Experiment 9

Design of Field Discharge Measurement

Objectives:

- Use what you learned in class during the previous experiments and apply it to an in-the-field situation. You are to measure stream flow, i.e. volumetric flow across an arbitrary cross section.
- The challenge is to conduct this experiment or field measurement with very few easy to obtain materials and devices. Key here is that you do not have access to electricity, any electronics, devices that just need to be set up, Power tools (except a battery driven electric drill with changeable bits), etc. because of its remote location. Rather, you are supposed to do this with tools like a pickaxe, a hammer, a shovel, a bucket, a hand saw, and what else you can find at the location (there is no Home Depot or Lowes).

Background:

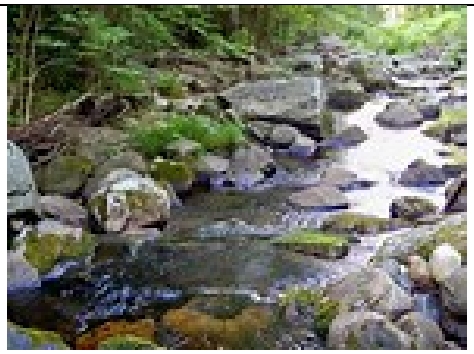
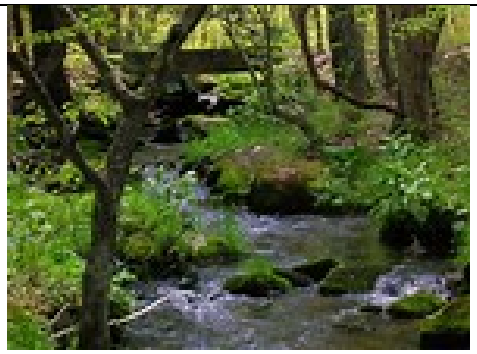
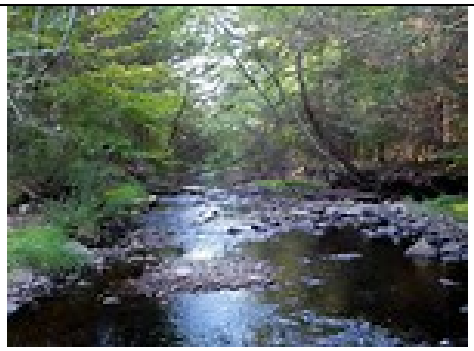
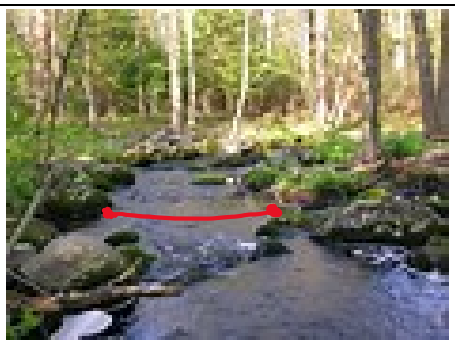
Many times, when in the field, you find that you need to measure flows while not having access to high-tech gadgets or other convenient flow measurement devices to do so. For example, when you work with Engineers without Borders in remote locations in Central America on water access improvement projects there is very little equipment available locally in addition to EWB not having the $$ to buy high grade equipment or are not being able to transport it to the location. Yet, remote streams need to be assessed for their ability to provide enough flow to the water access improvement project. The decision that need to be made is: is it worthwhile investing effort and $$ to divert/pump water or not? Do you need a second stream? Just imagine seeing yourself standing on the banks of a small stream (see the 4 images provided below) and needing to provide an answer that is supported with good numbers.

Set up:

The design task is a little open ended, there is no right number or one correct solution. This is because there could be several approaches that may work just fine. Also, there are no numbers given here so you need to work out a concept rather than a complete solution. This is more about you recognizing the task/problem at hand and describing and outlining a step by step process to get the discharge measured.

You are offered 4 different small streams the images of which you are shown below. These are quite typical of small rural areas and while they are small (and thus manageable and accessible) they are also challenging because of the small cross sections, small depths, irregular cross sections, and braided appearance.

Table 1 Stream Setups

 Stream 1	 Stream 2
 Stream 3	 Stream 4

Procedure

1) Pick one of these streams you want to work with. You probably need to assess (roughly) what the dimensions are …"at a location X (see my red line as an example) I think the stream is about 4m wide, I assume that it may have an average depth of 0.3m, perhaps using a trapezoidal cross-section, …" or you say …"I looked at this cross-section but think the one a few meters down stream (make the transition from looking at a 2-D image but associating a 3rd dimension when looking at it)"…
2) Describe how you want to measure discharge. Just do this conceptually at this point.
3) Now you build. You can introduce some small structures (you probably have to) but remember that you are in a rural area, no access by car, but you can walk some material and tools in (see list provided below). You can also move rocks and boulders, and also bring in twigs, branches, leaves, soil and dirt, i.e. "local building material".
4) You can use:
   - shovel
   - pickaxe

- hammer
- hand saw
- nails and screws
- electric (rechargeable battery) drill with changeable bits
- a couple of small wooden boards (2'x2', they are small and light enough to be carried)

5) You can either draw directly into the images (which is probably a little messy because it is tight in the 3rd dimension), or you can sketch what you see and use that as a construction plan background. It is important to convey with visuals how your system would look like (this is probably easier to understand for a 3rd person).
6) Recall how you measure discharge on the Armfield bench. How would you setup your stream cross-section and its alterations and then carry out a bench like measurement?
7) Lastly, any alteration to the stream must be temporary, i.e. you must return the stream to its pre-measurement condition once your assessment is done. This suggests that you better not build anything long-lasting but something that is easily removed. We do not want to impact the local biology, nor do we want to leave a hazard that could cause flooding.

Good luck!