Geomorphology Field Exercise -- Flow gauging

Your name:
The others in your group:

Today's lab will give you some practice in measuring important stream characteristics and calculating discharge rates.

We will split into SIX groups; each group will have a surveyor's level, tripod and a rod, a flow meter, ruler, and tape. Groups will work on sections of the Huntington River, each section consisting of a pool and a riffle.

You will each be responsible for using your collected data to calculate total stream discharge (Q) and Manning's friction coefficients (*n*) for the pool and riffle in which you worked. Each person should hand in his/her own calculations at the **start of next Wednesday's lab**. Your calculations should be explicit and show all unit conversions.

FIRST – Fill your 1 liter bottle with stream water from a flowing part of the river trying not to disturb the bottom. We will use this for suspended sediment determination.

SECOND – Use the syringe to draw up some river water then squirt it out. Repeat 3 times. Then, refill the syringe and place the filter on the top. Slowly squeeze the syringe to force water through the filter and into the 15 ml tube. Make sure there is at least 10 ml in the tube then cap tightly. Before the day is over, add a drop of nitric acid to the water in the tube. Filtering removes particles that could clog the ICP and could release metals when the acid is added. The acid keeps metals in solution and off the walls of the tube.

<u>Slope Determination</u>

WATER SURFACE slope must be measured with a surveyor's level and rod. This is a difficult but important measurement. Do it well! Calculate WATER SURFACE slopes for both the pool and riffle parts of the channel. Slopes can be determined by recording the difference in elevation measurements between an upstream and a downstream point in the pool and in the riffle. Spread out your measurement points as far as possible within the pool and within the riffle to get a more accurate slope value. This value (the "rise") divided by the distance measured between the two points (the "run") will give you the slope of the pool or riffle.

	Rise (meters)	Run (meters)	Slope (unitless)
Your Pool			
Your Riffle			

<u>Discharge Measurements</u>

Stream discharge or flow (Q) is equal to area (A) times velocity (V), so you'll need to make both velocity and channel geometry (i.e. cross-sectional area) determinations.

Using the surveying equipment, measure depth across the river to produce a representative river cross-section. This cross section should extend from top of bank to top of bank. Record these data and draw a cross section in the field using the graph paper provided. Choose a vertical and horizontal scale for which you can fit the whole cross section on the page. Divide the active channel part of the cross section into homogeneous (depth, flow characteristics) subsections.

Use a current meter to measure the current velocity (v) in the center of each subsection of the channel. It may be easiest to use a tape measure to determine where each measurement should be made. Based on the chosen scales or your graph, determine an area for each box on the graph paper. Count up the boxes in each subsection of your channel cross section to determine area (a). For each subsection, calculate the discharge by multiplying the area by the velocity: q = v x a

Add the areas calculated for each subsection to determine the total cross-sectional area (A) of the pool or riffle. Add the discharges calculated for each subsection to determine the total discharge (Q) in the pool or riffle. Calculate the wetted perimeter of the channel (P) by adding the total width (W) to twice the average depth: $P = W + 2(D_{AVG})$ or digitize your cross section but check your digitization by comparison with the above calculation; the results should be similar.

	A (m^2)	Q (m^3/sec)	P (meters)
Pool			
Riffle			

Bankfull Delineation

Check carefully around both your survey sites (riffle and pool) and estimate the height of bankfull flow. This height may be marked by a subtle terrace or a change in vegetation that reflects the yearly inundation. Survey the bankfull elevation and location so that you can include it on your cross-section.

Data Reduction

Now you can use your collected data to answer some questions about the characteristics of flow in the river.

The Manning equation can be used to estimate velocity or discharge in open channels. Open channels may include streams as well as pipes, culverts, manmade ditches, etc.:

$$Q\ (m^3/sec) = \frac{AR^{2/3}\ S^{1/2}}{n}$$

$$R = \text{hydraulic radius} = \frac{A}{P}$$

n = Manning’s friction coefficient

Note: The Manning’s Equation as shown here assumes units of meters. If feet are used, the numerator must be multiplied by 1.49.

1. Compare the slope of pools and riffles. Which has a higher flow gradient? How many times higher?

2. Compare the velocity between pools and riffles. Which has the higher velocity? How many times higher?

3. Compare the discharge between pools and riffles? How much do they differ? Why?

4. Calculate Manning's *n* for your pool and riffle. Show your work! How do the *n* values you calculate compare to each other and to those in the attached table? Are they reasonable? Speculate on the cause of any discrepancies you note.

5. I showed a graph of the extreme discharge values for drainage basins around the world. We would like you to compare the discharge you measured to the extreme discharge for a basin the size of the Huntington. To do this, you will need to find or measure the drainage basin area of the Huntington River above Audubon.

What is the drainage area of the Huntington above Audubon?

___________________ km^2 ____________________ $mile^2$

How does your flow estimate compare to the extreme discharge for a basin of similar size?

6. Last Spring, my hydrology class calculated, using data available on the web, the discharge one should expect for Vermont streams running at bankfull discharge based on the stream's drainage basin area. Use the attached graph to estimate bankfull discharge for the Huntington where we measured flow. Record your expected value here: _____________m^3/s.

7. Now, use your field observation of bankfull discharge height and Manning's equation to calculate a bankfull discharge for the Huntington River at Audubon farm. Assume "n" is same value you measured.

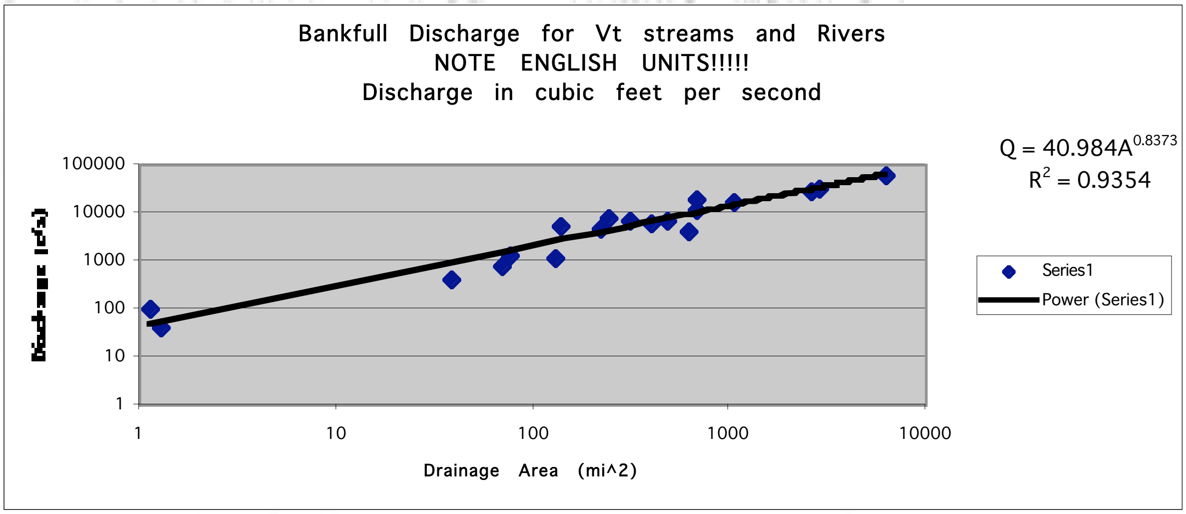
Show detailed calculations below and record your estimate for bankfull discharge here:

_____________m^3/s.

How close is your estimate of bankfull discharge to the regional estimate? Did you pick the right level in the field? What other assumption might cause error?

20 Divisions/Inch 5th, 10th, Accent


22
10,000


Bankfull Discharge for Vt streams and Rivers
NOTE ENGLISH UNITS!!!!!
Discharge in cubic feet per second
Q = 40.984A^0.8373
R^2 = 0.9354
100000
10000
1000
100
10
1
1
10
100
1000
10000
Drainage Area (mi^2)
Series1
Power (Series1)