Hydrologic Monitoring Station Information Summary

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Coho and Steelhead Restoration Project
Point Reyes National Seashore

Introduction

Hydrologic monitoring stations were established in 1997 as part of the Coho Salmon and Steelhead Trout Restoration Project (CSRP). Campbell Scientific dataloggers, pressure Transducers from Instrumentation Northwest, Inc., and tipping rain gauges are installed on Redwood, Pine Gulch, and Olema Creeks. The fourth watershed in the CSRP study area is Lagunitas Creek, which is monitored by USGS. A record extending back through the 1960's is available for this site.

These stations are important to understanding hydrologic conditions within each watershed. The monitoring performed in WY1998 was very important to understanding the condition and response of these stream systems to major hydrologic events. While there was no catastrophic flooding, we did have an extended period of saturated conditions and storm events.

These stations are also important to establishing other types of baseline information. The Fixed-Station Monitoring of CSRP Streams project was funded though the USGS-NPS Clean Water Initiative. It is a three year project that will help define the ambient water quality conditions in the four project watersheds. Surface water samples will be collected every other month throughout the year, with an additional synoptic storm study. Sample collection will be performed by USGS personnel using National Water Quality Assessment Program (NAQWA) protocols. They will be analyzed for major ions, nutrients, dissolved organic carbon, suspended organic carbon, and total suspended sediment. In addition to the fixed sampling, a synoptic sediment sample will be conducted at each of the four sites to determine total sediment load (sediment and bedload) in the system.

Hydrologic information collected at the three CSRP sites includes water level and rainfall for each site. Initially, stations were set to record data at five-minute intervals. This became burdensome and the decision was made to run the stations at 15-minute intervals. The data files are organized into raw data, daily, hourly, and 15-minute intervals. Information for the Lagunitas Creek gage is available through the Ukiah Field Office. This includes mean daily flow and peak values. Unfortunately, Lagunitas Creek is a managed system, and the data cannot be used for most hydrologic comparisons.

The information packets for the three watersheds monitored through the CSRP include mean daily flows for WY 1998, rainfall discharge relationships in annual and monthly format, and rating curves that were used at different times over the period of record. This summary includes an explanation of conditions at each station and a brief summary of what we observed in the system.

The mean daily flow sheets are modeled after information published in USGS documents. The mean daily discharge was calculated using the appropriate rating and the average water level for the 24-hour period. This 24-hour mean is calculated by the data

logger in the field and recorded in a daily summary along with minimum and maximum water levels and rainfall over the same period of time. These were double-checked in the office using both 15-minute and one-hour summaries, and it was determined as accurate.

There are a number of Rainfall-Discharge hydrographs that were developed from the hourly data. Annual and monthly hydrographs include a summary of information within the graph. This data includes total rainfall, runoff converted into inches of water, and other monthly maximum information. Also included in these graphs is a line illustrating the level of bankfull discharge, adopted from Dunne and Leopold, 1978. All of the data and charts are stored in the Hydrology computer. Program descriptions are included in the individual site information.

There is also a significant amount of rainfall information. There are two plus years of hourly data for the Bear Valley weather site and monthly data going back to 1965. There are a number of other stations that have been maintained for one to three years. The data has been compiled and is stored in the hydrology computer.

Each station discharge monitoring location has some characteristics regarding the cross-section, quality of data, and other issues. These are discussed for each station.

WY1998 Summary

WY 1998 started out slowly, but lasted long into the spring, resulting in the second wettest in the thirty-year record of Point Reyes National Seashore. While there were no single events that defined the year, and caused catastrophic flooding, the long duration of saturated conditions did lead to large-scale events. November rains were timed well with the salmon run, and were a welcome relief after a very long dry period (February through September). December was unusually dry and by the new year, the flows in the streams were down to a few cfs.

Beginning in January rainfall totals were very high. By mid January the conditions were saturated and we were hit by the first major storm. While the Bear Valley gage recorded 3.15 inches of rain, a concentrated cell sat over the Hagmaiers area dropping 6.5 inches of rainfall within a 24-hour period. While there were data problems at Pine Gulch Creek monitoring site, we were able to sample over the peak, recording a flow of approximately 900 cfs (there was flooding upstream of the bridge). This flow was not exceeded in any of the February storms. In Redwood Creek, the flows from this event were equal to the February peaks.

In general, WY1998 was defined by the events that occurred in February. In Olema and Redwood Creeks, 47% and 46% of the total discharge occurred during that 28-day period. According to Bear Valley weather station records, February rainfall total of 24.68 inches was 450% of normal. Not only did this set a record for the month, but it exceeded any one-month total ever recorded since 1965.

Stream flow throughout the area was excessive. Olema Creek exceeded bankfull flow, a channel shaping flow with a normal recurrence interval of 1.5 years, on nine separate occasions during the month. In addition the mean daily flow in this creek for the month of February was 75% of the bankfull flow. The discharge for the month of February equaled 16,516 acre-feet. Based upon an area of 8064 acres, discharge accounted for 24.58 inches of runoff, or nearly 100% of the precipitation monitored at two points within the watershed.

Reports for Lagunitas Creek indicate a peak flow of over 10,000 cfs. This has only been exceeded once, in 1982. During one point, MMWD was releasing water over Kent Dam at a rate of 5,000 cfs, and we observed a full spillway draining the Nicasio Reservoir. Access to Pine Gulch and Redwood was cut off during the largest events, but as described, conditions on these two watersheds were not any worse than the January event.

These events significantly altered a number of stream channels. Aggradation in Pine Gulch Creek and Bear Valley Creek continue to threaten facilities. In Olema Creek, changes within the confining walls were also significant. Though no official post flood survey was performed to predict redd success in Olema Creek, it is estimated that at least 10-20% of the redds were either scoured or buried by changes within the channel.

Observation of these events has helped us understand the dynamics of the local systems, and how they might respond and recover from such events. I have had the chance to investigate many of the watersheds within the Seashore. In general, they have been dramatically affected by past land use activities. The damage is long lasting for two reasons. First, most of the watersheds are small, and average flows are not large enough to clear the systems of choking sediment or other impediments. Any flows that might accomplish such a feat would invariably bring a great number of new sources of sediment to the stream. This brings up the second issue. These are small watersheds, and most catastrophic rainfall events do impact the entire watershed. Landslides, while a part of a dynamic system, are devastating to the areas just downstream. In the case of a small stream, a major storm event could bring many major slides into the stream. In the case of just one slide, the biota could adjust, but with many slides, it is possible that the extent of the impacts could affect most of the habitat.

I cannot count the number of times we have been asked why the fish have declined, especially in the last thirty years. It seems that last year was important to helping unlock some of that mystery. Dave and I have gone over some of the issues and have tried to piece together what might have happened based upon historic rainfall, streamflow, and cultural records.

Pine Gulch and its loss of coho salmon are a pertinent example. The watersheds in this area have been heavily used, including agriculture and logging since the mid-1800s, but it was not until 1979 that we actually lost the population of coho. The last logging in the Pine Gulch watershed occurred in the 1950s. Sediment from the initial logging, and now from the residual roads continues to enter the system and foul spawning habitat in those

local areas. Winter flows move some of that sediment through the system, but is host to more sliding activity. In the mid-1960s there was major flooding, followed in the late 1970s with major drought. From all of the local reports, fish were quite abundant in the mid 1960s. What has happened since then?

We now have a very rough account of information pieced together from different sources that identifies some of the hazards faced during different years, and how that may have impacted smolt numbers. This includes drought and a record of flows that might potentially reduce redd success. In the case of Pine Gulch, the BPUD dam was maintained for two straight years, an intense blow to a weakened population of fish. The dam was taken out about the time of the last documented observation of fish.

WY 1998 was significant and should help us eventually piece together what might have occurred in the past. The summary of information that we have started will become very valuable as we begin collecting the information about fish and tying it to hydrologic data.

Olema Creek

Hydrology Summary

Olema Creek

Olema Creek has the most complete data set over the past year and a half. The site is located at the Bear Valley Road Bridge, and has been modified this year to make it flood proof. In February 1998, peaking flows reached 12.6 feet on the staff plate, and the datalogger was about to be flooded. We pulled it out, and have since replaced it farther up the slope.

The Olema cross-section is rather stable. There are changes in scour from year to year, but at higher flows the water is confined between the bridge abutments. The quality of the rating curve is good at high flows, but needs to be changed each year for the lower flows. In dealing with the data, I have found that two sets of rating curves are necessary. One curve is used when the flow covers only one-half of the channel bottom. The other curve is used once flow extends to both sides of the bridge abutment. After large events, the channel bottom changes, so flow measurements should be concentrated on these events.

Last year I took 6 high flow measurements ranging from 500 to 1500 cfs. The peak flow was calculated at 2500 cfs, which is a rather significant flow for this system. The rainfall data is collected at the Bear Valley Headquarters and maintained separately through Bill Shook. Comparisons between rainfall and peak discharge at the monitoring site indicate a lag time of approximately three hours.

Data from Olema Creek is compiled in d:/CSRP Hydro/OLM/Stream Flow. There are a number of files and flow calculation sheets for different tributaries of Olema Creek. Most of these measurements were made to figure out contribution from different tributaries. The rebar that was installed was lost during the large February events. The following is a list of files and what they contain.

d:/CSRP Hydro/OLM/Stream Flow/Olm/

OLM1997raw.xls – Raw data from 1997. This is organized by three categories, 5 or 15 minute interval summaries (111), one-hour summaries (222), and one-day summaries (333). These are sorted using the autofilter tool in excel. This is where all of the raw data, corrected for possible time errors or water level adjustments is stored. There is no other manipulation of this data.

OLM1998raw.xls – Raw data from 1997. This is organized by three categories, 5 or 15 minute interval summaries (111), one-hour summaries (222), and one-day summaries (333). These are sorted using the autofilter tool in excel. This is where all of the raw data, corrected for possible time errors or water level adjustments is stored. There is no other manipulation of this data.

OLM Flow Measurement.xls – This file contains all of the data used to correlate water level to discharge. There are a number of sheets in the file. On the summary sheet I have tried to identify different rate curves and the time periods that they were used. The calculation sheet is used to convert field measurements into a flow.

OLM1day.xls -- This includes all of the one-day summaries for the Olema Gage. The sheet 333 has all of the data with columns to convert water level to discharge. There are also minimum and maximum water levels that can be converted to flow using the same formula.

WY1998 is the mean daily flow sheet for 1998, and WY1999 is the same for this WY. I have also created daily rainfall sheets to summarize the rainfall information. These sheets are labeled Rain WY19**.

OLM1hr.xls -- This includes all of the one-hour summaries for the Olema gage. The sheet 222 has all of the data and columns for calculating hourly discharge rates and volumes in acre-feet. I have also pasted in the hourly rainfall data for ease of calculation in the summary section.

There are a great number of charts that are monthly rainfall-discharge curves. These were developed from the 1-hour data so they are pretty detailed. This file contains a bulk of the information in the packet.

OLM5minute -- This has not been maintained. I found that 5-minute data was a bit much to deal with so in June I scaled it back to 15-minute recording intervals… In other watersheds you could get 5-minute rainfall intensities, but the BVY rain gage only records on 1-hour intervals.

Questa Olemadaily.xls -- Mean daily flow data collected from 1986-1989 by Questa Engineering is provided. These were pretty dry years… ~60 % of normal rainfall.

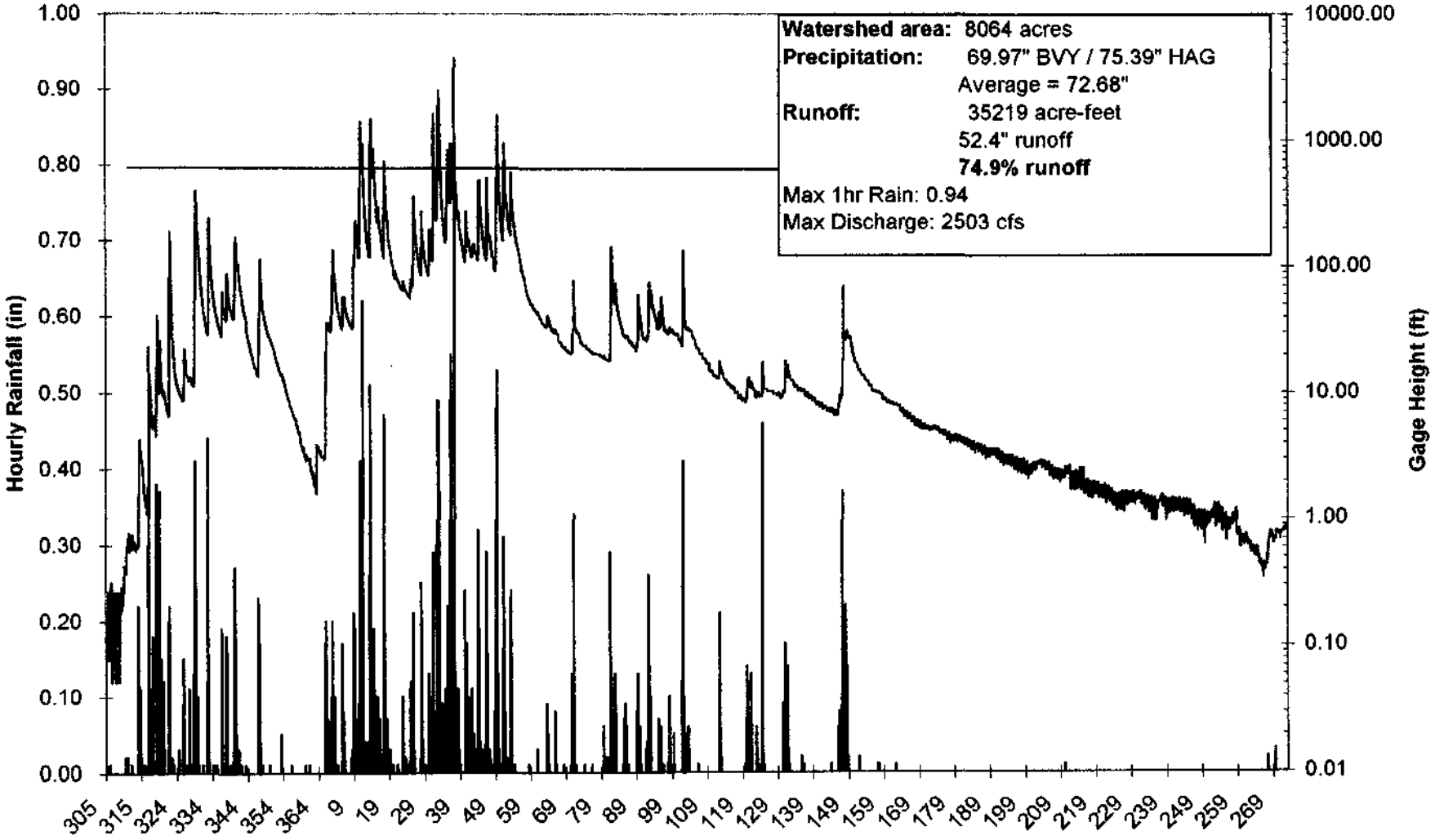
Olema Creek

Average Daily Flow

	October	November	December	January	February	March	April	May	June	July	August	September
1		0.49	51.2	3.5	525.5	48.9	30.8	11.7	16.4	4.2	2.1	1.3
2		0.49	36.7	30.9	1199.3	44.4	27.0	11.4	14.6	4.1	2.1	1.3
3		0.49	38.2	40.6	1339.6	39.9	50.2	10.1	13.3	3.9	2.1	1.2
4		0.49	41.8	86.3	203.8	35.2	50.7	9.9	12.2	3.8	1.9	1.1
6		0.49	59.4	45.2	593.8	36.7	36.8	9.9	11.2	3.7	1.8	1.0
6		0.51	42.6	38.4	818.7	34.1	40.5	10.2	10.4	3.6	1.7	1.0
7		0.66	93.5	48.4	733.6	31.1	38.2	10.3	10.2	3.5	1.8	0.9
8	*0.57*	0.66	87.0	37.6	283.2	28.9	30.8	9.7	9.5	3.4	1.7	1.0
9	*0.55*	0.63	51.7	42.7	154.9	24.7	31.4	9.7	8.9	3.4	1.7	1.1
10	*0.52*	2.79	34.6	171.7	162.0	22.9	30.4	9.7	8.5	3.4	1.6	1.1
11	*0.50*	2.19	24.3	423.1	154.1	21.6	28.6	10.0	8.3	3.2	1.5	1.1
12	*0.45*	1.78	18.8	608.5	137.2	23.4	27.1	15.2	8.1	3.0	1.5	1.0
13	*0.42*	8.19	15.5	191.0	127.4	38.3	49.3	13.5	7.6	3.0	1.4	0.9
14	*0.41*	5.81	57.6	579.8	346.4	29.0	32.2	12.0	7.1	3.0	1.4	0.9
15	*0.40*	13.0	42.5	663.0	176.9	24.6	30.1	11.1	6.7	2.8	1.4	1.0
16	*0.39*	13.1	32.2	275.8	223.6	23.4	25.3	10.8	6.4	2.7	1.5	0.8
17	*0.41*	9.5	27.2	178.8	168.0	22.1	21.9	10.2	6.0	2.7	1.5	0.8
18	*0.43*	9.2	22.3	285.8	107.5	21.3	19.9	9.7	5.8	2.6	1.5	0.7
19	*0.44*	61.7	17.9	207.4	938.4	21.0	18.2	9.3	5.6	2.5	1.5	0.7
20	*0.43*	14.4	15.3	118.6	285.8	20.1	15.0	8.8	5.4	2.5	1.5	0.6
21	*0.44*	10.7	13.0	87.4	563.6	19.4	14.5	8.3	5.3	2.6	1.4	0.6
22	*0.44*	9.3	10.6	76.5	288.7	18.6	13.6	7.9	5.3	2.8	1.3	0.6
23	*0.45*	16.7	8.9	70.3	341.7	48.4	15.3	7.6	5.3	2.8	1.3	0.4
24	*0.46*	13.0	7.7	66.4	209.3	63.8	13.9	7.4	5.1	2.7	1.3	0.4
26	*0.45*	12.4	6.6	60.2	131.6	48.7	12.3	7.2	4.9	2.5	1.3	0.6
26	*0.44*	207.6	5.6	134.3	93.7	34.6	11.5	7.0	4.7	2.4	1.4	0.8
27	*0.45*	96.9	5.2	164.5	70.5	28.8	10.7	8.8	4.5	2.3	1.3	0.7
28	*0.45*	46.2	4.9	98.5	55.2	27.3	9.9	30.9	4.4	2.3	1.3	0.8
29	*0.46*	50.0	4.4	158.8		24.9	9.3	28.6	4.4	2.3	1.3	0.8
30	*0.47*	116.1	3.8	99.0		22.9	8.9	26.0	4.3	2.4	1.3	0.9
31	*0.48*		3.4	136.1		39.0		19.5		2.3	1.3	
TOTAL	**10.9**	**725.8**	**884.6**	**5229.3**	**10434.1**	**967.9**	**754.3**	**372.5**	**230.3**	**92.3**	**47.8**	**26.0**
MEAN	**0.45**	**24.2**	**28.5**	**168.7**	**372.6**	**31.2**	**25.1**	**12.0**	**7.7**	**3.0**	**1.5**	**0.9**
MAX	**0.6**	**207.6**	**93.5**	**663.0**	**1339.6**	**63.8**	**50.7**	**30.9**	**16.4**	**4.2**	**2.1**	**1.3**
MIN	**0.4**	**0.5**	**3.4**	**3.5**	**55.2**	**18.6**	**8.9**	**7.0**	**4.3**	**2.3**	**1.3**	**0.4**
AC-FT	**29**	**1501**	**1599**	**10631**	**16516**	**1935**	**1503**	**748**	**456**	**183**	**95**	**52**
PEAK FLOW		**401**	**174**	**1525**	**2503**	**149**	**149**	**80**	**18**	**5**	**2**	**1**
CAL YR												
WTR YR	**35248**											

Water Year 1998

Olema Creek Rainfall-Runoff
November 1997-September 1998



0lema Creek

Average Daily Flow

	October	November	December	January	February	March	April	May	June	July	August	September
1	1.0	1.58	61.7									
2	1.0	1.35	63.1									
3	0.8	1.35	131.9									
4	0.8	1.63	54.1									
5	1.0	1.56	42.0									
6	10	1.80	46.8									
7	10	4.94	29.6									
8	1 3	3.19	23.7									
9	13	2.31	18.2									
10	10	2.23	14.6									
11	1.0	2.26	12.7									
12	1.3	1.77	10.7									
13	1.3	1.68	10.8									
14	1.0	1.77										
15	0.9	1.9										
16	1 .2	2.0										
17	1 .1	2.6										
18	1 .1	1.9										
19	1 .3	1 .8										
20	1 .2	1 .8										
21	1.1	2.1										
22	1.1	2.9										
23	1.1	8.3										
24	4.1	6.7										
25	2.2	4.3										
26	1 .6	4.2										
27	1.5	4.3										
28	1 .6	3.6										
29	1.5	71.6										
30	1.3	139.8										
31	1.3											
TOTAL	**39.9**	**289.2**	**520.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
MEAN	**1.29**	**9.6**	**40.0**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
MAX	**4.1**	**139.8**	**131.9**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
MIN	**0.8**	**1.3**	**10.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
AC-FT	**83**	**610**										
PEAK FLOW	**3**	**216**										
CAL YR												
WTR YR	**693**											

Water Year 1999

BVY Monthly Summary

WY1997
Bear Valley Headquarters WEAX Station
UTM Coordinates **517821.71**
4210553.67

	WY1997	BVY Normal	Annual %	% of Normal
Jul	0.000	0.110	0%	0%
Aug	0.000	0.112	0%	0%
Sep	0.150	0.367	1%	41%
Oct	1.380	2.110	6%	65%
NOV	4.500	5.281	14%	85%
Dec	16.090	6.444	17%	250%
Jan	12.610	8.800	23%	143%
Feb	0.470	5.657	15%	8%
Mar	1.090	5.529	15%	20%
Apr	0.000	2.378	6%	0%
May	0.000	0.781	2%	0%
Jun	0.000	0.156	0%	0%
	36.290	37.726	100%	96%

WY1998
Bear Valley Headquarters WEAX Station
UTM Coordinates **517821.71**
4210553.67

	WY1998	BVY Normal	difference	% of Normal
Oct	2.84	2.11	0.73	135%
NOV	10.31	5.26	5.05	196%
Dec	3.48	6.78	-3.30	51%
Jan	17.99	8.93	9.06	201%
Feb	24.68	5.48	19.20	450%
Mar	4.56	5.38	-0.82	85%
Apr	3.59	2.34	1.25	154%
May	5.19	0.77	4.42	675%
Jun	0.06	0.17	-0.11	36%
Jul	0.03	0.11	-0.08	28%
Aug	0	0.15	-0.15	0%
Sep	0	0.37	-0.37	0%
	72.70	37.84	34.86	192%

Bear Valley Rainfall

Daily Rainfall

	October	November	December	January	February	March	April	May	June	July	August	September
1	-	0.00	0.31	3.51	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2	-	0.01	0.01	1.10	0.01	1.03	0.00	0.00	0.00	0.00	0.00	0.00
3	-	0.00	0.00	0.00	0.07	0.05	0.00	0.00	0.45	0.00	0.00	0.00
4	-	0.00	1.97	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00
5	-	0.00	1.22	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
6	-	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	-	0.00	0.08	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
8	-	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	-	0.00	1.25	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
10	-	0.00	1.67	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	-	0.00	1.43	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	*0.00*	0.00	0.44	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
13	*0.00*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	*0.00*	0.00	0.01	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.40
15	*0.00*	0.00	0.00	0.15	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01
16	*0.00*	1.55	0.01	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
17	*0.00*	1.07	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.01
18	*0.10*	0.19	0.00	0.00	0.00	0.00	0.90	0.00	0.00	0.00	0.00	0.00
19	*0.00*	1 03	0.01	0.02	0.03	0.00	0.05	0.00	0.00	0.00	0.69	0.00
20	*0.00*	0.08	0.48	0.08	0.01	0.00	0.01	0.01	0.00	0.00	0.71	0.00
21	*0.00*	0.17	2.23	0.22	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01
22	*0.00*	0.26	0.10	3.04	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00
23	*0.00*	0.00	0.00	0.01	0.01	0.00	0.01	0.37	0.00	0.00	0.00	0.00
24	*0.14*	0.00	0.01	0.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
25	*0.00*	0.00	0.01	1.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
26	*0.00*	0.00	1.60	1.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	*0.00*	0.01	0.12	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	*0.07*	0.04	0.06	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
29	*0.98*	0.00	1.60	0.01		0.00	0.00	0.00	0.00	0.00	0.00	0.00
30	*0.09*	0.08	0.78	0.01		0.00	0.00	0.00	0.00	0.00	0.00	0.00
31	*0.00*	0.0	0.68	0.03		0.00		000		000	0.00	
TOTAL	**1.38**	**4.50**	**16.09**	**12.61**	**0.47**	**1.09**	**1.11**	**0.38**	**0.45**	**0.00**	**1.40**	**0.43**
MEAN	**0.07**	**0.15**	**0.52**	**0.41**	**0.02**	**0.04**	**0.04**	**0.01**	**0.02**	**0.00**	**0.05**	**0.01**
MAX	**0.98**	**1.55**	**2.23**	**3.51**	**0.13**	**1.03**	**0.90**	**0.37**	**0.45**	**0.00**	**0.71**	**0.40**
MIN	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max 1hr	**0.29**	**0.42**	**0.42**	**0.97**	**0.07**	**0.40**	**0.18**	**0.18**	**0.14**	**0.00**	**0.46**	**0.16**
CAL YR												
WTR YR	**39.91**											

Water Year 1997

Bear Valley Rainfall

Daily Rainfall

	October	November	December	January	February	March	April	May	June	July	August	September
1	*0.36*	0.01	0.01	0.52	1.26	0.00	0.01	0.64	0.02	0.00	0.00	0.00
2	*0.00*	0.01	0.01	0.64	4.19	0.08	0.14	0.19	0.00	0.00	0.00	0.00
3	*0.01*	0.00	0.63	0.70	1.36	0.00	0.97	0.09	0.00	0.00	0.00	0.00
4	*0.00*	0.00	0.27	0.18	0.46	0.00	0.00	0.04	0.00	0.00	0.00	0.00
5	*0.00*	0.00	0.21	0.01	1.71	0.49	0.00	0.86	0.00	0.00	0.00	0.00
6	*0.01*	0.04	0.03	0.57	2.47	0.01	0.33	0.00	0.00	0.00	0.00	0.00
7	*0.00*	0.03	1.12	0.10	2.32	0.19	0.01	0.00	0.03	0.00	0.00	0.00
8	*1.78*	0.01	0.15	0.00	0.30	0.01	0.05	0.00	0.00	0.00	0.00	0.00
9	*0.48*	0.00	0.01	0.84	0.01	0.00	0.20	0.00	0.00	0.00	0.00	0.00
10	*0.12*	0.91	0.01	0.82	0.87	0.01	0.06	0.00	0.00	0.00	0.00	0.00
11	*0.00*	0.04	0.03	0.57	2.47	0.01	0.33	0.00	0.00	0.00	0.00	0.00
12	*0.00*	0.03	1.12	0.10	2.32	0.19	0.01	0.00	0.03	0.00	0.00	0.00
13	*0.00*	0.01	0.15	0.00	0.30	0.01	0.05	0.00	0.00	0.00	0.00	0.00
14	*0.00*	0.00	0.01	0.84	0.01	0.00	0.20	0.00	0.00	0.00	0.00	0.00
15	*0.00*	0.91	0.01	0.82	0.87	0.01	0.06	0.00	0.00	0.00	0.00	0.00
16	*0.01*	0.74	0.00	0.52	1.06	0.01	0.00	0.02	0.00	0.00	0.00	0.00
17	*0.01*	0.29	0.02	0.12	0.11	0.00	0.01	0.01	0.00	0.00	0.00	0.00
18	*0.00*	1.02	0.00	1.45	0.27	0.01	0.00	0.00	0.00	0.00	0.00	0.00
19	*0.00*	0.07	0.00	0.32	2.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	*0.00*	0.01	0.05	0.12	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	*0.00*	0.04	0.00	0.00	1.80	0.08	0.00	0.00	0.00	0.00	0.00	0.00
22	*0.00*	0.37	0.00	0.01	0.06	0.03	0.00	0.00	0.00	0.00	0.00	0.00
23	*0.00*	0.01	0.01	0.36	1.25	1.16	0.54	0.00	0.00	0.00	0.00	0.00
24	*0.00*	0.16	0.00	0.04	0.01	0.37	0.00	0.01	0.00	0.00	0.00	0.00
25	*0.00*	0.45	0.00	0.35	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.05
26	*0.00*	1.62	0.00	0.71	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00
27	*0.00*	0.01	0.01	0.02	0.00	0.22	0.00	0.40	0.00	0.00	0.00	0.03
28	*0.00*	0.01	0.01	0.48	0.01	0.07	0.00	1.28	0.00	0.00	0.00	0.00
29	*0.01*	1.09	0.00	0.42		0.00	0.00	0.73	0.00	0.00	0.00	0.00
30	*0.00*	0.02	0.00	0.01		0.13	0.02	0.00	0.00	0.03	0.00	0.00
31	*0.04*		0.00	0.56		0.79		0.00		0.00	0.00	
TOTAL	**2.84**	**10.31**	**3.48**	**17.99**	**24.68**	**4.56**	**3.59**	**5.19**	**0.06**	**0.03**	**0.00**	**0.08**
MEAN	**0.09**	**0.34**	**0.11**	**0.58**	**0.88**	**0.15**	**0.12**	**0.17**	**0.00**	**0.00**	**0.00**	**0.00**
MAX	**1.78**	**1.63**	**1.12**	**3.15**	**4.19**	**1.16**	**0.97**	**1.28**	**0.03**	**0.03**	**0.00**	**0.05**
MIN	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max 1hr	**0.45**	**0.56**	**0.27**	**0.62**	**0.94**	**0.34**	**0.41**	**0.46**	**0.02**	**0.02**	**0.00**	**0.03**
CAL YR												
WTR YR	**72.81**											

Water Year 1998

Bear Valley Rainfall

Daily Rainfall

	October	November	December	January	February	March	April	May	June	July	August	September
1	0.00	0.05	0.00									
2	0.00	0.00	1.12									
3	0.00	0.01	0.39									
4	0.00	0.00	0.00									
5	0.00	0.00	0.70									
6	0.00	0.14	0.00									
7	0.00	1 .16										
8	0.01	0.31										
9	0.00	0.01										
10	0.00	0.11										
11	0.00	0.01										
12	0.00	0.01										
13	0.00	0.00										
14	0.00	0.01										
15	0.01	0.08										
16	0.00	0.00										
17	0.00	0.11										
18	0.00	0.01										
19	0.00	0.02										
20	0.00	0.00										
21	0.00	0.03										
22	0.00	0.30										
23	0.00	1.08										
24	1.36	0.29										
25	m	0.00										
26	m	0.00										
27	m	0.35										
28	m	0.01										
29	m	1.80										
30	m	1.32										
31	m											
TOTAL	**1.38**	**7.22**	**2.21**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
MEAN	**0.06**	**0.24**	**0.37**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
MAX	**1.36**	**1.80**	**1.12**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
MIN	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max 1hr	**0.49**	**0.40**										
CAL YR												
WTR YR	**10.81**											

Water Year 1999

Hagmaiers Rainfall

Daily Rainfall

	October	November	December	January	February	March	April	May	June	July	August	September
1	*0.00*	0.10	0.01									
2	*0.00*	0.00	1.99									
3	*0.00*	0.02	0.50									
4	*0.00*	0.00	0.00									
5	*0.00*	0.00	0.77									
6	*0.00*	0.26	0.00									
7	*0.00*	1.27	0.07									
8	*0.01*	0.31	0.08									
9	*0.00*	0.01	0.00									
10	*0.00*	0.11	0.00									
11	*0.00*	0.01	0.00									
12	*0.00*	0.01	0.00									
13	*0.00*	0.00	0.27									
14	*0.00*	0.01										
15	*0.01*	0.08										
16	*0.00*	0.31										
17	*0.00*	0.72										
18	*0.00*	0.00										
19	*0.00*	0.00										
20	*0.00*	0.00										
21	*0.00*	0.44										
22	*0.00*	0.03										
23	*0.00*	1.67										
24	*1.93*	0.20										
25	*0.00*	0.00										
26	*0.00*	0.33										
27	*0.00*	0.01										
28	*0.00*	0.01										
29	*0.00*	4.11										
30	*0.00*	1.34										
31	*0.00*											
TOTAL	**1.95**	**11.36**	**3.69**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
MEAN	**0.06**	**0.38**	**0.28**	**#DIV/0!**	**#DIV/OI**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
MAX	**1.93**	**4.11**	**1.99**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
MIN	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max 1hr	**0.59**	**0.76**										
CAL YR												
WTR YR	**17.00**											

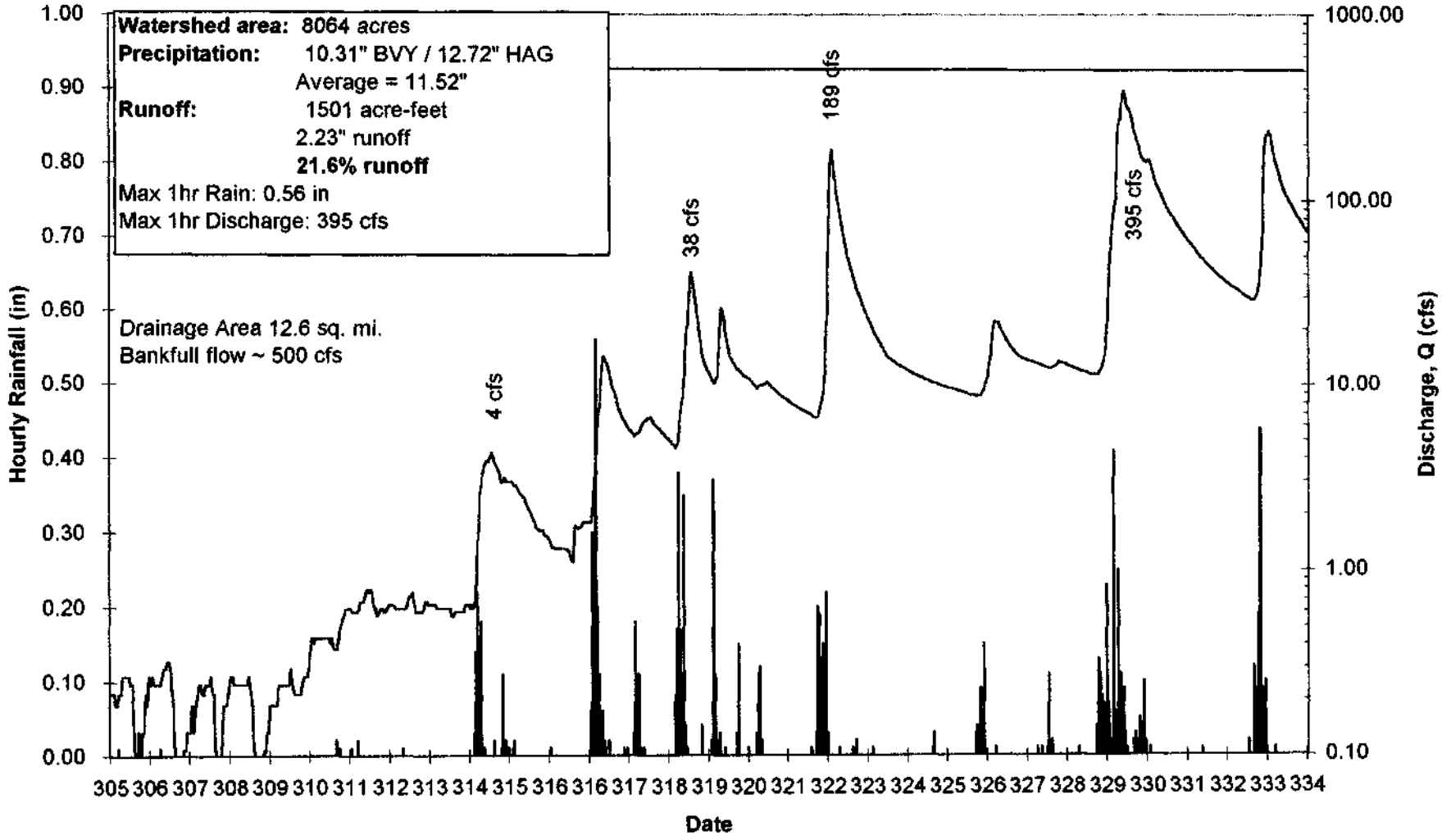
Water Year 1999

Olema Creek
Watershed area: 8064 acres

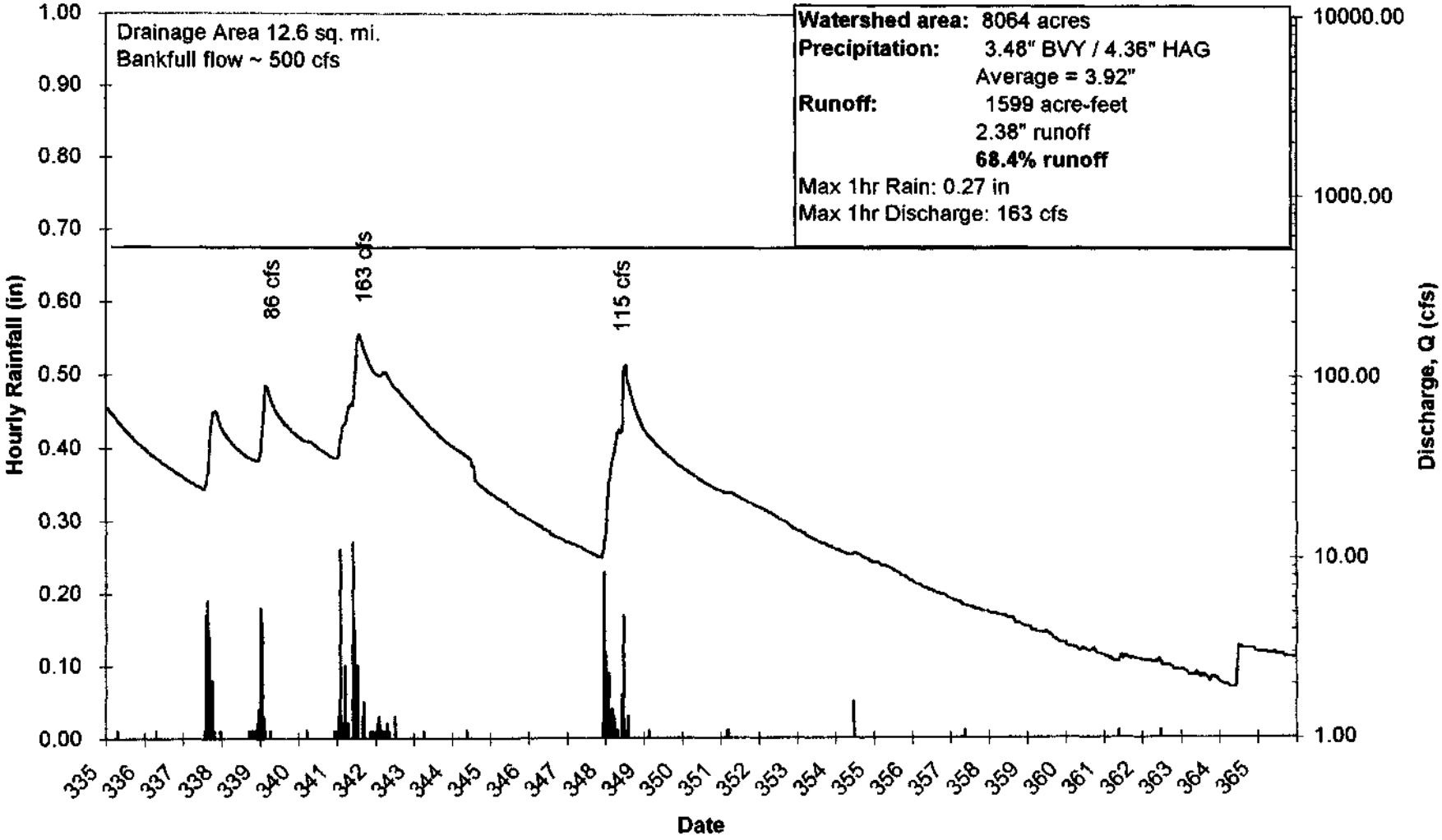
	Mean WL ft	Mean Daily Discharge, Q cfs	Max Discharge cfs	Min Discharge cfs	Runoff* Acre-feet	Runoff* in	Precipitation: BVY in	HAG in	Average in	Max 1 hr BVY in	% runoff**
97 October							2.84		2.84		
97 November	1.81	12.19	401	0.4	1501	2.23	10.31	12.72	11.52	0.56	19.4%
97 December	2.01	27.04	174	3.3	1599	2.38	3.48	4.36	3.92	0.27	60.7%
98 January	3.12	143.64	1525	3.3	10631	15.82	17.99	25.24	21.62	0.62	73.2%
98 February	3.91	271.30	2503	49	16516	24.58	24.68	24.01	24.35	0.94	101.0%
98 March	2.19	30.05	149	17	1935	2.88	4.56	4.82	4.69	0.34	61.4%
98 April	2.1	23.36	149	8.5	1503	2.24	3.59	3.37	3.48	0.41	64.3%
98 May	1.9	11.37	80	6.5	748	1.11	5.19	5.24	5.22	0.46	21.3%
98 June	1.81	7.27	18	4	456	0.68	0.06	0.10	0.08	0.01	storage
98 July	1.69	3.04	5	0.5	183	0.27	0.03	0.05	0.04	0.01	storage
98 August	1.63	1.46	2	0.5	95	0.14	0.00	0.00	0.00	0	storage
98 September	1.6	0.81	1.4	0.5	52	0.08	0.08	0.10	0.09	0.01	storage
98 October	1.62	1.23	3	0.81	83	0.12	1.38	1.93	1.66	0.49	7.5%
98 November			216	2	610	0.91	7.22	11.36	9.29	0.4	9.8%
98 December						0.00			#DIV/0!		#DIV/0!
99 January						0.00			#DIV/0!		#DIV/0!
99 February						0.00			#DIV/0!		#DIV/0!
99 March						0.00			#DIV/0!		#DIV/0!
99 April						0.00			#DIV/0!		#DIV/0!
99 May						0.00			#DIV/0!		#DIV/0!
99 June						0.00			#DIV/0!		#DIV/0!
99 July						0.00			#DIV/0!		#DIV/0!
99 August						0.00			#DIV/0!		#DIV/0!
99 September						0.00			#DIV/0!		#DIV/0!
99 October						0.00			#DIV/0!		#DIV/0!
99 November						0.00			#DIV/0!		#DIV/0!
99 December						0.00			#DIV/0!		#DIV/0!

* calculated from hourly data
** summer runoff comes from storage

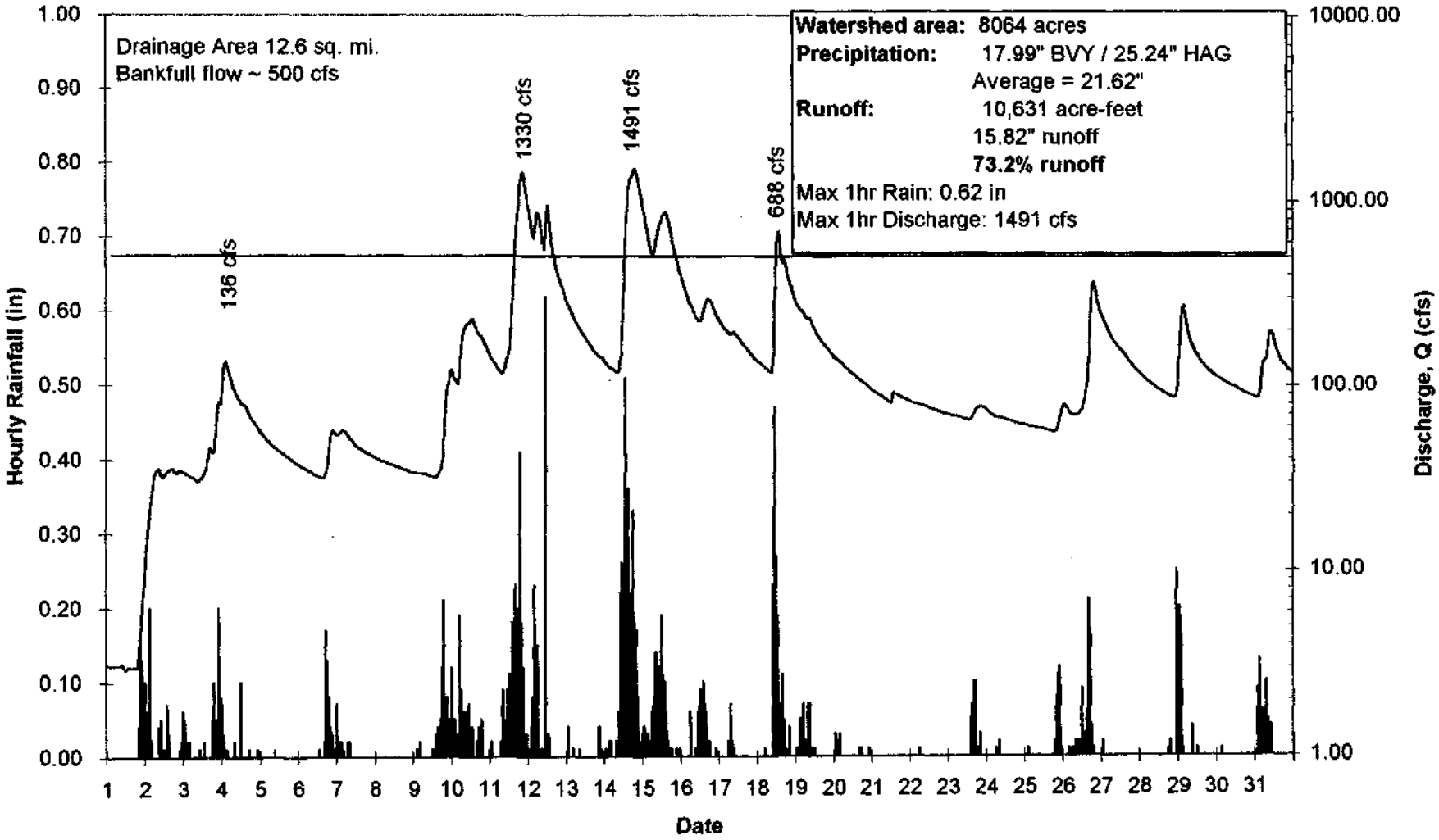
Olema Creek Rainfall-Discharge
November 1997



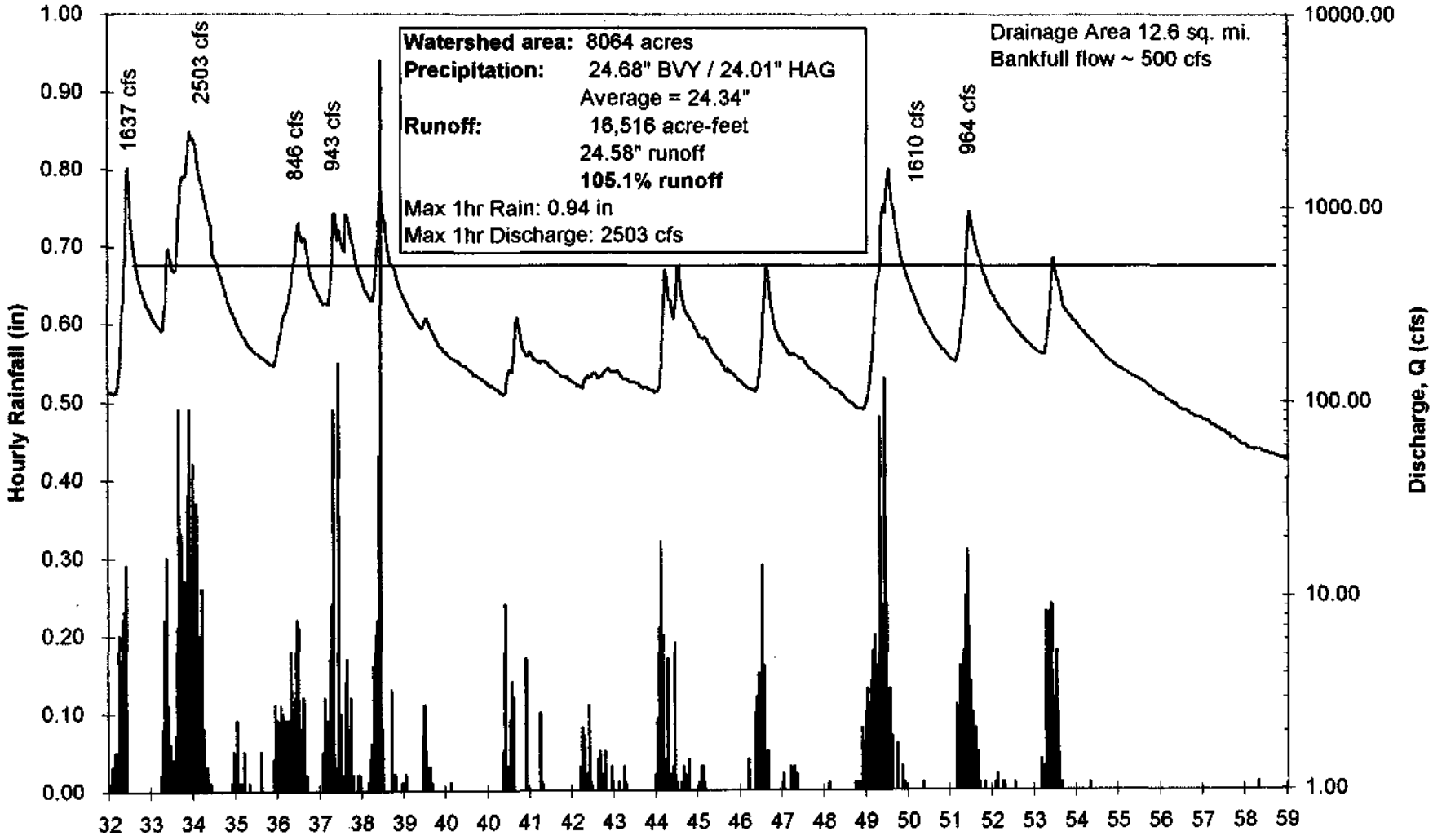
Olema Creek Rainfall-Discharge
December 1997



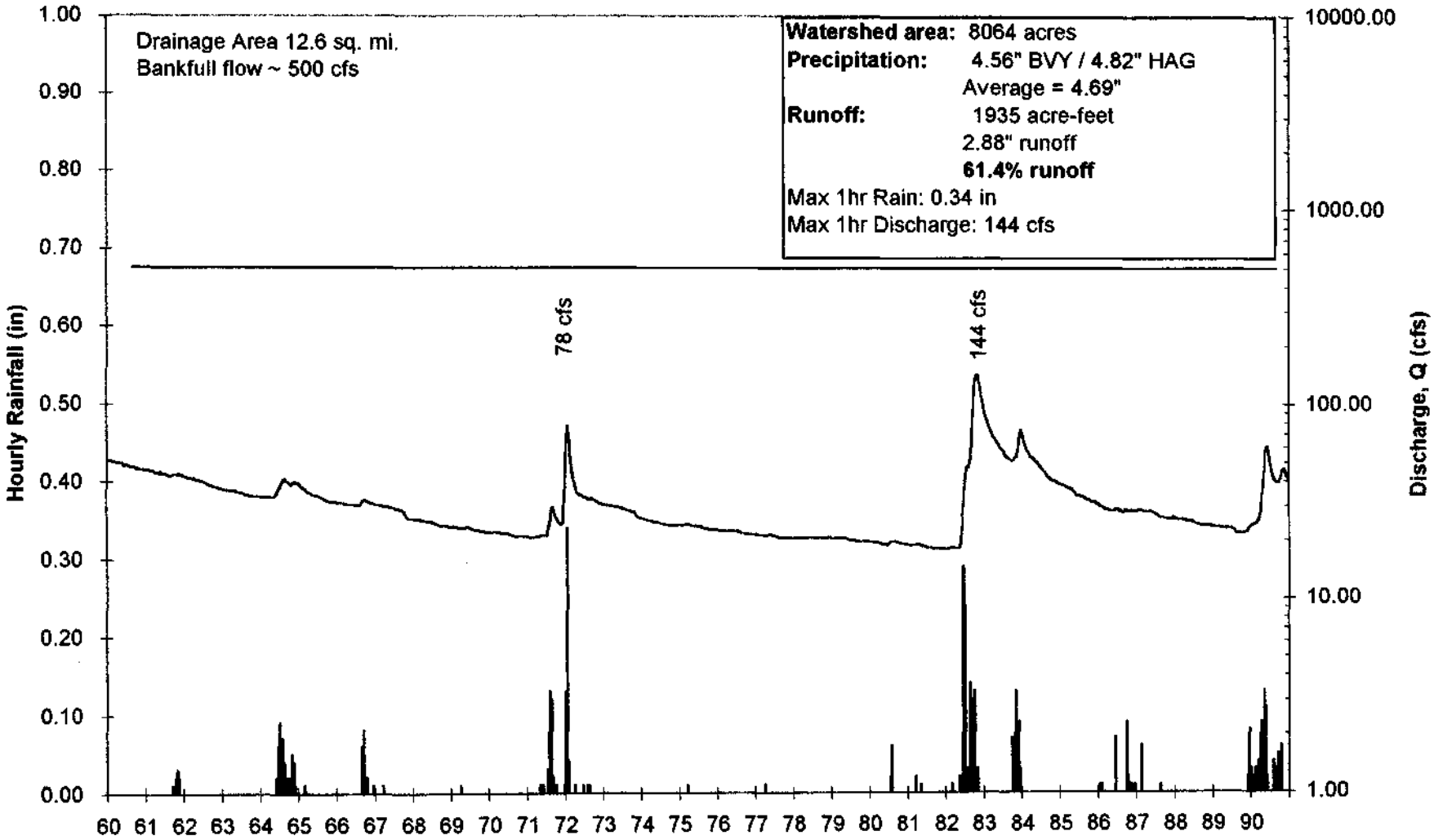
Olema Creek Rainfall-Discharge
January 1998



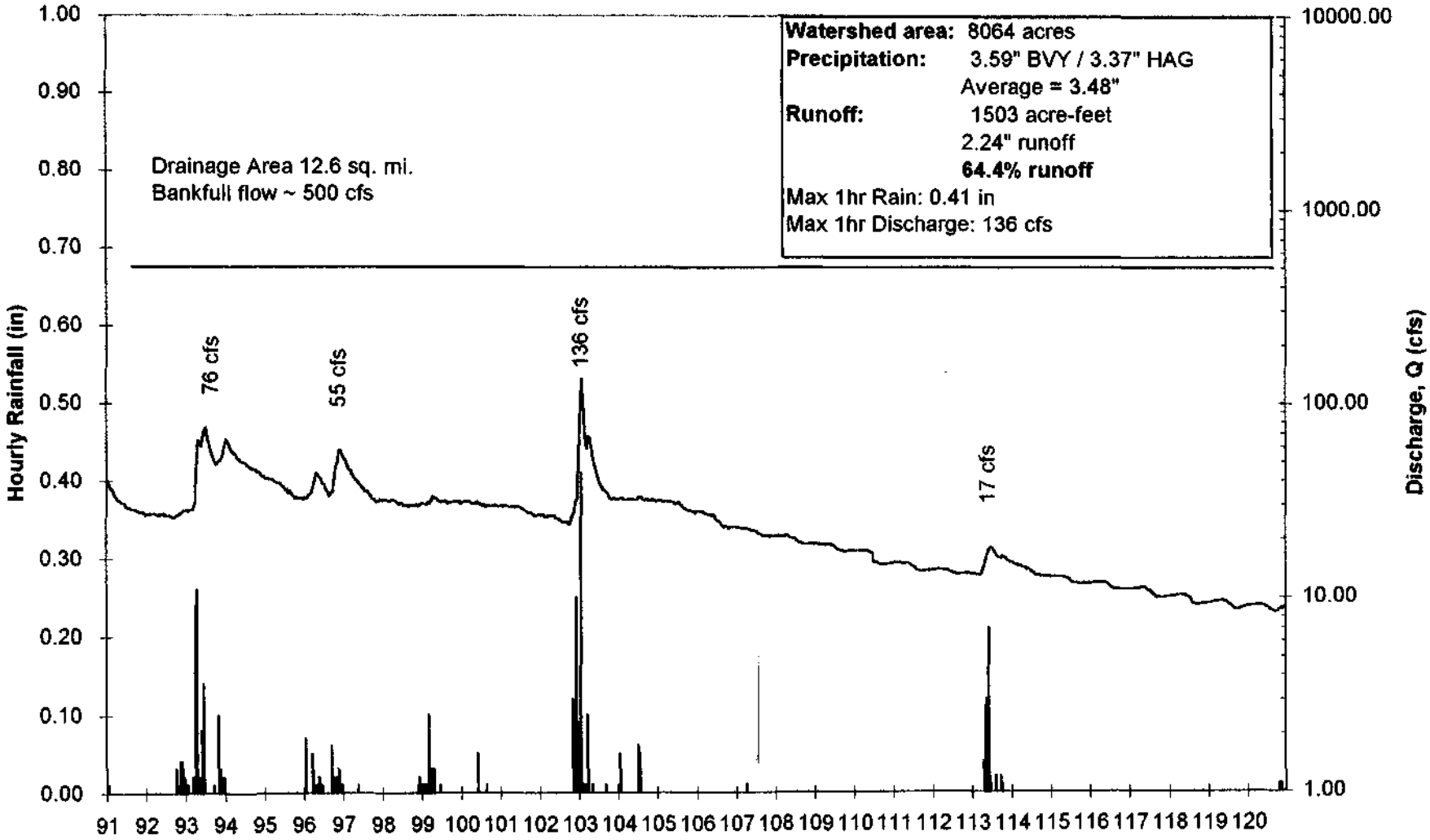
Olema Creek Rainfall-Discharge
February 1998



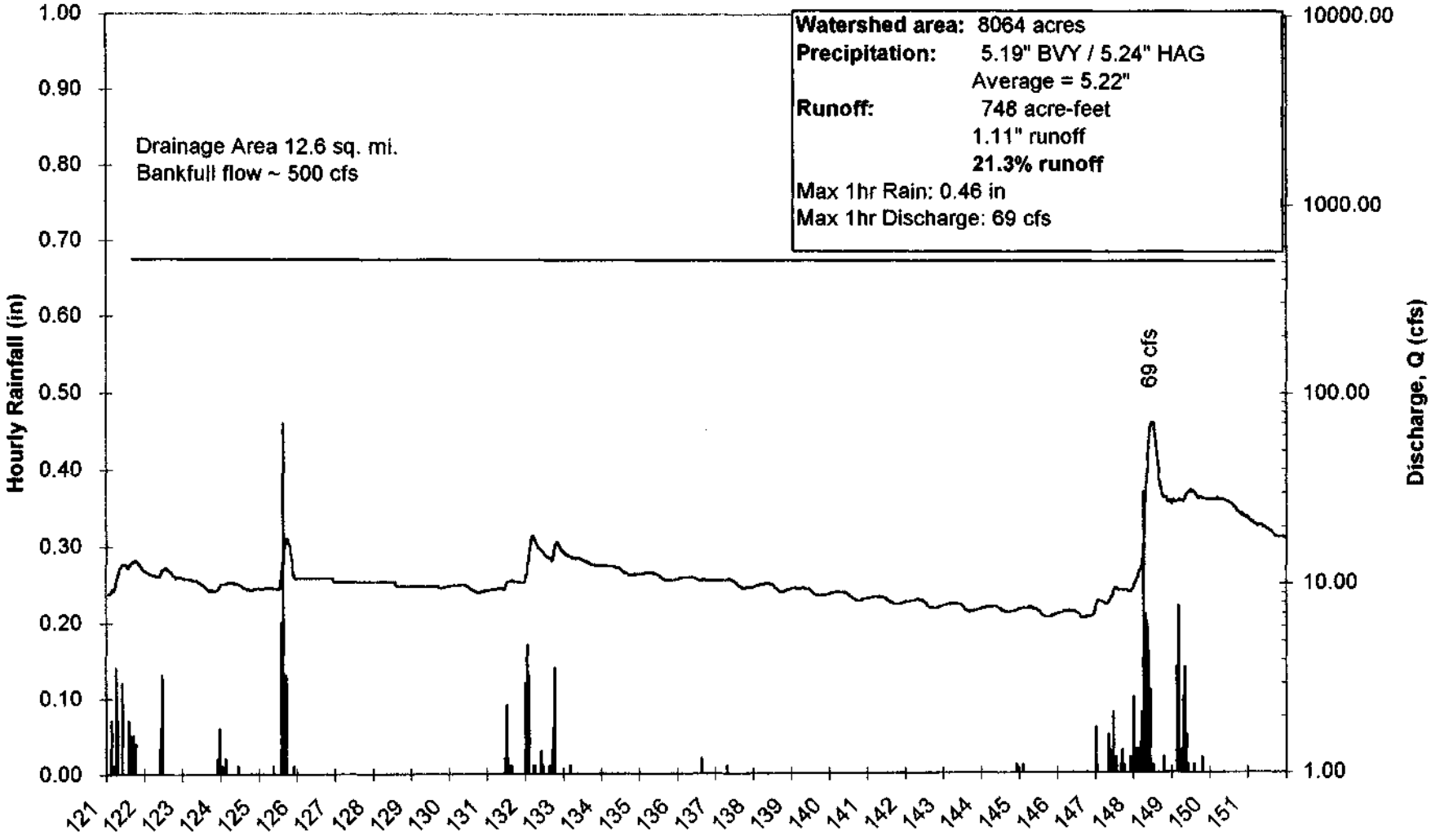
Olema Creek Rainfall-Discharge
March 1998



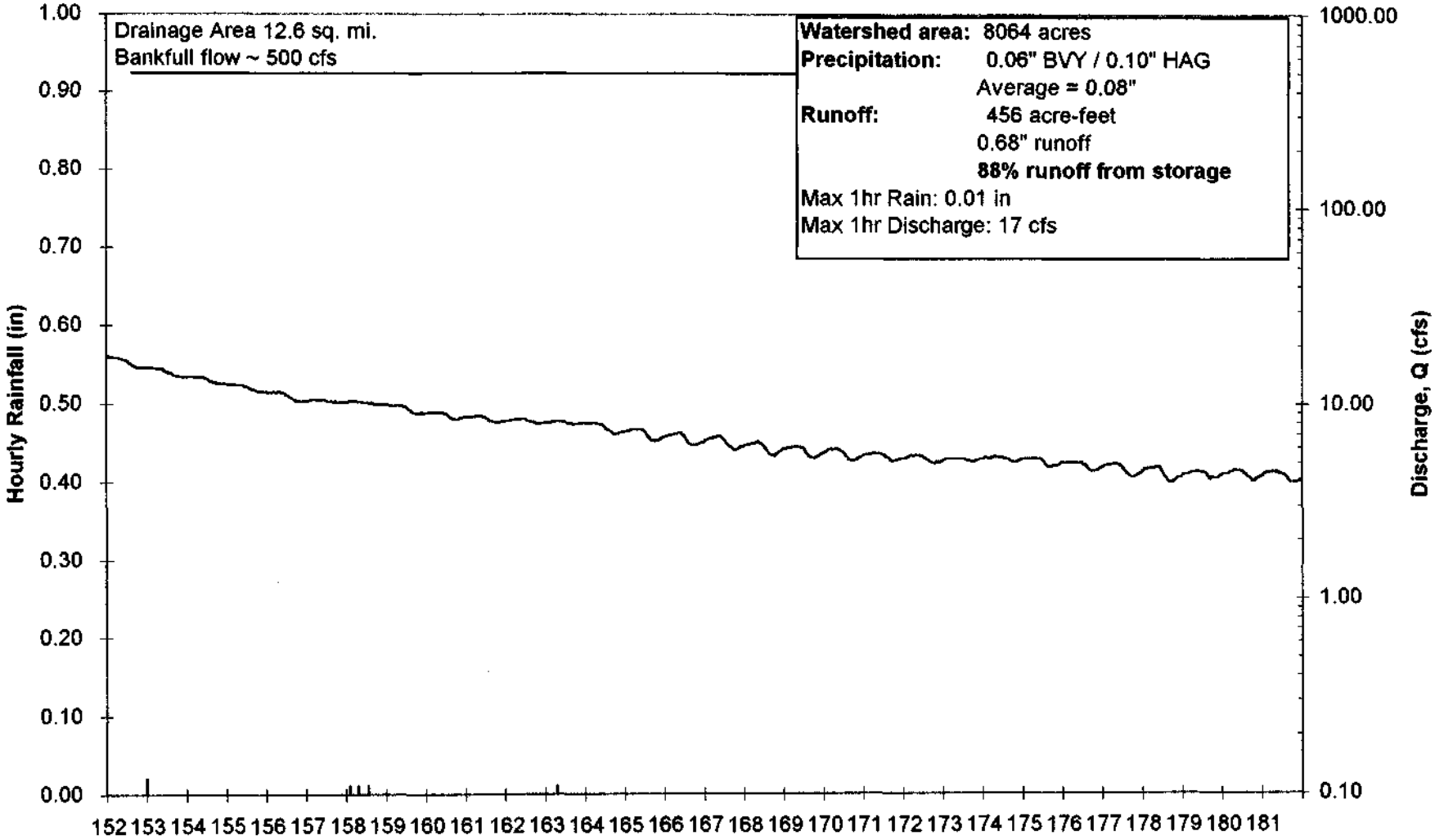
Olema Creek Rainfall-Discharge
April 1998



Olema Creek Rainfall-Discharge
May 1998

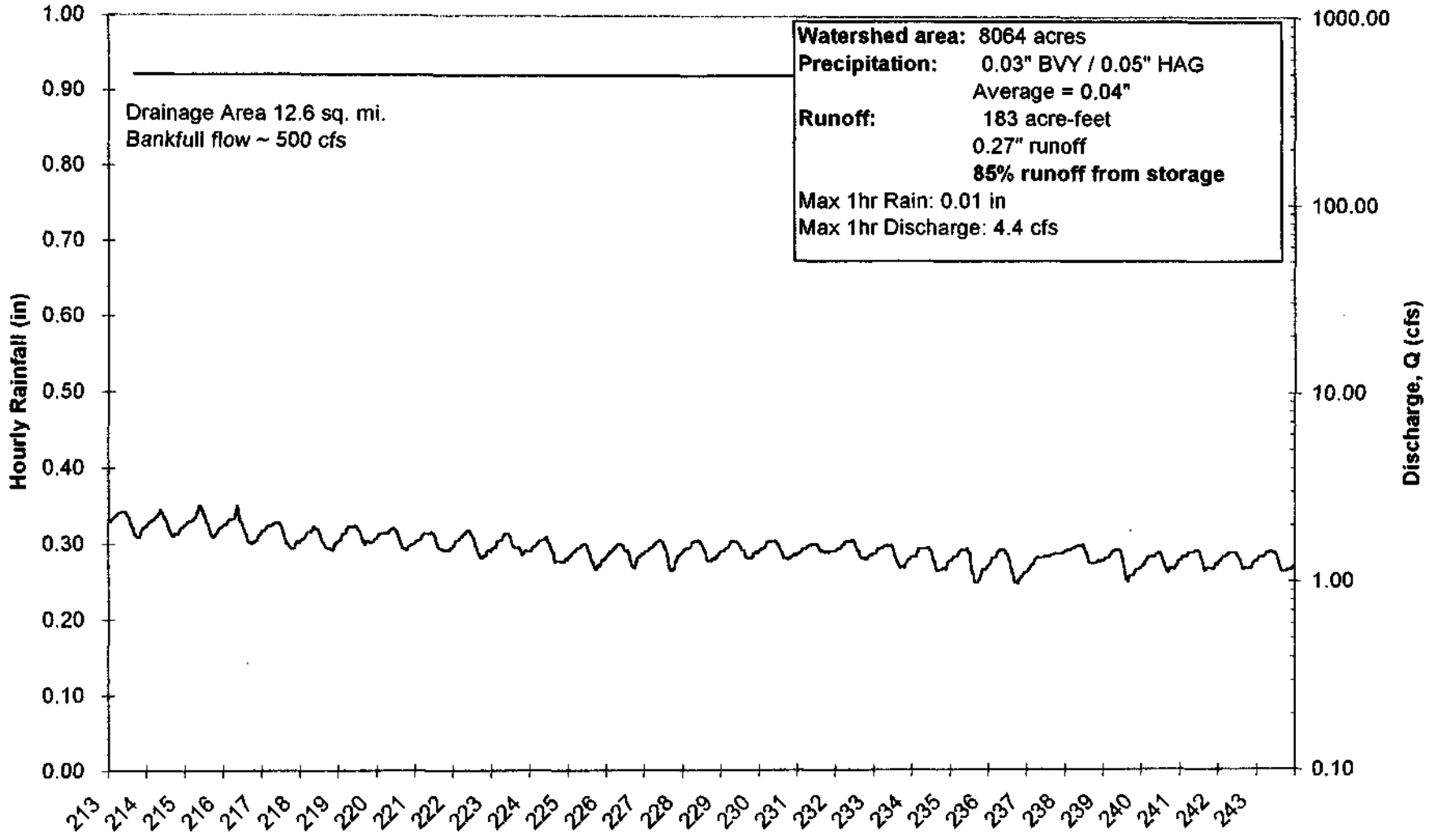


Olema Creek Rainfall-Discharge
June 1998

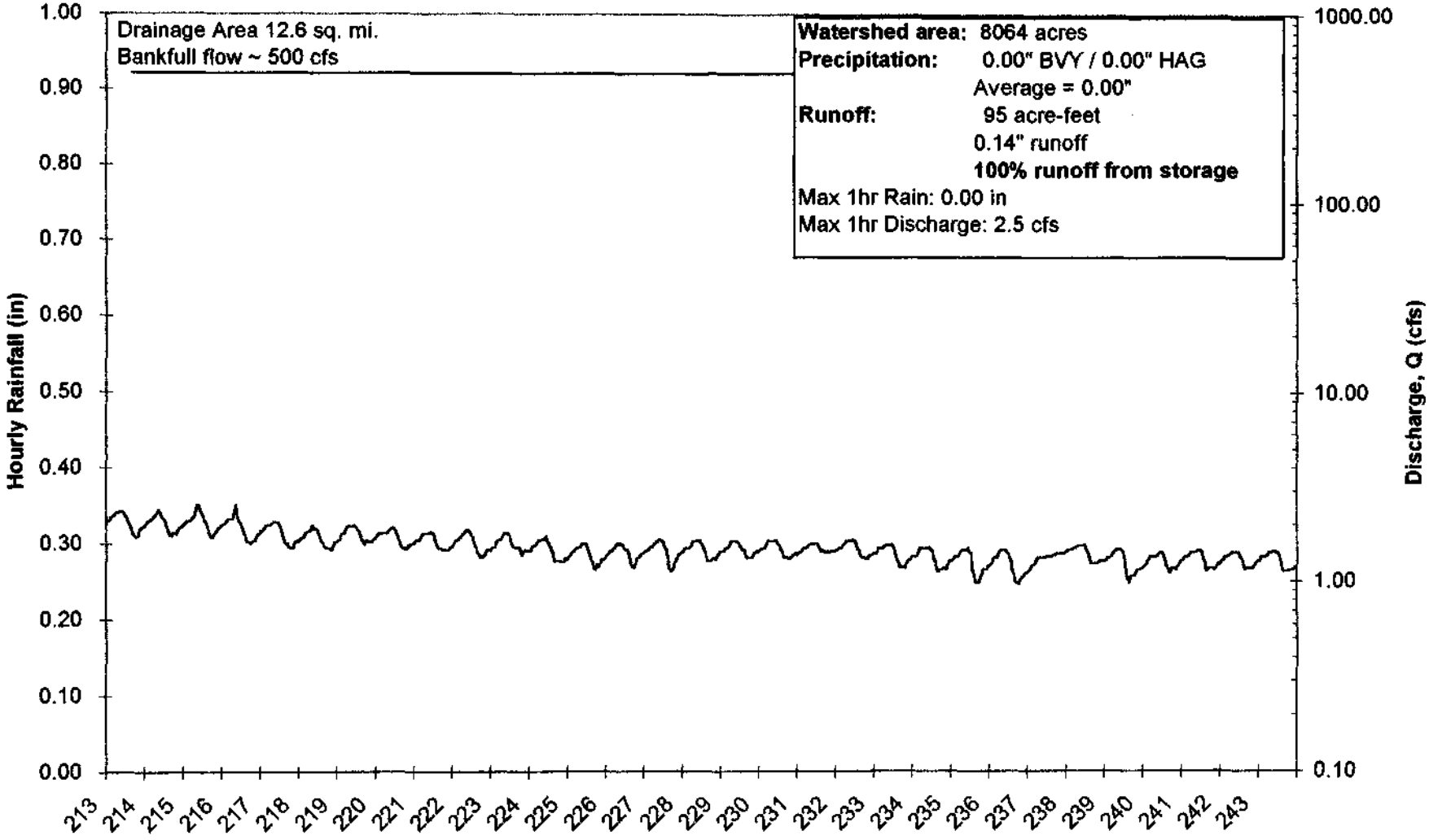


Olema Creek Rainfall-Discharge

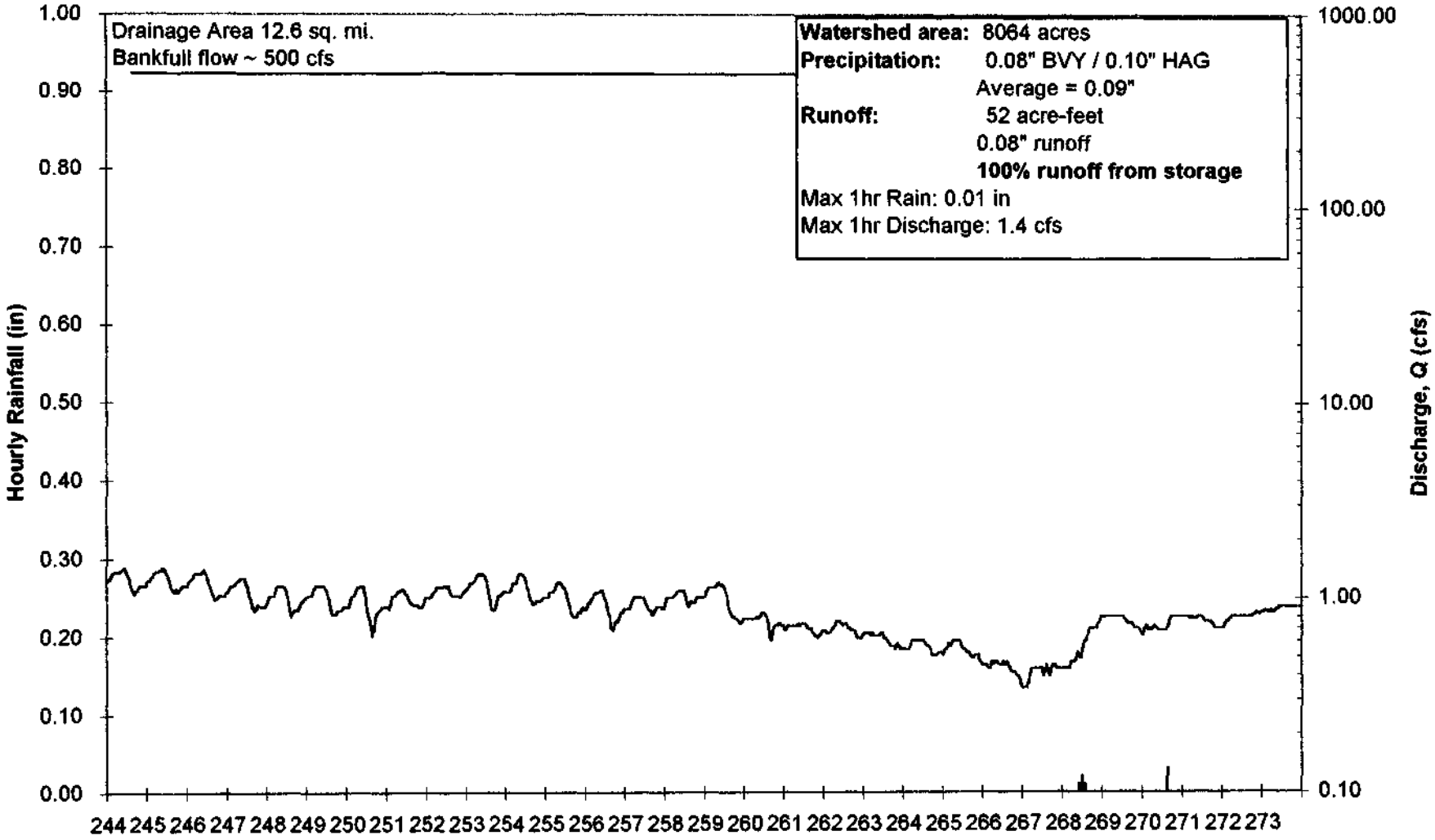
July 1998



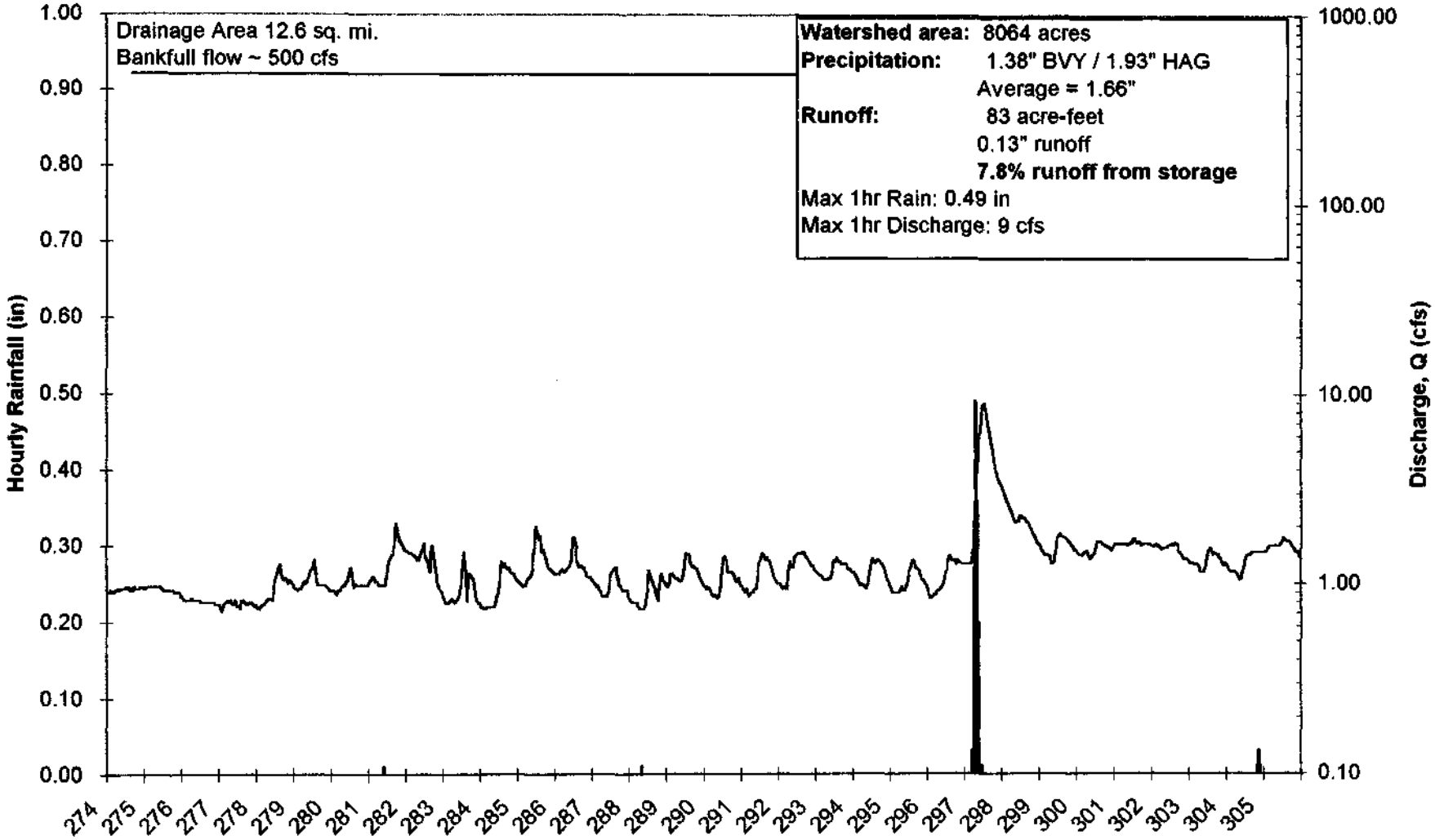
Olema Creek Rainfall-Discharge
August 1998



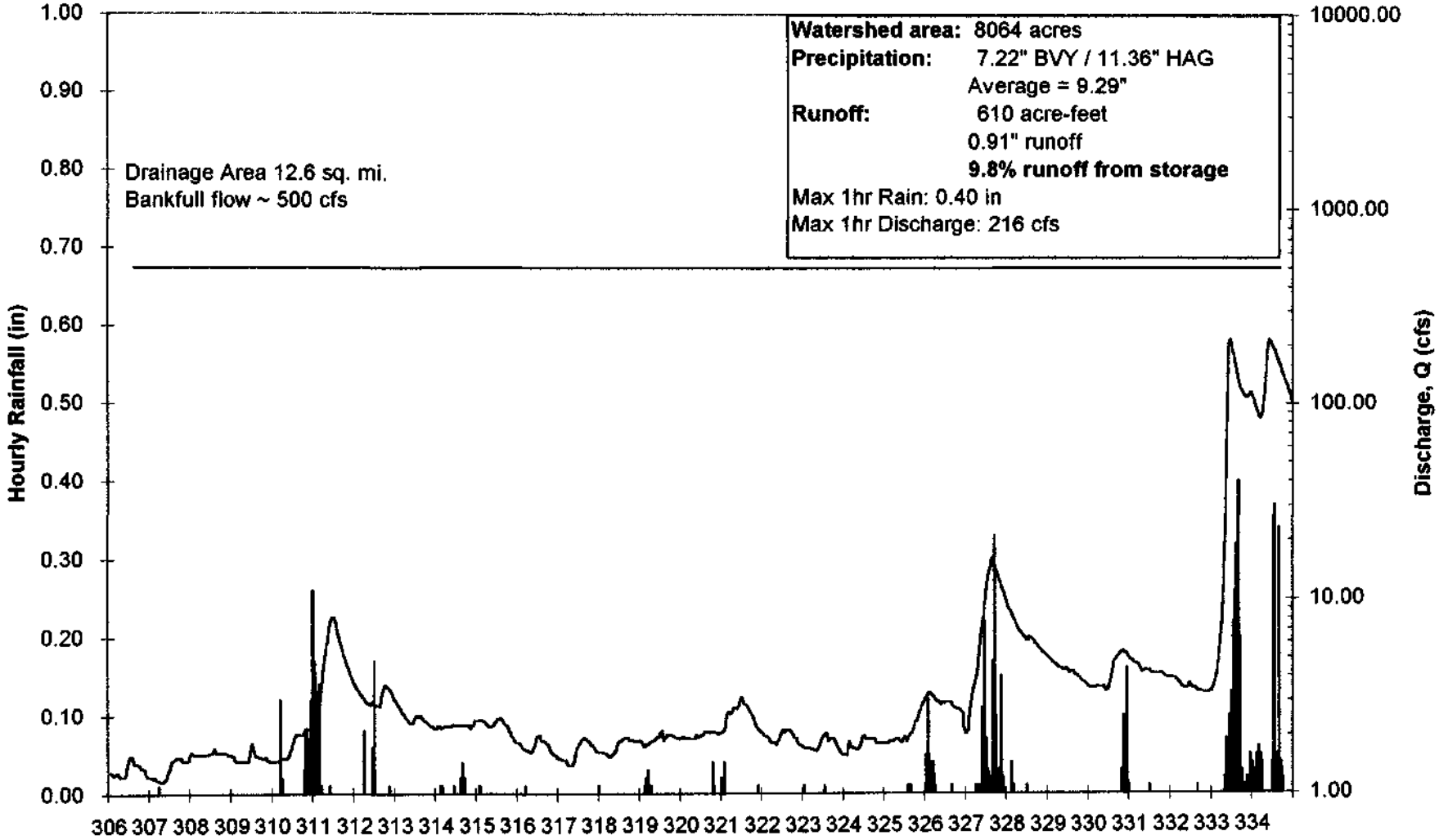
Olema Creek Rainfall-Discharge
September 1998



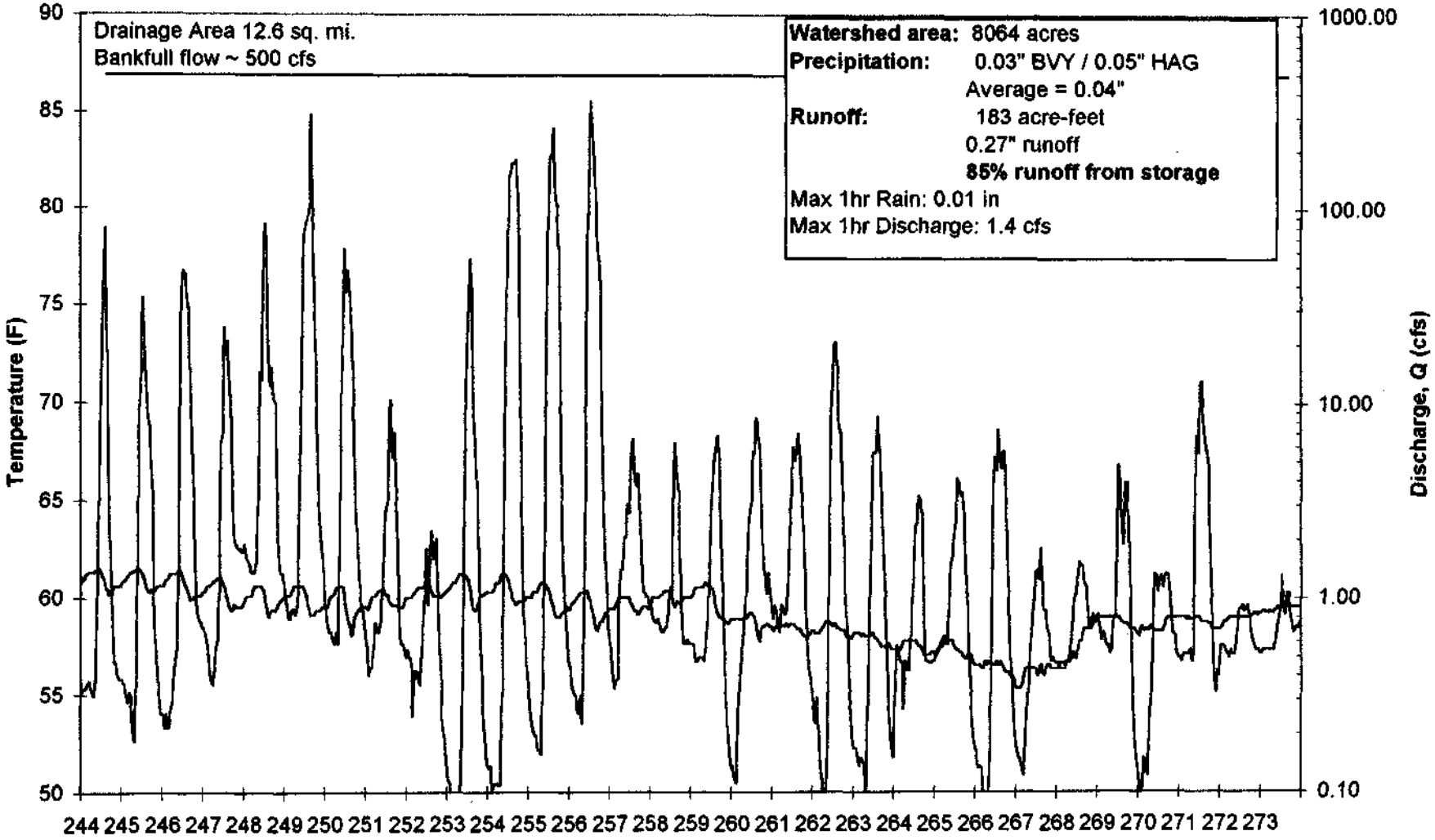
Olema Creek Rainfall-Discharge
October 1998



Olema Creek Rainfall-Discharge
November 1998



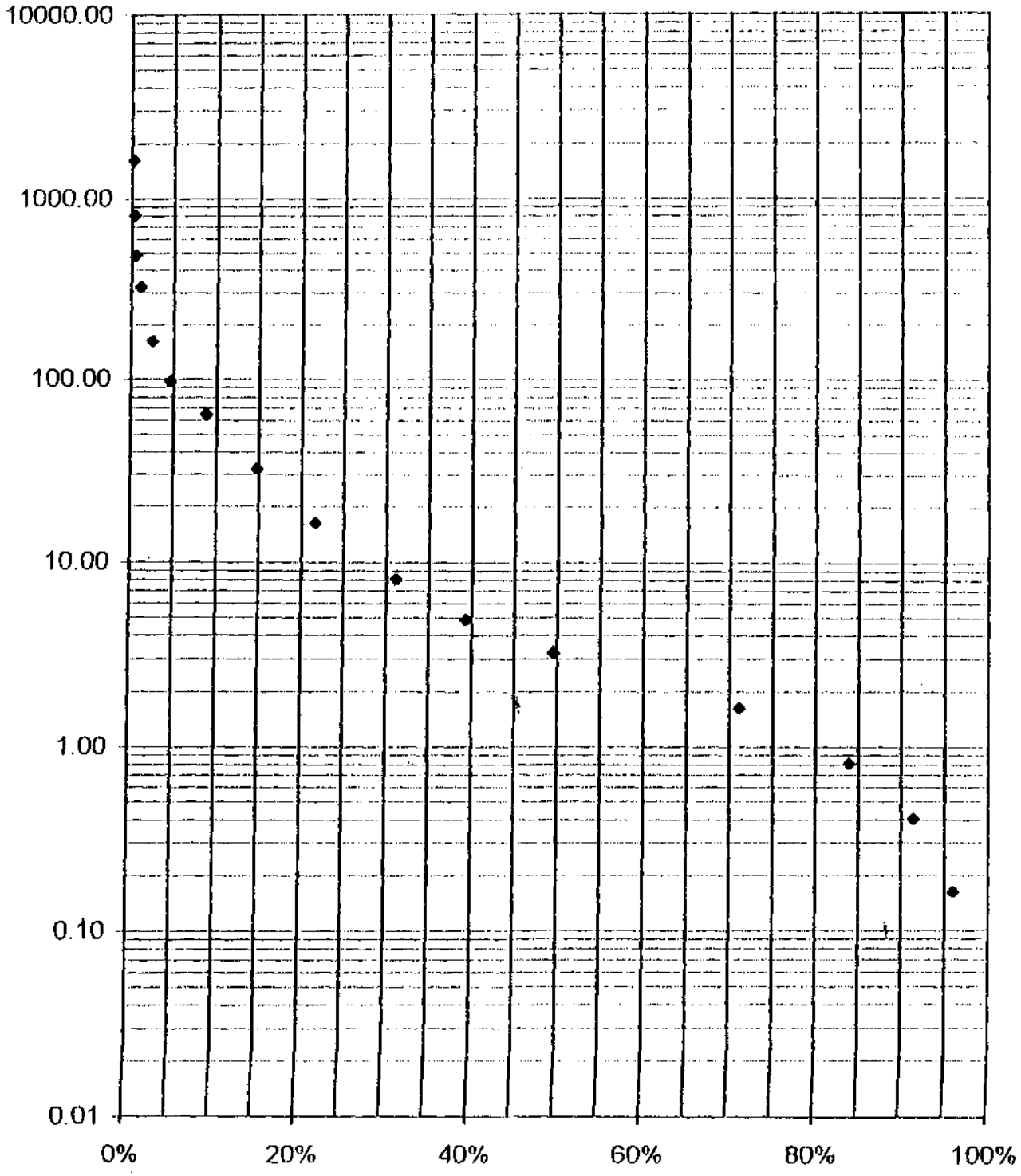
Olema Creek Temperature-Discharge
September 1998



Exceedance Frequency	RWD	OLM	PNG
96.16%	0.09	0.16	0.1
91.58%	0.24	0.40	0.25
84.07%	0.47	0.80	0.5
71.26%	0.94	1.6	1
49.75%	1.9	3.2	2
39.49%	3	5	3
31.28%	5	8	5
21.76%	9	16	10
14.94%	19	32	20
8.95%	38	64	40
4.76%	56	96	60
2.63%	94	160	100
1.23%	188	321	200
0.66%	282	481	300
0.49%	471	802	500
0.33%	941	1603	1000

Olema Creek Discharge Duration Curve

adjusted from PNG 1967-70 *1.60



Redwood Creek

Hydrology Summary

Redwood Creek

The Redwood Creek Gage was installed in November 1997 on the Highway 1 bridge near Pacific Way. This is a large box culvert, with flow mainly concentrated in two chambers. The stilling well is on the upstream wall directly in the center at high flows. There does need to be maintenance of the site in the winter, as it is possible for debris to get stuck on the wall, obstructing the monitoring capabilities. There is a tape used as the staff plate. The transducer cable runs through conduit along the bridge, and then is buried in conduit along the wing wall and to the station. The rain gage is located out in an open area. The cable is unprotected and has been cut in the past due to riparian clearing activities. I think that we have those resolved.

As mentioned, the cross-section is a box culvert. There are three sections, 10 feet wide by 12 feet high and 60 feet long. At low flow, water is concentrated in the right section (looking downstream). As flow picks up, the middle section has flow. At much higher flows water enters the left chamber, and it acts as a large eddy, with velocities of more than one-foot per second moving up through this section. A great deal

of silt is deposited in this section. High flows are measured off the downstream side of the bridge.

In the summer I installed a v-notch weir that worked well for about a month before collapsing. This caused a problem with the data for most of October. Now the site has been reworked by some high flows and a new low flow curve needs to be established. This is a good monitoring site, no backwater effects or flooding will occur at the site. Peak flows this year were close to 800 cfs.

The cross section is very stable at higher flows. This past year we made it down for 4 high flow events. However, these were still far below the peak that was about 8 feet on the staff plate. I am confident in the high flow rating curve but it would be good to get a few more flows between 5 and 8 feet on the staff. Again, at low flows a rating must be established with each new year.

d:/CSRP Hydro/RDW/Stream Flow/

RDW1997raw.xls – Raw data from 1997. This is organized by three categories, 5 or 15 minute interval summaries (111), one-hour summaries (222), and one-day summaries (333). These are sorted using the autofilter tool in excel. This is where all of the raw data, corrected for possible time errors or water level adjustments is stored. There is no other manipulation of this data.

RDW1998raw.xls – Raw data from 1997. This is organized by three categories, 5 or 15 minute interval summaries (111), one-hour summaries (222), and one-day summaries (333). These are sorted using the autofilter tool in excel. This is where all of the raw data, corrected for possible time errors or water level adjustments is stored. There is no other manipulation of this data.

RDW Flow Measurement.xls – This file contains all of the data used to correlate water level to discharge. There are a number of sheets in the file. On the summary sheet I have tried to identify different rate curves and the time periods that they were used. The calculation sheet is used to convert field measurements into a flow.

RDWPWA1992-3.xls -- In 1992 and 93, Phil Williams and Associates was contracted to do some monitoring on Redwood Creek. This is the mean daily flow information gathered just upstream of the Pacific Way Bridge (200 meters downstream of the existing monitoring station).

RDW1day.xls -- This includes all of the one-day summaries for the Redwood Gage. The sheet 333 has all of the data with columns to convert water level to discharge. There are also minimum and maximum water levels that can be converted to flow using the same formula.

WY1998 is the mean daily flow sheet for 1998, and WY1999 is the same for this WY. I have also created daily rainfall sheets to summarize the rainfall information. These sheets are labeled Rain WY19**.

RDW1hr.xls -- This includes all of the one-hour summaries for the Redwood gage. The sheet 222 has all of the data and columns for calculating hourly discharge rates and volumes in acre-feet. I have also pasted in the hourly rainfall data for ease of calculation in the summary section.

There are a great numb er of charts that are monthly rainfall-discharge curves. These were developed from the 1-hour data so they are pretty detailed. This file contains a bulk of the information in the packet.

RDW5minute -- This has not been maintained. I found that 5-minute data was a bit much to deal with so in June I scaled it back to 15-minute recording intervals… In other watersheds it would be possible to monitor 5-minute rainfall intensities.

Redwood Creek

Average Daily Flow

	October	November	December	January	February	March	April	May	June	July	August	September
1			19.9	2.9	128.3	16.6	9.7	5.4	10.0	2.3	0.8	0.5
2			14.3	17.1	338.3	15.6	8.9	5.4	9.0	2.3	0.7	0.5
3			11.7	16.9	498.6	14.5	13.4	5.0	8.2	2.3	0.6	0.5
4			10.9	28.7	186.6	13.2	69.8	5.1	7.5	2.1	0.6	0.5
5			17.0	23.1	177.2	13.3	21.0	5.3	7.0	2.1	0.6	0.4
6			15.7	19.3	290.7	13.2	19.1	5.4	6.7	2.1	0.6	0.4
7			40.0	22.9	355.3	12.3	18.5	5.1	6.4	1.9	0.6	0.4
8			45.6	21.3	226.5	11.8	16.5	4.9	6.1	1.9	0.6	0.4
9			30.1	21.3	130.0	11.1	15.6	4.4	5.7	1.9	0.6	0.4
10			22.1	50.1	105.5	10.5	14.5	4.3	5.4	1.8	0.5	0.4
11			18.2	199.5	88.6	9.9	13.4	4.3	5.2	1.7	0.6	0.5
12			14.8	428.4	84.6	10.1	12.4	9.4	5.0	1.6	0.6	0.5
13			12.6	176.1	91.6	10.3	12.7	8.3	4.7	1.5	0.6	0.5
14			21.5	345.6	145.3	9.8	11.5	6.9	4.5	1.5	0.7	0.5
15			21.9	514.5	125.4	9.2	10.7	6.2	4.2	1.3	0.7	0.5
16			18.9	302.9	107.2	8.8	9.8	5.8	4.0	1.2	0.7	0.5
17			17.0	238.1	98.3	8.5	9.1	5.3	3.7	1.2	0.6	0.5
18			15.1	264.9	74.5	8.0	8.6	5.0	3.6	1.1	0.6	0.5
19			12.9	211.7	207.0	8.0	8.1	4.7	3.5	1.0	0.7	0.5
20		4.1	11.3	130.5	166.0	7.0	7.7	4.5	3.4	1.0	0.9	0.5
21		2.5	10.0	63.0	209.6	7.0	7.2	4.2	3.3	1.4	0.8	0.5
22		1.9	8.8	44.5	174.5	6.0	6.9	4.1	3.2	1.3	0.8	0.5
23		16.8	7.9	41.4	167.2	10.0	7.3	3.9	3.2	1.2	0.7	0.5
24		7.8	7.2	41.2	135.1	14.0	7.0	3.8	3.1	1.2	0.7	0.5
25		6.3	6.5	38.1	95.7	12.3	6.3	3.8	3.0	1.1	0.7	0.5
26		75.3	5.9	42.8	67.1	11.1	6.0	3.6	2.8	1.1	0.8	0.4
27		37.8	5.5	64.1	45.8	10.3	5.7	5.3	2.7	1.0	0.7	0.4
28		20.3	5.3	45.4	41.2	9.9	5.5	15.7	2.6	0.9	0.6	0.4
29		15.1	5.0	103.9		9.1	5.3	15.7	2.6	0.9	0.6	0.5
30		28.5	3.4	76.3		8.4	5.0	13.8	2.5	0.9	0.5	0.5
31			3.1	65.7		10.0		11.6		0.9	0.5	
TOTAL	**0.0**	**216.5**	**459.7**	**3662.3**	**4561.7**	**329.7**	**373.3**	**196.5**	**142.9**	**45.8**	**20.3**	**13.8**
MEAN	**#DIV/0!**	**19.7**	**14.8**	**118.1**	**162.9**	**10.6**	**12.4**	**6.3**	**4.8**	**1.5**	**0.7**	**0.5**
MAX	**0.0**	**75.3**	**45.6**	**514.5**	**498.6**	**16.6**	**69.8**	**15.7**	**10.0**	**2.3**	**0.9**	**0.5**
MIN	**0.0**	**1.9**	**3.1**	**2.9**	**41.2**	**6.0**	**5.0**	**3.6**	**2.5**	**0.9**	**0.5**	**0.4**
AC-FT			**945**	**7310**	**9040**	**661**	**863**	**419**	**200**	**83**	**40**	**28**
PEAK FLOW		**116**	**91**	**766**	**740**	**24**	**88**	**67**	**11**	**2**	**1**	**1**

CAL YR

WTRYR **19589**

Water Year 1998

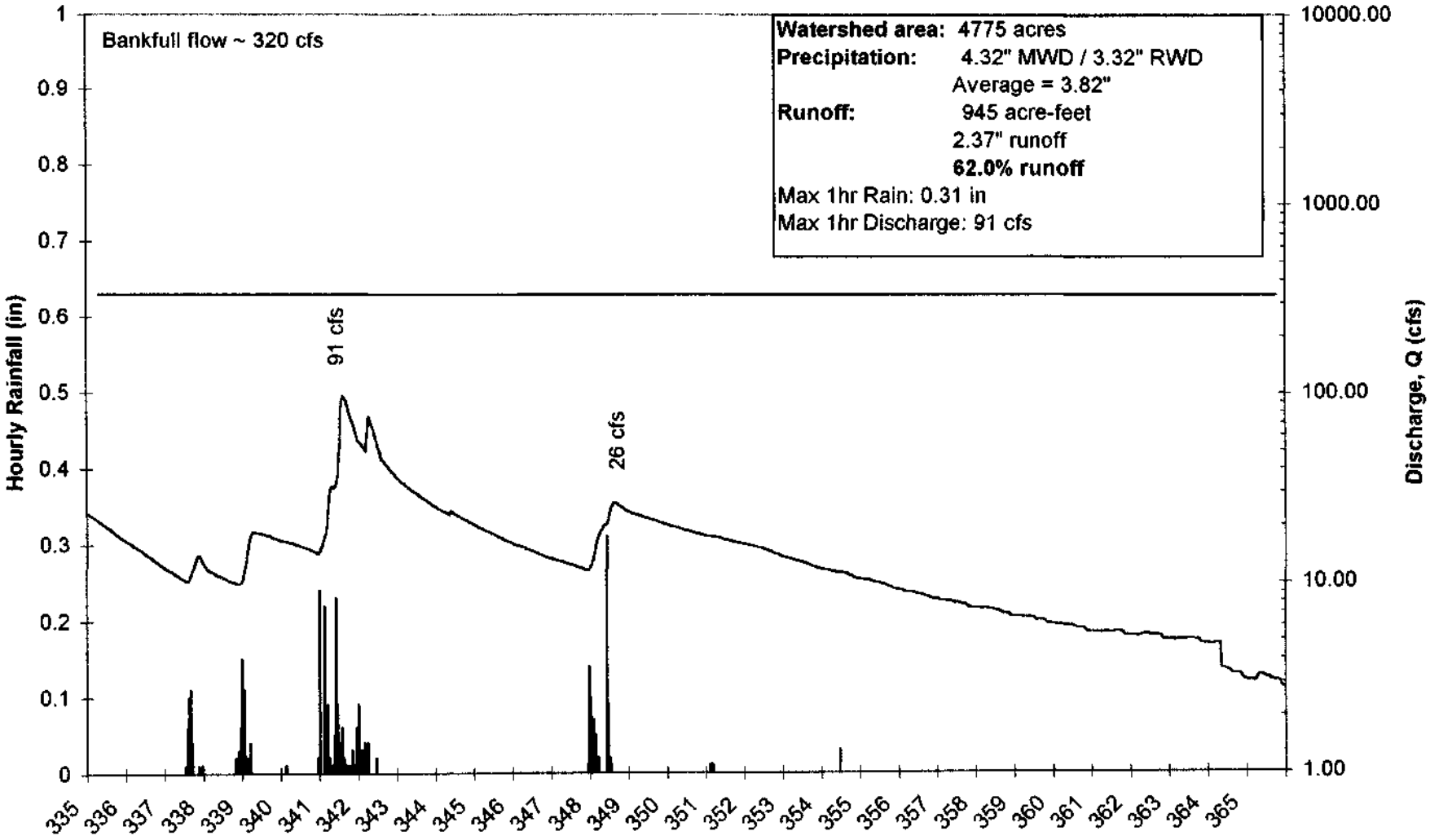
Redwood Creek Rainfall

Daily Rainfall

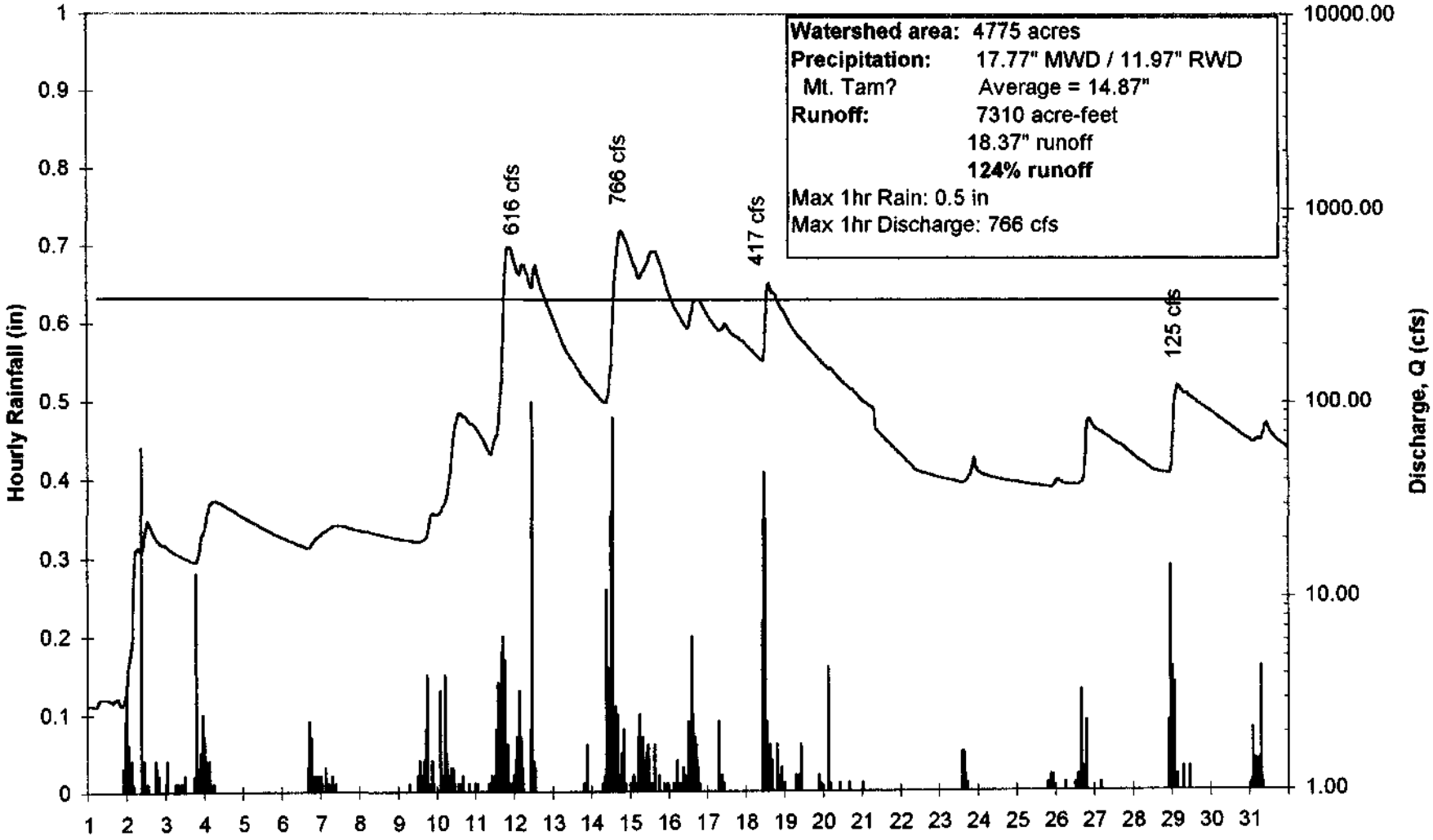
	October	November	December	January	February	March	April	May	June	July	August	September
1	*m*	0.00	0.00	0.12	0.92	0.00	0.01	0.23	0.00	m	0.00	0.00
2	*m*	0.00	0.00	0.87	3.30	0.29	0.08	0.03	0.00	m	0.00	0.00
3	*m*	0.00	0.34	0.59	1.06	0.01	1.10	0.05	0.00	m	0.00	0.00
4	*m*	0.00	0.12	0.17	0.46	0.00	0.06	0.12	0.00	m	0.00	0.00
5	*m*	0.00	0.34	0.00	0.62	0.38	0.00	0.54	0.00	m	0.00	0.00
6	*m*	0.05	0.03	0.28	1.94	0.00	0.53	0.16	0.00	m	0.00	0.00
7	*m*	0.01	1.28	0.10	1.52	0.13	0.00	0.00	0.04	m	0.00	0.00
8	*m*	0.00	0.25	0.00	0.25	0.00	0.03	0.00	0.00	m	0.00	0.00
9	*m*	0.00	0.00	0.43	0.00	0.00	0.03	0.00	0.00	m	0.00	0.00
10	*m*	0.75	0.00	0.51	0.35	0.00	0.02	0.00	0.00	0.00	0.00	0.00
11	*m*	0.02	0.00	1.10	0.10	0.00	0.00	0.11	0.00	0.00	0.00	0.01
12	*0.00*	0.00	0.00	1.01	0.43	0.24	0.36	0.89	0.00	0.00	0.00	0.00
13	*0.00*	0.76	0.15	0.08	0.08	0.03	0.18	0.00	0.00	0.00	0.00	0.00
14	*0.00*	0.36	0.75	1.86	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.12
15	*0.00*	0.84	0.00	0.63	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	*0.00*	0.44	0.00	0.77	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.10
17	*0.00*	0.02	0.03	0.13	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.05
18	*0.01*	0.85	0.00	1.33	0.07	m	0.00	0.00	0.00	0.00	0.00	0.00
19	*0.00*	0.19	0.00	0.14	1.60	m	0.00	0.00	0.00	0.00	0.02	0.00
20	*0.00*	0.00	0.03	0.19	0.01	m	0.00	0.00	0.00	0.00	0.00	0.00
21	*0.00*	0.01	0.00	0.00	1.15	m	0.00	0.00	0.00	0.00	0.00	0.00
22	*0.00*	0.31	0.00	0.00	0.02	m	0.00	0.00	0.00	0.00	0.00	0.00
23	*0.00*	0.02	0.00	0.13	0.91	m	0.12	0.00	0.00	0.00	0.00	0.00
24	*0.00*	0.02	0.00	0.00	0.00	0.16	0.01	0.00	0.01	0.00	0.00	0.00
25	*0.00*	1.2	0.00	0.06	0.05	0.01	0.00	0.00	0.02	0.00	0.05	0.00
26	*0.00*	1.24	0.00	0.32	0.00	0.01	0.00	0.00	0.00	0.00	0.04	0.00
27	*0.00*	0.00	0.00	0.01	0.01	0.03	0.00	0.71	0.00	0.00	0.01	0.00
28	*0.00*	0.00	0.00	0.38	0.00	0.01	0.00	0.98	0.00	0.00	0.00	0.00
29	*0.00*	0.77	0.00	0.38		0.00	0.00	0.30	m	0.00	0.00	0.00
30	*0.00*	0.02	0.00	0.00		0.15	0.00	0.00	m	0.01	0.00	0.00
31	*0.00*		0.00	0.37		0.32		0.00		0.00	0.00	
TOTAL	**0.01**	**7.88**	**3.32**	**11.96**	**16.54**	**1.77**	**2.53**	**4.12**	**0.07]**	**0.01**	**0.12**	**0.28**
MEAN	**0.00**	**0.26**	**0.11**	**0.39**	**0.59**	**0.07**	**0.08**	**0.13**	**0.00**	**0.00**	**0.00**	**0.01**
MAX	**0.01**	**1.24**	**1.28**	**1.86**	**3.30**	**0.38**	**1.10**	**0.98**	**0.04**	**0.01**	**0.05**	**0.12**
MIN	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max 1hr	**0.01**	**0.36**	**0.31**	**0.50**	**0.59**	**0.12**	**0.21**	**0.39**	**0.01**	**0.01**	**0.05**	**0.10**
CAL YR												
WTR YR	**48.61**											

Water Year 1998

Redwood Creek Rainfall-Discharge
December 1997

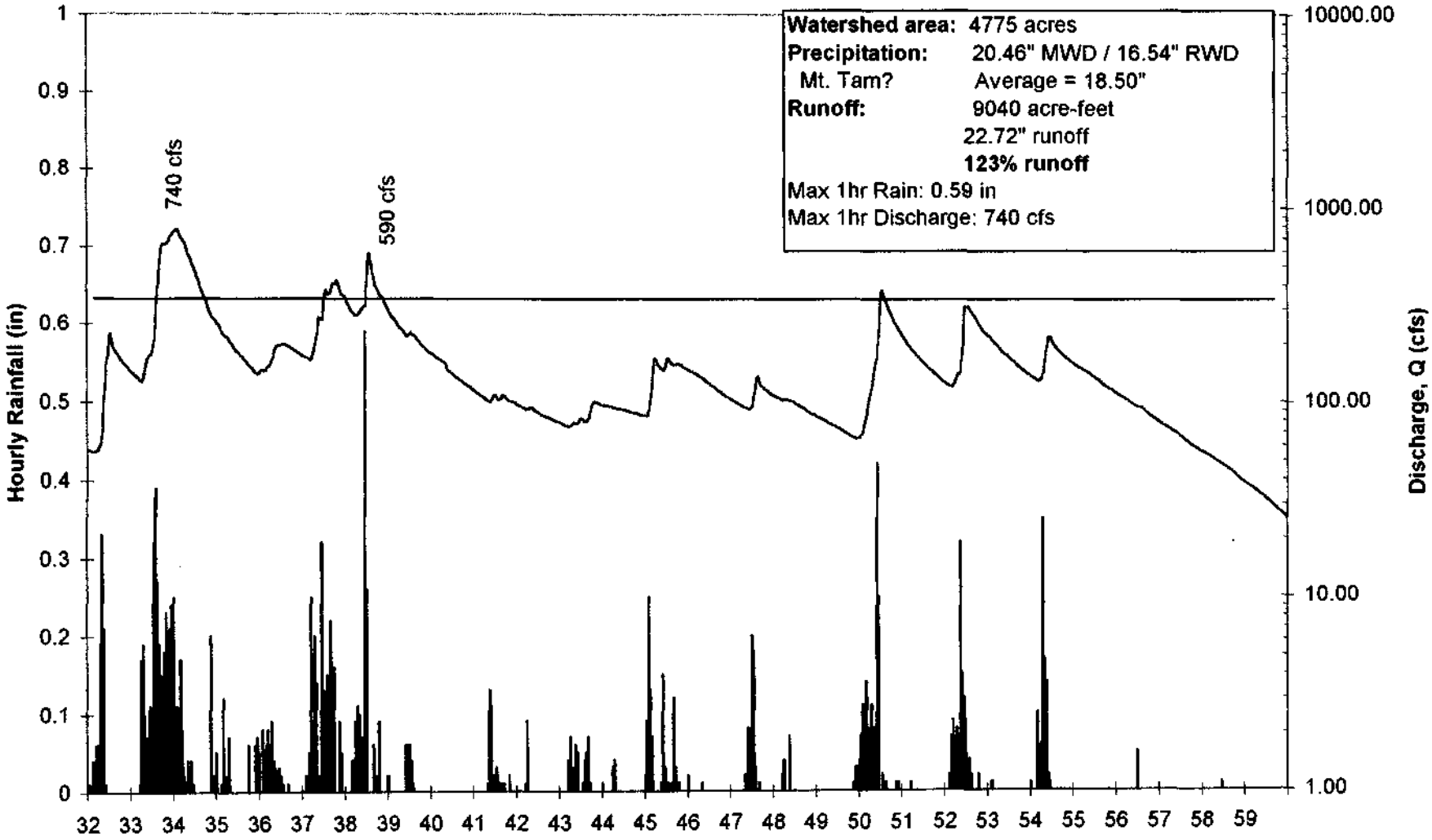


Redwood Creek Rainfall-Discharge
January 1998

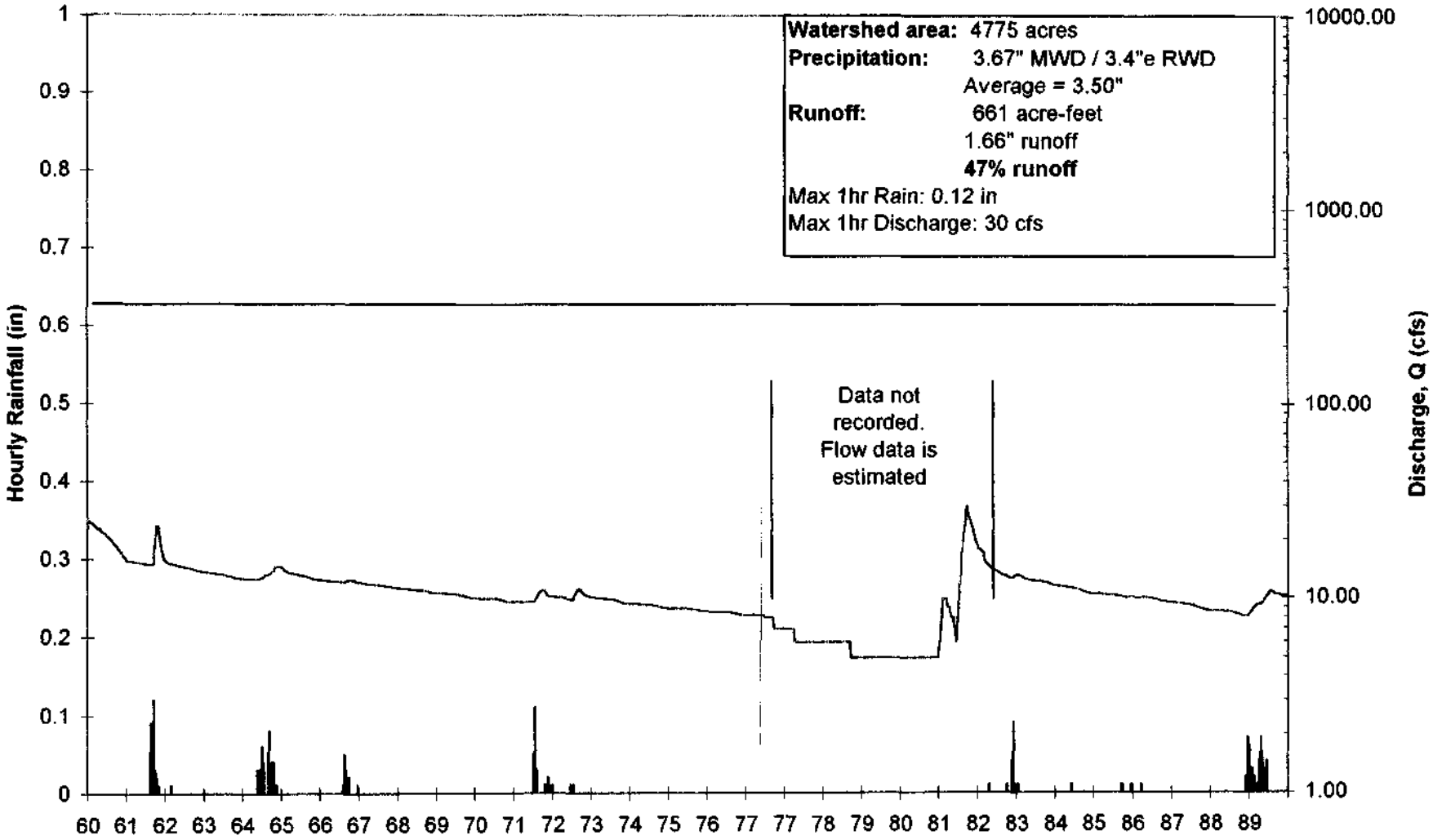


Redwood Creek Rainfall-Discharge

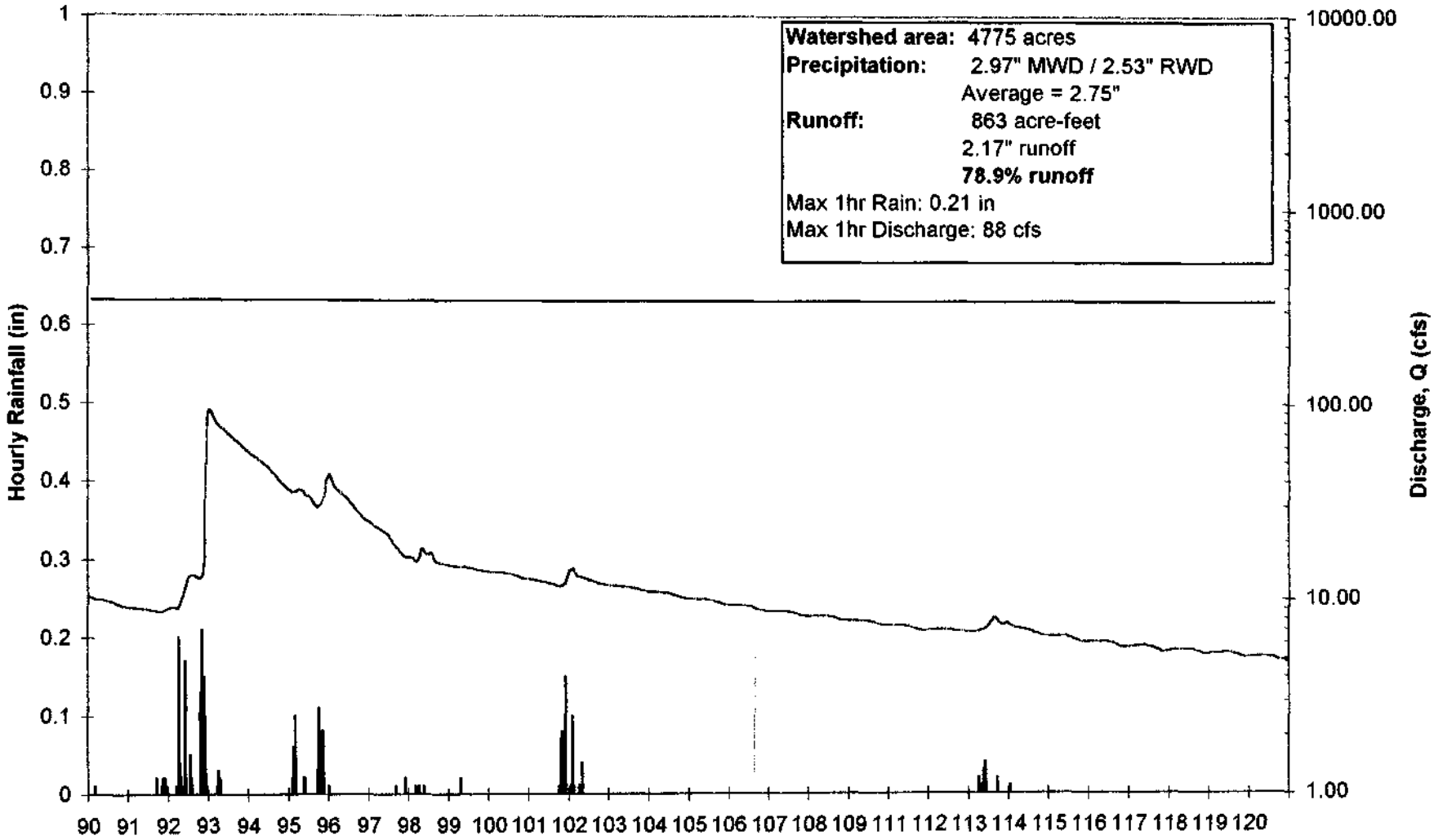
February 1998



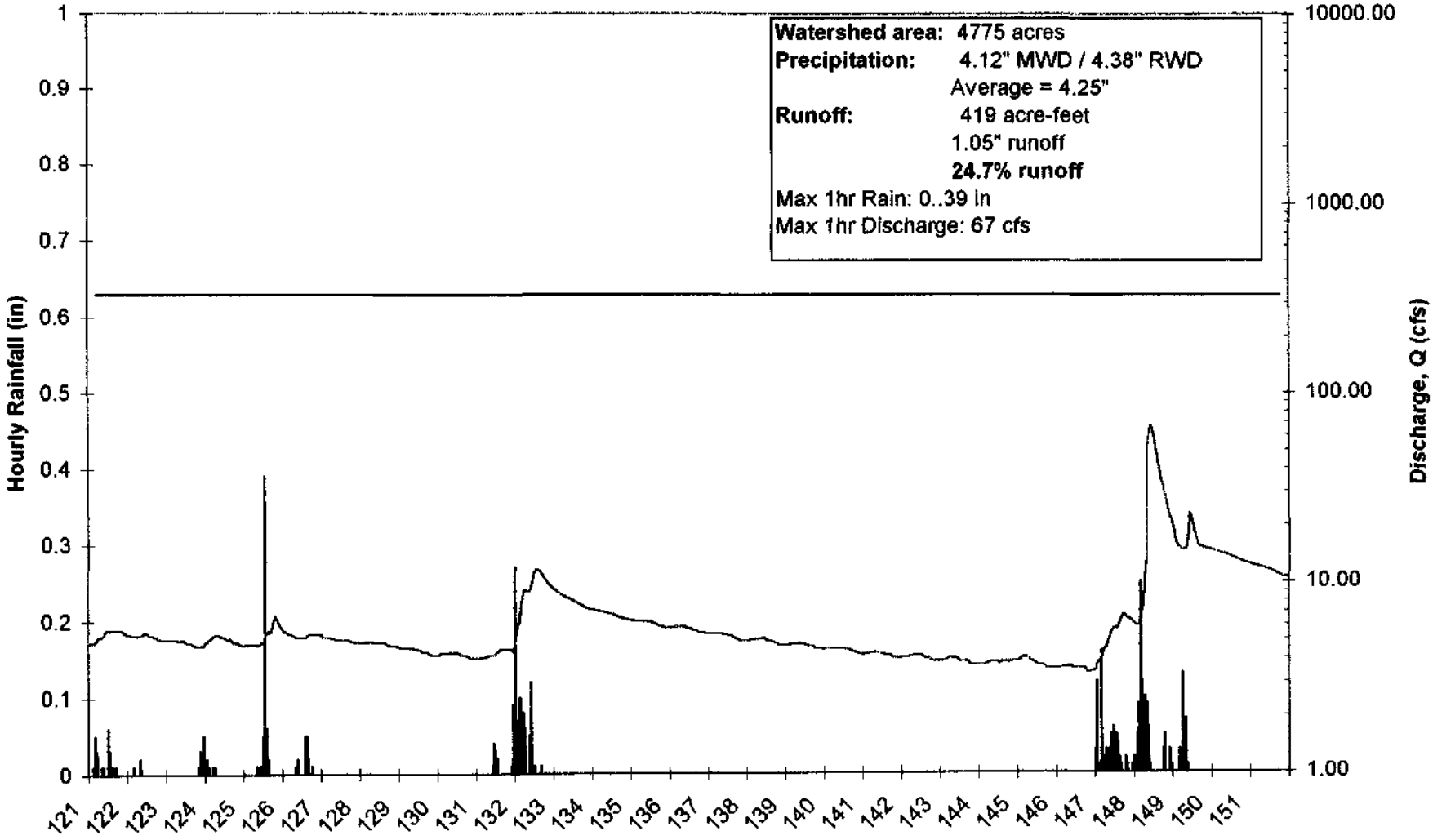
Redwood Creek Rainfall-Discharge
March 1998



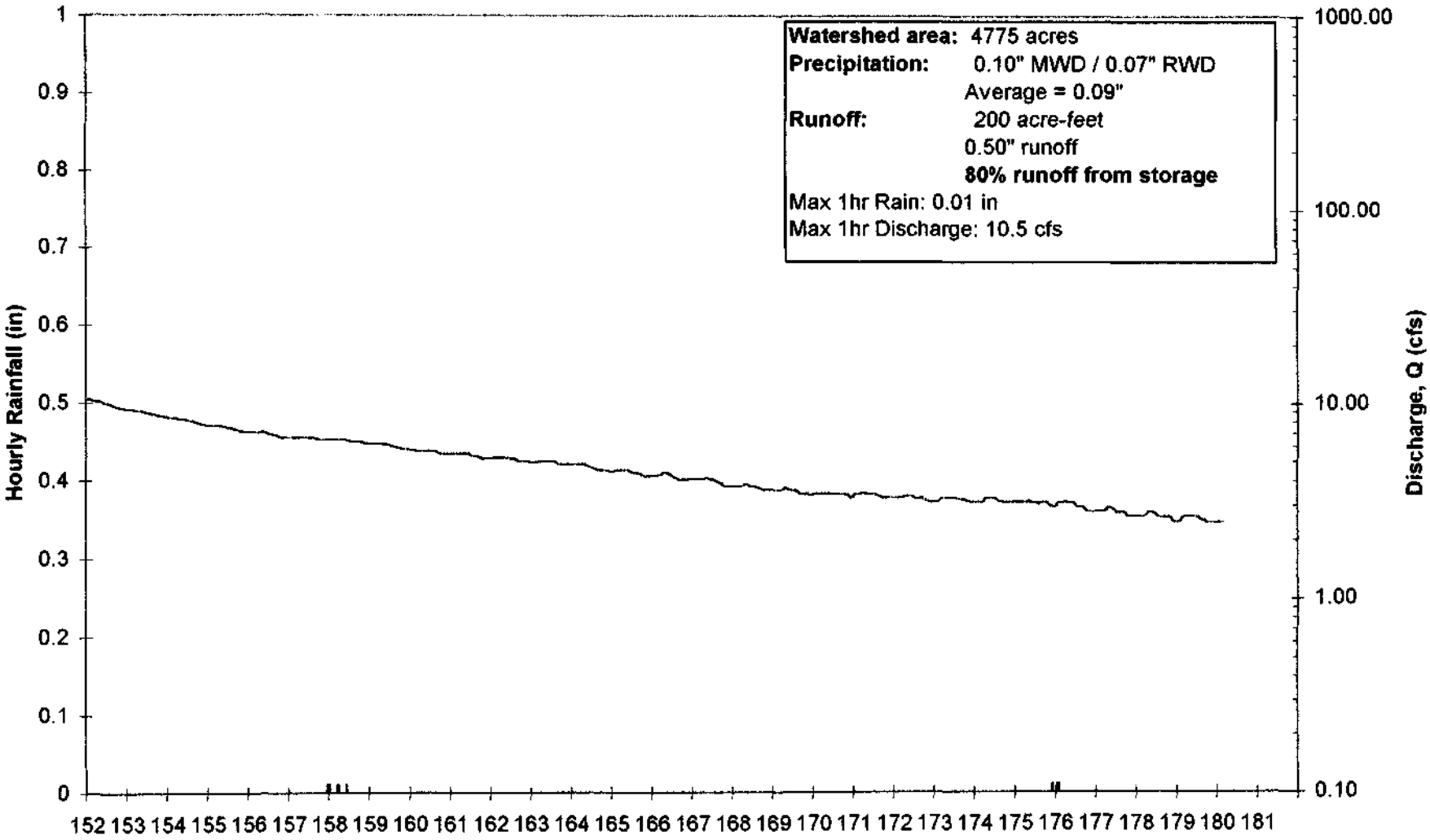
Redwood Creek Rainfall-Discharge
April 1998



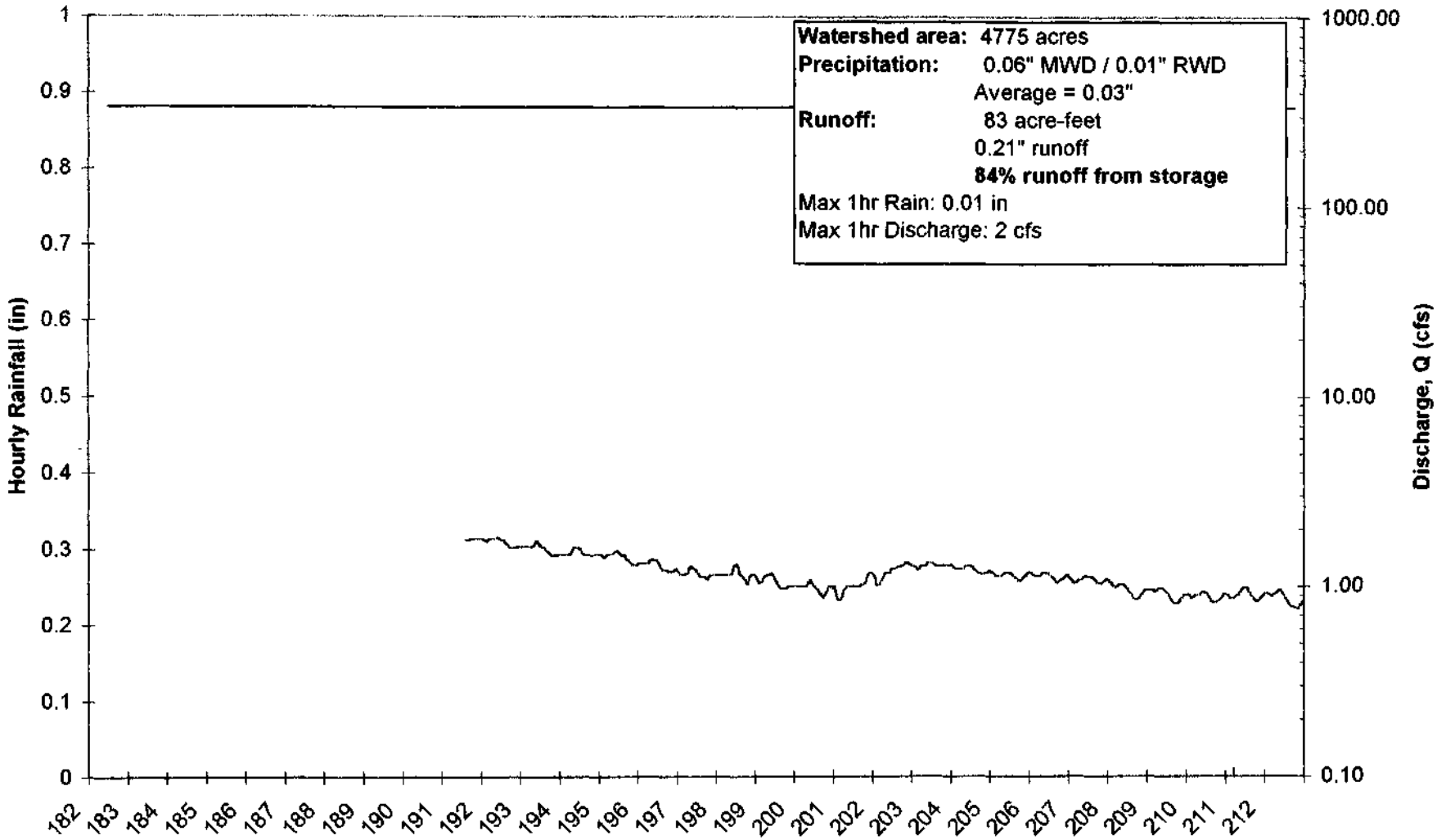
Redwood Creek Rainfall-Discharge May 1998



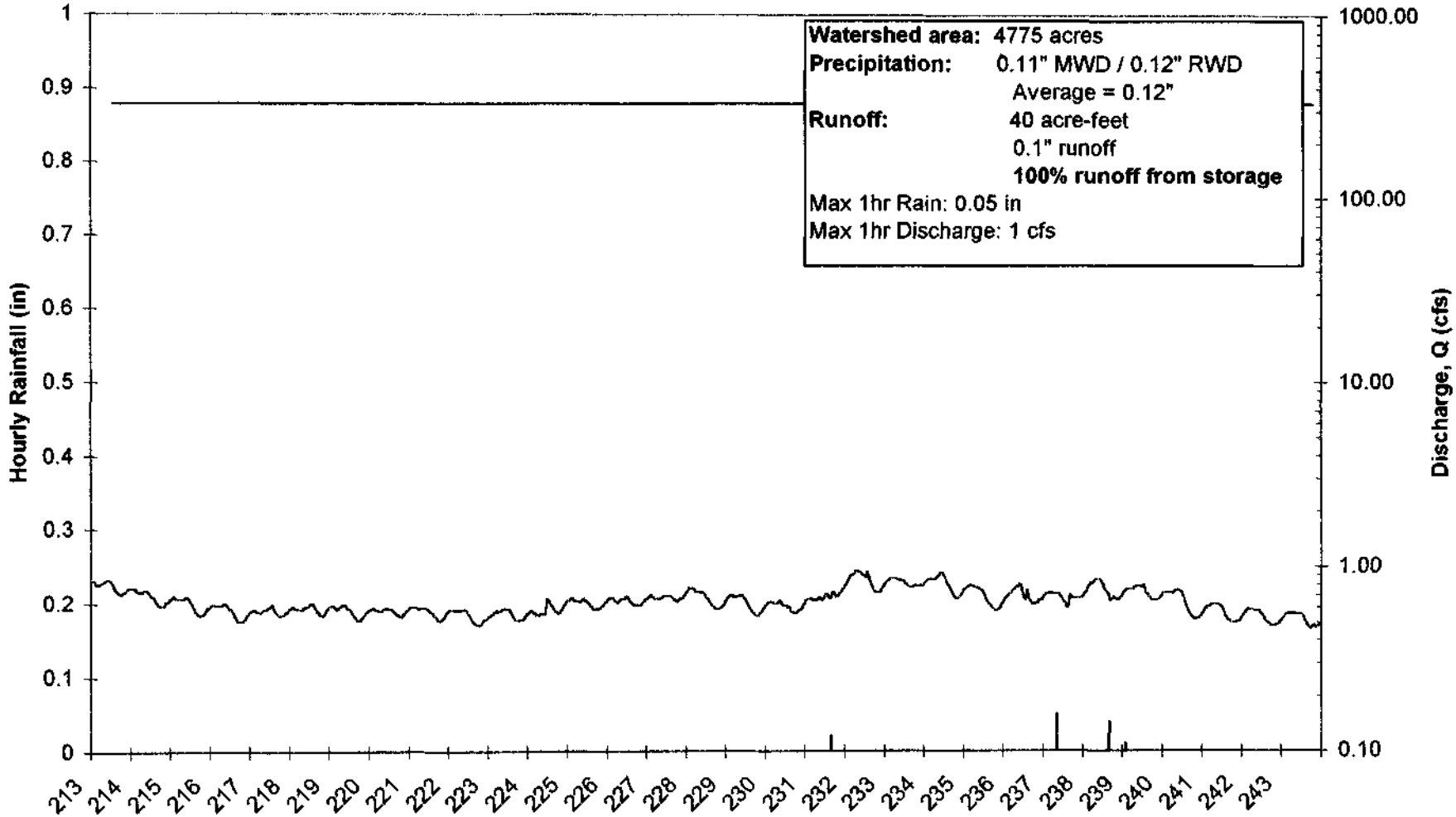
Redwood Creek Rainfall-Discharge June 1998



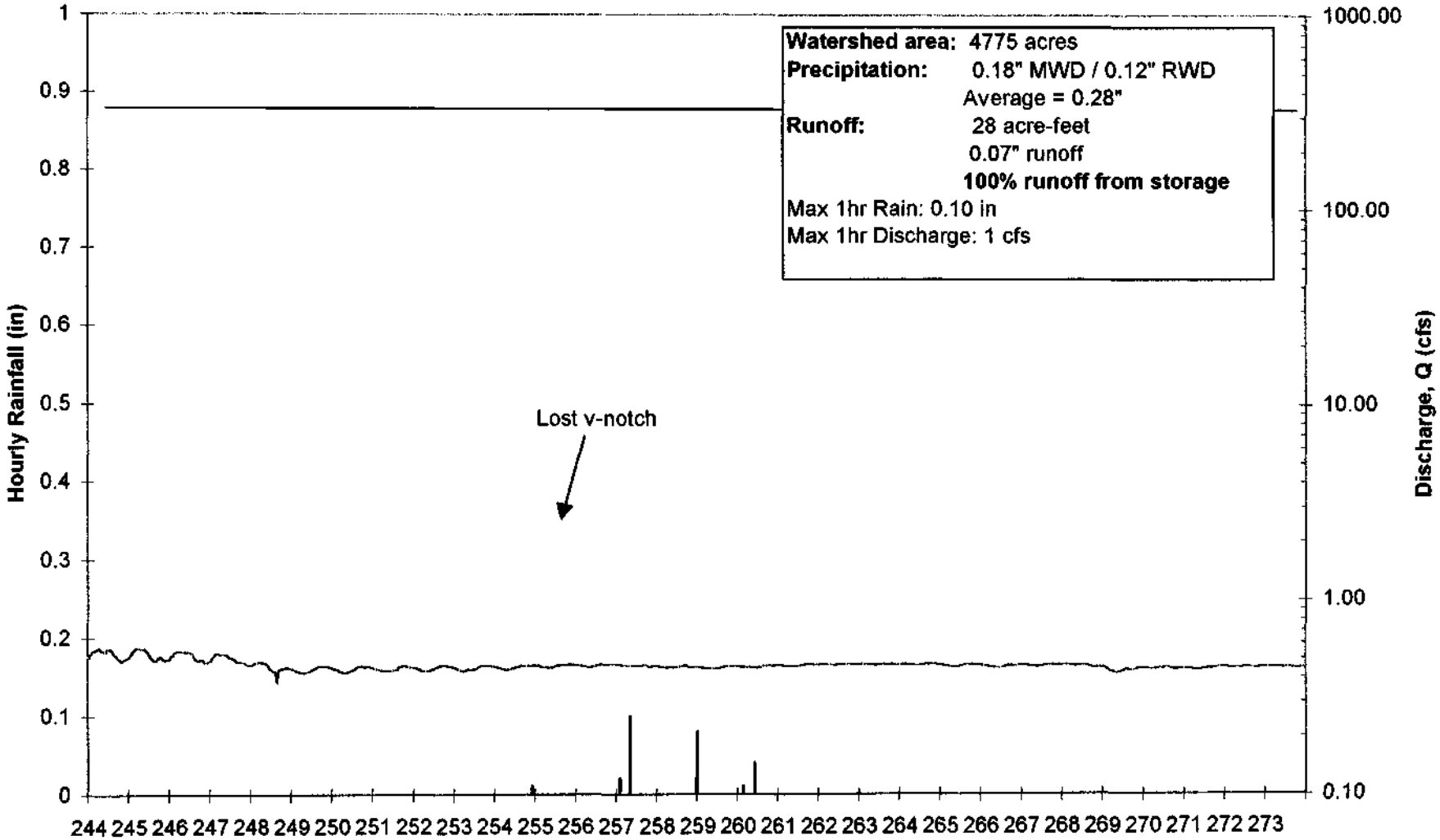
Redwood Creek Rainfall-Discharge
July 1998



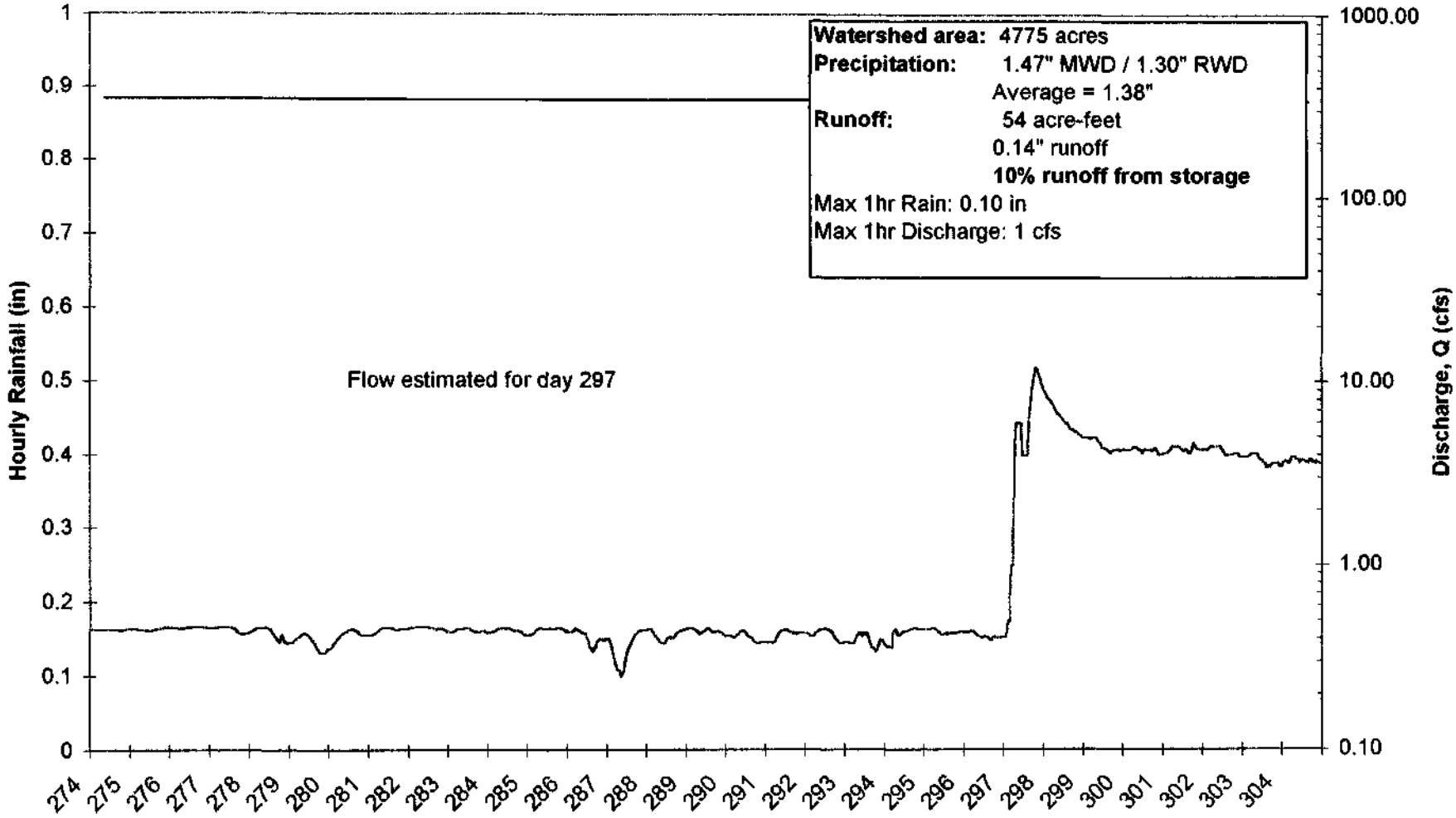
Redwood Creek Rainfall-Discharge
August 1998
Weir Installed July 21,1998



Redwood Creek Rainfall-Discharge
September 1998

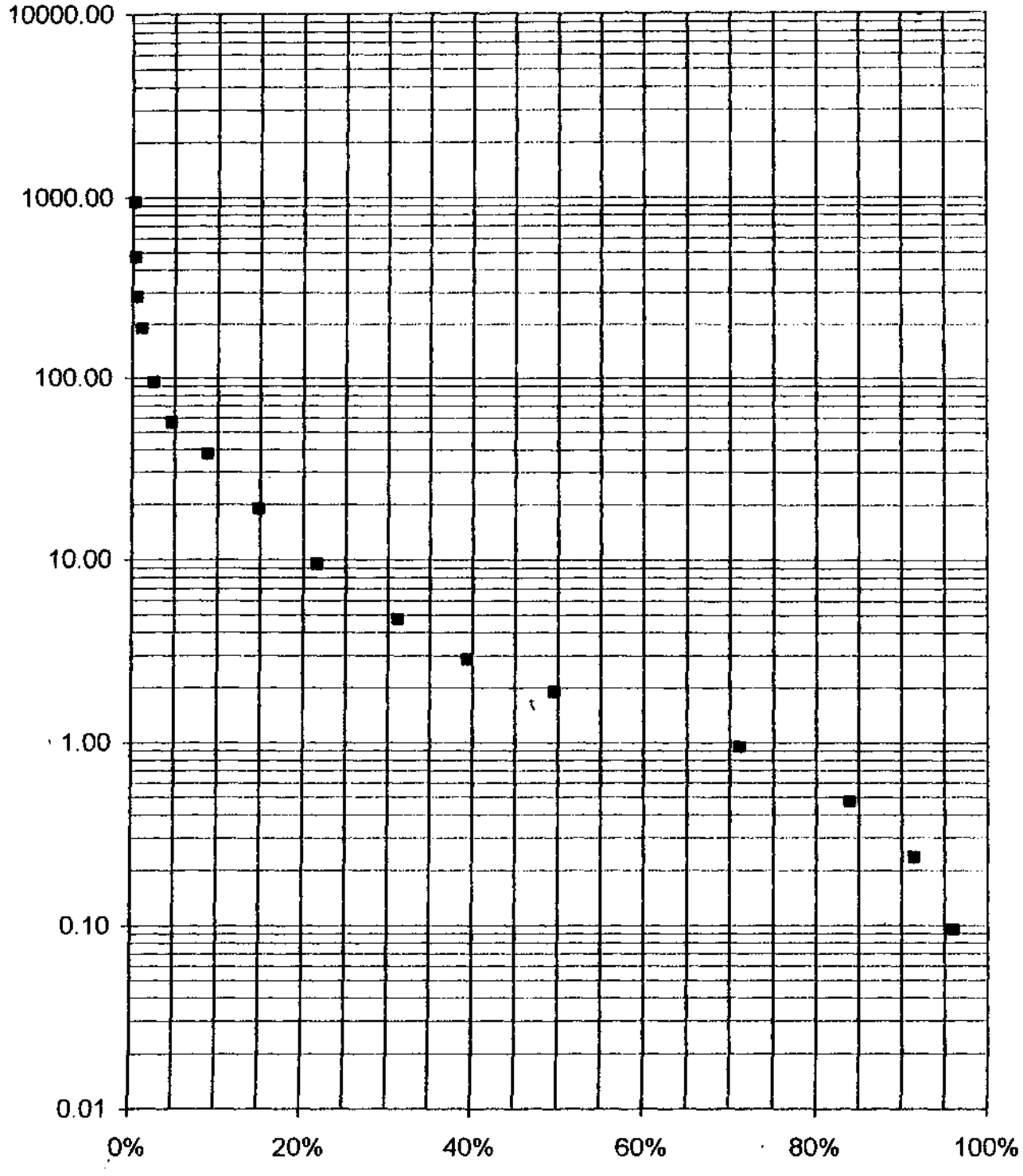


Redwood Creek Rainfall-Discharge
October 1998
Rainfall missing



Redwood Creek Discharge Duration Curve

adjusted from PNG 1967-70 *.94147



Pine Gulch Creek

Hydrology Summary

Pine Gulch Creek

Stilling Well –
Note Gravel Bar

Pine Gulch Creek is the most problematic station for many reasons. The site is located 100 meters downstream of the Olema-Bolinas Road Bridge. It is the only site to measure high flows in the watershed. However, it is located on the delta area, and there is a large problem with aggradation at the site. At our gage, the gravel level increased by 1.5 feet, and the thalweg moved to the other side of the channel. This past summer and currently, it is necessary to dig a small channel and pit over to the stilling well to measure the water level. While not ideal, the real reason for monitoring at this site is the low summer flows. The site is just downstream of the last water diversion in the stream.

As mentioned the site is not ideal. Besides all of the rest, high flows tend to flood out above the bridge, and the monitoring site. Therefore it is impossible to measure any sort of peak flow. The other problems at this site were hardware related. The transducer we installed had problems beginning almost immediately. It took until

May to get them resolved. Though INW was generous enough to send a replacement, I had problems running the equipment properly, and therefore the data is very spotty. The data that I did gather corresponded with the major channel changes, including that 1.5 feet of aggradation. I have developed the data since May, and the station should be all right as long as we keep a close eye on it.

In September, with the help of Don Murch (the landowner), we installed a v-notch weir. This worked very well until a storm exceeded the capacity of the weir at the end of October. A stilling well was mounted on the weir plate and we get a good deal of information regarding flow in relation to riparian diversions within the watershed. This has come in to play with the development of the Pine Gulch Creek Watershed Enhancement Project.

In regards to the Pine Gulch Creek Watershed Enhancement Project, the station will be used for monitoring and enforcement purposes on the low flows. Therefore, we need to install a weir annually or decide to build a more permanent structure that we could use for monitoring low flows. This is actually a realistic alternative, as it is private land, we will be involving the agencies in the process, and it would make sense to have a more permanent monitoring procedure at this site.

d:/CSRP Hydro/PNG/Stream Flow/

/usgs/--	Data in this file is from the USGS site. Data was collected from 1967-70. PNG Hydrograph.xls contains annual information from that data. This is the best historic data for any of the watersheds.
PNG1997raw.xls –	Raw data from 1997. This is organized by three categories, 5 or 15 minute interval summaries (111), one-hour summaries (222), and one-day summaries (333). These are sorted using the autofilter tool in excel. This is where all of the raw data, corrected for possible time errors or water level adjustments is stored. There is no other manipulation of this data.
PNG1998raw.xls –	Raw data from 1997. This is organized by three categories, 5 or 15 minute interval summaries (111), one-hour summaries (222), and one-day summaries (333). These are sorted using the autofilter tool in excel. This is where all of the raw data, corrected for possible time errors or water level adjustments is stored. There is no other manipulation of this data.

ACOE Model.xls -- This contains information for the modelers at the ACOE. They looked at water level over a two-month period, and I gave them the daily flow data for that time.

PNG Flow Measurement.xls – This file contains all of the data used to correlate water level to discharge. There are a number of sheets in the file. On the summary sheet I have tried to identify different rate curves and the time periods that they were used. The calculation sheet is used to convert field measurements into a flow.

PNG1day.xls -- This includes all of the one-day summaries for the Pine Gulch Gage. The sheet 333 has all of the data with columns to convert water level to discharge. There are also minimum and maximum water levels that can be converted to flow using the same formula.

WY1998 is the mean daily flow sheet for 1998, and WY1999 is the same for this WY. I have also created daily rainfall sheets to summarize the rainfall information. These sheets are labeled Rain WY19**.

PNG1hr.xls -- This includes all of the one-hour summaries for the Pine Gulch gage. The sheet 222 has all of the data and columns for calculating hourly discharge rates and volumes in acre-feet. I have also pasted in the hourly rainfall data for ease of calculation in the summary section.

There are a great number of charts that are monthly rainfall-discharge curves. These were developed from the 1-hour data so they are pretty detailed. This file contains a bulk of the information in the packet.

PNG5minute -- This has not been maintained. I found that 5-minute data was a bit much to deal with so in June I scaled it back to 15-minute recording intervals… In other watersheds it would be possible to monitor 5-minute rainfall intensities.

Pine Gulch Creek

Average Daily Flow

	October	November	December	January	February	March	April	May	June	July	August	September
1							11.5	6.2	7.8	3.6	2.5	1.0
2							9.3	5.8	7.3	3.6	2.4	1.0
3							11.5	5.1	6.9	3.6	2.1	0.9
4							14.3	5.7	6.5	3.7	2.0	1.0
5							12.4	8.6	6.1	3.7	2.0	0.9
6							14.0	8.6	6.0	3.3	2.0	0.9
7							14.2	8.4	6.1	3.3	1.8	0.9
8							12.1	8.4	5.8	3.3	1.7	0.9
9							13.9	7.4	5.5	3.3	1.7	0.9
10							13.2	5.9	5.4	3.4	1.6	0.9
11							12.7	6.1	5.3	3.2	1.6	0.8
12							m	9.2	5.3	3.6	1.6	0.9
13							m	7.6	5.1	3.4	1,4	0.9
14							m	6.7	4.9	3.2	1.5	1.0
15							m	6.2	4.8	3.2	*1.7*	1.0
16							m	5.9	4.5	3.1	1.9	0.9
17							m	5.5	4.5	3.2	1.3	0.9
18							m	5.3	4.4	3.1	1.4	0.7
19							m	5.1	4.3	3.1	1.4	0.8
20							6.9	4.9	4.3	3.1	1.8	0.9
21							6.6	4.8	4.3	3.3	1.7	0.9
22							6.5	4.7	4.2	3.4	1.7	0.8
23							7.1	4.6	4.3	3.4	1.8	0.8
24							6.2	4,7	4.1	3.4	1.6	0.9
25							5.3	4.6	4.1	3.2	1.7	1.1
26							5.1	4.5	3.8	3.0	2.0	1.2
27							4.8	5.4	3.8	2.9	1.7	1.2
28							4.6	10.8	3.8	2.6	1.5	1.1
29							4.4	9.7	3.8	2.5	1.5	1.2
30							4.3	9.1	3.6	2.5	1.6	1.2
31								8.4		2.4	1.3	

TOTAL		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**201.0**	**203.8**	**150.5**	**99.8**	**53.5**	**28.5**
MEAN		**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**9.1**	**6.6**	**5.0**	**3.2**	**1.7**	**0.9**
MAX		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**14.3**	**10.8**	**7.8**	**3.7**	**2.5**	**1.2**
MIN		**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**4.3**	**4.5**	**3.6**	**2.4**	**1.3**	**0.7**
AC-FT									**403**	**298**	**198**	**106**	**59**

PEAK FLOW									**16**	**8**	**4**	**3**	**3**

CAL YR		
WTR YR		**1064**

Pine Gulch Creek

Average Daily Flow

	October	November	December	January	February	March	April	May	June	July	August	September
1	1.2	1.8	16.1									
2	1.19	1.8	20.0									
3	1.02	1.9	31.0									
4	0.96	2.0	17.7									
5	0.83	2.0	13.5									
6	0.77	2.7	12.8									
7	0.88	5.3	10.2									
8	1.00	3.5	8.7									
9	0.95	7.0	6.9									
10	0.85	6.9	5.8									
11	0.94	7.2	4.6									
12	0.93	6.6	3.8									
13	0.94	6.5	3.7									
14	0.92	6.4										
15	0.93	6.4										
16	0.79	6.4										
17	0.68	7.2										
18	0.80	6.6										
19	0.72	6.4										
20	0.71	6.3										
21	0.69	6.2										
22	0.77	6.7										
23	0.90	9.4										
24	2.16	8.7										
25	2.83	7.2										
26	1.97	7.0										
27	1.72	7.1										
28	1.67	6.7										
29	1.58	28.1										
30	1.63	26.7										
31	1.72											
TOTAL	**35.7**	**214.5**	**154.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
MEAN	**1.15**	**7.1**	**11.9**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/OI**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
MAX	**2.8**	**28.1**	**31.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
MIN	**0.7**	**1.8**	**3.7**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**
AC-FT	**74**	**497**										
PEAK FLOW	**14**	**67**										
CAL YR												
WTRYR	**571**											

Water Year 1999

Pine Gulch Rainfall

Daily Rainfall

	October	November	December	January	February	March	April	May	June	July	August	September
1		0.00	0.00	0.15	1.69	0.00	0.00	0.24	0.00	0.00	0.00	0.00
2		0.00	0.00	0.61	3.68	0.20	0.10	0.06	0.00	0.00	0.00	0.00
3		0.00	0.44	0.64	0.86	0.00	0.76	0.06	0.00	0.00	0.00	0.00
4		0.00	0.14	0.12	0.29	0.00	0.01	0.07	0.00	0.00	0.00	0.00
5		0.00	0.28	0.01	1.01	0.39	0.01	0.46	0.00	0.00	0.06	0.00
6		0.12	0.01	0.30	1.70	0.00	0.58	0.04	0.02	0.00	0.00	0.00
7		0.03	1.44	0.04	1.32	0.11	0.01	0.00	0.03	0.00	0.00	0.00
8		0.00	0.36	0.00	0.40	0.00	0.05	0.00	0.00	0.00	0.00	0.00
9		0.00	0.00	0.22	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00
10		1.08	0.00	0.59	0.51	0.00	0.00	0.00	0.01	0.00	0.00	0.00
11		0.01	0.00	1.13	0.04	0.00	0.00	0.16	0.00	0.00	0.00	0.00
12		0.00	0.00	0.60	0.56	0.38	0.37	0.66	0.00	0.00	0.00	0.00
13		1.76	0.29	0.06	0.01	0.03	0.08	0.00	0.00	0.00	0.00	0.00
14		0.40	0.60	2.26	0.97	0.00	0.01	0.00	0.00	0.00	0.00	0.00
15		1.03	0.00	0.52	0.02	0.00	0.00	0.00	0.00	0.00	0.26	0.00
16		0.62	0.00	0.95	0.90	0.00	0.00	0.00	0.00	0.00	0.01	0.00
17		0.08	0.12	0.16	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18		0.83	0.00	1.42	0.14		0.00	0.00	0.00	0.00	0.00	0.00
19		0.03	0.00	0.09	1.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20		0.00	0.04	0.11	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21		0.00	0.00	0.00	1.71	0.13	0.00	0.00	0.00	0.00	0.03	0.00
22	0.00	0.44	0.00	0.00	0.08	0.04	0.01	0.01	0.00	0.00	0.00	0.00
23	0.00	0.01	0.00	0.23	0.92	0.62	0.09	0.00	0.00	0.00	0.00	0.00
24	0.00	0.05	0.00	0.00	0.00	0.18	0.01	0.00	0.00	0.01	0.00	0.00
25	0.00	1.06	0.00	0.12	0.13	0.01	0.00	0.00	0.01	0.00	0.00	0.02
26	0.00	1.33	0.00	0.61	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00
27	0.00	0.01	0.00	0.00	0.00	0.11	0.00	0.32	0.00	0.00	0.00	0.02
28	0.00	0.00	0.00	0.27	0.00	0.02	0.00	0.85	0.00	0.00	0.00	0.00
29	0.00	0.67	0.00	0.51		0.00	0.00	0.16	0.00	0.00	0.00	0.00
30	0.00	0.01	0.00	0.00		0.15	0.01	0.00	0.00	0.00	0.00	0.00
31	0.00		0.00	0.72		0.56		0.00		0.00	0.00	
TOTAL	**0.01**	**9.57**	**3.72**	**12.44**	**18.86**	**2.93**	**2.20**	**3.24**	**0.07**	**0.01**	**0.36**	**0.04**
MEAN	**0.00**	**0.32**	**0.12**	**0.40**	**0.67**	**0.10**	**0.07**	**0.10**	**0.00**	**0.00**	**0.01**	**0.00**
MAX	**0.01**	**1.76**	**1.44**	**2.26**	**3.68**	**0.62**	**0.76**	**0.85**	**0.03**	**0.01**	**0.26**	**0.02**
MIN	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
Max 1hr	**0.01**	**0.57**	**0.39**	**0.54**	**0.60**	**0.27**	**0.22**	**0.26**	**0.01**	**0.01**	**0.06**	**0.011**
CAL YR												
WTRYR	**53.45**											

Water Year 1998

Pine Gulch Rainfall

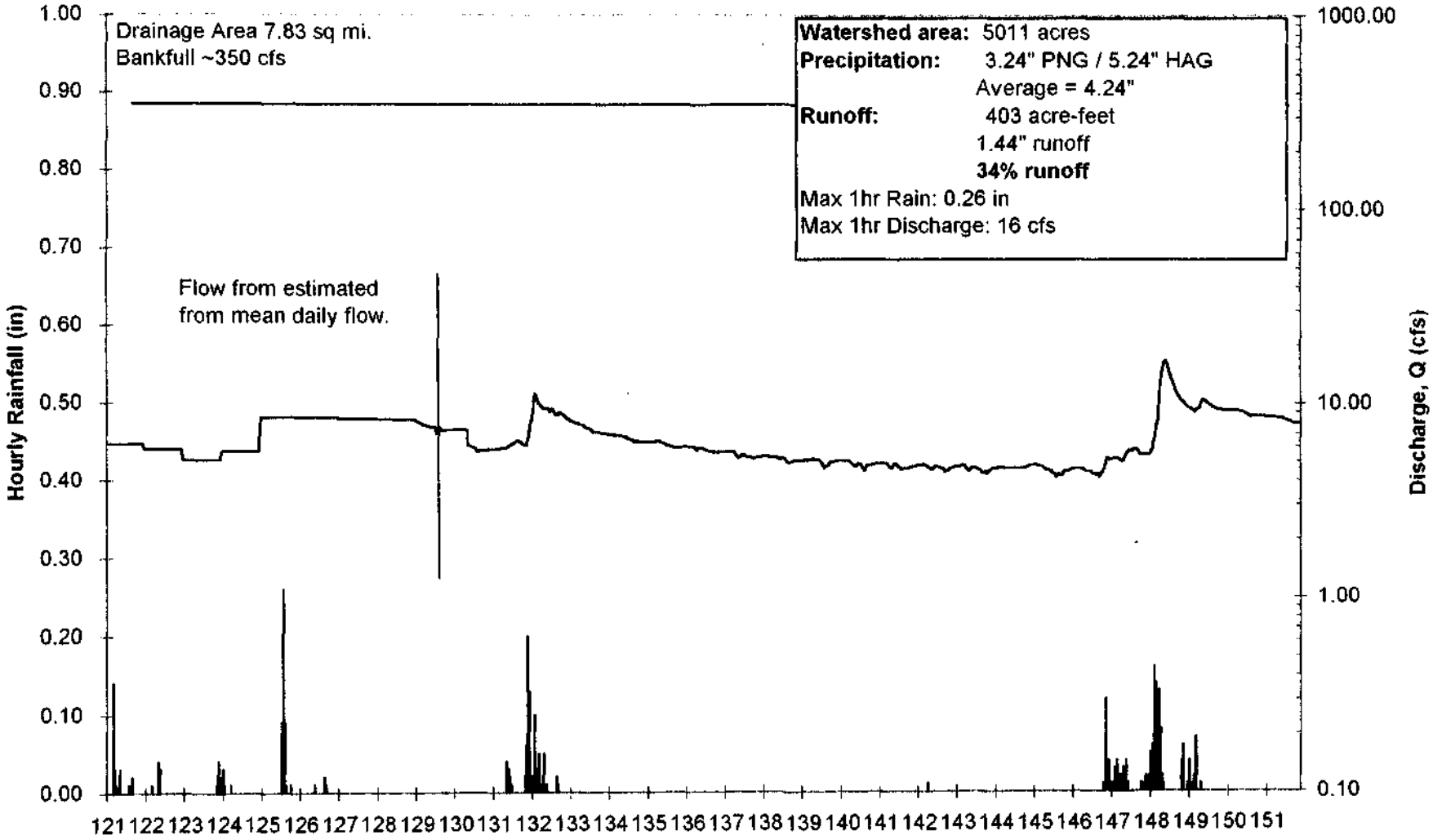
Daily Rainfall

	October	November	December	January	February	March	April	May	June	July	August	September
1	0.00	0.02	0.06									
2	0.00	0.00	0.05									
3	0.00	0.01	0.05									
4	0.00	0.00	0.02									
5	0.00	0.00	0.03									
6	0.00	0.41	0.03									
7	0.00	0.65	0.02									
8	0.04	0.09	0.03									
9	0.00	0.00	0.02									
10	0.00	0.18	0.02									
11	0.00	0.00	0.01									
12	0.00	0.00	0.01									
13	0.02	0.00	0.01									
14	0.00	0.00										
15	0.00	0.00										
16	0.00	0.07										
17	0.00	0.03										
18	0.00	0.00										
19	0.00	0.00										
20	0.00	0.00										
21	0.00	0.17										
22	0.00	0.02										
23	0.00	0.38										
24	0.87	0.13										
25	0.00	0.04										
26	0.00	0.03										
27	0.00	0.01										
28	0.01	0.02										
29	0.00	0.07										
30	0.00	0.04										
31	0.01											
TOTAL	**0.95**	**2.42**	**0.36**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
MEAN	**0.03**	**0.08**	**0.03**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**	**#DIV/0!**
MAX	**0.87**	**0.65**	**0.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
MIN	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

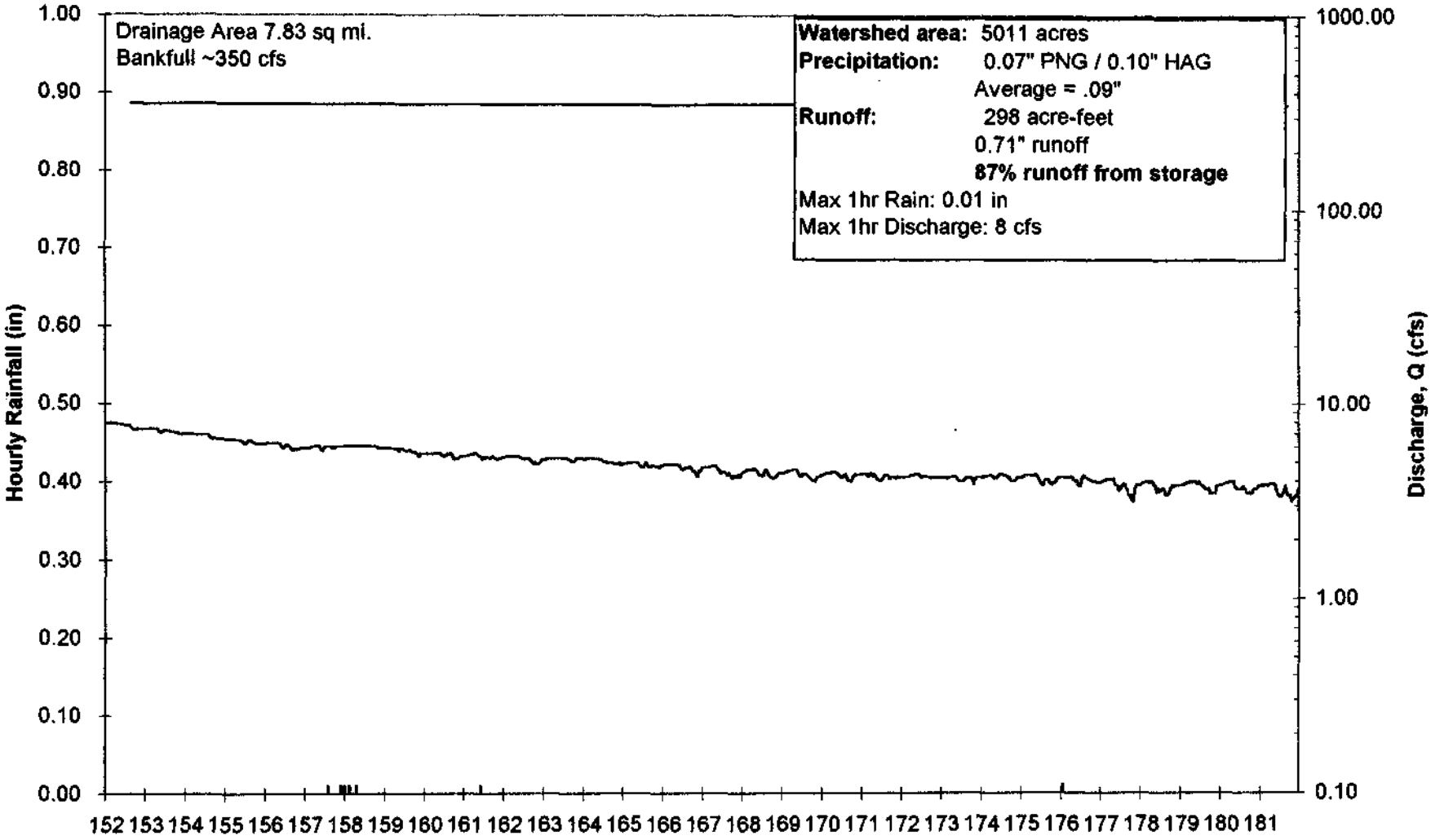
Max 1hr	**0.38**											

CAL YR	
WTRYR	**3.73**

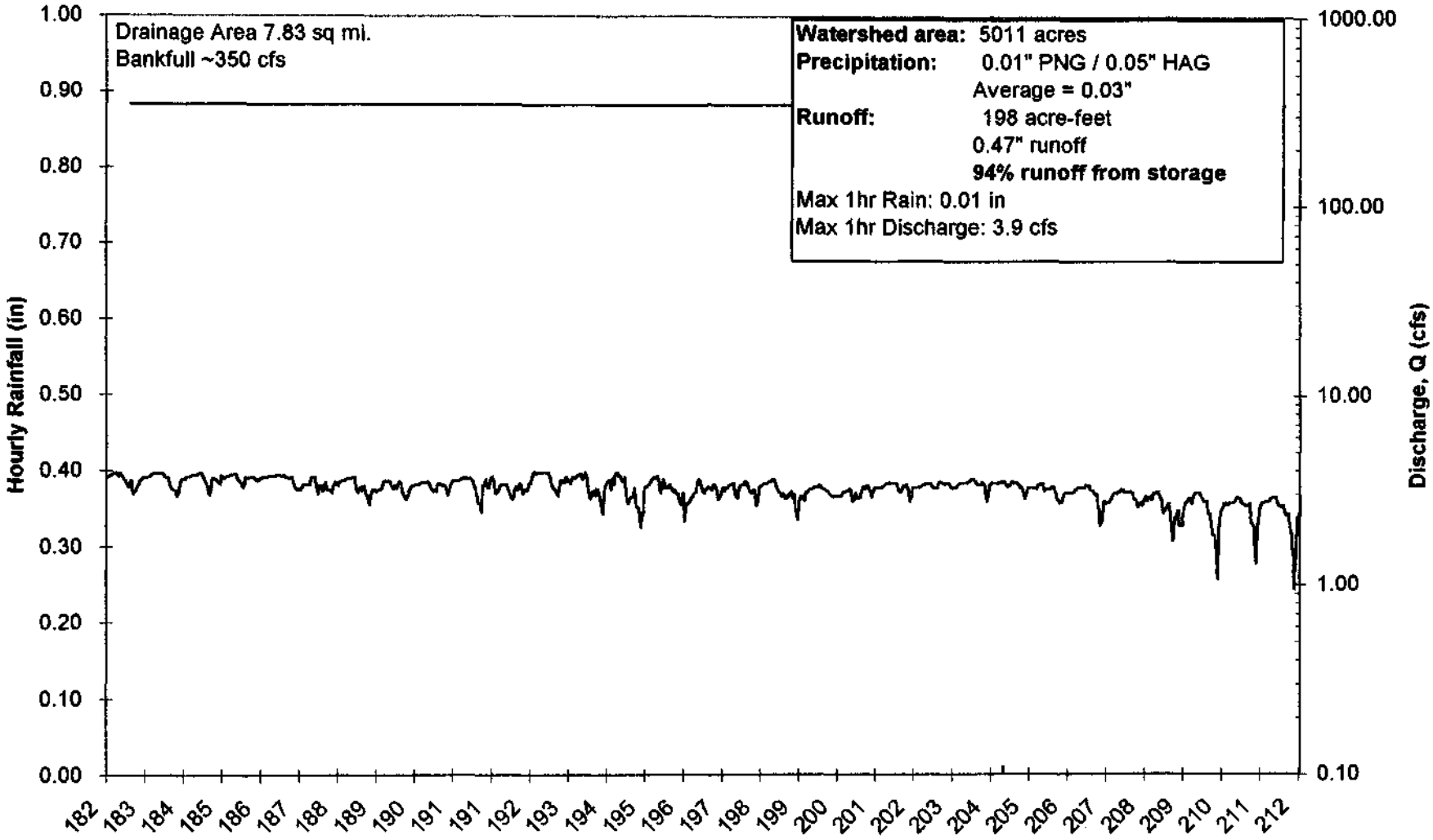
Pine Gulch Creek Rainfall-Discharge
May 1998



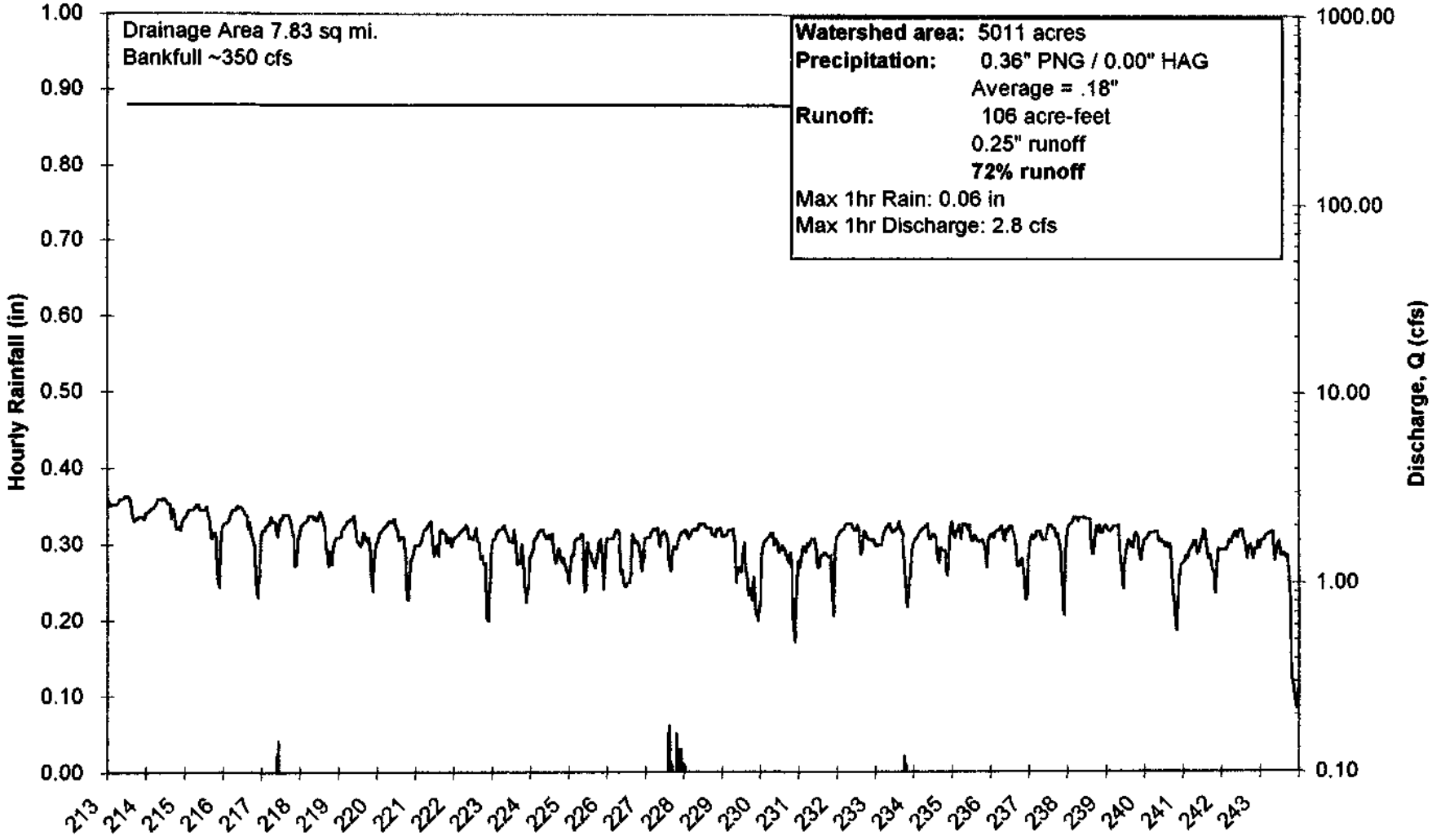
Pine Gulch Creek Rainfall-Discharge
June 1998



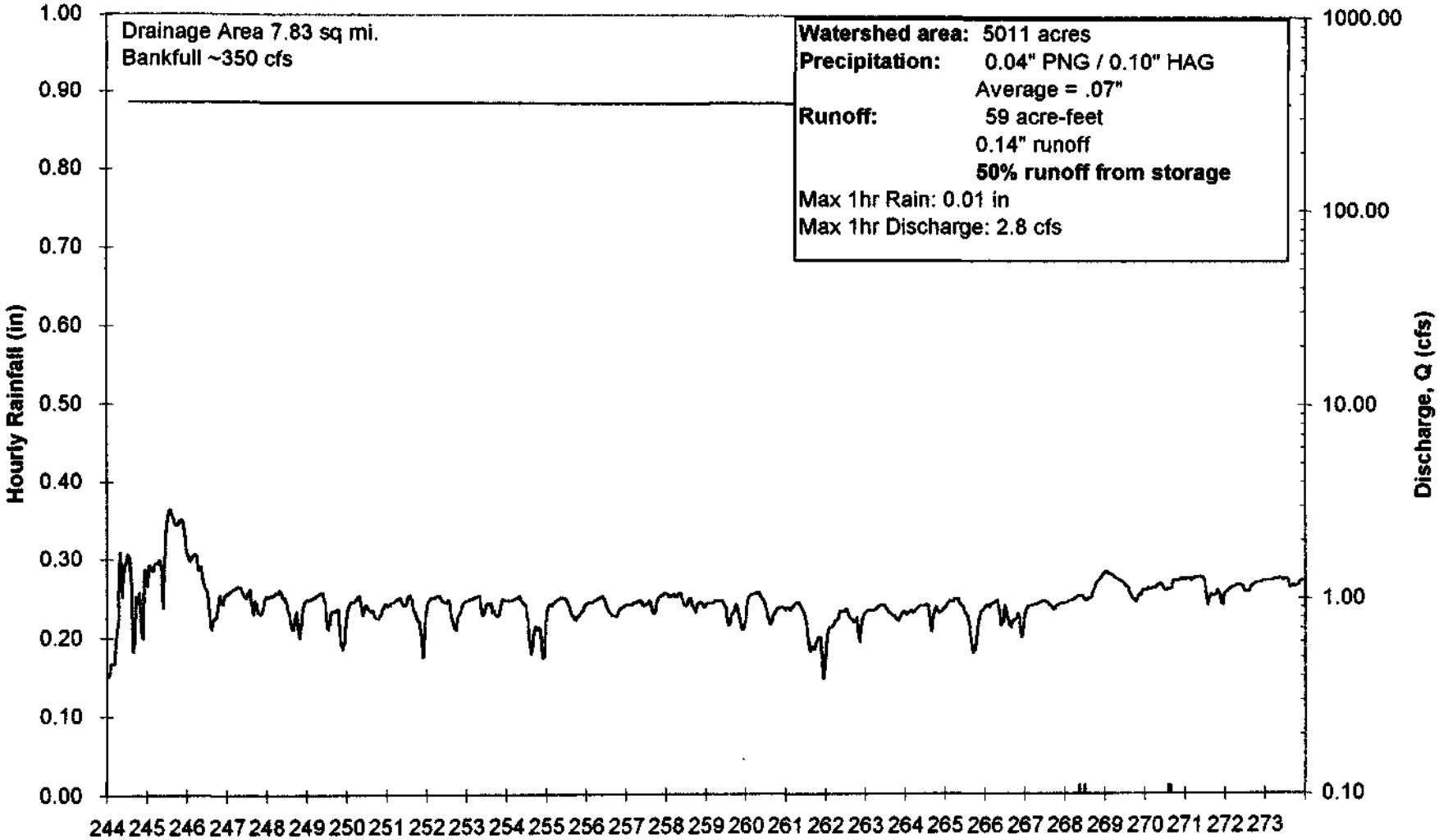
Pine Gulch Creek Rainfall-Discharge
July 1998



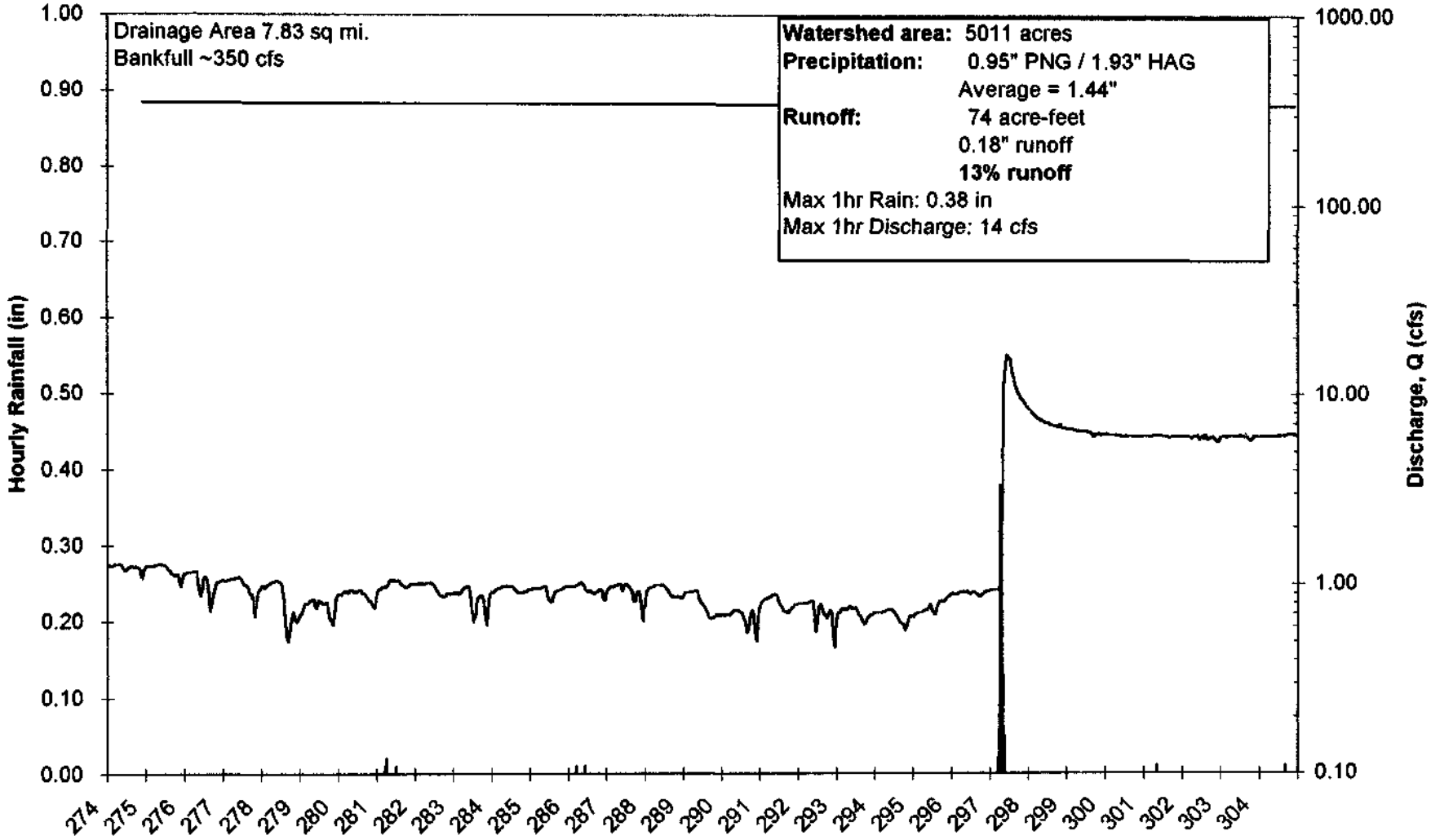
Pine Gulch Creek Rainfall-Discharge
August 1998



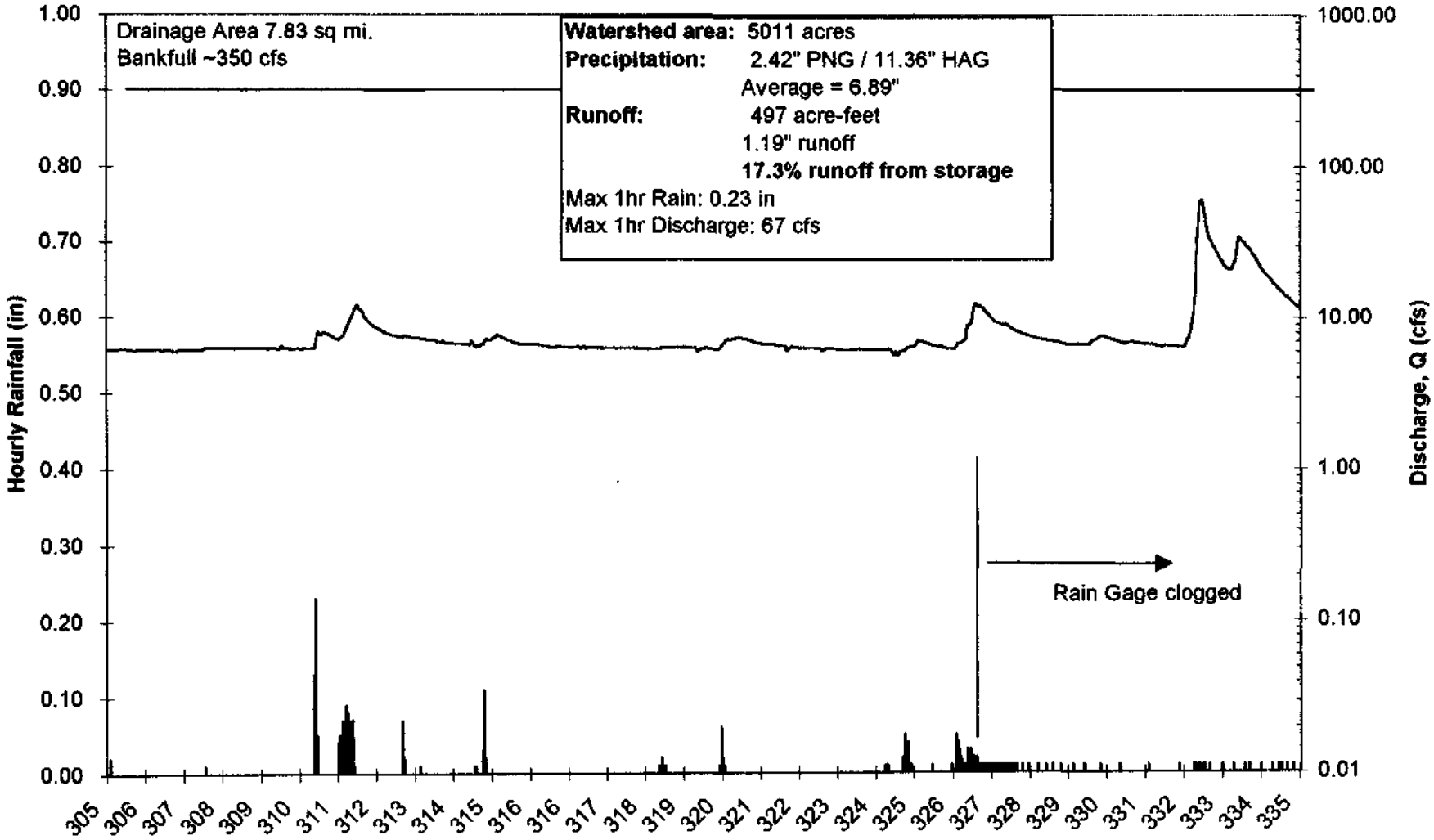
Pine Gulch Creek Rainfall –Discharge
September 1998



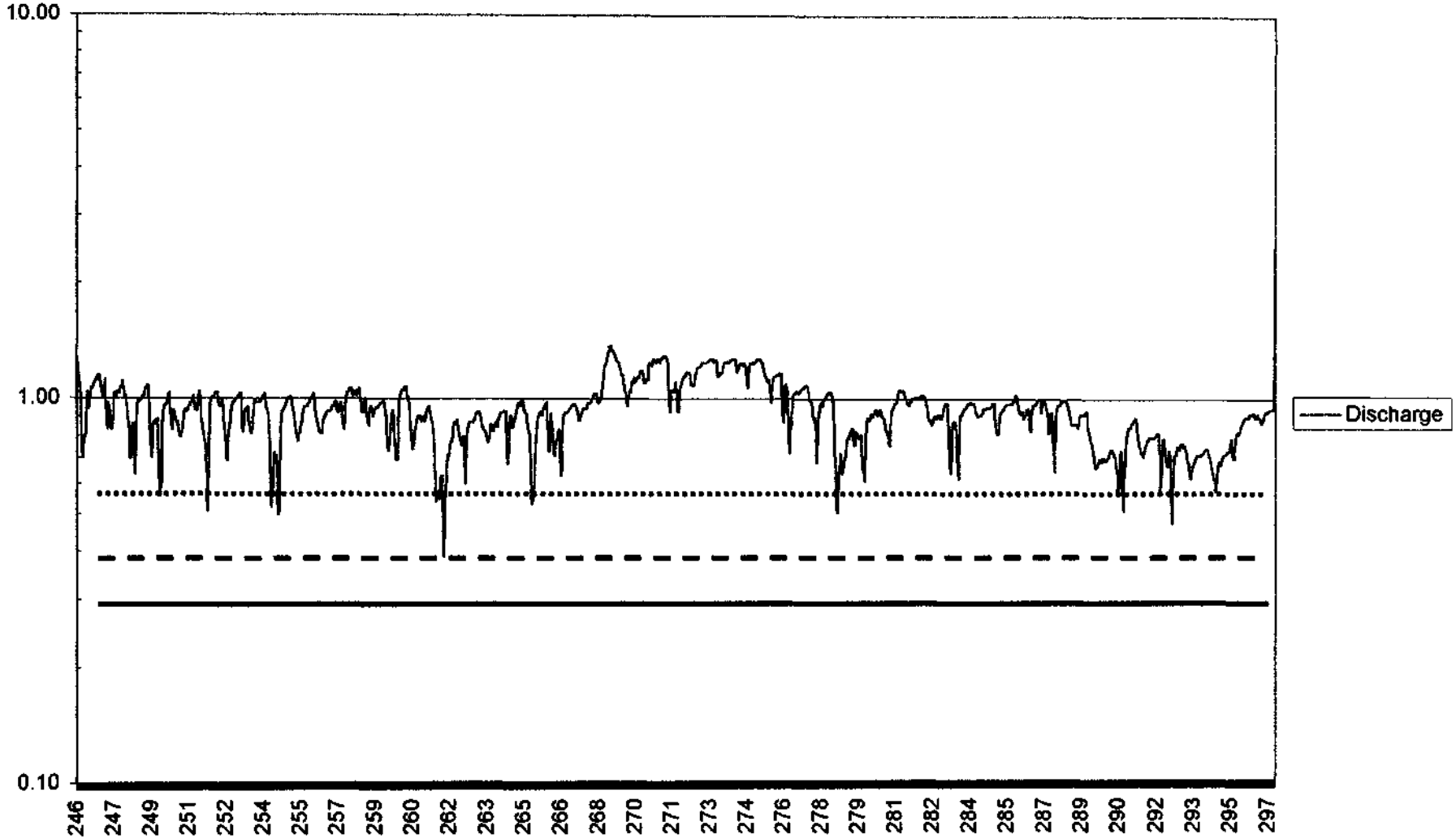
Pine Gulch Creek Rainfall-Discharge
October 1998



Pine Gulch Creek Rainfall-Discharge
November 1998



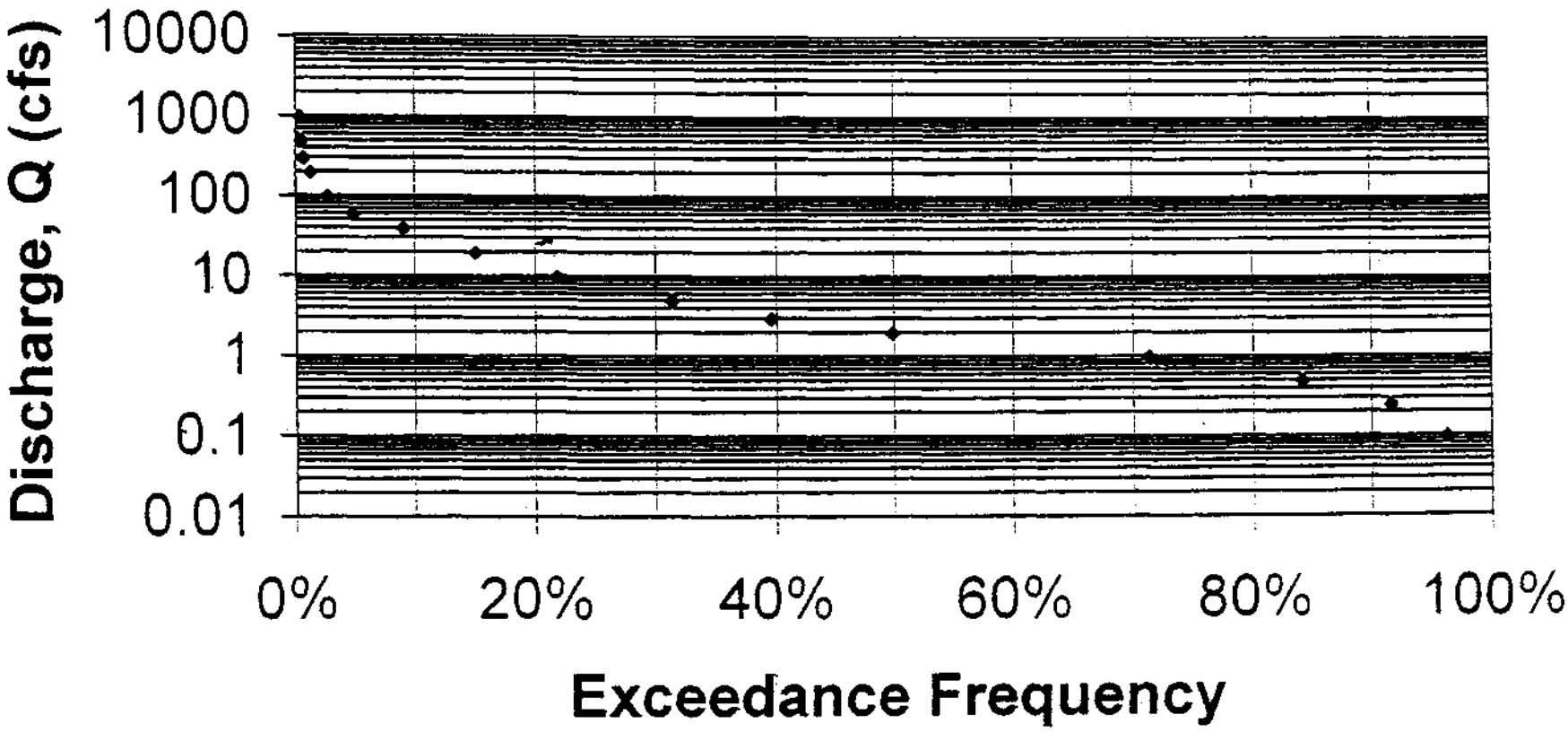
PNG Pumping
Wier
September 2 - October 22, 1998



Discharge Duration Curve

Pine Gulch Creek

WY 1967-70



Bear Valley Rainfall Records

Precipitation Data Summary

Rainfall Information

Redwood and Pine Gulch 1-day files also have rainfall information in them. The Olema gage has no rain gage, but we use the data from the headquarters weather station, which is within 500 meters of the site. The Bear Valley rainfall data is stored within the weather file in d:/CSRP Streams/. Inside that file there is information from WY 1997 and 1998. There are three types of files that are very important to the hydrologic monitoring information.

D:/CSRP Streams/Rainfall/BVY History/annualrain.xls

This file contains all of the historic rainfall information for the headquarters area. Beginning in 1965, daily rainfall information was recorded. In 1989, the seashore contracted with a person from the NWS to compile all of the data. The file has three main sheets:

BVY Normal Data: This has all of the monthly information. Mean monthly rainfall, maximum and minimum values are included for the period of record. There are some return interval calculations which is most useful considering annual rainfall. The rainfall total that we had for WY 1998 was a 20-year interval.

BVY Intensity Sheet: This sheet was developed from historic daily rainfall totals. It identifies the maximum amount of rainfall for a given number of days. This is a good indicator of rainfall duration records. I have developed a sheet to do these calculations annually. The results from the annual sheets should be added to the intensity sheet to continue this body of record.

There are some return interval calculations which is very useful for determining how often such rain intensities are met. Now that we have an hourly record of rainfall, it is possible that we determine intensities for these smaller periods of time. This could be done in a manner similar to what is shown in the DEPTH DURATION FREQUENCY SHEET. This only has a 10-year record of information from Point Reyes Station.

D:/CSRP Streams/Rainfall/WY**/ Note ** stands for different water years… 97, 98, 99

Beginning in 1997, we installed a recording weather station adjacent to the Red Barn. This enabled us to record and maintain hourly rainfall information. This is nice for the purpose of calculating rainfall intensities. In order to keep track of this information, I have established worksheets to store all of this information. The sheets do all of the summarizing of the information.

This past month, we installed tipping bucket rain gages at a few sites, including Hagmaiers (the headwater for both Olema and Pine Gulch), Pierce Point, the lighthouse, and one more is left to be installed at the FAA site on top of Mount Vision. These stations can store up to 80 inches of information. Therefore you could leave it for most of a season and then summarize the rainfall. I have tried it once. It is a little bit laborious breaking all of the information into hourly data… Basically it has to be done by hand. Once complete, it can be entered into the hourly sheet for the different stations.

*/BVYWY**.xls:* This worksheet contains all of the hourly rainfall data. There are separate sheets for each month. The sheets have been refined so that all you have to do is paste in the hourly data, and all of the daily data is calculated and displayed. There is a running cumulative total. Just enter in the final number from the previous month at the top of the new month.

There is also a sheet labeled WY**. This is a summary sheet for the daily rainfall during the entire water year. Just copy the values from the monthly sheets to this summary page for display.

Monthly Rainfall totals should be added to the annualrain.xls file at least once per year.

*/BVY***day.xls:* This contains the sheet to do all the calculations for the *BVY Intensity Sheet*. All you have to do is enter the daily information into the table, and all of the calculations are made. At the end of the year, the values of the results should be copied over to the Intensity Sheet.

BVY Normal data

Bear Valley — DAILY TOTAL RAINFALL — E10 0572 00
Point Reyes National Seashore — 38°02'38", 122°47'50", 50'

Average	**39.60**	**2.13**	**5.77**	**6.70**	**8.79**	**6.22**	**5.85**	**2.39**	**0.96**	**0.18**	**0.10**	**0.15**	**0.37**
Max	79.84	5.74	18.20	16.09	22.39	24.68	24.28	6.60	6.35	0.79	2.58	1.82	2.54
Min	15.03	0.00	0.61	0.01	0.40	0.47	0.24	0.00	0.00	0.00	0.00	0.00	0.00
Count	32	34	33	33	33	33	34	34	34	34	34	34	34
WYYear	**Sum**	**Oct**	**NOV**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**
1964													
1965	**38.60**	3.52	7.18	8.38	7.55	2.29	3.06	6.60	.01	.01	.00	.00	.00
1966	**27.65**	.20	5.69	3.53	10.31	4.54	1.46	1.19	.12	.17	.01	.28	.15
1967	**54.79**	.00	10.97	*12.00*	18.11	.49	7.16	5.10	.26	.67	.00	.00	.03
1968	**30.97**	1.57	*4.00*	3.93	7.58	5.35	6.45	.75	.56	.00	.00	.68	.10
1969		4.77	4.28	12.71			2.70	3.32	.17	.13	.00	.00	.00
1970	**48.82**	3.58	2.04	12.49	21.80	3.92	4.27	.27	.06	.39	.00	.00	.00
1971		2.90			1.64	.59	6.16	1.50	.97	.00	.00	.00	.00
1972	**26.04**	.56	4.08	9.34	3.03	5.15	1.15	2.29	.06	.35	.00	.03	.00
1973	**54.91**	5.74	9.10	5.78	16.76	9.90	5.98	.02	.10	.00	.00	.00	1.53
1974	**61.66**	3.41	**18.20**	8.50	8.23	4.65	10.41	5.40	.03	.25	**2.58**	.00	.00
1975	**32.07**	1.65	2.38	3.41	1.64	11.03	9.13	2.08	.15	.17	.34	.09	.00
1976	**21.10**	5.29	2.92	1:62	.49	4.39	.62	3.17	.07	.01	.06	**1.82**	.64
1977	**15.03**	.54	2.53	1.32	4.04	2.06	2.62	*.00*	*.00*	*.00*	.08	.00	1.84
1978	**46.56**	1.16	5.34	8.00	12.51	7.52	6.73	3.99	.08	.04	.00	.08	1.11
1979	**31.60**	.02	2.80	1.07	13.33	7.10	4.26	1.58	1.34	.04	.02	.00	.04
1980	**40.46**	4.21	5.89	7.92	7.97	9.48	1.85	2.50	.46	.17	.00	.00	.01
1961	**23.91**	.59	.61	4.26	7.90	2.55	6.68	.05	.73	.00	.01	.00	.53
1982	**55.47**	3.61	9.19	14.06	13.30	6.01	7.12	1.50	.00	.05	.00	.00	.63
1983	**79.84**	3.27	12.90	5.06	11.49	15.55	**24.28**	5.00	1.65	.00	.18	.43	.03
1984	**35.50**	.65	11.14	12.80	.40	2.55	2.65	2.30	2.00	.67	.00	.13	.21
1985	**32.27**	3.66	13.40	3.17	1.20	3.73	5.82	.17	.09	.09	.07	.00	.87
1986	**53.42**	1.47	5.84	3.65	9.38	17.13	8.47	2.83	1.58	.53	.00	.00	**2.54**
1987	**26.85**	.44	1.02	3.32	7.89	6.65	6.70	.79	.04	.00	.00	.00	.00
1968	**26.33**	1.43	3.75	11.17	7.46	.54	.24	1.74	.00	.00	.00	.00	.00
1989	**37.58**	.33	8.46	5.75	2.95	2.03	13.28	3.06	.19	.10	.00	.00	1.43
1990	**26.07**	2.71	1.95	.01	7.62	4.25	2.26	.92	**6.35**	.00	.00	.00	.00
1991	**25.05**	.00	.62	2.11	1.45	4.43	13.67	2.15	.62	.00	.00	.00	.00
1992	**32.12**	4.91	1.98	4.65	3.19	9.53	6.09	1.73	.00	.00	.00	.04	.02
1993	**44.13**	4.54	1.23	8.76	13.67	7.83	3.48	2.31	1.64	.67	.00	.00	.00
1994	**25.67**	1.38	4.92	3.79	3.90	7.28	.60	2.35	1.26	.14	.00	.00	.05
1995	**63.38**	.13	10.42	5.50	**22.39**	1.77	15.02	4.93	2.44	**.79**	.00	.00	.00
1996	**46.35**	.00	.73	13.40	10.32	9.95	2.73	4.83	4.17	.08	.00	.00	.15
1997	**39.91**	1.38	4.50	**16.09**	12.61	*.47*	1.09	1.11	.38	.45	.00	1.40	.43
1998	**72.81**	2.84	10.31	3.48	17.99	**24.68**	4.56	3.59	5.19	.06	.03	.00	.08
1999													
2000													

BVY Intensity Sheet

Rainfall Depth-Duration-Frequency for Bear Valley-Point Reyes

12/17/98	DWR #E10 0572 00	Elev	Lat	Long
4:41 PM	Analysis By Jim Goodridge 916 345 3106	feet	dd.ddd	ddd.ddd
	Data From : Wm Shook, Nat Park Ser	50'	38.044	122.797

estimated
maximum **Maximum Rainfall For Indicated Number Of Consecutive Days**

	1	**2**	**3**	**4**	**5**	**6**	**8**	**10**	**15**	**20**	**30**	**60**	**W-YR**
WY													
1965	2.05	3.11	3.70	4.67	5.28	5.84	6.83	7.46	10.21	13.37	13.81	19.96	38.60
1966	6.00	7.72	7.90	7.98	8.61	8.79	10.15	11.58	12.29	12.29	12.53	17.64	27.65
1967	6.42	**9.83**	**10.58**	**10.58**	**12.31**	12.53	13.98	**16.33**	18.01	18.09	18.17	*30.11*	59.67
1968	2.91	3.54	3.66	3.68	4.75	4.77	4.98	5.47	5.80	6.30	8.00	14.84	*30.97*
1969													
1970	5.07	6.02	6.42	6.62	7.90	9.20	13.03	14.43	17.97	21.27	21.83	34.32	48.82
1971													
1972	2.22	3.05	3.56	3.83	4.67	4.78	4.78	4.86	6.82	7.90	10.60	13.55	26.04
1973	3.07	5.71	5.79	7.97	8.47	9.17	11.58	13.84	15.28	15.92	18.77	29.48	54.91
1974	3.88	4.72	5.97	6.03	7.63	9.39	11.94	12.21	15.51	16.77	19.22	28.73	61.66
1975	2.96	3.98	3.98	4.65	5.43	6.41	8.00	8.80	9.95	11.03	11.38	20.16	32.07
1976	2.00	2.08	2.08	2.61	3.12	3.12	3.12	3.13	3.32	4.63	5.91	8.44	21.10
1977	2.10	2.10	2.10	2.27	2.37	2.42	2.58	2.58	2.62	2.62	3.89	4.68	15.03
1978	*2.80*	*3.80*	4.75	6.03	6.35	7.70	8.36	8.73	11.47	12.51	15.56	24.48	46.56
1979	4.45	4.50	4.92	7.57	8.54	8.58	11.66	11.85	12.22	12.22	13.35	21.45	31.60
1980	3.05	4.22	5.53	6.03	6.50	7.05	7.63	7.95	9.48	10.89	11.07	18.25	40.46
1981	2.50	3.50	4.05	4.69	4.69	4.72	6.77	6.98	7.90	7.90	9.14	14.71	23.91
1982	**7.10**	7.60	8.85	8.85	8.95	10.28	11.90	12.45	13.88	21.70	23.92	33.21	59.93
1983	6.70	6.70	7.38	8.90	8.90	10.20	13.58	14.68	**19.73**	**26.03**	**31.28**	**46.02**	**79.84**
1984	5.50	5.50	6.80	6.80	6.80	6.80	6.80	6.80	9.00	11.40	12.80	23.94	35.50
1985	3.63	3.63	5.27	5.27	5.38	6.32	7.27	7.38	9.40	11.46	14.07	17.74	32.27
1986	4.05	6.85	9.25	9.95	11.10	**13.50**	**15.10**	15.58	15.60	16.98	19.58	32.62	53.42
1987	3.50	3.60	4.86	4.96	5.66	5.66	5.66	5.66	6.62	8.42	11.37	18.09	26.85
1988	2.26	2.96	3.40	3.63	4.44	5.24	5.93	7.84	8.56	9.91	11.17	19.41	26.33
1989	2.70	3.07	3.11	3.75	4.12	4.32	5.33	6.58	8.61	10.09	13.28	16.31	36.15
1990	2.37	3.87	4.07	4.16	4.29	4.32	6.16	6.38	6.98	7.05	9.01	12.51	27.50
1991	2.51	3.51	4.02	4.62	5.62	5.86	5.91	6.87	8.18	9.28	14.9	18.31	25.05
1992	4.5	4.51	4.51	4.86	4.87	5.11	6.11	7.13	8.94	9.33	11.48	16.63	32.08
1993	2.62	3.7	4.22	4.6	5.54	5.54	7.07	9.29	11.45	12.37	15.21	23.04	44.19
1994	1.95	3.05	3.55	3.63	4.07	4.5	4.5	4.7	6.2	7.34	9.88	11.18	25.62
1995	3.90	7.01	7.02	7.55	8.02	9.00	11.14	11.75	14.27	17.52	22.29	27.89	63.43
1996	4.86	8.26	8.29	8.59	9.16	9.16	9.42	9.42	10.25	12.52	13.55	26.13	46.20
1997	3.51	4.61	5.29	6.57	7.67	7.73	9.45	9.47	12.29	12.31	20.38	28.71	*38.23*
1998	4.19	5.55	6.81	7.72	10.19	12.51	14.33	14.95	17.6	22.1	29.04	42.68	72.81
1999													
2000													

Rainfall Depth-Duration-Frequency for Point Reyes Station

12/17/98 DWR#E10 7088 20 Elevation 31'
4:41 PM Analysis By : Jim Goodridge 916 345 3106 Latitude 38°04'
Data From : Marin Co PWD Longitude 122°48'

	Maximum Rainfall For Indicated Number Of Consecutive Minutes										
Year	5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr	W-Yr
1975	.23	.29	.33	.41	.57	.85	1.22	1.72	2.34	3.45	27.85
1976	.07	.09	.13	.25	.50	.82	1.05	1.33	1.66	1.88	15.13
1977	.14	.26	.34	.47	.52	.73	.78	.88	1.33	2.54	13.03
1978	.21	.30	.36	.45	.69	.90	1.28	1.97	3.66	5.97	41.61
1979	**.32**	**.38**	.40	.54	.65	.88	1.19	1.76	2.72	2.98	27.61
1980	.23	.31	.33	.43	.59	.83	1.08	1.92	2.23	2.93	34.82
1981	.12	.15	.20	.37	.65	.89	1.00	1.67	1.87	3.57	21.08
1982	.21	.38	**.44**	**.83**	**1.13**	**1.68**	**2.43**	**4.25**	**6.49**	**8.07**	50.51
1983	.15	.25	.38	.50	.82					2.96	**54.71**
1984	.17	.26	.34	.44	.56	.87	1.18	1.87	2.01	3.20	28.59
1985	.11	.19	.29	.45	.70	.95	1.10	1.18	2.32	3.07	27.92
1986	.14	.28	.31	.55	.93	1.61	1.81	2.01	3.18	4.84	47.63
1987	.08	.14	.20	.30	.52	.71	.88	1.50	2.60	3.37	22.04
1988	.17	.21	.22	.31	.50	.96	1.09	1.25	1.30	2.42	24.73
1989											
Average	.17	.25	.31	.45	.67	.98	1.24	1.79	2.59	3.66	31.23
Stdev	.07	.09	.09	.14	.18	.31	.43	.81	1.35	1.62	12.94
Rec Max	.32	.38	.44	.83	1.13	1.68	2.43	4.25	6.49	8.07	54.71
YrsRec	14	14	14	14	14	13	13	13	13	14	14
CV	.402	.344	.287	.312	.274	.314	.350	.454	.522	.444	.414
RegCV	.404	.404	.404	.404	.404	.404	.404	.404	.404	.404	.336
Reg Skew	1.3	1.3	1.3	1,3	1.3	1.3	1.3	1.3	1.3	1.3	0.5
FIC	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
RP 2	.15	.23	.28	.41	.61	.89	1.13	1.64	2.37	3.35	30.39
RP 5	.22	.32	.39	.58	.86	1.26	1.60	2.31	3.35	4.73	39.73
RP 10	.26	.39	.48	.71	1.05	1.54	1.95	2.83	4.09	5.78	45.09
RP 25	.31	.46	.56	.83	1.23	1.81	2.29	3.32	4.80	6.78	51.28
RP 50	.35	.52	.63	.94	1.39	2.03	2.57	3.73	5.39	7.61	55.47
RP 100	.39	.57	.70	1.03	1.53	2.24	2.84	4.12	5.96	8.41	59.46
RP 200	.42	.63	.77	1.13	1.67	2.45	3.11	4.50	6.51	9.19	63.14
RP 500	.47	.70	.85	1.26	1.86	2.72	3.45	5.00	7.23	10.21	68.80
RP 1000	.50	.75	.92	1.35	2.00	2.93	3.72	5.39	7.79	11.00	71.22
RP 10000	.62	.92	1.12	1.66	2.45	3.59	4.56	6.60	9.55	13.48	81.82

ERROR CODES

3 -- Program Table full
4 -- Intermediate Storage full
5 -- Final Storage Area 2 not allocated
8 -- CR10X was reset by watch dog timer
9 -- Insufficient Input Storage
10 -- Low battery voltage
11 -- Attempt to allocate unavailable storage
12 -- Duplicate *4 ID
20 -- Subroutine encountered before END of previous subroutine
21 -- END without IF, LOOP, or SUBROUTINE
22 -- Missing END
23 -- Non-existent SUBROUTINE
24 -- ELSE in SUBROUTINE without IF
25 -- ELSE without IF
26 -- EXIT LOOP without LOOP
27 -- IF CASE without BEGIN CASE
30 -- IFs and/or LOOPS nested too deep
31 -- SUBROUTINES nested too deep
32 -- Instruction 3 and interrupt subroutine use same port •
33 -- Cannot use control port 6 as counter with Instruction 15 or SDM
40 -- Instruction does not exist
41 -- Incorrect Execution Interval
60 -- Insufficient Input Storage
61 -- Burst Measurement Scan Rate too Short
62 -- N<2 in FFT

*D Mode Errors
94 -- Program storage area full
95 -- Flash program does not exist
96 -- Addressed device not connected
97 -- Data not received within 30 seconds
98 -- Uncorrectable errors detected
99 - Wrong file type or editor error

DAY OF YEAR CALENDAR

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
JAN	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
FEB	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59			
MAR	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
APR	91	92	93	49	95	96	97	98	99	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115	116	117	118	119	120	
MAY	121	122	123	124	125	126	127	128	129	130	131	132	133	134	135	136	137	138	139	140	141	142	143	144	145	146	147	148	149	150	151
JUN	152	153	154	155	156	157	158	159	160	161	162	163	164	165	166	167	168	169	170	171	172	173	174	175	176	177	178	179	180	181	
JUL	182	183	184	185	186	187	188	189	190	191	192	193	194	195	196	197	198	199	200	201	202	203	204	205	206	207	208	209	210	211	212
AUG	213	214	215	216	217	218	219	220	221	222	223	224	225	226	227	228	229	230	231	232	233	234	235	236	237	238	239	240	241	242	243
SEP	244	245	246	247	248	249	250	251	252	253	254	255	256	257	258	259	260	261	262	263	264	265	266	267	268	269	270	271	272	273	
OCT	274	275	276	277	278	279	280	281	282	283	284	285	286	287	288	289	290	291	292	293	294	295	296	297	298	299	300	301	302	303	304
NOV	305	306	307	308	309	310	311	312	313	314	315	316	317	318	319	320	321	322	323	324	325	326	327	328	329	330	331	332	333	334	
DEC	335	336	337	338	339	340	341	342	343	344	345	346	347	348	349	350	351	352	353	354	355	356	357	358	359	360	361	362	363	364	365

Add 1 to unshaded values during leap years.

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