**Earth Sciences 5550—Geomorphology**

**LAB 6: Stream Hydrology**

**Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Lab Period (Tues/Fri):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Lab Purpose and Objectives**

In this lab we shall take a brief field trip to Adena Brook, a first order tributary of the Olentangy River. We shall observe the stream, its setting, its bedrock, determine some stream velocity profiles, and measure some basic chemical and physical properties of the stream water.

**Stream geology, geomorphology, setting**

Draw a sketch of this stream. Draw what you can see from where you are standing. Describe the stream’s setting, predict what kind of flow it has, where the stream flow velocity is greatest, smallest. Where is deposition occuring? What kind of deposition? Why? Where is erosion ocurring? Why? Describe the stream (bank height, grain size, vegetation, etc.).

**Stream water field measurements**

Use the field meter to determine the temperature, pH, dissolved oxygen content, and specific conductivity of the stream. Include the units.

T = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

pH = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

DO = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Conductivity = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Stream discharge**

If you wanted to measure the volumetric discharge of water in this stream, how would you do it?

If you wanted a quick & dirty estimate of flow velocity, where would you measure it? Be specific. “In the water” is not a good response here.

**Laminar and turbulent flow**

In class you learned about laminar and turbulent flow. The dimensionless Reynolds number (*Re*) describes where laminar flow changes to turbulent as water depth and velocity increase. Laminar flow occurs at *Re*<500. Well-defined turublent flow occurs at *Re*>2000.

The Reynolds number is given by:

$Re=VRρ/μ$ (1)

where:

V is mean velocity [m/s]

R is hydraulic radius [m] (R=A/P)

 is density [kg/m3]

 is molecular (i.e., dynamic) viscosity [Pa  s] or [kg/m  s]

Remember that in a wide, shallow channel, the hydraulic radius approximates the mean depth.

Determine the Reynolds number for this stream.

The Reynolds number is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Is flow in this stream laminar or turbulent?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

If the flow is turbulent, calculate the Froude number, which is given by

$Fr=\frac{V}{\sqrt{dg}}$ (2)

where:

V is mean velocity

d is depth

 is gravity (9.8 m/s2)

The Froude number distinguishes among types of turbulent flow.

Tranquil flow has Fr < 1

Critical flow as Fr = 1

Rapid flow has Fr > 1

The Froude number for this stream is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The flow is characterized as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Stream flow determination**

*Area-velocity method theory (the traditional approach)*: The discharge **Q** of a stream at a given point can be expressed as the product of the cross-sectional area and the mean water velocity. To get a representative area, we measure the depth **D** at a small interval **w** (say, 0.2 m) and the velocity **v** at a small interval. The surface velocity is greater than the water velocity closer to the bed, but Adena Brook is such a shallow stream that you might not worry about this error in your calculations. From engineering studies, mean velocity of a given cross-section segment is approximately 60% of the surface velocity.

Water discharge for each stream segment is v\*D\*w, and the total water discharge is the sum of each segment’s discharge:

 (2)

where *v*i is the average velocity of a stream segment, *Di* is the depth of the segment, *w* is the interval at which you are measuring width, and *W* is the total number of segments across the channel.

Total width of stream channel\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |  |  |
| --- | --- | --- | --- |
| Distance | Depth, h | V at 0.2 h | V at 0.8 h |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |