

CHAPTER 3: MEASURING STREAMFLOW

IN THIS CHAPTER:

Measuring Stream flow (Discharge)

Interpreting Your Results

Introduction

How much water is flowing in your stream has a huge impact on fish, benthic macroinvertebrate and human communities, just to name a few. Not only is the quantity of water important, but the timing of floods during different seasons, velocity, and channel dimensions also have a big impact on how healthy the stream is for aquatic organisms in the stream. Drought years, such as the ones we experience during the year of this publication, make it even more critical to measure streamflow.

Streamflow will change seasonally based on the timing of snowmelt, summer monsoons and irrigation seasons. Several rivers run dry in different segments due to natural characteristics and human-induced “dewatering.” Large climate patterns such as El Niño/La Niña (El Niño Southern Oscillation or ENSO) also change the amount of water flowing in streams. For the past 30 years, New Mexico’s climate has generally been very wet. You and your students may be one of the few people in your community capable of tracking long-term stream flow changes to help inform people what the quantity of water is in your stream.

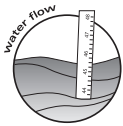
STREAMFLOW – WHAT AND WHY

What is Streamflow?

Streamflow is a measure of how much water is flowing in a small portion of a river at a specific time. The standard measurement for streamflow is cubic feet per second.

Why is Streamflow Important?

By measuring streamflow, students can determine how much life the river can support. The amount of water flowing in a river can affect many physical and biological characteristics of a river. Water temperature, levels of dissolved oxygen and turbidity are affected by streamflow. The temperature of water in slow flowing, shallow rivers tends to be warmer than that of deeper, faster-flowing rivers. Faster flow may cause waves and tumbling of water, which



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mixes atmospheric oxygen into the water thereby increasing dissolved oxygen levels. Faster flow of water can cause increased erosion of river banks which may result in elevated levels of turbidity. Thus, the rate of flow determines the conditions of the water, which determines the types of plants and animals living in and around the river.

Influences on Water Temperature

Natural factors

The geology of the area through which a river flows can affect streamflow. Water tends to flow faster over smooth surfaces, so if the riverbed is littered with boulders or large cobbles, this could slow the flow of water. Natural debris in the river, such as large boulders or downed trees or branches, can alter the course of the water, thereby slowing the flow.

Human influences

Land use activities can cause changes in streamflow. Damming of rivers controls the amount of water that flows and also when the water flows. Month-to-month changes in streamflow may vary greatly in undammed rivers, due to dry seasons, wet seasons, and spring run-off. These changes in streamflow might not be seen in dammed rivers.

INTERPRETING YOUR RESULTS

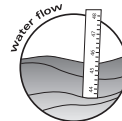
For small streams where water is generally cold (below 20 C) the following guidelines can be used to assess your flow data following Oswood and Barber (1982).

Excellent	Good	Fair	Poor
> 2 cfs	1-1.9 cfs	0.5-0.9 cfs	< 0.5 cfs

Greater than 2 cubic feet per second (cfs) is a bare minimum during low flow conditions that can produce and maintain a relatively stable environment in the river substrate.

Reflection Activity

Ask your students to consider the implications of how much water is flowing for the stream **if** the water was designated solely to serve humans.



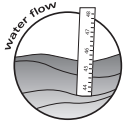
FIELD SHEET 1.1: MEASURING STREAMFLOW

The average person in New Mexico uses about 78 gallons of water per day for household use. In order to find out how many people this stream could support in one day, students can complete the following calculations:

$$\frac{\text{Streamflow in cfs}}{\text{Streamflow in cfs}} \times \frac{\text{gallons in 1 cf}}{\text{(7.4 gallons)}} = \frac{\text{gallons of water per second}}{\text{gallons of water per second}}$$

$$\frac{\text{Gallons per second}}{\text{Gallons per second}} \times \frac{\text{Seconds in minute}}{\text{Seconds in minute}} \times \frac{\text{gallons of water per minute}}{\text{gallons of water per minute}}$$

$$\frac{\text{Gallons of water per minute}}{\text{Gallons of water per minute}} \times \frac{\text{Number of minutes per day}}{\text{Number of minutes per day}} = \frac{\text{Total gallons of water per day in the river}}{\text{Total gallons of water per day in the river}}$$

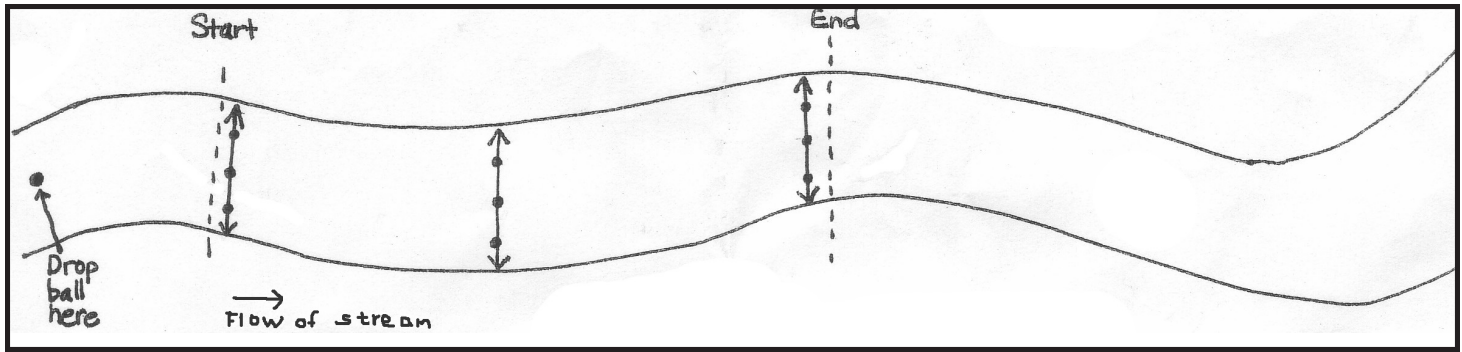


STREAMFLOW - HOW TO MEASURE

Streamflow is measured using a tape measure, yard- or meter stick, floatable object (such as a ping-pong ball or stick), timer, and data sheet.

1. Select a site. Find a fairly straight stretch of river where the water flows fast and the bottom is relatively flat.
2. Measure a length river at least 10 feet, placing a marker at the beginning point and another at the end point.
3. Drop a floating object in the center of the river at least 3 feet upstream of the beginning point.
4. Begin the timer once the floating object has reached the beginning point.
5. Stop the timer once the floating object has reached the ending point. (Note: if the object becomes lodged or stuck in an eddy, start the procedure over again.)
6. Drop the floating object into the river at least three times, recording the time it takes to travel the distance from beginning to end. Calculate an average time.
7. Measure the width of the river at the start point, the end point, and at a point midway between the start and end for a total of three width measurements. Calculate an average width.
8. Measure the depth of the river three times along each width line for a total of nine depth measurements. Calculate an average depth.
9. Divide the distance traveled by the floating object (usually 10 feet) by the average time of travel to obtain a velocity.
10. Multiply the average width by the average depth to obtain an area.
11. Multiply the velocity by the area to obtain a streamflow.
To obtain a final adjusted streamflow, multiply the streamflow by a factor of 0.9 for streams with a smooth bottom or for streams with a rough bottom use 0.8. This factor takes into consideration the uneven surface bottom of the river that will slow velocity down.

CALCULATING AND MEASURING STREAM FLOW



Measuring

1. Find a fairly straight stretch of river where the water flows fast and the bottom is relatively flat. Measure a 3-meter section, marking where it begins and ends. Record this as the distance in column A.
2. Drop a tennis ball (or preferably an orange or other citrus fruit) in the center of the river at least one meter upstream of the starting point. When the ball reaches the start point, begin timing in seconds. When the ball reaches the end point, stop the timer. Record the amount of seconds in column B. Repeat this step two more times. (If the ball gets lodged in a rock or stuck in an eddy, begin the trial over.)
3. Measure the width of the river at the start point, at the end point, and at a point midway between the start and end. Record these measurements in column D. (See lines with arrows, above.)
4. Measure the depth of the river 3 times along each width line for a total of nine depth measurements.

Record

these measurements in column F. (See dots on lines with arrows, above.)

A	B	C	D	E	F			G
Distance (meters or feet)	Time (sec.)	Average Time (sec.)	Width of River at 3 points	Average Width of River	Depth of River at 9 points			Average Depth of River

Calculating

5. Calculate the averages for columns B, D and F and record the averages in columns C, E and G.
6. Now, divide the distance (column A) by the average time (column C) to obtain the velocity. Record this number in the equation below.
7. Multiply the average width (column E) by the average depth (column G) to obtain the area. Record this number in the equation below.
8. Multiply the velocity by the area to obtain the streamflow and record that in the equation below.

$$\frac{\text{distance}}{\text{average time}} = \text{velocity} \quad \times \quad \text{average width} \times \text{average depth} = \text{area} \quad = \quad \text{streamflow}$$

9. To calculate the final adjusted streamflow, you must multiply your result by a factor which takes into consideration the uneven surface bottom of your river or stream. For streams with smooth, muddy, sandy or hard pan bottoms use a factor of 0.9, but for streams with a rough bottom with loose rocks or coarse gravel use a factor of 0.8.

$$\text{streamflow from equation above} \quad \times \quad \text{factor of 0.9 or 0.8} \quad = \quad \text{Final Adjusted Streamflow}$$