STREAMKEEPERS
MODULE 2

Advanced Stream Habitat Survey

PROJECT APPROVAL
- Not required

TRAINING
- Recommended

TIME COMMITMENT
- Half day per site (yearly)

NUMBER OF PEOPLE
- 2 or more

TIME OF YEAR
- Late summer / Early fall

This advanced survey adds details about stream conditions and habitat to information collected in Introductory Stream Habitat Survey Module 1.

REVISED 2023

Pêches et Océans Canada
Fisheries and Oceans Canada
Canada

Welcome to Streamkeepers

The Streamkeepers Program of Fisheries and Oceans Canada (DFO) Community Involvement Program provides these training modules. These modules encourage "hands on" environmental activities in watersheds in British Columbia. Volunteer groups, First Nations, schools, and individuals are using this material to monitor and restore local waterways. Your local Fisheries and Oceans Community Advisor can provide more information.

Project Purpose

This Advanced Survey adds details about stream conditions and habitat to information collected in the Introductory Stream Habitat Survey (Module 1). You can use these collected data to document changes over years by returning to a site several times. And you can also use this data from upstream and downstream to asses a suspected habitat problem by comparing this information. If you rehabilitate an area, you will want to survey it in later years to assess the effectiveness of your restoration work

Overview

Each STEP in this Advanced Habitat Survey correlates to information collected on your DATA SHEET.

STEP 1 Choose a reference site and establish a benchmark

STEP 2 Conduct a cross sectional survey (3 times)

STEP 3 Calculate stream discharge

STEP 4 Conduct longitudinal survey

STEP 5 Measure habitat characteristics

STEP 6 Conduct a habitat assessment

STEP 7 Enter data into Streamkeepers Database

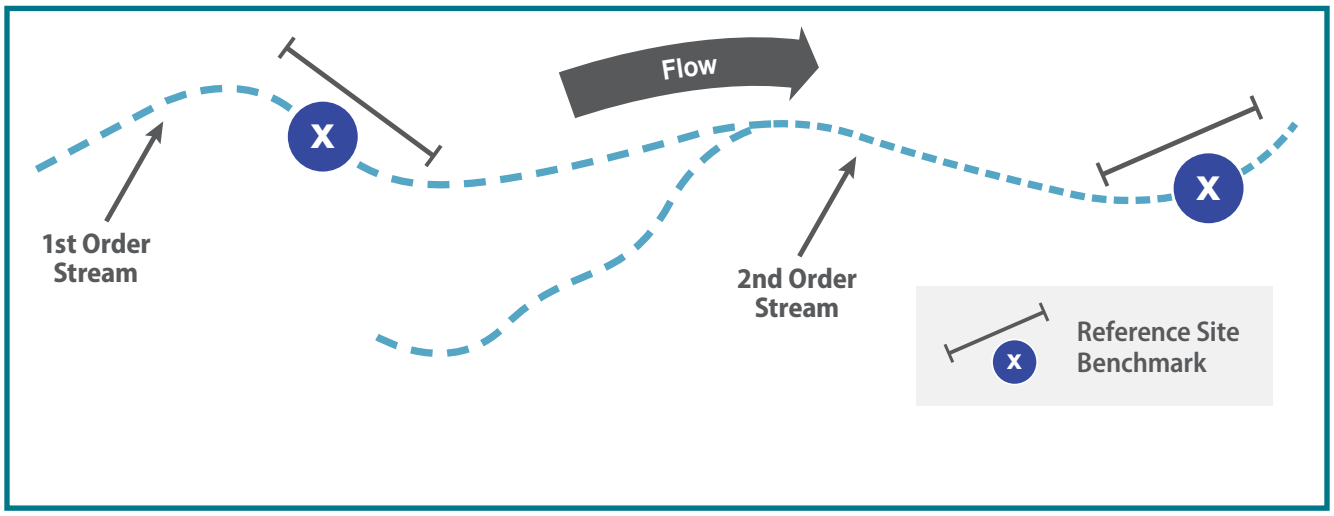
The survey methods show you how to collect consistent data so you can compare sites or streams with confidence, even when the information has been collected by different people or organizations. You will;

1. Decide whether to monitor long-term changes or document impacts of habitat problems.

2. Define the study area or areas and select a short section of stream that represents habitat in that stream segment which becomes your reference site.

3. Identify the reference site with a benchmark (using a photo and GPS to record the location) which enables people to find the exact location again. **Figure 1** shows examples for first and second order segments of a stream.

Figure 1
Reference Site and Benchmark on Stream Segments



After establishing a reference site, you can collect detailed information about:

• Physical habitat MODULE 2
• Water quality MODULE 3
• Benthic invertebrates MODULE 4
• Fish MODULE 11

You can establish several reference sites, each representing particular types of habitat and stream conditions in the watershed. Consider ease of access when you select the reference site(s). If you are interested in a second order stream, for example, you can establish sites on the first order headwater segments as well as on the second order segment. If you wish to measure the impact of a problem, you can collect data at reference sites upstream (control site), in the vicinity of the problem (impact site), and further downstream (recovery site). Do all the surveys on the same day. If this is not practical, survey over a few days, as long as stream flow conditions remain constant.

Monitoring many sites can be time consuming for one group, but a network of groups in one watershed can share the work. Each group can be responsible for one or two sites. If more than one group is involved, use these consistent methods and do the surveys at the same time to produce reliable and comparable data.

Many methods described here were developed for use on streams. They may not work as easily for large or deep rivers.

Project Guidance and Approval

You need no formal approval, but you should advise your Community Advisor, who can help coordinate equipment, training, and site selection. The methods used are technical in nature. They may seem complicated at first, but are not difficult to learn. This Module is included in the two day Streamkeepers training.

Level of Effort

The first time you survey a reference site it may take at least half a day on a small stream, and longer on a larger stream. Subsequent surveys of the same site take less time because the benchmark is already established.

Time of Year

Conduct the advanced survey during late summer or early fall, if possible. Stream flows are lower at these times, making it easier to work in the stream channel. It also is a good time of year to assess bank vegetation. If you repeat the survey annually, return at the same time of year, when flow and weather conditions are similar.

Personal Safety

Concern for personal safety is essential when working outdoors. Develop and follow a safety plan. Always tell someone where you are going and when you will return. Work in pairs, never alone. Carry emergency response phone numbers.

Do not attempt to wade fast water or water deeper than your knees. Watch out for slippery stream beds, undercut banks, waterfalls, and fast flowing areas. Avoid log jams, which can be unstable.

Get permission to cross or use private property. Beware of domestic animals and wildlife.

Warn everyone, especially children, about hazards such as syringes, needles, broken glass, and condoms. Remove them with tongs and place them in a special hazardous materials bucket, or flag them with bright tape. Avoid foul smelling areas, spills of unknown substances, or containers of hazardous or unidentified materials. These are to be reported to the nearest Fisheries and Oceans Canada office, follow protocols in Streamkeepers Module 9.

Observe, Record and Report Phone
24 Hours Toll Free
1-800-465-4336

Email:
DFO.ORR-ONS.
MPO@dfo-mpo.gc.ca

Health

Do not drink stream water and ensure exposed cuts and wounds are protected. Although it may look pristine, water can harbour bacteria or parasites that will make you sick. Know the symptoms and treatment for hypothermia. Carry a first aid kit. When working in isolated areas, carry a survival kit containing at least a lighter, fire starter, candle, flares, and a satellite phone or cell phone.

Clothing

Dress for the weather and stream conditions. Wear highly visible clothing. Wear waders with felts when walking in the stream.

Material and Equipment

- **data sheets**
- **clipboard and paper**
- **felt pen, pencils**
- **GPS unit**
- **cell phone**
- **camera**
- **clinometer**
- **tennis ball**
- **stopwatch**
- **fibreglass tape measure**
- **calculataor**
- **hip chain**
- **metre stick**
- **first aid kit**

Procedure

Module 2 procedures have been developed to minimize the amount of instream habitat disturbance during the survey. When the left or right bank is referred to this is determined while facing downstream. To record your survey use the Data Sheets provided at the end of this module, which you can download and print from - **https://www.pskf.ca/publications/sheets.php**
This data can then entered into the online Streamkeepers database - **https://www.streamkeepers.info**

Data Sheet
STEP 1

Establish a reference site and a benchmark

Establish a reference site

A reference site is where you will conduct your survey. This reference site represents habitat in that stream segment. The site will be a length of stream at least twelve times the bankfull channel width. **The bankfull channel** is the active stream channel to the edge of well-established perennial vegetation **(Figure 2)**.

For example, a reference site where the bankfull channel width is 2.5m, will have a boundary of 30m (12 x 2.5m) with 15m upstream and 15m downstream of the benchmark. This measurement should allow for a full pool, riffle, pool, riffle sequence. (**Figure 2a)**.

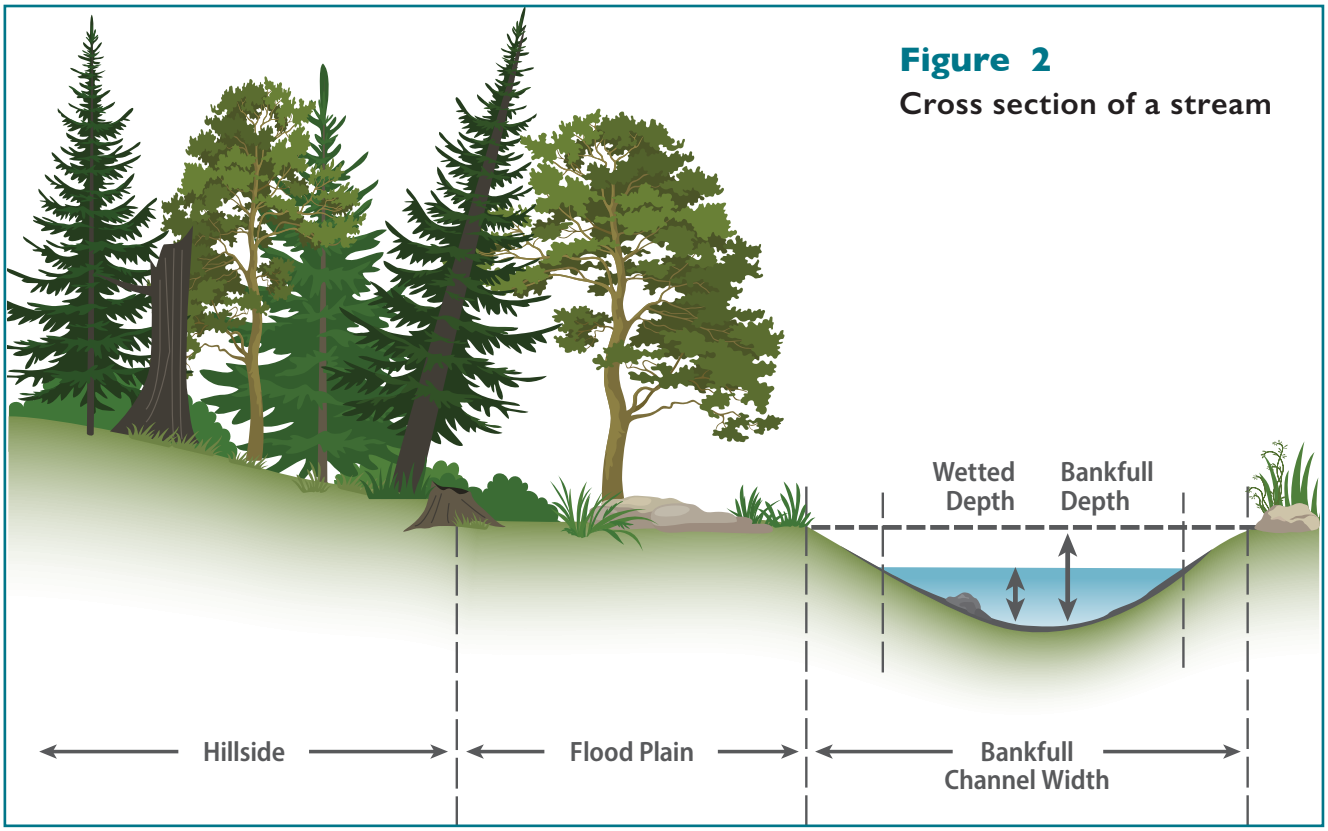


Figure 2
Cross section of a stream

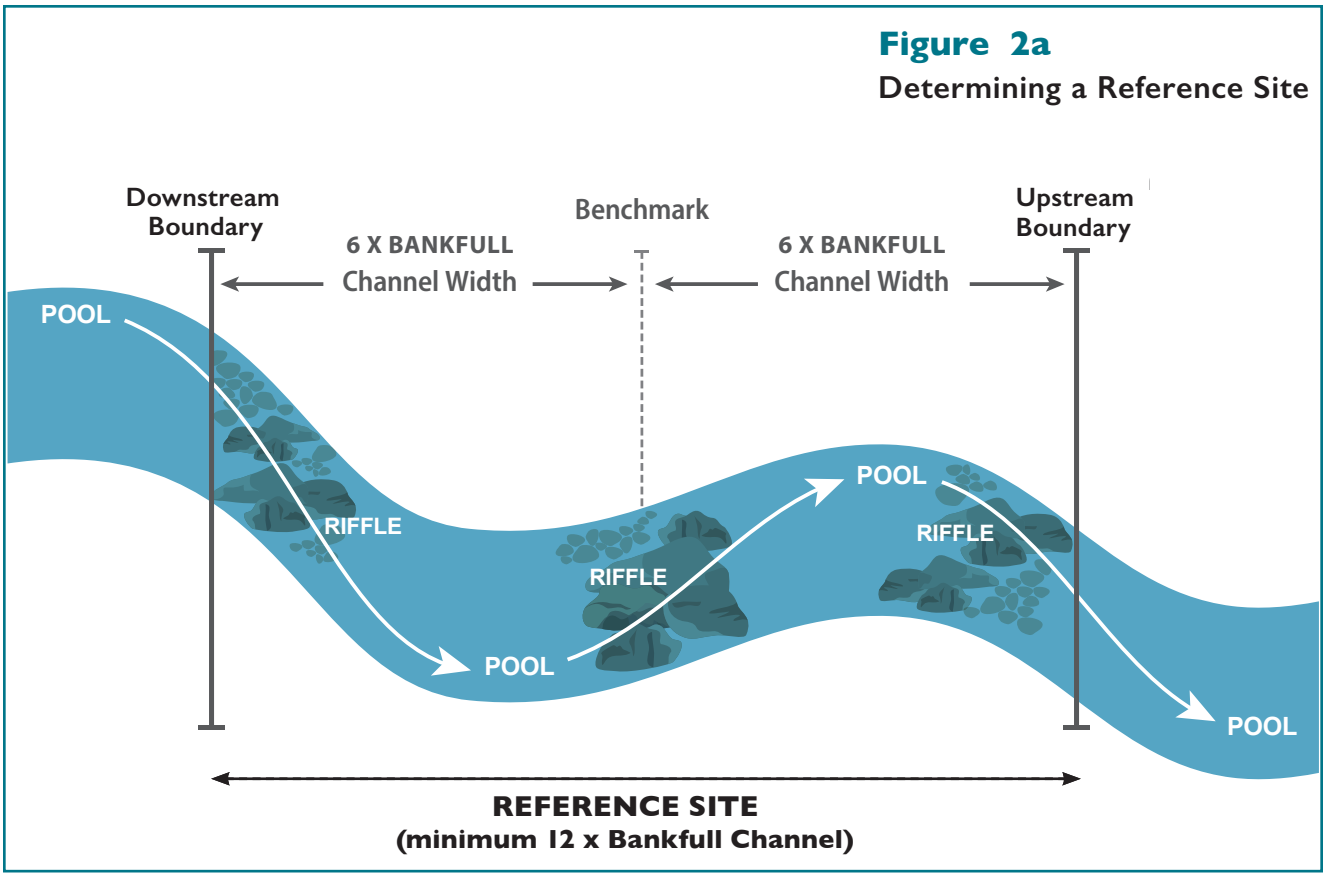


Figure 2a
Determining a Reference Site

Establish a benchmark

Once you select a suitable location for a reference site, establish a benchmark so the site can be found for future surveys. Locate your benchmark at a riffle where the bankfull channel width and general stream conditions appear typical of average conditions for the site and for the overall stream segment.

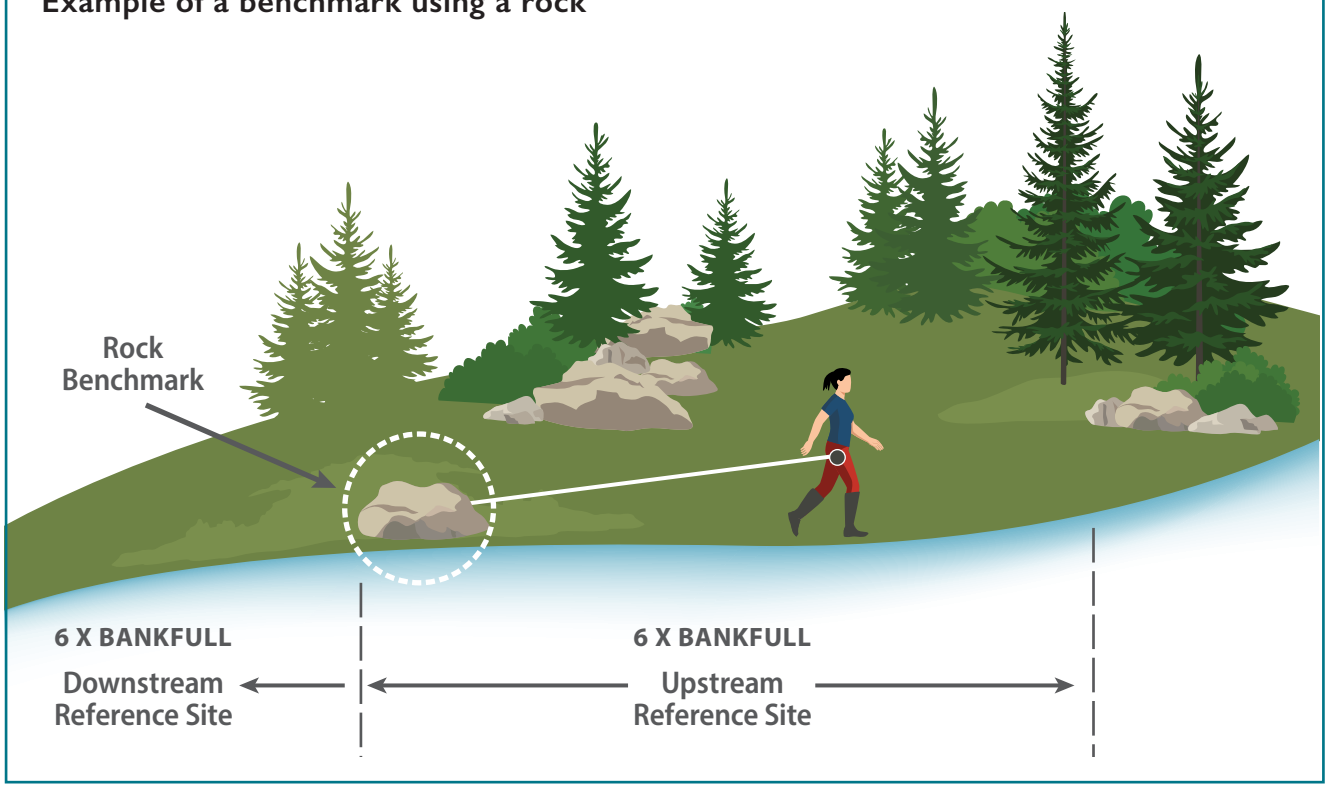
Choose the location for the benchmark carefully; you will make several measurements from this point:

- **Data Sheet: STEP 2 Cross Sectional Survey**
- **Data Sheet: STEP 3 Stream Discharge**
- **Data Sheet: STEP 4 Longitudinal Survey**

Identify the benchmark location (include a photo and GPS) which will enable people to find the exact location again.

▶ **Record directions to and location of the benchmark on Data Sheet: STEP 1**

Figure 3
Example of a benchmark using a rock



Data Sheet
STEP 2

Conduct a Cross Sectional Survey

Cross Sectional Surveys consist of measuring:

- **WIDTHS** of Wetted Channel and Bankfull Channel
- **DEPTHS** of Wetted Channel and Bankfull Channel
- AIR and WATER Temperatures **(Figure 4)**

These measurements are taken at three places **(Figure 2a)** within your reference site:

1. BENCHMARK
2. UPSTREAM BOUNDARY
3. DOWNSTREAM BOUNDARY

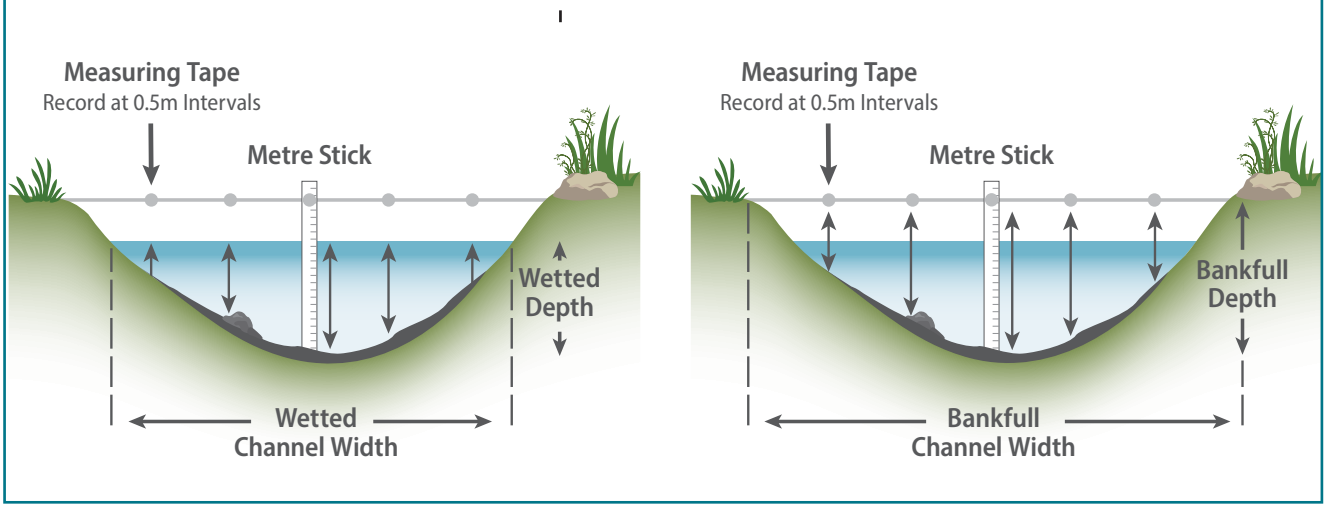
The stream channel is formed at the bankfull stage, during annual high water. Although you should never measure a stream at this high water stage, you may observe permanent reminders left by receding waters, which mark the boundaries of the bankfull channel. Sometimes the indicators are hard to find.

The bankfull channel width and depth reflect the total discharge or volume of water during annual high flow events. Bankfull channel flow is the channel forming water. A change in the bankfull channel dimensions may be a warning sign that natural runoff patterns in the watershed are changing. **(Figure 2)**

Bankfull Indicators

- **The edge of the active stream channel and beginning of the flood plain**
- **The start of well-established perennial vegetation such as trees, shrubs, and ferns**
- **A change in the bank slope from vertical to more horizontal**
- **A change in bank material from coarse gravel to fine sand or soil**
- **The highest stain lines (these mark the lines of frequent inundation and are formed by sediment or lichen).**

Figure 4



Conduct a cross-sectional survey at the benchmark

▶ **Record the following measurements on Data Sheet: STEP 2**

• **Width of wetted channel** - stretch a measuring tape from the left bank across the wetted area of the stream, at the same elevation as the top of the water. Make sure the tape is level and perpendicular to the stream flow. Use this measurement in calculating **STEP 3.**

• **Width of bankfull channel -** move the measuring tape up to the edges of the bankfull indicators. Hold measuring tape in position for next measurements. The measuring tape will now give a visual for where the water line would be at bankfull stage.

• **Wetted depth** - from stream bottom to top of water.

• **Bankfull depth -** from stream bottom to measuring tape.

Measure wetted and bankfull depths at regular intervals across the stream; every half meter in streams less than 5m wide, every metre in streams 5 - 15m wide, and every two metres in streams 15 - 25m wide. Take the initial measurement 0.1m away from the left bank. Where there is no water in the measurement area, mark an **X** on the datasheet. Calculate the average depth in cm then convert to metres. Use this measurement in calculating **STEP 3.**

Draw a sketch of the stream channel cross-section showing the wetted and bankfull channel widths and depths. **(Figure 4)** You will also do cross-sectional surveys at the upstream and downstream endpoints of your reference site once they are established.

Take three photos while the tape is in place. Take photos looking upstream and downstream of the cross-section. Also, take a photo of the cross-sectional view along the tape, with the benchmark in the background. Make sure the tape measure is visible in the photos. You can reduce glare from the water surface by taking the photos with the camera pointed down at the water surface or by using a polarizing filter. Have someone stand in the photos holding a paper showing the name of the creek, date, site number, and orientation in relation to stream flow.

Data Sheet
STEP 3

Calculate Stream Discharge

Stream discharge is measured in the riffle area at the benchmark, where you made wetted channel measurements in STEP 2.

A. Calculate stream cross-sectional area (m2)

Use your plot of wetted channel dimensions.
Multiply wetted width by average wetted depth.

▶ **Record this value on Data Sheet: STEP 3**

B. Calculate average time (in seconds)

Measure out a 10m length of stream and mark the ends (start point and end point). While standing at the downstream and upstream points, visually divide the stream width into five sections: one mid-stream, two near shore, and two half way to the middle **(Figure 5)**. Drop a tennis ball into the water 1 metre **upstream** of the start point. When the tennis ball crosses the start point begin timing and record how long it takes the tennis ball to float the 10m to the downstream endpoint. Repeat the process in the other four sections of the 10m length.

▶ **Record times for the five trials and calculate the average on Data Sheet: STEP 3**

C. Calculate the average velocity in m/sec

Divide the distance (10 m) by the average time in seconds, to get the average stream velocity in m/sec.

▶ **Record result on Data Sheet: STEP 3**

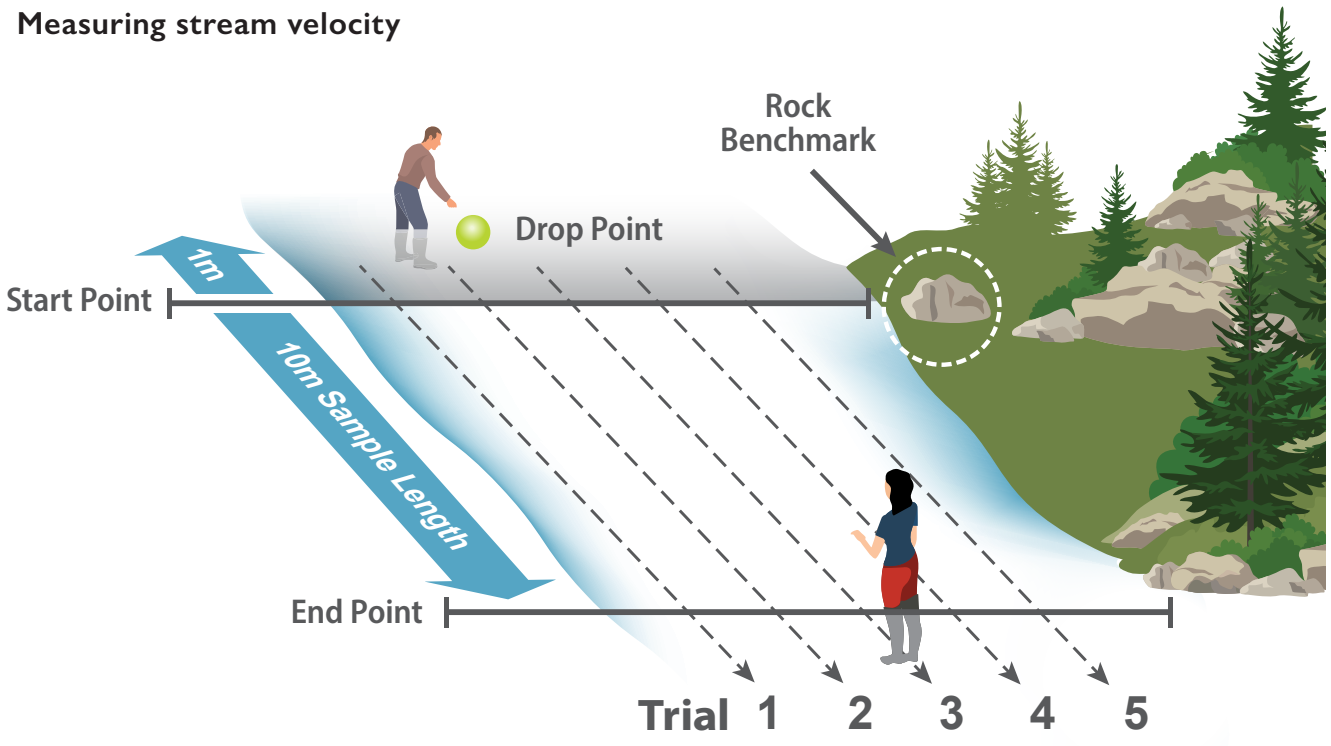
D. Calculate total stream discharge in m3/sec.

Multiply the cross-sectional area (m2) by average water velocity (m/sec) and by a correction factor of 0.8. This factor converts the surface velocity measurement to average velocity. Water flows at different speeds throughout the water column. Average velocity occurs just below the mid-depth.

▶ **Record stream discharge on Data Sheet: STEP 3**

cross-sectional area (m2)	**X**	**average velocity (m/sec)**	**X**	**0.8**	**=**	**discharge (m3/sec)**

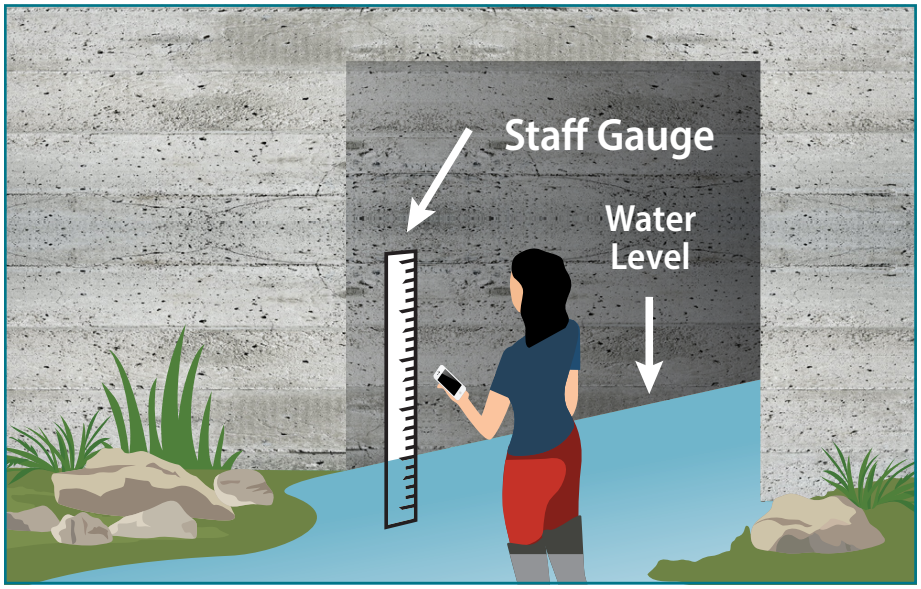
Figure 5
Measuring stream velocity



Calculate stream discharge using a Staff Gauge

If you plan to monitor stream discharge frequently, using a staff gauge will shorten your calculations. There may be a staff gauge already installed on an engineered area of the stream, such as a bridge crossing, box culvert or flood control area, or you may wish to install one. The staff gauge is a painted scale (marked in metres and centimetres) used to show the water depth **(Figure 6a)**.

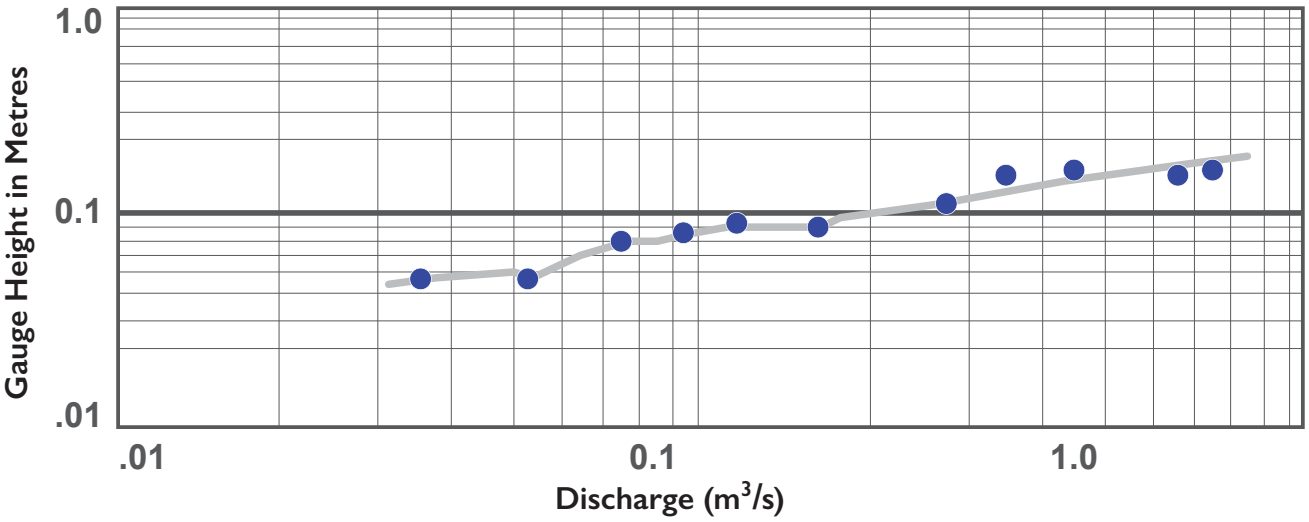
Figure 6a
Staff Gauge at a box culvert



Gauge readings and stream discharge rates are measured over a wide range of stream flows, then plotted on a logarithmic scale to produce a rating curve **(Figure 6b)**. Once the rating curve has been determined, you can read the staff gauge height, then estimate the stream discharge from the rating curve.

Figure 6b
Staff Gauge: example of rating curve on Logarithmic Scale

From Stream Channel Reference Site: An Illustrated Guide to Field Technique



STEP 4
Longitudinal Survey Defined

Longitudinal Surveys include information on habitat units - pools and riffles in STEP 4 and habitat characteristics in STEP 5. These measurements are taken over the entire length of the reference site (the site is at least twelve times the bankfull channel width).

On average, a pool-riffle sequence is repeated every six times the bankfull channel width and a full S-shaped meander is repeated every twelve times the bankfull channel width **(Figure 7).**

HABITAT UNITS
These are either pools or riffles within a stream reference site.

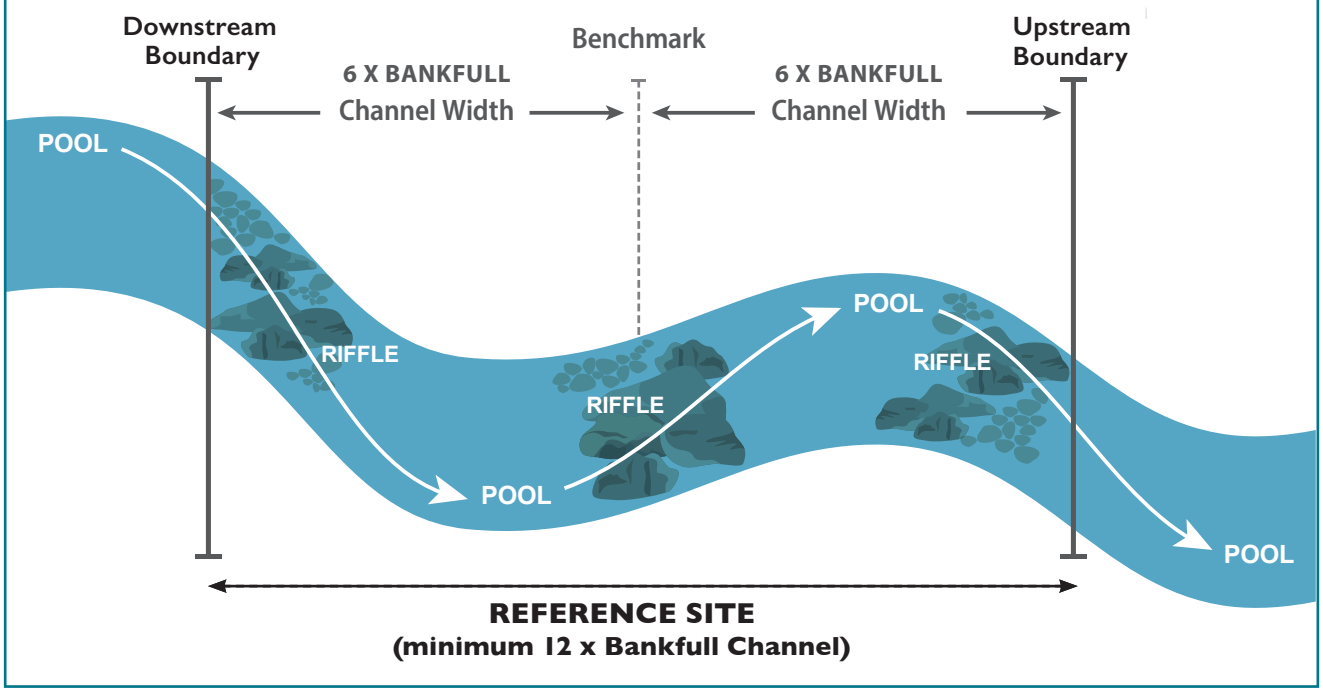
REFERENCE SITE
At least 12 times the bankfull channel width of a stream.

The benchmark is at the midpoint for a reference site survey. In this survey you will define upstream and downstream boundaries of the site and divide the site into distinct habitat units.
Each stream consists of a repeating pattern of pool and riffle habitat units.

POOLS have deeper water, lower velocity and water surface gradient, with little or no surface turbulence.

RIFFLES have shallower water, higher velocity and water surface gradient, and some surface turbulence.

Figure 7
Natural meander pattern of a stream



How to Conduct a Longitudinal Survey

Mark the upstream and downstream boundaries of reference site and define habitat units

A. Define UPSTREAM BOUNDARY of reference site.

Starting from the benchmark, using a hip chain, walk upstream, marking with flag tape the upstream end of each habitat unit, pool or riffle. (The upstream end of a habitat unit is the downstream end of the next habitat unit) continue to mark off the habitat units until you are at a distance away from the benchmark of 6 times the bankfull channel width. Walk to the end of the pool or riffle you are in and mark with a piece of flag tape. *This will be your upstream boundary for your reference site.* Break off the hip chain thread and reset to zero, return to your benchmark.

B. Define DOWNSTREAM BOUNDARY of reference site.

Starting from the benchmark, using a hip chain, walk downstream, marking with flag tape the downstream end of each habitat unit, pool or riffle. (The downstream end of a habitat unit is the upstream end of the next habitat unit) Continue to mark off the habitat units until you are at a distance away from the benchmark of 6 times the bankfull channel width. Walk to the end of the pool or riffle you are in and mark with a piece of flag tape. *This will be your downstream boundary for your reference site.* Break off the hip chain thread and reset to zero, return to your benchmark.

Longitudinal survey measurments of reference site

C. Measurements from benchmark to UPSTREAM BOUNDARY

Your team will walk from your benchmark to your upstream boundary tape. During this walk your team members will take the following measurements of **each** habitat unit:

- Identify whether unit is a pool or riffle.
- Length of habitat unit - use measuring tape.
- Percent slope of each habitat unit.
- Continuous length of reference site - use hipchain to measure.
- Make a cross sectional survey (instructions in STEP 2) at upstream boundary and take photo.
- Habitat characteristics of the upstream area will be recorded (instructions in STEP 5).

D. Measurements from benchmark to DOWNSTREAM BOUNDARY

Your team will walk from your benchmark to your downstream boundary tape. During this walk your team members will take the following measurements of **each** habitat unit:

- Identify whether unit is a pool or riffle.
- Length of habitat unit - use measuring tape.
- Percent slope of each habitat unit.
- Continuous length of reference site - use hipchain to measure.
- Make a cross sectional survey (instructions in STEP 2) at downstream boundary and take photo.
- Habitat characteristics of the downstream area will be recorded (instructions in STEP 5).

Data Sheet
STEP 4

Conduct a Longitudinal Survey

Measurements from benchmark to UPSTREAM BOUNDARY:

▶ Record the following measurements on Data Sheet: STEP 4

• Record whether the habitat unit is a pool or a riffle.
Using the flagging tapes, you will easily see the upstream and downstream ends of each habitat unit.

• Record length and take photo of habitat unit.
Measure the length between flags with the measuring tape.

• Record percent slope of habitat unit.
Measure the slope (change in elevation) by using a clinometer and a survey staff to record the elevation change at the water surface between the upstream and downstream markers of the habitat unit **(Figure 9)**.

Method: Have your partner stay at the downstream end of the habitat unit with the staff. Get your partner to position the staff with its base at the same elevation as the water surface. Stand at the upstream marker with your feet at the same elevation as the water surface. Hold the clinometer in front of one eye so you can see the scale through the view finder. Use your other eye to aim the clinometer at the staff downstream. Line up the hairline on the clinometer scale with the flagging tape on the staff. Read the percent slope from the clinometer scale on the right hand side **(Figure 8)**. *Ignore the scale on the left that gives the reading in degrees.*

• Record continuous length.
For this measurement you will maintain a continuous length record with the hipchain, **do not reset to zero** at the end of a habitat unit. Tie off the hip chain, zero it at the benchmark, and walk to the upstream end of the first habitat unit. The person wearing the hipchain should be the last person to walk upstream to avoid disturbing the line. Record the bottom of habitat unit reading as zero metres away from benchmark and the second reading from the top of the habitat unit. The hipchain reading for top of the habitat unit also will be entered on the next line on the **data sheet** as the reading for the bottom of the next habitat unit. Continue to survey each habitat unit moving upstream, repeating the methods above until you are at the upstream boundary. The actual length may be longer than the minimum length of the reference site (6 x bankfull channel width).

HOW TO MAKE A SURVEY STAFF

To make a 'survey staff' from a 2-3m long stick and flagging tape: tie a piece of flagging tape onto the staff at the eye level of the person holding the clinometer. Ensure the bottom of the upright staff is level with the bottom of their boot.

▶ **Record the following information on Data Sheet: STEP 4**

Upstream boundary measurements and description of the location. Use the final number on the hip chain as the actual length from the benchmark to the upstream boundary of the reference site.

• **Conduct a cross-sectional survey at the upstream boundary.** Follow the directions in STEP 2 starting on page 9.

▶ **Record these survey measurements on Data Sheet: STEP 4**

• **Record habitat characteristic measurements in the upstream area. (STEP 5)** Do this while returning to the benchmark (also collect hipchain thread and tape).

▶ **Record these habitat measurements on Data Sheet: STEP 5**

Repeat all of STEP 4 and STEP 5 measurements in the *downstream* area

Figure 8
Clinometer Scale

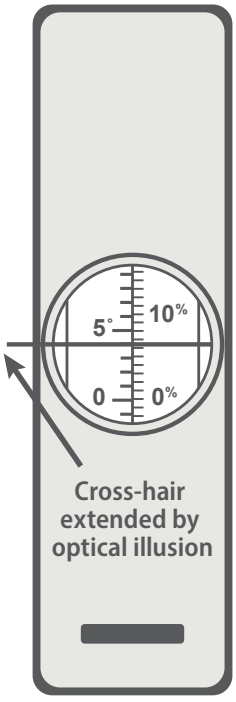
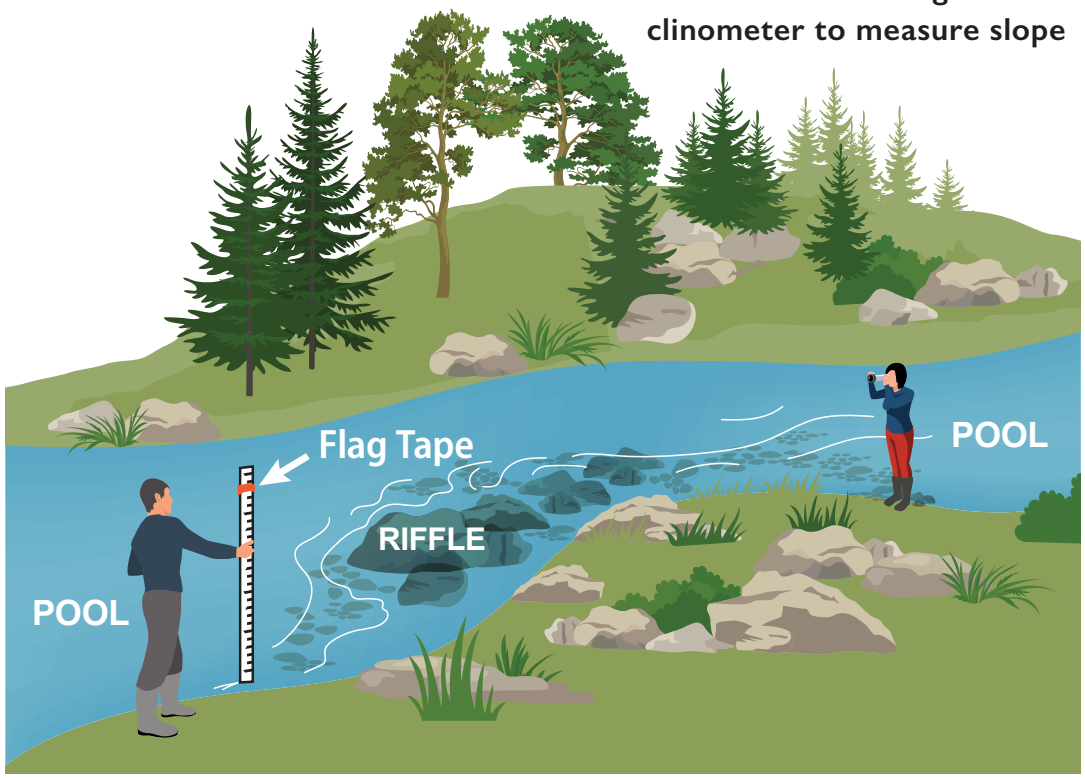


Figure 9
Positions while using the clinometer to measure slope



Data Sheet
STEP 5

Habitat Characteristics

Nine characteristics of stream habitat that indicate capacity for biological productivity

A. Measure these characteristics while walking back to the benchmark from the upstream or downstream boundary.	1. Instream cover 2. Off channel habitat 3. Bank stability 4. Length of bank with no vegetation
B. Measure these characteristics at or near the benchmark.	5. Streambed material 6. Embeddedness
C. Measure these characteristic for the entire reference site. *(From measurements of individual pool habitat units).*	7. Overhead canopy 8. Riparian zone 9. Percent pool habitat

Habitat characteristics, based on their significance to habitat quality

A. Primary characteristics:

- streambed material
- embeddedness of substrate
- instream cover

B. Secondary characteristics:

- percent pool habitat
- off-channel habitat
- bank stability

C. Tertiary characteristics:

- streambank vegetation
- overhead canopy
- size of riparian zone and plants

A. PRIMARY HABITAT CHARACTERISTICS

5.1 Streambed Material

Different kinds of streambed material influence plant and animal life in a stream. Substrate sizes range from "fines" like silt, sand, and clay, to large boulders and bedrock (Table 1) Although variety in substrate size is desirable, a streambed comprised primarily of fine sediment is less stable than one comprised primarily of boulder, cobble, and gravel. Large substrates also provide better quality fish and aquatic invertebrate habitat.

TABLE 1
SIZE CATEGORIES OF STREAMBED MATERIAL

fines	smaller than a ladybug
gravel	ladybug to tennis ball
cobble	tennis ball to basketball
boulder	larger than a basketball with definable edges
bedrock	solid slab of rock

Streambed material is measured at or near the benchmark, in an area of riffle substrate representative of the reference site. Measure 25 particles. Toss a pebble along the stream bank and begin a transect where the pebble comes to rest. Take one step from the bank into the stream. Without looking at the stream bottom, reach down to the toe of your boot and pick up the first particle touched by the tip of your finger.

Call out to the recorder as to whether you have picked up a fine, gravel, cobble, boulder, or bedrock. Take another step across the channel in the direction of the opposite bank and repeat the process. If you reach the opposite bank before you have measured 25 particles, turn around and begin another transect across the channel.

▶ **Convert the data to percentages and record on Data Sheet: STEP 5.1**

5.2 Embeddedness

Fine sediments often bury, or embed, some gravel and cobble substrate. Fines accumulate naturally in pools, where gradient and water velocity are reduced. In undisturbed streams, fines do not accumulate significantly in riffles, so large amounts of fines on riffle substrates may indicate erosion problems in the watershed.

Embedded riffle substrates provide less desirable habitat for invertebrates, and reduce habitat quality, stream productivity, and fish spawning habitat.

Embeddedness is measured at or near the benchmark, in an area of substrate representative of the reference site. Wade into the riffle. Pick up 5-10 pieces of gravel or cobble. Estimate the percentage of rock surface area buried in fines **(Figure 10)**. Often a stain line indicates the level of burial. Note these individual measurements and use to calculate the average estimated percent embeddedness.

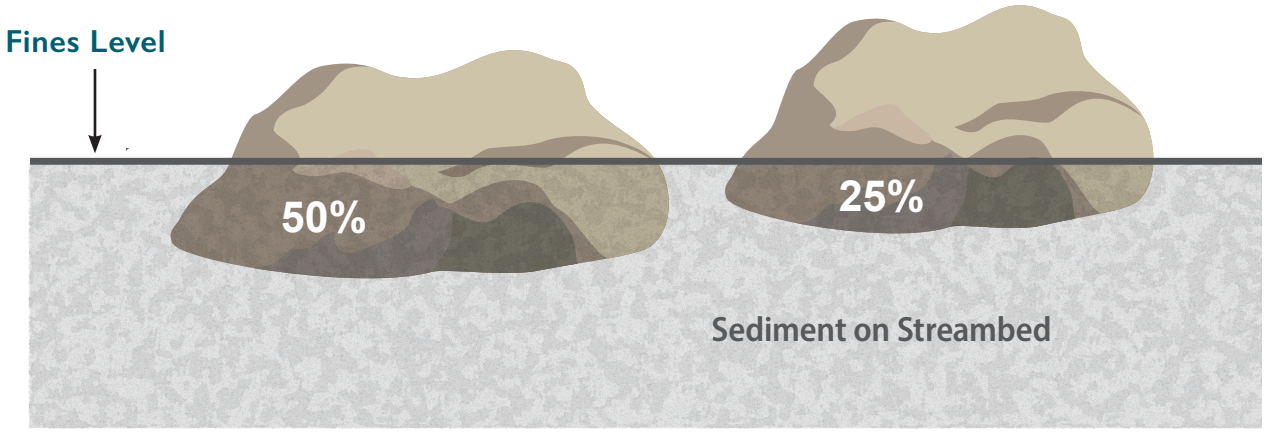
▶ **Record the estimated percent embeddedness on Data Sheet: STEP 5.2**

5.3 Instream Cover

Large woody debris (LWD) which includes stable logs and stumps, and undercut banks with large protruding root masses provide important instream cover habitat for fish and other animals. They provide shelter, cover from predators, and refuge during floods and droughts. Instream cover is counted in the upstream and downstream portions of the reference site, while walking back to the benchmark. Count the number of pieces of LWD at least 1 m long and 0.1 m in diameter that seem unlikely to wash away. On both stream banks count the number of stable undercut banks with roots protruding into the channel.

▶ **Record the number of LWD and rooted cutbanks on Data Sheet: STEP 5.3**

Figure 10
Estimating embeddedness of gravel and cobble



Divide the total cover number by the length of the survey site expressed in channel widths (the length of the reference site divided by the bankfull channel width - about 12).

▶ **Record this value on Data Sheet: STEP 5.3**

B. SECONDARY HABITAT CHARACTERISTICS

5.4 Percent Pool Habitat

Percent pool habitat refers to the proportion of pool habitat within the reference site. Pools are areas of low energy and riffles are areas of higher energy. Pool and riffle habitats alternate in stream channels. Both habitat types are important to aquatic organisms. Pools provide a refuge in flood conditions and may be the only habitat available during drought conditions. Many factors influence the relative abundance of pools and riffles. Percent pool habitat is calculated for the entire reference site.

Calculate the total length of pool habitat from the measurements obtained in STEP 4.

▶ **Record this value on Data Sheet: STEP 5.4**

Divide the total length of pool habitat by the total length of the reference site. Multiply by 100 to obtain percent pool habitat.

▶ **Record this value on Data Sheet: STEP 5.4**

Average slope is used to interpret the results for percent pool habitat. Calculate the average slope for the entire reference site from the slope data collected in **Step 4** (include 0% readings). This calculation is the average of the individual habitat values.

▶ **Record the average % slope on Data Sheet: STEP 5.4**

5.5 Off-channel Habitat

Side channels, ponds, wetlands, and secondary overflow channels next to the main channel provide off-channel habitat. These areas are isolated and protected from main channel flood flows which provide seasonal breeding and rearing areas for many animal species. Some are easy to see and others are less obvious. They may join the main stream channel only at some times of year or throughout the

year. Off-channel habitat is measured in the upstream and downstream portions of the reference site, while walking back to the benchmark. Search both banks for small channels that lead away from the main stream.

▶ **Record the number of side channels and backwater ponds on Data Sheet: STEP 5.5**

▶ **Record their approximate size, shape and potential as flood refuge. Decide if seasonal or year-round and take-photos**

5.6 Streambank Stability

Streams with unstable banks between the annual high water and low water marks often have unstable stream beds and poor instream habitat. Banks that are steep or damaged with no vegetation often are unstable. Soil can slide into the channel from unstable areas up the bank. Artificially stabilized stream banks indicate erosion problems. Bank stability is measured in the upstream and downstream portions of the reference site, while walking back to the benchmark. Examine the banks between annual high and low water marks for signs of existing or potential sloughing. Count the number of places on both banks with active erosion (sloughing soil, raw appearance), artificial bank stabilization, or signs of landslides into the channel. Measure the length of stream bank affected by each impact.

▶ **Record individual and total values for both left and right banks on Data Sheet: STEP 5.6**

C. TERTIARY HABITAT CHARACTERISTICS

5.7 Streambank Vegetation

Perennial vegetation at the edge of the bankfull channel includes trees, shrubs, and grasses. Stream bank vegetation contributes to a healthy stream habitat. It binds the soil with root networks, moderates temperature fluctuations, absorbs pollutants from runoff, and provides a source of food and large woody debris. Removing bank vegetation significantly degrades stream habitat.

Bank vegetation is measured in the upstream and downstream portions of the reference site, while walking back to the benchmark. Measure the lengths of stream bank with no vegetation at the edge of the bankfull channel.

▶ **Record the individual and total values for both the left and right banks on Data Sheet: STEP 5.7**

5.8 Overhead Canopy

Tree and shrub branches overhanging the stream form an overhead canopy. This canopy provides food, shade, and cover for organisms in the stream below. Overhead canopy is estimated standing at the benchmark while considering tree cover over the entire reference site. This is a visual estimate of the extent of the canopy within the bankfull channel area, recorded as a rough percentage. For example, there is 100% coverage when the branches on opposite banks meet or overlap at the center of the channel throughout the reference site. You can also estimate overhead cover from a recent large-scale aerial photograph.

▶ **Record the information on Data Sheet: STEP 5.8**

5.9 Riparian Zone

The riparian zone is the area between the stream bank and the upland slope at the edge of the flood plain. The extent of stream bank vegetation needs to be wide enough to provide a buffer from land use impacts near the stream and protect the flood plain up to the base of adjacent slopes. A good quality riparian buffer zone has several species of coniferous and deciduous trees and shrubs. However, the riparian zone may also contain disturbed land (e.g. houses, trails, farmland, forestry).

The extent of the riparian zone is estimated standing at the benchmark while considering conditions over the entire reference site. Estimate the average width of the riparian zone in terms of the number of bankfull channel widths.

▶ **Record the value on Data Sheet: STEP 5.9**

For example, if the distance to the upland slope on both sides of the stream is about twice as wide as the average bankfull channel width, record this as two channel widths on the form. Note the relative abundance of coniferous and deciduous trees, shrubs, and grasses in the riparian zone.

▶ **Record these on Data Sheet: STEP 5.9**

You can also estimate the width of the riparian zone from a recent aerial photograph, but you will need to estimate extent of vegetation based on current observations.

Data Sheet
STEP 6

Conduct a Habitat Assessment

Collecting, reporting and evaluating information

Rate the habitat quality of the reference site. Use your recorded measurements and observations from STEP 5 to complete the calculations. Transfer these measurements to the RESULTS column in Data Sheet: STEP 6.

Assign a score for each characteristic using the interpretation scoring table in Data Sheet: STEP 6. The scores for the nine habitat characteristics are weighted to reflect their importance to biological productivity of the stream.

Add the values to get the total score for the reference site. If the total score for the reference site is in the marginal or poor category, check the individual scores to identify particular problems at the site. This will help you choose a focus for any initial restoration efforts. You may wish to confirm poor results by doing water quality or stream invertebrate surveys at the site (Modules 3 and 4).

WEIGHTED CHARACTERISTICS

Primary habitat characteristics (1-3)
SCORE between 0 to 20 points
• relates to streambed composition and instream cover

Secondary habitat characteristics (4-6)
SCORE between 0 to 15 points
• relates to channel structure and stability

Tertiary habitat characteristics (7-9)
SCORE between 0 to 10 points
• relates to streamside vegetation

Data Sheet
STEP 7

Enter the data in the Streamkeepers Database at www.streamkeepers.info

Enter Data in Streamkeepers Database

Public relations

You can clean up streams, monitor their condition, and undertake enhancement projects, but you need the support of your community for these projects to succeed. Talk about your project with others whenever and wherever you can, including at schools and public meetings. Place signs at visible project sites and share on social media pages. Contact newspapers, radio stations and television stations. Module 10 contains specific information about increasing community awareness and working with the media.

Steps at a Glance

Advanced Stream Habitat Survey

STEP 1 CHOOSE A BENCHMARK

At benchmark conduct:

STEP 2 CROSS SECTIONAL SURVEY

and

STEP 3 STREAM DISCHARGE

ESTABLISH REFERENCE SITE BOUNDARIES:

STEP 4 HABITAT UNIT INFORMATION

From benchmark walk upstream and flag

- **habitat units**
- **upstream boundary**

Return to benchmark

From benchmark walk downstream and flag

- **habitat units**
- **downstream boundary**

Return to benchmark

From benchmark walk upstream while measuring:

STEP 4 HABITAT UNIT INFORMATION

At upstream boundary conduct:

STEP 2 CROSS SECTIONAL SURVEY

Return to benchmark while recording:

STEP 5 HABITAT CHARACTERISTICS

COLLECT HIPCHAIN THREAD AND FLAG TAPE

From benchmark walk downstream while measuring:

STEP 4 HABITAT UNIT INFORMATION

At downstream boundary conduct:

STEP 2 CROSS SECTIONAL SURVEY

Return to benchmark while measuring:

STEP 5 HABITAT CHARACTERISTICS

COLLECT HIPCHAIN THREAD AND FLAG TAPE

At benchmark complete remaining:

STEP 5 HABITAT CHARACTERISTICS

STEP 6 HABITAT ASSESSMENT

STEP 7 ENTER DATA in Streamkeepers Database

STREAMKEEPERS
MODULE 2

Advanced Stream Habitat Survey

PROJECT APPROVAL
- Not required

TRAINING
- Recommended

TIME COMMITMENT
- Half day per site (yearly)

NUMBER OF PEOPLE
- 2 or more

TIME OF YEAR
- Late summer / Early fall

This advanced survey adds details about stream conditions and habitat to information collected in Introductory Stream Habitat Survey Module 1.

REVISED 2023

Pêches et Océans Canada
Fisheries and Oceans Canada
Canada

Welcome to Streamkeepers

The Streamkeepers Program of Fisheries and Oceans Canada (DFO) Community Involvement Program provides these training modules. These modules encourage "hands on" environmental activities in watersheds in British Columbia. Volunteer groups, First Nations, schools, and individuals are using this material to monitor and restore local waterways. Your local Fisheries and Oceans Community Advisor can provide more information.

Project Purpose

This Advanced Survey adds details about stream conditions and habitat to information collected in the Introductory Stream Habitat Survey (Module 1). You can use these collected data to document changes over years by returning to a site several times. And you can also use this data from upstream and downstream to asses a suspected habitat problem by comparing this information. If you rehabilitate an area, you will want to survey it in later years to assess the effectiveness of your restoration work

Overview

Each STEP in this Advanced Habitat Survey correlates to information collected on your DATA SHEET.

STEP 1 Choose a reference site and establish a benchmark

STEP 2 Conduct a cross sectional survey (3 times)

STEP 3 Calculate stream discharge

STEP 4 Conduct longitudinal survey

STEP 5 Measure habitat characteristics

STEP 6 Conduct a habitat assessment

STEP 7 Enter data into Streamkeepers Database

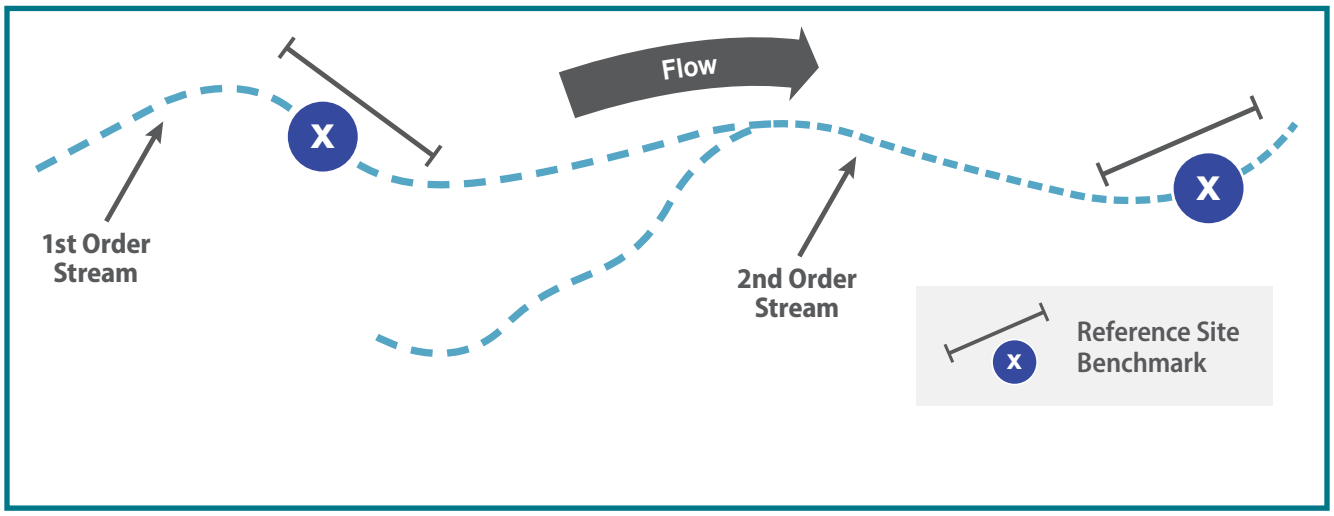
The survey methods show you how to collect consistent data so you can compare sites or streams with confidence, even when the information has been collected by different people or organizations. You will;

1. Decide whether to monitor long-term changes or document impacts of habitat problems.

2. Define the study area or areas and select a short section of stream that represents habitat in that stream segment which becomes your reference site.

3. Identify the reference site with a benchmark (using a photo and GPS to record the location) which enables people to find the exact location again. **Figure 1** shows examples for first and second order segments of a stream.

Figure 1
Reference Site and Benchmark on Stream Segments



After establishing a reference site, you can collect detailed information about:

• Physical habitat MODULE 2
• Water quality MODULE 3
• Benthic invertebrates MODULE 4
• Fish MODULE 11

You can establish several reference sites, each representing particular types of habitat and stream conditions in the watershed. Consider ease of access when you select the reference site(s). If you are interested in a second order stream, for example, you can establish sites on the first order headwater segments as well as on the second order segment. If you wish to measure the impact of a problem, you can collect data at reference sites upstream (control site), in the vicinity of the problem (impact site), and further downstream (recovery site). Do all the surveys on the same day. If this is not practical, survey over a few days, as long as stream flow conditions remain constant.

Monitoring many sites can be time consuming for one group, but a network of groups in one watershed can share the work. Each group can be responsible for one or two sites. If more than one group is involved, use these consistent methods and do the surveys at the same time to produce reliable and comparable data.

Many methods described here were developed for use on streams. They may not work as easily for large or deep rivers.

Project Guidance and Approval

You need no formal approval, but you should advise your Community Advisor, who can help coordinate equipment, training, and site selection. The methods used are technical in nature. They may seem complicated at first, but are not difficult to learn. This Module is included in the two day Streamkeepers training.

Level of Effort

The first time you survey a reference site it may take at least half a day on a small stream, and longer on a larger stream. Subsequent surveys of the same site take less time because the benchmark is already established.

Time of Year

Conduct the advanced survey during late summer or early fall, if possible. Stream flows are lower at these times, making it easier to work in the stream channel. It also is a good time of year to assess bank vegetation. If you repeat the survey annually, return at the same time of year, when flow and weather conditions are similar.

Personal Safety

Concern for personal safety is essential when working outdoors. Develop and follow a safety plan. Always tell someone where you are going and when you will return. Work in pairs, never alone. Carry emergency response phone numbers.

Do not attempt to wade fast water or water deeper than your knees. Watch out for slippery stream beds, undercut banks, waterfalls, and fast flowing areas. Avoid log jams, which can be unstable.

Get permission to cross or use private property. Beware of domestic animals and wildlife.

Warn everyone, especially children, about hazards such as syringes, needles, broken glass, and condoms. Remove them with tongs and place them in a special hazardous materials bucket, or flag them with bright tape. Avoid foul smelling areas, spills of unknown substances, or containers of hazardous or unidentified materials. These are to be reported to the nearest Fisheries and Oceans Canada office, follow protocols in Streamkeepers Module 9.

Observe, Record and Report Phone
24 Hours Toll Free
1-800-465-4336

Email:
DFO.ORR-ONS.
MPO@dfo-mpo.gc.ca

Health

Do not drink stream water and ensure exposed cuts and wounds are protected. Although it may look pristine, water can harbour bacteria or parasites that will make you sick. Know the symptoms and treatment for hypothermia. Carry a first aid kit. When working in isolated areas, carry a survival kit containing at least a lighter, fire starter, candle, flares, and a satellite phone or cell phone.

Clothing

Dress for the weather and stream conditions. Wear highly visible clothing. Wear waders with felts when walking in the stream.

Material and Equipment

- **data sheets**
- **clipboard and paper**
- **felt pen, pencils**
- **GPS unit**
- **cell phone**
- **camera**
- **clinometer**
- **tennis ball**
- **stopwatch**
- **fibreglass tape measure**
- **calculataor**
- **hip chain**
- **metre stick**
- **first aid kit**

Procedure

Module 2 procedures have been developed to minimize the amount of instream habitat disturbance during the survey. When the left or right bank is referred to this is determined while facing downstream. To record your survey use the Data Sheets provided at the end of this module, which you can download and print from - **https://www.pskf.ca/publications/sheets.php**
This data can then entered into the online Streamkeepers database - **https://www.streamkeepers.info**

Data Sheet
STEP 1

Establish a reference site and a benchmark

Establish a reference site

A reference site is where you will conduct your survey. This reference site represents habitat in that stream segment. The site will be a length of stream at least twelve times the bankfull channel width. **The bankfull channel** is the active stream channel to the edge of well-established perennial vegetation **(Figure 2)**.

For example, a reference site where the bankfull channel width is 2.5m, will have a boundary of 30m (12 x 2.5m) with 15m upstream and 15m downstream of the benchmark. This measurement should allow for a full pool, riffle, pool, riffle sequence. (**Figure 2a)**.

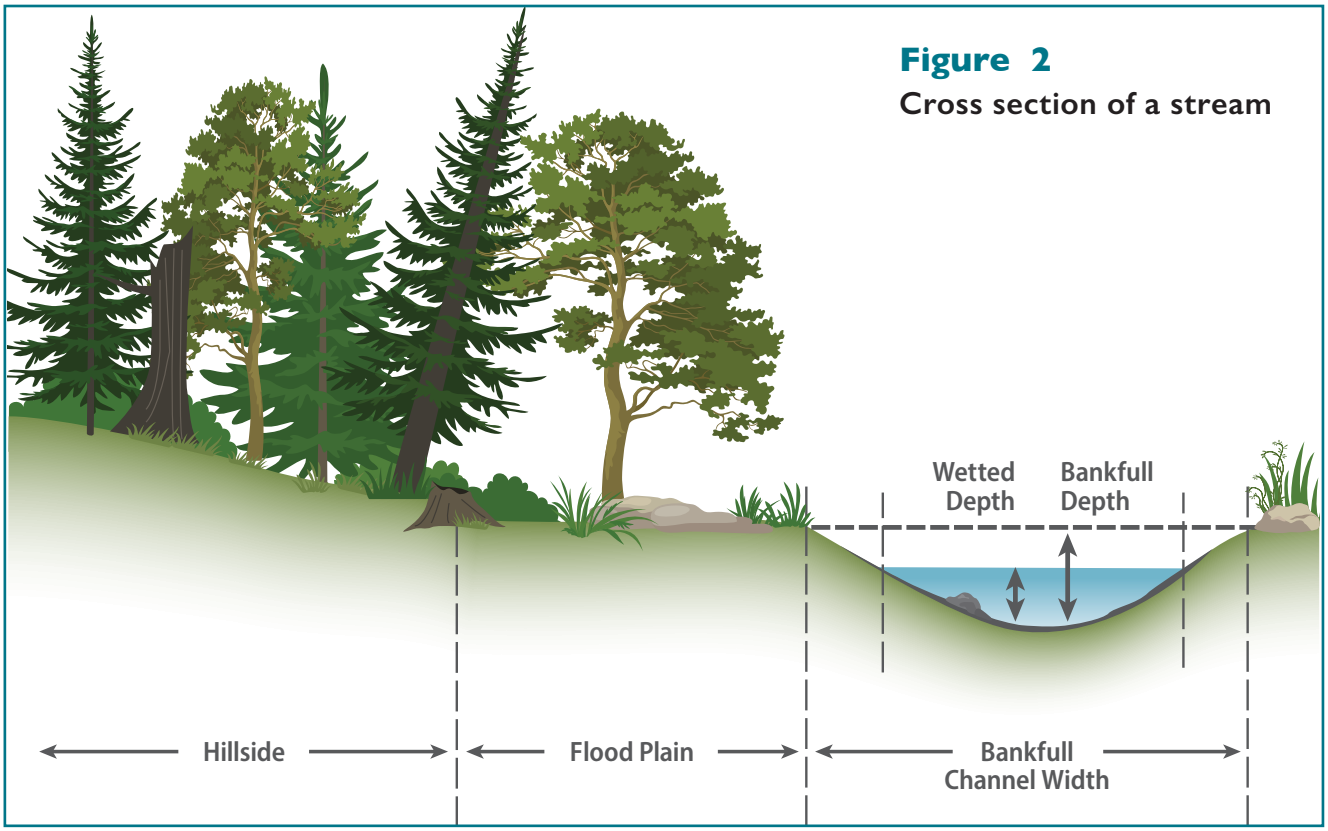


Figure 2
Cross section of a stream

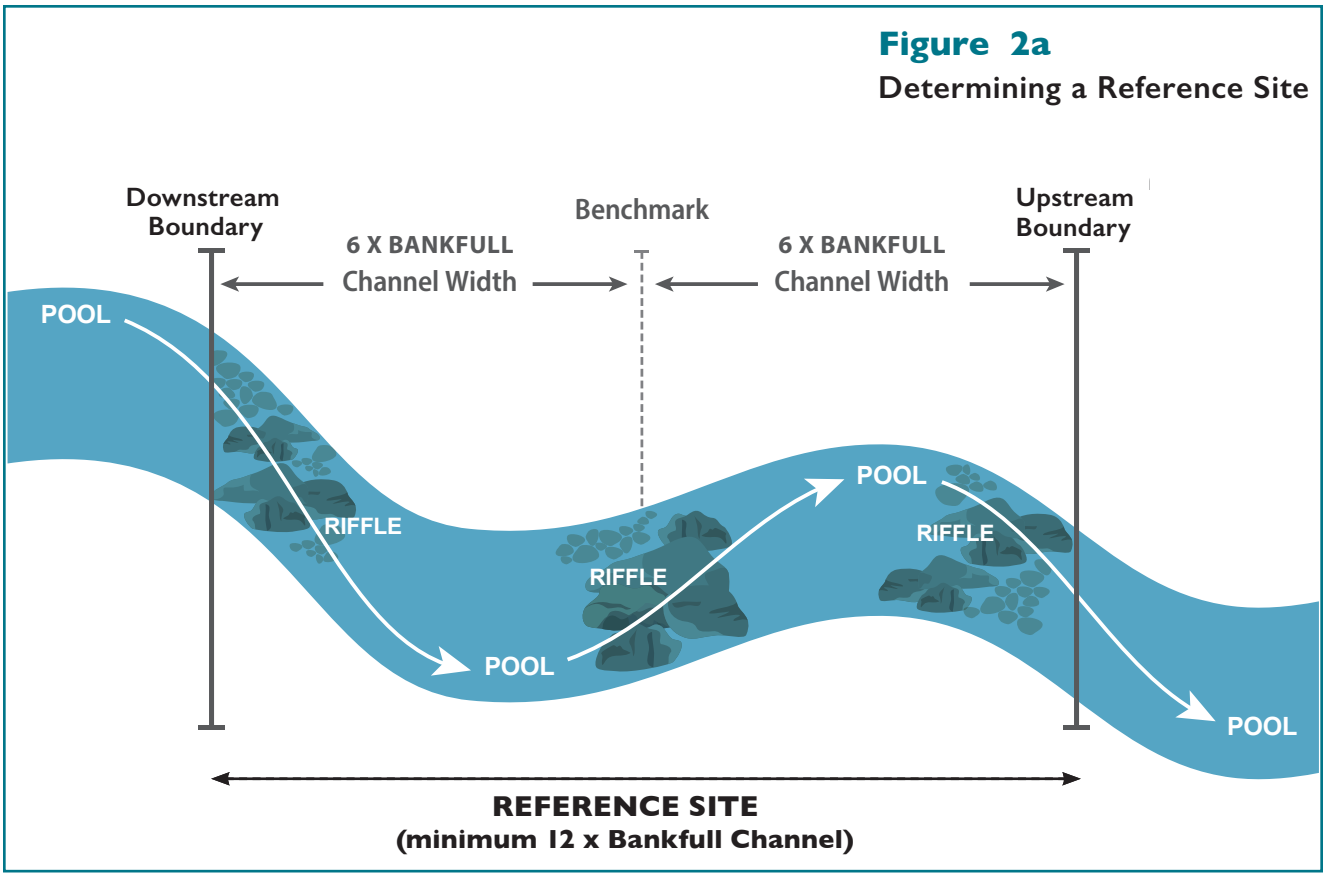


Figure 2a
Determining a Reference Site

Establish a benchmark

Once you select a suitable location for a reference site, establish a benchmark so the site can be found for future surveys. Locate your benchmark at a riffle where the bankfull channel width and general stream conditions appear typical of average conditions for the site and for the overall stream segment.

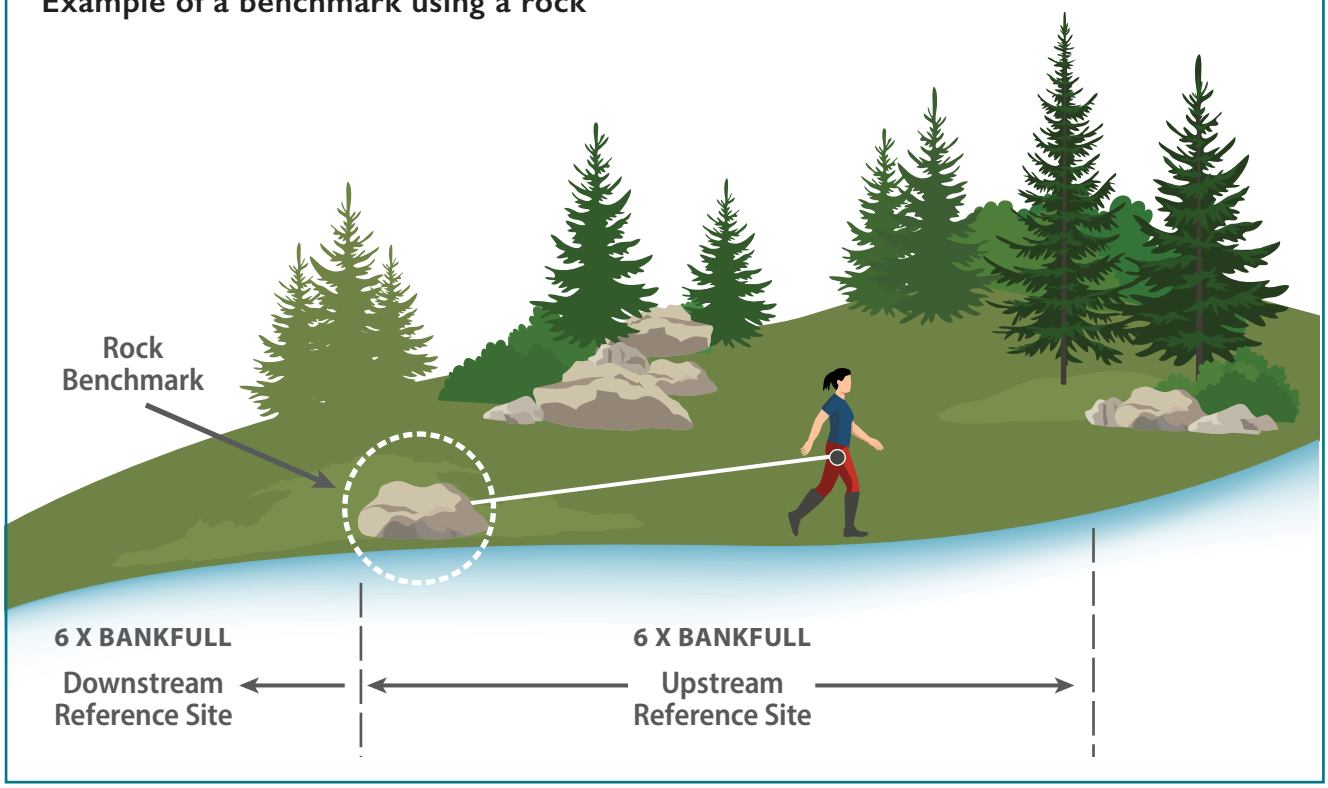
Choose the location for the benchmark carefully; you will make several measurements from this point:

- **Data Sheet: STEP 2 Cross Sectional Survey**
- **Data Sheet: STEP 3 Stream Discharge**
- **Data Sheet: STEP 4 Longitudinal Survey**

Identify the benchmark location (include a photo and GPS) which will enable people to find the exact location again.

▶ **Record directions to and location of the benchmark on Data Sheet: STEP 1**

Figure 3
Example of a benchmark using a rock



Data Sheet
STEP 2

Conduct a Cross Sectional Survey

Cross Sectional Surveys consist of measuring:

- **WIDTHS** of Wetted Channel and Bankfull Channel
- **DEPTHS** of Wetted Channel and Bankfull Channel
- AIR and WATER Temperatures **(Figure 4)**

These measurements are taken at three places **(Figure 2a)** within your reference site:

1. BENCHMARK
2. UPSTREAM BOUNDARY
3. DOWNSTREAM BOUNDARY

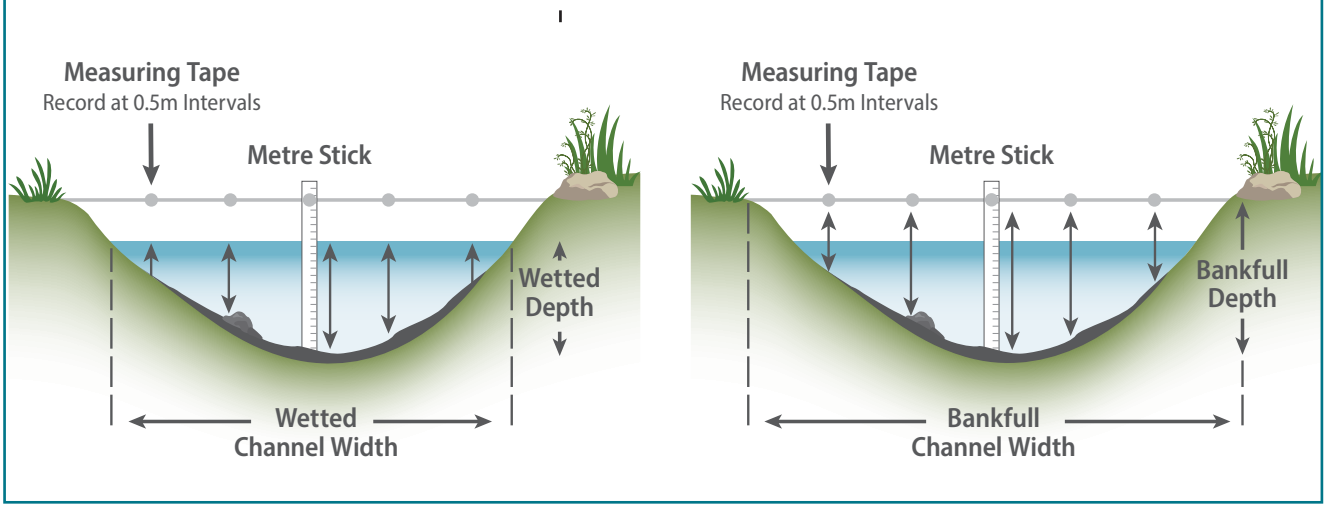
The stream channel is formed at the bankfull stage, during annual high water. Although you should never measure a stream at this high water stage, you may observe permanent reminders left by receding waters, which mark the boundaries of the bankfull channel. Sometimes the indicators are hard to find.

The bankfull channel width and depth reflect the total discharge or volume of water during annual high flow events. Bankfull channel flow is the channel forming water. A change in the bankfull channel dimensions may be a warning sign that natural runoff patterns in the watershed are changing. **(Figure 2)**

Bankfull Indicators

- **The edge of the active stream channel and beginning of the flood plain**
- **The start of well-established perennial vegetation such as trees, shrubs, and ferns**
- **A change in the bank slope from vertical to more horizontal**
- **A change in bank material from coarse gravel to fine sand or soil**
- **The highest stain lines (these mark the lines of frequent inundation and are formed by sediment or lichen).**

Figure 4



Conduct a cross-sectional survey at the benchmark

▶ **Record the following measurements on Data Sheet: STEP 2**

• **Width of wetted channel** - stretch a measuring tape from the left bank across the wetted area of the stream, at the same elevation as the top of the water. Make sure the tape is level and perpendicular to the stream flow. Use this measurement in calculating **STEP 3.**

• **Width of bankfull channel -** move the measuring tape up to the edges of the bankfull indicators. Hold measuring tape in position for next measurements. The measuring tape will now give a visual for where the water line would be at bankfull stage.

• **Wetted depth** - from stream bottom to top of water.

• **Bankfull depth -** from stream bottom to measuring tape.

Measure wetted and bankfull depths at regular intervals across the stream; every half meter in streams less than 5m wide, every metre in streams 5 - 15m wide, and every two metres in streams 15 - 25m wide. Take the initial measurement 0.1m away from the left bank. Where there is no water in the measurement area, mark an **X** on the datasheet. Calculate the average depth in cm then convert to metres. Use this measurement in calculating **STEP 3.**

Draw a sketch of the stream channel cross-section showing the wetted and bankfull channel widths and depths. **(Figure 4)** You will also do cross-sectional surveys at the upstream and downstream endpoints of your reference site once they are established.

Take three photos while the tape is in place. Take photos looking upstream and downstream of the cross-section. Also, take a photo of the cross-sectional view along the tape, with the benchmark in the background. Make sure the tape measure is visible in the photos. You can reduce glare from the water surface by taking the photos with the camera pointed down at the water surface or by using a polarizing filter. Have someone stand in the photos holding a paper showing the name of the creek, date, site number, and orientation in relation to stream flow.

Data Sheet
STEP 3

Calculate Stream Discharge

Stream discharge is measured in the riffle area at the benchmark, where you made wetted channel measurements in STEP 2.

A. Calculate stream cross-sectional area (m2)

Use your plot of wetted channel dimensions.
Multiply wetted width by average wetted depth.

▶ **Record this value on Data Sheet: STEP 3**

B. Calculate average time (in seconds)

Measure out a 10m length of stream and mark the ends (start point and end point). While standing at the downstream and upstream points, visually divide the stream width into five sections: one mid-stream, two near shore, and two half way to the middle **(Figure 5)**. Drop a tennis ball into the water 1 metre **upstream** of the start point. When the tennis ball crosses the start point begin timing and record how long it takes the tennis ball to float the 10m to the downstream endpoint. Repeat the process in the other four sections of the 10m length.

▶ **Record times for the five trials and calculate the average on Data Sheet: STEP 3**

C. Calculate the average velocity in m/sec

Divide the distance (10 m) by the average time in seconds, to get the average stream velocity in m/sec.

▶ **Record result on Data Sheet: STEP 3**

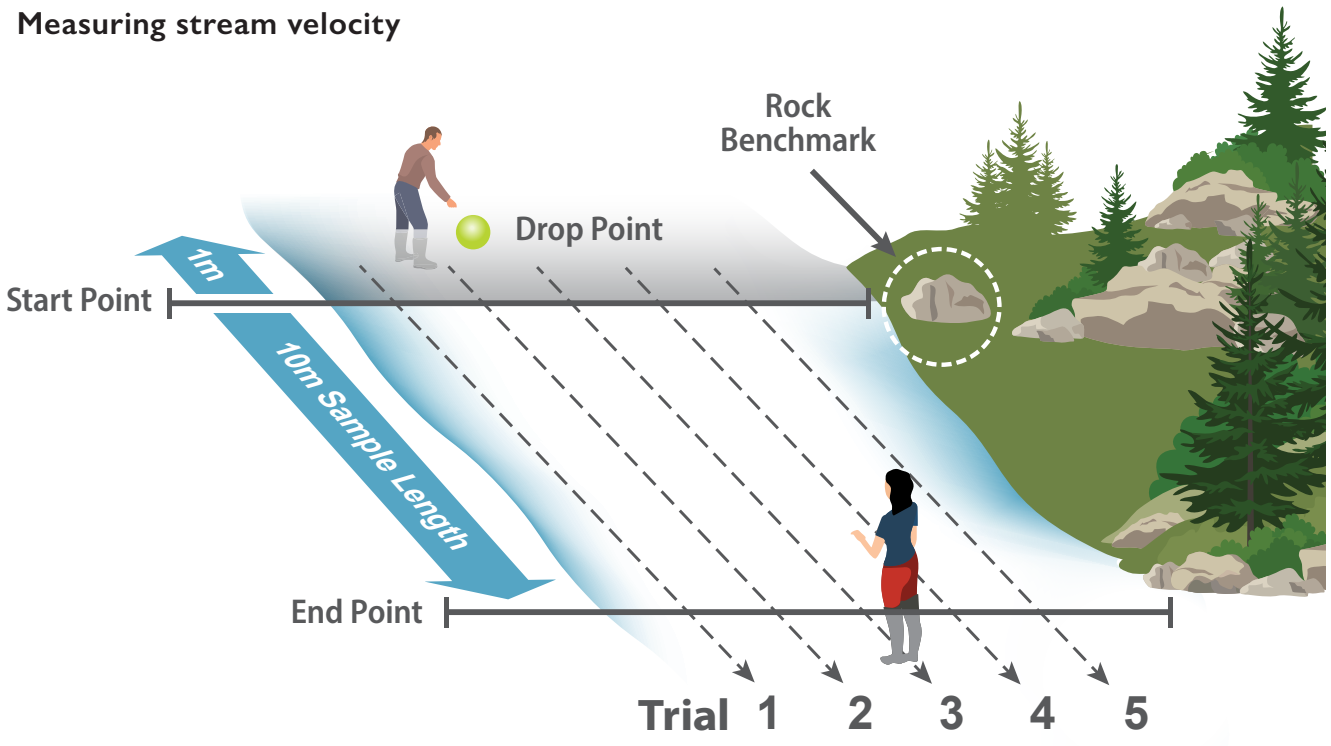
D. Calculate total stream discharge in m3/sec.

Multiply the cross-sectional area (m2) by average water velocity (m/sec) and by a correction factor of 0.8. This factor converts the surface velocity measurement to average velocity. Water flows at different speeds throughout the water column. Average velocity occurs just below the mid-depth.

▶ **Record stream discharge on Data Sheet: STEP 3**

cross-sectional area (m2)	**X**	**average velocity (m/sec)**	**X**	**0.8**	**=**	**discharge (m3/sec)**

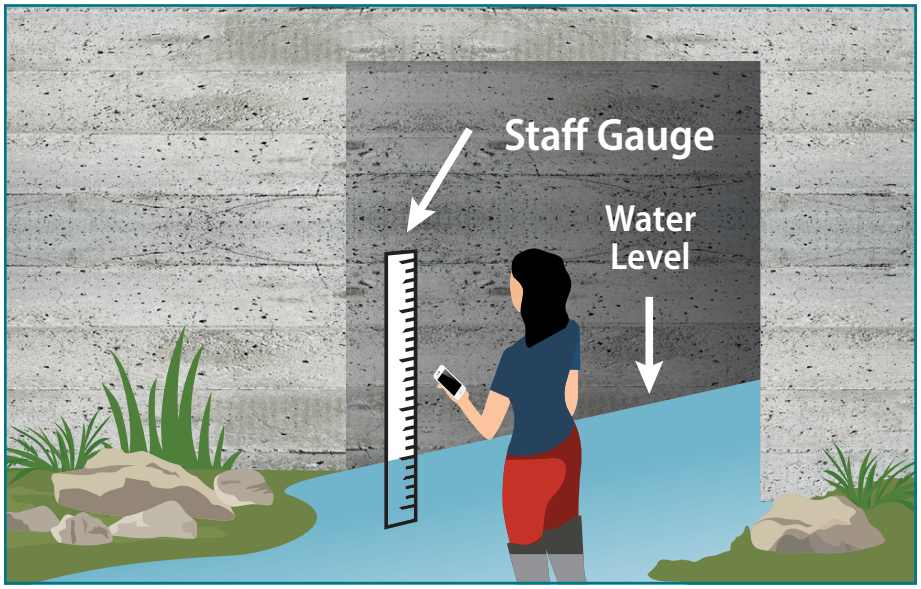
Figure 5
Measuring stream velocity



Calculate stream discharge using a Staff Gauge

If you plan to monitor stream discharge frequently, using a staff gauge will shorten your calculations. There may be a staff gauge already installed on an engineered area of the stream, such as a bridge crossing, box culvert or flood control area, or you may wish to install one. The staff gauge is a painted scale (marked in metres and centimetres) used to show the water depth **(Figure 6a)**.

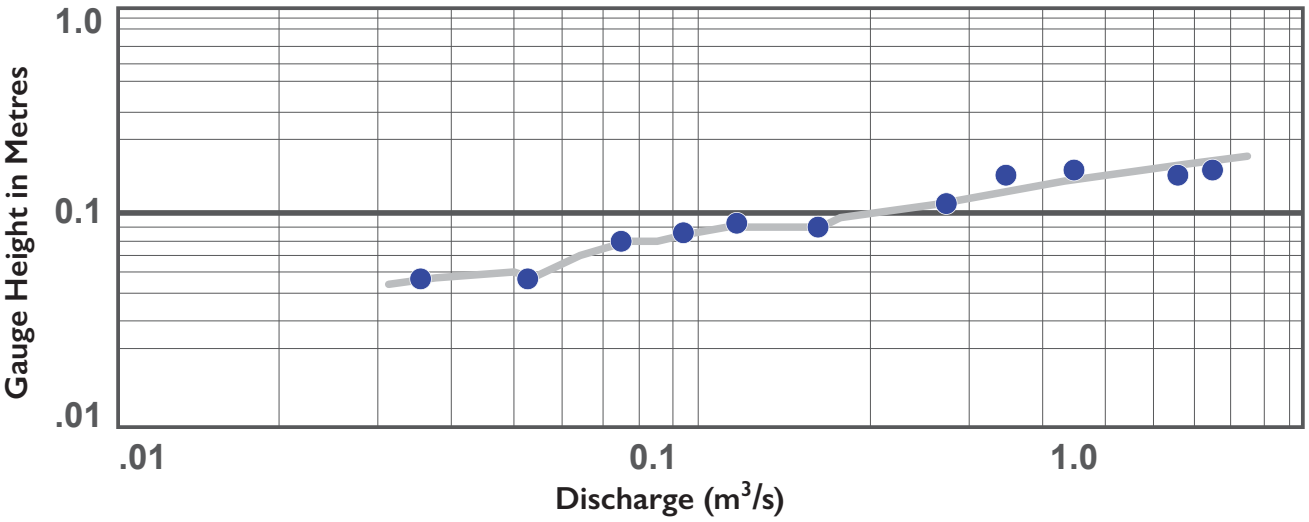
Figure 6a
Staff Gauge at a box culvert



Gauge readings and stream discharge rates are measured over a wide range of stream flows, then plotted on a logarithmic scale to produce a rating curve **(Figure 6b)**. Once the rating curve has been determined, you can read the staff gauge height, then estimate the stream discharge from the rating curve.

Figure 6b
Staff Gauge: example of rating curve on Logarithmic Scale

From Stream Channel Reference Site: An Illustrated Guide to Field Technique



STEP 4
Longitudinal Survey Defined

Longitudinal Surveys include information on habitat units - pools and riffles in STEP 4 and habitat characteristics in STEP 5. These measurements are taken over the entire length of the reference site (the site is at least twelve times the bankfull channel width).

On average, a pool-riffle sequence is repeated every six times the bankfull channel width and a full S-shaped meander is repeated every twelve times the bankfull channel width **(Figure 7).**

HABITAT UNITS
These are either pools or riffles within a stream reference site.

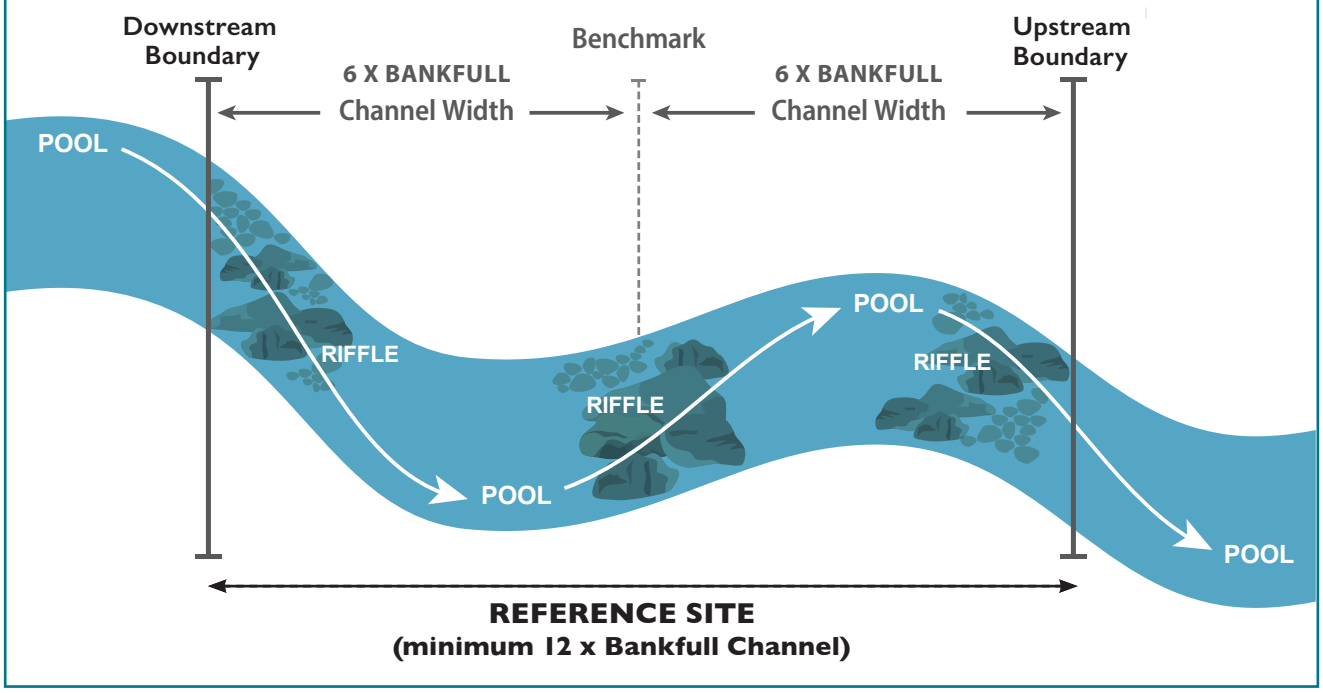
REFERENCE SITE
At least 12 times the bankfull channel width of a stream.

The benchmark is at the midpoint for a reference site survey. In this survey you will define upstream and downstream boundaries of the site and divide the site into distinct habitat units.
Each stream consists of a repeating pattern of pool and riffle habitat units.

POOLS have deeper water, lower velocity and water surface gradient, with little or no surface turbulence.

RIFFLES have shallower water, higher velocity and water surface gradient, and some surface turbulence.

Figure 7
Natural meander pattern of a stream



How to Conduct a Longitudinal Survey

Mark the upstream and downstream boundaries of reference site and define habitat units

A. Define UPSTREAM BOUNDARY of reference site.

Starting from the benchmark, using a hip chain, walk upstream, marking with flag tape the upstream end of each habitat unit, pool or riffle. (The upstream end of a habitat unit is the downstream end of the next habitat unit) continue to mark off the habitat units until you are at a distance away from the benchmark of 6 times the bankfull channel width. Walk to the end of the pool or riffle you are in and mark with a piece of flag tape. *This will be your upstream boundary for your reference site.* Break off the hip chain thread and reset to zero, return to your benchmark.

B. Define DOWNSTREAM BOUNDARY of reference site.

Starting from the benchmark, using a hip chain, walk downstream, marking with flag tape the downstream end of each habitat unit, pool or riffle. (The downstream end of a habitat unit is the upstream end of the next habitat unit) Continue to mark off the habitat units until you are at a distance away from the benchmark of 6 times the bankfull channel width. Walk to the end of the pool or riffle you are in and mark with a piece of flag tape. *This will be your downstream boundary for your reference site.* Break off the hip chain thread and reset to zero, return to your benchmark.

Longitudinal survey measurments of reference site

C. Measurements from benchmark to UPSTREAM BOUNDARY

Your team will walk from your benchmark to your upstream boundary tape. During this walk your team members will take the following measurements of **each** habitat unit:

- Identify whether unit is a pool or riffle.
- Length of habitat unit - use measuring tape.
- Percent slope of each habitat unit.
- Continuous length of reference site - use hipchain to measure.
- Make a cross sectional survey (instructions in STEP 2) at upstream boundary and take photo.
- Habitat characteristics of the upstream area will be recorded (instructions in STEP 5).

D. Measurements from benchmark to DOWNSTREAM BOUNDARY

Your team will walk from your benchmark to your downstream boundary tape. During this walk your team members will take the following measurements of **each** habitat unit:

- Identify whether unit is a pool or riffle.
- Length of habitat unit - use measuring tape.
- Percent slope of each habitat unit.
- Continuous length of reference site - use hipchain to measure.
- Make a cross sectional survey (instructions in STEP 2) at downstream boundary and take photo.
- Habitat characteristics of the downstream area will be recorded (instructions in STEP 5).

Data Sheet
STEP 4

Conduct a Longitudinal Survey

Measurements from benchmark to UPSTREAM BOUNDARY:

▶ Record the following measurements on Data Sheet: STEP 4

• Record whether the habitat unit is a pool or a riffle.
Using the flagging tapes, you will easily see the upstream and downstream ends of each habitat unit.

• Record length and take photo of habitat unit.
Measure the length between flags with the measuring tape.

• Record percent slope of habitat unit.
Measure the slope (change in elevation) by using a clinometer and a survey staff to record the elevation change at the water surface between the upstream and downstream markers of the habitat unit **(Figure 9)**.

Method: Have your partner stay at the downstream end of the habitat unit with the staff. Get your partner to position the staff with its base at the same elevation as the water surface. Stand at the upstream marker with your feet at the same elevation as the water surface. Hold the clinometer in front of one eye so you can see the scale through the view finder. Use your other eye to aim the clinometer at the staff downstream. Line up the hairline on the clinometer scale with the flagging tape on the staff. Read the percent slope from the clinometer scale on the right hand side **(Figure 8)**. *Ignore the scale on the left that gives the reading in degrees.*

• Record continuous length.
For this measurement you will maintain a continuous length record with the hipchain, **do not reset to zero** at the end of a habitat unit. Tie off the hip chain, zero it at the benchmark, and walk to the upstream end of the first habitat unit. The person wearing the hipchain should be the last person to walk upstream to avoid disturbing the line. Record the bottom of habitat unit reading as zero metres away from benchmark and the second reading from the top of the habitat unit. The hipchain reading for top of the habitat unit also will be entered on the next line on the **data sheet** as the reading for the bottom of the next habitat unit. Continue to survey each habitat unit moving upstream, repeating the methods above until you are at the upstream boundary. The actual length may be longer than the minimum length of the reference site (6 x bankfull channel width).

HOW TO MAKE A SURVEY STAFF

To make a 'survey staff' from a 2-3m long stick and flagging tape: tie a piece of flagging tape onto the staff at the eye level of the person holding the clinometer. Ensure the bottom of the upright staff is level with the bottom of their boot.

▶ **Record the following information on Data Sheet: STEP 4**

Upstream boundary measurements and description of the location. Use the final number on the hip chain as the actual length from the benchmark to the upstream boundary of the reference site.

• **Conduct a cross-sectional survey at the upstream boundary.** Follow the directions in STEP 2 starting on page 9.

▶ **Record these survey measurements on Data Sheet: STEP 4**

• **Record habitat characteristic measurements in the upstream area. (STEP 5)** Do this while returning to the benchmark (also collect hipchain thread and tape).

▶ **Record these habitat measurements on Data Sheet: STEP 5**

Repeat all of STEP 4 and STEP 5 measurements in the *downstream* area

Figure 8
Clinometer Scale

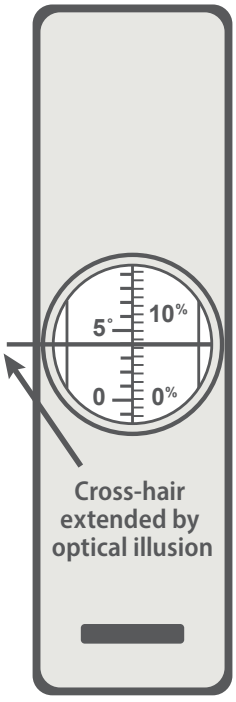
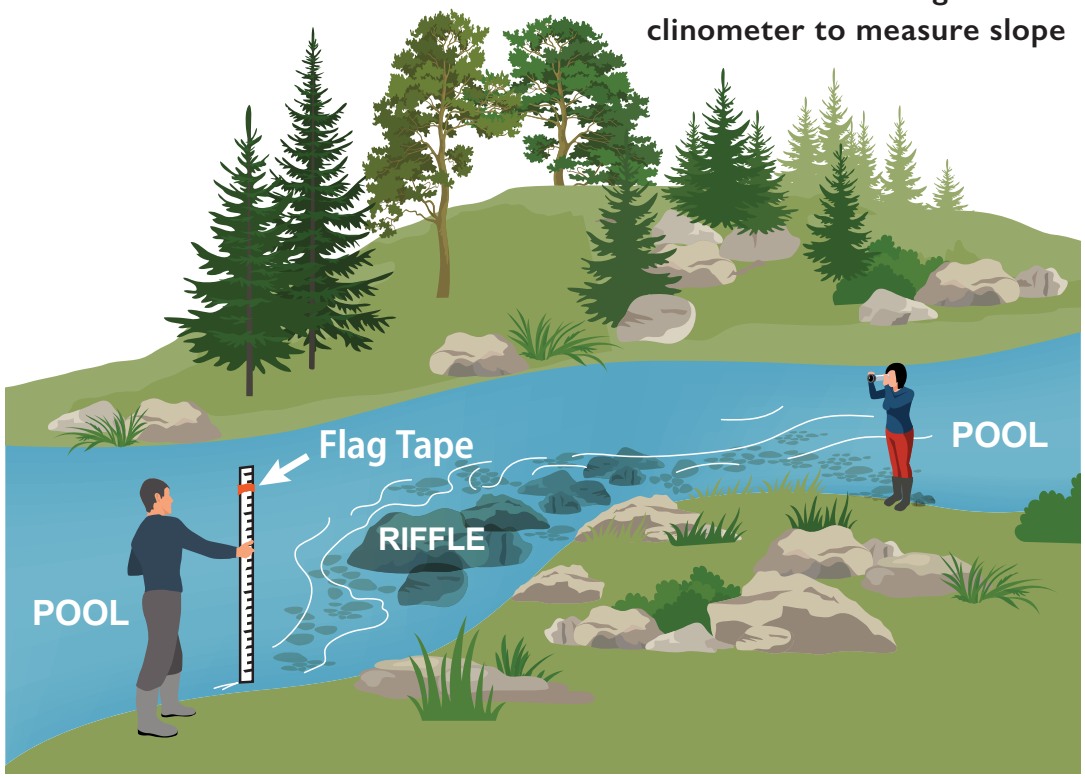


Figure 9
Positions while using the clinometer to measure slope



Data Sheet
STEP 5

Habitat Characteristics

Nine characteristics of stream habitat that indicate capacity for biological productivity

A. Measure these characteristics while walking back to the benchmark from the upstream or downstream boundary.	1. Instream cover 2. Off channel habitat 3. Bank stability 4. Length of bank with no vegetation
B. Measure these characteristics at or near the benchmark.	5. Streambed material 6. Embeddedness
C. Measure these characteristic for the entire reference site. *(From measurements of individual pool habitat units).*	7. Overhead canopy 8. Riparian zone 9. Percent pool habitat

Habitat characteristics, based on their significance to habitat quality

A. Primary characteristics:

- streambed material
- embeddedness of substrate
- instream cover

B. Secondary characteristics:

- percent pool habitat
- off-channel habitat
- bank stability

C. Tertiary characteristics:

- streambank vegetation
- overhead canopy
- size of riparian zone and plants

A. PRIMARY HABITAT CHARACTERISTICS

5.1 Streambed Material

Different kinds of streambed material influence plant and animal life in a stream. Substrate sizes range from "fines" like silt, sand, and clay, to large boulders and bedrock (Table 1) Although variety in substrate size is desirable, a streambed comprised primarily of fine sediment is less stable than one comprised primarily of boulder, cobble, and gravel. Large substrates also provide better quality fish and aquatic invertebrate habitat.

TABLE 1
SIZE CATEGORIES OF STREAMBED MATERIAL

fines	smaller than a ladybug
gravel	ladybug to tennis ball
cobble	tennis ball to basketball
boulder	larger than a basketball with definable edges
bedrock	solid slab of rock

Streambed material is measured at or near the benchmark, in an area of riffle substrate representative of the reference site. Measure 25 particles. Toss a pebble along the stream bank and begin a transect where the pebble comes to rest. Take one step from the bank into the stream. Without looking at the stream bottom, reach down to the toe of your boot and pick up the first particle touched by the tip of your finger.

Call out to the recorder as to whether you have picked up a fine, gravel, cobble, boulder, or bedrock. Take another step across the channel in the direction of the opposite bank and repeat the process. If you reach the opposite bank before you have measured 25 particles, turn around and begin another transect across the channel.

▶ **Convert the data to percentages and record on Data Sheet: STEP 5.1**

5.2 Embeddedness

Fine sediments often bury, or embed, some gravel and cobble substrate. Fines accumulate naturally in pools, where gradient and water velocity are reduced. In undisturbed streams, fines do not accumulate significantly in riffles, so large amounts of fines on riffle substrates may indicate erosion problems in the watershed.

Embedded riffle substrates provide less desirable habitat for invertebrates, and reduce habitat quality, stream productivity, and fish spawning habitat.

Embeddedness is measured at or near the benchmark, in an area of substrate representative of the reference site. Wade into the riffle. Pick up 5-10 pieces of gravel or cobble. Estimate the percentage of rock surface area buried in fines **(Figure 10)**. Often a stain line indicates the level of burial. Note these individual measurements and use to calculate the average estimated percent embeddedness.

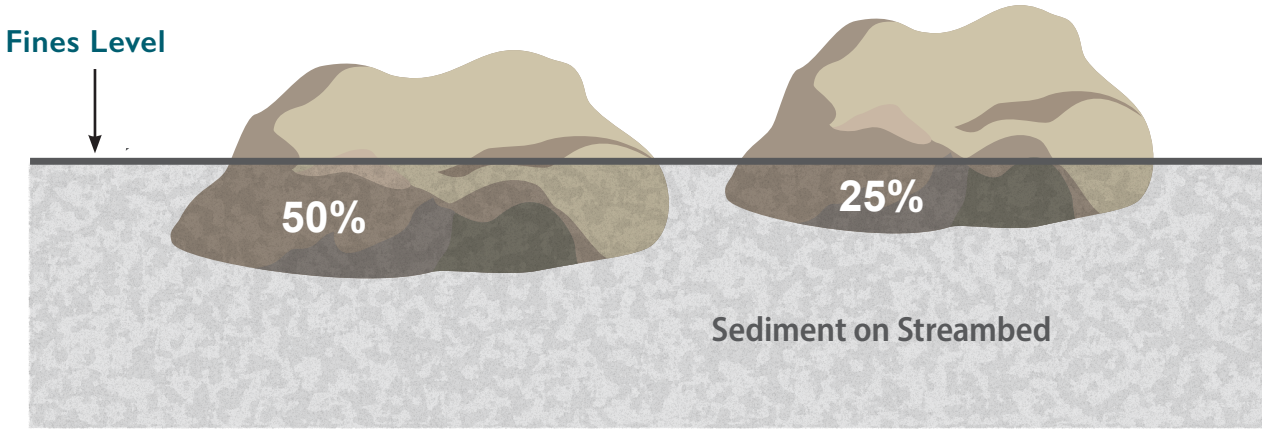
▶ **Record the estimated percent embeddedness on Data Sheet: STEP 5.2**

5.3 Instream Cover

Large woody debris (LWD) which includes stable logs and stumps, and undercut banks with large protruding root masses provide important instream cover habitat for fish and other animals. They provide shelter, cover from predators, and refuge during floods and droughts. Instream cover is counted in the upstream and downstream portions of the reference site, while walking back to the benchmark. Count the number of pieces of LWD at least 1 m long and 0.1 m in diameter that seem unlikely to wash away. On both stream banks count the number of stable undercut banks with roots protruding into the channel.

▶ **Record the number of LWD and rooted cutbanks on Data Sheet: STEP 5.3**

Figure 10
Estimating embeddedness of gravel and cobble



Divide the total cover number by the length of the survey site expressed in channel widths (the length of the reference site divided by the bankfull channel width - about 12).

▶ **Record this value on Data Sheet: STEP 5.3**

B. SECONDARY HABITAT CHARACTERISTICS

5.4 Percent Pool Habitat

Percent pool habitat refers to the proportion of pool habitat within the reference site. Pools are areas of low energy and riffles are areas of higher energy. Pool and riffle habitats alternate in stream channels. Both habitat types are important to aquatic organisms. Pools provide a refuge in flood conditions and may be the only habitat available during drought conditions. Many factors influence the relative abundance of pools and riffles. Percent pool habitat is calculated for the entire reference site.

Calculate the total length of pool habitat from the measurements obtained in STEP 4.

▶ **Record this value on Data Sheet: STEP 5.4**

Divide the total length of pool habitat by the total length of the reference site. Multiply by 100 to obtain percent pool habitat.

▶ **Record this value on Data Sheet: STEP 5.4**

Average slope is used to interpret the results for percent pool habitat. Calculate the average slope for the entire reference site from the slope data collected in **Step 4** (include 0% readings). This calculation is the average of the individual habitat values.

▶ **Record the average % slope on Data Sheet: STEP 5.4**

5.5 Off-channel Habitat

Side channels, ponds, wetlands, and secondary overflow channels next to the main channel provide off-channel habitat. These areas are isolated and protected from main channel flood flows which provide seasonal breeding and rearing areas for many animal species. Some are easy to see and others are less obvious. They may join the main stream channel only at some times of year or throughout the

year. Off-channel habitat is measured in the upstream and downstream portions of the reference site, while walking back to the benchmark. Search both banks for small channels that lead away from the main stream.

▶ **Record the number of side channels and backwater ponds on Data Sheet: STEP 5.5**

▶ **Record their approximate size, shape and potential as flood refuge. Decide if seasonal or year-round and take-photos**

5.6 Streambank Stability

Streams with unstable banks between the annual high water and low water marks often have unstable stream beds and poor instream habitat. Banks that are steep or damaged with no vegetation often are unstable. Soil can slide into the channel from unstable areas up the bank. Artificially stabilized stream banks indicate erosion problems. Bank stability is measured in the upstream and downstream portions of the reference site, while walking back to the benchmark. Examine the banks between annual high and low water marks for signs of existing or potential sloughing. Count the number of places on both banks with active erosion (sloughing soil, raw appearance), artificial bank stabilization, or signs of landslides into the channel. Measure the length of stream bank affected by each impact.

▶ **Record individual and total values for both left and right banks on Data Sheet: STEP 5.6**

C. TERTIARY HABITAT CHARACTERISTICS

5.7 Streambank Vegetation

Perennial vegetation at the edge of the bankfull channel includes trees, shrubs, and grasses. Stream bank vegetation contributes to a healthy stream habitat. It binds the soil with root networks, moderates temperature fluctuations, absorbs pollutants from runoff, and provides a source of food and large woody debris. Removing bank vegetation significantly degrades stream habitat.

Bank vegetation is measured in the upstream and downstream portions of the reference site, while walking back to the benchmark. Measure the lengths of stream bank with no vegetation at the edge of the bankfull channel.

▶ **Record the individual and total values for both the left and right banks on Data Sheet: STEP 5.7**

5.8 Overhead Canopy

Tree and shrub branches overhanging the stream form an overhead canopy. This canopy provides food, shade, and cover for organisms in the stream below. Overhead canopy is estimated standing at the benchmark while considering tree cover over the entire reference site. This is a visual estimate of the extent of the canopy within the bankfull channel area, recorded as a rough percentage. For example, there is 100% coverage when the branches on opposite banks meet or overlap at the center of the channel throughout the reference site. You can also estimate overhead cover from a recent large-scale aerial photograph.

▶ **Record the information on Data Sheet: STEP 5.8**

5.9 Riparian Zone

The riparian zone is the area between the stream bank and the upland slope at the edge of the flood plain. The extent of stream bank vegetation needs to be wide enough to provide a buffer from land use impacts near the stream and protect the flood plain up to the base of adjacent slopes. A good quality riparian buffer zone has several species of coniferous and deciduous trees and shrubs. However, the riparian zone may also contain disturbed land (e.g. houses, trails, farmland, forestry).

The extent of the riparian zone is estimated standing at the benchmark while considering conditions over the entire reference site. Estimate the average width of the riparian zone in terms of the number of bankfull channel widths.

▶ **Record the value on Data Sheet: STEP 5.9**

For example, if the distance to the upland slope on both sides of the stream is about twice as wide as the average bankfull channel width, record this as two channel widths on the form. Note the relative abundance of coniferous and deciduous trees, shrubs, and grasses in the riparian zone.

▶ **Record these on Data Sheet: STEP 5.9**

You can also estimate the width of the riparian zone from a recent aerial photograph, but you will need to estimate extent of vegetation based on current observations.

Data Sheet
STEP 6

Conduct a Habitat Assessment

Collecting, reporting and evaluating information

Rate the habitat quality of the reference site. Use your recorded measurements and observations from STEP 5 to complete the calculations. Transfer these measurements to the RESULTS column in Data Sheet: STEP 6.

Assign a score for each characteristic using the interpretation scoring table in Data Sheet: STEP 6. The scores for the nine habitat characteristics are weighted to reflect their importance to biological productivity of the stream.

Add the values to get the total score for the reference site. If the total score for the reference site is in the marginal or poor category, check the individual scores to identify particular problems at the site. This will help you choose a focus for any initial restoration efforts. You may wish to confirm poor results by doing water quality or stream invertebrate surveys at the site (Modules 3 and 4).

WEIGHTED CHARACTERISTICS

Primary habitat characteristics (1-3)
SCORE between 0 to 20 points
• relates to streambed composition and instream cover

Secondary habitat characteristics (4-6)
SCORE between 0 to 15 points
• relates to channel structure and stability

Tertiary habitat characteristics (7-9)
SCORE between 0 to 10 points
• relates to streamside vegetation

Data Sheet
STEP 7

Enter the data in the Streamkeepers Database at www.streamkeepers.info

Enter Data in Streamkeepers Database

Public relations

You can clean up streams, monitor their condition, and undertake enhancement projects, but you need the support of your community for these projects to succeed. Talk about your project with others whenever and wherever you can, including at schools and public meetings. Place signs at visible project sites and share on social media pages. Contact newspapers, radio stations and television stations. Module 10 contains specific information about increasing community awareness and working with the media.

Steps at a Glance

Advanced Stream Habitat Survey

STEP 1 CHOOSE A BENCHMARK

At benchmark conduct:

STEP 2 CROSS SECTIONAL SURVEY

and

STEP 3 STREAM DISCHARGE

ESTABLISH REFERENCE SITE BOUNDARIES:

STEP 4 HABITAT UNIT INFORMATION

From benchmark walk upstream and flag

- **habitat units**
- **upstream boundary**

Return to benchmark

From benchmark walk downstream and flag

- **habitat units**
- **downstream boundary**

Return to benchmark

From benchmark walk upstream while measuring:

STEP 4 HABITAT UNIT INFORMATION

At upstream boundary conduct:

STEP 2 CROSS SECTIONAL SURVEY

Return to benchmark while recording:

STEP 5 HABITAT CHARACTERISTICS

COLLECT HIPCHAIN THREAD AND FLAG TAPE

From benchmark walk downstream while measuring:

STEP 4 HABITAT UNIT INFORMATION

At downstream boundary conduct:

STEP 2 CROSS SECTIONAL SURVEY

Return to benchmark while measuring:

STEP 5 HABITAT CHARACTERISTICS

COLLECT HIPCHAIN THREAD AND FLAG TAPE

At benchmark complete remaining:

STEP 5 HABITAT CHARACTERISTICS

STEP 6 HABITAT ASSESSMENT

STEP 7 ENTER DATA in Streamkeepers Database

Enter the data: Streamkeepers Database, www.streamkeepers.info

Advanced Stream Habitat Survey Data Sheet

(use a new data sheet for each reference site surveyed) **Module 2**

Stream Name / Nearest Town:		Date
Organization Name:		Watershed code
Contact Name:		Phone:
Crew Names:		Email:
		Stream Section #
		Length Surveyed

STEP 1 BENCHMARK LOCATION

GPS: (use 'degrees decimal')	Latitude:	Longitude:
Survey Start time:	Survey End Time:	Duration:

Location (distance from known stream landmark, directions to benchmark)

Weather ☐ clear ☐ shower (1-2.5 cm in 24 hr.) ☐ snow ☐ overcast ☐ storm (<2.5 cm in 24 hr.) ☐ rain on snow

STEP 2 CROSS-SECTIONAL SURVEY

Location relative to benchmark	Photos taken: (yes or no)
Wetted channel width (m)	Average wetted depth (m)
Bankfull channel width (m)	Average bankfull depth (m)
Temperature: Air: Water:	Turbidity:

Take measurements every 0.5m in streams less than 5m wide, every 1m in streams 5 to 15m

Left Bank (m)	0.10															**Right Bank**
Wetted Depth (cm)																Wetted Depth
Bankfull Depth (cm)																Bankfull Depth

STEP 3 CALCULATE DISCHARGE

Cross-sectional area of Wetted stream (m^2) _____ (wetted width) **x** _____ (average wetted depth) **=** _____ **(m^2)**

Average Time (sec)
(_____ **trial 1 +** _____ **trial 2 +** _____ **trial 3 +** _____ **trial 4 +** _____ **trial 5) =** _____ **total trials ÷ 5 =** _____ **Average Time (sec)**

Average Velocity (m/sec) _____ **length (m) ÷** _____ **average time (sec) =** _____ **Average Velocity (m/sec)**

Average Stream Discharge (m3 /sec) _____ **cross sectional area (m^2) x** _____ **average velocity (m/sec) x 0.8 correction factor =** _____ **Discharge (m^3 /sec)**

Advanced Stream Habitat Survey Data Sheet - Module 2

STEP 4 LONGITUDINAL SURVEY, MEASUREMENTS

Length of survey site (minimum 12 times the bankfull width) Minimum m	Actual Length of Survey Site m

Upstream survey boundary

6x Bankfull Measurement m	Actual Length of Survey Site m
Upstream Location Description: Lat:	Lng:

habitat unit type (pool or riffle)	bottom of habitat unit (m) (hip chain)	top of habitat unit (m) (hip chain)	length of habitat unit (m) (measuring tape)	% slope (clinometer)	Photo taken (yes/no)
	0m Up	Up			
	Up	Up			
	Up	Up			
	Up	Up			
	Up	Up			
	Up	Up			
	Up	Up			

Left Bank	0.10															**Right Bank**
Wetted Depth																
Bankfull Depth																

Upstream Average Depth: _____m

Downstream survey boundary

6x Bankfull Measurement m	Actual Length of Survey Site m
Downstream Location Description: Lat:	Lng:

habitat unit type (pool or riffle)	top of habitat unit (m) (hip chain)	bottom of habitat unit (m) (hip chain)	length of habitat unit (m) (measuring tape)	% slope (clinometer)	Photo taken (yes/no)
	0m Dn	Dn			
	Dn	Dn			
	Dn	Dn			
	Dn	Dn			
	Dn	Dn			
	Dn	Dn			
	Dn	Dn			

Left Bank	0.10															**Right Bank**
Wetted Depth																
Bankfull Depth																

Downstream Average Depth: _____ m

Advanced Stream Habitat Survey Data Sheet - Module 2

STEP 5 HABITAT CHARACTERISTICS

5.1 Streambed material at benchmark						Count	x4 = %
1	6	11	16	21	**fines** (<0-2cm) - ladybug size and smaller		%
2	7	12	17	22	**gravel** (0.2-5 cm) - ladybug to tennis ball		%
3	8	13	18	23	**cobble** (5 ·25cm) - tennis ball to basketball		%
4	9	14	19	24	**boulder** (>25cm) – bigger than a basketball		%
5	10	15	20	25	**bedrock** - slab of rock		%
5.2 Percent embeddedness cover of gravel and cobble by fine sediment Estimated %					Total	25	100%
					Total cobble plus boulder		%

5.3 Instream Cover	Left Bank	Right Bank	Total #
Large Woody Debris			
Rooted Cutbank			
		Total Instream Cover=	

Actual Survey Length m	Divided by Bankfull Width m	= (answer)
Divide Total Instream Cover by (answer) above to find Instream Cover Ratio		

5.4 Percent Pool Habitat – from step 4			% slope
Total Pool Habitat m	Divided by Actual Survey Length m	=	% Pool Habitat

5.5 Off Channel Habitat (Describe: Flood Refuge, Pond, Side Channel, Size, and if Seasonal (Ephemeral) or Year-round)	
Present	

5.6 Bank Stability	Count	Left Bank	Right Bank	Comments (Soil Type, Topography)
Active Bank Erosion		m	m	
Slides Reaching Channel		m	m	
Bank Stabilization		m	m	

5.7 Length of Bank with No Vegetation	Left Bank	m	Right Bank	m
% Bank With Vegetation (Length of bank with no vegetation divided by Actual Survey Length)		%		%

5.8 Overhead canopy % bankfull channel covered by overhanging branches	%

5.9 Riparian zone	# of channel widths	
type and amount of vegetation	coniferous trees	none ☐ few ☐ many ☐
	deciduous trees	none ☐ few ☐ many ☐
	shrubs	none ☐ few ☐ many ☐
	grasses	none ☐ few ☐ many ☐
Adjacent land use and impacts		

Advanced Stream Habitat Survey Field Data Sheet
(use a new data sheet for each reference site surveyed) Module 2

HABITAT ASSESSMENT *(the score in bold, estimate a value within the range listed)*

Characteristic	Results	Good	Acceptable	Marginal	Poor	Score
1: Streambed material: % boulder and cobble		**15 - 20** 50%	**10 - 15** 30-50%	**5 - 10** 10-30%	**0 - 5** <10%	
2: Embeddedness:		**15 - 20** 25–0%	**10 - 15** 50-25%	**5 - 10** 75-50%	**0 - 5** >75%	
3: Instream cover:		**15 - 20** >3	**10 - 15** 2 to 3	**5 - 10** 1 to 2	**0 - 5** <1	
4: % Pool Habitat	% Slope	**11 - 15**	**7 - 11**	**3 - 7**	**0 - 3**	
<2% stream slope		>60% pool	50-60%	40-50%	<40%	
2-5% stream slope		>50% pool	40-50%	30-40%	<30%	
>5% stream slope	% Pool	>40% pool	30-40%	20-30%	<20%	
5: Off-channel habitat: ponds, side channels with protection from flood flows		**11 - 15** year round, good protection	**7 - 11** seasonal, good protection	**3 - 7** seasonal, minimal protection	**0 - 3** little or none, no protection	
6: Bank Stability evidence of erosion or bank failure ***(see note 1)***		**11 - 15** stable none	**7 - 11** Moderately Stable some	**3 - 7** moderately unstable some	**0 - 3** unstable lots	
7. Bank vegetation: % stream bank covered by vegetation		**8 - 10** >90%	**5 - 8** 70-90%s	**2 - 5** 50-70%	**0 - 2** <50%	
8. Overhead canopy: % bankfull channel overhung by trees and shrubs		**8 - 10** >30%	**5 - 8** 20-30%	**2 - 5** 10-20%	**0 - 2** 0-10%	
9. Riparian zone: # bankfull channels		**8 - 10** 2 or more abundant on whole floodplain	**5 - 8** 1 to 2 good species mix	**2 - 5** <1 common, few species	**0 - 2** 0 sparse or absent	
Total Score		**102 - 135**	**66 - 102**	**30 - 66**	**0 - 30**	

Note 1: The evidence of erosion or bank failure changes from **Good** (intact banks) to **Acceptable** (healed or banks stabilized) to **Marginal** (active erosion or extensive bank stabilization) to Poor (many actively eroding areas or upslope slides reaching channel).

Enter the data: Streamkeepers Database,
www.streamkeepers.info

Data entered on (date): _____
Name: _____