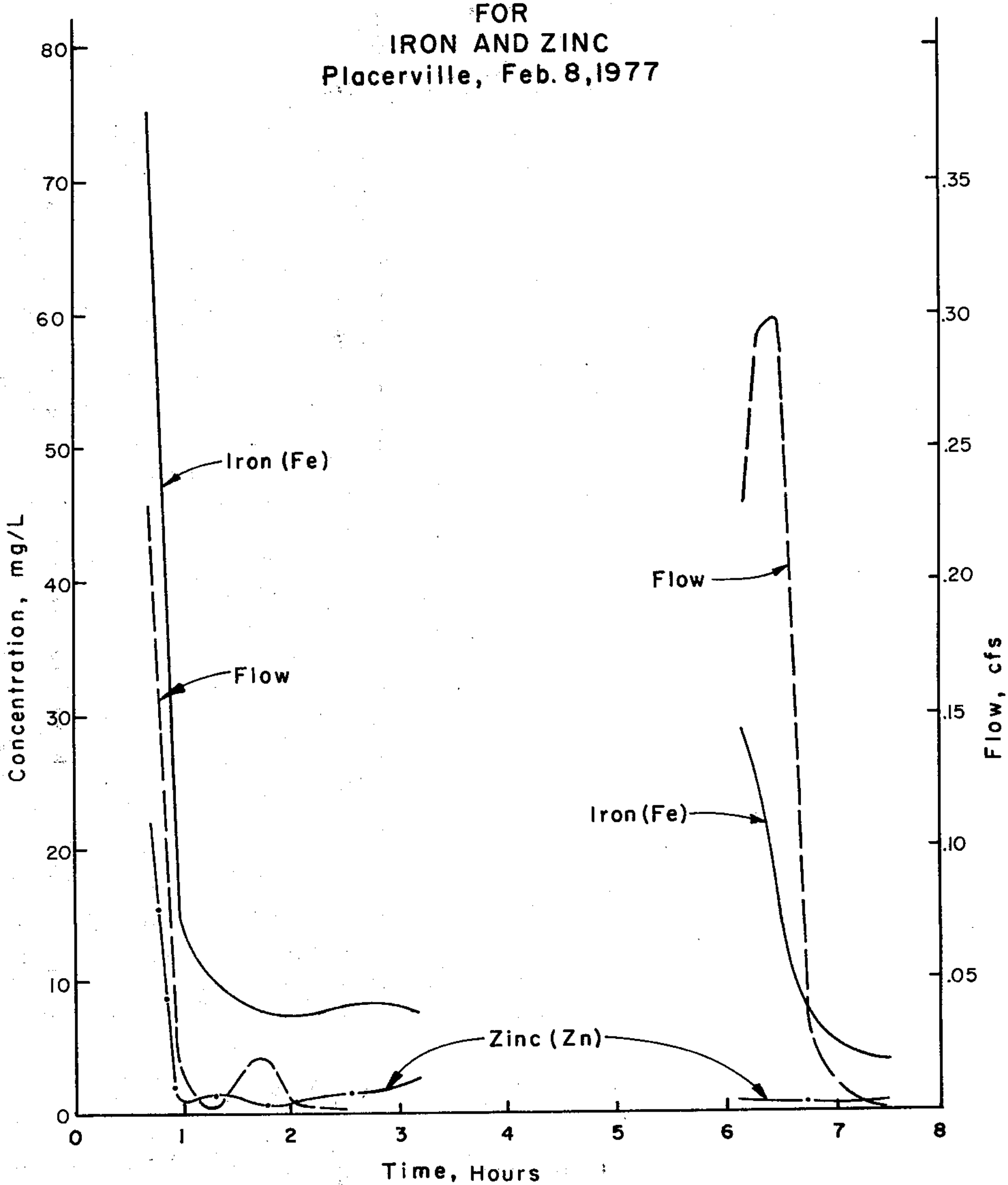


Figure 13
RUNOFF CONDUCTIVITY
Walnut Creek, Dec. 29-30, 1976

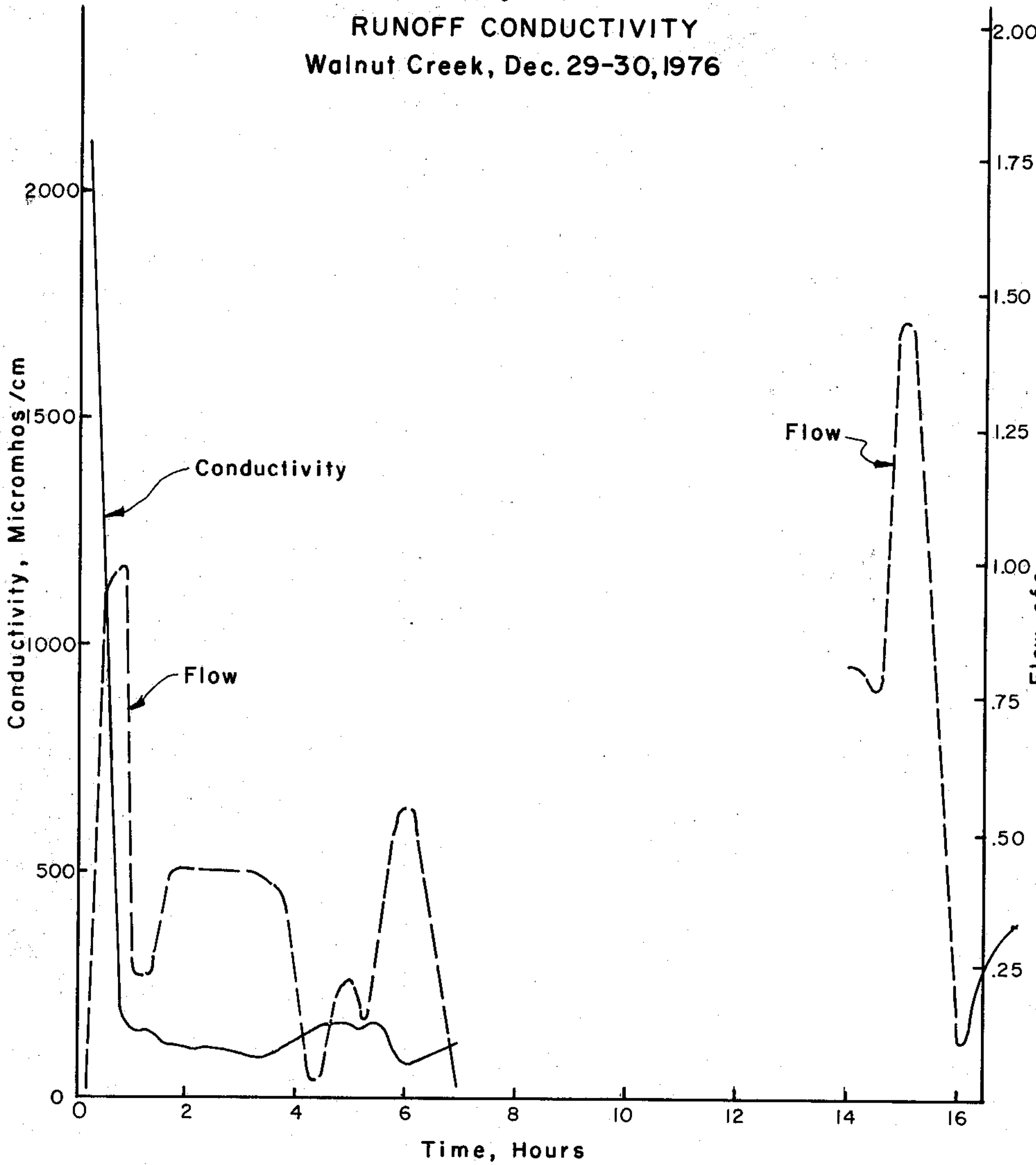


Figure 14

RUNOFF CONCENTRATIONS FOR CHEMICAL OXYGEN DEMAND Walnut Creek, Dec. 29-30, 1976

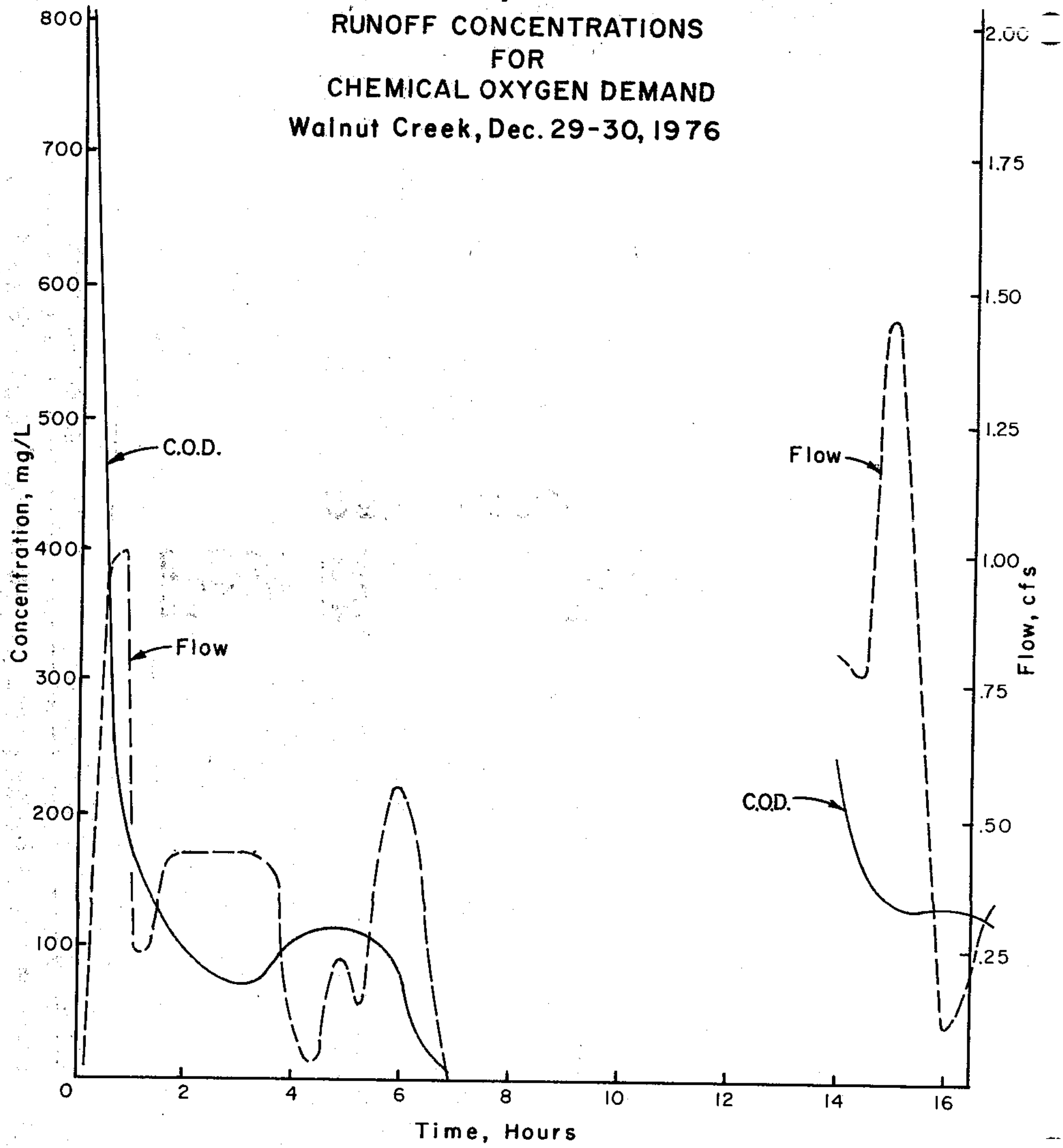
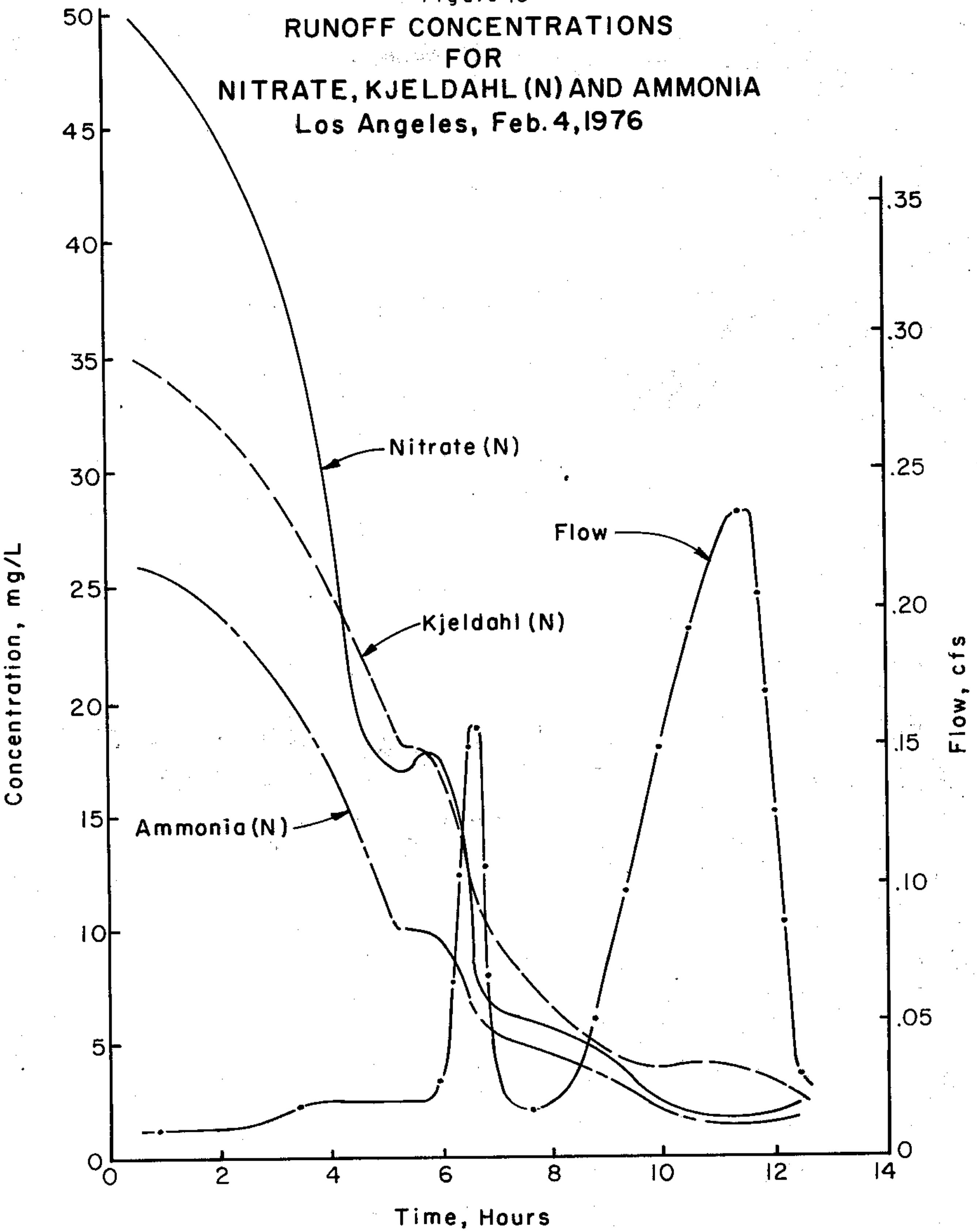


Figure 15

RUNOFF CONCENTRATIONS FOR NITRATE, KJELDAHL (N) AND AMMONIA

Los Angeles, Feb. 4, 1976



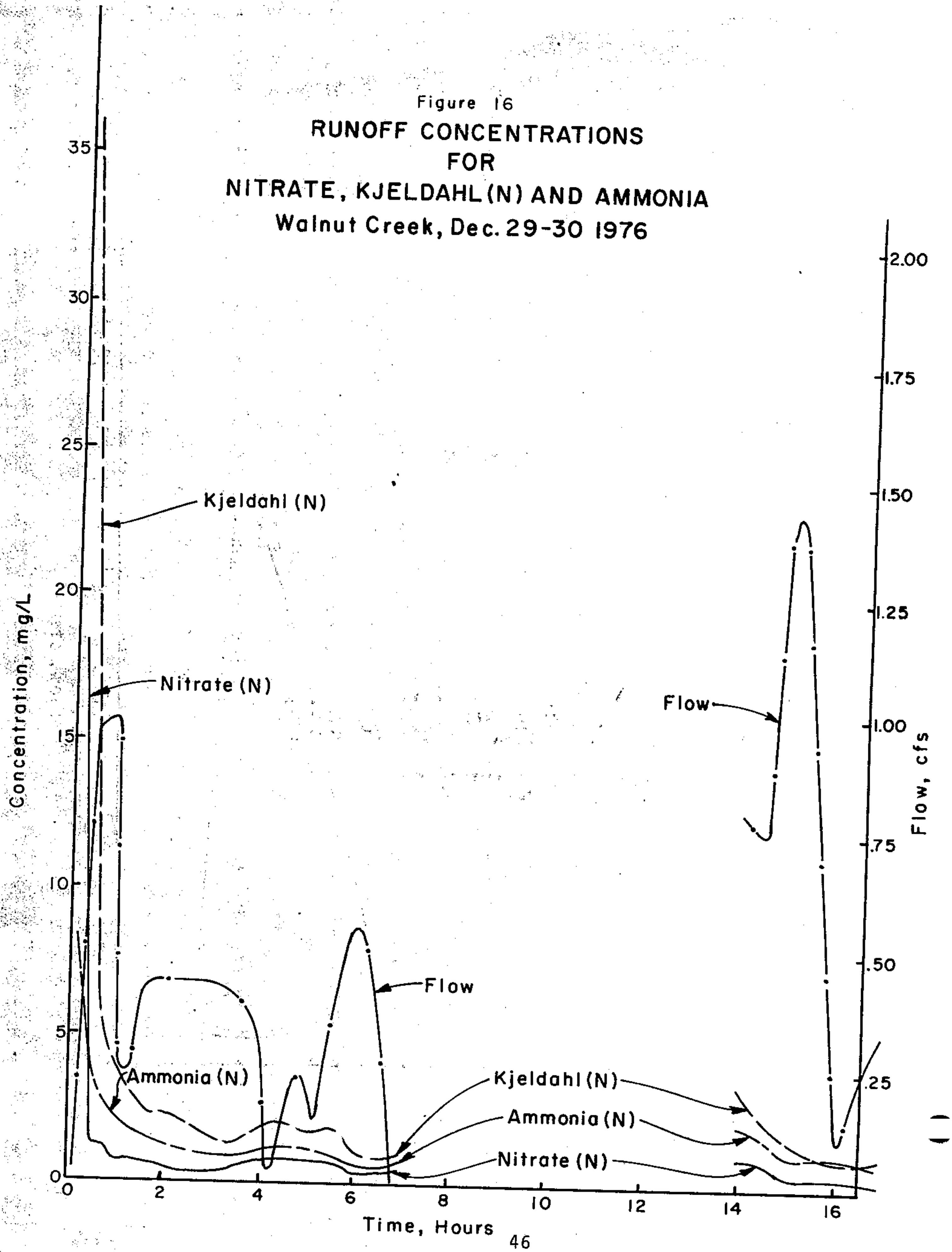


Figure 16
RUNOFF CONCENTRATIONS
FOR
NITRATE, KJELDAHL(N) AND AMMONIA
Walnut Creek, Dec. 29-30 1976
Kjeldahl (N)
Nitrate (N)
Ammonia (N)
Flow
Kjeldahl (N)
Ammonia (N)
Nitrate (N)
Flow
Concentration, mg/L
Flow, cfs
Time, Hours
0
5
10
15
20
25
30
35
2
4
6
8
10
12
14
16
.25
.50
.75
1.00
1.25
1.50
1.75
2.00

Figure 17
RUNOFF CONCENTRATIONS
FOR
TOTAL AND ORTHO PHOSPHATE
Walnut Creek, Dec. 29-30, 1976

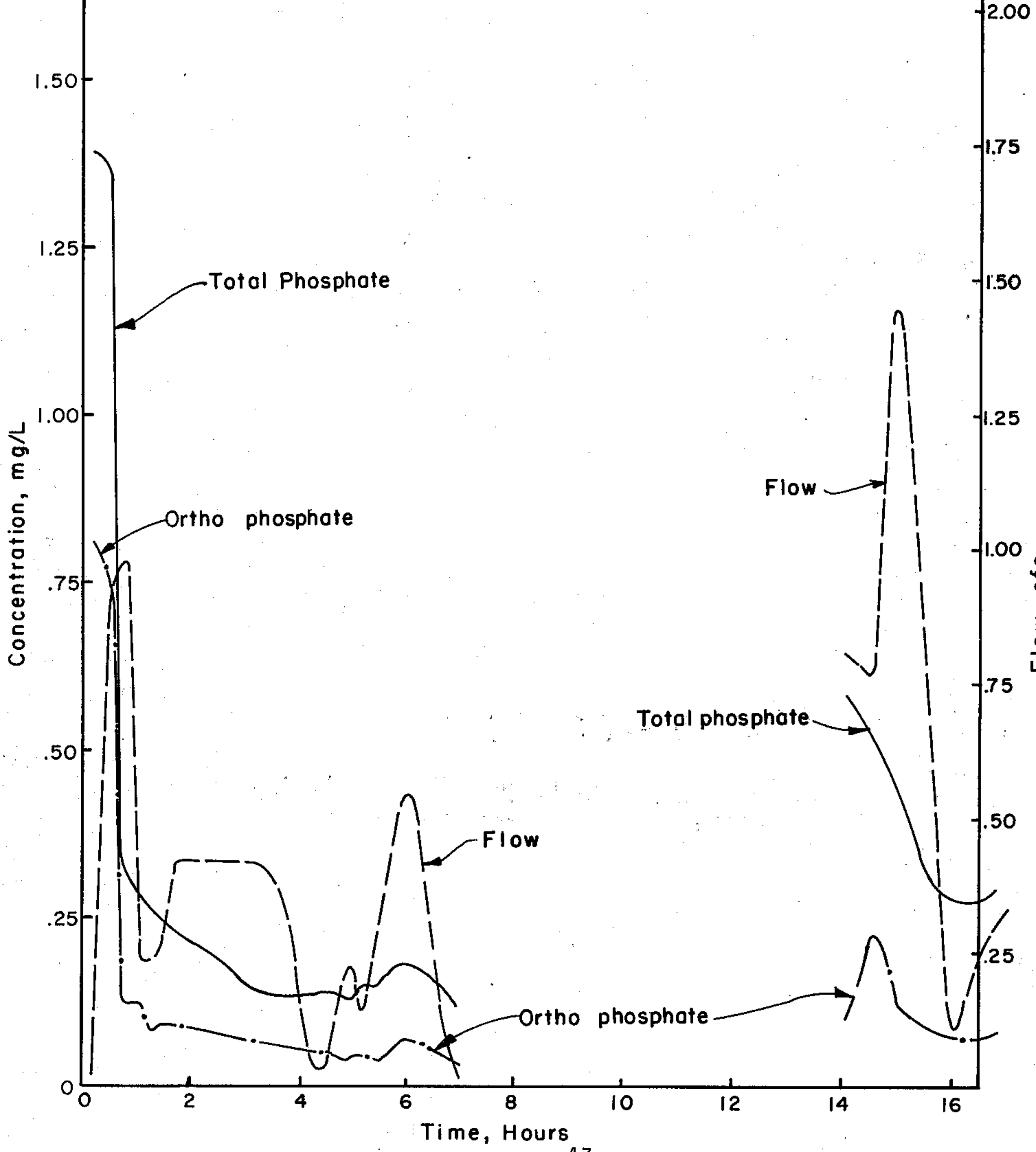
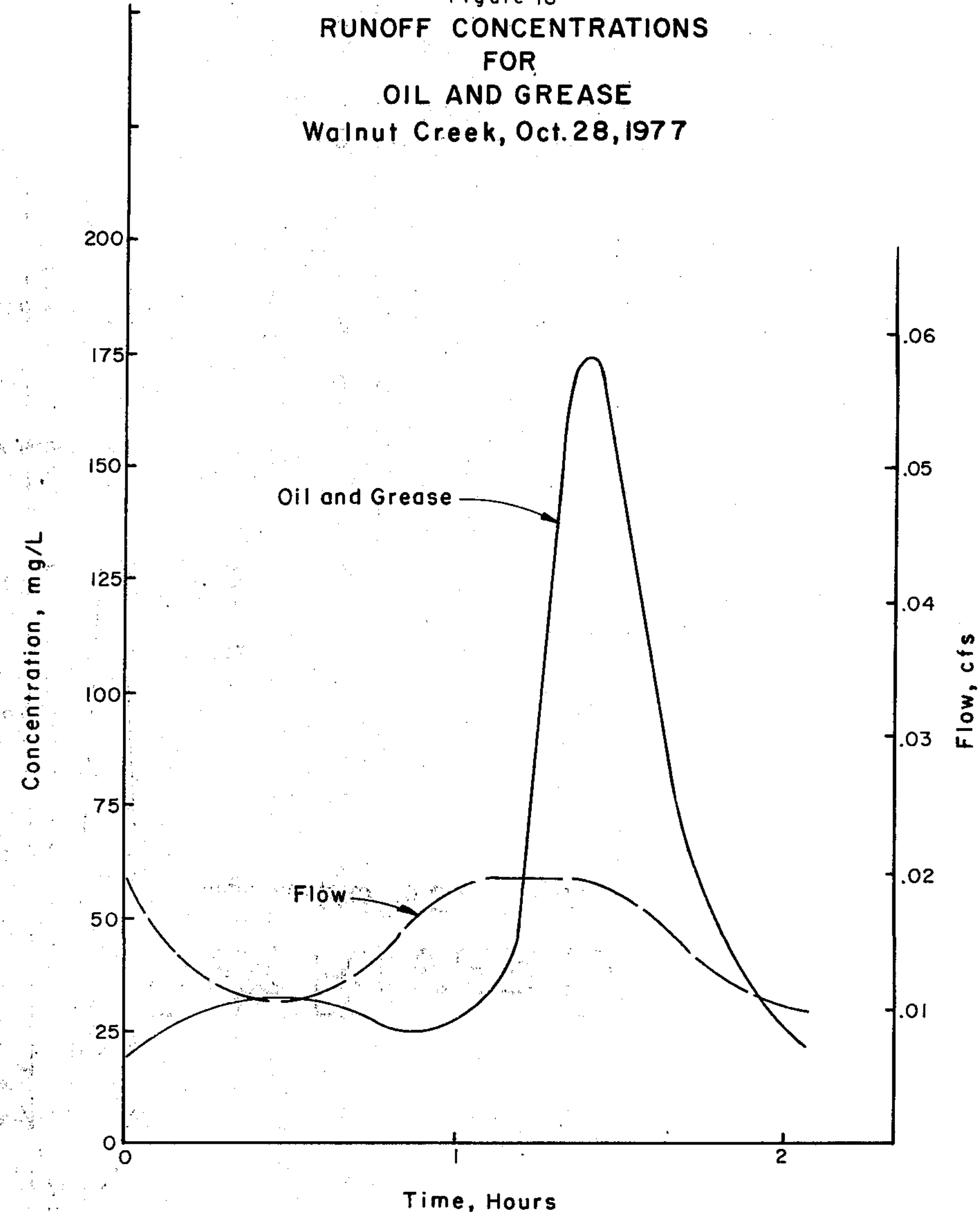


Figure 18
RUNOFF CONCENTRATIONS
FOR
OIL AND GREASE
Walnut Creek, Oct. 28, 1977



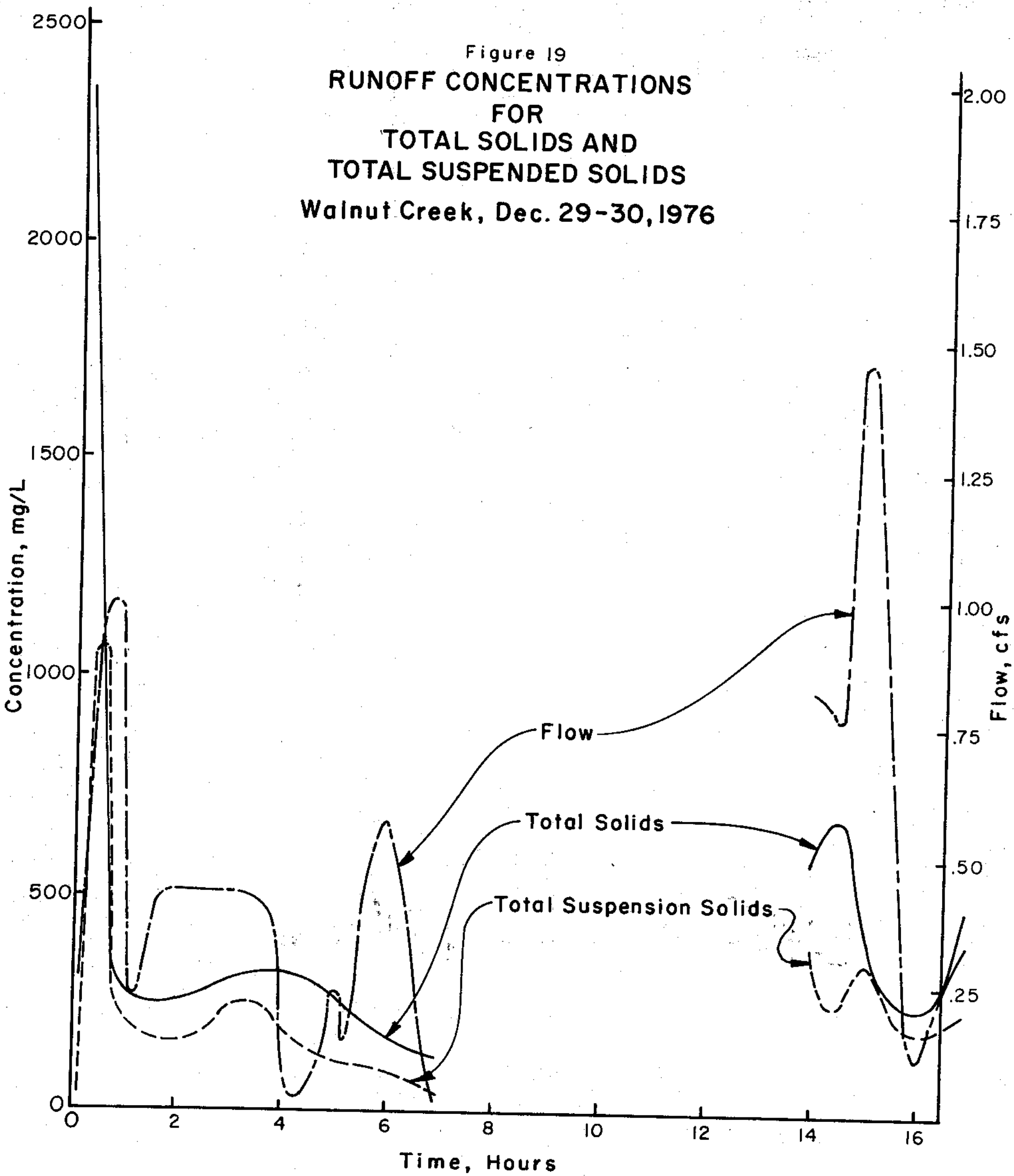
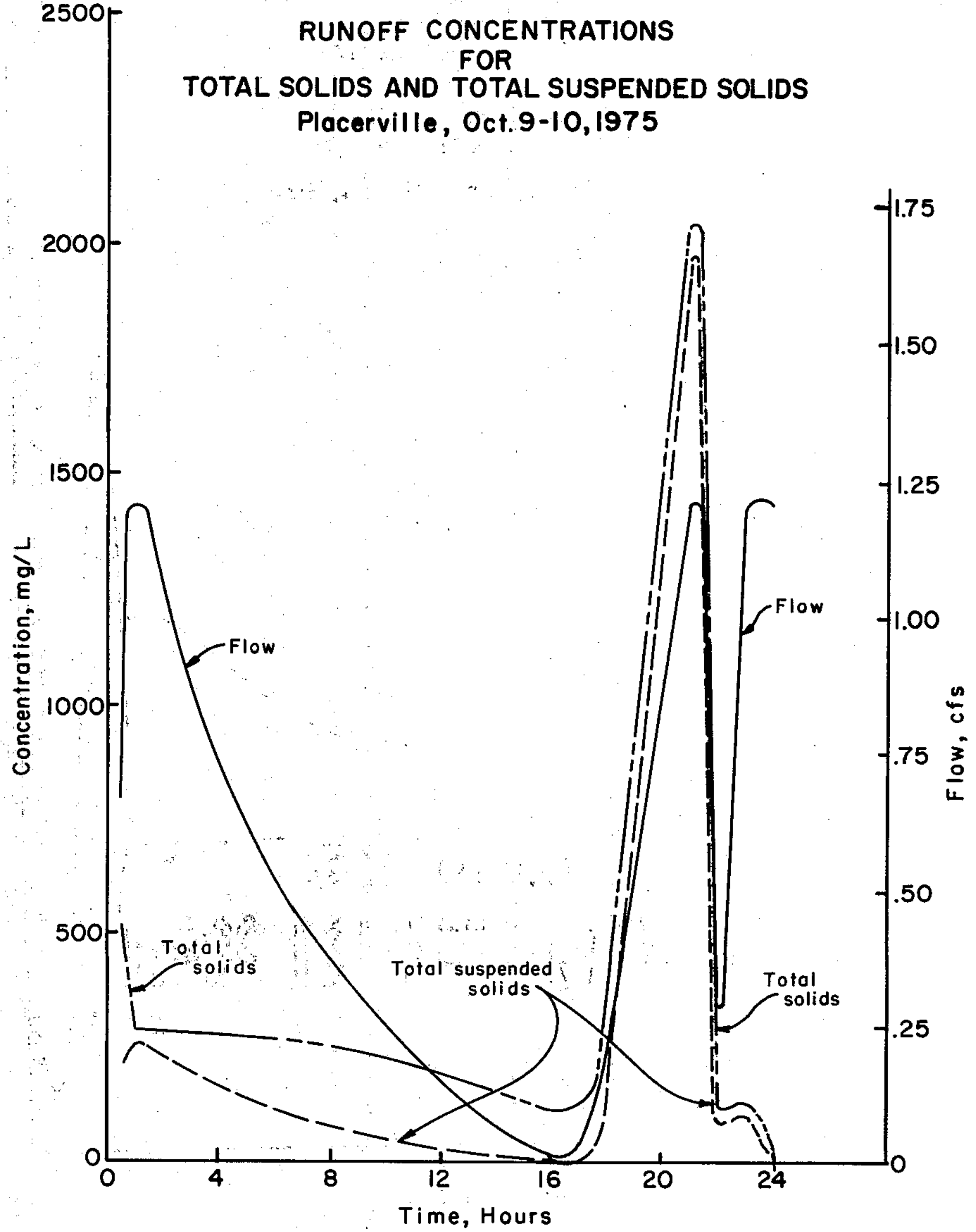


Figure 19
RUNOFF CONCENTRATIONS
FOR
TOTAL SOLIDS AND
TOTAL SUSPENDED SOLIDS
Walnut Creek, Dec. 29-30, 1976
Concentration, mg/L
2500
2000
1500
1000
500
0
Flow, cfs
2.00
1.75
1.50
1.25
1.00
.75
.50
.25
Flow
Total Solids
Total Suspension Solids
0
2
4
6
8
10
12
14
16
Time, Hours

Figure 20


RUNOFF CONCENTRATIONS
FOR
TOTAL SOLIDS AND TOTAL SUSPENDED SOLIDS
Placerville, Oct. 9-10, 1975
2500
2000
1500
1000
500
0
Concentration, mg/L
1.75
1.50
1.25
1.00
.75
.50
.25
0
Flow, cfs
Flow
Flow
Total solids
Total suspended solids
Total solids
0
4
8
12
16
20
24
Time, Hours

Therefore, using the average BOD's for the 17 and 7% dilutions, the average for 25.6 and 18.6 mg/l gives a test result of 22 mg/l. BOD seems to increase with dilution and then decreases. This may be an indication of toxicity due to the presence of certain metals. Because of these results and time constraints in getting the water sample to a laboratory for testing in a timely manner, no futher testing of BOD was performed. Instead, chemical oxygen demand (COD) was run on all field samples. COD is a measure of the oxygen equivalent of that portion of the organic matter in a sample that can be chemically oxidized.

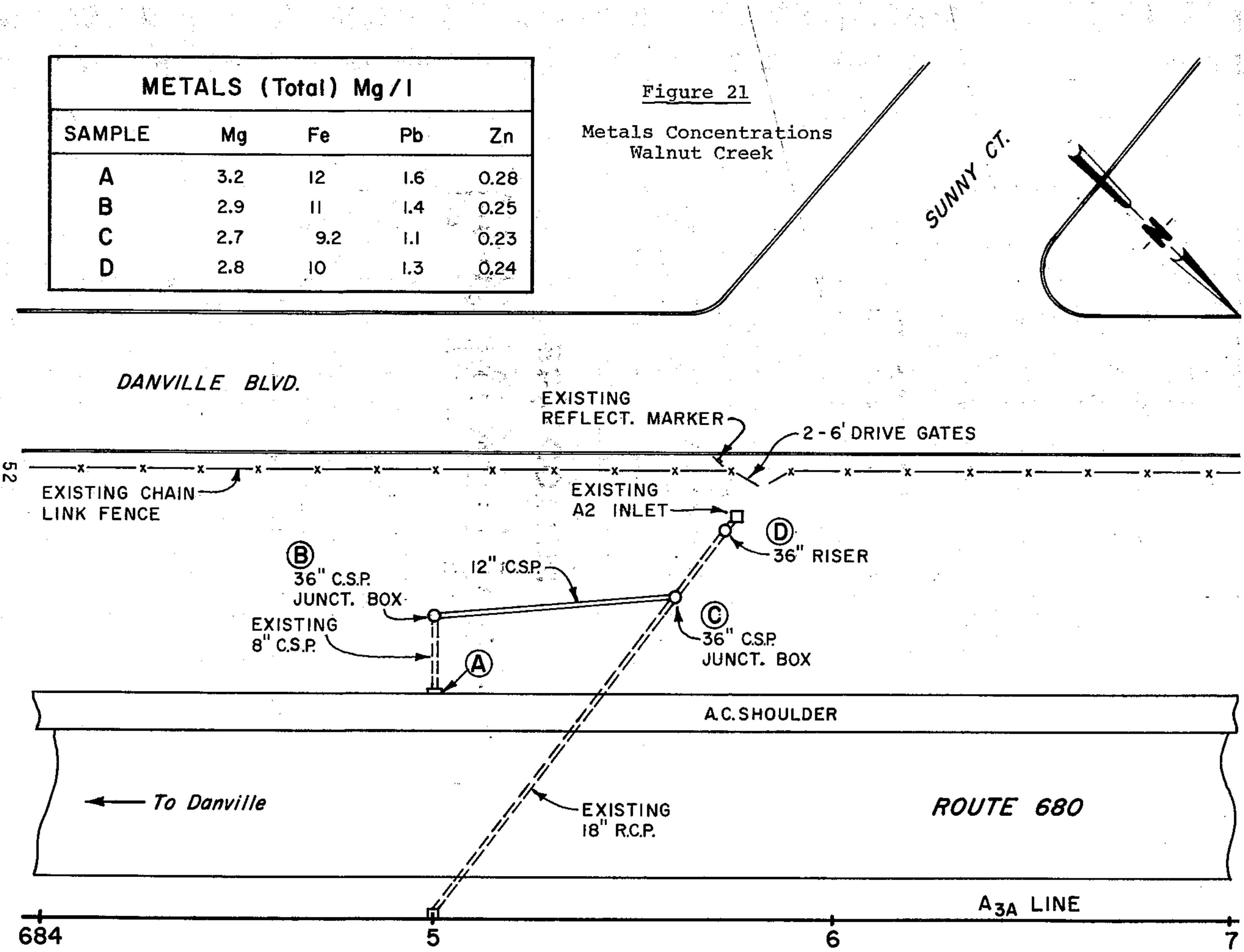
In order to collect all the freeway drainage at the Walnut Creek site, one 8" CSP downdrain had to be intercepted and connected to the 18" RCP where sampling was to be performed. A 12" CSP was used to divert the flow. Tests were made on various sections along the pipe to determine if there were any noticeable changes in metal ions. Tests were made for magnesium, iron, lead and zinc. Figure 21 shows the sample locations (A, B, C, D) and concentrations recorded. The results show that there is no significant increase in concentrations. Additional testing should be conducted to confirm these results.

Asbestos was measured during runoff from one storm that occurred at the Los Angeles I-405 site on December 4, 1974. Total rainfall for the storm was 2.20 inches over a 14 hour period. The sample was taken near the end of the storm runoff and tested at Truesdail Laboratory.

METALS (Total) Mg/l				
SAMPLE	Mg	Fe	Pb	Zn
A	3.2	12	1.6	0.28
B	2.9	11	1.4	0.25
C	2.7	9.2	1.1	0.23
D	2.8	10	1.3	0.24

<u>Figure 21</u>

Metals Concentrations
Walnut Creek



The sample was filtered and then ashed to destroy organic material. The asbestos-like fibers that were 75 microns in length were counted using an optical microscope. Results showed 25 asbestos-like fibers per ml. A more precise method utilizes an electron microscope, however, Truesdail Laboratory did not have one at the time of the testing. Cost estimates for performing this test using an electron microscope were high.

The asbestos result was discussed with the California Department of Health. They indicated that an electron microscope should be used to detect the fibers. However, based on the fibers found using the optical method, they thought the result was not high and would convert to about one million fibrils per liter(7).

Because of the high cost for performing this test and the reasonable amount found in the Los Angeles runoff sample, no further tests were performed for asbestos.

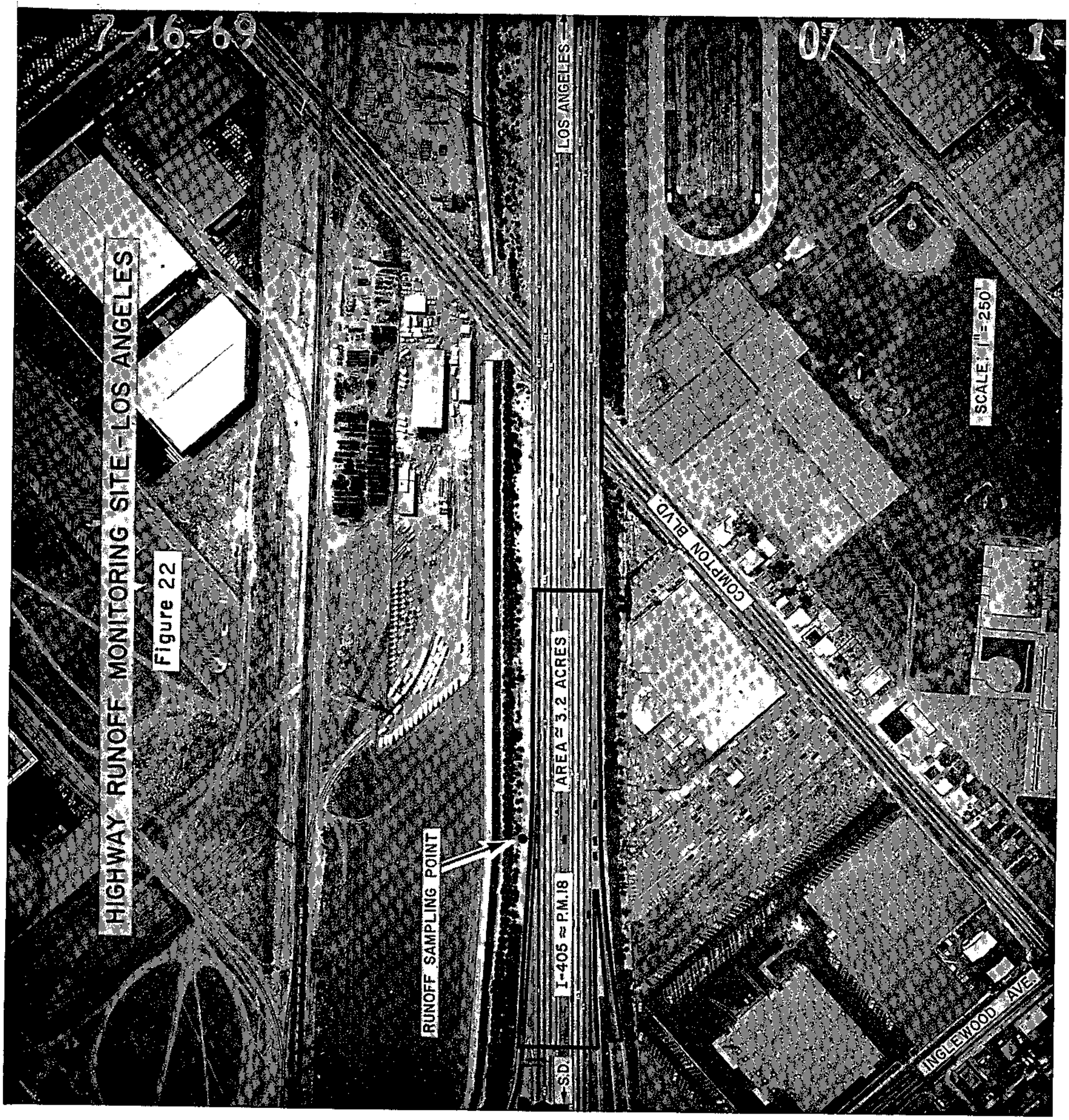
In a 1973 EPA study, emissions from disc pads, brake linings and clutch facings were collected from vehicles driven through test cycles at high and low operating temperatures(8). EPA estimated that the average asbestos produced from passenger cars was 28.51 μg/mi, from light trucks, 87.51 μg/mi, from medium trucks, 290.72 μg/mi, and from heavy trucks, 951.12 μg/mi. It is not known how much of the asbestos is in fibrous form and thus it would be difficult to relate this to harmful health effects. FHWA is conducting futher studies on this subject.

Flow

Runoff flows were monitored at each of the three field sites. In order to determine accurate flows, flumes were installed at the Los Angeles and Placerville sites. The Parshall flume was not installed at the Placervile site until September of 1977. Prior to that time, the culvert downdrain was on such a steep gradient with discharge at the right-of-way fence that it was not possible to install a flow measuring device. However, maintenance personnel modified the pipe by placing a 90° elbow at the pipe outlet and added a 12" diameter CSP extension on a relatively shallow gradient. This work was done to prevent scouring of a drainage across private property. The highway drainage was directed into Weber Creek which flows into Folsom Reservoir.

For Walnut Creek, pipe flow hydraulic relationships were used to determine flows. Two weirs were tried for calibrating flow with depth, but high velocities and backwater from the frontage road storm drain complicated this procedure. Flow velocity measurements were also attempted by timing a floating object over a known distance from an upstream point in the RCP to the sample point. However, velocities were so great that the floating object was never observed as it passed through the small opening in the RCP at the sampling point.

Figure 22 shows the drainage area of about 3.2 acres for the Los Angeles I-405 site. A wooden flume was installed at the site in order to get uniform flow that could be correlated with depth. The flume configuration is shown in Figures 23 and 24. Wooden blocks were installed at the flume entrance to dissipate energy (See Figure 24). A sonic water level recorder was installed over the flume to record changes in water level.


HIGHWAY RUNOFF MONITORING SITE-LOS ANGELES
Figure 22
7-16-69
07-LA
LOS ANGELES
SCALE: 1"=250'
COMPTON BLVD.
AREA ≈ 3.2 ACRES
I-405 ≈ P.M.18
RUNOFF SAMPLING POINT
S.D.
INGLEWOOD AVE.

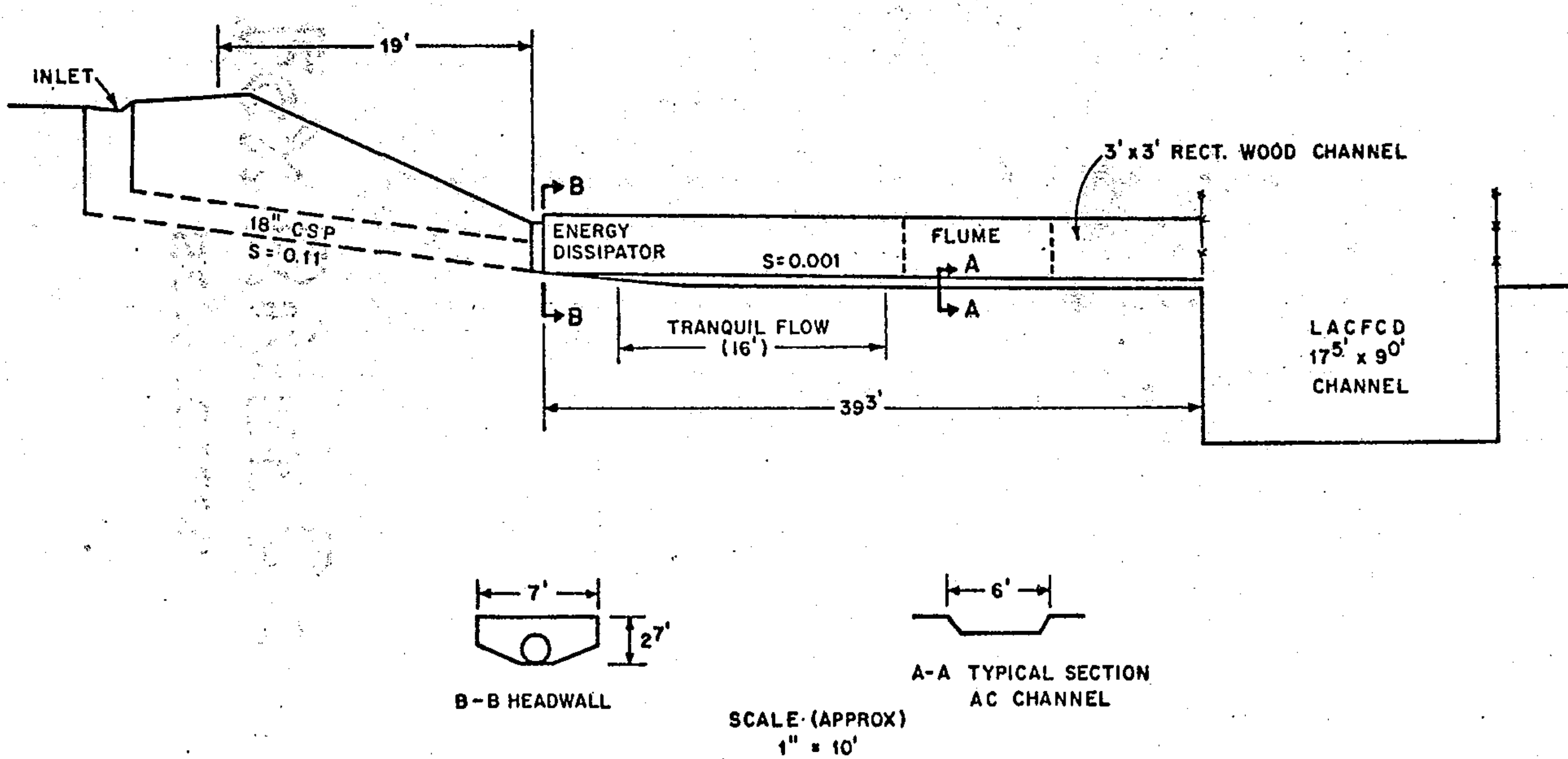
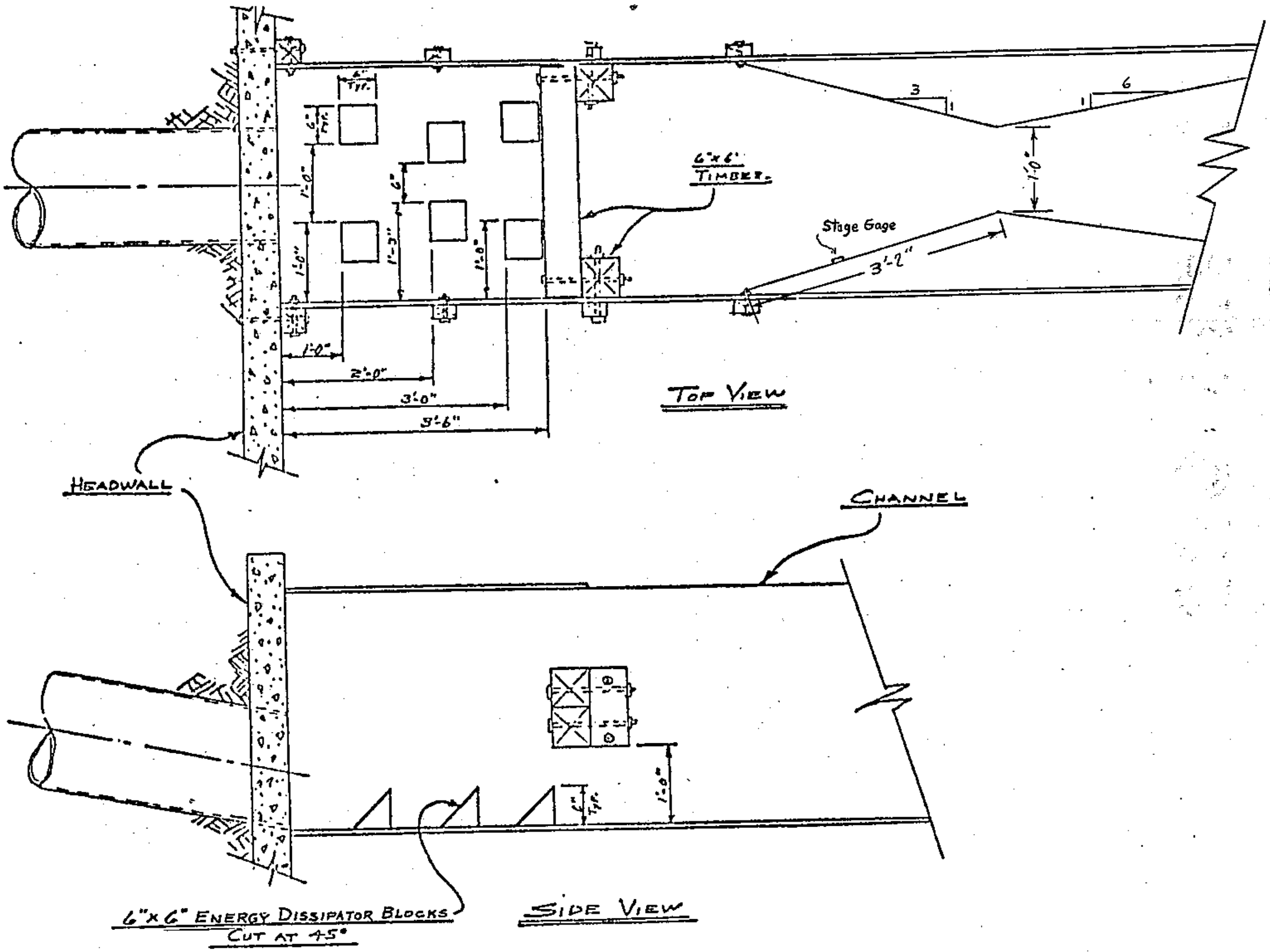
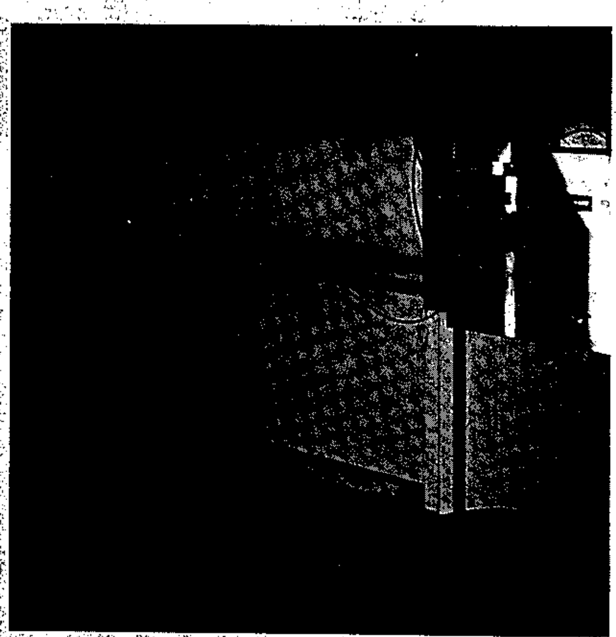


Figure 23
Flume Installation at Los Angeles

FIGURE 24

FLUME PLAN AT LOS ANGELES





Sonic water level recorder over flume

The instrument sent a light beam to the water surface which was reflected to the sensor. Changes in water depth in the flume were recorded by the sensor. Changes less than 0.02 foot in depth were not distinguishable by the sensor.

A stage measuring tape was fastened inside the flume to visually record depths. These depths were correlated to the recorded depths by the sonic water level flow recorder. Figure 24 shows the measuring location.

Contact was made with Dr. Young Kim of California State University, Los Angeles, regarding laboratory or field calibration of the flume. After Dr. Kim's field review, he advised that the following relationship would be just as valid for estimating flows in the flume as would be determined by making a laboratory calibration(9):

$$Q = 3.5\ h^{1.56}$$

where:

Q = flow, cfs

h = depth of flow

A plot of the stage-discharge curve is shown in Figure 25.

Figure 26 shows the drainage area of about 2.1 acres for the Walnut Creek I-680 site. Flows were determined using the equation(10):

$$Q = \frac{K}{n} D^{8/3} S^{1/2}$$

where:

K = discharge factor

n = Manning's roughness coefficient

D = depth of water

S = gradient

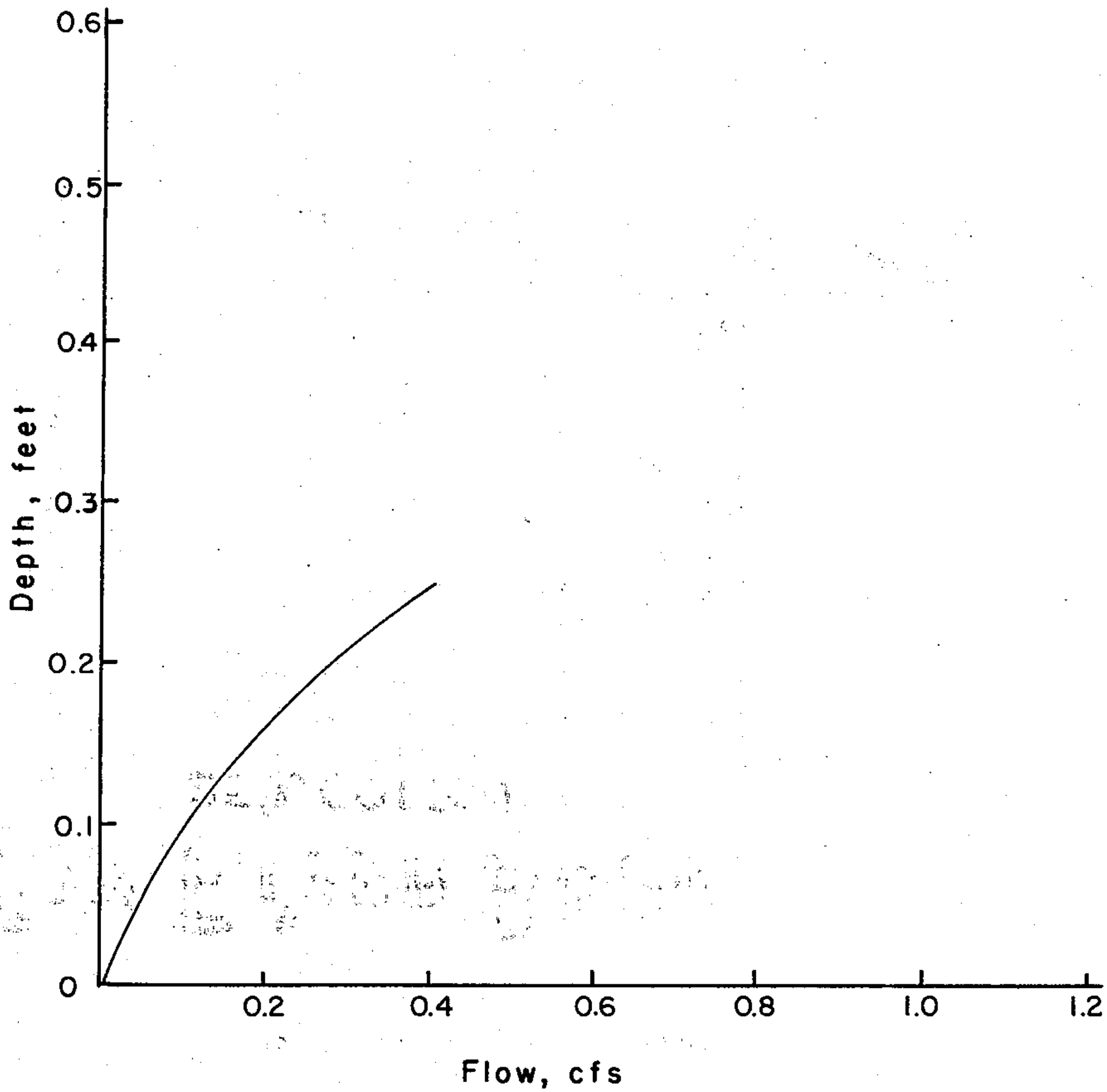
After consultation with Mr. Herb Gregory, FHWA Region IX Hydraulics Engineer, and Dr. Kenneth Kerri, California State University, Sacramento, it was decided that this would be satisfactory for estimating flows. Dr. Kerri recommended using a water truck to discharge a known flow through the pipe and recording stage. However, because of the traffic conditions on I-680, it was decided not to proceed with a field calibration.

Figure 27 shows the stage-discharge curve for the 18" diameter RCP.

Figure 25

FLOW VS DEPTH @ LOS ANGELES, I-405

flume $Q=3.5h^{1.56}$ w = 1' s = 0.001



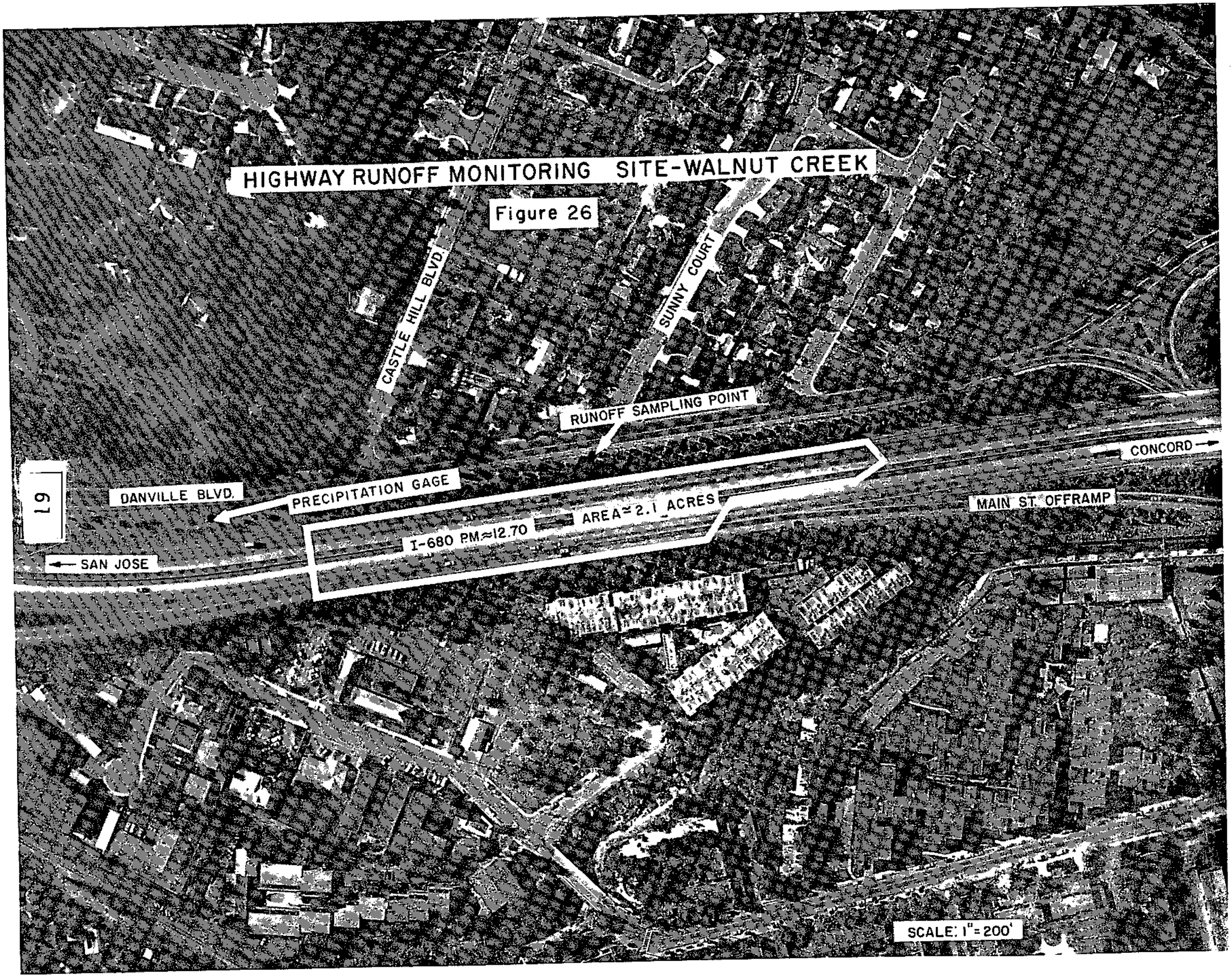

HIGHWAY RUNOFF MONITORING SITE-WALNUT CREEK
Figure 26
CASTLE HILL BLVD.
SUNNY COURT
RUNOFF SAMPLING POINT
CONCORD
DANVILLE BLVD.
PRECIPITATION GAGE
AREA ≈ 2.1 ACRES
MAIN ST. OFFRAMP
I-680 PM ≈ 12.70
SAN JOSE
SCALE: 1" = 200'

Figure 27

FLOW VS DEPTH @ WALNUT CREEK, I-680

18"RCP n = 0.012 s = 0.11

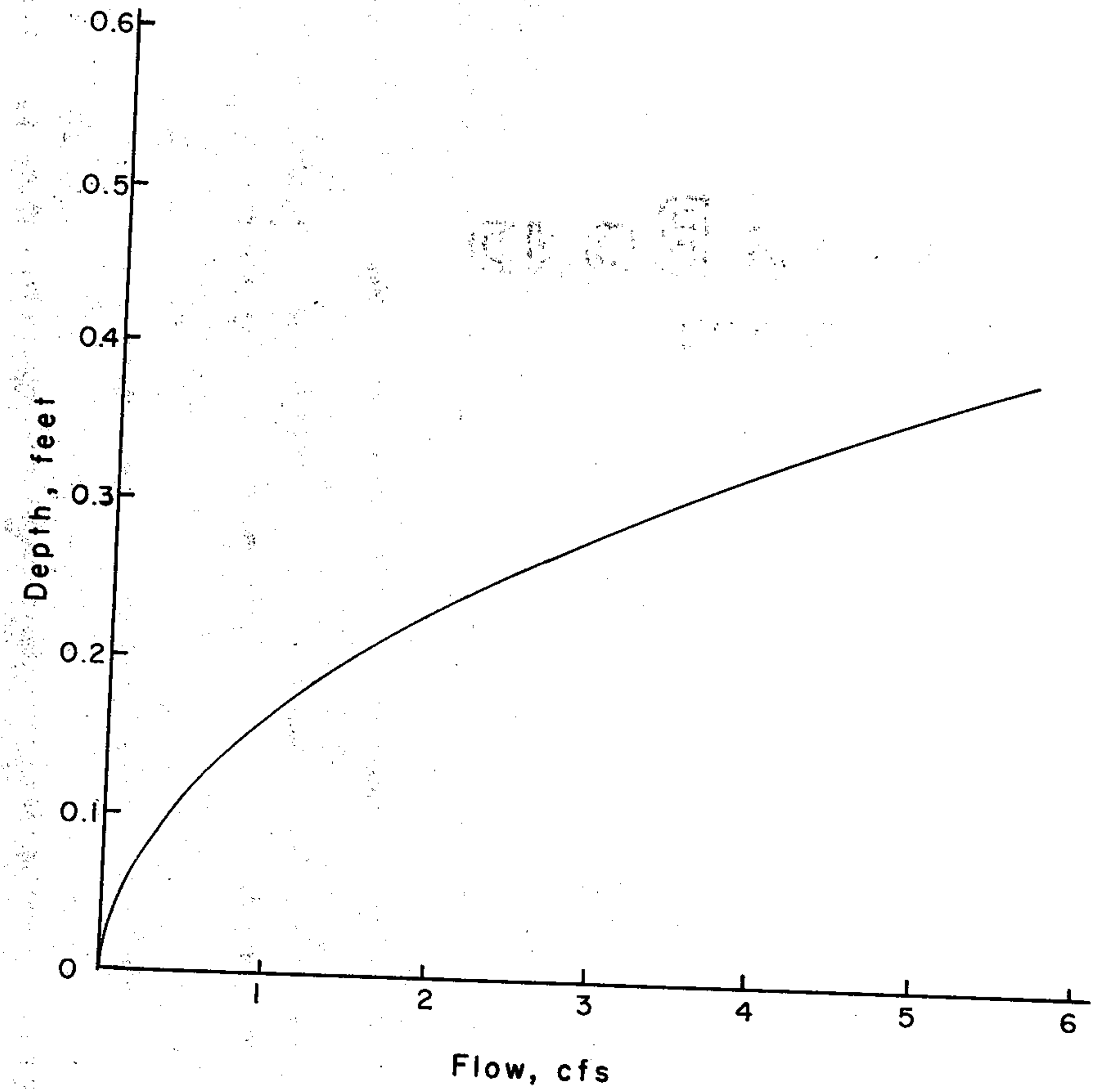


Figure 28 shows the drainage area of about 2 acres for the Placerville site on Route 50. A relationship between flow and depth was determined for culvert flows prior to 1977 using the formula:

$$Q = \frac{K}{n} D^{8/3} S^{1/2}$$

Figure 29 shows the stage-discharge curve for the culvert and flume for the period prior to installation of the pipe extension, after the extension was added, and for the winter 1977-78 with the flume in place.

During the Spring of 1977, a contract was made with the Department of Civil Engineering at California State University, Sacramento to calibrate a wooden flume that was designed and built at TransLab. Figure 30 shows the flume configuration. The flume was installed at the CSUS Hydraulics Lab at the same gradient as would exist in the field. Flows were discharged into the flume and depths recorded at several points. Analysis of the relationships between flow and depth for these various points was made to determine the most accurate measuring point. CSUS submitted a report of their findings to TransLab(11).

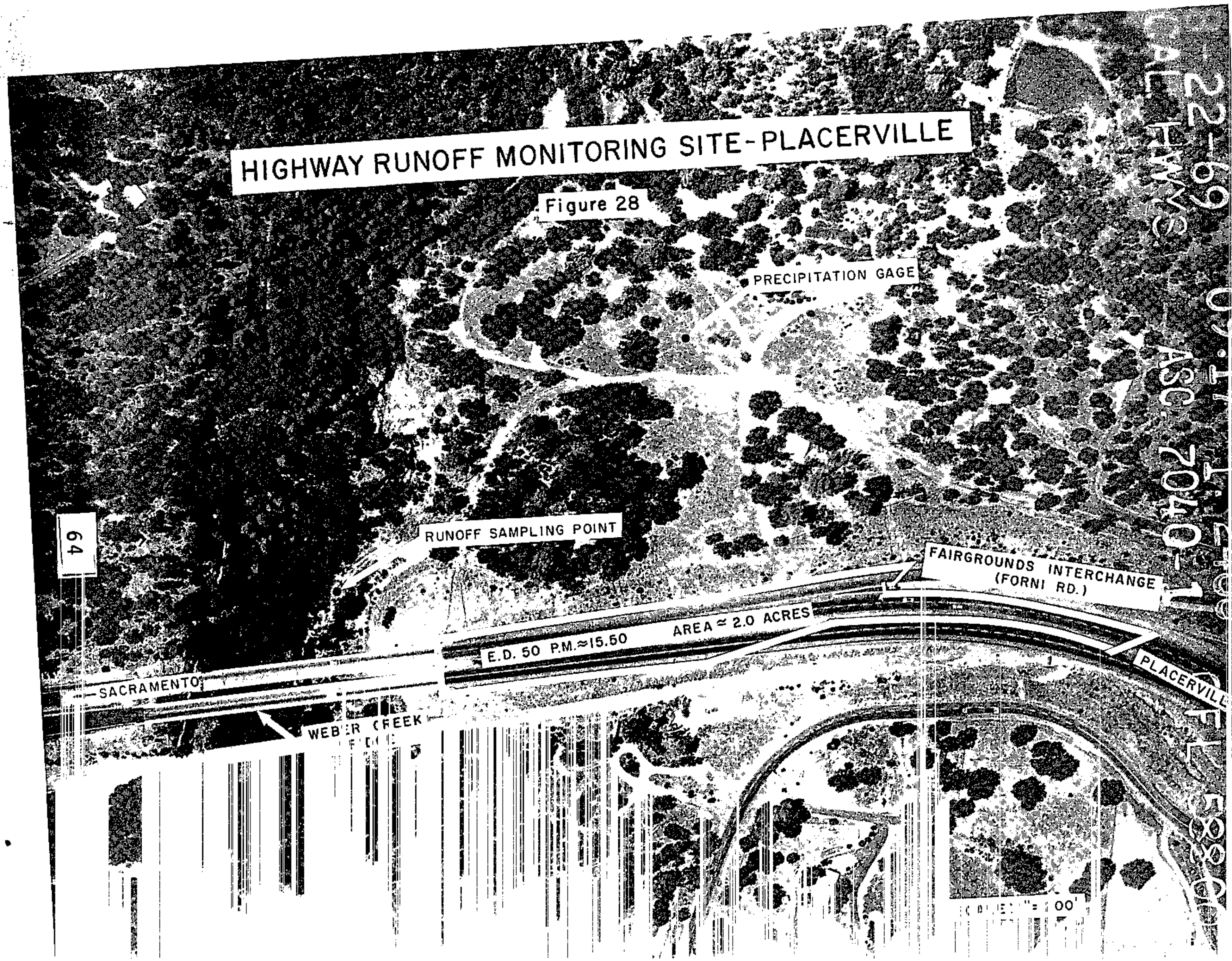


Figure 28

HIGHWAY RUNOFF MONITORING SITE-PLACERVILLE

Figure 29

FLOW VS DEPTH @ PLACERVILLE, RTE. 50

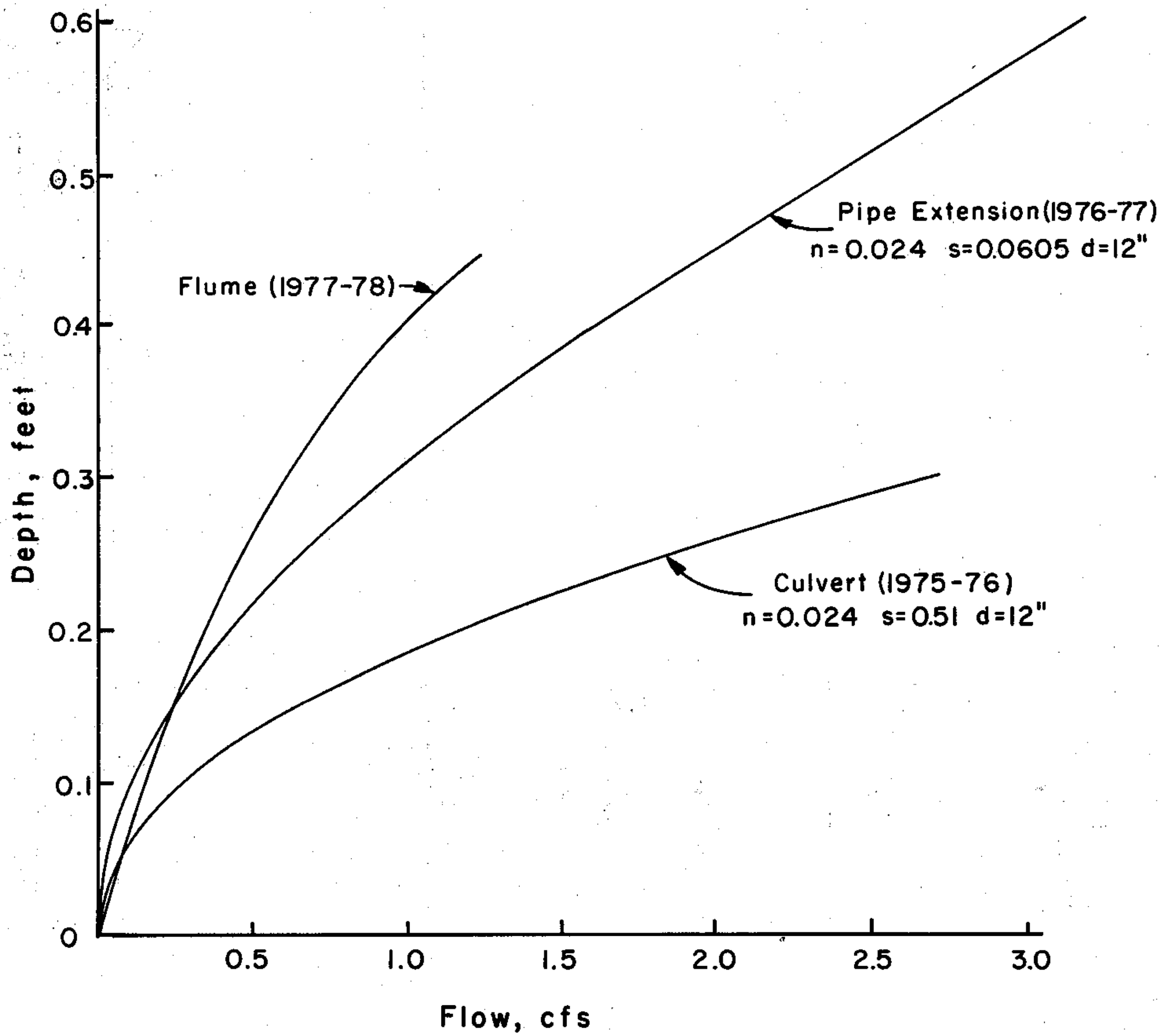
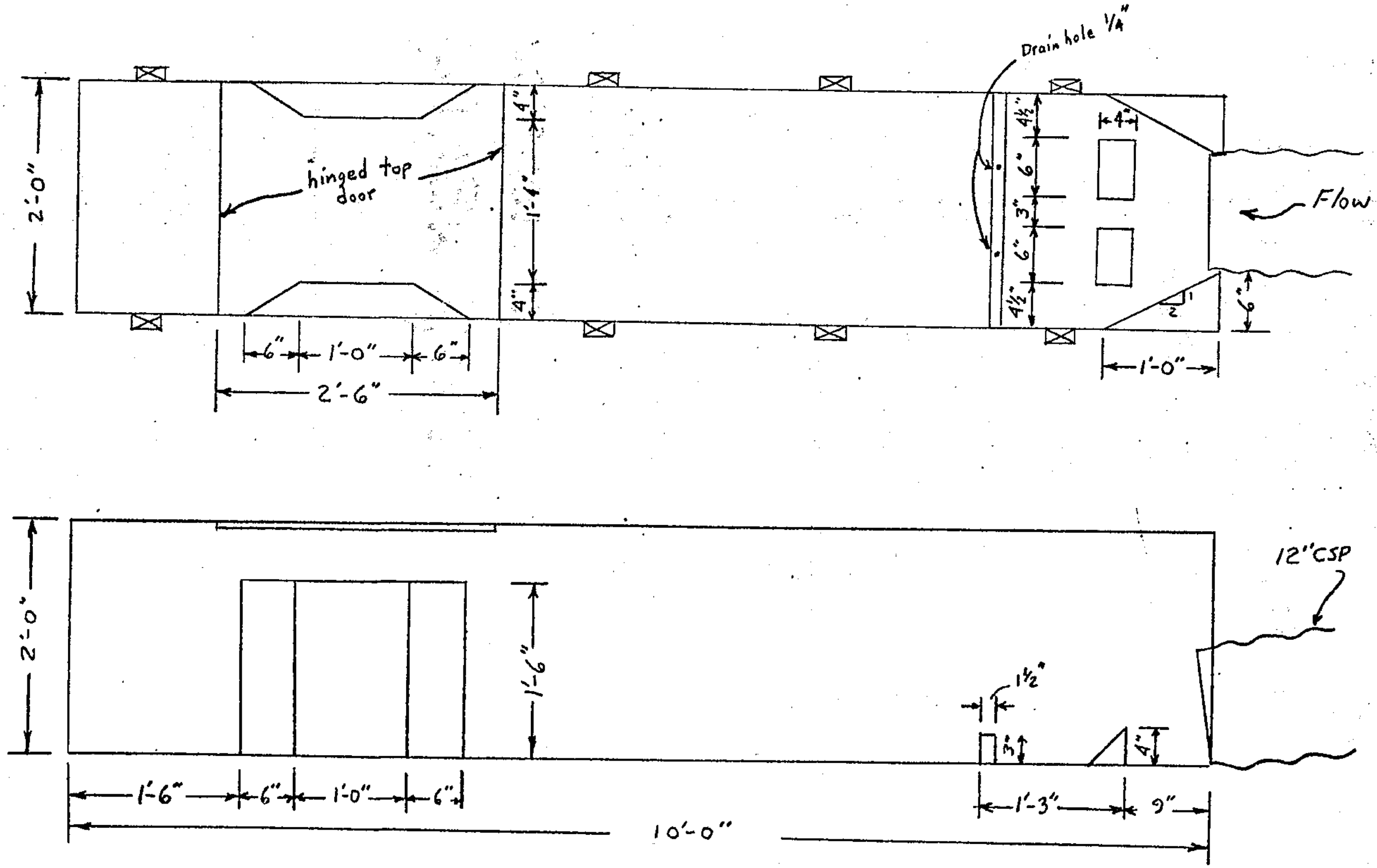
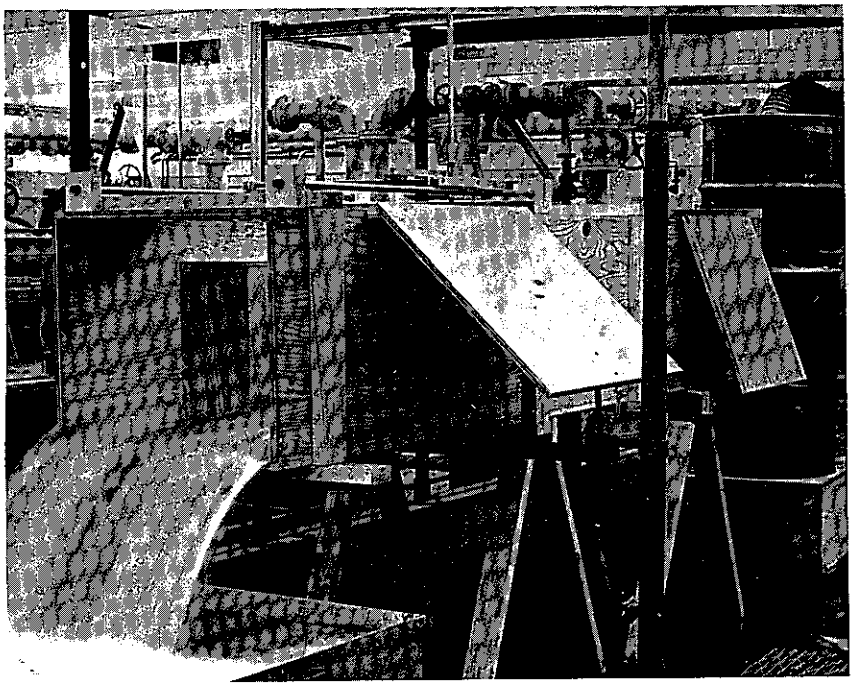


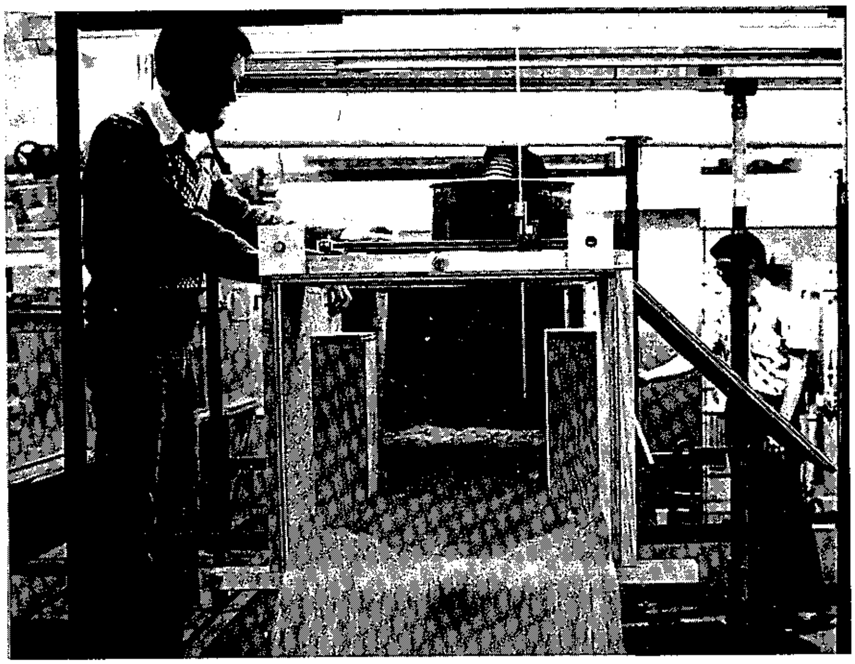
Figure 30

Flume Installation @ Placerville





Laboratory calibration of Placerville flume



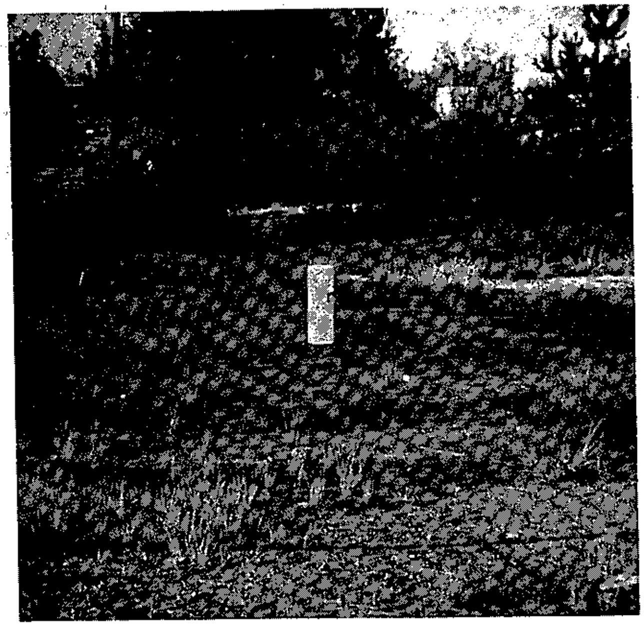
Measuring stages during laboratory calibration of flume

Precipitation

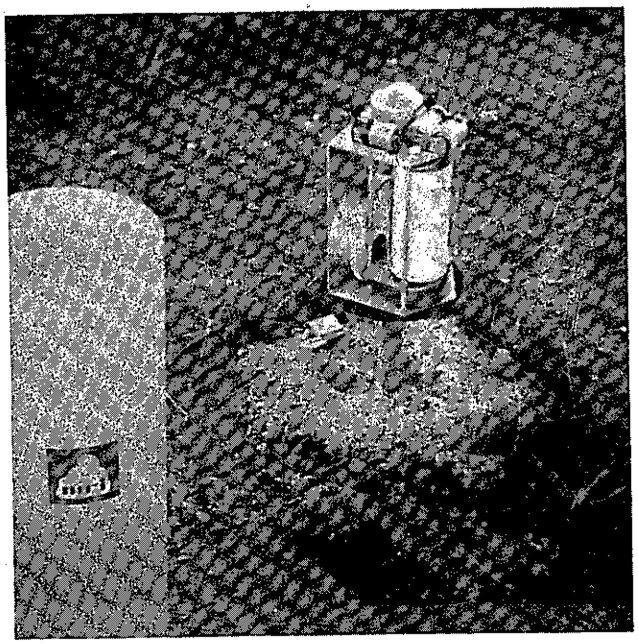
Precipitation information was obtained from both on-site measurements and from climatological records of the National Weather Service. Precipitation gages were installed at each of the three sites as follows:

Site	Equipment
Los Angeles, I-405	Weather Measure P511 (tipping bucket) with Long Term Event Recorder P522
Walnut Creek, I-680	Meteorological Research Instruments Rain Gage Model 304
Placerville, Route 50	Meteorological Research Instruments Rain Gage Model 304

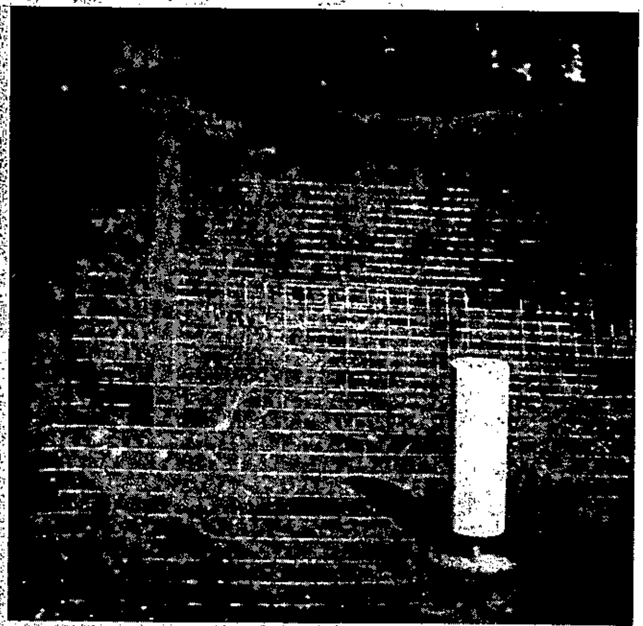
In addition, fence post gages were installed at the Walnut Creek and Placerville sites as back up measuring devices in case of equipment malfunction. The precipitation gages at the Placerville and Walnut Creek sites had frequent failures and required a lot of field time to check and repair equipment.



Precipitation gage at Walnut Creek site



Inside mechanism of precipitation gage at
Walnut Creek site



Precipitation recording instruments (fence post gage and MR1), Placerville site

Weather Measure precipitation gage on pole at Los Angeles site

The following table shows the rainfall information for each site for each sampling period.

TABLE 5

Rainfall Characteristics

Location	Date Sampled	Rain-fall, in.	Dura-tion, hr.	Ave. Inten-sity in/hr	Max. Inten-sity in/hr
Los Angeles, I-405	Feb. 4, 1976	0.19	24	0.02	0.32
	March 1	0.18	8	0.03	0.06
	Dec. 30	0.95	12	0.08	0.30
	Jan. 5, 1977	0.66	32	0.08	0.23
	Jan. 20	0.18	*	*	*
	Dec. 21	0.04	4	0.01	0.01
	Jan. 3, 1978	0.22	8	0.03	0.20
	Jan. 4	0.70	4	0.17	0.58
	Jan. 6	1.02	**	0.15	0.40
	Jan. 14	1.51	**	**	**
Walnut Creek, I-680	Oct. 9-10, 1975	1.30	19	0.07	0.18
	Dec. 21	0.13	5	0.03	0.15
	Jan. 9, 1976	0.27	9	0.03	0.30
	Feb. 5	0.16	6	0.03	0.17
	Oct. 1	0.44	4	0.11	0.36
	Nov. 11	0.30	11	0.03	0.33
	Dec. 29	0.05	15	0.08	0.18
	Oct. 28, 1977	0.09	6	0.01	0.02
	Nov. 21	3.27	19	0.18	0.40
	Dec. 14	1.23	12	0.10	0.26
	Dec. 21	0.03	1	0.15	0.15
Placerville, Route 50	Oct. 9-10, 1975	2.00	13	0.20	0.30
	Oct. 30	0.30	5	0.20	0.30
	Nov. 15	0.10	9	0.10	0.20
	Feb. 8, 1977	0.27	6	0.05	0.25
	March 16	0.20	*	*	*
	Sept. 19	0.11	4	0.01	?
	Nov. 21	2.19	22	0.10	0.24
	Dec. 11	0.31	3	0.10	0.27
	Dec. 14-15	2.32	17	0.13	0.50

* Gage malfunction, data not available.
** Equipment stolen, records not available.

A relationship between the duration of a storm in hours and the frequency of occurrence was developed from the information derived during the course of the study. The relationships are shown in Figure 31. The data show that 50% of the rainstorms for both Los Angeles and Walnut Creek are of about 6-7 hours duration and for Placerville about 3-4 hours.

Rainfall information for all storms occurring at the three field sample sites for the winters of 1974-5 through 1977-8 is shown in the Appendix beginning on page 128. As can be seen from this information, several storms occurred at each site. Not all storms were sampled since the attempt was to capture a typical storm of moderate intensity where a dry period existed prior to the sample date and also to sample those storms where the pavement was flushed. Several storms did not produce significant precipitation to cause flushing of the pavement. Also, many storms came in at night and on the weekends making it very difficult to assemble sampling crews.

The drought during the 1975 to 1977 period posed a very difficult situation for sampling. During the first part of the drought, some storms were not sampled since they did not present the best conditions for sampling. However, as the winter progressed, it became apparent that a drought was occurring and very limited rainfall fell during the remaining few months of the winter.

The following table shows the normal and actual precipitation for each calendar year during the course of this study:

Figure 31

FREQUENCY OF STORM DURATION

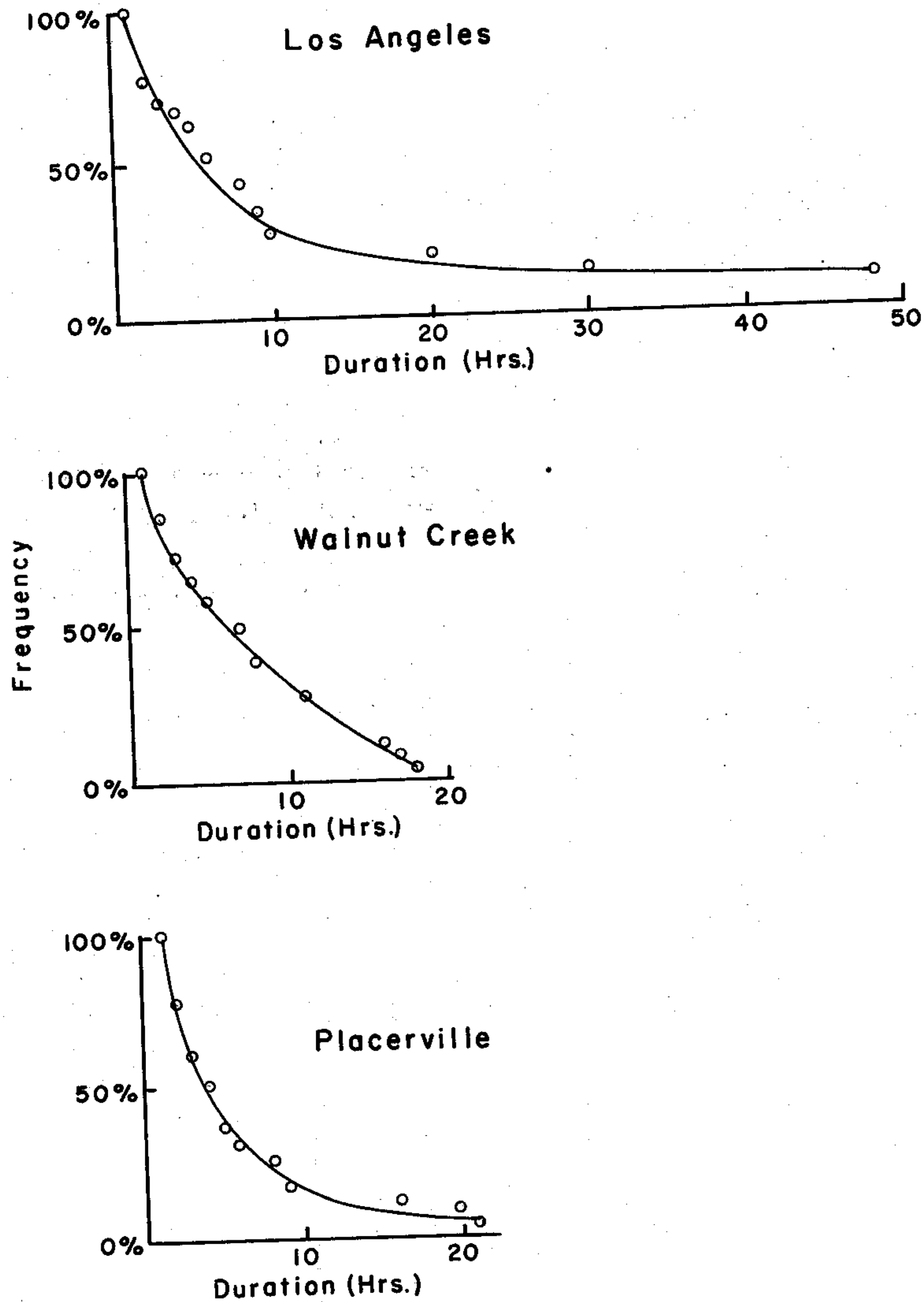


TABLE 6

Annual Rainfall

Location	Normal	1974	1975	1976	1977
		Rainfall, inches			
Los Angeles, I-405	11.5	12.8	7.3	9.3	13.7
Walnut Creek, I-680	18	13.9	15.9	7.4	7.8
Placerville, Route 50	39.8	34.4	34.9	11.4	23.0

There were also two tropical storms that hit the southern portion of the state. These storms, which were of hurricane force, came inland at Baja California (Mexico) as follows(12):

Name	Date
Kathleen	September 9-10, 1976
Doreen	August 16-18, 1977

Both storms brought intense rainfall to southern California resulting in extensive damage in several locations.

Since the normal rainfall in California occurs in the mid-October to the following April period, all three pavement runoff sites were inactivated through the dry late spring to early fall time frame (May-October). Consequently, although both tropical storms brought significant rainfall at the Los Angeles I-405 sampling site, sampling was not accomplished because of the summer shut-down period.

PARTICULATE FALLOUT

Particulate fallout, or dustfall, was measured twice at the Los Angeles I-405 sampling site. The measuring apparatus consisted of dustfall jars mounted on 4"x4" posts located 8 feet above ground level. The sample jars were located in a grid fashion as shown in Figure 32 and included one sample jar located 500 feet west of the freeway (W-500), three located along the west shoulder (W-1, 2, 3), three located in the median (M-1, 2, 3), three located along the east shoulder (E-1, 2, 3), and one sample jar located 500 feet east of the freeway.

Samples were collected and analyzed according to the American Society for Testing and Materials method designated ASTM D1739-70. The samples were tested at the Transportation Laboratory Chemistry Lab. The sample periods were:

July 27 - August 26, 1976
February 2 - March 3, 1977

Results from the samples are shown in the following table:

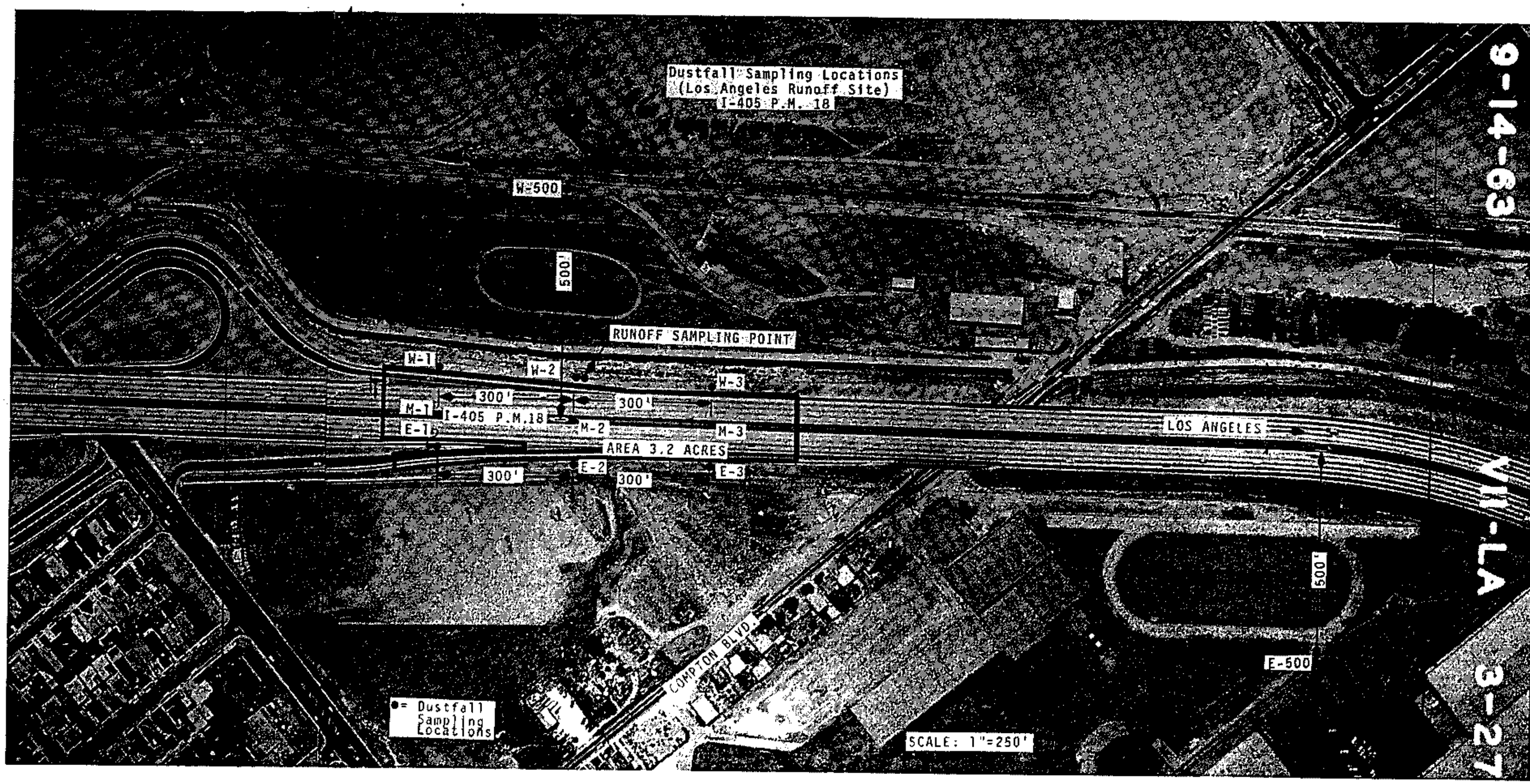

9-14-63
VII-LA
3-27
Dustfall Sampling Locations
(Los Angeles Runoff Site)
I-405 P.M. 18
W-500
500'
RUNOFF SAMPLING POINT
W-1
W-2
W-3
300'
300'
M-1
I-405 P.M.18
M-2
M-3
E-1
AREA 3.2 ACRES
E-2
E-3
300'
300'
LOS ANGELES
500'
E-500
COMPTON BLVD.
● = Dustfall Sampling Locations
SCALE: 1"=250'

Figure 32

TABLE 7

Particulate Fallout

July 27-August 26, 1976

Sample No.	Total** Dustfall (mg)	Pb (mg)	Cr (mg)	PO_4(P) (mg)	NO_3(N) (mg)	pH
W-1	200	0.4	<0.1	0.34	0.2	5.0
W-2	215	0.4	<0.1	0.40	0.6	4.5
W-3	75	0.3	<0.1	0.09	<0.1	5.7
Average	163	0.4	<0.1	0.28	0.3	4.84
M-1	270	0.2	<0.1	0.12	1.6	4.2
M-2	275	0.2	<0.1	0.06	1.9	4.7
M-3	300	0.2	<0.1	0.09	0.2	4.4
Average	282	0.2	<0.1	0.09	1.2	4.59
E-1	305	0.6	<0.1	0.12	1.0	4.6
E-2	330	<0.1	<0.1	0.09	0.2	4.7
E-3	295	2.9	<0.1	0.09	0.2	4.6
Average	310	1.2	<0.1	0.10	0.5	4.63
W-500	200	<0.1	<0.1	0.77	0.4	5.1
E-500	373	0.1	<0.1	0.21	3.4	5.5

February 2-March 3, 1977

Sample No.	Total** Dustfall (mg)	Pb (mg)	Cr (mg)	PO_4(P) (mg)	NO_3(N) (mg)	pH
W-1	357	0.6	0.007	0.86	3.6	4.1
W-2	434	0.8	0.012	0.52	4.1	3.7
W-3	482	0.9	0.010	0.49	3.9	3.8
Average	424	0.8	0.010	0.62	3.9	3.84
M-1	470	1.6	0.017	0.64	3.4	3.8
M-2*	643	2.1	0.014	0.86	3.4	3.8
M-3	489	2.1	0.018	0.64	4.8	3.9
Average	534	1.9	0.016	0.71	3.9	3.83
E-1	429	2.2	0.024	1.01	4.6	4.2
E-2	401	1.4	0.011	0.55	4.2	3.9
E-3	392	1.8	0.022	0.67	4.2	4.0
Average	407	1.8	0.019	0.74	4.3	4.02
W-500	499	0.3	0.016	0.83	4.3	4.3
E-500	259	0.4	0.018	0.28	4.4	3.9

*Sample M-2 for February 2-March 3, 1977, contaminated with rust.

**Represents total (mg), per surface area of sampler (182.3 cm^2), per 30 day period.

Dustfall collection jar on west
shoulder I-405, Los Angeles

Installation of dustfall jar
with bird ring

The dustfall results for the July 27 - August 26, 1976 period shows an overall increase in the total dustfall from the western most sampling location (W-500) to the eastern most location (E-500) of 200 mg to 373 mg. The concentration of lead (Pb) also followed the increasing pattern from a westerly to an easterly location along the roadway. The levels of nitrate nitrogen NO_3(N) also reflect the general trend in lower readings at the westerly sampling points to higher readings at the easterly points.

For the February 2 - March 3, 1977 sampling period, total dustfall showed 499 mg at the westerly sample point (W-500) compared to 259 at the easterly point (E-500). Concentrations of lead, chromium, phosphate and nitrate nitrogen, showed an overall increase from west to east.

Wind patterns during the normal traffic period (early mornings to mid evening) for the summer period are usually from sea to land. During the winter period of February 2 - March 3, there is a more stable atmospheric condition, especially during the morning peak traffic rush. The sea breeze is also generally lighter than in the summer.

For more details on the dustfall study, the reader is referred to reference 3.

TRAFFIC

Traffic information was obtained from the Caltrans Office of Traffic and the Traffic Departments in Districts 03 and 07. The following table presents the traffic details for each site:

Los Angeles, I-405

Period Between Storms	No. Days	No. Vehicles	ADT*
Dec. 12, 1975 - Feb. 4, 1976	54	9,612,000	178,000
Feb. 9 - March 1, 1976	21	4,032,000	192,000
Nov. 12 - Dec. 30, 1976	48	8,742,000	186,000
Jan. 3 - Jan. 5, 1977	2	320,000	160,000
Jan. 7 - Jan. 20, 1977	13	2,346,000	180,500
Dec. 18 - Dec. 21, 1977	2	422,400	211,200
Dec. 28, 1977 - Jan. 3, 1978	5	830,900	166,200
Jan. 3 - Jan. 4, 1978	1	183,000	183,000
Jan. 5 - Jan. 6, 1978	1	194,800	194,800
Jan. 11 - Jan. 14, 1978	3	605,700	201,900
		Total ADT =	1,853,600
		Average ADT =	185,400
		Standard Deviation =	155

*Average daily traffic (both directions)

Walnut Creek, I-680

Period Between Storms	No. Days	No. Vehicles	ADT
July 15 - Oct. 9, 1975	86	6,192,000	72,000
Dec. 13 - Dec. 21, 1975	8	532,800	66,600
Dec. 21, 1975 - Jan. 6, 1976	19	1,233,100	64,900
Jan. 9 - Feb. 5, 1976	27	1,661,000	61,500
Sept. 28 - Oct. 1, 1976	3	212,000	70,700
Oct. 1 - Nov. 11, 1976	41	2,749,000	67,000
Nov. 14 - Dec. 29, 1976	45	2,902,000	64,500
Sept. 29 - Oct. 28, 1977	29	1,862,000	64,200
Nov. 6 - Nov. 21, 1977	15	1,021,500	68,100
Dec. 12 - Dec. 14, 1977	2	134,600	67,300
Dec. 18 - Dec. 21, 1977	3	193,600	64,500
		Total ADT =	731,300
		Average ADT =	66,500
		Standard Deviation =	30

PROJECT 657117 LOCATION Placerville DIST. 03 CO. ED RTE. 50 PM. 15.5

PARAMETER	DATE November 21, 1977	STORM NO. 2				
SAMPLE NO.	2P-1	-3	-5	-8	-10	-13
TIME	0845	0915	0945	1030	1130	1330
FIELD						
Flow, cfs	.22	.30	.52	.30	.18	.11
Temp, °C	6.7	6.7	6.7	6.7	6.7	7.3
Cond, µmhos/cm	18	20	12	17	25	47
pH	6.3	6.4	6.4	6.3	6.4	6.6
D.O. mg/l	–	–	–	–	–	–
MAJOR IONS						
B mg/l	0.07	0.03	0.02	0.05	0.04	0.02
Ca mg/l	4.3	5.1	9.9	3.5	3.8	5.6
Cl mg/l	1.1	0.7	0.7	0.8	1.0	2.2
CO_3 mg/l	0	0	0	0	0	0
HCO_3 mg/l	7	10	10	7	10	12
K mg/l	1.4	1.5	1.8	1.2	0.8	1.0
Mg mg/l	2.1	2.8	5.7	1.5	1.2	1.2
Na mg/l	3.4	1.6	1.9	1.9	1.8	3.1
SiO_2 mg/l	1.2	1.0	1.1	1.2	1.3	2.4
SO_4 mg/l	1.8	2.4	1.4	1.8	3.7	5.3
METALS						
Cd mg/l x 10^{-3}	<4	→	→	→	→	→
Cr mg/l	0.02	0.03	0.06	0.02	0.01	0.01
Cu mg/l	0.04	0.06	0.09	0.04	0.04	0.04
Fe mg/l	8.0	10	17	5.3	3.7	3.0
Hg mg/l x 10^{-3}	<0.2	→	→	→	→	→
Mn mg/l	0.14	0.19	0.37	0.10	0.09	0.09
Mo mg/l	<0.04	→	→	→	→	→
Ni mg/l	0.04	0.05	0.09	0.03	0.03	0.03
Pb mg/l	0.6	0.8	1.9	0.4	0.3	0.3
Zn mg/l	0.18	0.22	0.41	0.14	0.14	0.19
Lab pH	6.8	6.6	6.9	6.7	6.9	6.9
NUTRIENTS						
Nitrate (N) mg/l	0.6	0.6	0.6	0.5	0.5	0.6
Kjeldahl (N) mg/l	1.0	1.1	1.1	0.7	0.8	1.0
Ammonia (N) mg/l	0.3	0.3	0.3	0.2	0.3	0.4
Total P mg/l	0.15	0.24	0.24	0.13	0.14	0.12
Ortho P mg/l	0.02	0.04	0.05	0.03	0.02	0.01
MISCELLANEOUS						
Oil & Grease mg/l	8	9	9	14	7	5
Total Solids mg/l	129	243	217	131	99	109
Volatile Portion (T.S.)%	31	27	23	34	48	56
Total Sus. Solids mg/l	96	219	190	85	61	44
Volatile Portion (TSS)%	17	20	22	20	49	57
COD mg/l	74	92	115	53	66	83
PRECIPITATION (p)						
Δp, (inches)	.54	.06	.11	.09	.09	.11
p, (Total)	.54	.60	.71	.80	.89	1.00

MAINTENANCE PRACTICES

The major maintenance practices that relate to the freeway operation at the three sample sites include: street sweeping, drainage cleanout, litter pickup, and weed/vegetation control. In addition to these maintenance practices, a New Jersey median barrier was constructed at the Walnut Creek I-680 site just prior to monitoring pavement runoff in the Fall of 1975. A New Jersey barrier is being installed at the Los Angeles I-405 site following the completion of sampling in the 1977-8 winter.

The drainage culvert cleanout practice consisted mainly of removing debris from the drainage inlet to culverts. Debris would collect on the inlet grate and, for culverts that had an unobstructed inlet, debris would accumulate inside. A hydraulic jetting method was used to free the drain.

The major maintenance practice that affects improvement in water quality is street sweeping. Studies by others have indicated that removal of sand, debris, and other inert material from the curb and gutter will greatly improve water quality(13). The following information describes the street sweeping practices carried out by Caltrans maintenance at the three sites.

Los Angeles, I-405

	Area Swept
December, 1976*	all
January, 1977*	all
February, 1977*	all
March, 1977*	all
June 13, 1977	shoulders
June 16, 1977	median
September 16, 1977	shoulders

*Not sure whether median, shoulder or both were swept.

Walnut Creek, I-680

	Area Swept
September 17, 1976**	shoulders
September 22-23, 1976**	"
September 29, 1976**	"
October 4, 1976	median
October 19, 1976	"
October 29, 1976**	shoulders
November 1, 1976	median
November 8, 1976**	shoulders
November 16, 1976**	"
November 29, 1976**	"
December 13, 1976**	"
October 20, 1977	N-bound shoulder
October 21, 1977	S-bound shoulder
October 25, 1977	"
October 27, 1977	median
November 2, 1977	shoulders
December 1, 1977	median & shoulders
December 6, 1977	" "
December 12-13, 1977	" "
January 23, 1978	shoulders
January 25, 1978	median

**Sweeping was performed in the area of the sample site but not sure if it included sample site.

Placerville, Route 50

November 16, 1977***	median & shoulders
February 22, 1978	" "

***Records were not maintained on sweeping operations at the Placerville site prior to January 1977.

A description of the street sweeping equipment is as follows:

Placerville

Type: Mobil Sweeper Model TE-4

Capacity: 4 cy

Sweeper Broom: 2 Gutter brooms, each 42" diameter (.025" x .125" x 26" long steel wire strands)

Pickup Broom: 1 pickup broom, 36" diameter and 58" in length (broom fibers are 66% .06" diameter and 34% .08" diameter crimped, oval shape made of polypropylene)

Walnut Creek and Los Angeles

Type: Wayne (Ford Motor Co.) Model 964

Capacity: 4 cy

Sweeper Broom: 1 Gutter broom, 42" diameter (.025" x .125" x 26" long steel wire strands)

Pickup Broom: 1 pickup broom, 36" diameter and 58" in length (broom fibers are 66% .06" diameter and 34% .08" diameter crimped, oval shape made of polypropylene)

REFERENCES

1. "Water Pollution Effects of Street Surface Contaminants", URS Research Company, prepared for Federal Water Quality Administration, Department of the Interior, Contract No.14-12-921, September 1970.

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5. "Storm Water Management Model", Vol. 1 - Final Report, Vol. II - Verification and Testing, Vol. III - User's Manual, and Vol. IV - Program Listing, U.S. Environmental Protection Agency, July 1971.

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10. "Handbook of Hydraulics", King and Brater, 5th Edition, McGraw-Hill, 1963.

11. "Parshall Flume Calibration", by Don Hansen and Geary Long, Department of Civil Engineering, California State University, Sacramento, for Caltrans, May 1977.

12. Communication with California Department of Water Resources (Bill Arbola) and National Weather Service at Redwood City (415)876-2886.

13. "Water Pollutants in Urban Runoff", by James Sartor and Gail Boyd, Woodward-Clyde Consultants, paper presented at U.S. Environmental Protection Agency National Conference on 208 Planning and Implementation, Spring 1977.

APPENDICES

Check List
Highway Surface Runoff Data Form
Water Quality Data
  1975-76
  1976-77
  1977-78
Precipitation Data

CHECK LIST

Instruments, Equipment and Miscellaneous Items for Sampling Highway Surface Runoff

Gate Keys (R/W and cover plates on CMP risers)
Combination Locks (0703)
Vehicle ready (Translab)
Flashlights/Lantern
Rain gear, hard hats
First aid kit
Folding ruler
pH meter
Conductivity meter
Thermometer
Accessories for Precip gage
Tools (screwdriver, pliers, etc)

Sample Scoop (1/2 gal. polyethylene bottle)
Bottles, polyethylene
  1/2 gal. size
  Min. of 24 bottles for sampling storm
  (Note: keep shipping cartons for future use)
Bottles, glass
  1 liter size
  Min. of 8 bottles for sampling storm
Bucket, plastic
  2 gal. size

Miscellaneous glass ware(beakers, pipet)
Disposable wipers (Kimwipes, clean rags)
Ice chests (Styrofoam)
(Enough for icing 24 samples)
Ice (obtain just before sampling)
Distilled water
Conc. Nitric Acid (HNO_3)
pH Buffers
Labels, masking tape, grease pencils, marking Pens

Required data sheets

Note: Battery operated instruments should be checked periodically. All instruments are to be calibrated prior to taking to field.

HIGHWAY SURFACE RUNOFF DATA

LOCATION ____________________ DATE ____________________

STORM NO. ____________________ SAMPLERS ____________________

____

	TIME	SAMPLE NO.	DEPTH (FT.)	WATER TEMP. C.	pH	E.C. umhos/cm READ	@ 25° C.	D.O. mg/l	REMARKS

Water Quality Data

1975-76

PROJECT LOCATION Los Angeles DIST. 07 CO. LA RTE. 405 P.M. 18.0

PARAMETER	DATE 2/4/76	STORM NO. 1								
SAMPLE NO.	1	2	3	4	5	6				
TIME	0630	0943	1115	1145	1235	1310				
FIELD										
Flow, cfs	0.01	0.02	0.02	0.02	0.16	0.02				
Temp, °C	12.3	13.6	12.8	13.9	13.5	13.6				
Cond, μmhos/cm	1369	1110	591	814	358	287				
pH	6.1	6.9	6.5	6.9	6.7	6.4				
D.O. mg/l	12.0	12.3	12.1	10.2	13.0	11.7				
MAJOR IONS										
B mg/l	0.67	0.62	0.54	0.52	0.32	0.29				
Ca mg/l	195	124	71	78	34	27				
Cl mg/l	224	148	80	96	39	27				
CO_3 mg/l	0	0	0	0	0	0				
HCO_3 mg/l	33	39	44	37	22	21				
K mg/l	33.0	20.0	15.0	15.0	6.8	5.5				
Mg mg/l	20.0	12.0	7.2	8.4	4.3	3.2				
Na mg/l	92	58	38	42	15	12				
SiO_2 mg/l	3.8	5.5	8.5	7.9	10.2	9.8				
SO_4 mg/l	215	150	105	115	55	40				
METALS										
Cd mg/l	0.08	0.05	0.02	0.02	0.02	0.01				
Cr mg/l	0.04	0.03	0.04	0.03	0.05	0.04				
Cu mg/l	0.30	0.21	0.19	0.19	0.16	0.12				
Fe mg/l	2.9	1.4	5.5	4.2	5.5	3.8				
Hg mg/l $\times 10^{-4}$	<2	5	6	2	30	10				
Mn mg/l	0.87	1.35	0.46	0.53	0.28	0.20				
Mo mg/l	0	0	0	0	0	0				
Ni mg/l	0.36	0.28	0.23	0.22	0.15	0.12				
Pb mg/l	5.8	2.3	2.0	2.4	3.8	2.8				
Zn mg/l	14.0	10.0	2.8	4.4	6.4	5.6				
Lab pH	5.5	6.2	6.3	6.2	6.1	6.1				
NUTRIENTS										
Nitrate (N) mg/l	50.0	32.0	17.0	18.0	9.8	6.2				
Kjeldahl (N) mg/l	35.0	26.0	18.0	18.0	12.0	9.0				
Ammonia (N) mg/l	26.0	18.0	10.0	10.0	6.8	5.2				
Total P mg/l	0.72	0.43	0.64	0.54	0.66	0.37				
Ortho P mg/l	0.09	0.06	0.14	0.12	0.27	0.10				
MISCELLANEOUS										
Oil & Grease mg/l 2	23.0	7.2	35.0	32.0	20.0	7.0				
Total Solids mg/l	1630	1200	870	860	560	390				
Volatile Portion (T.S.)%	41	42	49	52	54	41				
Total Sus. Solids mg/l	43	22	123	89	216	136				
Volatile Portion (T.S.S.)%	66	57	55	56	63	34				
COD mg/l	420	700	610	400	460	340				
PRECIPITATION (p)										
Δp, (inches)	0.02	0.03	0.01	0.02	0.03	0.00				
p, (Total)	0.02	0.05	0.06	0.08	0.11	0.11				

PROJECT LOCATION Los Angeles DIST. 07 CO. LA RTE. 405 P.M. 18.0

PARAMETER	DATE 3/1/76	STORM NO. 2	
SAMPLE NO.	1	2	3
TIME	0555	0705	0825
FIELD			
Flow, cfs	0.15	0.24	0.03
Temp, °C	13.2	14.0	14.0
Cond, µmhos/cm	139	103	130
pH	6.6	7.0	7.2
D.O. mg/l	11.3	11.5	11.2
MAJOR IONS			
B mg/l	0.18	0.17	0.17
Ca mg/l	11.0	7.7	12.0
Cl mg/l	15.0	8.7	11.0
CO_3 mg/l	0	0	0
HCO_3 mg/l	9.8	8.5	13.0
K mg/l	2.6	2.4	2.2
Mg mg/l	1.7	1.9	1.5
Na mg/l	7.7	5.1	5.9
SiO_2 mg/l	3.9	3.9	4.7
SO_4 mg/l	20	15	17
METALS			
Cd mg/l	0.00	0.00	0.00
Cr mg/l	0.01	0.01	0.01
Cu mg/l	0.06	0.07	0.07
Fe mg/l	2.2	4.4	2.3
Hg mg/l $\times 10^{-4}$	10	5	3
Mn mg/l	0.10	0.11	0.09
Mo mg/l	0	0	0
Ni mg/l	0.04	0.06	0.06
Pb mg/l	1.3	2.2	1.5
Zn mg/l	1.8	1.3	1.0
Lab pH	6.6	6.6	7.0
NUTRIENTS			
Nitrate (N) mg/l	2.4	1.8	2.3
Kjeldahl (N) mg/l	4.1	3.9	3.5
Ammonia (N) mg/l	2.2	1.5	1.8
Total P mg/l	0.18	0.25	0.17
Ortho P mg/l	0.0	0.0	0.0
MISCELLANEOUS			
Oil & Grease mg/l	2.8	26.0	30.0
Total Solids mg/l	189	239	177
Volatile Portion (T.S.) %	58	58	55
Total Sus. Solids mg/l	44	139	48
Volatile Portion (T.S.S.) %	66	50	27
COD mg/l	290	130	220
PRECIPITATION (p)			
Δp, (inches)	0.01	0.09	0.04
p, (Total)	0.01	0.10	0.14

PROJECT LOCATION Walnut Creek DIST. 04 CO. CC RTE. 680 P.M. 12.7

PARAMETER	DATE 10/9/75-10/10/75	STORM NO. 1			
SAMPLE NO.	1	2	3	4	5
TIME	2035	2110	2230	1200	1300
FIELD					
Flow, cfs	0.300	.040	.002	2.500	1.100
Temp, °C	14.6	-	-	16.0	18.0
Cond, µmhos/cm	75	101	140	73	150
pH	8.6	-	-	7.4	6.5
D.O. mg/l	10.8	-	-	-	-
MAJOR IONS					
B mg/l	0.08	0.08	0.18	0.17	0.20
Ca mg/l	18	18	27	26	26
Cl mg/l	3.5	0.8	9.2	5.0	8.8
CO_3 mg/l	0	0	0	0	0
HCO_3 mg/l	3.9	44.0	54.0	30.0	55.0
K mg/l	3.0	3.2	4.4	5.7	5.2
Mg mg/l	3.3	3.0	4.2	10.0	6.6
Na mg/l	4.2	5.0	7.0	5.6	6.2
SiO_2 mg/l	6.0	6.8	9.4	4.2	11.0
SO_4 mg/l	12	11	20	9	24
METALS					
Cd mg/l	0	0	.01	.01	.01
Cr mg/l $\times 10^{-3}$	32	32	36	112	60
Cu mg/l	48	52	60	128	68
Fe mg/l	7.7	6.6	8.2	32.0	15.0
Hg mg/l $\times 10^{-4}$	<2	<2	<2	<3	<2
Mn mg/l	0.18	0.17	0.22	0.58	0.32
Mo mg/l	0	0	0	0	0
Ni mg/l	0.03	0.03	0.03	0.08	0.05
Pb mg/l	1.2	1.2	1.5	3.3	1.8
Zn mg/l	0.29	0.29	0.38	0.76	0.48
Lab pH	8.1	8.1	8.0	8.0	7.9
NUTRIENTS					
Nitrate (N) mg/l	0.88	0.94	1.85	1.08	1.76
Kjeldahl (N) mg/l	2.6	1.8	2.6	2.4	2.7
Ammonia (N) mg/l	0.5	0.7	0.9	0.7	0.9
Total P mg/l	0.26	0.28	0.32	0.54	0.44
Ortho P mg/l	0.07	0.07	0.09	0.22	0.14
MISCELLANEOUS					
Oil & Grease mg/l	16.0	33.0	0.8	41.0	11.0
Total Solids mg/l	219.0	261.0	252.0	576.0	415.0
Volatile Portion (T.S.)%	20	33	6	25	36
Total Sus. Solids mg/l	133	115	145	510	228
Volatile Portion (T.S.S.)%	22	28	29	19	23
COD mg/l	121	134	192	244	185
PRECIPITATION (p)					
Δp_i (inches)	.04	.08	.00	.03	.07
p_i (Total)	.04	.12	.12	.15	.22

PROJECT LOCATION Walnut Creek DIST. 04 CO. CC RTE. 680 P.M. 12.7

PARAMETER	DATE 12/21/75-12/22/75	STORM NO. 2								
SAMPLE NO.	1	2	3	4	5					
TIME	2030	2100	2135	2400	0100					
FIELD										
Flow, cfs	0.3	1.1	0.3	0.1	0.05					
Temp, °C	14.3	–	14.1	–	14.1					
Cond, µmhos/cm	–	–	–	–	–					
pH	–	–	–	–	–					
D.O. mg/l	–	–	–	–	–					
MAJOR IONS										
B mg/l		.16		.17						
Ca mg/l		15		18						
Cl mg/l		11		18						
CO_3 mg/l		0		0						
HCO_3 mg/l		38		35						
K mg/l		2.6		2.2						
Mg mg/l		3.0		2.7						
Na mg/l		7.0		8.6						
SiO_2 mg/l		7.1		7.6						
SO_4 mg/l		11		13						
METALS										
Cd mg/l		0		0						
Cr mg/l $\times 10^3$		80		80						
Cu mg/l $\times 10^3$		48		36						
Fe mg/l		6.0		3.4						
Hg mg/l $\times 10^4$		<2		<2						
Mn mg/l		0.17		0.14						
Mo mg/l		0		0						
Ni mg/l		0.04		0.02						
Pb mg/l		1.6		0.84						
Zn mg/l		0.32		0.24						
Lab pH		7.5		7.5						
NUTRIENTS										
Nitrate (N) mg/l		1.35		1.50						
Kjeldahl (N) mg/l		4.0		4.3						
Ammonia (N) mg/l		0.7		0.8						
Total P mg/l		0.27		0.16						
Ortho P mg/l		0.11		0.14						
MISCELLANEOUS										
Oil & Grease mg/l		20		33						
Total Solids mg/l		234		230						
Volatile Portion (T.S.)%		36		37						
Total Sus. Solids mg/l		94		61						
Volatile Portion (TSS)%		29		35						
COD mg/l		130		168						
PRECIPITATION (p)										
Δp, (inches)	.03	.01	.03	.02	.01					
p, (Total)	.03	.04	.07	.09	.10					

PROJECT: LOCATION: Walnut Creek DIST. 04 CO. CC RTE 680 P.M. 12.7

PARAMETER	DATE 1/9/76 STORM NO. 3									
SAMPLE NO.	1									
TIME	1030									
FIELD										
Flow, cfs	.05									
Temp, °C	9.1									
Cond, μmhos/cm	144									
pH	8.3									
D.O. mg/l	–									
MAJOR IONS										
B mg/l	0.14									
Ca mg/l	24									
Cl mg/l	8.5									
CO_3 mg/l	0									
HCO_3 mg/l	34									
K mg/l	5.4									
Mg mg/l	9.0									
Na mg/l	6.1									
SiO_2 mg/l	6.1									
SO_4 mg/l	20									
METALS										
Cd mg/l	0.01									
Cr mg/l	0.08									
Cu mg/l $\times 10^{-3}$	108									
Fe mg/l	30									
Hg mg/l $\times 10^{-4}$	<2									
Mn mg/l	0.47									
Mo mg/l	0									
Ni mg/l	0.08									
Pb mg/l	1.9									
Zn mg/l	0.51									
Lab pH	–									
NUTRIENTS										
Nitrate (N) mg/l	1.05									
Kjeldahl (N) mg/l	3.2									
Ammonia (N) mg/l	1.5									
Total P mg/l	0.53									
Ortho P mg/l	0.13									
MISCELLANEOUS										
Oil & Grease mg/l	6.6									
Total Solids mg/l	383									
Volatile Portion (T.S.)%	32									
Total Sus. Solids mg/l	248									
Volatile Portion (T.S.S.)%	27									
COD mg/l	192									
PRECIPITATION (p)										
Δp, (inches)	.29									
p, (total)	.29									

PROJECT LOCATION Walnut Creek DIST. 04 CO. CC RTE. 680 PM. 12.7

PARAMETER	DATE 2/5/76	STORM NO. 4	
SAMPLE NO.	1	2	3
TIME	1300	1400	1500
FIELD			
Flow, cfs	0.08	0.03	0.33
Temp, °C	3.5	3.5	3.0
Cond, μmhos/cm	105	140	120
pH	–	–	–
DO. mg/l	–	–	–
MAJOR IONS			
B mg/l	0.33	0.25	0.22
Ca mg/l	22	46	27
Cl mg/l	19	26	17
CO_3 mg/l	0	0	0
HCO_3 mg/l	37	70	55
K mg/l	4.0	6.0	4.4
Mg mg/l	7.2	12.0	7.6
Na mg/l	13	17	13
SiO_2 mg/l	–	–	–
SO_4 mg/l	62	45	28
METALS			
Cd mg/l	0.00	0.01	0.01
Cr mg/l	0.05	0.17	0.06
Cu mg/l $\times 10^{-3}$	88	136	166
Fe mg/l	15	28	19
Hg mg/l $\times 10^{-4}$	<2	<2	<2
Mn mg/l	0.34	0.60	0.40
Mo mg/l	0	0	0
Ni mg/l	0.05	0.09	0.08
Pb mg/l	2.2	3.2	2.8
Zn mg/l	0.52	0.80	0.56
Lab pH	7.2	7.7	7.9
NUTRIENTS			
Nitrate (N) mg/l	3.1	3.7	2.8
Kjeldahl (N) mg/l	6.2	6.5	4.4
Ammonia (N) mg/l	2.8	2.8	2.0
Total P mg/l	0.47	0.62	0.49
Ortho P mg/l	0.06	0.11	0.11
MISCELLANEOUS			
Oil & Grease mg/l	43.0	17.0	6.5
Total Solids mg/l	520	680	502
Volatile Portion (T.S.)%	31	29	33
Total Sus. Solids mg/l	307	448	315
Volatile Portion (TSS)%	26	24	25
COD mg/l	237	194	206
PRECIPITATION (p)			
Δp, (inches)	0.15	0.02	0.03
p, (Total)	0.15	0.17	0.20

PROJECT LOCATION Placerville DIST. 03 CO. ED RTE. 50 PM. 15.5

PARAMETER	DATE 10/9/75-10/10/75	STORM NO. 1						
SAMPLE NO.	1	2	3	4	5	6	7	8
TIME	1930	1945	2145	1130	1600	1700	1800	1850
FIELD								
Flow, cfs	0.670	1.210	0.670	.002	1.210	0.290	1.210	1.210
Temp, °C	–	–	–	14.9	14.8	–	–	–
Cond, µmhos/cm	–	–	–	46	16	–	–	–
pH	–	–	–	7.7	7.3	–	–	–
D.O. mg/l	–	–	–	10.4	10.5	–	–	–
MAJOR IONS								
B mg/l	0.15	0.06	0.04	0.11	0.10	0	0.05	0.01
Ca mg/l	26.0	4.0	3.6	5.2	21.0	2.0	4.8	1.2
Cl mg/l	13.0	1.0	1.0	2.5	1.0	1.0	1.0	0.8
CO_3 mg/l	0	0	0	0	0	0	0	0
HCO_3 mg/l	24.0	9.2	8.5	18.0	13.0	6.7	7.9	6.1
K mg/l	4.7	1.5	1.3	0.8	3.6	0.7	1.0	0.5
Mg mg/l	5.6	2.9	2.4	0.84	14.0	1.5	3.0	1.3
Na mg/l	5.7	1.3	1.2	2.7	2.4	0.7	1.9	1.0
SiO_2 mg/l	2.8	0.9	0.8	3.6	0.8	0.4	1.0	0.5
SO_4 mg/l	24	3	1	6	2	0	3	1
METALS								
Cd mg/l	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01
Cr mg/l $\times 10^{-3}$	52	48	32	8	160	32	36	36
Cu mg/l	60	28	24	20	96	16	32	7
Fe mg/l	11	9.3	7.6	1.4	40	5.3	7.6	2.4
Hg mg/l $\times 10^{-4}$	< 5	<5	<5	<5	<5	<5	<5	<5
Mn mg/l	0.56	0.18	0.14	0.08	0.72	0.18	0.18	0.06
Mo mg/l	0	0	0	0	0	0	0	0
Ni mg/l	0.04	0.04	0.02	0.02	0.12	0.03	0.02	0.01
Pb mg/l	1.6	1.4	0.80	0.24	4.5	0.88	1.5	1.5
Zn mg/l	1.80	0.26	0.18	0.47	0.62	0.30	0.27	0.14
Lab pH	6.2	6.7	6.9	7.3	7.3	6.8	6.8	6.8
NUTRIENTS								
Nitrate (N) mg/l	0.77	0.61	0.22	0.80	0.20	0.19	0.36	0.24
Kjeldahl (N) mg/l	6.6	1.6	1.0	0.9	2.3	0.6	0.8	0.5
Ammonia (N) mg/l	3.0	0.8	0.5	0.4	0.5	0.3	0.5	0.3
Total P mg/l	0.47	0.21	0.16	0.08	0.92	0.10	0.37	0.14
Ortho P mg/l	0.04	0.07	0.05	0.02	0.31	0.03	0.02	0.01
MISCELLANEOUS								
Oil & Grease mg/l	3.8	2.7	27	2.6	28	0.5	0.5	0
Total Solids mg/l	512	292	275	111	2030	108	118	32
Volatile Portion (T.S.) %	47	20	30	22	10	9.3	12	69
Total Sus. Solids mg/l	216	262	152	13	1970	106	105	22
Volatile Portion (TSS) %	29	18	14	53	10	17	18	20
COD mg/l	336	80	61	51	232	25	61	7
PRECIPITATION (p)								
Δp, (inches)	0.1	0.2	0.1	0.2	0.3	0.2	0.2	0.2
p, (Total)	0.1	0.3	0.4	0.6	0.9	1.1	1.3	1.5

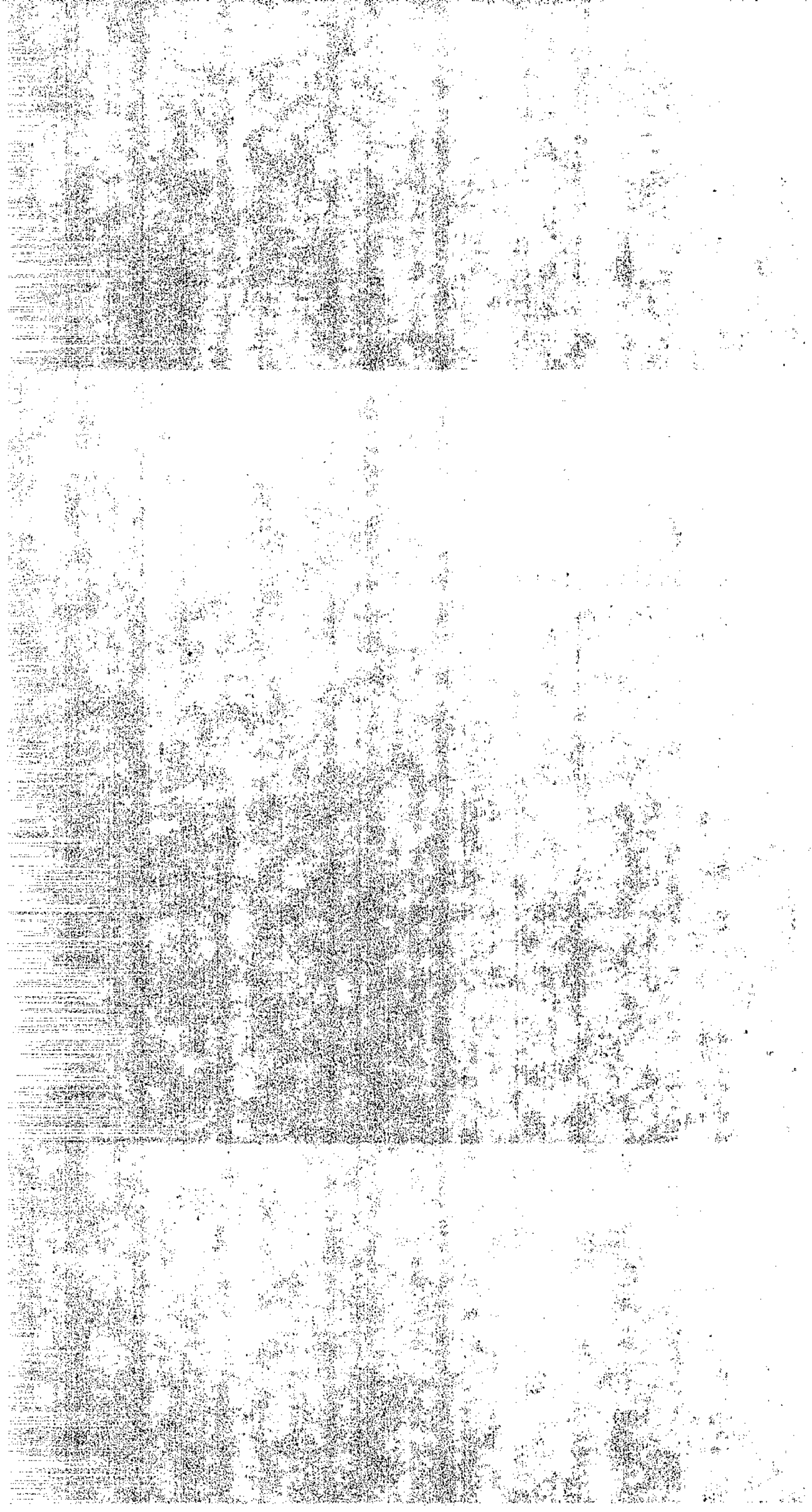
PROJECT LOCATION Placerville DIST. 03 CO. ED RTE. 50 P.M. 15.5

PARAMETER	DATE 10/30/75	STORM NO. 2								
SAMPLE NO.	1	2	3	4	5					
TIME	0050	0120	0150	0220	0250					
FIELD										
Flow, cfs	0.97	0.38	0.77	1.21	0.50					
Temp, °C	10.8	10.5	10.2	9.9	9.5					
Cond, μmhos/cm	91	24	12	11	9					
pH	7.2	7.8	6.8	6.7	6.7					
D.O. mg/l	–	–	–	–	–					
MAJOR IONS										
B mg/l	0.09		0.05		0.08					
Ca mg/l	9.2		2.1		1.2					
Cl mg/l	3.2		0.2		0.0					
CO_3 mg/l	0		0		0					
HCO_3 mg/l	85		6.1		4.9					
K mg/l	1.6		0.5		0.3					
Mg mg/l	3.2		1.0		0.4					
Na mg/l	3.2		1.2		0.9					
SiO_2 mg/l	0.7		0.4		0.3					
SO_4 mg/l	12		11		20					
METALS										
Cd mg/l	<.01		<.01		<.01					
Cr mg/l x 10^{-3}	116		96		56					
Cu mg/l x 10^{-3}	30		12		0					
Fe mg/l	8.9		3.2		1.4					
Hg mg/l x 10^{-4}	< 2		< 2		< 2					
Mn mg/l	0.23		0.07		0.03					
Mo mg/l	0		0		0					
Ni mg/l	0.03		0.01		0.00					
Pb mg/l	1.2		0.44		0.20					
Zn mg/l	0.36		0.09		0.05					
Lab pH	8.1		8.1		8.0					
NUTRIENTS										
Nitrate (N) mg/l	0.56		0.12		0.05					
Kjeldahl (N) mg/l	1.6		0.5		0.4					
Ammonia (N) mg/l	0.7		0.2		0.1					
Total P mg/l	0.20		0.08		0.03					
Ortho P mg/l	0.09		0.04		0.02					
MISCELLANEOUS										
Oil & Grease mg/l	16		2.5		0.6					
Total Solids mg/l	250		97		48					
Volatile Portion (T.S.)%	29		21		31					
Total Sus. Solids mg/l	214		84		25					
Volatile Portion (T.S.S)%	84		12		8					
COD mg/l	117		23		11					
PRECIPITATION (p)										
Δp, (inches)	0.11	0.13	0.09	0.18	0.04					
p, (total)	0.11	0.24	0.33	0.51	0.55					

PROJECT LOCATION Placerville DIST. 03 CO. ED RTE 50 P.M. 15.5

PARAMETER	DATE 11/15/75	STORM NO. 3								
SAMPLE NO.	1	2								
TIME	1630	1715								
FIELD										
Flow, cfs	0.29	2.70								
Temp, °C	12.2	11.7								
Cond, µmhos/cm	141	28								
pH	7.5	7.0								
D.O. mg/l	–	–								
MAJOR IONS										
B mg/l	0.13	0.05								
Ca mg/l	19	18								
Cl mg/l	14	1.8								
CO_3 mg/l	0	0								
HCO_3 mg/l	18	13								
K mg/l	4.4	4.8								
Mg mg/l	6.4	11								
Na mg/l	7.7	3.9								
SiO_2 mg/l	1.5	0.8								
SO_4 mg/l	9.0	24.0								
METALS										
Cd mg/l	<.01									
Cr mg/l $\times 10^{-3}$	164	88								
Cu mg/l $\times 10^{-3}$	64	96								
Fe mg/l	19	37								
Hg mg/l $\times 10^{-4}$	< 2	< 2								
Mn mg/l	0.43	0.67								
Mo mg/l	0	0								
Ni mg/l	0.06	0.17								
Pb mg/l	1.8	3.2								
Zn mg/l	0.67	0.98								
Lab pH	8.0	7.9								
NUTRIENTS										
Nitrate (N) mg/l	0.68	0.28								
Kjeldahl (N) mg/l	5.3	0.9								
Ammonia (N) mg/l	1.2	0.2								
Total P mg/l	0.48	0.44								
Ortho P mg/l	0.10	0.10								
MISCELLANEOUS										
Oil & Grease mg/l	18	11								
Total Solids mg/l	477	686								
Volatile Portion (T.S.) %	35	19								
Total Sus. Solids mg/l	394	605								
Volatile Portion (TSS) %	33	16								
COD mg/l	209	120								
PRECIPITATION (p)										
Δp, (inches)	0.05	0.05								
p, (Total)	0.05	0.10								

Water Quality Data
1976-77



PROJECT LOCATION L. A. DIST. 07 CO. RTE. 405 PM.

PARAMETER	DATE 12/30/76	STORM NO. 1								
SAMPLE NO.	1	2	3	4	5	6	7	8	9	10
TIME	0745	0800	0815	0830	0845	0900	0915	0945	1015	1045
FIELD										
Flow, cfs	0.033	0.096	0.096	0.082	0.262	0.680	0.742	0.480	0.163	0.082
Temp, °C	13.2	13.2	13.3	13.4	13.1	12.9	12.9	13.2	13.9	14.2
Cond, μmhos/cm	889	740	634	497	276	169	133	80	69	96
pH	6.8	6.7	6.6	6.6	6.8	6.9	7.0	7.1	7.1	7.1
D.O. mg/l	9.2	8.9	9.6	10.0	9.3	9.4	9.4	10.3	9.6	8.9
MAJOR IONS										
B mg/l	4.6	3.2	2.6	2.3	1.1	0.64	0.42	0.31	0.17	0.19
Ca mg/l	94	79	67	62	27	18	13	10	7.9	9.9
Cl mg/l	142	122	102	81	35	21	16	11	8	12
CO_3 mg/l										
HCO_3 mg/l	18	14	14	13	9	10	9	9	7	9
K mg/l	13	11	10	9.2	4.9	4.1	3.2	2.5	1.7	1.7
Mg mg/l	8.6	7.6	6.6	6.2	3.7	4.0	3.1	2.1	1.3	1.5
Na mg/l	43	37	33	30	14	10	8.3	6.6	4.8	6.3
SiO_2 mg/l	3.4	3.2	3.1	3.2	1.9	1.3	1.2	1.1	1.0	1.4
SO_4 mg/l	146	111	98	83	41	25	19	15	11	13
METALS										
Cd mg/l	0.06	0.04	0.03	0.02	0.01	0.01	0.01	0.01	0	0
Cr mg/l	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.01
Cu mg/l	0.21	0.18	0.17	0.16	0.12	0.13	0.12	0.08	0.06	0.06
Fe mg/l	3.2	2.9	3.1	3.0	7.0	8.4	7.2	5.2	2.6	2.6
Hg mg/l $\times 10^{-3}$	5.5	0.4	1.5	0.4	0.2	<0.2	—	—	—	<0.2
Mn mg/l	0.56	0.45	0.38	0.35	0.23	0.20	0.16	0.11	0.07	0.08
Mo mg/l	< 0.04	—	—	—	—	—	—	—	—	<0.04
Ni mg/l	0.50	0.50	0.40	0.40	0.30	0.24	0.16	0.12	0.08	0.12
Pb mg/l	9.8	8.9	7.6	7.0	5.2	5.6	3.9	2.6	1.8	2.0
Zn mg/l	6.3	5.2	4.0	3.6	2.6	2.2	1.5	1.2	1.6	1.4
Lab pH @ 25°C	5.8	5.7	5.8	5.8	6.0	6.2	6.4	6.4	6.5	6.5
NUTRIENTS										
Nitrate (N) mg/l	0.55	0.35	0.35	0.35	0.65	1.7	2.6	1.9	1.2	1.9
Kjeldahl (N) mg/l	27	27	20	16	10	7.5	6.7	4.3	2.7	3.1
Ammonia (N) mg/l	17	16	14	12	7.0	4.2	3.1	2.4	1.7	2.0
Total P mg/l	0.59	0.45	0.40	0.42	0.42	0.50	0.39	0.27	0.17	0.16
Ortho P mg/l	0.15	0.10	0.08	0.07	0.09	0.11	0.08	0.06	0.04	0.03
MISCELLANEOUS										
Oil & Grease mg/l	32	26	71	36	0	54	22	0	26	68
Total Solids mg/l	989	806	707	585	444	431	570	367	205	203
Volatile Portion (T.S.) %	55	50	50	49	58	56	68	68	63	64
Total Sus. Solids mg/l	119	91	100	71	186	290	463	264	132	105
Volatile Portion (TSS) %	100	69	74	72	70	62	74	73	70	74
COD mg/l	562	538	481	493	356	369	354	204	123	128
PRECIPITATION (p)										
Δ p, (inches)	0.02	0.03	0.06	0.03	0.09	0.04	0.13	0.11	0.06	0.01
p, (Total)	0.02	0.05	0.11	0.14	0.23	0.27	0.40	0.51	0.57	

PROJECT LOCATION DIST. CO. RTE. P.M.

PARAMETER	DATE 12/30/76	STORM NO. 1								
SAMPLE NO.	11	12								
TIME	1115	1215								
FIELD										
Flow, cfs	0.043	0.023								
Temp, °C	14.6	14.9								
Cond, μmhos/cm	121	17								
pH	7.0	7.2								
D.O. mg/l	8.7	9.7								
MAJOR IONS										
B mg/l	0.25	0.33								
Ca mg/l	14	14								
Cl mg/l	16	17								
CO_3 mg/l										
HCO_3 mg/l	9	9								
K mg/l	2.1	2.5								
Mg mg/l	1.7	1.7								
Na mg/l	7.3	8.1								
SiO_2 mg/l	2.0	2.4								
SO_4 mg/l	18	20								
METALS										
Cd mg/l	0	0								
Cr mg/l	0.01	0.01								
Cu mg/l	0.06	0.06								
Fe mg/l	2.2	1.9								
Hg mg/l $\times 10^{-3}$	< 0.2	< 0.2								
Mn mg/l	0.08	1.00								
Mo mg/l	< 0.04	< 0.04								
Ni mg/l	0.14	0.14								
Pb mg/l	2.0	1.9								
Zn mg/l	1.0	1.0								
Lab pH @25°C	6.4	6.4								
NUTRIENTS										
Nitrate (N) mg/l	2.3	2.6								
Kjeldahl (N) mg/l	3.2	3.7								
Ammonia (N) mg/l	2.3	2.4								
Total P mg/l	0.16	0.16								
Ortho P mg/l	0.02	0.02								
MISCELLANEOUS										
Oil & Grease mg/l	28	19								
Total Solids mg/l	219	210								
Volatile Portion (T.S.) %	64	57								
Total Sus. Solids mg/l	94	79								
Volatile Portion (T.S.S.) %	78	76								
COD mg/l	141	142								
PRECIPITATION (p)										
Δp, (inches)										
p, (Total)										

PROJECT LOCATION L.A. DIST. 07 CO. RTE 405 P.M.

PARAMETER	DATE 1/5/77	STORM NO. 2								
SAMPLE NO.	1	2	3	4	5	6	7	8		
TIME	1610	1625	1640	1655	1710	1725	1755	1825		
FIELD										
Flow, cfs	0.068	0.096	0.082	0.182	0.402	0.128	0.015	0.068		
Temp, °C	13.7	13.7	13.4	13.2	12.7	12.8	12.9	12.4		
Cond, µmhos/cm	345	205	146	102	85	96	94	67		
pH	7.0	7.1	7.0	7.0	7.1	7.2	7.1	7.1		
D.O. mg/l	9.1	9.1	9.2	9.2	9.4	9.4	9.2	9.4		
MAJOR IONS										
B mg/l	0.18	0.16	0.19	0.12	0.11	0.14	0.16	0.14		
Ca mg/l	21	19	18	14	13	11	12	10		
Cl mg/l	29	27	24	18	11	10	11	7.8		
CO_3 mg/l										
HCO_3 mg/l	21	13	13	12	15	26	10	6		
K mg/l	3.7	3.3	3.2	2.7	3.4	2.4	2.3	1.9		
Mg mg/l	3.0	2.9	2.9	2.5	3.8	2.4	2.4	1.8		
Na mg/l	18	11	11	8.5	6.5	6.1	6.7	5.1		
SiO_2 mg/l	1.6	1.5	1.7	1.9	1.4	1.7	2 0	2.0		
SO_4 mg/l	42	32	29	21	17	17	18	15		
METALS										
Cd mg/l	0.01	0.01	0	0	0.01	0	0.01	0		
Cr mg/l	0.03	0.04	0.01	0.02	0.04	0.02	0.02	0.02		
Cu mg/l	0.08	0.06	0.06	0.06	0.10	0.06	0.06	0.04		
Fe mg/l	4.5	4.2	4.6	5.1	11	6.2	4.9	4.0		
Hg mg/l $\times 10^{-3}$	<0.2	<0.2	0.2	0.2	0.2	<0.2	<0.2	<0.2		
Mn mg/l	0.16	0.16	0.16	0.13	0.21	0.12	0.11	0.08		
Mo mg/l	<0.04							<0.04		
Ni mg/l	0.10	0.14	0.16	0.14	0.16	0.11	0.11	0.10		
Pb mg/l	1.7	1.8	1.6	1.7	3.6	1.4	1.2	1.2		
Zn mg/l	0.8	1.0	0.9	0.7	1.1	0.9	0.7	0.6		
Lab pH @25°C	7.0	6.8	6.8	6.9	7.1	7.2	7.2	7.1		
NUTRIENTS										
Nitrate (N) mg/l	2.2	2.8	2.4	1.6	1.1	1.2	1.3	1.0		
Kjeldahl (N) mg/l	7.7	6.2	5.9	5.4	4.3	3.7	3.7	3.3		
Ammonia (N) mg/l	3.5	3.7	3.9	3.0	2.2	2.3	2.4	2.1		
Total P mg/l	0.27	0.23	0.26	0.26	0.34	0.26	0.23	0.19		
Ortho P mg/l	0.09	0.10	0.09	0.10	0.15	0.12	0.10	0.08		
MISCELLANEOUS										
Oil & Grease mg/l	128	0	88	126	31	73	0	59		
Total Solids mg/l	387	292	270	227	319	229	346	318		
Volatile Portion (T.S.) %	54	52	56	58	54	47	75	76		
Total Sus. Solids mg/l	150	82	61	86	57	10	229	182		
Volatile Portion (T.S.S.) %	59	41	61	63	67	<1	86	78		
COD mg/l	363	194	194	196	195	171	165	130		
PRECIPITATION (p)										
Δp, (inches)	0.04	0.01	0.02	0.03	<0.01	<0.01	0.01	0.02		
p, (Total)	0.04	0.05	0.07	0.10	0.10+	0.10+	0.11	0.13		

PROJECT LOCATION

PARAMETER	DATE 1/20/77				STORM NO. 3					
SAMPLE NO.	1	2	3	4	5	6	7	8		
TIME	2035	2050	2105	2120	2135	2150	2220	2250		
FIELD										
Flow, cfs	0.096	0.112	0.096	0.112	0.112	0.096	0.068	0.023		
Temp, °C	15.4	15.4	15.3	15.3	15.4	15.2	15.0	15.1		
Cond, μmhos/cm	712	307	466	161	63	191	169	182		
pH	6.3	6.3	6.3	6.4	6.4	6.5	6.5	6.6		
D.O. mg/l	8.7	8.9	8.7	9.2	8.8	9.0	8.9	8.7		
MAJOR IONS										
B mg/l	0.41	0.35	0.29	0.24	0.18	0.15	0.14	0.13		
Ca mg/l	64	56	45	32	24	19	17	19		
Cl mg/l	96	84	64	43	30	22	18	16		
CO_3 mg/l										
HCO_3 mg/l	15	13	12	12	11	10	11	13		
K mg/l	12	8	6.3	4.9	3.7	3.0	2.6	2.8		
Mg mg/l	6.8	5.4	4.4	3.1	2.2	1.8	1.6	1.8		
Na mg/l	44	27	20	14	11	8.7	7.9	8.2		
SiO_2 mg/l	2.2	2.2	2.2	2.0	2.2	2.0	2.1	2.4		
SO_4 mg/l	94	80	64	64	36	29	27	27		
METALS										
Cd mg/l	0.04	0.04	0.03	0.02	0.02	0.01	0.01	0.01		
Cr mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0	0.02		
Cu mg/l	0.13	0.14	0.11	0.09	0.08	0.06	0.06	0.06		
Fe mg/l	2.2	2.4	2.0	1.9	1.6	1.5	1.2	1.2		
Hg mg/l × 10^{-3}	< 0.2	< 0.2	0.2	< 0.2	———	———	———	< 0.2		
Mn mg/l	0.50	0.42	0.32	0.23	0.17	0.12	0.11	0.10		
Mo mg/l	< 0.04	———	———	———	———	———	———	< 0.04		
Ni mg/l	0.36	0.36	0.29	0.23	0.18	0.15	0.14	0.12		
Pb mg/l	3.3	4.7	4.0	3.2	2.5	2.1	1.7	1.7		
Zn mg/l	3.1	3.0	2.4	1.8	1.5	1.5	1.8	1.4		
Lab pH	6.0	5.9	6.0	6.1	6.2	6.3	6.4	6.6		
NUTRIENTS										
Nitrate (N) mg/l	11	11	11	5.8	5.2	4.7	2.9	3.8		
Kjeldahl (N) mg/l	19	14	14	12	9.0	7.9	6.0	5.7		
Ammonia (N) mg/l	12	9.1	8.7	7.0	5.5	4.5	4.0	3.8		
Total P mg/l	0.40	0.33	0.27	0.24	0.20	0.19	0.16	0.15		
Ortho P mg/l	0.09	0.07	0.05	0.03	0.02	0.02	0.01	0.01		
MISCELLANEOUS										
Oil & Grease mg/l	32	14	31	52	39	27	40	28		
Total Solids mg/l	664	567	462	360	275	237	181	174		
Volatile Portion (T.S.)%	47	50	54	56	60	60	56	49		
Total Sus. Solids mg/l	81	66	53	60	47	68	29	20		
Volatile Portion (TSS)%	85	91	77	95	100	82	72	40		
COD mg/l	454	379	341	301	255	220	189	188		
PRECIPITATION (p)										
Δp, (inches)	0.01	0.01	0.01	0.01	0.02	0.00	0.01	0.00		
p, (Total)	0.01	0.02	0.03	0.04	0.06	0.06	0.07	0.07		

PROJECT — LOCATION Walnut Creek — DIST. 04 CO. CC RTE 680 P.M.

DATE October 1, 1976 — STORM NO. 1

PARAMETER					
SAMPLE NO.	1	2	3	4	5
TIME	1230	1245	1300	1315	1400
FIELD					
Flow, cfs	0.003	0.003	0.003	0.003	0.001
Temp, °C	18.6	18.1	18.7	18.6	18.9
Cond, µmhos/cm	211	177	193	210	253
pH	7.4	7.2	7.1	7.2	7.3
D.O. mg/l	5.7	5.3	5.2	5.2	5.0
MAJOR IONS					
B mg/l	0.17	0.17	0.16	0.22	0.21
Ca mg/l	29	32	33	34	37
Cl mg/l	13	10	11	13	18
CO_3 mg/l	0	0	0	0	0
HCO_3 mg/l	63	61	61	62	61
K mg/l	4.8	5.1	5.2	5.4	5.2
Mg mg/l	8.0	7.0	6.6	6.4	6.2
Na mg/l	6.2	7.6	8.2	9.1	9.8
SiO_2 mg/l	7.9	11.9	11.0	13.0	13.0
SO_4 mg/l	23	22	23	27	34
METALS					
Cd mg/l	0.00	0.01	0.01	0.00	0.00
Cr mg/l	0.07	0.06	0.06	0.05	0.04
Cu mg/l	0.13	0.12	0.12	0.13	0.13
Fe mg/l	24	21	18	17	14
Hg mg/l $\times 10^{-3}$	0.2	0.3	< 0.2	< 0.2	< 0.2
Mn mg/l	0.42	0.38	0.35	0.34	0.31
Mo mg/l	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Ni mg/l	0.10	0.10	0.08	0.08	0.08
Pb mg/l	3.0	2.7	2.8	2.8	2.3
Zn mg/l	0.72	0.64	0.72	0.72	0.72
Lab pH @ 25°C	7.5	7.4	7.5	7.3	7.1
NUTRIENTS					
Nitrate (N) mg/l	1.7	1.7	1.8	2.0	2.4
Kjeldahl (N) mg/l	5.6	14.0	4.8	4.0	5.0
Ammonia (N) mg/l	1.3	1.6	1.7	2.0	2.2
Total P mg/l	0.79	0.57	0.53	0.53	0.46
Ortho P mg/l	0.26	0.12	0.13	0.11	0.08
MISCELLANEOUS					
Oil & Grease mg/l	16	24	31	32	20
Total Solids mg/l	829	511	499	499	482
Volatile Portion (T.S.) %	24	31	38	43	48
Total Sus. Solids mg/l	627	330	305	275	230
Volatile Portion (TSS) %	16	18	22	27	32
COD mg/l	241	247	245	250	261
PRECIPITATION (p)					
Δp, (inches)	0.03	0.10	0.08	0.05	0.15
p, (Total)	0.03	0.13	0.21	0.26	0.41

LOCATION Walnut Creek DIST. 04 CO. CC RTE 690 P.M. 15.9

DATE November 11, 1976 STORM NO. 2

PARAMETER										
SAMPLE NO.	1	2	3	4	5	6	7	8	9	10
TIME	0935	0950	1005	1020	1035	1050	1120	1150	1220	1305
FIELD										
Flow, cfs	0.93	0.76	0.76	0.65	0.76	0.60	0.10	0.81	1.45	0.03
Temp, °C	14.6	14.5	14.6	14.5	14.6	14.8	15.1	14.7	14.1	14.6
Cond, μmhos/cm	239	210	211	203	192	202	228	203	138	191
pH	7.0	6.9	7.1	7.1	7.1	7.1	7.1	7.3	7.4	7.3
D.O. mg/l	6.7	5.9	5.8	5.8	5.7	5.6	5.5	5.6	5.1	5.5
MAJOR IONS										
B mg/l	0.34	0.20	0.23	0.23	0.21	0.21	0.22	0.22	0.15	0.26
Ca mg/l	26	30	31	32	31	31	33	32	25	31
Cl mg/l	16	14	13	12	12	12	15	12	7	11
CO_3 mg/l	0	0	0	0	0	0	0	0	0	0
HCO_3 mg/l	26	41	49	38	43	45	44	46	41	48
K mg/l	4.6	5.3	5.0	5.0	5.1	4.9	4.9	5.3	4.2	4.6
Mg mg/l	5.8	6.9	6.6	6.4	6.6	6.1	6.1	6.7	5.8	5.3
Na mg/l	7.0	7.4	7.4	7.4	7.4	7.3	8.5	7.4	5.7	7.6
SiO_2 mg/l	4.2	4.8	5.4	5.6	5.4	6.1	7.1	6.8	5.4	7.5
SO_4 mg/l	28	28	26	26	24	25	28	26	16	23
METALS										
Cd mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Cr mg/l	0.03	0.05	0.05	0.04	0.04	0.04	0.03	0.04	0.05	0.03
Cu mg/l	0.17	0.20	0.20	0.20	0.20	0.19	0.24	0.25	0.18	0.17
Fe mg/l	13	17	17	17	18	16	15	19	19	14
Hg mg/l $\times 10^{-3}$	0.2	0.2	0.2	0.2	0.5	0.6	0.7	0.7	0.5	0.5
Mn mg/l	0.34	0.40	0.37	0.35	0.37	0.33	0.34	0.36	0.32	0.29
Mo mg/l	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Ni mg/l	0.08	0.08	0.08	0.09	0.09	0.08	0.12	0.10	0.09	0.08
Pb mg/l	2.2	2.5	2.5	2.5	2.7	2.5	2.8	3.1	2.6	2.3
Zn mg/l	0.80	0.80	0.80	0.80	0.80	0.72	0.88	0.80	0.64	0.72
Lab pH @ 25°C	7.0	7.1	7.2	7.2	7.2	7.2	7.2	7.3	7.5	7.3
NUTRIENTS										
Nitrate (N) mg/l	3.5	3.1	2.9	2.8	2.6	1.8	3.0	3.1	1.6	2.4
Kjeldahl (N) mg/l	3.0	6.5	6.1	5.8	5.4	5.1	5.6	5.2	3.4	3.8
Ammonia (N) mg/l	3.1	2.9	2.6	2.5	2.4	2.5	2.6	2.2	1.5	2.0
Total P mg/l	0.45	0.53	0.53	0.51	0.54	0.48	0.49	0.55	0.50	0.42
Ortho P mg/l	0.09	0.13	0.12	0.09	0.09	0.07	0.09	0.13	0.11	0.07
MISCELLANEOUS										
Oil & Grease mg/l	52	0	0	15	23	20	55	23	45	38
Total Solids mg/l	460	553	531	521	520	466	487	524	462	424
Volatile Portion (T.S.)%	50	46	40	42	40	40	42	35	29	35
Total Sus. Solids mg/l	206	315	295	297	305	276	265	329	332	240
Volatile Portion (T.S.S.)%	28	31	23	28	26	31	35	27	23	27
COD mg/l	319	314	304	306	290	282	300	294	213	242
PRECIPITATION (p)										
Δp, (inches)	0.05	0.03	0.01	0.01	0.02	0.02	0.02	0.03	0.01	0.00
p, (Total)	0.05	0.08	0.09	0.10	0.12	0.14	0.16	0.19	0.20	0.20

PROJECT [illegible] LOCATION Walnut Creek [illegible] DIST. [illegible] CO. [illegible] RTE. [illegible] P.M. [illegible]

PARAMETER	DATE December 29-30,1976 STORM NO. 3									
SAMPLE NO.	1	2	3	4	5	6	7	8	9	10
TIME	2110	2130	2145	2200	2215	2245	2315	0015	0115	0155
FIELD										
Flow, cfs	0.02	0.93	0.99	0.23	0.23	0.42	0.42	0.42	0.02	0.23
Temp, °C	11.6	10.3	9.9	9.9	9.8	9.8	9.8	9.5	9.3	9.0
Cond, μmhos/cm	2105	675	182	146	140	113	105	78	150	151
pH	10.4	10.9	9.9	9.4	9.3	9.3	9.6	9.2	9.4	9.2
D.O. mg/l	6.3	6.7	7.0	7.0	7.0	7.0	7.0	7.2	7.2	7.4
MAJOR IONS										
B mg/l	0.55	0.32	0.25	0.22	0.21	0.22	0.18	0.17	0.17	0.18
Ca mg/l	270	140	30	26	20	20	17	17	22	20
Cl mg/l	240	31	11	7.8	7.8	8.3	2.6	3.9	9.6	12
CO_3 mg/l	80	81	0	2	0	3	0	0	0	0
HCO_3 mg/l	87	0	34	38	31	38	35	23	40	34
K mg/l	16	14	3.6	3.3	2.9	2.3	2.2	1.9	1.8	1.8
Mg mg/l	22	17	4.8	4.2	3.2	2.5	2.4	1.6	1.9	1.9
Na mg/l	100	19	6.0	5.0	4.8	3.9	3.3	2.5	5.0	5.9
SiO_2 mg/l	34	22	4.8	5.2	4.2	5.7	4.8	3.1	6.1	5.4
SO_4 mg/l	440	47	25	19	19	14	11	7.4	15	15
METALS										
Cd mg/l	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cr mg/l	0.05	0.06	0.03	0.02	0.02	0.02	0.02	0.01	0.01	0.01
Cu mg/l	0.23	0.21	0.08	0.08	0.07	0.07	0.06	0.04	0.05	0.05
Fe mg/l	15	34	10	10	7.7	6.9	6.4	3.8	3.3	3.6
Hg mg/l $\times 10^{-3}$	< 0.2	—	—	—	—	—	—	—	—	<0.2
Mn mg/l	0.96	0.87	0.21	0.20	0.16	0.14	0.12	0.08	0.08	0.09
Mo mg/l	< 0.04	—	—	—	—	—	—	—	—	<0.04
Ni mg/l	0.14	0.15	0.06	0.07	0.06	0.05	0.04	0.04	0.05	0.07
Pb mg/l	3.2	5.4	1.7	1.5	1.3	1.1	1.0	0.7	0.7	0.7
Zn mg/l	1.64	1.60	0.40	0.40	0.32	0.32	0.24	0.16	0.16	0.20
Lab pH @ 25°C	9.5	10.2	7.7	8.5	7.6	8.7	8.2	7.4	7.6	7.4
NUTRIENTS										
Nitrate (N) mg/l	18	1.4	1.2	0.85	0.85	0.60	0.45	0.35	0.85	0.80
Kjeldahl (N) mg/l	36	12	5.0	3.6	3.1	2.2	2.0	1.3	2.0	1.8
Ammonia (N) mg/l	8.4	3.7	2.4	2.0	1.9	1.4	1.1	0.8	1.2	1.2
Total P mg/l	1.39	1.37	0.32	0.31	0.26	0.23	0.21	0.13	0.14	0.13
Ortho P mg/l	0.81	0.74	0.12	0.12	0.09	0.09	0.08	0.06	0.05	0.04
MISCELLANEOUS										
Oil & Grease mg/l	153	33	50	28	30	52	112	14	5	0
Total Solids mg/l	2340	1480	314	320	244	268	235	303	300	222
Volatile Portion (T.S.) %	35	28	34	36	35	27	26	78	74	60
Total Sus. Solids mg/l	303	1067	189	216	128	168	173	244	175	125
Volatile Portion (TSS) %	36	26	36	34	22	20	32	90	100	92
COD mg/l	806	368	189	160	145	112	100	63	114	114
PRECIPITATION (p)										
Δp, (inches)	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01
p, (Total)	0.01	0.01	0.02	0.02	0.02	0.03	0.04	0.05	0.06	0.07

PROJECT LOCATION Walnut Creek DIST. 04 CO. CC RTE. 680 P.M. 15.9

PARAMETER	DATE December 29-30,1976 STORM NO. 3								
SAMPLE NO.	11	12	13	14	15	16	17	18	19
TIME	0210	0225	0255	0355	1100	1130	1200	1300	1400
FIELD									
Flow, cfs	0.14	–	0.55	0.01	0.81	0.76	1.45	0.10	0.33
Temp, °C	8.9	9.0	8.6	8.2	–	–	–	–	–
Cond, μmhos/cm	142	159	70	118	–	–	–	–	–
pH	9.1	9.2	9.1	9.0	–	–	–	–	–
D.O. mg/l	7.4	7.3	7.5	7.6	–	–	–	–	–
MAJOR IONS									
B mg/l	0.16	0.18	0.17	0.16	0.26	0.24	0.23	0.21	0.22
Ca mg/l	18	23	11	17	34	26	19	15	12
Cl mg/l	11	14	4.9	7.0	22	11	5.2	5.2	3.4
CO_3 mg/l	0	0	0	0	0	0	0	0	0
HCO_3 mg/l	31	39	20	34	48	–	27	27	20
K mg/l	1.8	1.9	1.2	1.4	5.2	4.6	3.1	2.3	2.0
Mg mg/l	1.7	1.9	1.8	1.4	9.0	7.0	5.7	3.4	3.3
Na mg/l	5.8	6.9	3.1	4.6	12	8.0	4.7	4.1	3.1
SiO_2 mg/l	5.3	6.7	3.1	5.0	5.8	7.3	2.9	3.7	2.2
SO_4 mg/l	15	17	5.8	12	30	–	15	12	6.4
METALS									
Cd mg/l	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Cr mg/l	0.02	0.01	0.01	0.01	0.06	0.06	0.06	0.04	0.04
Cu mg/l	0.05	0.05	0.04	0.04	0.13	0.13	0.14	0.10	0.09
Fe mg/l	3.0	3.0	4.7	2.1	24	22	18	10	11
Hg mg/l x 10^{-3}	<0.2 →								<0.2
Mn mg/l	0.08	0.08	0.08	0.06	0.47	0.37	0.32	0.18	0.18
Mo mg/l	<0.04 →								<0.04
Ni mg/l	0.06	0.05	0.05	0.05	0.10	0.11	0.10	0.07	0.08
Pb mg/l	0.6	0.6	0.8	0.4	2.7	2.3	2.2	1.5	1.6
Zn mg/l	0.16	0.20	0.16	0.12	0.64	0.56	0.48	0.32	0.36
Lab pH @ 25°C	7.3	7.6	7.5	7.5	7.9	–	7.8	7.8	7.7
NUTRIENTS									
Nitrate (N) mg/l	0.85	1.0	0.30	0.50	1.3	1.3	0.60	0.60	0.50
Kjeldahl (N) mg/l	1.7	1.8	0.9	1.0	3.5	2.4	1.6	1.4	1.1
Ammonia (N) mg/l	1.1	0.9	0.6	0.8	2.2	1.8	1.1	1.2	1.1
Total P mg/l	0.15	0.15	0.18	0.12	0.58	0.51	0.43	0.27	0.29
Ortho P mg/l	0.05	0.04	0.07	0.03	0.10	0.22	0.11	0.07	0.08
MISCELLANEOUS									
Oil & Grease mg/l	0	4	40	47	12	8	11	61	0
Total Solids mg/l	203	210	148	124	579	679	406	234	462
Volatile Portion (T.S.)%	49	46	34	43	29	34	26	31	61
Total Sus. Solids mg/l	95	83	94	36	388	232	339	180	235
Volatile Portion (TSS)%	77	77	37	75	23	26	16	18	31
COD mg/l	103	117	65	12	248	176	132	135	121
PRECIPITATION (p)									
Δp, (inches)	0.01	0.01	0.01	0.02	0.07	0.00	0.01	0.01	0.01
p, (Total)	0.08	0.09	0.10	0.12	0.19	0.19	0.20	0.21	0.22

PROJECT LOCATION Placerville DIST. 03 CO. ED RTE. 50 P.M. 15.5

PARAMETER	DATE 2/8/77				STORM NO. 2					
SAMPLE NO.	1	2	3	4	5	6	7	8	9	10
TIME (PST)	0942	0957	1015	1030	1045	1100	1125	1210	1510	1525
FIELD										
Flow, cfs	0.23	0.02	0.003	0.003	0.02	0.003	0.0007	< 0.0003	0.23	0.30
Temp, °C	9.2	10.7	9.4	9.7	9.7	10.0	10.0	9.2	9.2	9.0
Cond, μmhos/cm	500	218	259	292	202	179	207	289	106	71
pH	6.5	6.7	6.9	7.0	7.1	7.6	7.2	7.2	6.7	7.2
D.O. mg/l	–	–	–	–	–	–	–	–	–	–
MAJOR IONS										
B mg/l	0.24	0.17	0.17	0.18	0.16	0.12	0.15	0.18	0.06	0.05
Ca mg/l	78	16	15	15	13	11	13	15	11	9.1
Cl mg/l	133	30	42	53	31	25	31	48	4.7	2.6
CO_3 mg/l										
HCO_3 mg/l	37	21	24	13	21	20	27	39	21	14
K mg/l	13	5.3	4.6	4.0	3.7	3.1	3.3	3.6	4.2	2.8
Mg mg/l	38	5.8	4.2	3.9	3.5	3.0	4.0	4.2	8.0	5.9
Na mg/l	150	28	36	48	30	24	29	44	8.0	5.6
SiO_2 mg/l	2.3	1.5	2.0	2.5	2.2	2.0	2.4	2.9	0.8	0.5
SO_4 mg/l	54	23	26	29	20	17	19	25	4.0	2.4
METALS										
Cd mg/l	0.02	0	0	0	0	0	0	0	0	0
Cr mg/l	0.26	0.05	0.03	0.02	0.02	0.02	0.02	0.02	0.08	0.01
Cu mg/l	0.32	0.06	0.05	0.05	0.05	0.04	0.04	0.04	0.07	0.04
Fe mg/l	76	17	9.4	8.1	7.7	7.2	8.0	7.9	29	19
Hg mg/l $\times 10^{-3}$	0.5	<0.2	—	—	—	—	—	—	—	<0.2
Mn mg/l	2.20	0.41	0.30	0.28	0.26	0.22	0.23	0.21	0.44	0.32
Mo mg/l	< 0.04	—	—	—	—	—	—	—	—	<0.04
Ni mg/l	0.38	0.08	0.07	0.08	0.08	0.05	0.05	0.06	0.10	0.08
Pb mg/l	8.0	1.5	0.9	0.8	0.8	0.7	0.7	0.7	2.3	1.6
Zn mg/l	22	0.88	1.20	1.00	0.72	0.76	1.24	2.80	0.60	0.40
Lab pH 25°C	6.6	6.6	6.6	5.6	6.4	6.5	6.7	7.0	7.3	6.8
NUTRIENTS										
Nitrate (N) mg/l	7.0	3.8	4.4	4.4	3.9	2.2	3.2	3.6	0.35	0.35
Kjeldahl (N) mg/l	20	5.6	5.6	6.2	4.9	4.7	4.6	4.9	5.4	1.9
Ammonia (N) mg/l	3.3	2.2	1.9	2.0	1.8	1.8	1.8	1.8	1.0	0.4
Total P mg/l	0.92	0.49	0.39	0.37	0.33	0.29	0.31	0.30	0.68	0.39
Ortho P mg/l	0.30	0.19	0.02	0.01	0.00	0.01	0.01	0.02	0.18	0.13
MISCELLANEOUS										
Oil & Grease mg/l	118	119	143	0	0	3	27	25	0	0
Total Solids mg/l	1290	406	414	441	336	300	326	388	748	428
Volatile Portion (T.S.)%	36	26	42	41	43	43	43	40	24	22
Total Sus. Solids mg/l	670	151	117	119	90	101	90	90	679	378
Volatile Portion (TSS)%	35	<1	38	39	38	39	32	30	22	20
COD mg/l	662	325	298	310	257	219	241	274	267	139
PRECIPITATION (p)										
Δp (inches)	0.03	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.13	0.03
p (Total)	0.03	0.03	0.04	0.05	0.06	0.07	0.08	0.08	0.21	0.24

PROJECT LOCATION Placerville [illegible]

PARAMETER	DATE 2/8/77 STORM NO. 2									
SAMPLE NO.	11	12								
TIME	1555	1630								
FIELD										
Flow, cfs	0.008	0.0007								
Temp, °C	9.2	9.5								
Cond, μmhos/cm	85	105								
pH	7.0	7.3								
D.O. mg/l	–	–								
MAJOR IONS										
B mg/l	0.05	0.08								
Ca mg/l	4.1	5.2								
Cl mg/l	4.2	7.0								
CO_3 mg/l										
HCO_3 mg/l	14	19								
K mg/l	1.2	1.3								
Mg mg/l	1.7	1.5								
Na mg/l	9.7	8.2								
SiO_2 mg/l	0.7	1.3								
SO_4 mg/l	3.7	5.8								
METALS										
Cd mg/l	0	0								
Cr mg/l	0.07	0.03								
Cu mg/l	0.02	0.02								
Fe mg/l	5.0	3.9								
Hg mg/l $\times 10^{-3}$	< 0.2	< 0.2								
Mn mg/l	0.10	0.10								
Mo mg/l	< 0.04	< 0.04								
Ni mg/l	0.03	0.04								
Pb mg/l	0.04	0.3								
Zn mg/l	0.24	0.44								
Lab pH 25°C	6.8	6.8								
NUTRIENTS										
Nitrate (N) mg/l	0.35	0.35								
Kjeldahl (N) mg/l	1.2	1.5								
Ammonia (N) mg/l	0.5	0.7								
Total P mg/l	0.14	0.12								
Ortho P mg/l	0.05	0.04								
MISCELLANEOUS										
Oil & Grease mg/l	18	13								
Total Solids mg/l	120	118								
Volatile Portion (T.S.)%	42	46								
Total Sus. Solids mg/l	62	33								
Volatile Portion (T.S.S.)%	35	36								
COD mg/l	59	72								
PRECIPITATION (p)										
Δp, (inches)	0.02	0.02								
p, (Total)	0.26	0.28								

PROJECT LOCATION Placerville DIST. 03 CO. ED RTE 50 P.M. 15.5

PARAMETER	DATE 3/16/77				STORM NO. 3					
SAMPLE NO.	1	2	3	4	5	6	7	8	9	10
TIME	0915	0930	0945	1000	1015	1030	1100	1130	1230	1330
FIELD										
Flow, cfs (timed)	0.084	0.13	0.067	0.042	0.023	0.011	0.004	0.061	0.074	0.035
Temp, °C	6.8	7.1	7.1	7.2	7.2	7.1	6.3	7.1	7.5	8.6
Cond, μmhos/cm 25°C	432	149	155	170	192	218	313	210	111	147
pH	9.2	9.0	11.5	10.2	9.1	9.0	9.0	8.9	8.8	8.8
D.O. mg/l	7.0	6.7	6.8	6.8	6.8	6.6	7.1	6.7	6.6	6.7
MAJOR IONS										
B mg/l	0.12	0.09	0.09	0.09	0.10	0.11	0.09	0.09	0.08	0.11
Ca mg/l	13	9.8	6.6	5.9	5.9	6.5	9.5	8.4	5.2	6.0
Cl mg/l	73	27	25	28	32	38	56	44	17	20
CO_3 mg/l										
HCO_3 mg/l	31	25	22	24	27	28	37	33	19	26
K mg/l	2.6	4.2	2.9	2.2	2.0	1.7	2.2	2.4	1.8	1.7
Mg mg/l	5.3	10	6.1	4.5	4.0	3.5	4.1	5.8	3.8	3.0
Na mg/l	88	28	25	26	30	34	48	42	19	25
SiO_2 mg/l	3.3	1.6	1.6	1.7	2.3	2.8	4.3	3.6	1.7	2.5
SO_4 mg/l	11	6.0	6.0	6.0	7.0	7.7	9.9	11	4.0	3.5
METALS										
Cd mg/l	0	0	0	0	0	0	0	0	0	0
Cr mg/l	0.04	0.10	0.06	0.05	0.04	0.03	0.03	0.05	0.04	0.02
Cu mg/l	0.06	0.08	0.06	0.05	0.04	0.04	0.03	0.05	0.04	0.03
Fe mg/l	13	31	19	14	13	10	10	19	13	8.9
Hg mg/l $\times 10^{-3}$	<0.2	—	—	—	—	—	—	—	—	<0.2
Mn mg/l	0.23	0.48	0.30	0.22	0.20	0.17	0.18	0.30	0.19	0.14
Mo mg/l	<0.04	—	—	—	—	—	—	—	—	<0.04
Ni mg/l	0.10	0.16	0.12	0.11	0.08	0.09	0.10	0.12	0.10	0.10
Pb mg/l	0.6	1.3	0.8	0.6	0.5	0.5	0.5	0.8	0.5	0.4
Zn mg/l	0.68	0.44	0.36	0.32	0.36	0.40	0.68	0.40	0.24	0.28
Lab pH 25°C	7.5	7.5	7.2	7.3	7.3	7.3	7.4	7.4	7.2	7.2
NUTRIENTS										
Nitrate (N) mg/l	0.9	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.7
Kjeldahl (N) mg/l	2.3	2.7	1.6	1.4	1.3	1.6	1.5	1.9	1.4	1.1
Ammonia (N) mg/l	0.5	0.6	0.5	0.4	0.4	0.5	0.4	0.5	0.5	0.3
Total P mg/l	0.36	0.52	0.33	0.26	0.23	0.21	0.25	0.29	0.22	0.17
Ortho P mg/l	0.06	0.11	0.07	0.06	0.05	0.04	0.03	0.05	0.07	0.05
MISCELLANEOUS										
Oil & Grease mg/l	0	0	0	0	72	1	54	31	28	0
Total Solids mg/l	516	689	386	321	288	274	315	393	255	213
Volatile Portion (T.S.) %	25	33	24	29	28	29	26	26	24	27
Total Sus. Solids mg/l	296	586	294	218	164	136	120	245	177	91
Volatile Portion (T.S.S.) %	23	33	20	28	24	32	27	27	23	24
COD mg/l	188	222	152	116	108	106	114	157	98	85
PRECIPITATION (p)										
Δp, (inches)	0.07	0.01	0.01	0.01	0.01	0.00	0.01	0.03	0.03	0.03
p, (Total)	0.07	0.08	0.09	0.10	0.11	0.11	0.12	0.15	0.18	0.21

PARAMETER	DATE 3/16/77 STORM NO. 3
SAMPLE NO.	11
TIME	1430
FIELD	
Flow, cfs (timed)	0.02
Temp, °C	9.9
Cond, μmhos/cm	160
pH	8.7
DO mg/l	6.9
MAJOR IONS	
B mg/l	0.10
Ca mg/l	7.1
Cl mg/l	25
CO_3 mg/l	
HCO_3 mg/l	28
K mg/l	1.9
Mg mg/l	3.6
Na mg/l	27
SiO_2 mg/l	3.1
SO_4 mg/l	5.7
METALS	
Cd mg/l	0
Cr mg/l	0.03
Cu mg/l	0.03
Fe mg/l	10
Hg mg/l $\times 10^{-3}$	<0.02
Mn mg/l	0.17
Mo mg/l	<0.04
Ni mg/l	0.08
Pb mg/l	0.5
Zn mg/l	0.36
Lab pH 25°C	7.3
NUTRIENTS	
Nitrate (N) mg/l	0.9
Kjeldahl (N) mg/l	1.5
Ammonia (N) mg/l	0.5
Total P mg/l	0.18
Ortho P mg/l	0.05
MISCELLANEOUS	
Oil & Grease mg/l	0
Total Solids mg/l	243
Volatile Portion (T.S.) %	28
Total Sus. Solids mg/l	92
Volatile Portion (TSS) %	29
COD mg/l	106
PRECIPITATION (p)	
Δp, (inches)	0.00
p, (Total)	0.21

Water Quality Data
1977-78

PROJECT 657117 LOCATION Los Angeles DIST. 07 CO. LA RTE 405 P.M. 18.0

PARAMETER	DATE December 21, 1977	STORM NO. 1								
SAMPLE NO.	LA-137	-138	-139	-140	-141	-142				
TIME	1630	1645	1700	1715	1745	1815				
FIELD										
Flow, cfs	.008	.008	.008	.005	.005	.005				
Temp, °C	16	15.7	15.7	15.7	15.6	15.4				
Cond, μmhos/cm	–	–	–	–	–	–				
pH	6.9	6.9	6.9	6.6	6.6	6.6				
D.O. mg/l	7.86	7.89	7.51	7.61	7.70	7.55				
MAJOR IONS										
B mg/l	0.91	0.82	0.73	0.73	0.71	0.68				
Ca mg/l	61	51	50	45	43	42				
Cl mg/l	105	74	78	67	59	58				
CO_3 mg/l	0	0	0	0	0	0				
HCO_3 mg/l	59	46	46	39	38	34				
K mg/l	10	9.4	9.2	9.0	8.6	7.8				
Mg mg/l	8.5	7.4	7.3	7.3	6.8	6.0				
Na mg/l	59	42	41	36	30	29				
SiO_2 mg/l	7.5	6.9	7.4	7.1	7.1	6.5				
SO_4 mg/l	92	76	75	69	61	64				
METALS										
Cd mg/l x 10^{-3}	10	12	10	8	8	8				
Cr mg/l	0.03	.03	0.02	0.03	0.02	0.02				
Cu mg/l	0.16	0.17	0.16	0.15	0.15	0.14				
Fe mg/l	7.7	8.7	8.6	12	9.8	7.2				
Hg mg/l x 10^{-3}	0.2	→	→	→	→	→				
Mn mg/l	0.42	0.40	0.37	0.38	0.37	0.35				
Mo mg/l	<0.04	→	→	→	→	→				
Ni mg/l	0.16	0.16	0.14	0.15	0.14	0.15				
Pb mg/l	2.2	2.3	2.3	2.3	2.3	2.1				
Zn mg/l	1.40	1.44	1.27	1.25	1.40	1.60				
Lab pH	6.0	5.8	5.8	5.7	5.6	5.6				
NUTRIENTS										
Nitrate (N) mg/l	12.3	10.6	10.7	9.7	9.4	9.6				
Kjeldahl (N) mg/l	7.8	12.9	12.2	12.7	12.5	12.4				
Ammonia (N) mg/l	6.8	6.7	6.7	6.7	6.8	6.8				
Total P mg/l	0.95	0.76	1.06	0.72	0.76	0.67				
Ortho P mg/l	0.46	0.11	0.61	0.20	0.22	0.28				
MISCELLANEOUS										
Oil & Grease mg/l	16	18	17	18	18	17				
Total Solids mg/l	690	589	641	583	522	478				
Volatile Portion (T.S.)%	34	39	30	37	42	37				
Total Sus. Solids mg/l	189	167	233	207	278	167				
Volatile Portion (T.S.S.)%	58	65	35	51	45	55				
COD mg/l	336	336	324	317	307	298				
PRECIPITATION (p)										
Δp, (inches)	.03	–	–	–	–	.01				
p, (Total)	.03	.03	.03	.03	.03	.04				

Fox River Bond

PROJECT 657117 LOCATION Los Angeles DIST. 07 CO. LA RTE. 405 P.M. 15.0

PARAMETER	DATE January 3, 1978	STORM NO. 2							
SAMPLE NO.	LA-143	-144	-145	-146	-147	-148	-149	-150	-151
TIME	1503	1518	1533	1548	1603	1633	1703	1733	1803
FIELD									
Flow, cfs	.033	.055	.068	.145	.163	.33	.082	.043	.015
Temp, °C	15.5	15	14.6	14.1	14.3	13.5	13.6	13.8	14
Cond, μmhos/cm									
pH	6.3	6.5	6.5	6.6	6.6	6.3	6.6	6.5	6.4
D.O. mg/l	8.04	7.93	8.0	9.13	8.20	8.46	8.20	9.08	8.68
MAJOR IONS									
B mg/l	1.32	1.16	1.01	0.20	0.20	0.61	0.28	0.20	0.21
Ca mg/l	43	34	27	18	12	8.0	9.1	10	12
Cl mg/l	38	26	26	11	5.5	3.0	3.6	4.0	5.2
CO_3 mg/l	0	0	0	0	0	0	0	0	0
HCO_3 mg/l	25	21	21	12	11	5	10	12	15
K mg/l	6.8	5.6	4.7	3.1	2.2	1.9	2.0	2.0	1.9
Mg mg/l	5.2	4.3	3.5	2.5	1.7	1.5	1.6	1.6	1.5
Na mg/l	26	19	13	7.5	4.7	2.9	3.3	4.0	4.3
SiO_2 mg/l	6.1	5.3	4.7	3.6	3.0	2.1	2.5	2.9	3.2
SO_4 mg/l	78	61	46	30	19	11	12	14	15
METALS									
Cd mg/l x 10^{-3}	12	8	8	8	4	4	4	4	4
Cr mg/l	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01
Cu mg/l	0.14	0.12	0.10	0.09	0.07	0.07	0.06	0.06	0.05
Fe mg/l	7.4	6.7	6.8	5.5	4.3	4.7	4.5	4.2	3.1
Hg mg/l x 10^{-3}	<0.2	→	→	→	→	→	→	→	→
Mn mg/l	0.30	0.27	0.23	0.18	0.11	0.10	0.10	0.10	0.09
Mo mg/l	<0.04	→	→	→	→	→	→	→	→
Ni mg/l	0.16	0.12	0.10	0.07	0.06	0.06	0.05	0.04	0.04
Pb mg/l	1.7	1.7	1.6	1.6	1.2	1.4	1.0	1.0	1.0
Zn mg/l	1.44	1.18	1.13	1.00	0.72	0.53	0.48	0.55	0.59
Lab pH	6.4	6.7	6.4	6.2	6.5	5.8	6.3	6.4	6.7
NUTRIENTS									
Nitrate (N) mg/l	8.8	6.4	4.5	2.9	2.0	1.6	1.6	1.8	1.9
Kjeldahl (N) mg/l	11.3	10.4	7.2	5.1	5.0	2.5	2.5	2.8	2.6
Ammonia (N) mg/l	6.1	5.6	4.0	3.2	3.0	1.4	1.4	1.6	1.5
Total P mg/l	0.49	0.53	0.41	0.36	0.27	0.42	0.22	0.23	0.23
Ortho P mg/l	0.21	0.16	0.13	0.13	0.10	0.24	0.04	0.03	0.04
MISCELLANEOUS									
Oil & Grease mg/l	22	29	25	22	13	13	14	12	99
Total Solids mg/l	467	391	339	271	178	170	166	160	162
Volatile Portion (T.S.)%	34	40	38	39	43	39	38	39	53
Total Sus. Solids mg/l	188	172	173	140	88	110	99	89	67
Volatile Portion (T.S.S.)%	55	56	51	37	22	35	20	53	72
COD mg/l	266	253	228	174	129	110	103	105	102
PRECIPITATION (p)									
Δp, (inches)	.05	.01	.02	.02	.01	.08	–	–	.03
p, (Total)	.05	.06	.08	.10	.11	.19	.19	.19	.22

PROJECT 657117 LOCATION Los Angeles DIST. 07 CO. LA RTE 405 P.M. 19.0

PARAMETER	DATE January 4, 1978	STORM NO. 3								
SAMPLE NO.	LA-152	-153	-154	-155	-156	-157	-158	-159		
TIME	1110	1125	1140	1155	1210	1240	1455	1555		
FIELD										
Flow, cfs	1.26	6.05	.284	.043	.043	.033	.711	.262		
Temp, °C	16.3	16	16.2	16.5	16.5	16.3	15.5	14.9		
Cond, μmhos/cm										
pH	6.3	6.4	6.3	6.3	6.4	6.4	6.5	6.5		
D.O. mg/l	7.75	7.78	7.86	7.61	7.66	7.73	7.96	8.55		
MAJOR IONS										
B mg/l	0.18	0.13	0.11	0.12	0.11	0.15	0.05	0.09		
Ca mg/l	15	7.3	5.0	6.4	7.8	11	10	5.4		
Cl mg/l	8.0	2.3	3.4	4.7	5.0	7.0	6.8	2.4		
CO_3 mg/l	0	0	0	0	0	0	0	0		
HCO_3 mg/l	7	5	5	7	10	12	9	7		
K mg/l	4.1	2.7	1.4	1.4	1.4	1.9	2.8	1.2		
Mg mg/l	4.4	3.1	1.2	1.1	1.2	1.6	3.0	1.1		
Na mg/l	6.1	2.4	2.5	2.9	3.4	4.8	4.4	2.0		
SiO_2 mg/l	2.8	1.6	1.2	1.6	2.1	3.3	2.8	1.7		
SO_4 mg/l	17	4.6	5.6	8.2	10	15	13	5.3		
METALS										
Cd mg/l x 10^{-3}	8	4	4	4	4	4	4	4		
Cr mg/l	0.05	0.03	0.01	0.01	0.01	0.01	0.03	0.01		
Cu mg/l	0.15	0.10	0.05	0.05	0.05	0.05	0.10	0.04		
Fe mg/l	16	13	4.1	3.1	3.0	4.0	11	3.7		
Hg mg/l x 10^{-3}	<0.2	→						→		
Mn mg/l	0.30	0.22	0.07	0.06	0.07	0.10	0.20	0.06		
Mo mg/l	<0.04	→						→		
Ni mg/l	0.10	0.05	0.03	0.03	0.04	0.03	0.06	0.03		
Pb mg/l	5.3	2.7	1.1	1.0	0.9	1.1	3.1	0.8		
Zn mg/l	1.05	0.50	0.27	0.30	0.33	0.39	0.53	0.24		
Lab pH	6.1	6.1	5.9	6.1	6.1	6.2	6.1	6.1		
NUTRIENTS										
Nitrate (N) mg/l	1.6	0.5	0.6	0.8	0.9	1.1	0.9	0.5		
Kjeldahl (N) mg/l	3.1	2.3	1.4	1.3	1.4	2.3	2.3	1.3		
Ammonia (N) mg/l	1.2	0.6	0.5	0.6	0.8	1.1	1.0	0.5		
Total P mg/l	0.80	0.50	0.20	0.15	0.17	0.20	0.52	0.16		
Ortho P mg/l	0.25	0.09	0.04	0.03	0.03	0.04	0.21	0.05		
MISCELLANEOUS										
Oil & Grease mg/l	23	19	15	41	19	18	25	15		
Total Solids mg/l	481	279	125	90	110	144	324	93		
Volatile Portion (T.S.) %	33	33	41	31	42	35	27	20		
Total Sus. Solids mg/l	374	239	76	53	41	68	272	64		
Volatile Portion (TSS) %	27	33	50	4	10	0	24	9		
COD mg/l	224	102	73	83	91	108	148	62		
PRECIPITATION (p)										
Δp, (inches)	.13	.23	–	–	.01	–	.08	.26		
p, (Total)	.13	.35	.35	.35	.36	.36	.44	.70		

PROJECT 657117 LOCATION Los Angeles DIST 07 CO. LA RTE. 405 P.M. 18.0

PARAMETER	DATE January 6, 1978 STORM NO. 4									
SAMPLE NO.	LA-160	-161	-162	-163	-164	-165	-166	-167		
TIME	0712	0727	0742	0757	0812	0842	0912	1012		
FIELD										
Flow, cfs	.402	.402	.353	1.00	.774	.711	.307	.055		
Temp, °C	15.2	15	15.1	15.1	15.3	15.2	15	15.7		
Cond, μmhos/cm										
pH	5.8	6.0	6.5	6.2	6.2	6.1	6.3	6.2		
D.O. mg/l	7.85	9.07	8.02	8.04	8.43	8.34	8.07	8.36		
MAJOR IONS										
B mg/l	0.13	0.13	0.13	0.10	0.06	0.06	0.09	0.10		
Ca mg/l	6.9	6.1	6.6	5.5	3.5	4.5	5.1	7.6		
Cl mg/l	3.3	2.5	2.7	7.6	2.6	3.2	6.6	5.5		
CO_3 mg/l	0	0	0	0	0	0	0	0		
HCO_3 mg/l	10	10	11	7	7	7	9	13		
K mg/l	1.3	1.1	1.2	1.2	0.9	0.8	0.9	1.0		
Mg mg/l	1.1	0.9	0.9	0.9	1.0	0.7	0.7	0.7		
Na mg/l	2.9	2.5	2.5	1.9	1.2	1.8	3.8	3.3		
SiO_2 mg/l	2.0	1.8	1.9	1.6	1.0	1.2	1.4	2.1		
SO_4 mg/l	11	9.6	11	8.6	5.0	5.9	6.3	9.2		
METALS										
Cd mg/l $\times 10^{-3}$	<4	→	→	→	→	→	→	→		
Cr mg/l	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00		
Cu mg/l	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04		
Fe mg/l	3.0	2.2	2.0	3.1	2.3	1.7	1.8	1.7		
Hg mg/l $\times 10^{-3}$	<0.2	→	→	→	→	→	→	→		
Mn mg/l	0.06	0.05	0.05	0.06	0.04	0.04	0.04	0.05		
Mo mg/l	<0.04	→	→	→	→	→	→	→		
Ni mg/l	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.03		
Pb mg/l	0.7	0.6	0.6	0.8	0.6	0.6	0.6	0.6		
Zn mg/l	0.30	0.26	0.26	0.28	0.18	0.20	0.20	0.26		
Lab pH	6.4	6.6	6.8	6.7	6.5	6.6	6.7	6.8		
NUTRIENTS										
Nitrate (N) mg/l	0.7	0.6	0.6	0.5	0.4	0.6	0.5	0.7		
Kjeldahl (N) mg/l	1.7	1.5	1.8	1.4	1.2	1.4	1.0	1.6		
Ammonia (N) mg/l	1.0	0.9	1.0	0.9	0.5	0.6	0.6	1.1		
Total P mg/l	0.17	0.15	0.15	0.18	0.12	0.11	0.12	0.12		
Ortho P mg/l	0.05	0.05	0.05	0.06	0.05	0.05	0.04	0.03		
MISCELLANEOUS										
Oil & Grease mg/l	21	12	14	16	11	45	13	13		
Total Solids mg/l	134	113	115	126	98	100	100	109		
Volatile Portion (T.S.) %	28	27	31	32	31	25	28	36		
Total Sus. Solids mg/l	90	89	85	100	85	81	51	48		
Volatile Portion (T.S.S.) %	13	35	42	41	35	31	47	31		
COD mg/l	83	73	77	80	53	55	52	71		
PRECIPITATION (p)										
Δp, (inches)	0	.02	.03	.06	.10	.11	.08	.04		
p, (Total)	—	.02	.05	.11	.21	.32	.40	.44		

PROJECT 657117 LOCATION Los Angeles DIST. 07 CO. LA RTE. 405 P.M. 18.0

DATE January 14, 1978 STORM NO. 5

PARAMETER										
SAMPLE NO.	LA-168	-169	-170	-171	-172	-173	-174	-175	-176	-177
TIME	1035	1050	1105	1120	1135	1205	1235	1335	1435	1535
FIELD										
Flow, cfs	.711	.201	.402	.428	1.96	.307	.068	.48	.068	.262
Temp, °C	14.8	14.9	14.9	14.9	14.6	14.9	14.8	14.3	14.2	14
Cond, μmhos/cm										
pH	5.8	5.9	5.9	6.1	6.1	6.1	6.1	6.1	6.4	6.4
D.O. mg/l	7.94	8.04	7.85	8.29	8.12	8.86	8.71	8.91	8.25	9.08
MAJOR IONS										
B mg/l	0.21	0.20	0.16	0.17	0.05	0.05	0.10	0.10	0.08	0.08
Ca mg/l	11	9.7	8.5	9.1	5.5	5.3	8.0	5.6	6.6	6.4
Cl mg/l	7.5	6.2	5.1	4.4	1.7	2.2	3.5	2.7	2.3	2.1
CO_3 mg/l	0	0	0	0	0	0	0	0	0	0
HCO_3 mg/l	8	10	10	11	7	8	12	6	14	12
K mg/l	1.9	1.5	1.5	2.0	1.6	0.9	1.3	0.9	1.0	1.0
Mg mg/l	1.7	1.1	1.0	1.7	1.7	0.7	1.1	0.8	0.8	0.9
Na mg/l	4.9	4.3	3.6	3.9	1.7	1.7	2.5	1.8	1.9	1.8
SiO_2 mg/l	1.8	2.0	1.9	2.1	1.3	1.3	2.1	1.6	2.0	1.8
SO_4 mg/l	19	17	15	14	5.6	7.9	12	7.3	7.3	6.7
METALS										
Cd mg/l x 10^{-3}	4	<4	<4	<4	4	<4	→	→	→	→
Cr mg/l	0.02	0.01	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.01
Cu mg/l	0.05	0.04	0.04	0.04	0.06	0.03	0.03	0.03	0.04	0.03
Fe mg/l	4.2	2.5	2.4	5.2	6.7	1.9	2.8	2.2	2.1	2.9
Hg mg/l x 10^{-3}	0.2	→	→	→	→	→	→	→	→	→
Mn mg/l	0.12	0.07	0.07	0.11	0.12	0.04	0.06	0.48	0.04	0.04
Mo mg/l	<0.04	→	→	→	→	→	→	→	→	→
Ni mg/l	0.06	0.04	0.04	0.05	0.05	0.12	0.06	0.03	0.02	0.02
Pb mg/l	1.3	0.7	0.7	0.7	1.6	0.6	0.6	0.6	0.4	0.5
Zn mg/l	0.53	0.38	0.34	0.42	0.33	0.48	0.30	0.23	0.21	0.31
Lab pH	6.6	6.6	6.8	6.6	6.7	6.6	6.8	6.4	6.8	6.9
NUTRIENTS										
Nitrate (N) mg/l	1.5	1.5	1.3	1.4	0.6	0.6	0.8	0.8	0.7	0.6
Kjeldahl (N) mg/l	2.6	2.5	2.2	2.3	1.3	1.2	1.6	1.5	1.1	1.3
Ammonia (N) mg/l	1.3	1.3	1.3	1.3	0.5	0.7	1.0	0.8	0.7	0.8
Total P mg/l	0.08	0.05	0.10	0.08	0.11	0.11	0.14	0.10	0.10	0.13
Ortho P mg/l	0.04	0.03	0.06	0.05	0.04	0.03	0.03	0.03	0.02	0.03
MISCELLANEOUS										
Oil & Grease mg/l	22	20	20	18	18	11	15	16	11	12
Total Solids mg/l	171	136	132	171	153	76	106	90	81	93
Volatile Portion (T.S.)%	35	33	36	32	20	21	17	34	26	31
Total Sus. Solids mg/l	65	39	47	104	95	34	49	54	34	57
Volatile Portion (T.S.S.)%	31	62	49	22	21	38	37	57	20	42
COD mg/l	137	106	103	105	91	61	76	73	64	65
PRECIPITATION (p)										
Δp, (inches) *										
p, (Total)										

* No data due to vandalism

PROJECT 657117 LOCATION Walnut Creek DIST. 04 CO. CC RTE 680 P.M. 12.7

PARAMETER	DATE October 28/29, 1977 STORM NO. 1									
SAMPLE NO.	IW-1	-2	-3	-4	-5					
TIME	1030	1055	1135	1155	0035					
FIELD										
Flow, cfs	.02	.01	.02	.02	.01					
Temp, °C	16.5	16.6	16.8	16.3	16.0					
Cond, μmhos/cm	452	471	451	353	317					
pH	7.0	7.3	7.1	7.1	7.1					
D.O. mg/l	8.85	8.09	8.52	9.05	8.78					
MAJOR IONS										
B mg/l	0.34	0.49	0.36	0.26	0.29					
Ca mg/l	41	48	38	27	29					
Cl mg/l	54	62	51	37	35					
CO_3 mg/l	0	0	0	0	0					
HCO_3 mg/l	49	64	45	40	41					
K mg/l	13	14	13	8.9	7.4					
Mg mg/l	0.8	1.0	0.7	0.5	0.5					
Na mg/l	35	39	31	24	23					
SiO_2 mg/l	8.1	9.7	8.5	6.9	6.9					
SO_4 mg/l	56	57	54	41	42					
METALS										
Cd mg/l $\times 10^{-3}$	8	6	4	<4	<4					
Cr mg/l	0.02	0.02	0.02	0.01	0.01					
Cu mg/l	0.17	0.19	0.15	0.12	0.14					
Fe mg/l	7.5	8.8	5.4	4.0	4.3					
Hg mg/l $\times 10^{-3}$	<0.2	→	→	→	→					
Mn mg/l	0.38	0.50	0.31	0.22	0.25					
Mo mg/l	<0.04	→	→	→	→					
Ni mg/l	0.07	0.08	0.06	0.04	0.06					
Pb mg/l	1.6	2.6	0.8	0.6	0.7					
Zn mg/l	1.16	2.32	0.66	0.51	0.74					
Lab pH	6.9	6.9	6.9	7.0	6.9					
NUTRIENTS										
Nitrate (N) mg/l	4.4	5.2	5.2	4.0	4.0					
Kjeldahl (N) mg/l	12	13	12	10	9.5					
Ammonia (N) mg/l	5.1	4.8	5.1	4.3	4.2					
Total P mg/l	0.99	1.13	0.82	0.64	0.57					
Ortho P mg/l	0.04	0.03	0.04	0.05	0.02					
MISCELLANEOUS										
Oil & Grease mg/l	19	32	30	174	22					
Total Solids mg/l	665	784	576	253	236					
Volatile Portion (T.S.) %	52	53	52	58	54					
Total Sus. Solids mg/l	143	202	108	61	62					
Volatile Portion (T.S.S.) %	48	52	52	88	47					
COD mg/l	505	592	501	360	356					
PRECIPITATION (p)										
Δp, (inches)	.08	.01	–	–	.01					
p, (Total)	.08	.09	.09	.09	.10					

PROJECT 657117 LOCATION Walnut Creek DIST. 04 CO. CC RTE 680 P.M. 12.7

PARAMETER	DATE November 21, 1977 STORM NO. 2									
SAMPLE NO.	2W-1	-2	-3	-4	-5	-6	-7	-8	-9	-10
TIME	0150	0205	0220	0235	0250	0305	0335	0435	0530	0700
FIELD										
Flow, cfs	.80	.80	.80	.60	.60	.80	.60	1.42	.60	.07
Temp, °C	8.9	8.7	8.7	8.5	8.2	8.2	8.2	8.0	8.4	9.2
Cond, μmhos/cm @ 25°C	71	63	67	73	58	59	64	55	58	1 25
pH	7.5	7.1	7.1	7.0	7.4	7.6	7.6	7.8	7.3	7.7
D.O. mg/l	12.1	12.1	11.9	11.9	12.0	12.0	11.9	11.8	11.8	11.1
MAJOR IONS										
B mg/l	0.07	0.11	0.13	0.08	0.16	0.13	0.11	0.14	0.10	0.13
Ca mg/l	9.3	9.4	10	12	11	10	10	10	10	22
Cl mg/l	1.7	2.5	2.4	2.9	1.8	2.1	2.3	2.0	2.1	6.6
CO_3 mg/l	0	0	0	0	0	0	0	0	0	0
HCO_3 mg/l	22	21	23	26	23	32	23	23	24	44
K mg/l	1.7	1.6	1.6	1.7	1.8	1.6	1.7	1.6	1.7	3.5
Mg mg/l	1.6	1.6	1.5	1.9	2.1	1.8	1.6	1.9	2.0	4.6
Na mg/l	3.1	3.3	3.0	3.3	2.6	2.5	2.8	2.3	2.2	5.2
SiO_2 mg/l	2.8	2.8	3.0	3.6	3.0	3.2	3.6	3.8	3.1	6.0
SO_4 mg/l	8.2	7.3	7.9	8.2	6.3	6.6	6.6	5.6	5.6	17
METALS										
Cd mg/l x 10^{-3}	<4	→	→	→	→	→	→	→	→	<4
Cr mg/l	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.03
Cu mg/l	0.07	0.06	0.06	0.07	0.08	0.07	0.07	0.08	0.08	0.12
Fe mg/l	4.3	4.4	4.1	5.6	7.0	5.3	4.5	6.0	6.4	12
Hg mg/l x 10^{-3}	<0.02	→	→	→	→	→	→	→	→	→
Mn mg/l	0.09	0.09	0.08	0.11	0.12	0.10	0.09	0.11	0.12	0.24
Mo mg/l	<0.04	→	→	→	→	→	→	→	→	→
Ni mg/l	0.04	0.04	0.04	0.04	0.04	0.06	0.04	0.05	0.04	0.06
Pb mg/l	0.5	0.5	0.5	0.6	0.7	0.6	0.6	0.6	0.8	1.8
Zn mg/l	0.18	0.17	0.16	0.18	0.21	0.19	0.17	0.20	0.21	0.45
Lab pH	7.2	7.2	7.2	7.2	7.4	7.3	7.8	7.4	7.3	7.1
NUTRIENTS										
Nitrate (N) mg/l	0.9	–	2.6	1.0	1.6	1.0	1.0	1.0	1.0	2.0
Kjeldahl (N) mg/l	1.5	0.8	1.6	1.5	1.5	1.4	1.3	1.3	1.4	2.8
Ammonia (N) mg/l	0.6	0.6	0.6	0.6	0.5	0.4	0.5	0.4	0.4	0.9
Total P mg/l	0.21	0.19	0.19	0.22	0.22	0.20	0.17	0.20	0.21	0.40
Ortho P mg/l	0.09	0.08	0.08	0.09	0.10	0.10	0.08	0.09	0.07	0.11
MISCELLANEOUS										
Oil & Grease mg/l	12	10	10	11	11	9	11	12	18	21
Total Solids mg/l	142	123	87	149	155	137	111	145	149	312
Volatile Portion (T.S.) %	33	39	100	35	36	38	36	29	38	33
Total Sus. Solids mg/l	104	97	65	55	75	77	63	85	86	188
Volatile Portion (T.S.S.) %	35	39	100	2	31	28	40	15	27	25
COD mg/l	62	62	59	71	68	53	55	73	88	170
PRECIPITATION (p)										
Δp, (inches)	.37	.03	.03	.04	.03	.04	.11	.10	.03	.23
p, (Total)	.37	.40	.43	.47	.50	.54	.65	.75	.78	1.01

PROJECT 657117 LOCATION Walnut Creek DIST. 04 CO. CC RTE 680 P.M. 12.7

PARAMETER	DATE November 21, 1977 STORM NO. 2		
SAMPLE NO.	2W-11	-12	-13
TIME	0830	1000	1200
FIELD			
Flow, cfs	2.13	.50	.10
Temp, °C	9.8	11.7	13.6
Cond, µmhos/cm	56	70	111
pH	7.4	7.5	7.5
D.O. mg/l	11.1	10.3	9.8
MAJOR IONS			
B mg/l	0.12	0.07	0.13
Ca mg/l	13	14	19
Cl mg/l	2.6	3.1	5.1
CO_3 mg/l	0	0	0
HCO_3 mg/l	22	28	38
K mg/l	2.5	2.5	2.7
Mg mg/l	3.8	3.3	3.2
Na mg/l	3.0	3.1	4.5
SiO_2 mg/l	2.5	3.4	5.8
SO_4 mg/l	5.9	9.6	13.2
METALS			
Cd mg/l x 10^{-3}	4	6	4
Cr mg/l	0.04	0.03	0.02
Cu mg/l	0.12	0.19	0.11
Fe mg/l	13	11	9.3
Hg mg/l x 10^{-3}	<0.2	→	→
Mn mg/l	0.22	0.19	0.18
Mo mg/l	<0.04	→	→
Ni mg/l	0.05	0.06	0.07
Pb mg/l	1.6	1.3	1.3
Zn mg/l	0.40	0.45	0.38
Lab pH	7.1	7.1	7.0
NUTRIENTS			
Nitrate (N) mg/l	1.2	1.4	1.6
Kjeldahl (N) mg/l	2.3	2.1	3.0
Ammonia (N) mg/l	0.8	0.9	1.1
Total P mg/l	0.38	0.40	0.38
Ortho P mg/l	0.11	0.14	0.08
MISCELLANEOUS			
Oil & Grease mg/l	23	20	27
Total Solids mg/l	284	240	245
Volatile Portion (T.S.)%	21	26	33
Total Sus. Solids mg/l	216	170	132
Volatile Portion (TSS)%	15	15	27
COD mg/l	175	132	180
PRECIPITATION (p)			
Δp, (inches)	.24	.15	.14
p, (Total)	1.25	1.40	1.54

PROJECT 657117 LOCATION Walnut Creek DIST. 04 CO. CC RTE. 680 P.M. 12.7

PARAMETER	DATE December 4, 1977 STORM NO. 3									
SAMPLE NO.	3W-1	-2	-3	-4	-5	-6	-7	-8	-9	-10
TIME	1435	1455	1515	1545	1615	1715	1815	1915	2015	2130
FIELD										
Flow, cfs	.02	.02	.02	.02	.02	.02	.50	1.42	1.62	1.92
Temp, °C	15.5	15.5	15.5	15	15	15	14.5	14.5	15	15
Cond, μmhos/cm	969	375	267	281	267	234	134	44	15	15
pH	7.3	7.1	7.2	7.4	7.3	7.4	7.3	7.7	7.1	7.0
D.O. mg/l	9.3	10.1	9.6	9.7	9.8	9.8	10.4	9.6	9.8	9.9
MAJOR IONS										
B mg/l	0.55	0.42	0.29	0.23	0.24	0.22	0.16	0.10	0.06	0.08
Ca mg/l	90	66	46	43	35	37	36	17	7.3	5.7
Cl mg/l	69	41	28	24	19	18	12	4.4	1.6	0.9
CO_3 mg/l	0	0	0	0	0	0	0	0	0	0
HCO_3 mg/l	48	41	40	37	38	49	47	32	18	15
K mg/l	8.4	8.0	6.1	6.1	5.2	5.4	7.3	3.3	1.3	1.1
Mg mg/l	15	13	10	10	8.3	8.4	14	5.3	1.5	1.4
Na mg/l	27	20	16	13	11	11	8.7	4.1	1.7	1.1
SiO_2 mg/l	13	11	10	9.3	9.0	11	9.4	4.8	2.4	1.7
SO_4 mg/l	180	120	70	71	54	46	28	11	4.2	2.3
METALS										
Cd mg/l x 10^{-3}	8	6	6	6	6	4	8	4	<4	<4
Cr mg/l	0.04	0.07	0.06	0.06	0.05	0.05	0.10	0.04	0.02	0.02
Cu mg/l	0.17	0.17	0.15	0.19	0.17	0.17	0.25	0.12	0.06	0.06
Fe mg/l	20	24	20	20	16	18	41	16	4.5	4.5
Hg mg/l x 10^{-3}	0.2	→	→	→	→	<0.2	→	→	→	→
Mn mg/l	0.53	0.50	0.42	0.42	0.34	0.36	0.73	0.30	0.08	0.08
Mo mg/l	<0.04	→	→	→	→	→	→	→	→	→
Ni mg/l	0.13	0.11	0.10	0.10	0.08	0.08	0.14	0.08	0.05	0.04
Pb mg/l	2.1	2.2	1.8	1.7	1.6	1.8	3.8	1.6	0.6	0.6
Zn mg/l	1.19	0.94	0.76	0.74	0.62	0.68	1.16	0.47	0.18	0.18
Lab pH	7.1	7.2	7.3	7.3	7.4	7.5	7.4	7.6	7.2	7.3
NUTRIENTS										
Nitrate (N) mg/l	7.4	4.8	3.6	3.2	2.7	2.9	2.2	1.2	0.9	0.8
Kjeldahl (N) mg/l	11.2	9.1	7.5	7.8	7.0	8.0	7.6	3.8	1.2	1.1
Ammonia (N) mg/l	4.8	4.2	4.5	3.9	3.5	3.5	1.8	0.9	0.5	0.4
Total P mg/l	0.54	0.62	0.55	0.55	0.43	0.47	0.95	0.44	0.15	0.15
Ortho P mg/l	0.16	0.17	0.15	0.18	0.14	0.15	0.34	0.22	0.07	0.06
MISCELLANEOUS										
Oil & Grease mg/l	22	24	18	13	16	18	41	23	15	10
Total Solids mg/l	825	836	639	614	513	540	922	411	123	130
Volatile Portion (T.S.)%	38	30	33	31	35	33	22	24	22	22
Total Sus. Solids mg/l	152	373	307	316	235	286	739	313	74	93
Volatile Portion (TSS)%	50	22	29	22	24	34	20	14	4	4
COD mg/l	435	409	355	314	286	303	464	180	70	54
PRECIPITATION (p)										
Δp, (inches)	.01	.01	-	.01	.01	.01	.04	.08	.23	.40
p, (Total)	.01	.02	.02	.03	.04	.05	.09	.17	.40	.80

PROJECT 657117 LOCATION Walnut Creek DIST. 04 CO. CC RTE. 680 P.M. 15.9

PARAMETER	DATE December 21, 1977 STORM NO. 4									
SAMPLE NO.	4W-1	-2	-3	-4	-5					
TIME	1255	1310	1325	1340	1430					
FIELD										
Flow, cfs	.02	.07	.03	.01	.01					
Temp, °C	7.7	7.0	6.7	6.7	8.0					
Cond, μmhos/cm @ 25°	488	378	294	307	305					
pH	7.6	7.4	7.5	7.3	7.4					
D.O. mg/l										
MAJOR IONS										
B mg/l	0.43	0.32	0.25	0.22	0.21					
Ca mg/l	59	37	34	38	37					
Cl mg/l	39	24	25	24	26					
CO_3 mg/l	0	0	0	0	0					
HCO_3 mg/l	37	30	27	29	33					
K mg/l	8.6	8.2	5.3	5.7	5.4					
Mg mg/l	11	12	7.5	7.8	7.3					
Na mg/l	17	11	11	12	13					
SiO_2 mg/l	4.4	5.1	4.2	4.5	5.5					
SO_4 mg/l	110	50	22	68	65					
METALS										
Cd mg/l $\times 10^{-3}$	8	8	6	8	6					
Cr mg/l	0.04	0.06	0.04	0.04	0.04					
Cu mg/l	0.18	0.14	0.17	0.18	0.17					
Fe mg/l	19	30	16	16	14					
Hg. mg/l $\times 10^{-3}$	0.2	0.2	0.2	0.2	0.2					
Mn mg/l	0.51	0.64	0.40	0.40	0.36					
Mo mg/l	<0.04 →	→	→	→	→					
Ni mg/l	0.10	0.10	0.10	0.12	0.10					
Pb mg/l	2.0	2.4	1.4	1.4	1.4					
Zn mg/l	1.6	0.83	0.72	0.92	—					
Lab pH	7.2	7.4	7.3	7.2	7.3					
NUTRIENTS										
Nitrate (N) mg/l	4.1	2.6	2.8	2.9	2.7					
Kjeldahl (N) mg/l	9.3	8.6	8.6	8.5	7.8					
Ammonia (N) mg/l	4.1	3.6	4.5	4.6	3.9					
Total P mg/l	0.68	0.96	0.53	0.48	0.49					
Ortho P mg/l	0.31	0.38	0.20	0.14	0.14					
MISCELLANEOUS										
Oil & Grease mg/l	16	16	19	19	19					
Total Solids mg/l	724	776	531	512	502					
Volatile Portion (T.S.)%	33	34	31	31	33					
Total Sus. Solids mg/l	332	548	269	235	224					
Volatile Portion (T.S.S.)%	26	26	22	22	29					
COD mg/l	278	313	247	250	250					
PRECIPITATION (p)										
Δp, (inches)	.01	.02	–	–	–					
p, (Total)	.01	.03	.03	.03	.03					

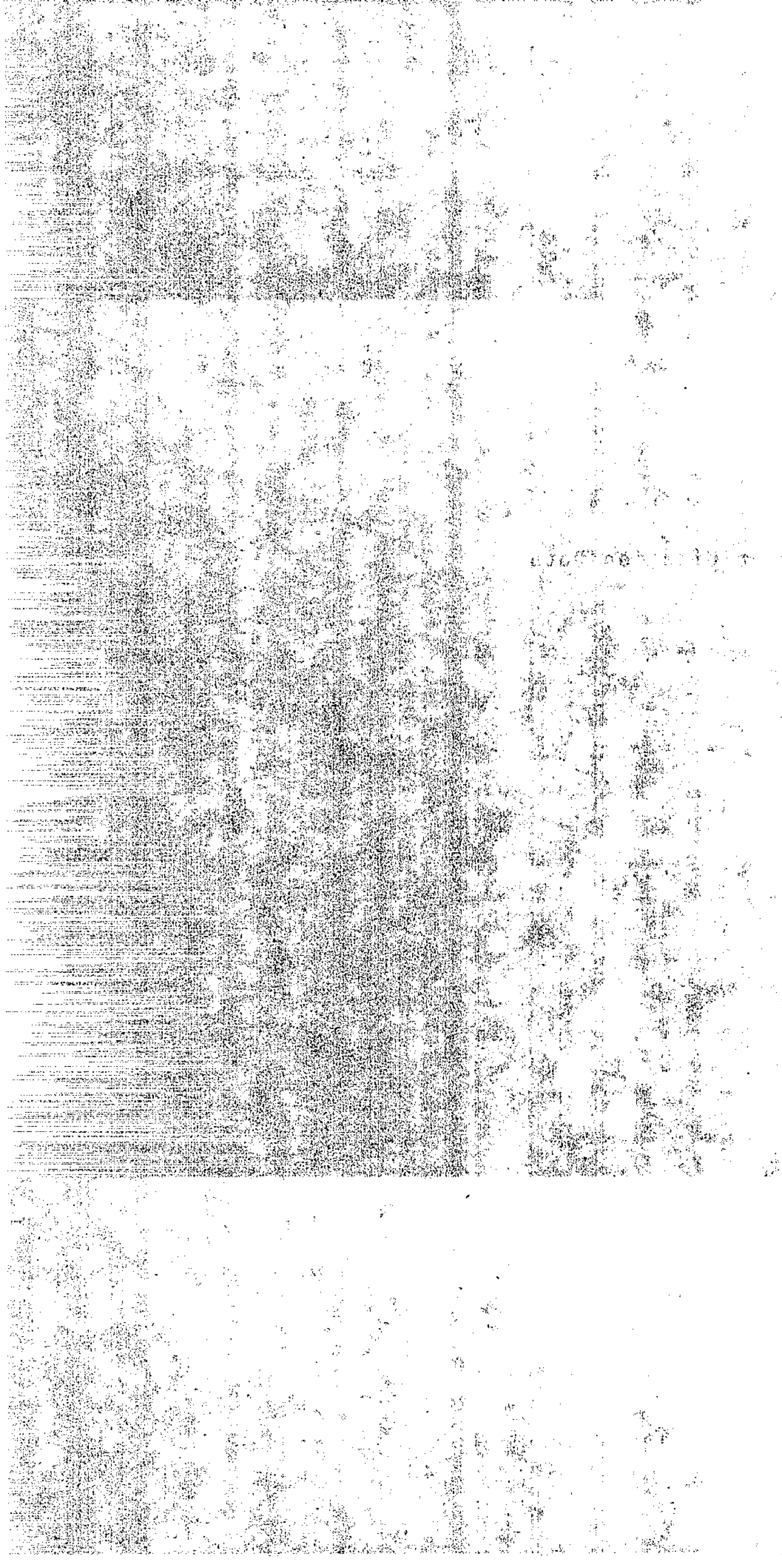
PROJECT 657117 LOCATION Placerville DIST. 03 CO. ED RTE. 50 P.M. 15.5

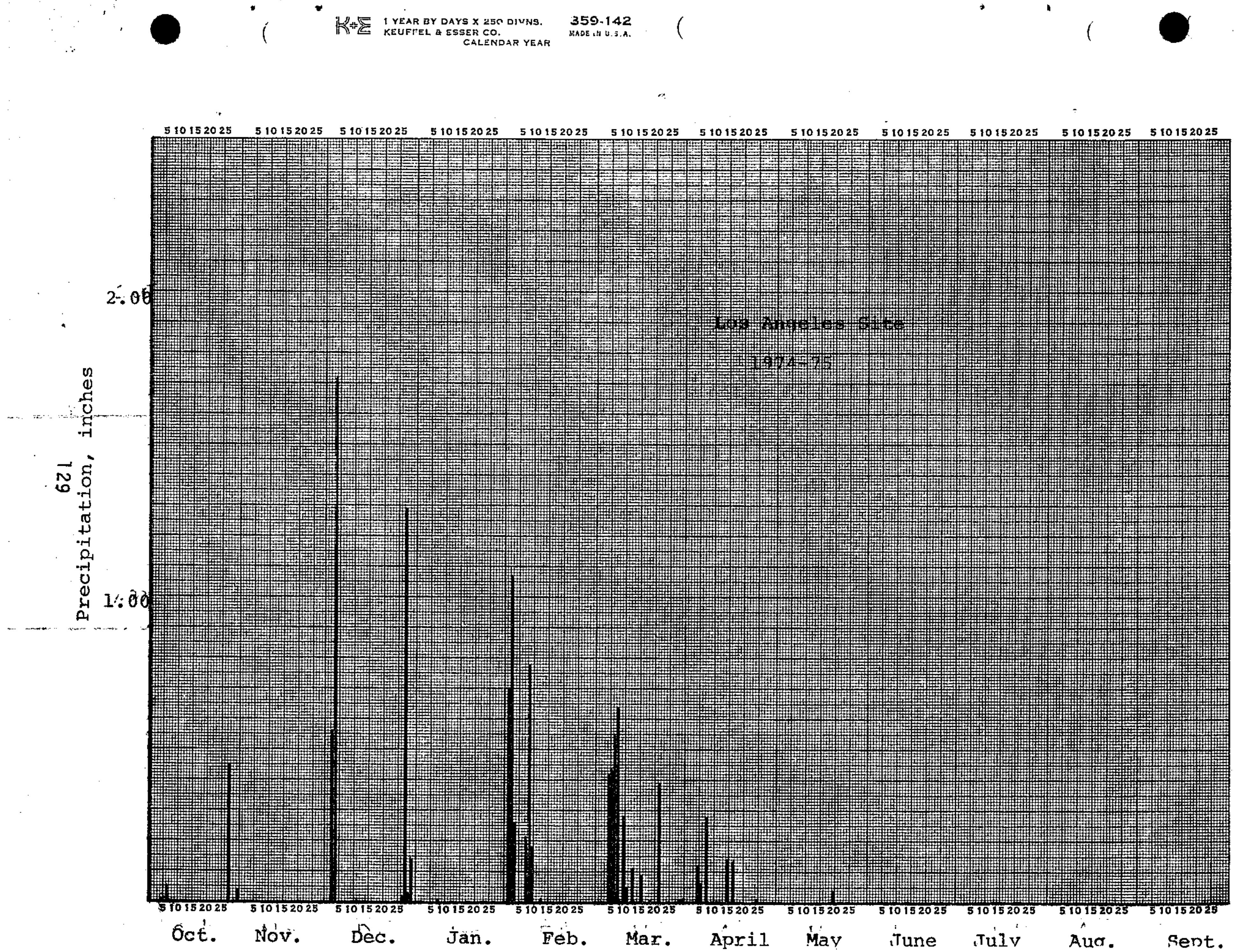
PARAMETER	DATE September 19, 1977 STORM NO. 1									
SAMPLE NO.	1P-1	-2	-3	-4						
TIME	0920	0955	1015	1035						
FIELD										
Flow, cfs	.08	.03	.03	.02						
Temp, °C	17	16	17	18						
Cond, μmhos/cm (25°C)	373	285	300	300						
pH	6.2	6.1	6.5	6.2						
D.O. mg/l										
MAJOR IONS										
B mg/l	0.28	0.24	0.24	0.22						
Ca mg/l	46	34	35	31						
Cl mg/l	25	20	18	17						
CO_3 mg/l	0	0	0	0						
HCO_3 mg/l	27	28	27	29						
K mg/l	7.3	6.8	6.1	5.4						
Mg mg/l	8.9	6.0	6.4	5.3						
Na mg/l	11	9.4	10	8.5						
SiO_2 mg/l	3.7	3.1	4.3	4.1						
SO_4 mg/l	55	42	39	35						
METALS										
Cd mg/l $\times 10^{-3}$	8	8	8	4						
Cr mg/l	0.04	0.03	0.02	0.02						
Cu mg/l	0.13	0.10	0.10	0.09						
Fe mg/l	12	8.1	7.2	7.2						
Hg mg/l $\times 10^{-3}$	<0.2	<0.2	<0.2	<0.2						
Mn mg/l	1.12	0.85	0.79	0.70						
Mo mg/l	<0.04	<0.04	<0.04	<0.04						
Ni mg/l	0.14	0.12	0.10	0.10						
Pb mg/l	1.7	1.1	1.0	0.92						
Zn mg/l	2.5	2.2	2.0	1.8						
Lab pH	5.9	6.2	6.4	6.4						
NUTRIENTS										
Nitrate (N) mg/l	3.9	2.5	2.6	2.4						
Kjeldahl (N) mg/l	13	10	11	8.8						
Ammonia (N) mg/l	5.4	4.6	4.4	4.4						
Total P mg/l	0.88	0.75	0.68	0.67						
Ortho P mg/l	0.22	0.01	0.07	0.04						
MISCELLANEOUS										
Oil & Grease mg/l	18	14	21	19						
Total Solids mg/l	870	630	610	510						
Volatile Portion (T.S.)%	58	64	61	59						
Total Sus. Solids mg/l	240	140	125	85						
Volatile Portion (TSS)%	38	58	53	28						
COD mg/l	660	534	516	495						
PRECIPITATION (p)										
Δp, (inches)	.06	.05	–	–						
p, (Total)	.06	.11	.11	.11						

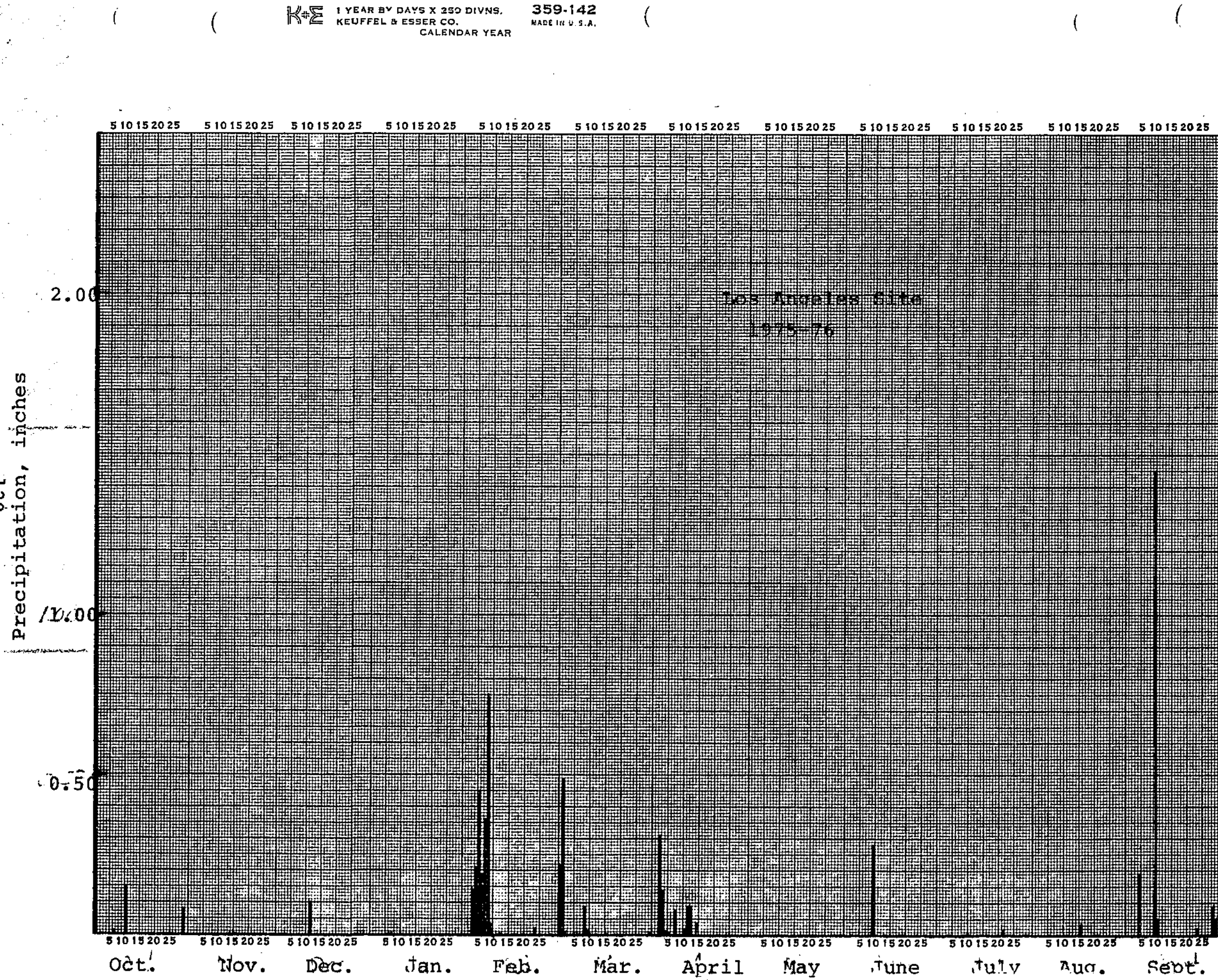
PROJECT 657117 LOCATION Placerville DIST. 03 CO. ED RTE. 50 PM. 15.5

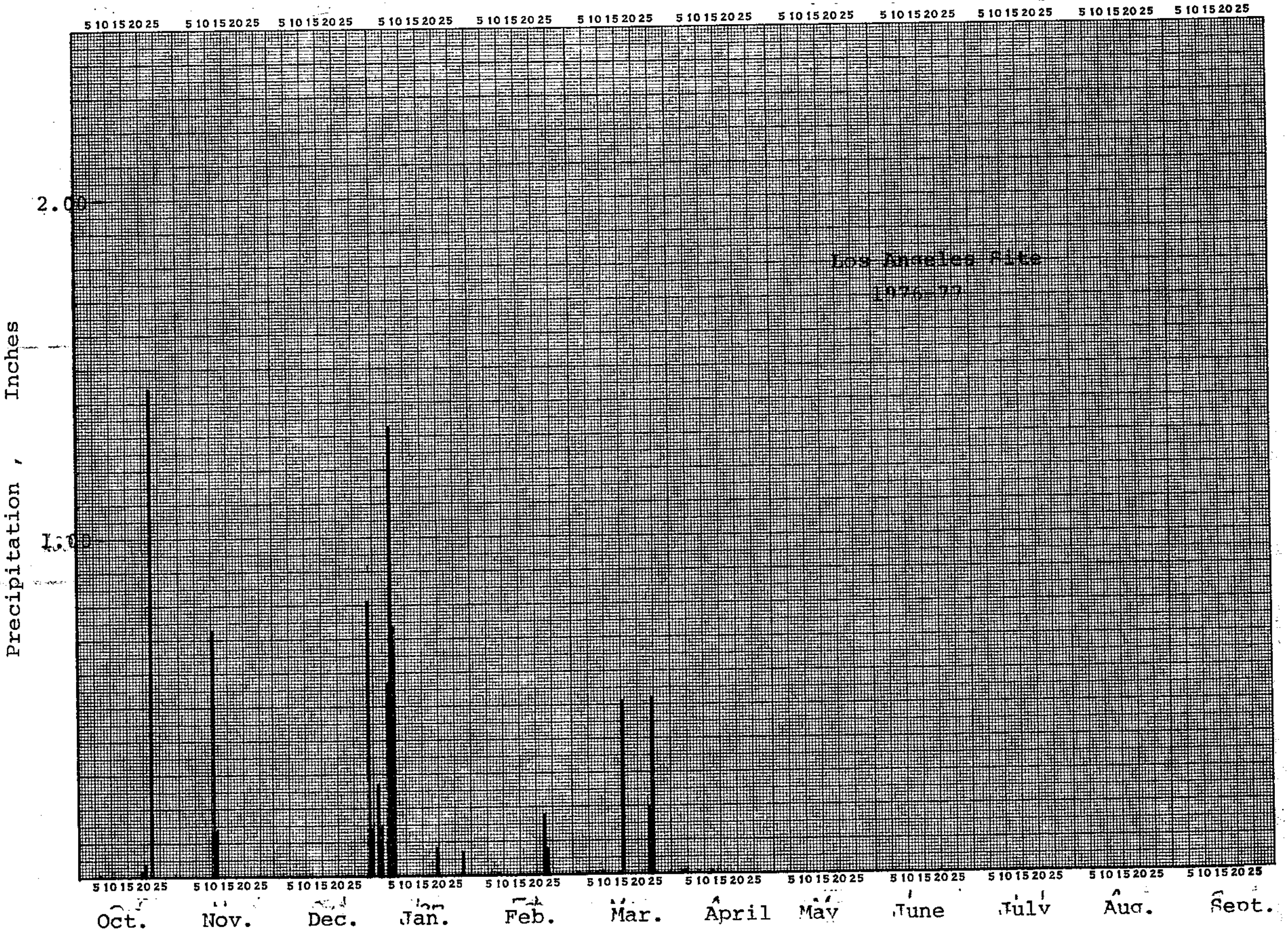
PARAMETER	DATE November 21, 1977 STORM NO. 2									
SAMPLE NO.	2P-1	-3	-5	-8	-10	-13				
TIME	0845	0915	0945	1030	1130	1330				
FIELD										
Flow, cfs	.22	.30	.52	.30	.18	.11				
Temp, °C	6.7	6.7	6.7	6.7	6.7	7.3				
Cond, μmhos/cm	18	20	12	17	25	47				
pH	6.3	6.4	6.4	6.3	6.4	6.6				
D.O. mg/l	–	–	–	–	–	–				
MAJOR IONS										
B mg/l	0.07	0.03	0.02	0.05	0.04	0.02				
Ca mg/l	4.3	5.1	9.9	3.5	3.8	5.6				
Cl mg/l	1.1	0.7	0.7	0.8	1.0	2.2				
CO_3 mg/l	0	0	0	0	0	0				
HCO_3 mg/l	7	10	10	7	10	12				
K mg/l	1.4	1.5	1.8	1.2	0.8	1.0				
Mg mg/l	2.1	2.8	5.7	1.5	1.2	1.2				
Na mg/l	3.4	1.6	1.9	1.9	1.8	3.1				
SiO_2 mg/l	1.2	1.0	1.1	1.2	1.3	2.4				
SO_4 mg/l	1.8	2.4	1.4	1.8	3.7	5.3				
METALS										
Cd mg/l x 10^{-3}	<4 →					→				
Cr mg/l	0.02	0.03	0.06	0.02	0.01	0.01				
Cu mg/l	0.04	0.06	0.09	0.04	0.04	0.04				
Fe mg/l	8.0	10	17	5.3	3.7	3.0				
Hg mg/l x 10^{-3}	<0.2 →					→				
Mn mg/l	0.14	0.19	0.37	0.10	0.09	0.09				
Mo mg/l	<0.04 →					→				
Ni mg/l	0.04	0.05	0.09	0.03	0.03	0.03				
Pb mg/l	0.6	0.8	1.9	0.4	0.3	0.3				
Zn mg/l	0.18	0.22	0.41	0.14	0.14	0.19				
Lab pH	6.8	6.6	6.9	6.7	6.9	6.9				
NUTRIENTS										
Nitrate (N) mg/l	0.6	0.6	0.6	0.5	0.5	0.6				
Kjeldahl (N) mg/l	1.0	1.1	1.1	0.7	0.8	1.0				
Ammonia (N) mg/l	0.3	0.3	0.3	0.2	0.3	0.4				
Total P mg/l	0.15	0.24	0.24	0.13	0.14	0.12				
Ortho P mg/l	0.02	0.04	0.05	0.03	0.02	0.01				
MISCELLANEOUS										
Oil & Grease mg/l	8	9	9	14	7	5				
Total Solids mg/l	129	243	217	131	99	109				
Volatile Portion (T.S.)%	31	27	23	34	48	56				
Total Sus. Solids mg/l	96	219	190	85	61	44				
Volatile Portion (TSS)%	17	20	22	20	49	57				
COD mg/l	74	92	115	53	66	83				
PRECIPITATION (p)										
Δp, (inches)	.54	.06	.11	.09	.09	.11				
p, (Total)	.54	.60	.71	.80	.89	1.00				

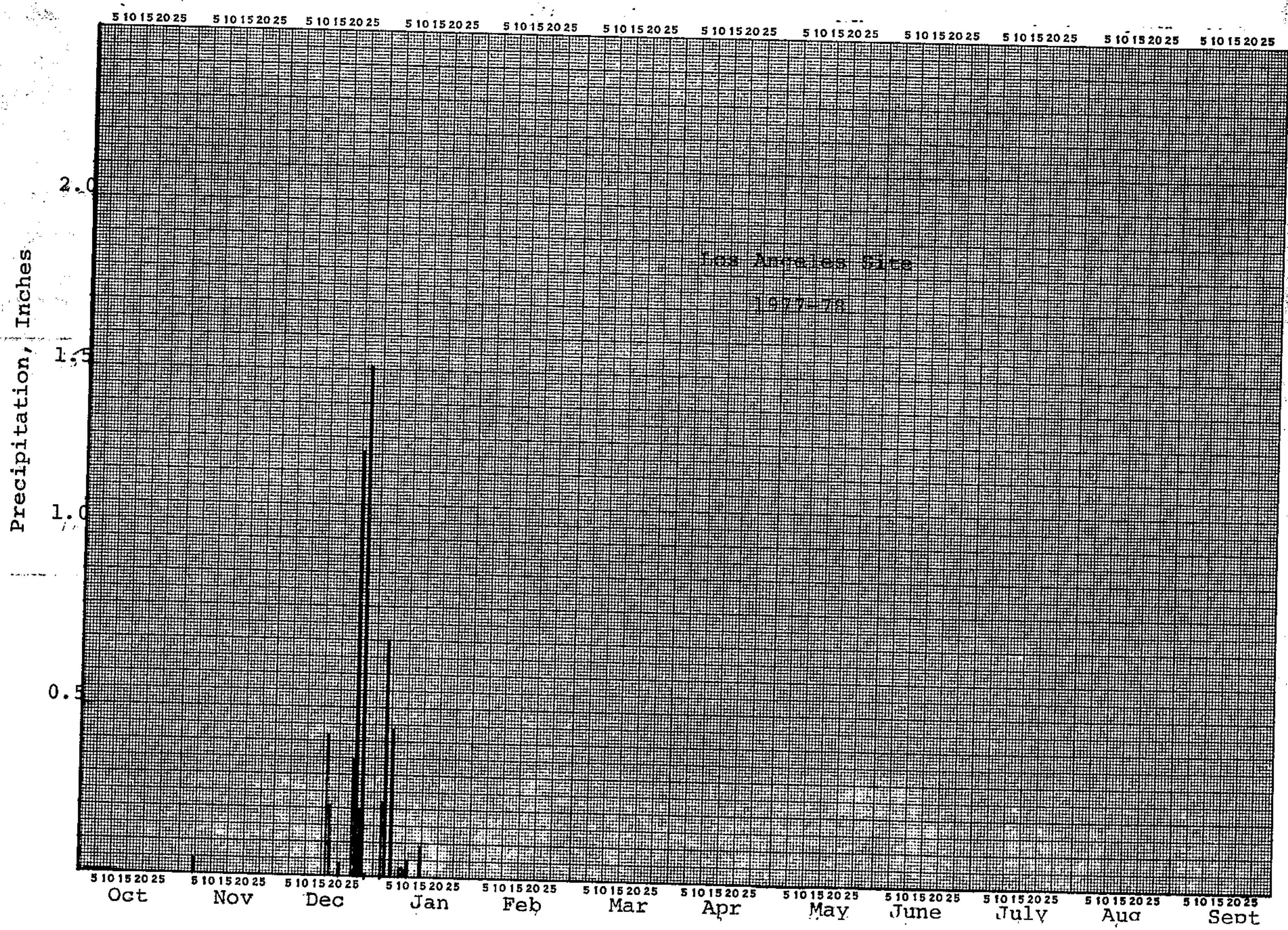
Precipitation Data



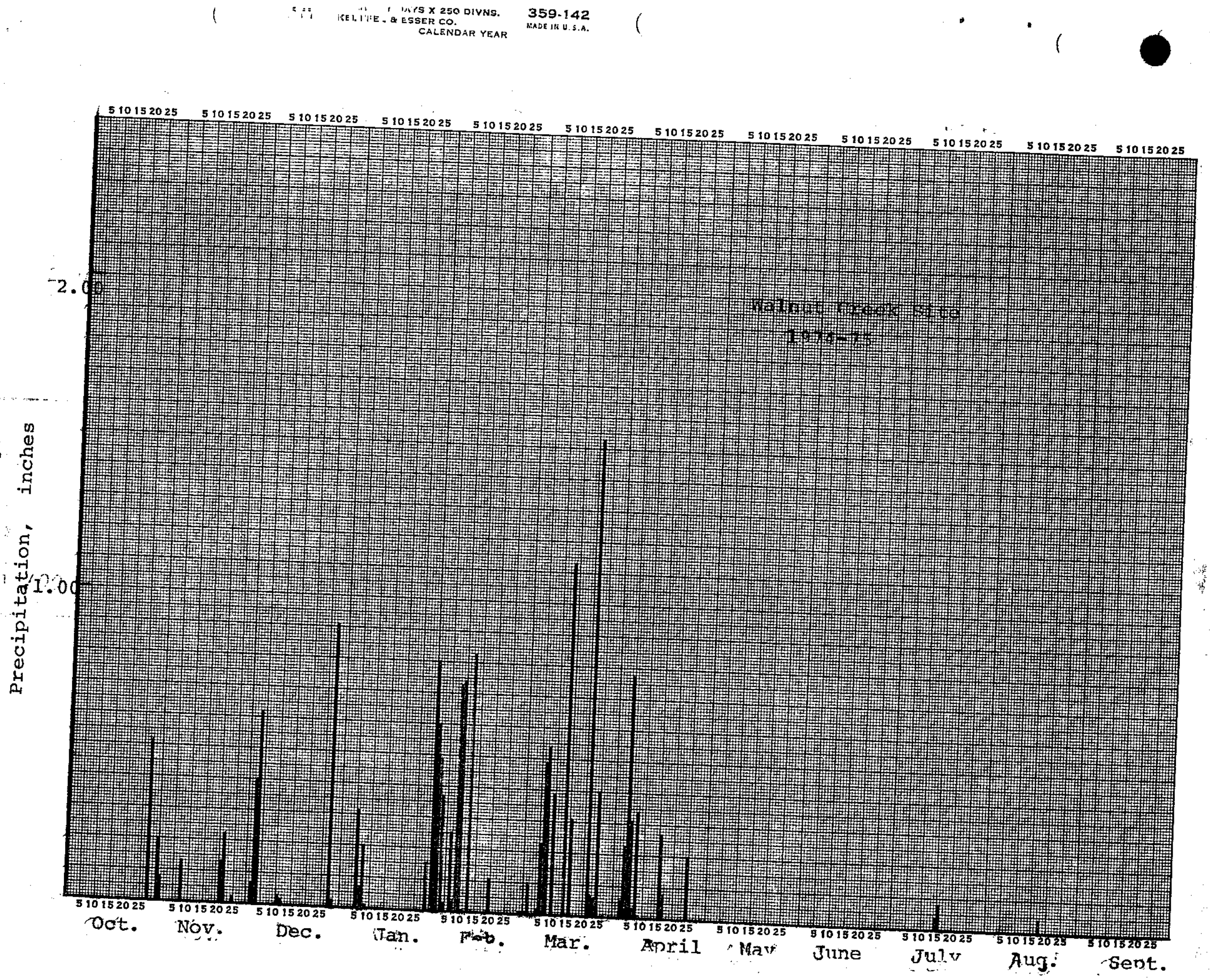

K+E 1 YEAR BY DAYS X 250 DIVNS. KEUFFEL & ESSER CO. CALENDAR YEAR 359-142 MADE IN U.S.A.
Los Angeles Site
1974-75
2.00
1.00
Precipitation, inches
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.

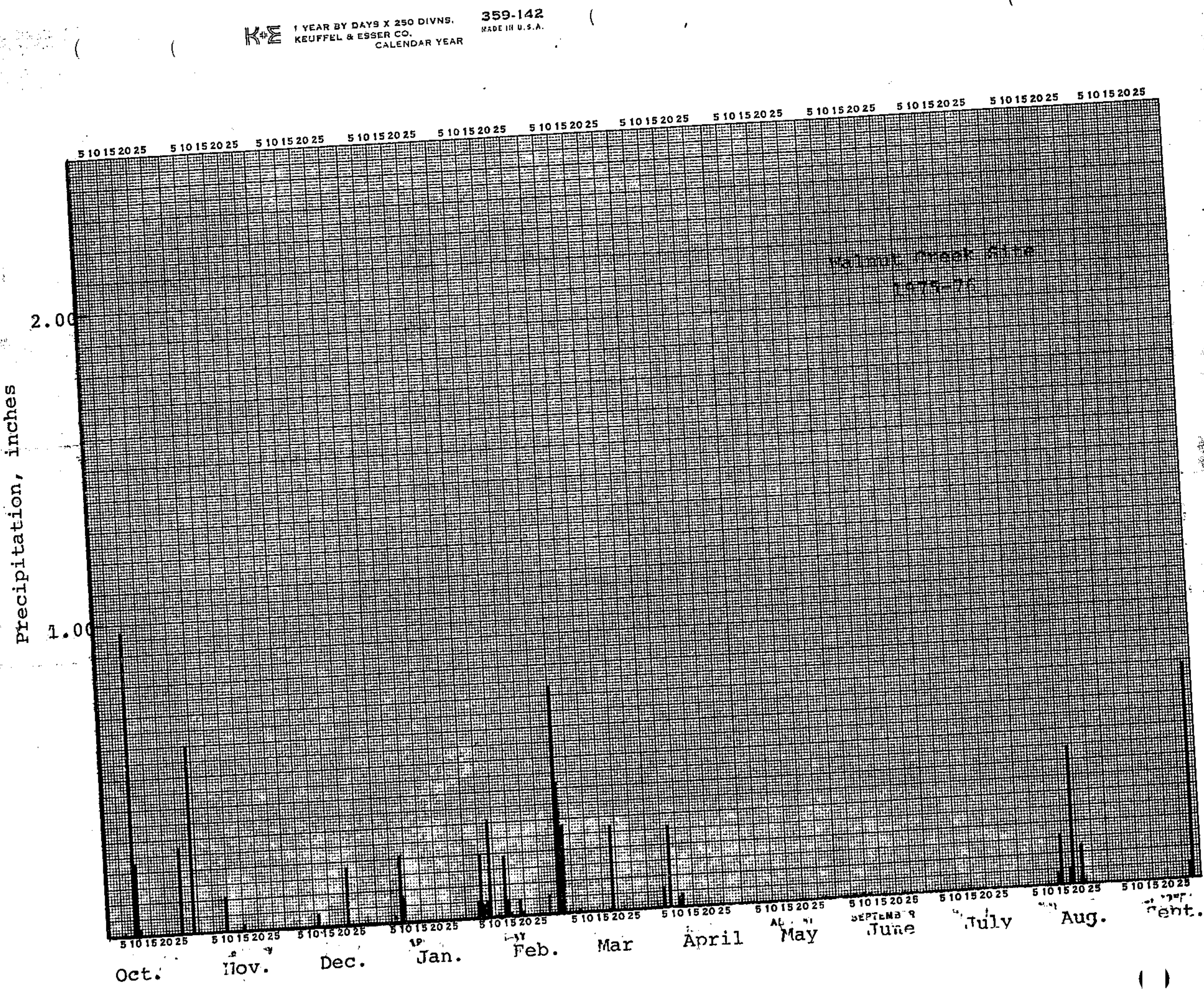

1 YEAR BY DAYS X 250 DIVNS.
KEUFFEL & ESSER CO.
CALENDAR YEAR
359-142
MADE IN U.S.A.
Los Angeles Site
1975-76
Precipitation, inches
2.00
1.00
0.50
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.
5 10 15 20 25

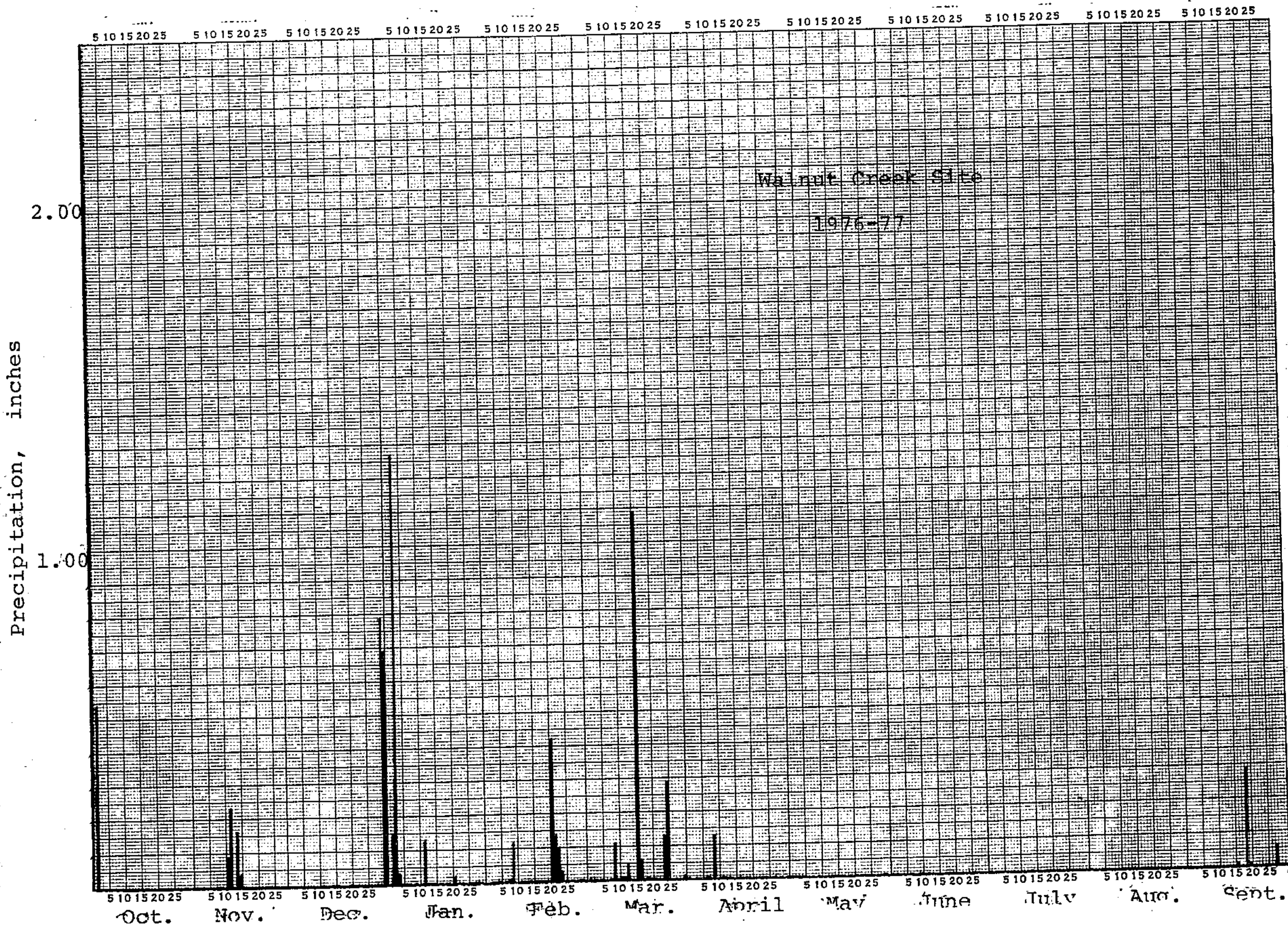

Los Angeles Site
1976-77
Precipitation, Inches
2.00
1.00
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.

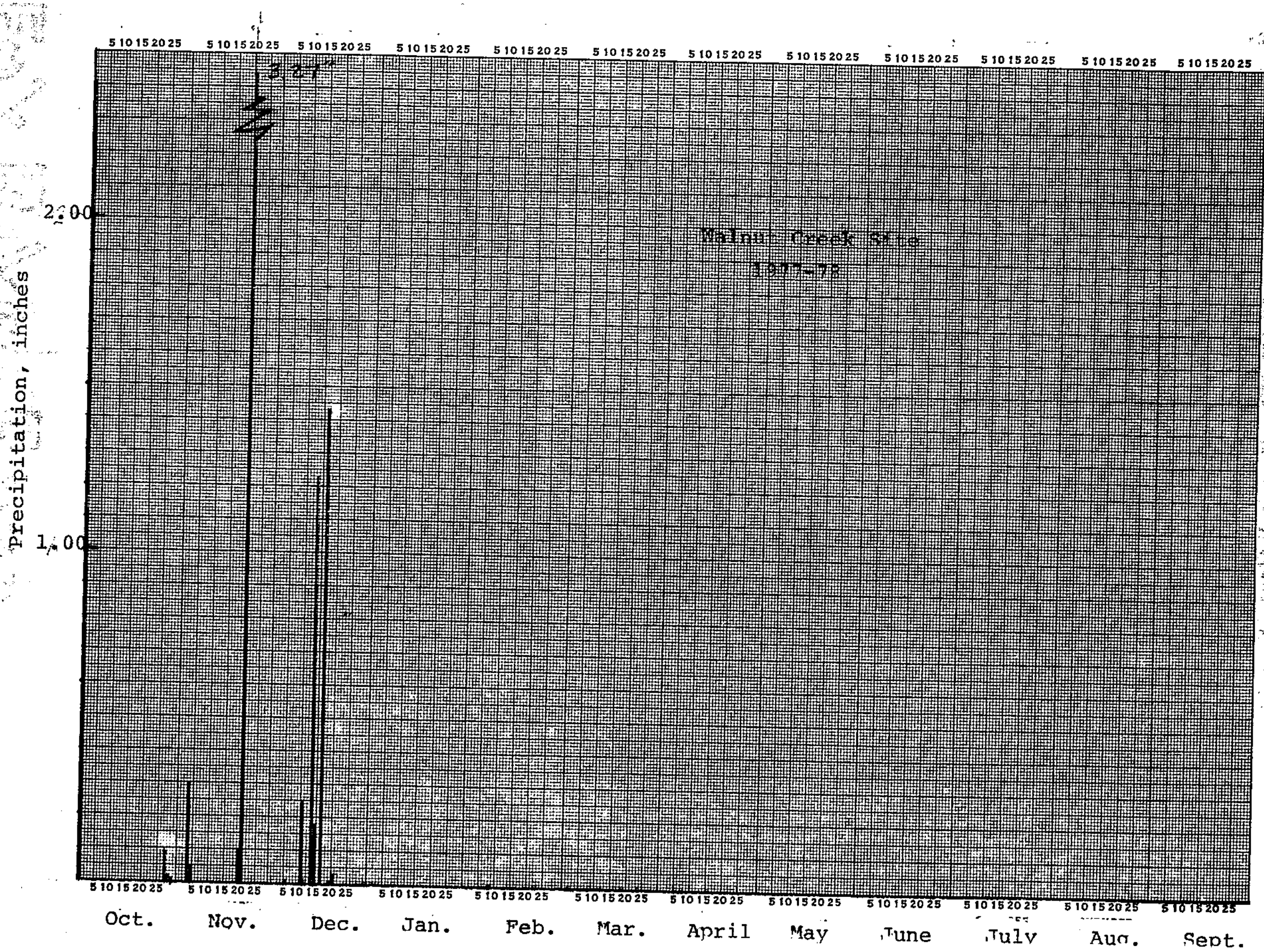


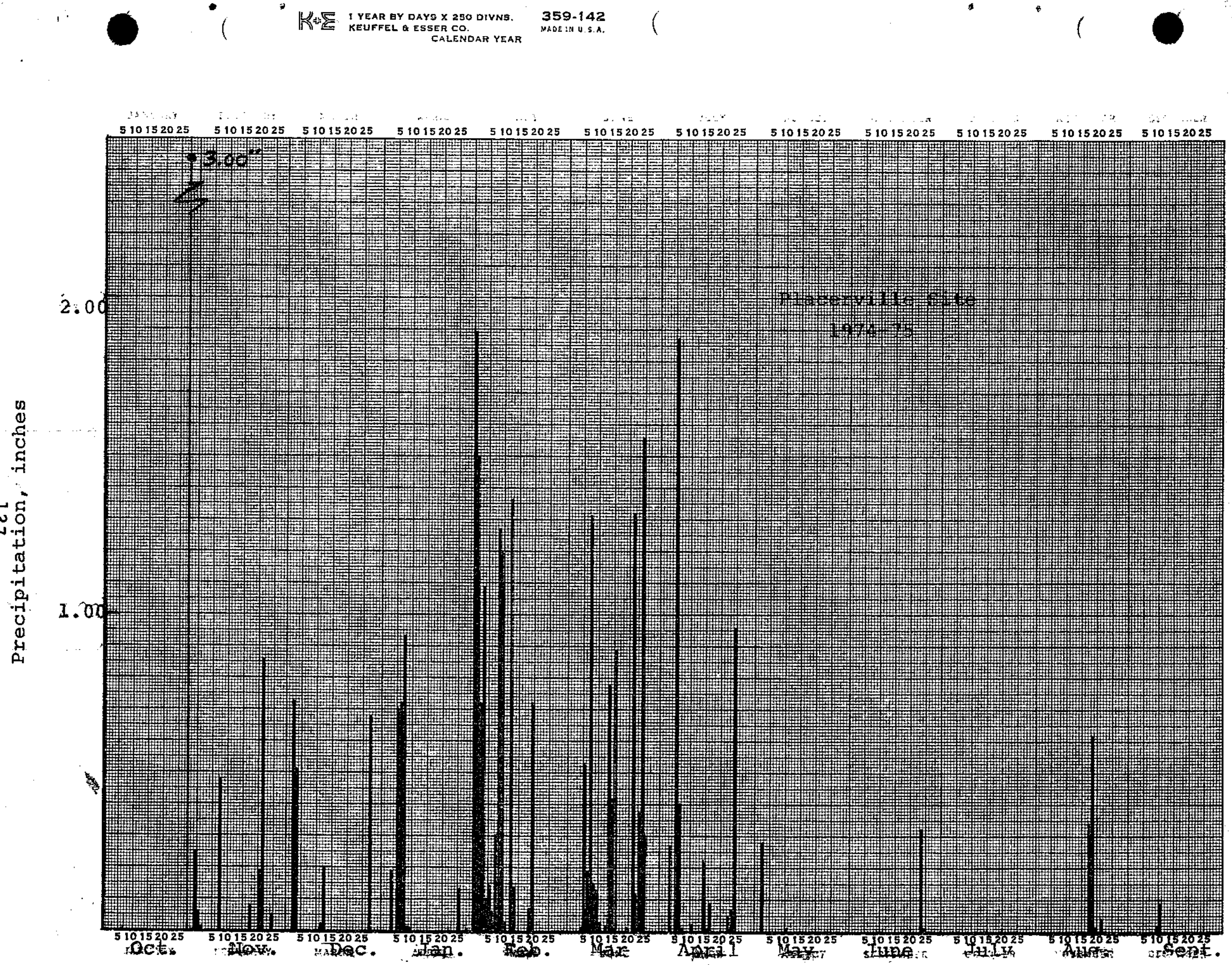
Los Angeles Site
1977-78
Precipitation, Inches
2.0
1.5
1.0
0.5
5 10 15 20 25
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May
June
July
Aug
Sept


DAYS X 250 DIVNS.
KEUFFEL & ESSER CO.
CALENDAR YEAR
359-142
MADE IN U.S.A.
Walnut Creek Site
1974-75
Precipitation, inches
2.00
1.00
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.

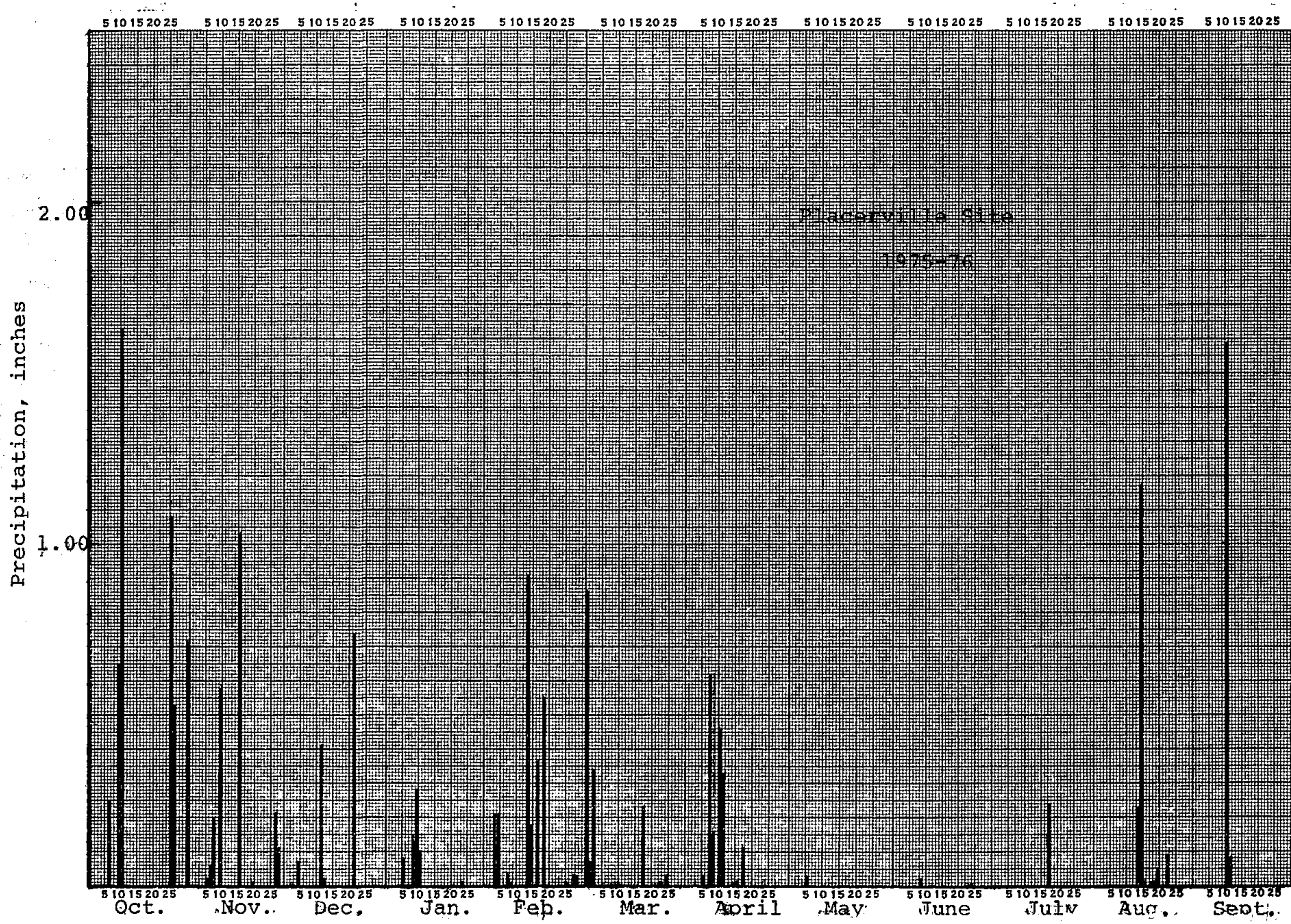

K+E 1 YEAR BY DAYS X 250 DIVNS. KEUFFEL & ESSER CO. CALENDAR YEAR
359-142 MADE IN U.S.A.
2.00
1.00
Precipitation, inches
Oct.
Nov.
Dec.
Jan.
Feb.
Mar
April
May
June
July
Aug.
Sept.

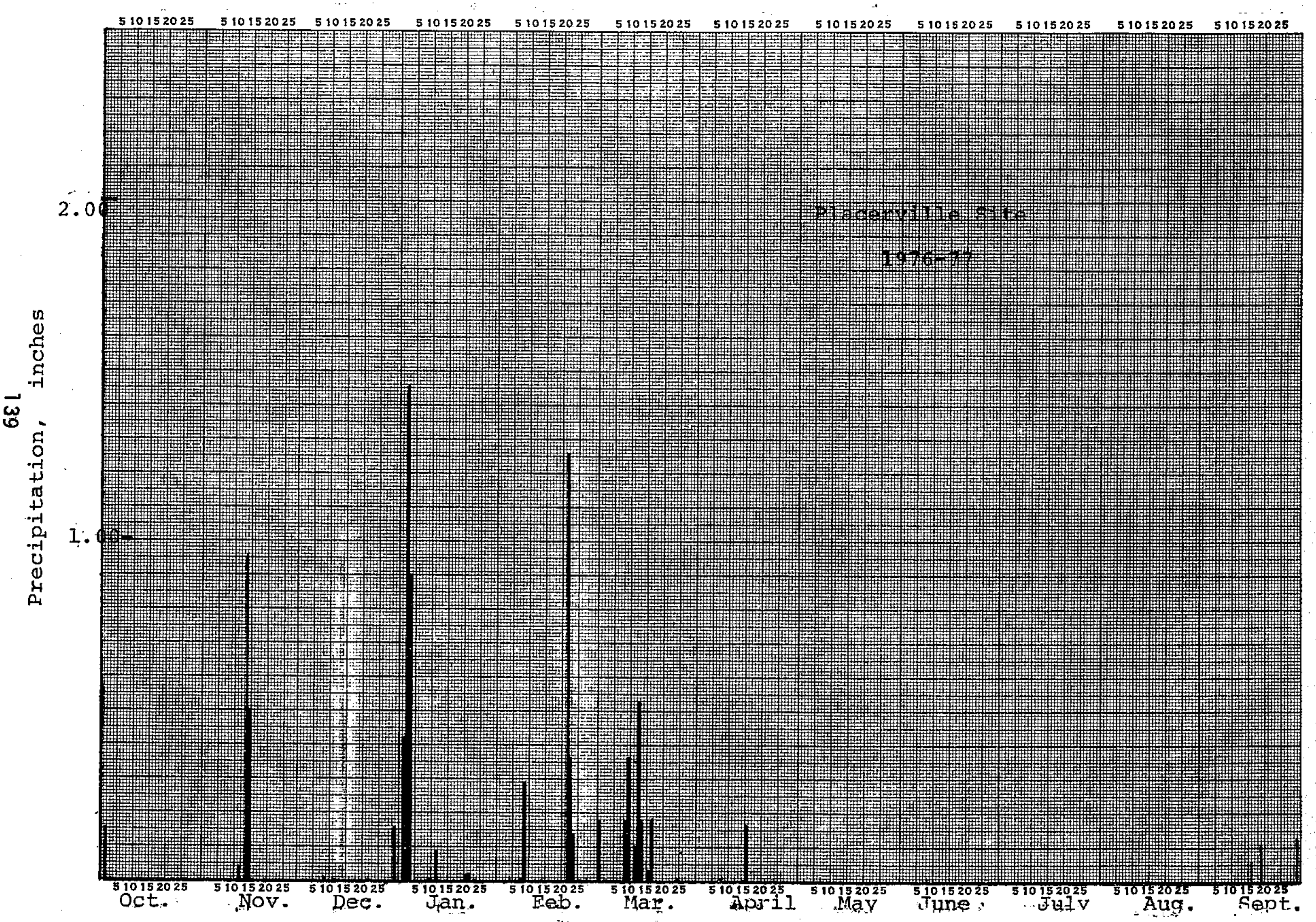

Walnut Creek Site
1976-77
Precipitation, inches
2.00
1.00
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.

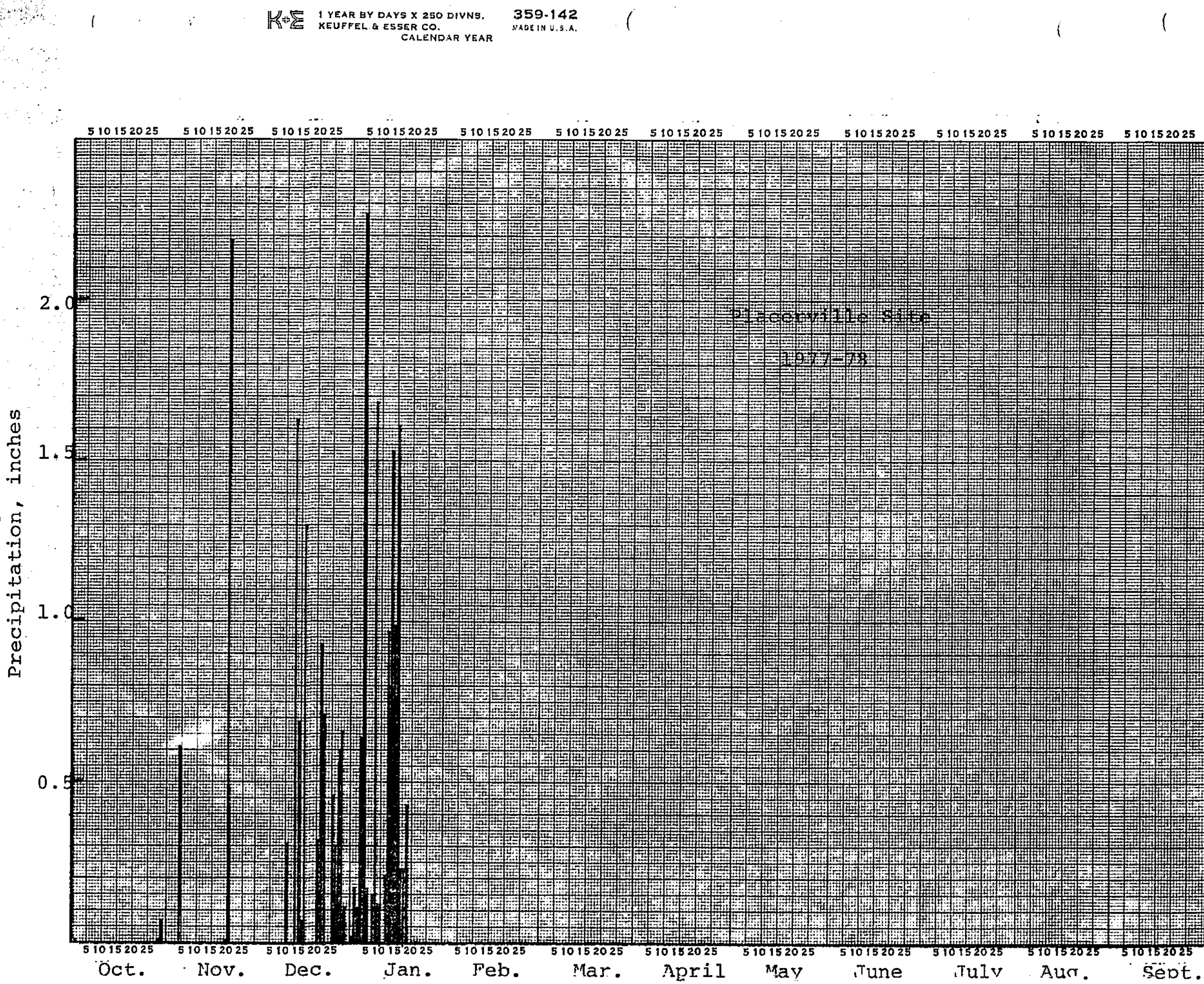

Walnut Creek Site
1977-78
3.27"
2.00
1.00
Precipitation, inches
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.



K+E 1 YEAR BY DAYS X 250 DIVNS. KEUFFEL & ESSER CO. CALENDAR YEAR
359-142
MADE IN U.S.A.
3.00"
Placerville Site
1974-75
2.00
1.00
Precipitation, inches
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.


Placerville Site
1975-76
Precipitation, inches
2.00
1.00
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.


Placerville Site
1976-77
2.00
1.00
Precipitation, inches
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.


K+E 1 YEAR BY DAYS X 250 DIVNS. KEUFFEL & ESSER CO. CALENDAR YEAR
359-142 MADE IN U.S.A.
Placerville Site
1977-78
Precipitation, inches
2.0
1.5
1.0
0.5
Oct.
Nov.
Dec.
Jan.
Feb.
Mar.
April
May
June
July
Aug.
Sept.