2006 California Envirothon
Aquatics Station
Total = 100 points

Please write team number on top of each page of test. You may unstaple the test and work on questions in any order, however, pages should be returned to their correct order when turned in. You may choose to *split your team up* and work on multiple questions at once or work on questions together. Please show all work, as you may receive partial credit where possible.

I. Water Cycle

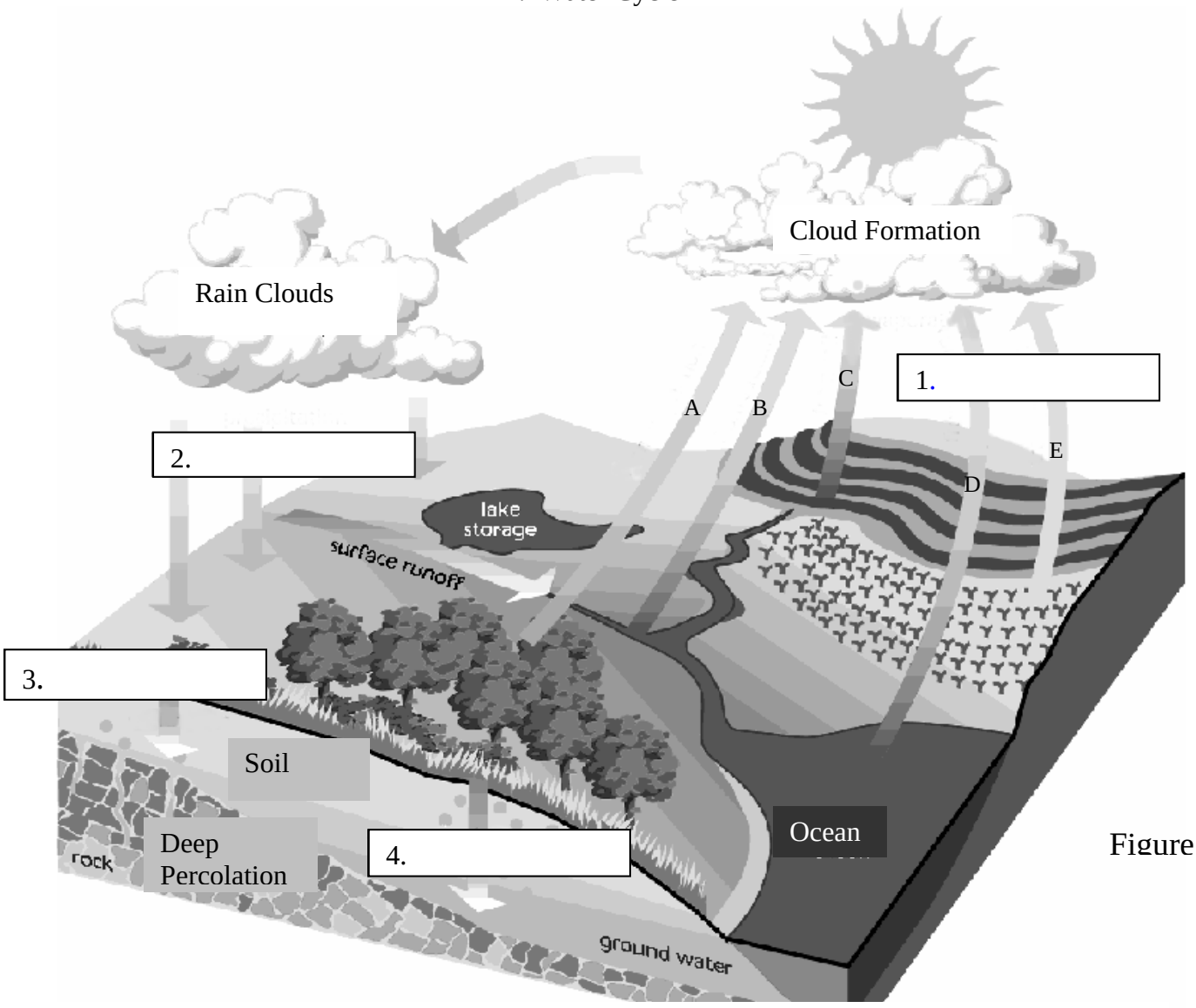


Figure 1.

The next five questions apply to Figure 1. (Answers to 1-5 can be found at: http://www.usda.gov/stream_restoration/newtofc.htm, Chapter 2, Page 2.3-2.4

1. This figure is an illustration of the transfer of water from precipitation to surface water and ground water, to storage and runoff, and eventually back to the atmosphere. What is this cycle called? _____ (1 pt..)

Surface Runoff	Percolation	Precipitation
Infiltration	Evaporation	Transpiration
Erosion	Consolidation	Perspiration

3. There are five arrows pointing towards the cloud formation. These are lettered A-E. These arrows represent processes or locations where moisture for cloud formation comes from. List the processes or locations in the blanks provided below. (5 pts)

   A. _____ B. _____

   C. _____ D. _____

   E. _____ (Hint: The arrow at location E is moving up from a broad-leafed crop plant with lots of surface area. This crop uses lots of water.)

4. Precipitation can do one of three things once it reaches the earth. What are those three things? (3 pts)
   a. _____
   b. _____
   c. _____

5. A portion of precipitation never reaches the ground because of vegetation, forest floors, or other surfaces. What is this process called? (Hint it is not evaporation, it is the process of being hung up on surface objects) (1pts)_____

6. Impervious surfaces such as pavement and rooftops generate _____ more runoff than a woodland area of the same size. (1 pt)
   (Answer at http://www.epa.gov/owow/nps/facts/point7.htm)

   a. 4 times b. 6 times c. 9 to12 times

II. Physical Processes

7. You will be using channel geometry to estimate the amount of water currently in the creek at the pool cross-section site using the electronic level. To do this you will need to know three things.

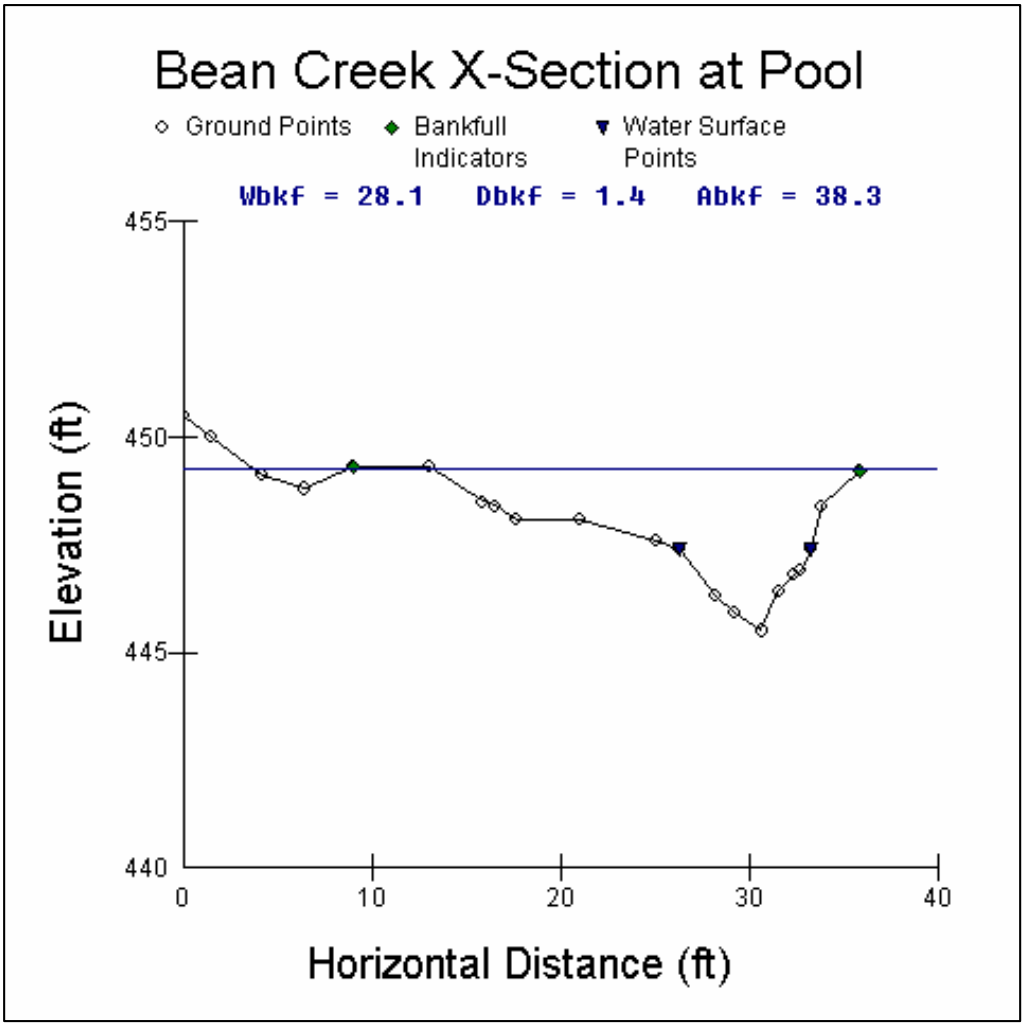
   a. You must first know the elevation of a reference point, commonly known as a Bench Mark or BM. The rebar is our BM and exists at an elevation of 450feet above sea level. Enter this value in the chart on page 4. (2 Points)

   b. Next you will need to determine the instrument height or the HI (to the nearest 10^{th} of a foot). To do this you will first set the rod on the BM (or rebar) and add this reading to the BM elevation to determine your HI. Enter this value in the chart on page 4. (2 Points)

   c. To establish the level of the current water surface you will need to subtract the rod reading (foresight, FS) at the waters edge from the HI. This will give your current water

surface elevation (to the nearest 10th ft.). Enter this value in the on the chart on page 4. (2 Points)

d. Graph this elevation directly on the Bean Creek X-Section at Pool graph below. (2 Points)



e. Using your vast math knowledge determine the current area that the water occupies in the channel. Enter this value in the chart on page 4. (2 Points)

f. Because you know the volume of water at the cross-section you can determine a rough estimate of discharge using the continuity equation Q=VA; where Q is discharge in feet^3/second, V is velocity in feet/second, and A is area in feet^2. Assume the water is flowing at 0.5 feet per second what is the discharge at the pool site in feet^3/second (cfs)? Enter this value in the chart on page 4. (2 Points)

Item	Value
• BM (given)	450 (2)
• HI (BM+Rod Reading)	(2)
• FS (measure)	(2)
• Water Surface Elevation (HI-FS)	(2)
• Cross-Sectional Area (calculate)	(2)
• Discharge in cubic feet/sec (calculate)	(2)

8. The continuity equation does not account for physical conditions of the channel as it leaves out roughness of the bed and does not account for slope of the channel; Manning's accounts for roughness and slope. Manning's equation is as follows:

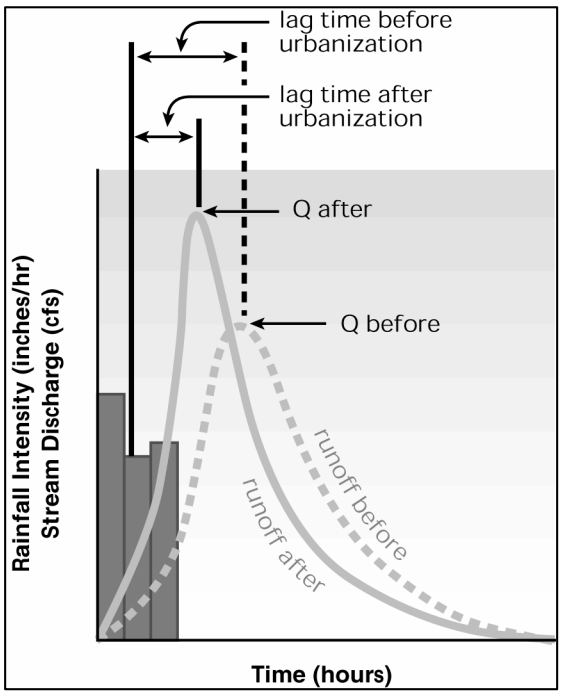
$$Q=1.46/n\ (A)\ (A/WP)^{2/3}\ (S)^{1/2}$$

Where: Q =discharge in cfs
n=Manning's roughness coefficient=.035
A=Area in feet^2 (calculated above)
WP=wetted perimeter (measure off cross-section below)
S=slope = .018

Using your values from the problem above for A (area), measure the wetted perimeter from the cross-section, use 0.035 for n, 0.018 for S, and calculate the new Q or discharge. Be sure to set up the problem on the test so we may see your work. Record this value in the chart below. (4 Points)

a. Discharge using Q=VA	(1)
b. Discharge using Manning's Equation $Q=1.46/n\ (A)\ (A/WP)^{2/3}\ (S)^{1/2}$	(2)
c. Difference	(1)

9. Which value do you believe is the most correct and why? (2 Points).
http://www.usda.gov/stream_restoration/newtofc.htm, Ch 7, Page 7-18)



10. The figure below is a storm hydrograph. It shows how stream discharge changes over time in response to a storm event. This area under the curve is the amount of water and how it is distributed in the creek after a storm. Look at the line that represents before and after urbanization and answer the following questions: (http://www.usda.gov/stream_restoration/newtofc.htm, Ch 1, Page 1-15)

a. Does the storm water runoff of an urbanized environment more or less quickly than an un-urbanized environment? (2 Points)

b. Look at the hydrographs for before and after urbanization. Why do you think there is a difference in their shapes? (2 Points)

c. What physical changes in the urban environment causes the change in the storm hydrograph? (2 Points).

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d. What Best management Practices could be used to help restore the storm hydrograph to a more pre-urbanized condition? (2 Points)

e. If the timing of water is important for human use (e.g. draught in the summertime), what do you notice about the hydrograph for post urbanization that might affect baseflow levels? What would you propose to cause this to happen? (3 Points) http://www.usda.gov/stream_restoration/newtofc.htm, Ch 1, Page 1-15)

f. Again considering the timing of water flows how would you expect the hydrograph to respond to climate changes that result in the reduction of spring snowpack, earlier snowmelt, and more runoff in the winter months with less runoff in the spring and summer? (How would the hydrograph look?)(2 Points)

_____

_____

g. How would you expect the lag time to change? Increase or Decrease? (2 Points)

h. How do you think this climate change would affect the size material in Bean Creek and why? (2 Points)

11. Returning to the concept of discharge and Manning's Equation, If we were to remove some of the fine material in the creek what would that do to the roughness of the channel and how would that affect the stream discharge? (2 Points)

12. Take a look at the watershed map on page 11. Do you notice how the creek and its watershed appear to be offset? Isn't this an interesting pattern? Look at the other creeks in the area. Do they follow the same trend? Do you have an explanation for the pattern seen on the topographic map of the watershed? (2 Points)

III. Chemical Processes

13. The following table has water quality data taken from the creek that flows along the soccer field up the hill. It also has some data from Bean Creek. Fill in the blanks in the table using the water quality test kits provided. (10 Points)

Test/Location	Bean Creek	Soccer Field Creek
a. Time/Date	(2)	N/A
b. Air Temperature	(2)	N/A
c. Water Temperature	(2)	N/A
d. PH	(2)	6.0
Dissolved Oxygen (DO)	11-12 ppm	9 ppm
e. Alkalinity	(2)	52 ppm
Nitrate	1.1 ppm	8.8 ppm

a. What differences do you notice about the water quality of Bean Creek versus that of the Soccer Field Creek? (2 Points)

b. Given that the Soccer Field Creek is much more likely to be affected by urbanization, what do you think might be the cause of the water quality differences between the two creeks? (2 Points) http://www.epa.gov/safewater/dwh/c-ioc/nitrates.html,

IV. Biological Processes

14. The chemical, physical and biological conditions of an aquatic system are very closely related. Looking back at the physical condition of bottom size distribution, why and how does this affects the following?

    a. Fish Spawning and Rearing (2 Points)

    b. Macroinvertebrate (aquatic insects) habitat (2 Points)

15. Given the current conditions of Bean Creek where would you expect to find aquatic insects and why? (2 Points)

16. Select some brave soul from your team to go and investigate this habitat type. What did you find? (2 Points)

17. Laid out on the table are some aquatic insects collected from Bean Creek. Using the identification cards, classify the insects and draw them below. You may draw the insects you discovered from your investigation above and you may use the back of this paper if you need to. (12 Points)

Name	Drawing

18. What does the diversity of insect type lead you to believe about Bone Creek? (2 Points)

6. What does the sensitivity of the insect populations you identified tell you about Bean Creek? (2 Points)

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7. Looking up at the channel banks and the type of vegetation present in the ecosystem what do you notice? (2 Points)

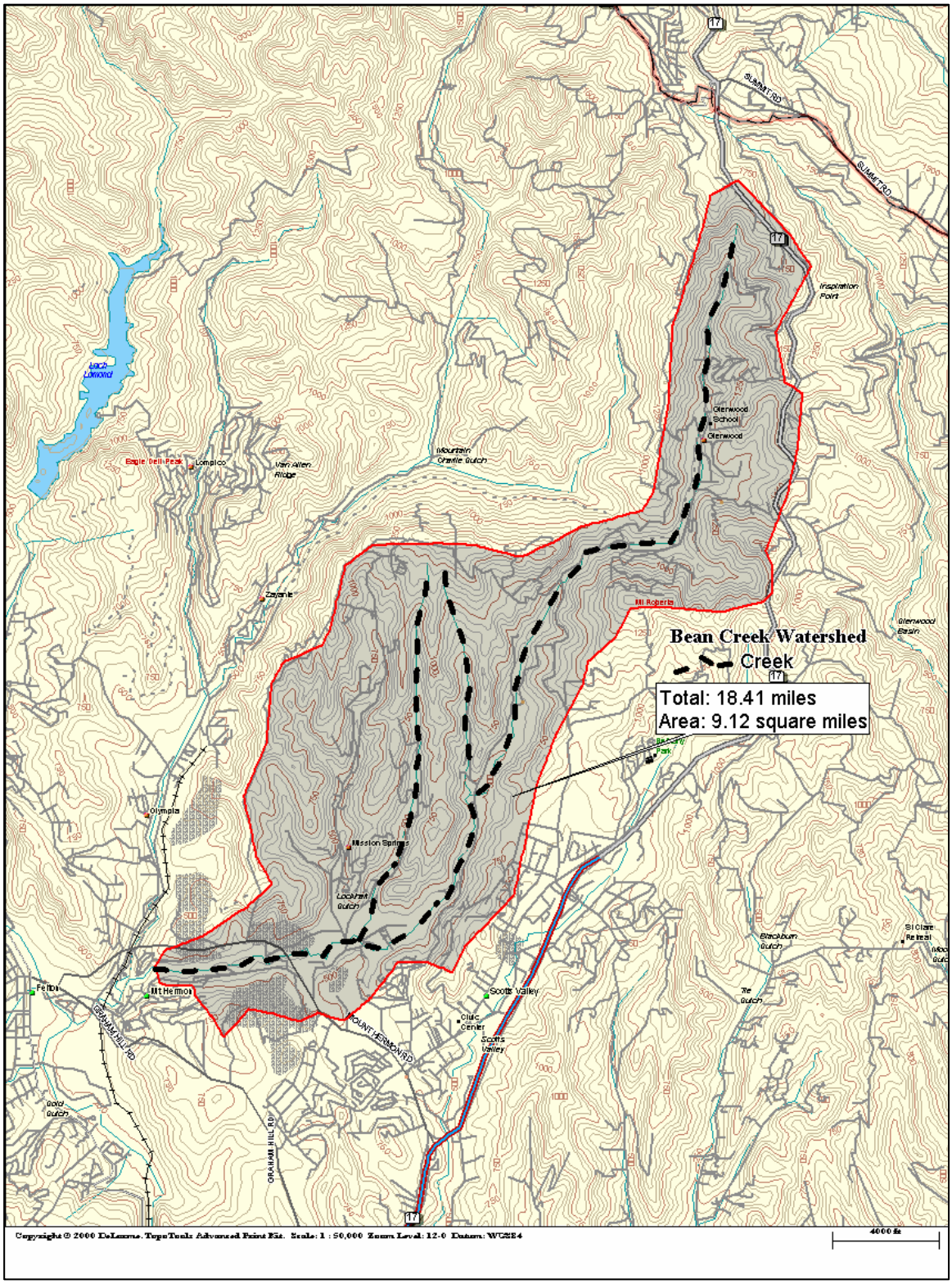
19. Consider yourself an aquatic ecologist who has just been asked to summarize the effect of urbanization on the chemical, physical and biological condition of Bean Creek. Please provide a short summary of the effects that natural and man caused influences may have had on this ecosystem. (5 Points)

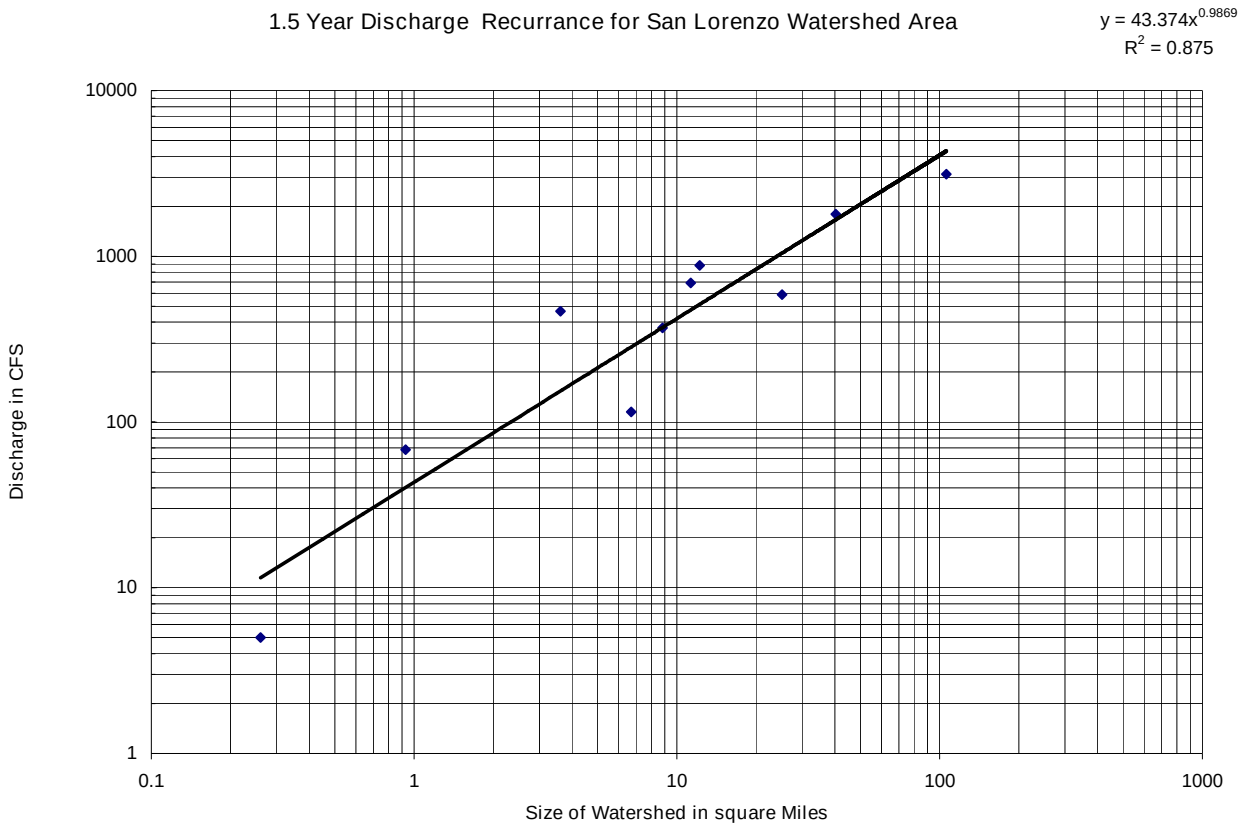
Chemical:

Physical:

Biological:

Map of the Bean Creek Watershed


Bean Creek Watershed
Creek
Total: 18.41 miles
Area: 9.12 square miles
Loch Lomond
Lompico
Zayante
Mt Roberts
Glenwood School
Glenwood
Inspiration Point
Mission Springs
Olympia
Mt Hermon
Felton
Scotts Valley
Civic Center
Scotts Valley
SUMMIT RD
GRAHAM HILL RD
MOUNT HERMON RD
17
Copyright © 2000 DeLorme. TopoTools Advanced Print Ed. Scale: 1 : 50,000 Zoom Level: 12-0 Datum: WGS84
4000 ft


1.5 Year Discharge Recurrance for San Lorenzo Watershed Area
y = 43.374x^0.9869
R^2 = 0.875
Discharge in CFS
10000
1000
100
10
1
0.1
1
10
100
1000
Size of Watershed in square Miles