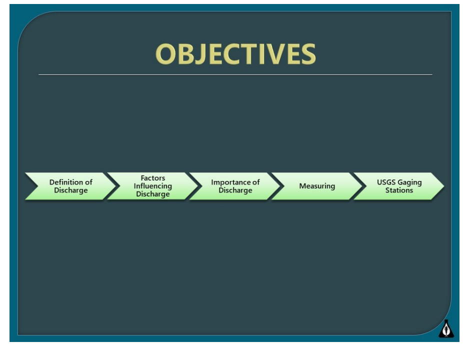
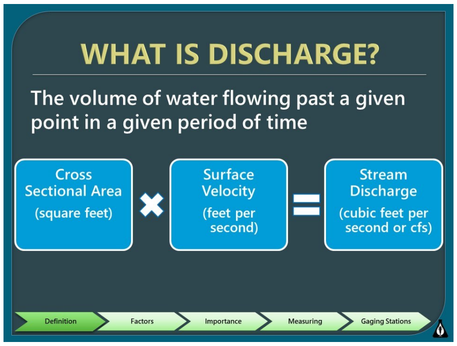
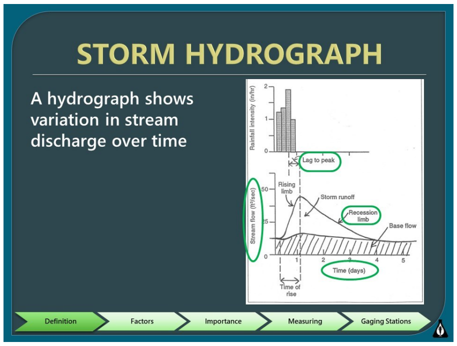
Chapter 3
Stream Discharge

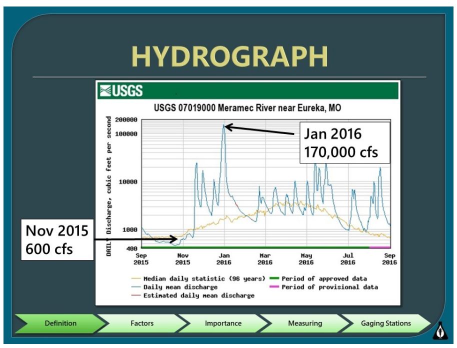


Once a site has been determined, the next step in monitoring is to determine the volume and velocity of water flowing in your stream. This is called stream discharge. In this chapter, you will:

- Define stream discharge
- Understand the factors affecting discharge
- Understand the importance of discharge
- Measure stream discharge
- Know how to use United States Geological Survey (USGS) Gage Stations







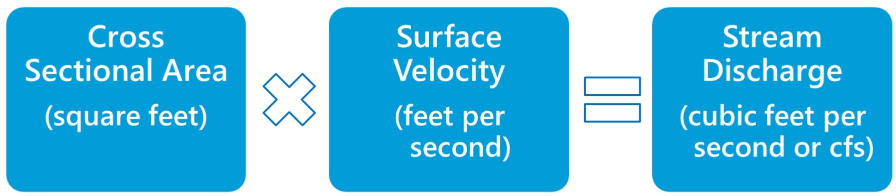
What is Stream Discharge?

Stream discharge is also referred to as flow. It measures the volume of water flowing past a given point in a given period of time. Stream discharge is expressed as a rate with two components:

- Volume of water, expressed in cubic feet.
- Time, expressed in seconds.

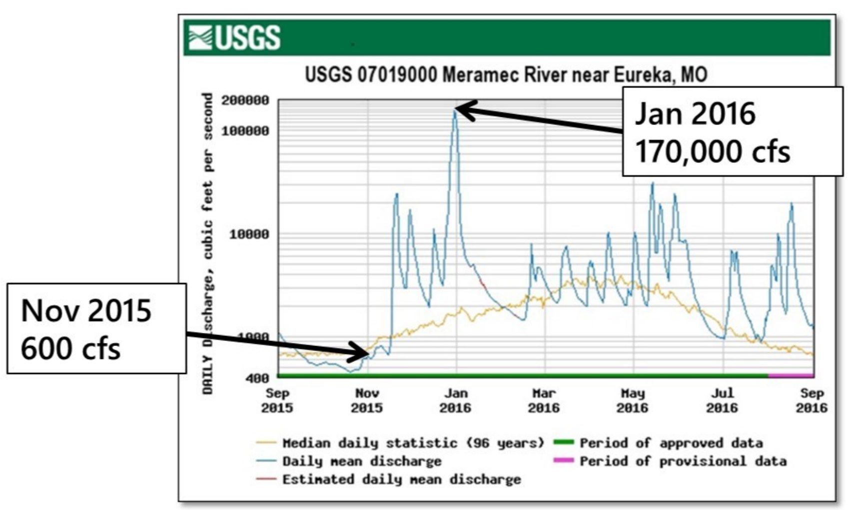
For example, one cfs refers to one cubic foot of water flowing past a given point every second.

Although it sounds difficult, calculating stream discharge is easy. The mathematical formula can be articulated as the cross-sectional area of a stream multiplied by the surface velocity of the water.



Hydrographs

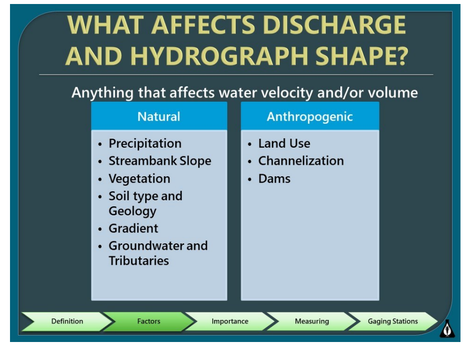
A stream's discharge changes over time. When stream discharge measurements are collected over time, they can be used to create a hydrograph. In the example below, time is represented on the X axis of the graph. The discharge is represented on the Y axis and is measured in cubic feet per second (cfs). This hydrograph shows the variation in discharges for different seasons of the year for the Meramec River near Eureka, MO. As you can see, the daily mean discharge in November of 2015 was 600 cfs, while the discharge in January was much higher at 170,000 cfs.

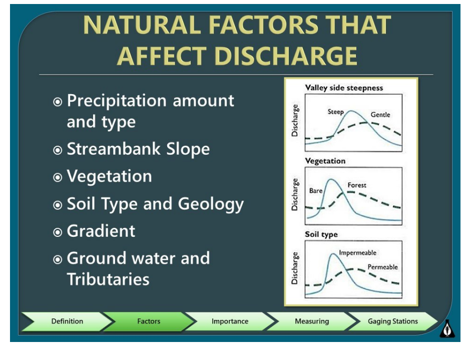


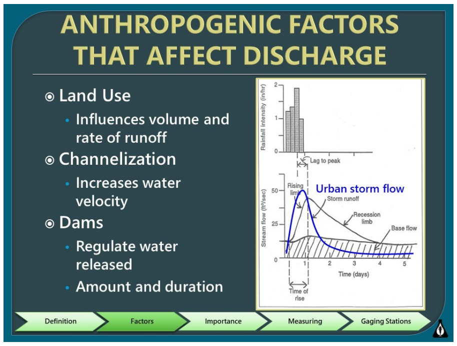
Natural Factors Affecting Stream Discharge

There are many natural factors that can affect the stream discharge:

- ***Precipitation:*** The type and amount of precipitation determines how much water is introduced into the system and how quickly it is released over time. A downpour of rain will introduce a lot of water flowing into the system very quickly, whereas snow or ice will release the moisture more slowly into the system.
- ***Streambank Slope:*** If the streambanks are steep, water will be confined to a smaller stream channel and will travel faster through the channel, resulting in an increased stream discharge after a storm event. With gently sloping streambanks, the influx of water after a storm event has more room to spread out. This slows the stream's discharge.
- ***Vegetation:*** Vegetation absorbs water and releases it to the atmosphere through evapotranspiration. It increases the water storage capacity of soil, making it like a sponge. This allows the soil to store water during dry periods and will increase your flow. Vegetation also adds surface roughness to the stream channel, streambanks, and flood plain, which will slow down the stream discharge. Removing vegetation from the land or replacing it with concrete removes that surface roughness and the absorption of water into the soil, allowing a dramatic increase in discharge in a short period of time.
- ***Soil Type:*** Permeable soils, such as gravel and sand, allow greater absorption of water into the ground, regulating increased stream discharges and smoothing out the shape of a hydrograph. Impermeable soils, such as clay or bedrock, do not allow for absorption and act more like concrete, increasing stream discharge.
- ***Channel gradient:*** High-gradient streams occur in steep topography, such as in areas of the Ozarks. Lower gradient streams tend to move water more slowly, while higher gradient streams move water faster.
- ***Other Factors:*** Groundwater, springs, adjacent wetlands, and tributaries contribute to portions of the total flow of a stream and can be crucial during dry times.







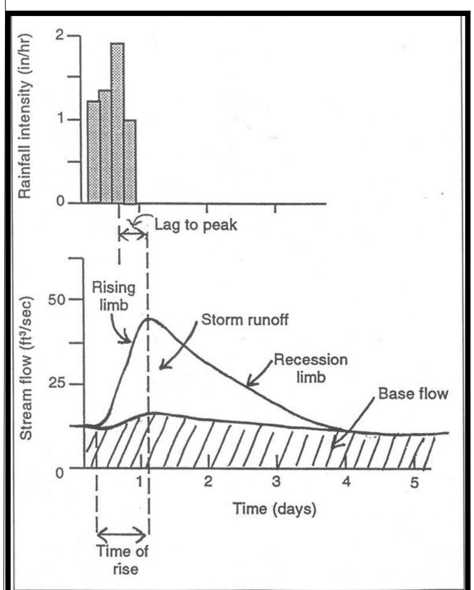
Anthropogenic Factors Affecting Stream Discharge

Anthropogenic or man-made factors affect stream discharge. Land use, channelization, and dams can have a tremendous effect on water velocity and volume.

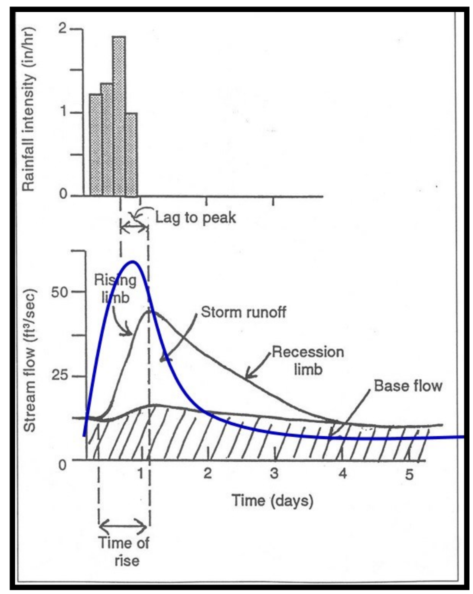
For example, compare the two graphs below. The first one represents the normal storm flow for a stream in a natural, well-vegetated landscape, as it responds to a precipitation event.

However, in an urban setting, vegetation is usually converted to streets, parking lots, and concrete. The second graph shows a blue line, which represents how an urban stream typically responds to a storm event. This type of stream is referred to as “flashy” because water enters and exits the stream much faster than streams in more vegetated areas.

Normal Storm Flow



Urban Storm Flow

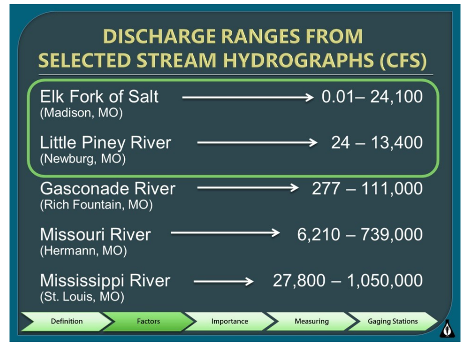


- ***Land Use:*** When vegetated areas and wetlands are converted to bare soil or impervious surfaces, the volume and rate of runoff and stream discharge dramatically increases during storm events. This leads to flashy streams.

- ***Channelization:*** The straightening of a stream channel and removal of woody debris results in increased water velocity and erosional force.

- ***Dams:*** These man-made (or beaver made) structures change the flow of water by slowing or detaining it. The release of water can fluctuate, dramatically altering the physical and chemical conditions both upstream and downstream of a dam.

Stream Discharge Ranges of Missouri's Streams

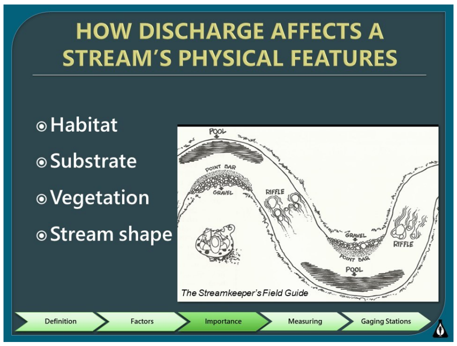


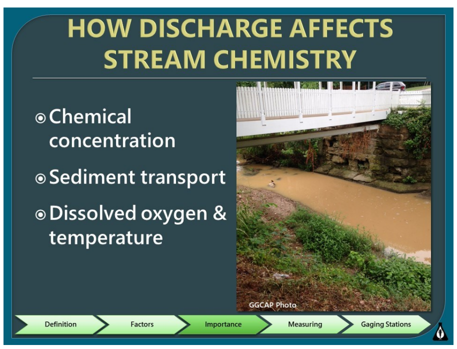
The table below describes the ranges of discharge of a few selected Missouri streams:

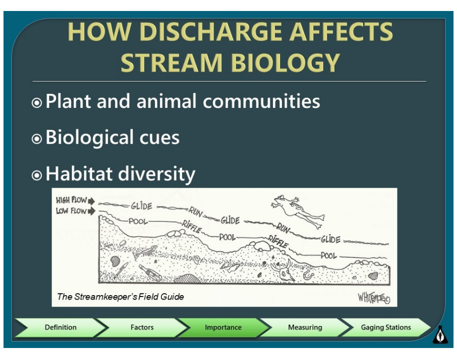
Stream	Range of Discharge (cfs)
Elk Fork of Salt River *Madison, MO*	0.01—24,100
Little Piney River *Newburg, MO*	24—13,400
Gasconade River *Rich Fountain, MO*	277—111,000
Missouri River *Herman, MO*	6,210—739,000
Mississippi River *St. Louis, MO*	27,800—1,050,000

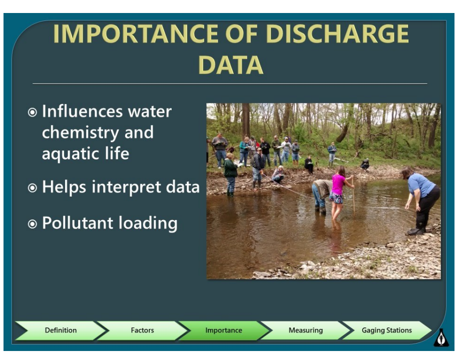
Notice how stream flow varies ***between*** streams and ***within*** them. The differences in discharge between these streams are mainly due to stream and watershed size. The range of flow within each stream can vary due to seasonality. Compare the Elk Fork of the Salt River with the Little Piney River. Both of these watersheds are approximately the same size but have very different flow ranges. The Elk Fork in Northern Missouri receives no groundwater recharge. Additionally, the land use around it is mostly agricultural, so runoff from cleared, non-forested land is higher and contributes to a higher stream discharge. The Little Piney is situated in a karst area and receives groundwater recharge from natural springs. The maximum discharge is lower in the Little Piney because it is located in a heavily forested watershed. This reduces overland flow to the river.

Stream Discharge and Stream Quality









Stream discharge has a large effect on the physical, chemical, and biological characteristics of a stream:

- ***Physical Features:*** The flow of water and other material changes the shape of the stream channel, the size of substrate in the streambed, and the types of riparian vegetation that are able to grow in or near the stream. These characteristics, in turn, influence the types of habitat available for aquatic life.

- As water moves substrate in the streambed, it erodes streambanks and deposits material downstream, shaping the stream channel. Variability in a stream's discharge influences the migration of the stream channel over time.

- ***Stream Chemistry:*** Stream discharge also affects water chemistry. The flow transports sediment and debris. A large volume of fast moving water carries more sediment and larger debris than a small volume of slow moving water. High volume flows have greater erosional energy, while smaller and slower flows allow sediment to be deposited. The concentration of chemicals and sediment is also affected. Larger volumes of water will dilute chemical and sediment pollutants. Stream discharge can also affect dissolved oxygen and water temperature. Fast moving water will tumble over substrate, introduce atmospheric oxygen into the water, and raise the dissolved oxygen of the water. Smaller volumes are influenced more by temperature. Streams with smaller volumes of slow-moving water warm up faster in the sun. Hot water holds less oxygen than cold water.

- ***Stream Biology:*** Stream discharge determines the types of habitat available for aquatic plants and animals. Streams with a variety of velocities can support a more diverse aquatic community. Additionally, fish like trout and salmon and pollution-sensitive macroinvertebrates require high concentrations of dissolved oxygen, low water temperatures, and gravel substrates to lay their eggs. Fish such as carp and catfish and pollution-tolerant macroinvertebrates can survive in warmer water and softer substrates. Variations in stream discharge also provide biological cues for aquatic life to complete their life cycles, including reproduction.

Because of its effect on water quality, stream discharge is an important characteristic of any stream. It influences water chemistry and aquatic life, helps us to interpret other kinds of data collected at the stream, and can aide in determining the severity and extent of a pollutant entering a stream. For these reasons, we encourage monitors to measure stream discharge every time they visit a stream to collect data!

Preparation for Measuring Discharge

In order to calculate stream discharge for your site, you will need to gather some materials:

- A Float (Wiffle Golf Ball)*
- 100-Foot Tape Measure (10ths of a Foot)*
- 2 Sticks or Metal Stakes
- Depth Stick, Marked in 10ths of a Foot
- Stopwatch or Watch with a Second Hand
- 10-Foot Rope
- Stream Discharge Data Sheet

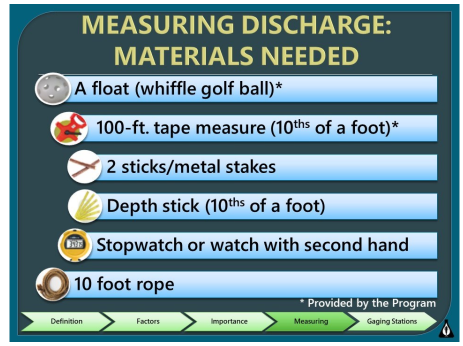
** Items Provided by Missouri Stream Team*

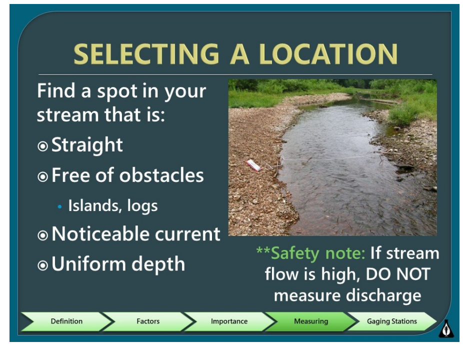
Select a safe and appropriate location within your stream site. Find a spot that is:

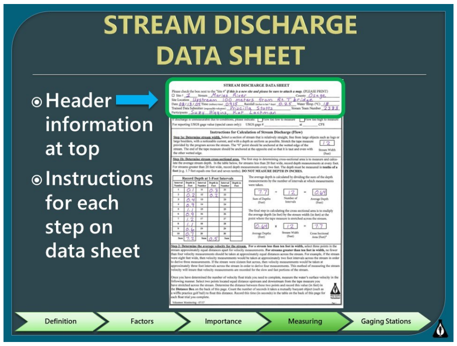
- Straight and free of obstacles like sandbars, large rocks or trees
- Has a noticeable current
- Has a uniform depth across the streambed, if possible

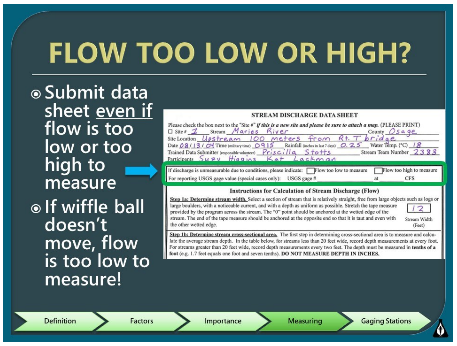
If you cannot find such a location in your 300-foot stream site, you can choose a location outside of your designated site in order to measure discharge. However, be sure there are no inputs or outputs such as tributaries or intake pipes between the site location and the discharge measurement location.

Stay safe! If the stream flow is high (over your knees), with a noticeable current, do not risk taking discharge measurements.









Stream Discharge Data Sheet

The ***Stream Discharge Data Sheet*** is a valuable tool when calculating stream discharge. Double check that you have filled out the header information accurately. Incorrect information in the header can delay processing for the data you collect. *Stream Discharge data should be collected every time you monitor your stream site*.

Instructions for calculating stream discharge can be found on this form.

STREAM DISCHARGE DATA SHEET

Please check the box next to the "Site #" ***if this is a new site and please be sure to attach a map.*** (PLEASE PRINT)

☐ Site # 1 Stream Maries River County Osage

Site Location Upstream 100 meters from Rt. T bridge

Date 08/13/04 Time (military time) 0915 Rainfall (inches in last 7 days) 0.25 Water Temp. (°C) 18

Trained Data Submitter (responsible volunteer) Priscilla Stotts Stream Team Number 2383

Participants Suzy Higgins, Kat Lackman

If discharge is unmeasurable due to conditions, please indicate: ☐ Flow too low to measure ☐ Flow too high to measure

For reporting USGS gage value (special cases only): USGS gage # ____ at ____ cfs

Instructions for Calculation of Stream Discharge (Flow)

Step 1a: Determine stream width. Select a section of stream that is relatively straight, free from large objects such as logs or large boulders, with a noticeable current, and with a depth as uniform as possible. Stretch the tape measure provided by the program across the stream. The "0" point should be anchored at the flowing edge of the stream. The end of the tape measure should be anchored at the opposite end so that it is taut and even with the other flowing edge. Do not measure nonflowing water.

Stream Width (Feet): 12

Step 1b: Determine stream cross-sectional area. The first step in determining cross-sectional area is to measure and calculate the average stream depth. In the table below, for streams less than 20 feet wide, record depth measurements at every foot. For streams greater than 20 feet wide, record depth measurements every two feet. The depth must be measured in **tenths of a foot** (e.g. 1.7 feet equals one foot and seven tenths). **DO NOT MEASURE DEPTH IN INCHES.**

Record Depth at 1-Foot Intervals

Interval Number	Depth in Feet	Interval Number	Depth in Feet	Interval Number	Depth in Feet
1	0.1	11	0.3	21	
2	0.2	12	0.2	22	
3	0.4	13		23	
4	0.9	14		24	
5	1.1	15		25	
6	0.9	16		26	
7	1.2	17		27	
8	1.1	18		28	
9	0.6	19		29	
10	0.7	20		30	
Sum	7.2	Sum	0.5	Sum	

The average depth is calculated by dividing the sum of the depth measurements by the number of intervals at which measurments were taken.

7.7 (Sum of Depths (feet)) ÷ 12 (Number of Intervals) = 0.64 (Average Depth (feet))

The final step in calculating the cross-sectional area is multiply the average depth (in feet) by the stream width (in feet) at the point where the tape measure is stretched across the stream.

0.64 (Average Depths (feet)) x 12 (Stream Width (feet)) = 7.7 (Cross Sectional Area (feet)²)

Step 2: Determine the average velocity for the stream. A minimum of four velocity measurements should be taken from equal intervals across the stream's width. For example, if the stream is eight feet wide, then velocity measurements should be taken at approximately every foot and a half across the stream in order to derive four measurements. For a stream width of 16 feet, velocity measurements should be taken at approximately three feet increments across the stream to derive four measurements. This method of measuring the stream velocity will ensure that velocity measurements are recorded for the slow and fast portions of the stream. For greater accuracy, more than four measurements are recommended for wider streams.

To measure the water's surface velocity, the first step is to select two points located equal distance upstream and downstream from the tape measure you have stretched across the stream. Determine the distance between these two points and record this value (in feet) in the **Distance Box** on the back of this page. A 10-foot total float distance is a recommended starting point. This distance can be lenghtened or shortened depending on stream swiftness. Count the number of seconds it takes a neutrally buoyant object (such as a wiffle practice golf ball) to float this distance. Record this time (in seconds) in the table on the back of this page for each float trial you complete.

Water Quality Volunteer

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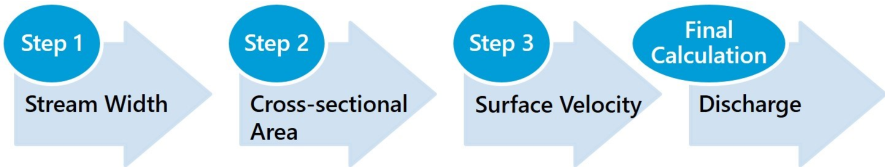
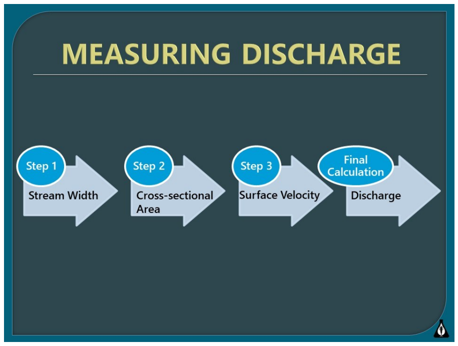
Please submit a discharge data sheet even if the flow is too high or too low to measure. Use your wiffle golf balls to determine if the flow is too low to measure (i.e. if you drop the wiffle ball and it doesn't move, it's too low.) Just check the box at the top of the form and send it in to us!

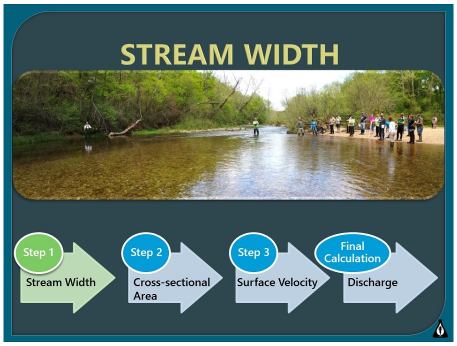
Measuring Stream Discharge

Stream discharge can be measured in just four basic steps:

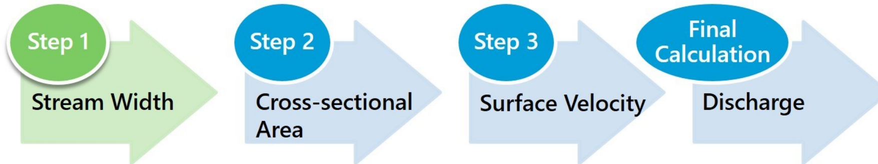
1. Determine Stream Width
2. Determine Cross-Sectional Area
3. Measure Surface Velocity
4. Calculate Stream Discharge







Stream Width

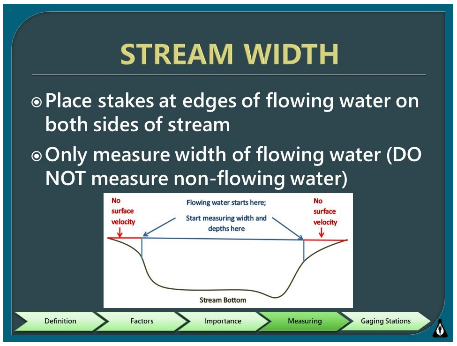


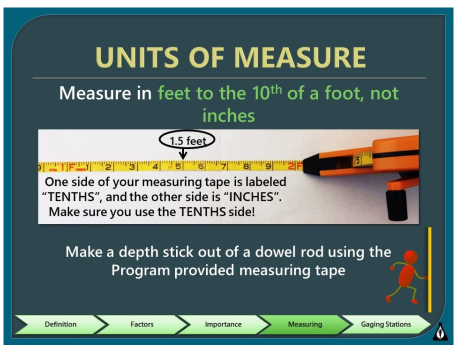
The first step in calculating discharge is to determine the width of your stream. To do this, place two stakes at the edges of the flowing water on each side of the stream. Stretch and anchor the tape measure between the stakes so that it is taut and perpendicular to the flow.

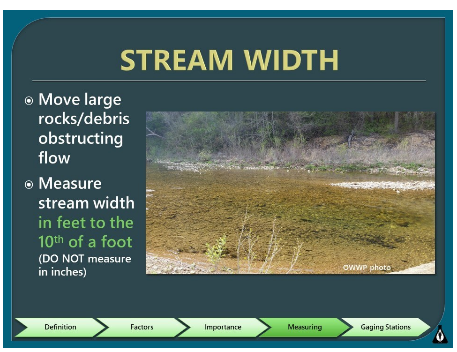
Sometimes, the flowing water is several inches from the edge of a streambank. Dead water, water that is not flowing, or eddies at the edge of a stream should not be counted when determining your stream width. Be sure to measure only where water is flowing. You may want to drop your wiffle ball on the water to determine if the water is flowing.

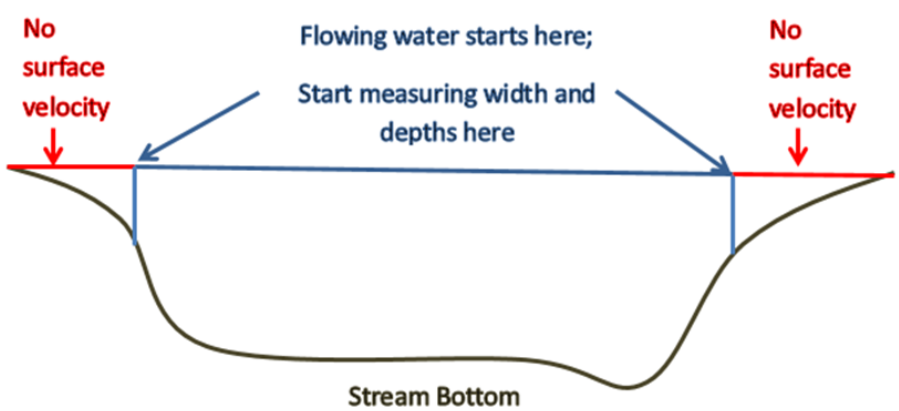
You should move obstacles obstructing the flow in your stream, if you are able. If you do, be sure to move them downstream from where you are taking your measurement.

Measure the stream width in feet to the 10th of a foot, not inches. To do this, be sure to use the correct side of your tape measure and record the width on the Stream Discharge Data Sheet.

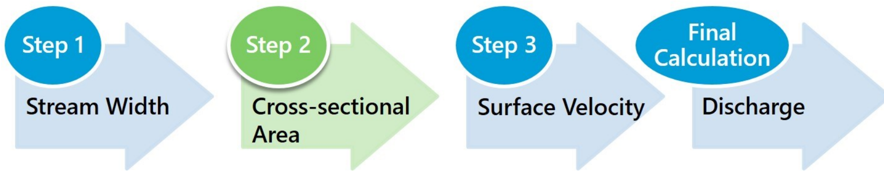








Cross-Sectional Area



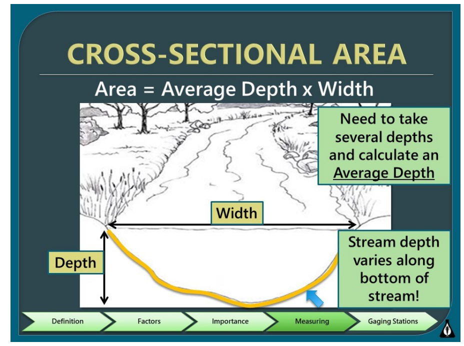
The next step is to determine the cross-sectional area of your stream. To do this, the depth of the stream is multiplied by the width of the stream: ***Area = Depth X Width.*** Unfortunately, stream beds are not flat and even. The depth of a stream varies along the bottom; often being shallower at the edges and deeper in the middle. Consequently, you will take several depth readings across the stream and calculate an average depth in order to determine the cross-sectional area. Use the following guidelines to determine the number of depth readings needed.

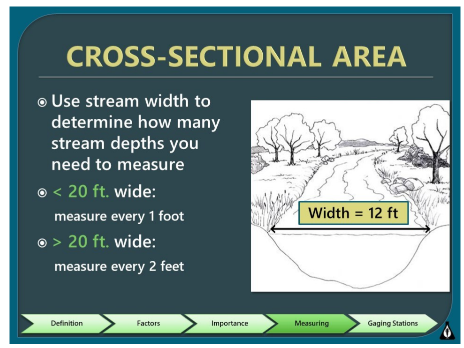
Stream Width	Depths Measurements
< 20 feet	Depth every 1 foot
20 feet to 60 feet	Depth every 2 feet
60 feet to 90 feet	Depth every 3 feet
> 90 feet	Depth every 4 feet

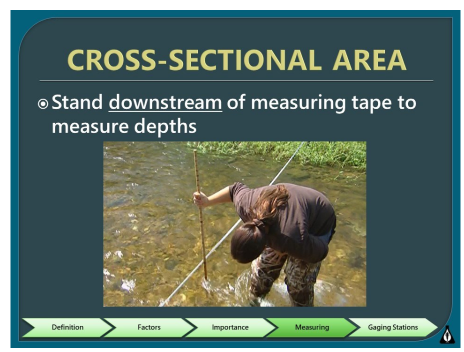
Stream depth is measured in feet to the 10th of a foot, not inches. Make a depth stick out of a dowel rod using the correct side (tenths) of the measuring tape provided.

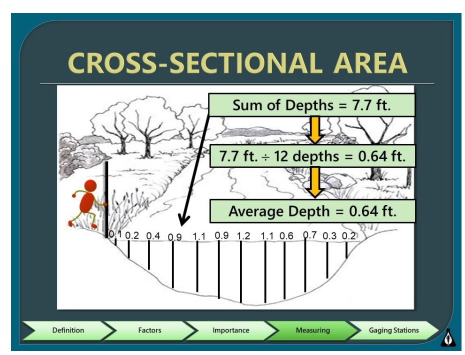
When taking your depth readings, always stand downstream so your legs do not impede stream flow. With the tape measure still anchored to the stakes at the stream banks, measure the stream depth at the appropriate intervals across the transect. Do not measure on top of large rocks or other objects. You want to be sure you are measuring the stream bottom. Record each depth reading on the front of your Stream Discharge Data Sheet.

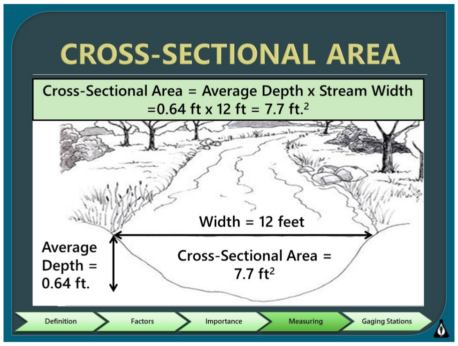
Once all measurements have been taken across your stream, add all the depths and record the ***Sum of Depths***. Divide the sum of depths by the number of depth intervals to determine your ***Average Depth.***

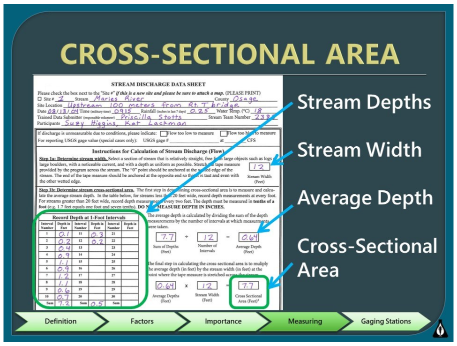












Cross-Sectional Area

Once you have determined the average depth, determining the cross-sectional area is easy. Simply multiply the average depth by the stream width to calculate the cross-sectional area. The following example shows how the cross sectional area is determined on the Stream Discharge Data Sheet.

STREAM DISCHARGE DATA SHEET

Please check the box next to the "Site #" *if this is a new site and please be sure to attach a map.* (PLEASE PRINT)

☐ Site # 1 Stream Maries River County Osage

Site Location Upstream 100 meters from Rt. T bridge

Date 08/13/04 Time (military time) 0915 Rainfall (inches in last 7 days) 0.25 Water Temp. (°C) 18

Trained Data Submitter (responsible volunteer) Priscilla Stotts Stream Team Number 2383

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If discharge is unmeasurable due to conditions, please indicate: ☐ Flow too low to measure ☐ Flow too high to measure

For reporting USGS gage value (special cases only): USGS gage # ______ at ______ cfs

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Stream Width (Feet): 12

Step 1b: Determine stream cross-sectional area. The first step in determining cross-sectional area is to measure and calculate the average stream depth. In the table below, for streams less than 20 feet wide, record depth measurements at every foot. For streams greater than 20 feet wide, record depth measurements every two feet. The depth must be measured in **tenths of a foot** (e.g. 1.7 feet equals one foot and seven tenths). **DO NOT MEASURE DEPTH IN INCHES.**

Record Depth at 1-Foot Intervals

Interval Number	Depth in Feet	Interval Number	Depth in Feet	Interval Number	Depth in Feet
1	0.1	11	0.3	21	
2	0.2	12	0.2	22	
3	0.4	13		23	
4	0.9	14		24	
5	1.1	15		25	
6	0.9	16		26	
7	1.2	17		27	
8	1.1	18		28	
9	0.6	19		29	
10	0.7	20		30	
Sum	7.2	Sum	0.5	Sum	

The average depth is calculated by dividing the sum of the depth measurements by the number of intervals at which measurments were taken.

7.7 (Sum of Depths (feet)) ÷ 12 (Number of Intervals) = 0.64 (Average Depth (feet))

The final step in calculating the cross-sectional area is multiply the average depth (in feet) by the stream width (in feet) at the point where the tape measure is stretched across the stream.

0.64 (Average Depths (feet)) x 12 (Stream Width (feet)) = 7.7 (Cross Sectional Area (feet)^2)

Step 2: Determine the average velocity for the stream. A minimum of four velocity measurements should be taken from equal intervals across the stream's width. For example, if the stream is eight feet wide, then velocity measurements should be taken at approximately every foot and a half across the stream in order to derive four measurements. For a stream width of 16 feet, velocity measurements should be taken at approximately three feet increments across the stream to derive four measurements. This method of measuring the stream velocity will ensure that velocity measurements are recorded for the slow and fast portions of the stream. For greater accuracy, more than four measurements are recommended for wider streams.

To measure the water's surface velocity, the first step is to select two points located equal distance upstream and downstream from the tape measure you have stretched across the stream. Determine the distance between these two points and record this value (in feet) in the **Distance Box** on the back of this page. A 10-foot total float distance is a recommended starting point. This distance can be lenghtened or shortened depending on stream swiftness. Count the number of seconds it takes a neutrally buoyant object (such as a wiffle practice golf ball) to float this distance. Record this time (in seconds) in the table on the back of this page for each float trial you complete.

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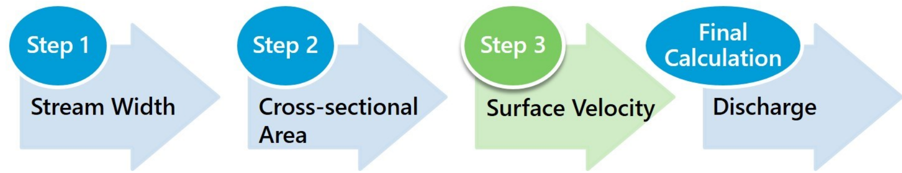
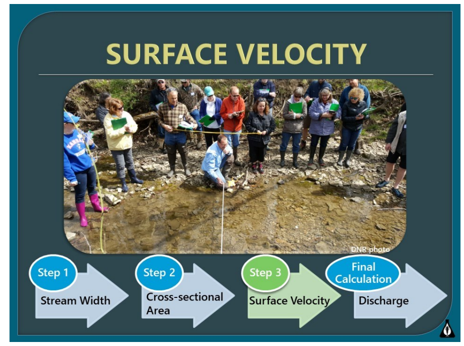
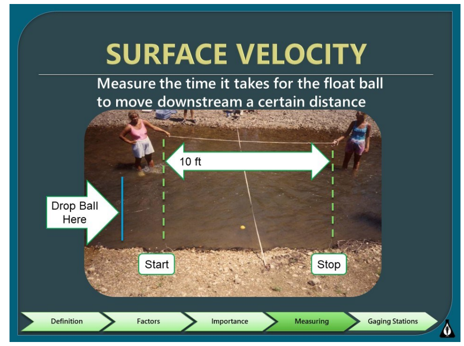
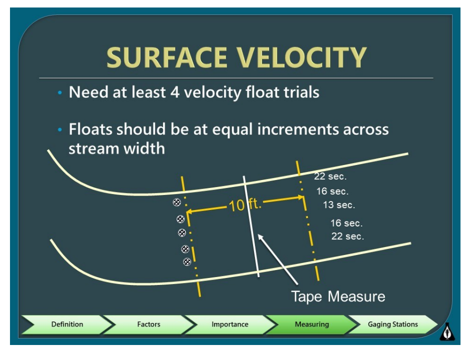
Surface Velocity







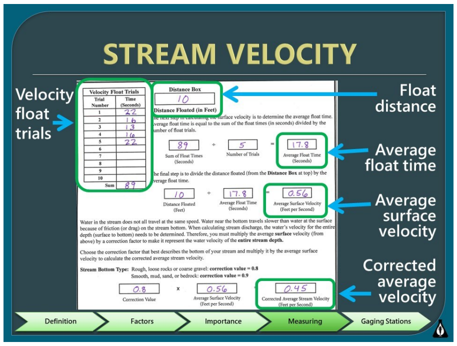


The third step of measuring stream discharge is to determine surface velocity. ***Velocity is expressed as a rate: distance per unit of time.*** To measure this, you will conduct a series of velocity float trials; measuring the time it takes for the wiffle ball to float downstream a certain distance.

A minimum of four velocity float trials are required. Since we will also be taking an average of the velocity float trials, the greater number of measurements, the more accurate the average float time velocity will be.

Use the following process to measure surface velocity:

1. Select two points located equal distance upstream and downstream from the tape measure you have stretched across the stream. The distance will depend on the swiftness of the stream, usually 10 feet. In faster water, you may want this distance to be greater, while shorter in slow water.
2. Record this distance in feet in the ***Distance Floated*** box on page 2 of the Stream Discharge Data Sheet.
3. Place stakes, large rocks, or distinct sticks on each side of the stream to mark the start and finish lines of the float distance.
4. Drop the wiffle golf ball upstream from the start point and record the time it takes to float from the start point to the finish point using a stop watch.
5. Record each float time in seconds in the "Velocity Float Trials" column on your data sheet. Float trials should be spaced at equal increments across the stream width if possible, so that your floats represent the different velocities across the entire stream.
6. Add all the float trials together and record the ***Sum of Float Trials***.
7. Divide this sum by the number of float trials to get an ***Average Float Time***.
8. Divide the ***Distance Floated*** (in feet), by the ***Average Float Time*** (in seconds), to get your ***Average Surface Velocity*** (in feet/seconds).
9. Multiply the ***Average Surface Velocity*** by a correction value to make it represent the water velocity of the entire stream depth. If the stream bottom has rough loose rocks or coarse gravel, the correction value you use is 0.8. If the stream bottom is smooth, muddy, or is bedrock, the correction value you use is 0.9. This will give you the ***Corrected Average Stream Velocity*** (in feet/second).



Surface Velocity

The following example shows how the surface velocity is determined on the Stream Discharge Data Sheet (page 2).

Velocity Float Trials

Trial Number	Time (seconds)
1	22
2	16
3	13
4	16
5	22
6	
7	
8	
9	
10	
Sum	89

Distance Box

10

Distance Floated (in feet)

The next step in calculating the surface velocity is to determine the average float time. Average float time is equal to the sum of the float times (in seconds) divided by the number of float trials.

89 (Sum of Float Times (seconds)) ÷ 5 (Number of Trials) = 17.8 (Average Float Time (seconds))

The final step is to divide the distance floated (from the **Distance Box** at top) by the average float time.

10 (Distance Floated (feet)) ÷ 17.8 (Average Float Time (seconds)) = 0.56 (Average Surface Velocity (feet per second))

Water in the stream does not all travel at the same speed. Water near the bottom travels slower than water at the surface because of friction (or drag) on the stream bottom. When calculating stream discharge, the water's velocity for the entire depth (surface to bottom) needs to be determined. Therefore, you must multiply the average **surface** velocity (from above) by a correction factor to make it represent the water velocity of the **entire stream depth.**

Choose the correction factor that best describes the bottom of your stream and multiply it by the average surface velocity to calculate the corrected average stream velocity.

Stream Bottom Type: Rough, loose rocks or coarse gravel: **correction value = 0.8**
Smooth, mud, sand, or bedrock: **correction value = 0.9**

0.8 (Correction Value) x 0.56 (Average Surface Velocity (feet per second)) = 0.45 (Corrected Average Stream Velocity (feet per second))

Step 3: Calculate the stream discharge. Multiply the cross-sectional area $(Feet)^2$ from **Step 1** by the corrected average stream velocity (Feet/Second) from **Step 2.**

7.7 (Cross-Sectional Area $(feet)^2$) x 0.45 (Corrected Average Stream Velocity (feet per second)) = 3.47 (Stream Discharge $(feet)^3$ per second or cubic feet per second (cfs))

Fish Present (Please Mark) **Yes** ✓ or **No** ☐

PLEASE KEEP A COPY AND SEND ORIGINAL DATA TO: VWQM Coordinator
Water Protection Program
Department of Natural Resources
PO Box 176
Jefferson City, MO 65102-0176

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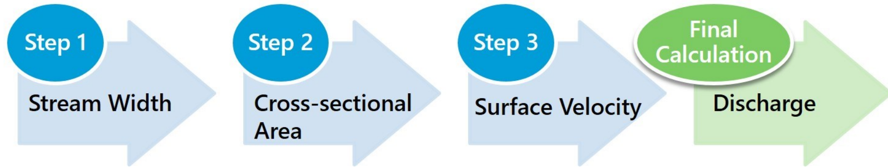
Page 2

Calculate Stream Discharge



The final step is the easiest! Simply multiply the ***Cross-Sectional Area*** from the front of your Stream Discharge Data Sheet, by the ***Corrected Average Stream Velocity*** from the back of your data sheet, to arrive at the ***Stream Discharge*** in cubic feet per second (cfs). Below is an example of the final calculation on a data sheet:

Velocity Float Trials	
Trial Number	**Time (seconds)**
1	22
2	16
3	13
4	16
5	22
6	
7	
8	
9	
10	
Sum	89

Distance Box

10

Distance Floated (in feet)

The next step in calculating the surface velocity is to determine the average float time. Average float time is equal to the sum of the float times (in seconds) divided by the number of float trials.

89 ÷ 5 = 17.8

Sum of Float Times (seconds) ÷ Number of Trials = Average Float Time (seconds)

The final step is to divide the distance floated (from the **Distance Box** at top) by the average float time.

10 ÷ 17.8 = 0.56

Distance Floated (feet) ÷ Average Float Time (seconds) = Average Surface Velocity (feet per second)

Water in the stream does not all travel at the same speed. Water near the bottom travels slower than water at the surface because of friction (or drag) on the stream bottom. When calculating stream discharge, the water's velocity for the entire depth (surface to bottom) needs to be determined. Therefore, you must multiply the average **surface** velocity (from above) by a correction factor to make it represent the water velocity of the **entire stream depth.**

Choose the correction factor that best describes the bottom of your stream and multiply it by the average surface velocity to calculate the corrected average stream velocity.

Stream Bottom Type: Rough, loose rocks or coarse gravel: **correction value = 0.8**
Smooth, mud, sand, or bedrock: **correction value = 0.9**

0.8 x 0.56 = 0.45

Correction Value x Average Surface Velocity (feet per second) = Corrected Average Stream Velocity (feet per second)

Step 3: Calculate the stream discharge. Multiply the cross-sectional area (Feet)² from **Step 1** by the corrected average stream velocity (Feet/Second) from **Step 2.**

7.7 x 0.45 = 3.47

Cross-Sectional Area (feet)² x Corrected Average Stream Velocity (feet per second) = Stream Discharge (feet)³ per second or cubic feet per second (cfs)

Fish Present (Please Mark) **Yes** ✓ or **No** ☐

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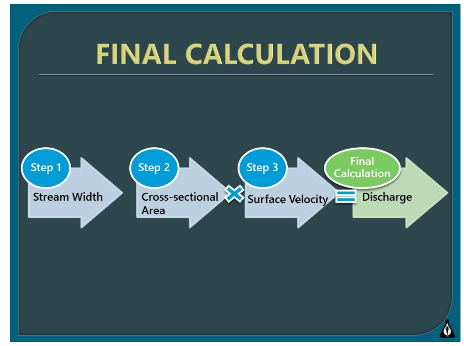

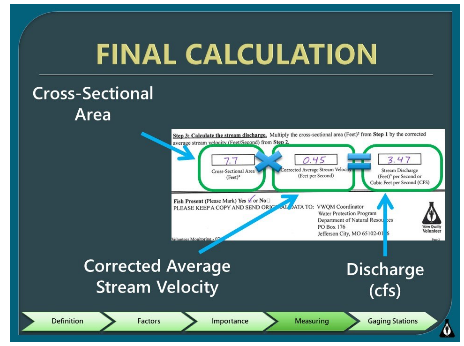

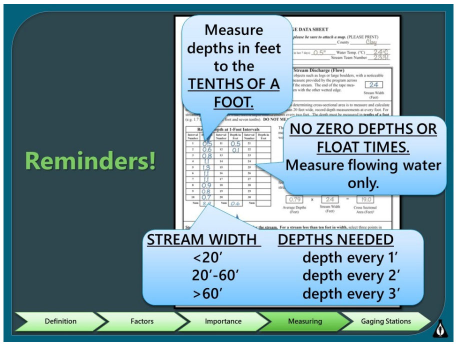

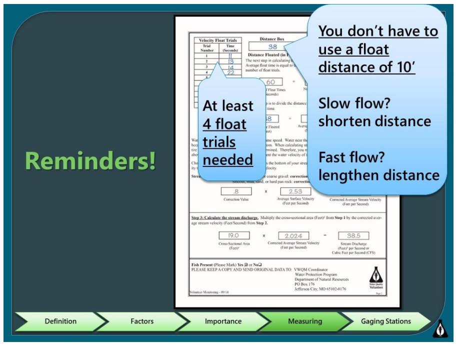

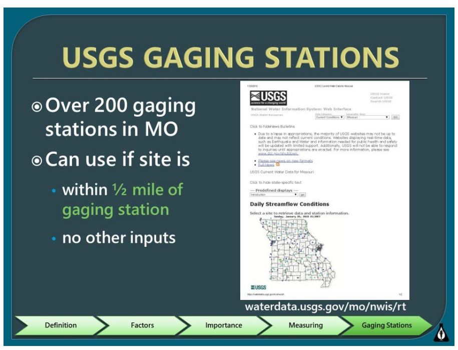

A Few Reminders

- Measure depths of your stream in feet to the tenths of a foot.
- No zero depths or float times are permitted. Only measure flowing water.
- Double check to make sure you have recorded enough depths for your stream's width:

Stream Width	Depths Measurements
< 20 feet	Depth every 1 foot
20 feet to 60 feet	Depth every 2 feet
60 feet to 90 feet	Depth every 3 feet
> 90 feet	Depth every 4 feet

- Double check to make sure you have recorded enough float trials for your stream:

Minimum Number of Float Trials
4 Trials

- Your distance floated does not have to be 10 feet. However, remember to record whatever distance you decide to use. We recommend at least 5 feet for a minimum float distance.
- Submit data sheet, including header information, even if flow is too low or too high to measure.
- Read the directions on the data sheet to prevent errors in your calculations. You may want others to review your data sheet for accuracy.

USGS Gaging Stations

The United States Geological Survey maintains over 200 gaging stations on streams throughout Missouri. Many of these stations record stream discharge every day. Data is in real-time format and updated hourly. The site also includes an interactive map. <u>You can use a gaging station for your stream discharge data if there is a station within a half mile of your site location AND there are no inputs or outputs between your site and the gaging station.</u> Fill in the data sheet header and record the gage number and stream discharge at the time of sampling.

USGS website:
waterdata.usgs.gov/mo/nwis/rt