I. Objectives

1. Calculate and plot flood recurrence data.

II. Introduction

Gauges placed along a stream monitor the volume of water in the stream, referred to as discharge, at several locations. The USGS and other organizations collect the data from gauging stations to determine the frequency of flooding along the stream. Estimates of flood frequency become more accurate when many years of discharge records are used. The flood frequency is typically expressed as a recurrence interval. To calculate the recurrence interval, the peak annual flood of the stream is used. The peak annual flood is the highest discharge recorded for the year at a gauging station.

III. Materials

Data sheets, log normal graph paper or EXCEL graph, rulers, calculators

IV. Theory and Calculations

The formula for determining the recurrence interval (T, in years) for a flood of a given discharge is:

$$T = \frac{(n+1)}{m}$$

where n = the number of years of record (labeled "span" in data table), and m = the rank or order of the annual flood discharges from the largest (1) to the smallest (11) for the number of years of record. The recurrence interval is calculated from the peak annual flood data and plotted on a flood frequency graph. The line on a flood frequency graph allows geologists to estimate the average number of years that will elapse until a flood of a particular magnitude reoccurs. Flood frequency graphs are used in flood prediction.

V. Prelab Definitions

1. recurrence interval

2. flood frequency

3. peak annual flood

4. best-fit line

5. rank

VI. Lab Procedure

Divide into groups of 2-4 students. Half your group will be working with Sabino Creek Data Sets 1 and 2 in Table 2, and the other half of your group with the Green River Data Sets 1 and 2 in Table 2. Most data sets cover 11 years with 11 annual flow records but one has some missing data and its 11 records span 31 years. Use your assigned data set to estimate the likely discharge for a 100-year flood for each period of record.

1. For each data set assigned, rank the peak flood discharge in order of magnitude, starting with 1 for the largest and ending with 11 for the smallest. Write these results in the Rank columns C and G of Table 1.

2. Using the equation in the **Theory and Calculations** section, based on the ranked flow, calculate the Recurrence interval and write the results in columns D and H.

3. Plot the peak flood discharge (y) and recurrence interval (x) for each of the 11 floods from Data Set 1 for your assigned stream.

4. Using a ruler, draw a best-fit straight line through the data points. If you do not know how to draw a best-fit line, ask your instructor. The line should be extended all the way to the right side edge of the graph.

5. Plot the peak flood discharge and recurrence interval for each of the 11 floods from Data Set 2 on the same graph paper. Using a ruler, draw a best-fit straight line for this data. The line should be extended all the way to the right side of the graph.

6. Based on where the best fit line intersects the grid line for a recurrence interval of 100 years, read the estimated discharge value from the y-axis. This value is your estimate of the 100 year flood!

Table 1: Flow Recurrence Intervals							
Sabino Creek – Data Set 1				Sabino Creek – Data Set 2			
A	B	C	D	E	F	G	H
Span 11 yrs	Peak flood discharge (cfs)	Rank (1 = largest)	Recurrence interval	Span 31 yrs	Peak flood discharge (cfs)	Rank (1 = largest)	Recurrence interval
1948	350			1976	7730		
1949	1430			1977	2750		
1950	2260			1978	7400		
1951	750			1983	6500		
1952	1640			1991	2600		
1953	861			1993	12900		
1954	5100			1995	3530		
1955	2000			1996	2900		
1956	55			1999	15400		
1957	2030			2005	13120		
1958	1500			2006	16000		
Green River – Data Set 1				Green River – Data Set 2			
A	B	C	D	E	F	G	H
Span 11 yrs	Peak flood discharge (cfs)	Rank (1 = largest)	Recurrence interval	Span 11 yrs	Peak flood discharge (cfs)	Rank (1 = largest)	Recurrence interval
1941	9310			1976	4490		
1942	10900			1977	9920		
1943	12900			1978	6450		
1944	13600			1979	8730		
1945	12800			1980	5200		
1946	22000			1981	9300		
1947	9990			1982	10800		
1948	6420			1983	9140		
1949	9810			1984	10900		
1950	11800			1985	7030		
1951	18400			1986	11800		

VII. Lab Discussion

1. Based on your data, what is the predicted discharge for a 100-year flood? To find this information, read the value from your graph where it intersects the 100 yr recurrence interval line.

Table 2: Estimated 100-Year Flood Discharges Based on Recurrence Intervals	
Data sets	Estimated discharge (cfs) for a 100-year flood
Sabino Creek – Data Set 1 (1948-1958)	
Sabino Creek – Data Set 2 (1976-2006)	
Green River – Data Set 1 (1941-1951)	
Green River – Data Set 2 (1976-1986)	

2. How do your estimations of the 100-year flood compare to each other? Remember you are comparing Data Set 1 and 2 **for the same river**.

3. Suggest possible human activities in the watershed that could have caused the differences in predicted floods that result from the two sets of data for your river.

4. Based on the flood predictions for all four data sets, what does the contrast in predicted flood discharges imply about the usefulness of the 100-year flood as a legal designation for these two streams?

5. If you are about to buy a house that is located adjacent to, but just outside the 100-year floodplain, what information should you obtain before purchasing your home?

Lab courtesy of Dr. Jim Washburne