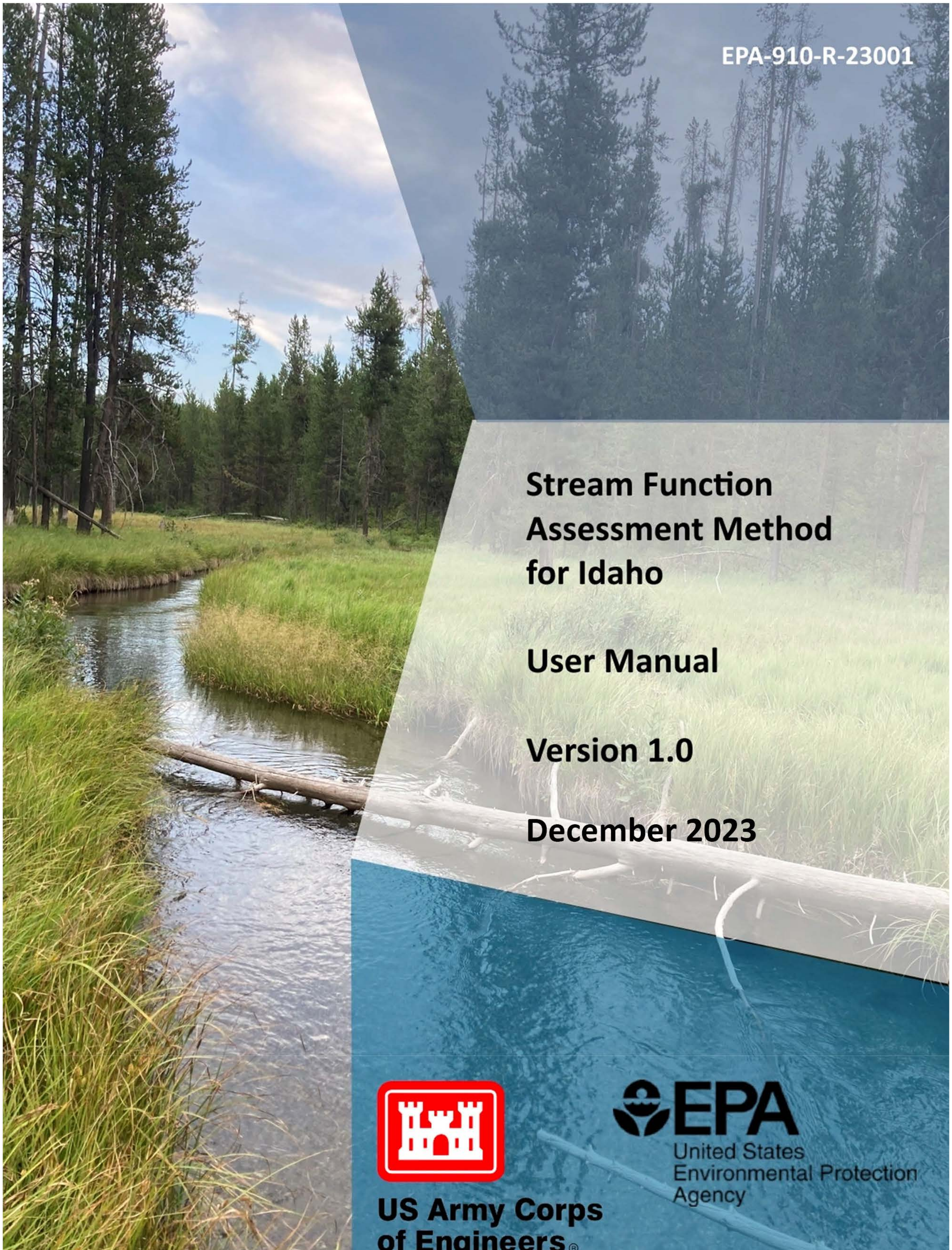

EPA-910-R-23001

Stream Function Assessment Method for Idaho

User Manual

Version 1.0

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US Army Corps of Engineers®

EPA United States Environmental Protection Agency

Prepared by:

Tracie-Lynn Nadeau
U.S. Environmental Protection Agency, Region 10

Robert Coulombe
CSS-Inc.

Tad Deshler
Sealaska Technical Services, LLC

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Acronyms

AEP	annual exceedance probability
BFW	bankfull width
BHR	bank height ratio
BURP	Beneficial Use Reconnaissance Project
CMH	create and maintain habitat
CR	chemical regulation
CV	coefficient of variation
CWA	Clean Water Act
DBH	diameter at breast height
DD.MM	degrees.minutes (to hundredths of a degree)
DRNAREA	drainage area
EAA	extended assessment area
EPA	U.S. Environmental Protection Agency
ESU	evolutionarily significant unit
FEMA	Federal Emergency Management Agency
FV	flow variation
GIS	geographic information system
GPS	global positioning system
HUC	hydrologic unit code
IBA	Important Bird Area
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IMPNLCD01	percentage of impervious area
MB	maintain biodiversity
NC	nutrient cycling
NFHL	National Flood Hazard Layer
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Administration
PAA	proximal assessment area
SC	sediment continuity
SDAM	Streamflow Duration Assessment Method
SFAM	Stream Function Assessment Method
SM	substrate mobility
SST	sub/surface transfer
STS	sustain trophic structure
SWS	surface water storage
TMDL	Total Maximum Daily Load
ToT	time of travel
TR	thermal regulation
USACE	U.S. Army Corps of Engineers (Corps)
USGS	U.S. Geological Survey

1 Introduction

The Stream Function Assessment Method (SFAM) was developed to provide a standardized, rapid, more function-based method for assessing stream function. This method is intended to further federal and state regulatory objectives by informing mitigation planning. While the SFAM was originally developed and applied in Oregon (Nadeau *et al*., 2020a), it reflects data and research from across the Pacific Northwest. The Idaho version of SFAM, including this User Manual, closely follows the method developed for Oregon, with modifications made to reflect Idaho-specific data sources and recently available data and research. The SFAM is applicable statewide.

The USACE/EPA Final Compensatory Mitigation Rule (2008; Mitigation Rule), under Clean Water Act[1] (CWA) Section 404, promotes the use of function assessment to determine the appropriate amount of compensatory mitigation to replace the loss of functions provided by streams due to unavoidable impacts to aquatic resources. Compensatory mitigation is commonly understood as the requirement to offset loss or impacts to functions and values associated with permitted actions; occurring only after impacts are first avoided and minimized to the extent possible. Federal (CWA) policies require mitigation for impacts to waters of the U.S, which includes streams. SFAM has been developed to provide a predictable, transparent, and scientifically robust approach to assessing the ecological processes affected by unavoidable impacts to streams.

Idaho has a mature federal wetland mitigation process in place. However, Idaho lacks an equivalent process for stream aquatic resources. Filling this gap became increasingly important with the release of the 2008 Final Compensatory Mitigation Rule. Staff from the U.S. Army Corps of Engineers (Corps), and the U.S. Environmental Protection Agency (EPA) identified the need for a function-based stream assessment method as an important first step towards filling this gap. Idaho state agencies (i.e., Departments of Environmental Quality, Water Resources, and Fish and Game) agreed with the need for this method.

Across the country, there is extensive experience with assessing impacts to wetlands to inform mitigation, but standardized approaches to assess stream impacts and inform stream mitigation are not as advanced (David *et al*., 2021). Although advances are being made, existing methods generally assess structural conditions to quantify impacts and mitigation requirements. There is growing awareness that these existing methods do not adequately mitigate for impacts to stream functions (Bernhardt *et al*., 2005; Bronner *et al.*, 2013; Lave *et al*., 2008; Lave and Doyle, 2020; National Research Council, 2002; Peimer *et al*., 2022). Research indicates that structural condition and the type of impact (e.g., installation of riprap) are not defensible indicators of function (NRC 2002; Sandin and Solimini, 2009). Further, the efficacy of structure and condition-based restoration practices is uncertain

[1] "Compensatory Mitigation for Losses of Aquatic Resources; Final Rule" Department of Defense 33 CFR Parts 325 and 332. Environmental Protection Agency 40 CFR Part 230 73(70) (10 April 2008), pp 19594-19705.

(Bernhardt and Palmer, 2011; Doyle and Shields, 2012; Lave and Doyle, 2020; Louhi *et al*., 2011; Mecklenburg and Fay, 2011; Roni *et al*., 2008; Sundermann *et al*., 2011; Violin *et al*., 2011; Whiteway *et al*., 2010). Thus, SFAM seeks to improve assessment and mitigation outcomes by providing a clearer link between project objectives and stream functions (Schwartz and Herricks, 2007) and supporting implementation of a function-based stream mitigation program.

While SFAM has been developed for mitigation application, it could also inform management, conservation, and restoration decision making and monitoring efforts. A Scientific Rationale documenting the development of the initial SFAM — from conception through measure development, iterative field testing and statistical method (model) analysis — is available to the user community (Nadeau *et al.,* 2020b). The Scientific Rationale document developed for the Oregon version of SFAM also provides scientific support for the development process, measure inclusion, and calculation of outputs. Similarly, a sister document details standard performance index development and specific modifications and updates resulting in the current SFAM for Idaho (Nadeau *et al*. 2023). The Scientific Rationale document for SFAM for Idaho supports a deeper critical understanding of the method, facilitates the transfer and adaptation of SFAM, and promotes improvements as new information becomes available.

2 Overview of SFAM

2.1 Limitation of Use

Idaho's extremely varied climate, hydrology, and geology results in a broad range of streams and rivers. Given this extensive variety of streams, and our aim to develop an assessment method that supports the federal compensatory mitigation program, our objective in modifying SFAM for Idaho is that it would apply to wadeable streams. We are exploring scientifically-supported modifications for non-wadeable streams and large rivers, which may be addressed in future versions of the method.

2.2 Ecological Functions & Values

Federal and state regulatory programs are responsible for maintaining the quantity, quality, and beneficial uses of streams (Mitigation Rule, Idaho's Minimum Instream Flow and Beneficial Use Laws). Therefore, SFAM has been designed to assess both the functions and values that streams provide. Stream functions are dynamic and interrelate physical, chemical and biological processes that create and maintain the character of a stream and the associated riparian system, and determine the flux of energy, materials and organisms through or within a stream system. Stream values are the ecological and societal benefits that the stream system provides, determined by (a) the opportunity to provide a particular function and (b) the local significance of that function.

As a practical manner, a function can either be expressed or not expressed at a given site, but a value is the context of that function in the broader landscape. For example, a stream site may be effective for removing nutrients, but the value of the stream reach performing that function is higher if there is a higher concentration of nutrients entering the reach from upstream (opportunity), and there are uses downstream that would benefit from lower nutrient concentrations (significance).

Four functional groups provide the basis for a function-based assessment for streams:

1. **Hydrologic functions:** include movement of water through the watershed and the variable transfer and storage of water along the stream channel, its floodplain, and associated alluvial aquifer.
2. **Geomorphic functions:** encompass hydraulic and sediment transport processes that generate variable forces within the channel and the variable input, transfer and storage of sediment within the channel and adjacent environs that are generally responsible for channel form at multiple scales.
3. **Biological functions:** include processes that result in maintenance and change in biodiversity, trophic structure, and habitat within the stream channel.
4. **Water quality functions:** encompass processes that govern the cycling, transfer, and regulation of energy, nutrients, chemicals and temperature in surface and groundwater, and between the stream channel and associated riparian system.

Within these broad groups, a suite of 11 stream functions is identified. The 11 functions were identified through expert workshops and extensive literature review (EPA, 2012). To ensure that the functions were categorized and described sufficiently for application to mitigation, the following criteria guided the selection and definition of the functions:

1. **Relevance:** function assessed is relevant to impacts resulting from proposed actions and is relevant to a broad spectrum of native species across varying stream types and spatial scales.
2. **Utility:** function assessed is practical for mitigation accounting because it is practically measurable and quantifiable, responsive to actions, and predictable.
3. **Multi-functionality:** function assessed represents the interrelated character of stream functions and is likely to contribute to positive change in other functions and influence overall stream system health.

Definitions of the 11 functions assessed by SFAM are provided in **Table 2.1**.

Table 2.1. Stream Function Categorization, Definition, and Ecosystem Services Provided

FUNCTIONAL GROUP	SPECIFIC FUNCTIONS	DEFINITION AND SERVICES/VALUES PROVIDED
Hydrologic functions	Surface water storage (SWS)	Temporary storage of surface water in relatively static state, generally during high flow, as in floodplain inundation, backwater channels, wetland depressions. Providing regulating discharge, replenishes soil moisture, provides pathways for fish and invertebrate movement, low velocity habitat and refuge, and contact time for biogeochemical processes.
	Sub/surface transfer (SST)	Transfer of water between surface and subsurface environments, often through hyporheic zone. Provides aquifer recharge, base-flow, exchange of nutrients/chemicals through hyporheic, moderates flow, and maintains soil moisture.
	Flow variation (FV)	Daily, seasonal and inter-annual variation in flow. Provides variability in stream energy driving channel dynamics, provides environmental cues for life history transitions, redistributes sediment, provides habitat variability (temporal), provides sorting of sediment and differential deposition.
Geomorphic functions	Sediment continuity (SC)	The balance between transport and deposition of sediment such that there is no net erosion or deposition (aggradation or degradation) within the channel. Maintains channel character and associated habitat diversity, provides sediment source and storage for riparian and aquatic habitat succession, maintains channel equilibrium.
	Substrate mobility (SM)	Regular movement of channel bed substrate. Provides sorting of sediments, mobilizes/flushes fine sediment, creates and maintains hydraulic diversity, creates and maintains habitat.
Biological functions	Maintain biodiversity (MB)	Maintain the variety of species, life forms of a species, community compositions, and genetics. Biodiversity provides species and community resilience in the face of disturbance and disease, full spectrum trophic resources, balance of resource use (through interspecies competition).
	Create and maintain habitat (aquatic/riparian) (CMH)	Create and maintain the suite of physical, chemical, thermal and nutritional resources necessary to sustain organisms. Habitat sustains native organisms. Habitat includes in-channel habitat, as defined largely by depth, velocity, and substrate, and riparian habitat, as defined largely by vegetative structure.
	Sustain trophic structure (STS)	Production of food resources necessary to sustain all trophic levels including primary producers, consumers, prey species and predators. Trophic structure provides basic nutritional resources for aquatic resources, regulates the diversity of species and communities.
	Nutrient cycling (NC)	Transfer and storage of nutrients from environment to organisms and back to environment. Provides basic resources for primary production, regulates excess nutrients, provides sink and source for nutrients.

FUNCTIONAL GROUP	SPECIFIC FUNCTIONS	DEFINITION AND SERVICES/VALUES PROVIDED
Water Quality functions	**Chemical regulation (CR)**	Moderation of chemicals in the water. Limits the concentration of beneficial and detrimental chemicals in the water.
	Thermal regulation (TR)	Moderation of water temperature. Limits the transfer and storage of thermal energy to and from streamflow and hyporheic zone.

2.3 Measures of Function & Value

Stream functions are expressed in varied and complex ways; therefore, they are difficult, costly, and time-consuming to measure directly. To enable the assessment of functions and values within the constraints of a rapid method, measures were identified for each function.

Measures are metrics that allow a quantitative or qualitative assessment of specific characteristics that may indicate the extent to which a particular function is active. Measures can be continuous or discrete variables and may be assessed in the field (e.g., streambank incision, substrate embeddedness, bankfull width [BFW]), in the office (e.g., geographic information system [GIS] analysis of land use or impervious areas), or collected from existing sources (e.g., 303(d) listing). SFAM measures are primarily quantitative; however, where no practical quantitative approach yet exists to assess an attribute, measures consisting of observations and scores that represent a defined range (rather than a continuous set of measures) are used.

SFAM measures (**Table 2.2**) meet the following inclusion criteria:

- **Rapid:** can be measured within the anticipated timeframe of a rapid assessment method.
- **Repeatable:** multiple trained assessment teams would likely come up with the same value for this measure for a site at a given point in time.
- **Science-based:** a panel of scientists with relevant expertise would agree that the measure is either a direct measure or highly correlated indicator of a particular stream function; it is likely that the relationship between the measure and the function(s) it assesses could be substantiated through peer-reviewed literature or through rigorous scientific evaluation.

Table 2.2. SFAM Function and Value Measures

Function Measures	
F1	Natural Cover
F2	Invasive Vegetation
F3	Native Woody Vegetation
F4	Large Trees
F5	Vegetated Riparian Corridor Width
F6	Fish Passage Barriers
F7	Floodplain Exclusion
F8	Bank Armoring
F9	Bank Erosion
F10	Overbank Flow
F11	Wetland Vegetation
F12	Side Channels
F13	Lateral Migration
F14	Wood
F15	Incision
F16	Embeddedness
F17	Channel Bed Variability

Value Measures	
V1	Rare Species Occurrence & Special Habitat Designations
V2	Water Quality Impairments
V3	Protected Areas
V4	Impervious Area
V5	Riparian Area
V6	Extent of Downstream Floodplain Infrastructure
V7	Zoning
V8	Frequency of Downstream Flooding
V9	Impoundments
V10	Fish Passage Barriers
V11	Water Source
V12	Surrounding Land Cover
V13	Riparian Continuity
V14	Watershed Position
V15	Flow Restoration Needs
V16	Unique Habitat Features

3 Overview of the SFAM Assessment Process

SFAM is a rapid, science-based approach to assessing the ecological functions and values of a stream reach. Both office work (e.g., data collection from maps, online resources) and field work (onsite measurements and observations) are required to assess measures and calculate SFAM scores.

There are several components of SFAM:

- **SFAM Workbook:** Excel spreadsheets that calculate function and value scores based on the measures assessed for a given site.
- **User Manual** (this document): step-by-step instructions and guidance on completing an SFAM assessment.
- **Online resources:** stream-related datasets from state and federal agencies, local governments, and the scientific community.
- **Scientific Rationale**: documents describing the development and modification of SFAM (i.e., conception, measure development, iterative field testing, statistical analysis) and providing supporting information from the scientific literature.

It takes approximately two hours to complete the office component and anywhere from four to eight hours to collect the field data for the field component, depending on the size of the site. Once all the data is collected, it takes approximately two hours to input and review data and to evaluate the results. While one person can conduct the office component and data entry for SFAM, a minimum of two people are needed to collect the field data.

An SFAM assessment may be conducted any time of the year. However, the wet season is recommended for onsite data collection, preferably after a significant flow event that will leave signs of the extent of high water across the site but not during a high flow event that could hamper data collection efforts and provide biased results. If possible, visit the site at least once during the driest time of the year and once during the wet season.

3.1 Basic Steps to Completing an SFAM Assessment

The basic steps to complete an SFAM assessment are as follows:

1. Complete the office component using GIS software and publicly available datasets or online resources. See **Appendix 5** for a compilation of the online resources listed in this User Manual.
2. Prepare equipment and documents for your field visit.
3. Visit the site and collect data needed for the field component.
4. Enter data in the SFAM Workbook.
5. Review and interpret results.

The following sections of this User Manual provide detailed instructions on completing each of these steps.

3.2 Navigating the Workbook

Save a copy of the SFAM Workbook with your site name and date of assessment (or using another naming protocol you have established).

The SFAM Workbook contains ten tabs, each with its own specific purpose (**Table 3.1**).

Table 3.1. Purpose and Description of SFAM Workbook Tabs

Tab	Purpose	Description
Cover Page	**Data entry**	Worksheet for entering information about the general characteristics of your site and assessment notes.
Values	**Data entry**	Worksheet for entering office-collected data about your site. Contains 16 questions/measures of stream value.
Functions	**Data entry**	Worksheet for entering field-collected data about your site. Data entry cells are linked to field data sheets. Contains 17 questions/measures of stream function.
Scores	**Summary of scores (automatically calculated)**	Worksheet with outputs of: 1. Numerical scores (between 0.0 and 10.0) of functions and values for your site. 2. Ratings (Higher, Moderate or Lower) for the functions and values at your site. 3. Grouped function and value scores and ratings (i.e., the representative function/value for each thematic functional group).
Subscores	**Summary of measure outputs (automatically populated)**	Worksheet providing the measure subscores that contribute to each function and value score, and summarizes the rationale for the model.
Site Layout Field Form	**Data entry**	Worksheet (printable) with instructions, diagrams, and space for recording field data to guide establishment of the PAA and EAA for your site.
Proximal Assessment Area (PAA) Field Form	**Data entry**	Worksheet (printable) with: 1. Instructions and space for recording field data assessed in the PAA of your site. 2. Automatically calculated outputs for a subset of these measurements which are also linked to the orange data entry cells in the 'Functions' worksheet. See **Appendix 6.** Sample Field Forms.

Tab	Purpose	Description
Extended Assessment Area (EAA) Field Form	**Data entry**	Worksheet (printable) with: 1. Instructions and space for recording field data assessed in the EAA of your site. 2. Automatically calculated outputs for a subset of these measurements. See **Appendix 6.** Sample Field Forms.
Extra PAA Transects or Data	**Data entry (as needed)**	Worksheet (printable) with additional space for field data entry for use with large or complex sites as needed.
Rare Species	**Reference**	Lists of rare species considered for the Rare Species Values question (V1).
Rare Plants	**Reference**	Lists of rare plants considered for the Rare Species Values question (V1).

Instructions for answering the questions on each tab are provided on that tab and in this Manual. Cells on several tabs of the SFAM Workbook (Cover Page, Values, Functions) are color coded to help guide you: yellow cells in the Values tab indicate where data is entered; orange cells in the Functions tab are linked to the PAA or EAA Field Forms; green cells indicate where automatically calculated outputs are displayed.

3.3 Scales of an SFAM Assessment

Each measure in SFAM is evaluated at a scale or spatial extent applicable or relevant for the particular measure being assessed. To accomplish this, SFAM establishes three assessment area extents: Project Area, Proximal Assessment Area, and Extended Assessment Area (**Figure 3.1**).

The **Project Area (PA)** is the spatial extent of the direct impact (e.g., removal, fill, grading, planting, etc.) that a project (e.g., permitted action, mitigation, restoration) will have on a stream and surrounding area. Some projects may have multiple areas of impact but are part of a single larger project.

The **Proximal Assessment Area (PAA)** allows for assessment of functions likely to be directly impacted by actions taken in the PA. The PAA includes the entire channel, both streambanks, the riparian area, and upland adjacent to the impacted area on both sides of the stream.

The PAA has two sets of boundaries. The longitudinal boundaries are determined by the upstream and downstream extent of the PA, or 50 feet, whichever is greater.

The lateral boundaries extend from the channel edge a distance of two times the bankfull width (2 × BFW) or 50 feet, whichever is greater. Refer to the Bankfull Width text box on the following page for a description of this measurement.

The **Extended Assessment Area (EAA)** allows for assessment of functions that may be expressed at a reach scale that is broader than the footprint of the project. The EAA has the same lateral boundaries as the PAA (2 × BFW, 50 feet minimum), but the longitudinal boundaries extend a distance equal to five times BFW in each direction from the PAA. The EAA includes the entire PAA.

Riparian areas are the transition zones between aquatic systems and terrestrial systems, and usually have characteristics of both. Riparian areas can store water; help protect soil and streambanks from excess erosion; absorb the water, nutrients, and energy from larger flow events; and provide organic inputs into the stream to support aquatic organisms.

Riparian areas occur in a wide range of climatic, hydrologic, and ecological environments, and can naturally support a variety of plant communities. While riparian areas provide habitat for a variety of animals, SFAM does not evaluate the riparian habitat itself; but rather the contribution of the riparian area to stream functions.

In addition, observations or measurements for several measures (i.e., F1, F2, F3, F4, F15, F16, F17) are taken along 11 transects which run perpendicular to the stream through the riparian area, floodplain, and potentially upland adjacent to the channel.

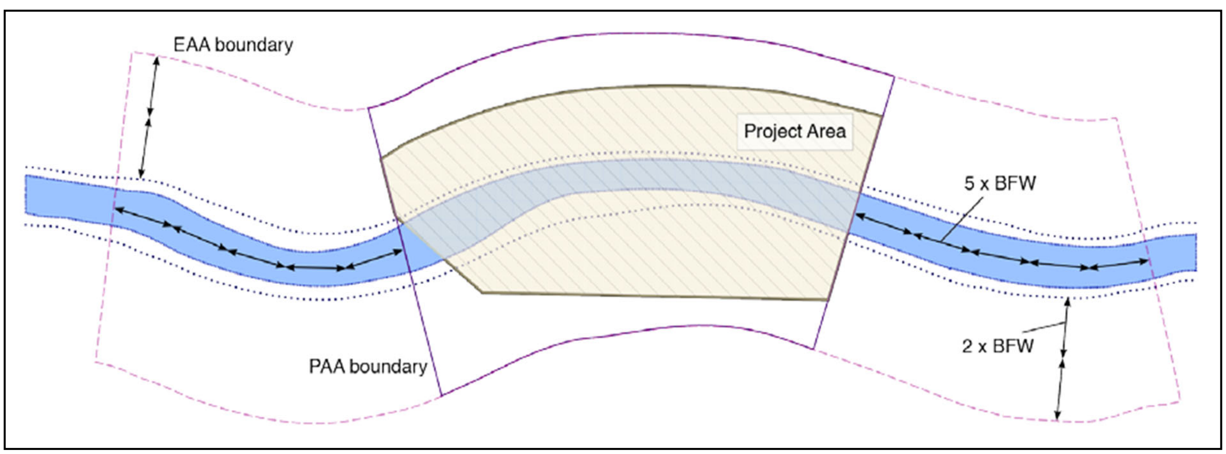


Figure 3.1 Layout of the three assessment areas in SFAM

Detailed instructions on delineating each of these assessment areas and transect locations are provided in the office component (**Section 4**) and field component (**Section 5**) instructions of this Manual.

Bankfull Width. SFAM uses the bankfull width (BFW) to scale assessment boundaries to stream size; a larger stream size (and therefore larger BFW) will result in a larger assessment area. The bankfull width is the portion of the channel that contains the bankfull discharge, which is a flow event that occurs frequently (every 1 to 2 years), but that does not include larger flood events. The bankfull discharge has an important role in forming the physical dimensions of the channel.

For most stream channels, the BFW can be identified in the field by an obvious slope break that differentiates the channel from a relatively flat floodplain terrace higher than the channel, or a transition from exposed stream sediments or more water tolerant vegetation (e.g., willows) to terrestrial vegetation. In locations without vegetation, moss growth on rocks along the banks can be an indicator of this 'line' as can breaks in bank slope or substrate composition.

The BFW is measured by the distance across the channel (perpendicular to stream flow) between the lines on each bank demarcating the bankfull stage. In SFAM, the BFW should be measured in at least three places within the PA/PAA that are somewhat uniform (avoid taking measurements in irregular areas such as meanders or bends, road or trail crossing, or large wood jams). The average of these measures is used for establishing extent of the assessment areas.

Note that:

- **Mid-channel bars** are included in the BFW (**Figure 3.2, Width A**). Mid-channel bars are defined as channel features lower in elevation than the line at the top of the active channel and are frequently dry during baseflow conditions.
- **Islands** are not included in the BFW. Islands are channel features that are dry even when the river is at bankfull stage. If a mid-channel feature is as high as the surrounding floodplain, it is considered an island. Measure and sum the multiple "bankfull widths" surrounding the island (**Figure 3.2, Widths B and C**).

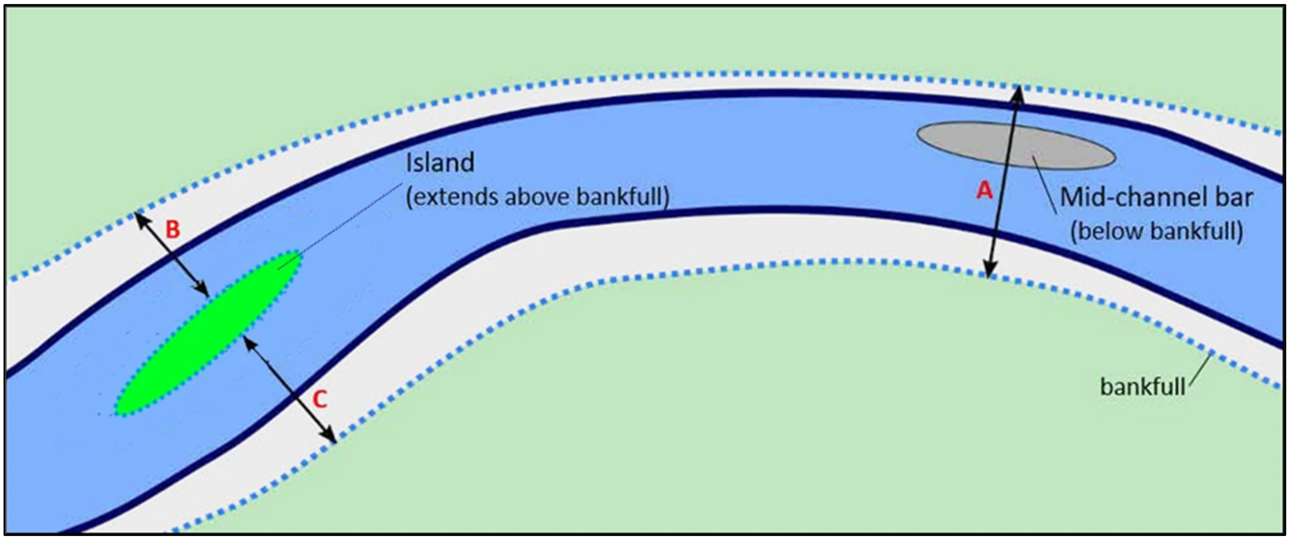


Figure 3.2. Measuring bankfull width
Mid-channel bars below the bankfull elevation are included in bankfull width (Width A). Islands above the bankfull elevation are not included in bankfull width; bankfull width intersected by an island is the sum of the bankfull widths surrounding the island (Width B+ Width C).

3.4 Applying SFAM Under Specific Circumstances

There are specific circumstances or conditions where the application of SFAM may need to be adjusted. Adjustments for some of those common circumstances are described below. For these, and for any circumstance that is not fully covered by SFAM, please provide a general description of adjustments that were made in the Assessment Notes box on the Cover Page of the SFAM Workbook.

Single vs Multiple SFAM Assessments

SFAM is designed to assess a single project on one stream reach at a time. This assures data is being collected within areas likely to change as a result of the project and makes SFAM outputs more sensitive.

Some projects may include multiple locations on a single stream, such as a series of bendway weirs or large wood placements. These locations may be combined into a single PA when the PAAs for each location would otherwise abut or overlap. Project locations where the PAAs do not abut should be split into separate PAs and two SFAM assessments performed.

When there is a series of very similar projects on one stream, then it may be sufficient to assess a subset of these and assume results will be similar. Preliminary consultation with the agencies is recommended to determine the number of assessments needed, but at least three are recommended to be representative.

Separate SFAM assessments are needed when a project spans more than one stream, such as when a project is at the junction of two streams. The PA for each stream should only include the activities that are located on that stream. In such cases, the PAA of one stream would abut the PAA of the other at the confluence. The EAA for these assessments should only include the associated stream and adjacent riparian area for their respective subject stream. If needed, adjustments to the EAA can be made as described below for assessments with access constraints.

SFAM Assessment on Dry Channels

A ‘dry-channel assessment’ is one that should be conducted when ANY portion (length) of the stream is dry (i.e., having no surface water in cross-section). If any of the stream reach along the length of the EAA is dry, follow the ‘dry-channel’ instructions for measures that require modification of the data collection method. The measures with modified instructions for a dry channel are Cover, Embeddedness, and Channel Bed Variability.

SFAM Assessment with Access Issues

While assessment of both sides of the streambank is optimal and expected, if it is infeasible to access one streambank/side of the channel to collect data (due to physical site conditions or legal constraints), data collection for certain measures can be restricted to one side of the stream. The measures with modified instructions for sites with access issues are Invasive Weeds, Native Woody Vegetation, Large Trees, Vegetated Riparian Corridor Width, Overbank Flow, and Wetland Vegetation. Do not enter data for these measures for the un-accessed side of the streambank. It is important that you indicate on the PAA Field Form if data was collected on only one side by selecting “Left” or “Right” bank from the drop-down menu in cell R15 (which will modify calculations accordingly).

We do not recommend that you use other resources (e.g., aerial imagery or Google Earth™) to make estimates or educated guesses about these measures.

SFAM Assessment with Partially or Fully Restricted Access to the Extended Assessment Area

Data collected in the EAA are an important component of an SFAM assessment. These data provide information about reach-level processes and channel structure variability that inform several of the function subscores. Standard performance indices developed for each of the measures are based on the data collection protocols that contribute to the accuracy, consistency, transparency, and repeatability of the field method. Furthermore, in assessing impacts, it is beneficial to get information beyond the PA, in the EAA, because it considers aspects of stream function that are not directly impacted which are reflected in assessment outputs. Thus, it is important to collect data as directed for each of the measures to the extent possible to assure meaningful outputs. If you must make an adjustment to the data collection protocol, we recommend solving the issue at the level of the problem (i.e., at the measure level), and clearly document those adjustments on the Cover Page.

If you are unable to secure legal access to the EAA, or encounter physical barriers that prevent you from accessing the EAA, use the following guidance to adjust the data collection method:

- If only some portion of the EAA is accessible, adjust the length of the EAA to the accessible stream area. If the length of the adjusted EAA is 10 × BFW or longer, take all EAA measurements in that reduced area (i.e., still do the 11 transects).
- If the adjusted EAA is < 10 × BFW in length, then:

  i. Collect the data as directed for Side Channels, Wood, Lateral Migration, Embeddedness and Incision in the adjusted EAA.

  ii. Do not collect the component measures for Channel Bed Variability (Wetted Width and Thalweg Depth). Rather, based on the features of the reach within the adjusted EAA that you can observe upstream and downstream, indicate the category (Lower, Moderate, Higher) that best describes channel bed variability and manually enter the corresponding number from **Table 3.2** into the Functions tab of the SFAM Workbook. **Table 3.3** provides general expectations informing estimates of Wetted Width and Thalweg Depth.

Table 3.2. Numerical data entry inputs for Wetted Width and Thalweg Depth

	Category		
Numerical Data Entry on Workbook	Lower	Moderate	Higher
Wetted Width	0.108	0.305	0.455
Thalweg Depth	0.162	0.440	0.655

Table 3.3. General Wetted Width and Thalweg Depth expectations

Channel Bed Variability	Wetted Width	Thalweg Depth
Lower	Widest portions of stream <2X wider than the narrowest portions	Deepest portions (pools) <3X depth of the shallowest areas (riffles)
Moderate	Widest portions of stream 2-3X wider than the narrowest portions	Deepest portions (pools) 3-6X depth of the shallowest areas (riffles); this occurs in several locations
Higher	Widest portions of stream >3X wider than the narrowest portions	Deepest portions (pools) >6X depth of the shallowest areas (riffles); this occurs in several locations

SFAM Assessment on Multiple Channels

A stream with multiple channels is one where the flow of water splits between two or more paths separated by an 'island'; a mid-channel feature that would still be exposed during bankfull flow (see Bankfull Width instruction box above). Most SFAM measures can be evaluated as described for multiple channel streams, recognizing that the 'banks' of the stream refer to the outer-most banks of the stream, not the banks of the islands. Two measures, Embeddedness and Channel Bed Variability, require modified instructions for multiple channel streams.

SFAM Assessment with No Pre-Defined Impact

For assessments with undefined footprints (e.g., non-regulatory uses), it is not necessary to delineate a PA. However, the upstream and downstream extent of the PAA must be designated. It is recommended that the PAA be centered within the stream reach at a representative area and the length of the PAA (distance between the upstream and downstream PAA boundaries) be scaled to the bankfull width of the stream. In this case, the PAA length would be at least 30x the average bankfull width, resulting in an EAA length of at least 40x bankfull width. Stream assessment lengths of 40x width are recognized as necessary to characterize the habitat and several biotic assemblages associated with a stream reach (EPA, 2013).

SFAM Assessment for Long Project Areas (PA > 1000 feet)

When the PA is longer than 1000 feet, additional PAA transects are needed to represent the vegetation in the riparian area. The maximum distance between transects should be 250 feet. For example, a PA of 2000 feet would require eight PAA transects. This maximum distance restriction also applies to transects for the EAA.

SFAM Assessments for Linear Projects Crossing Multiple Streams

For linear projects such as pipelines, roads, powerlines, etc., that will have impacts to multiple streams, preliminary work with the agencies is recommended to determine the number of assessments needed. It may be appropriate to evaluate multiple streams that are similar in nature, such as the same stream classification, flow permanence class (ephemeral, intermittent, perennial), slope, surrounding land use, structure, etc., using “representative” stream reaches for SFAM assessments. More than one SFAM assessment will be needed to represent multiple streams.

SFAM Assessments at Crossings

It will often be the case that an SFAM PA is centered on a significant structure (e.g., road, culvert, bridge, diversion, etc.). It is important to capture the impact of the structure in the assessment by evaluating the Function Measures as closely as possible to the methods described in the User Manual. Measurement transects should not be moved to avoid the structure. Rather, the collected data and observations should reflect the structure(s). In some cases, it may not be physically possible to record the requested data. (e.g., measuring stream depth within a small culvert). In such cases, there are often analogous measures or assumptions that could be made that allow the assessor to record relevant data.

The measures with modified instructions for an assessment centered on a structure are Natural Cover, Invasive Vegetation, Native Woody Vegetation, Large Trees, Incision, Embeddedness, and Channel Bed Variability.

4 Office Component Instructions

The office component of an SFAM assessment uses data and information available from online resources, reports, maps, etc., about the site and surrounding area to generate scores for the values or services provided by the site, and provides advance information on some function measures. A list of online resources included in this User Manual is provided in **Appendix 5**.

The office component should be completed prior to the field component discussed in **Section 5**. To maximize efficiency, users should review this entire section before starting an SFAM assessment.

4.1 Create a Site Map

These instructions will guide you in developing a preliminary map of the SFAM site described in **Section 3.4**. This can be done on a digital or printed map. The site map is needed to indicate the approximate and relative locations of the PA, PAA and EAA (**Section 6.4**), for answering Value questions in the office and for locating the approximate location of assessment area boundaries in the field. The PAA and EAA both use average BFW in determining their extent and this can only be generally estimated in the office. Once on site, users should take accurate measurements and physically lay out the PA, PAA, and EAA using measuring tapes and flags.

Step 1. Create a Digital Map of the Site

There are a variety of tools that can be used to generate a digital site map. Experience using GIS software could be advantageous but is not required. The instructions provided here do not require use of GIS software.

The site map should be based on recent aerial imagery centered on the project site. Sources for aerial imagery include:

- Google Earth™: https://www.google.com/earth/versions/, available on the web or as a standalone application
- Microsoft Imagery: http://www.bing.com/maps/

The instructions provided here are for the stand-alone Google Earth™ application as it is widely used and available, but instructions can be modified as needed to apply to other sources of aerial imagery.

Begin by entering the latitude and longitude (or other place description) of your project area in the Google Earth™ search box. This will create a “pin” at the selected coordinates.

Step 2. Draw the Project Area

Delineate the extent of your PA on the Google Earth™ image by creating a polygon using the polygon drawing tool in the toolbar.

The PA is the spatial extent of direct impact (e.g., removal, fill, grading, planting, etc.) that a project (e.g., permitted action, mitigation, restoration) will have on a stream and surrounding area. Some projects may have multiple areas of impact but are part of a singular larger project. If a project includes multiple but related areas of impact, the PA should encompass all areas of impact. If the exact footprint of the PA is unknown, delineate an area that includes the maximum possible footprint of the PA.

The PA can be labelled by adding a placemark and including "PA" as the Name. The placemark will use the default icon (or the most recently used icon), but the icon can be hidden by right-clicking on it, selecting Properties/Style-Color, and changing the opacity of the icon to 0%. The color and thickness of the polygon lines can also be controlled through the Style-Color section of Properties.

Note the elevation at either end of the PA. This information is used to calculate gradient, as described in more detail in **Section 4.3**.

Tip: *To modify a polygon, right-click on it, either in the image or in the Sidebar at the left of the screen, and select Properties. Drag the vertices to the desired locations, and then click OK in the properties window to save the changes.*

Step 3. Draw the Estimated Proximal Assessment Area Boundaries

Use the polygon drawing tool to draw the approximate boundaries of the PAA. The longitudinal boundaries of the PAA are at the upstream and downstream extent of the PA, or 50 feet of stream length centered on the PA, whichever is the greater stream length. Locate the approximate lateral boundaries of the PAA at a distance of 2 × the average BFW or 50 feet from the stream edge (bankfull edge), whichever is greater, on each side of the stream. If the edge of the stream is visible on aerial images, estimate the average BFW throughout the PA using the Ruler tool on the toolbar. If BFW is not visible, use an estimate based on visible reaches upstream and downstream, or use 50 feet. Label the PAA using the procedure described above for the PA, choosing a different color for the polygon lines.

Note– the PAA lateral boundaries can be smaller than the PA.

Tip: *To use the Ruler tool, select it and then click on the map in the location you want to start your measurement. Use your computer mouse to extend the line out, pausing to display the distance of the line or clicking once to create a new segment of the line. The line can be saved using the Save option at the bottom of the window, or discarded by either closing the window or selecting the Clear option at the bottom of the window (if you wish to measure additional distances).*

Step 4. Draw the estimated Extended Assessment Area boundaries

Use a drawing tool on the Create & Share tab to draw the approximate boundaries of the EAA. The upstream and downstream EAA boundaries are identified by multiplying the average BFW by 5 and measuring that distance upstream and downstream from the PAA upper and lower boundaries, respectively. The lateral boundaries of the EAA are the same distance from the stream edge (bankfull) as for the PAA above (i.e., 2 × BFW or 50 feet, whichever is greater). Note that the EAA contains the entire PAA (i.e., the PAA is part of the EAA). Label the EAA.

Figure 4.1 shows an example of a site map with PA, PAA, and EAA boundaries drawn and labeled.

Step 5. Save A Copy of the Site Map

Save the Google Earth™ image of the site map by using the snipping tool on your computer to select the desired extent of the image (Windows+Ctrl+S on a PC running Windows or Shift+Command+5 on a Macintosh).

Figure 4.1. Example of a site map with Project Area, Proximal Assessment Area, and Extended Assessment Area

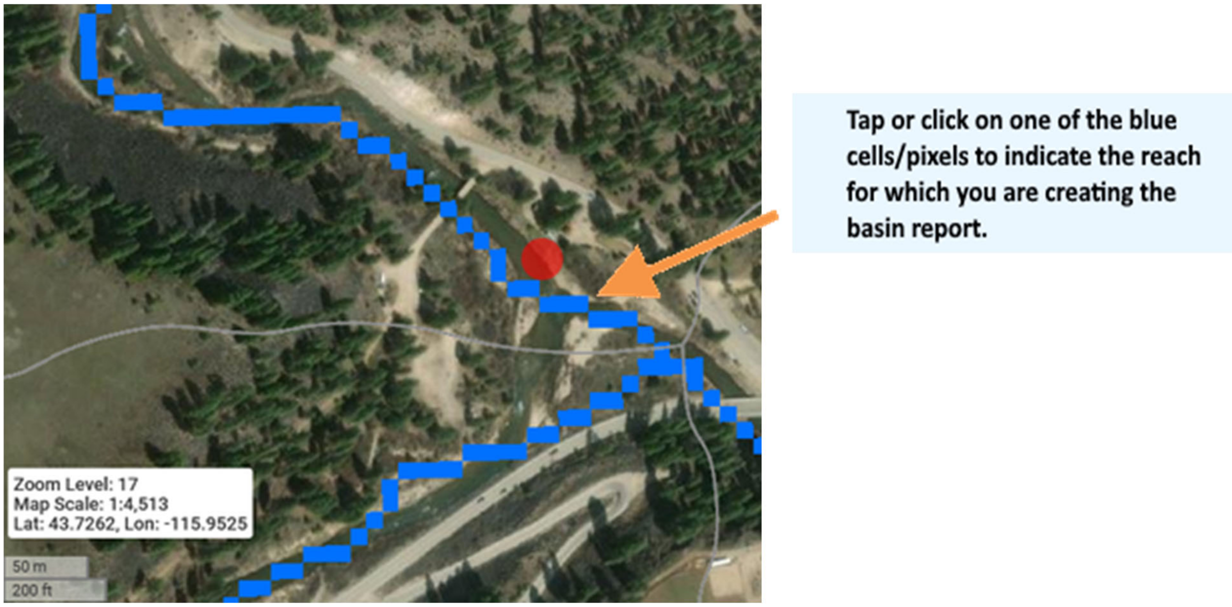
4.2 Generate a StreamStats Report

A StreamStats Report is created using data from the U.S. Geological Survey (USGS) StreamStats database. The StreamStats Report provides information about the drainage area of your PA. An example StreamStats Report (partial) is shown in **Figure 4.2**.

To create a StreamStats Report, go to https://streamstats.usgs.gov/ss. This webpage has detailed instructions on how to create a report. These steps are also summarized below.

1. Zoom (located on the bottom left corner of the map) or use the search feature to locate the project site.

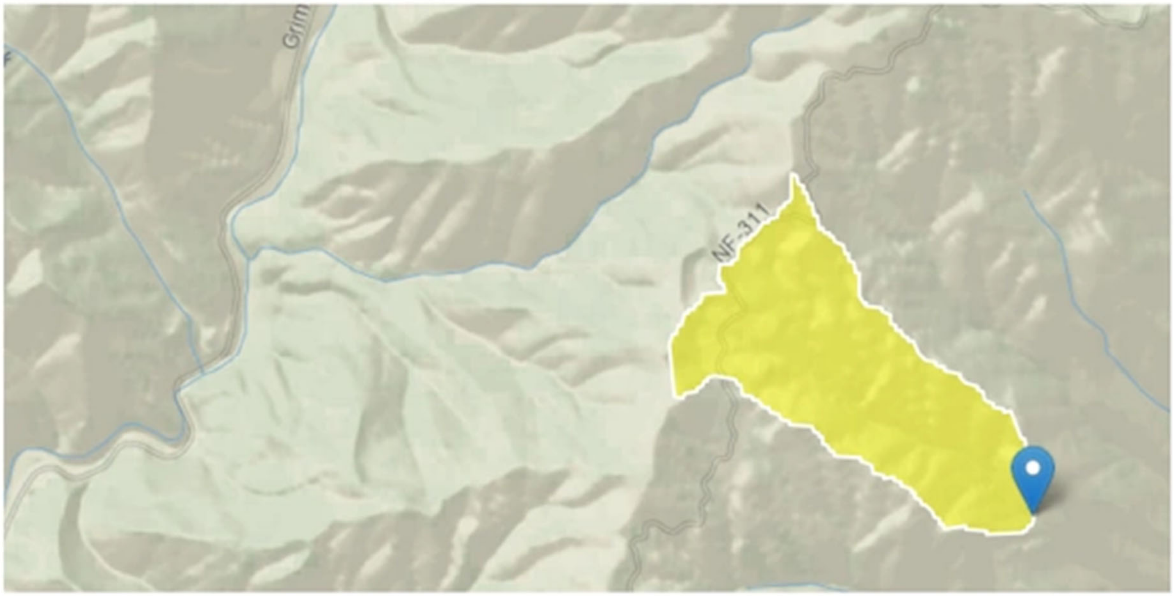
2. Select Idaho as the State Study Area. The basin delineation tool will be enabled once you have zoomed in to level 15 or greater.
3. Click Delineate and then click on a blue stream cell on the map that corresponds with the downstream end of the PA.



4. Once the basin is delineated, click Continue from the menu at the left of the screen to generate a report of basin statistics.
5. Select Peak-Flow Statistics under the Scenarios menu (this will provide the 2-year peak flood data).
6. Scroll down the side bar, expand the Basin Characteristics menu and select the DRNAREA (drainage area) and IMPNLCD01 (percentage of impervious area) parameters, along with any others that are of interest. Some basin characteristics may already be checked because they are required by one of the selected scenarios.
7. Click Continue on the bottom of the menu, which will generate a Report.
8. Under "Select available reports to display:", click "Open Report." This will generate a combined Basin Characteristics Report and Scenario Flow Report. The report title can be edited and comments can be added. The report should be printed as a pdf file for recordkeeping purposes. The data can also be downloaded for use in GIS applications, using the "Download" button at the bottom of the report.
9. Record the values for DRNAREA and IMPNLCD01 for entry into the SFAM Workbook. These are found under the Basin Characteristics header.
10. Record the 2-year peak flood flow for entry into the SFAM Workbook. This value can be found in the Peak-Flow Statistics Flow Report at the bottom of the StreamStats report. The 2-year peak flood flow is the 50-percent AEP (annual exceedance probability) flood row on the report table.

StreamStats Report

Region ID: ID
Workspace ID: ID20230614160155162000
Clicked Point (Latitude, Longitude): 43.78126, -115.92473
Time: 2023-06-14 09:02:19 -0700



Basin Characteristics

Parameter Code	Parameter Description	Value	Unit
DRNAREA	Area that drains to a point on a stream	0.33	square miles
IMPNLCD01	Percentage of impervious area determined from NLCD 2001 impervious dataset	0.11	percent
LC11FOREST	Percentage of forest from NLCD 2011 classes 41-43	32.8	percent
PRECPRIS10	Basin average mean annual precipitation for 1981 to 2010 from PRISM	25.8	inches

Peak-Flow Statistics Flow Report [Peak Flow Region 4 2016 5083]

Statistic	Value	Unit
80-percent AEP flood	1.16	ft^3/s
66.7-percent AEP flood	1.65	ft^3/s
50-percent AEP flood	2.3	ft^3/s

Figure 4.2. Example StreamStats Report (partial)

4.3 Complete the Cover Page of the SFAM Workbook

Use information about your site to answer questions on the Cover Page, as described below. Data is entered either by typing a number into the appropriate Workbook cell or by selecting options from the drop-down menus.

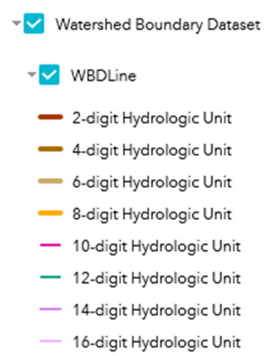
General Site Information

Record information about the name of the project, date of assessment, name of data collectors, a project number (if applicable), the site latitude and longitude (the center of the PA), the assessment timing (current conditions or predicted conditions), and the PA length and area into the appropriate Workbook cells. This information will automatically populate in the header of all other Workbook tabs.

Hydrologic Unit Code

The Hydrologic Unit Code (HUC) is used to identify watersheds or subwatersheds. HUCs at various spatial scales are used to answer some of the questions on the Value tab of the SFAM workbook. The HUC can be obtained from the USGS National Map Viewer (https://apps.nationalmap.gov/viewer/). Enter the project coordinates or other location identifier in the search box at the upper right of the screen. Then click on the layers tab from the toolbar at the top of the screen and select Watershed Boundary Dataset.

Once you have entered search parameters for your site, the 12-digit (subwatershed) HUC will be displayed in the center of the screen, at the location of your project coordinates. Some of the measures of Value described in **Section 4.4** require 6-digit or 8-digit HUCs, which are simply the first six or eight digits, respectively, of the HUC12. It may be helpful for answering some of the measures of Value to display the boundaries of the various HUC levels. This can be done by expanding the Watershed Boundary Dataset layer within the Map Viewer and selecting WBDLine. You can keep this screen open while working on the measures of Value described in Section 4.4 or save screen shots at the appropriate scale(s) (Windows+Ctrl+S on a PC running Windows or Shift+Command+5 on a Macintosh). See **Figure 4.6** for an example of various delineated HUC boundaries.



Elevation

The elevation for your site can be determined from the Google Earth™ application. The elevation is displayed at the bottom of the screen. Enter this value (in feet) into the appropriate Workbook cell.

Hydrologic Landscape Classification

The Hydrologic Landscape Classification Climate Class of a site can be determined from the Pacific Northwest Hydrologic Landscapes map. A pdf of this map can be obtained at https://pasteur.epa.gov/uploads/268/PNW_HLs_41.5x36_v2_300dpi_060415.pdf. Currently, there is no public map viewer option for this dataset, but the GIS data can be obtained at https://gaftp.epa.gov/EPADataCommons/ORD/HydrologicLandscapes/pnw_hydrologic_lan dscape_class.zip for those users who have the desire to use their own GIS software.

If you can identify your project site on the pdf map with a reasonable degree of accuracy, it should be possible to identify the five-character Hydrologic Classification Code for the assessment unit where your project is located. The possible values for each of the five components of the Hydrological Classification Code are shown in **Figure 4.3**. If the first letter of the code, representing climate class, is M (Moist), W (Wet), or V (Very Wet), then choose "yes" from the drop-down menu, otherwise select No. This same data source should also be used to determine whether any contributing basins to the assessment reach have a Climate Class of moist, wet, or very wet. The USGS National Map Viewer, described above under the Hydrologic Unit Code header, could be useful in identifying contributing basins. If the Hydrologic Classification Code is not available for the site (or contributing basin), such is the case for some streams draining basins along the eastern Idaho border, select the class of the closest adjacent basin. An excerpt of the Pacific Northwest Hydrologic Landscapes map, showing a section of the map at the eastern Idaho border, is provided in **Figure 4.3**.

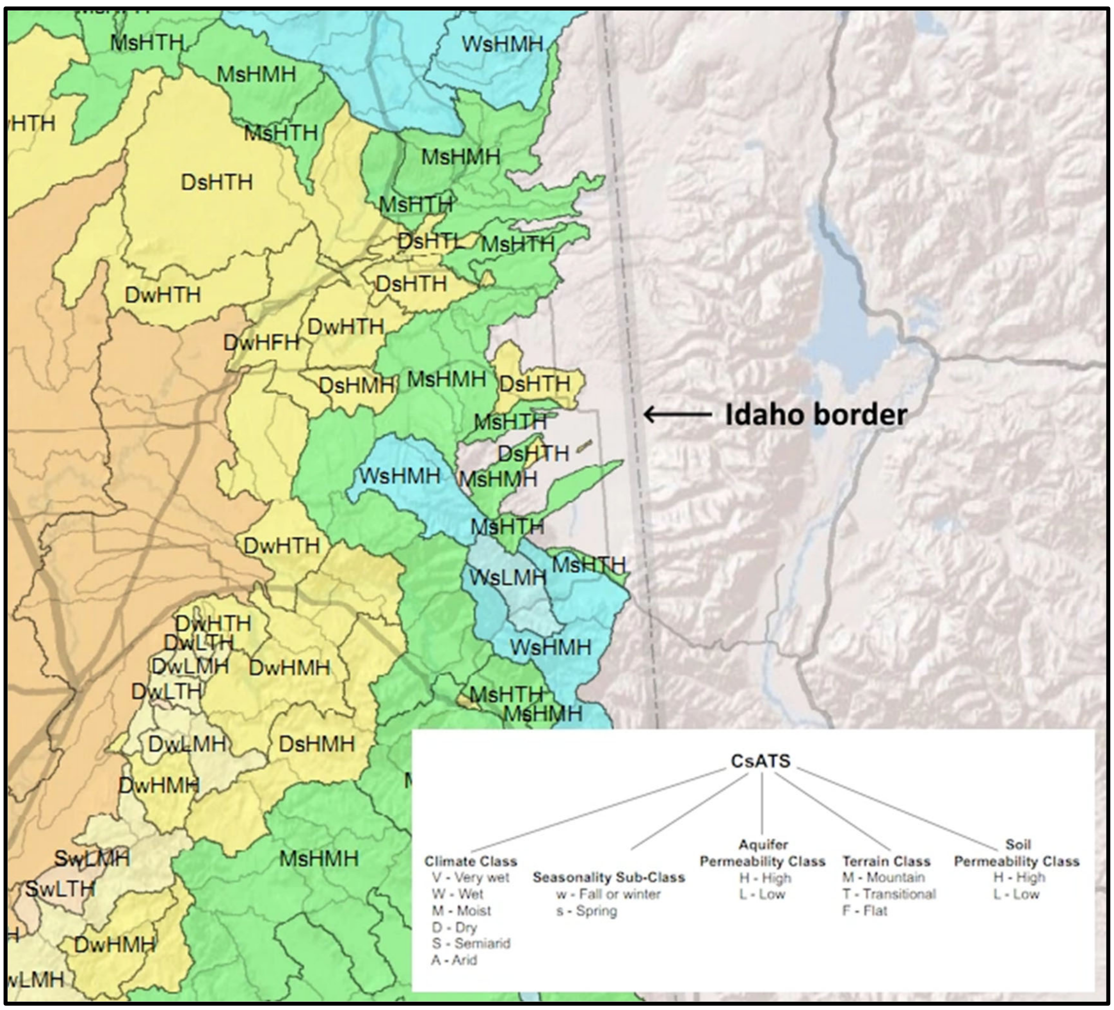


Figure 4.3. Excerpt from the Pacific Northwest Hydrologic Landscapes map

Permeability, Erodibility, and Gradient

Permeability ratings for both Aquifer and Soil should also be obtained from the Hydrologic

Landscape Classification described above. The third character in the five-character Hydrologic Classification Code specifies the Aquatic Permeability Class, using either H (high) or L (low). Similarly, the fifth character in the Hydrologic Classification Code specifies the Soil Permeability Class, using the same H (high) and L (low) convention.

The Erodibility rating class can be estimated using the Geological Map of Idaho. A pdf of this map can be obtained at https://www.idahogeology.org/product/m-9 and an interactive version can be found at https://www.idahogeology.org/WebMap/. If you intend to use the interactive version of the map, it may be helpful to also review the pdf map to view the map key. After locating your project site on either the pdf or the interactive version of the map, make note of the map unit within which your site is found. An excerpt of the Geological Map of Idaho is provided in **Figure 4.4**, with an example map unit circled in red. The figure also includes a description of the map unit from the Geological Map of Idaho. Using the description of the map unit, assign the erodibility rating class according to **Table 4.1**. Because the map unit descriptions do not necessarily include the same geological characteristic terms from Table 4.1, it may be necessary to conduct a simple web search to determine which erodibility class to associate with the specific minerals found in the description of the map unit. For example, the description shown on **Figure 4.4** includes the mineral grandiorite, which is similar to granite. Therefore, the erodibility rating class of the map unit Kg on **Figure 4.4** would be 'Difficult to Erode'.

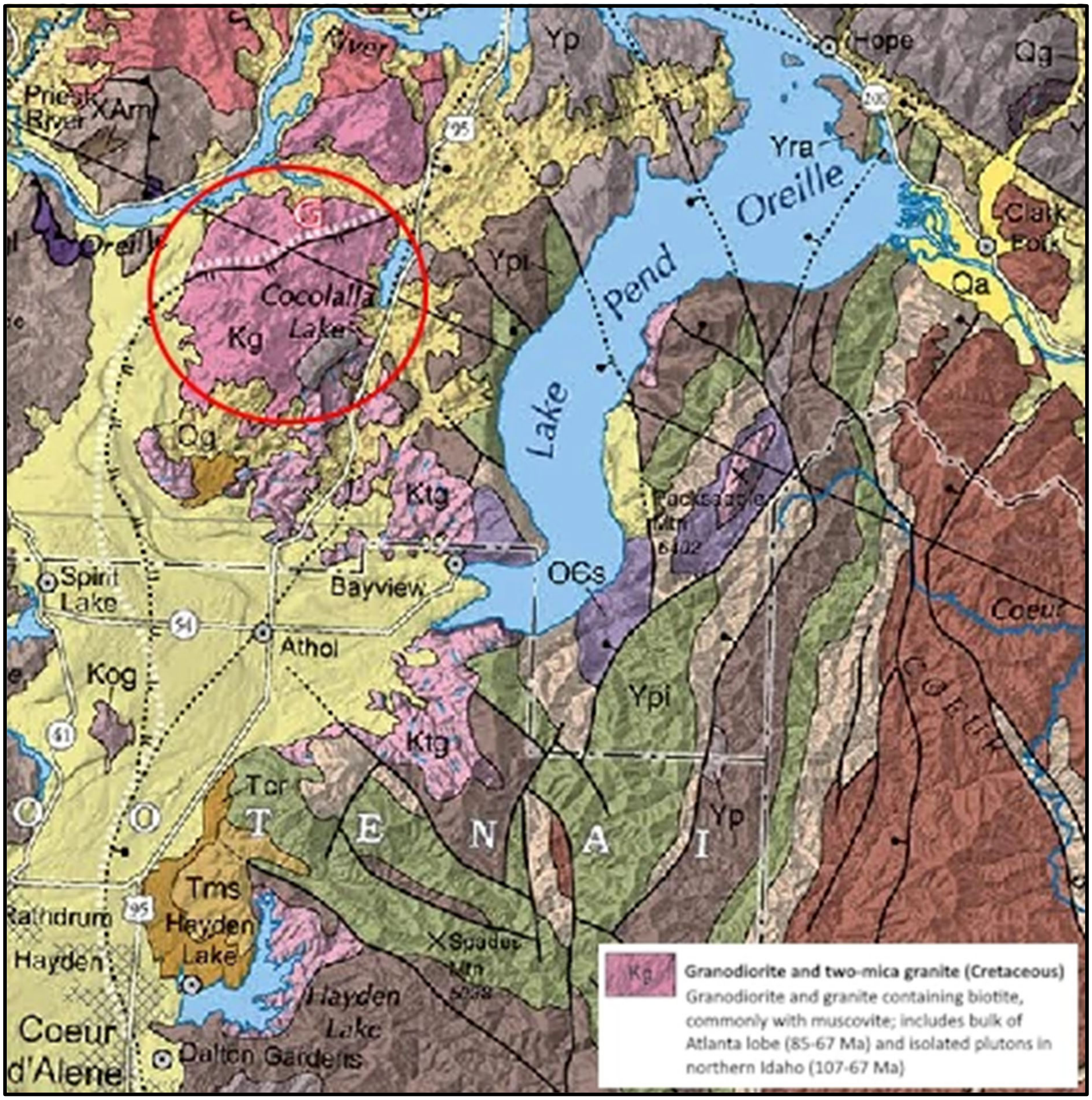


Figure 4.4. Excerpt from the Geological Map of Idaho

Table 4.1. Erodibility Classification

Rating Class	Geological Characteristics
Easily Erodible	Quaternary sediments, including alluvial and glacial deposits (gravel, sand, silt, colluvium)
Moderately Erodible	Sedimentary, including dissolvable (e.g., limestone, dolomites), fine-grained (e.g., shales, mudstones, clays), medium-grained, and coarse-grained (e.g., conglomerates, pyroclastics)
Difficult to Erode	Consolidated volcanics (e.g., basalt, granite, rhyolite), metamorphics (e.g., marble)

Gradient can be determined from Google Earth™ by noting the elevation at both ends of the PA. The elevation is found at the bottom of the Google Earth™ window, next to the latitude and longitude. Divide the change in elevation between the ends of your project site by the length of the project site, then multiply by 100 to obtain the gradient as a percentage. If the estimated gradient classification (i.e., <2%, 2-6%, >6%) determined using this tool is different from the gradient class observed on site, select the gradient observed on site.

Flow Duration or Permanence Class

The information to determine whether the channel is perennial, intermittent, or ephemeral can be obtained from the National Hydrography Dataset, which can be accessed at https://apps.nationalmap.gov/viewer/. Enter the coordinates for the project site in the search box at the upper right. From the layers list (accessed from the toolbar at top of screen), select the National Hydrography Dataset (NHD). This will automatically select all the layers within the dataset, including Flowline, as shown in **Figure 4.5**. You can expand the NHD layer to view the legend for the Flowline layer, and thereby determine whether the channel is perennial, intermittent, or ephemeral. If there is no NHD information about the subject stream reach, or you do not agree with the NHD designation, and other information is available to support a designation, provide that information on the Cover Page notes.

If there is no additional information available, then apply the Streamflow Duration Assessment Method for the Pacific Northwest (SDAM; https://www.epa.gov/measurements/streamflow- duration-assessment-method-pacific-northwest) in the field to distinguish between perennial, intermittent, and ephemeral streamflow of the subject reach.

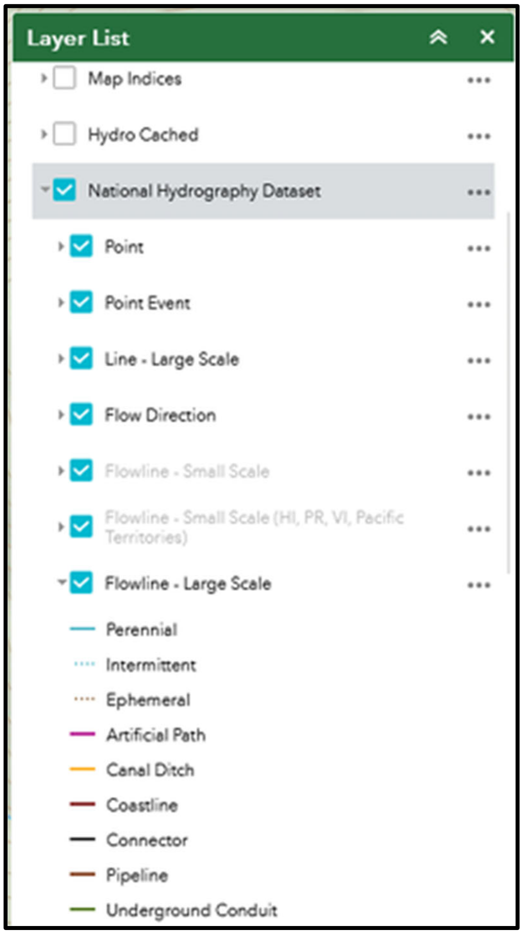


Figure 4.5. Excerpt of layer list from USGS National Map Viewer

Level III EPA Ecoregion

Ecoregions are geographic areas that exhibit generally similar ecosystem characteristics, specifically the type, quality, and quantity of environmental resources. This information is used to set performance expectations for several function measures.

The appropriate Level III EPA ecoregion can be identified at https://idaho-epscor-gem3-uidaho.hub.arcgis.com/datasets/3a21a75ffc8244f6a1c85a19b8ff7713_0/explore. Enter the project coordinates in the search bar at the upper right, then mouse over the center of the screen to identify the ecoregion. Alternatively, you can identify the appropriate ecoregion using a static pdf map (https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/id/id_eco_lg.pdf).

Select the appropriate ecoregion from the drop-down menu. Once an ecoregion is selected, the adjacent cell will auto-populate to show whether the site is located within the "Western Mountains" or "Xeric" ecoregion of the state.

Average Stream Width

Estimate whether the average width of the stream throughout the PA is >50 feet or ≤ 50 feet using an aerial image of the site (see **Section 4.1**). If you are able to see the edges of the stream on your image, you may be able to use the Ruler tool in Google Earth™ (or a comparable tool from other applications) to estimate stream width. Once bankfull width measurements have been taken in the field, update this cell, if needed.

2-Year Peak Flood Flow

Refer to the StreamStats Report to identify the 2-Year Peak Flood Flow. The 2-Year Peak Flood Flow is flow at or near bankfull discharge or effective discharge, at the point where water begins to overtop banks and inundate the floodplain. It is also an indicator of when channel forming or maintaining processes are occurring.

Size of Drainage Area

Refer to the StreamStats Report to identify the size of the drainage area or DRNAREA (i.e., the total basin area flowing into the PA) of your site. This information does not directly inform function or value measures, but rather is used to provide site context to users and reviewers. Note that the StreamStats method is based upon a natural landscape and if the stream is primarily fed by piped streams and waterways, modeled data will not necessarily be accurate.

4.4 Complete the Value Tab of the SFAM Workbook

Use the information from the StreamStats Report and other online resources described below to answer the following questions on the Values tab of the SFAM Workbook by selecting options from the drop-down menus (Column H of the Value tab). Refer to **Table 2.1** or the Acronyms list (pg. viii) for function acronyms used below. A list of the online resources described in this User Manual, including those described in this section, is provided in **Appendix 5**. That appendix also indicates which of these datasets may be downloaded for use in a stand-alone GIS application. However, completing the Values tab following the instructions included in this User Manual for accessing the identified online resources does not require any specialized knowledge or software for using GIS.

The questions for some measures of Value reference several spatial scales, including:

- the PAA;
- within a HUC12 subwatershed;
- streams within a 1-mile radius of the PAA, but not the PAA;
- within a 2-mile radius of the PA;
- within a HUC8 watershed; and
- streams within the same HUC6 watershed but not within 1 mile of the PAA.

To answer the questions most efficiently for measures of Value at these various spatial scales using the indicated data sources, users should access the USGS National Map Viewer described in **Section 4.3**. The USGS National Map Viewer can display the underlying available data at each of the spatial scales described above using the + or – buttons found at the upper left of the screen. To view data at scales that reference a particular HUC, the Watershed Boundary Dataset described in **Section 4.3** should also be used. The USGS National Map Viewer is the best data source for identifying the size of the applicable HUC12, HUC8, and HUC6 watersheds. An example of these three HUC scales, using watersheds near Boise, is provided in **Figure 4.6**. This figure was created using the Light Gray Canvas basemap in the USGS National Map Viewer, but users may want to select a basemap with additional details to provide landmarks for comparison with the other GIS data sources described below. The Basemap Gallery can be accessed from the toolbar at the top of the screen. As the USGS National Map Viewer can display only one scale at a time, once the appropriate scale is displayed in the USGS National Map Viewer for your project, it may be helpful to capture screen shots (Windows+Ctrl+S on a PC running Windows or Shift+Command+5 on a Macintosh) at indicated spatial scales for later reference, because these spatial scales will be used to answer questions for multiple measures of Value.

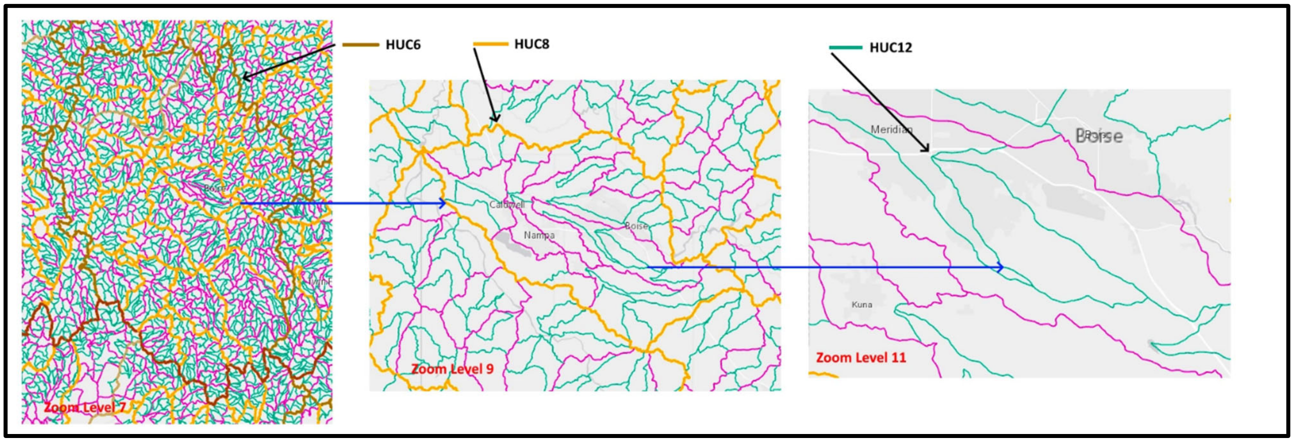


Figure 4.6. Examples for HUC6 (brown boundary), HUC8 (orange boundary), and HUC12 (green boundary) watersheds from the USGS National Map Viewer

V1. Rare Species Occurrence & Special Habitat Designations

Are there rare species or special habitat designations in the vicinity of the Project Area?

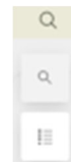
Informs SWS, FV, SM, MB, STS, NC, CR, and TR values.

The information for each submeasure can be obtained from a variety of online map sources, as described below. This information can be supplemented by available survey data for the PA and its vicinity, or personal knowledge about the site. If such supplemental information is used, users should provide information about the survey in the External Data section on the Cover Page. There may be streams for which little data on rare species and special habitats exist. In such cases, a response of "none/not known" is acceptable.

Rare animal and plant species found in Idaho are listed in **Appendix 2** and **Appendix 3**, respectively. The list of rare animal species (**Appendix 2**) was obtained from the Idaho State Wildlife Action Plan (IDFG, 2023). The list in **Appendix 2** consists of species listed in Appendix 5 of the Idaho State Wildlife Action Plan that are identified as Species of Greatest Conservation Need that inhabit wetland and aquatic habitats. The plant list in **Appendix 3** is from the Idaho Native Plant Society rare plant list (https://idahonativeplants.org/rare-plants-list/), which is the primary database for spatial information and population and habitat conditions for rare plants in Idaho.

Anadromous Fish or Rare Non-Anadromous Fish Species

The first question asks whether the PA is within a HUC12 that supports anadromous fish species. There are two sources of data that should be used to answer this question, including Idaho's Generalized Fish Distribution dataset maintained by IDFG (https://data-idfggis.opendata.arcgis.com/datasets/generalized-fish-distribution/explore) and Idaho's Beneficial Use Reconnaissance Project (BURP) dataset maintained by the Idaho Department of Environmental Quality (IDEQ). BURP data can be obtained from the water quality mapping tool (https://www.deq.idaho.gov/water-quality/surface-water/monitoring-and-assessment/) maintained by IDEQ. The question can be answered using the following steps:

1. Make note of the latitude and longitude of the project site, as entered on the cover page of the SFAM Workbook.
2. Open the IDFG Generalized Fish Distribution website.
3. Use the search function at the upper right of the IDFG Generalized Fish Distribution webpage to enter the project latitude and longitude, using the format DD.MM (degrees and hundredths of a degree), or the name of the creek. Note that there are two search icons on this site. The upper search icon is for searching all available GIS data sources maintained by IDFG, not the Generalized Fish Distribution dataset specifically. The lower icon should be used for finding a named location. For example, Lawyer Creek, a tributary to the Clearwater River, could be identified by name or by using the coordinates N 46.17, W 116.26, which could also be entered as 46.17 -116.26.

4. Find the location of your PA on the IDFG Generalized Fish Distribution webpage. Note that the DD.MM coordinates entered in step 3 may not necessarily be centered on the stream reach for the project. The map view can be shifted, as needed to center your project area.
5. Resize the area around your PA, using the + or – buttons at the right of the screen to approximately the same size as the HUC12 subwatershed, as determined from the USGS National Map Viewer described in **Section 4.3** and the introduction to **Section 4.4**. If fish are known to be present within this HUC12, they will be shown as blue lines. If there are no blue lines within this HUC12, respond "no" to this question.
6. Click on each blue line within the approximate boundaries of the HUC12 to determine which fish species are present. More than one species may be documented, as indicated at the bottom of each window that pops up after clicking the blue line. The anadromous species within this dataset are salmon, steelhead, and Pacific lamprey. Note that this dataset also includes records for bull trout and white sturgeon, but Idaho populations of these species are not anadromous.
7. Respond "yes" if salmon, steelhead, or Pacific lamprey are present within this HUC12. If no salmon, steelhead, or Pacific lamprey are present within the HUC12, according to the IDFG Generalized Fish Distribution dataset, then search the IDEQ's water quality mapping tool for BURP data, as described in Step 8.
8. Within the IDEQ water quality mapping tool, start by selecting the subbasin (HUC8) for your project, using the drop-down menu at the left of the screen. Recall that the HUC8 is simply the first eight digits of the HUC12.
9. Within the HUC8, zoom in to the HUC12, as described in Step 5 above. This will

require zooming in to a scale of at least 1:290,000 (scale bar is shown at lower left of map) to activate the BURP dataset. Any BURP data available for your HUC12 will be shown with a circle symbol (half green-half black).

10. Click “Select BURP” at the top of the screen, which will prompt you to draw a rectangle around the monitoring site(s) within your HUC12. This will bring up a table of the selected data at the bottom of the map.
11. Access the data for each monitoring event by clicking the “DATA” link at the right of the table. This will take you the BURP Data Viewer.
12. Access the fish data by clicking the “Fish” link at the menu at the left of the page. After accessing each of the monitoring event pages (if there are more than one), respond “yes” if salmon, steelhead, or Pacific lamprey were identified and “no” if they were not.

Answering the second question, regarding the presence of fish of conservation concern, may require consulting more than one dataset, including the IDFG Generalized Fish Distribution and BURP datasets described above for the first question. Rare fish species are listed on the Rare Species tab of the SFAM Workbook and in **Appendix 2**. The spatial scale of this question (i.e., within the PAA, within 1 mile of the PAA, within the same HUC6 but not within 1 mile of the PAA) differs from the first question, which focuses on the HUC12, and informs whether a response of high, intermediate, low, or none/not known is entered using the drop-down menu. The boundaries of these different spatial scales can be approximated using the scale bar for each GIS data source (to estimate a 1-mile radius) and the USGS National Map Viewer described in the introduction to this section (to identify the HUC6 watershed).

The IDFG Generalized Fish Distribution dataset primarily includes information on salmonids, anadromous species which may also be fish species of conservation concern, specifically Chinook salmon, sockeye salmon, and steelhead. However, only certain evolutionary significant units (ESUs) of these species are on the rare species list. Both Snake River fall run and spring/summer runs of Chinook salmon, and Snake River steelhead and sockeye are listed as threatened under the Endangered Species Act (ESA). If either the Generalized Fish Distribution or BURP datasets indicate that Chinook salmon, sockeye salmon, or steelhead are present at one of the specified spatial scales, additional research is necessary to determine whether or not these fish populations are among the protected ESUs. This information can be obtained from the NOAA’s Protected Resources App (https://www.webapps.nwfsc.noaa.gov/portal/apps/webappviewer/index.html?id=7514c715b8594944a6e468dd25aaacc9). The Protected Resources App includes designated critical habitat for these listed species, which for the purposes of this measure of Value is considered a surrogate for fish presence.

The Idaho rare species list in **Appendix 2** also includes non-anadromous fish species, such as sculpins, cyprinids (e.g., chubs, peamouth), and suckers. In addition to the BURP dataset, another data source for the presence of these non-anadromous species is the Idaho Crucial Habitat dataset (https://www.arcgis.com/apps/mapviewer/index.html?layers=01a6b9de82214764b8443416 fabae6f5).

The presence of any of the rare fish species listed in **Appendix 2** can also be determined from available survey data, if any, for the PAA and its vicinity or personal knowledge about the site.

To summarize, the second question regarding the presence of fish of conservation concern can be answered using the following steps:

1. Make note of the latitude and longitude of the project site, as entered on the cover page of the SFAM Workbook.
2. Open the Idaho Generalized Fish Distribution and Crucial Habitat datasets, IDEQ's water quality mapping tool (for the BURP data), NOAA's Protected Resources App, and the USGS National Map Viewer.
3. Using the DD.MM format of latitude and longitude for your project site, locate your PAA on each of the data sources described in Step 2 above, except for the IDEQ water quality mapping tool, for which your project site should be identified using the appropriate HUC8. Note that this second question refers to the PAA, whereas question one refers to the PA. Recall that both of these areas encompass the same stream length (see **Figure 4.1**).
4. On the Idaho Generalized Fish Distribution website, note whether the stream reach within your PAA is shown as a blue line. If it is, click on the blue line to identify the species that are present. If any species found within your PAA are on the Idaho rare species list in **Appendix 2**, then respond "high" to this question using the drop-down menu. If you can respond "high" at this step using the Idaho Generalized Fish Distribution dataset, then no further research is required to answer this question. If Chinook salmon, sockeye salmon, or steelhead are indicated as present in your PAA, additional research is required to determine whether they are a listed ESU, as described in Step 5. If there is no blue line within your PAA, go to Step 6.
5. Using NOAA's Protected Resources App, determine whether critical habitat (shown as an orange line) for any listed species is present within your PAA. If so, click the orange line to determine whether the critical habitat is for Snake River Chinook salmon (fall run or spring/summer runs), Snake River sockeye salmon, or Snake River steelhead ESUs. If it is, then respond "high" to this question using the drop-down menu. As with Step 4, if you can respond "high" at this step using NOAA's Protected Resources App, then no further research is required to answer this question.
6. Using the IDEQ water quality mapping tool, determine whether any BURP data are available for your PAA. If there are, review the fish data, as described in Steps 10-12 for question one above. If any species found within your PAA, as surveyed by BURP, are on the Idaho rare species list in **Appendix 2**, then respond "high" to this question using the drop-down menu. If there are no BURP fish data for your PAA or

there have not been any identifications of rare species listed on Appendix 2 within the BURP dataset, then go to **Step 7**.

7. Using the Idaho Crucial Habitat dataset, identify the 3-square mile hexagon that surrounds your PAA. The transparency of the Crucial Habitat layer should be increased to 50% or more (default is 0%) using the slider bar at the right of the screen so you can see the underlying geographic information. Click on the hexagon. Data on fish species of concern are provided in the field called Aq_SOC. Hexagons designated as priority level 1 or 3 contain one or more non-anadromous species on the rare fish species list in **Appendix 2**. If the hexagon surrounding your PAA is designated as 1 or 3 in the AQ_SOC field, then respond "high" to this question. As with Steps 4 and 5, if you can respond "High" at this step using the Idaho Crucial Habitat dataset, then no further research is required to answer this question.
8. If none of the datasets described in Steps 4-7 resulted in a response of "high" to this question, then those steps should be repeated using the next larger area (i.e., within 1 mile of the PAA). Because most of the datasets described in Steps 4-7 do not contain scale bars (except for the IDEQ water quality mapping tool), a 1-mile radius can be approximated using the USGS National Map Viewer, which does have a scale bar. Note whether the 1-mile radius around your PAA encompasses any additional stream reaches. In many cases it would not. If it does not, then the results from querying the datasets described in Steps 4-7 would be identical at the 1-mile scale to the PAA scale. In such cases, no additional research is necessary and you can go to Step 9. If additional stream reaches are within the 1-mile radius, repeat Steps 4, 5 (if necessary), 6, and 7 to determine if fish species of conservation concern are present within 1 mile of the PAA. If they are, then respond "intermediate" using the drop-down menu. If they are not, go to Step 9.
9. Use the USGS National Map Viewer to identify the HUC6 around your PAA. Then scale the datasets described in Steps 4, 5 (if necessary), 6, and 7 to approximate the size of the HUC6, using the + or – buttons on each website. Repeat the research described in those steps for the HUC6 area. If fish species of conservation concern are present within the HUC6, but not within 1 mile of the PAA, then respond "low" using the drop-down menu. If no fish species of conservation concern are found within the HUC6, then respond "none/not known" to this question.

Rare Amphibian and Reptile Species

Idaho-specific data for the question about the presence of rare reptile and amphibian species can be found in the Idaho Species Diversity Database (https://idfg.idaho.gov/species/). Separate pages exist for each of the five reptile and amphibian species listed in **Appendix 2** and the **Rare Species** tab of the SFAM Workbook. Another data source is the Reptile iNaturalist Project (https://www.inaturalist.org/projects/idaho-amphibian-and-reptile-inaturalist-project), which includes observations of amphibians and reptiles in Idaho by citizen scientists. The iNaturalist website includes a map viewer that can be used to identify observations of rare species that may be near your project site. The iNaturalist website also includes field guides for both reptiles (https://www.inaturalist.org/guides/3184) and amphibians (https://www.inaturalist.org/guides/3183) that can be used to identify the expected range for each species. In the absence of a specific observation of a rare species, the species range information can be used as a surrogate for species presence at or in the vicinity of your project site.

The question about rare amphibians and reptiles can be answered using the following steps:

1. Make note of the location of your PAA and the HUC6 in which your PAA is located using the USGS National Map Viewer, as described in the introduction to **Section 4.4**. Because some of the maps listed in Step 2 are small-scale (i.e., the entire state of Idaho), it may be helpful to zoom out the National Map Viewer so the HUC6 is displayed on a similar scale.
2. The observations and ranges for each of the five rare amphibian and reptile species listed in **Appendix 2** will need to be researched individually, using the data sources listed above.
3. Research each species at the three spatial scales listed in this question (i.e., PAA, within 1 mile of the PAA, and within the HUC6). At the scale used for the maps listed in Step 2, it may be difficult to locate the PAA on these maps with much accuracy. Consequently, you should start by determining whether any of the five reptile or amphibian species have been observed within the HUC6 for your project. If so, then you can access the individual observation records found at each of the top two websites for each species above to obtain more precise locations to compare to the two larger scales evaluated for this question (i.e., PAA and 1 mile around the PAA).
4. If none of the five reptile and amphibian species is found within the HUC6, respond "none/not known" to this question. If one or more of the five reptile and amphibian species has been found within the HUC6, or whose range overlaps with the HUC6, then respond "high" if the observation/known range is within the PAA, "intermediate" if it is within 1 mile of the PAA, or "low" if it is within the HUC6 but outside of 1 mile from the PAA.

Important Bird Areas

The question about Important Bird Areas (IBAs) can be answered by using the IBA Explorer maintained by the Audubon Society (https://gis.audubon.org/portal/apps/sites/?_gl=1*v33xif*_ga*MTY1ODY5NDcyMS4xNjc4OTE4NTY5*_ga_X2XNL2MWTT*MTY4MDA0NDM3My4zLjEuMTY4MDA0NDQ4MS4yMS4wLjA.#/nas-hub-site/pages/data-review). The IBA Explorer webpage shows IBAs of both state and global significance.

The question about whether IBAs are within a 2-mile radius of the PA can be answered using the following steps:

1. Use the USGS National Map Viewer to approximate a 2-mile radius around your PA.
2. Using the IBA Explorer, select the "browse by county" option at the upper right. Select the county in which your project is located.
3. Note whether any IBA overlaps with the 2-mile radius you approximated in Step 1. If it does, respond "yes" to this question. If it does not, then respond "no."

Rare Waterbirds

The data sources listed above under the Reptiles and Amphibians subsection also provide information on observations and expected ranges of the 16 rare waterbird species listed in **Appendix 2**. The steps to follow to answer this question are the same as those described above under the Reptiles and Amphibians subsection.

Rare Songbirds, Raptors, and Mammals

Appendix 2 lists eight songbird and raptor species and eight mammal species of conservation concern. The data sources listed above under the Reptiles and Amphibians subsection also provide information on observations and expected ranges of these other bird species and mammal species. To answer this question, follow the same steps as previously described in the Reptiles and Amphibians subsection.

Rare Invertebrates

Appendix 2 includes 18 invertebrate species of conservation concern. Invertebrate data are collected annually by IDEQ for the BURP. Follow the steps below to access any applicable BURP data for invertebrates.

1. Determine whether any BURP invertebrate data are available for your PAA, using the IDEQ water quality mapping tool. Start by selecting the subbasin (HUC8) for your project, using the drop-down menu at the left of the screen. Within the HUC8, zoom in to your PAA. This will require zooming in to a scale of at least 1:290,000 (scale bar is shown at lower left of map) to activate the BURP dataset. Any BURP data available for your PAA will be shown with a circle symbol (half green-half black).
2. If BURP data are available for your PAA, click "Select BURP" at the top of the screen, which will prompt you to draw a rectangle around the monitoring site within your PAA. This will bring up a table of the selected data at the bottom of the map. If there are no BURP data available for your PAA, go to Step 5.
3. Access the data for each monitoring event by clicking the "DATA" link at the right of the table. This will take you the BURP Data Viewer.
4. Access the invertebrate data by clicking the "Macros (Bugs)" link at the menu at the left of the page. After accessing each of the monitoring event pages (if there are more than one) and reviewing the data, respond "high" to this question using the drop-down menu if any of the invertebrate species observed in your PAA are listed in **Appendix 2**. If none of the observed invertebrate species are listed in **Appendix 2**, go to Step 5.
5. Repeat Steps 1-4 above for the next larger area (i.e., within 1 mile of the PAA). If rare invertebrate species have been observed within 1 mile of the PAA, then respond "intermediate" using the drop-down menu. If there are no BURP invertebrate data for within 1 mile of the PAA or the existing BURP data for that area do not include any species listed in **Appendix 2**, go to Step 6.
6. Repeat Steps 1-4 above for the next larger area (i.e., HUC6, but not within 1 mile of the PAA). If rare invertebrate species have been observed within the HUC6, but not

within 1 mile of the PAA, then respond “low” using the drop-down menu. If there are no BURP invertebrate data within the HUC6, but not within 1 mile of the PAA, or the existing BURP data for that area do not include any species listed in **Appendix 2**, then respond “none/not known.”

Rare Plants

The iNaturalist website for Idaho (https://www.inaturalist.org/places/idaho) includes information for many of the rare plant species listed in **Appendix 3.** Given the many rare plant species included in Appendix 3 and the lack of GIS-based data sources for their occurrence, the user may have to rely on available survey data and/or personal knowledge about the site. Rare plant surveys are periodically conducted as part of the Idaho Natural Heritage Program. A partial list of their publications is available at https://idfg.idaho.gov/content/page/botany-publications-idaho-natural-heritage-program. A survey for rare plants is unnecessary for completing the SFAM assessment. In the absence of any knowledge about the presence of rare plants in the PA or vicinity, selecting “none/not known” is an acceptable answer to the question about rare plant species.

V2. Water Quality Impairments

Is the reach designated as not supporting one or more beneficial uses for any of the following parameters: sediment, nutrient, metals & toxics, temperature, or flow modification?
Informs FV, SC, CMH, STS, NC, CR, and TR values.

The information for each of the five questions in this category can be obtained from the interactive water quality mapping tool (https://www.deq.idaho.gov/water-quality/surface-water/monitoring-and-assessment/) maintained by the IDEQ. First select the subbasin (HUC8) for your project site using the drop-down menu at the upper left. Then zoom to the approximate project coordinates (coordinates are shown at bottom right of map). Clicking on a specific reach will result in a pop-up window that identifies the status of that reach, including “Fully Supporting”, “Not Assessed”, “Not Supporting”. If the reach that includes your PA is designated as “Not Supporting”, click on the link for that reach in the “Status” column to determine the parameter(s) causing the impairment. For each parameter (i.e., sediment, nutrient, metals and toxics, temperature, and flow modification), respond “yes” or “no” for whether that parameter is the cause of the “Not Supporting” designation.

Water quality impairment data is collected and maintained by IDEQ. If users are aware of more recent data/information, provide this information in the Assessment Notes section on the Cover Page but do not change the question response based on this information.

V3. Protected Areas

Is the Project Area boundary within 300 feet of a Conservation Site?
Informs MB and STS values.

Use information from IDFG’s map viewer at https://www.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=b1314f8e41c5483283637e1a7e37ae91 to determine if your PA is within 300 feet of a Conservation Site. These sites represent a variety of ecosystems and typically have intact ecological processes, exemplary native plant communities, unique geologic processes, or important habitat for species. Most Conservation Sites contain wetland or riparian habitat and have been classified into conservation priority categories according to habitat diversity, biodiversity significance, condition, and landscape context. If users are aware of other lands within 300 feet of the PA that are protected specifically for their high ecological significance and managed for biodiversity, provide this information in the Assessment Notes section on the Cover Page tab (i.e., tax lot number, ownership, and how it is protected) and answer "yes" to the question.

V4. Impervious Area

What is the percent impervious area in the drainage basin?
Informs SWS, FV, SC, SM, CMH, STS, NC, CR, and TR values.

Record the percent impervious area in the drainage basin (IMPNLCD01).

V5. Riparian Area

What is the percentage of intact riparian area within 2 miles upstream of the Project Area?

Informs CMH, STS, NC, CR, and TR values.

Intact refers to a riparian area with forest or otherwise unmanaged (i.e., natural) perennial cover appropriate for the basin that is at least 15 feet wide on both sides of the channel.

Use aerial imagery (e.g., Google Earth™) to visually estimate the percentage of intact riparian area within 2 miles of the upstream PA boundary, including all contributing tributaries.

Unmanaged perennial cover is vegetation that includes wooded areas, native prairies, sagebrush, vegetated wetlands, as well as relatively unmanaged commercial lands in which the ground and vegetation is disturbed less than annually, such as lightly grazed pastures, timber harvest areas, and rangeland. It does not include water, pasture, row crops (e.g., vegetable, orchards, tree farms), lawns, residential areas, golf courses, recreational fields, pavement, bare soil, rock, bare sand, or gravel or dirt roads.

V6. Extent of Downstream Floodplain Infrastructure

What is the extent of infrastructure (e.g., buildings, bridges, utilities, row crops) in the floodplain?
Informs SWS, SC, CMH, and STS values.

The floodplain, defined here as land that has a 1 percent annual chance of flooding (also known as the 100-year floodplain), can be viewed using the Federal Emergency Management Agency's (FEMA) National Flood Hazard Layer Viewer (NFHL; https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd). Use the zoom feature at the upper left or the search box to zoom into your project area. The 100-year floodplain is delineated in light blue within the Flood Hazard Zone layer, which should already be selected by default. The Flood Hazard Zone is one of the layers within the NFHL Viewer.

Using the NFHL Viewer, identify the floodplain on both sides of the channel for the stream length between the Project Area and either the next largest water body or 2 miles downstream of the PA, whichever is less. Estimate whether development (e.g., buildings, bridges, utilities, row crops, etc.) occupies >50% of this area. This map will also be used to access information for V7 below.

V7. Zoning

What is the dominant zoned land use designation downstream of the Project Area?
Informs SWS, CMH, and STS values.

The NFHL dataset, described under V6 above, is used to assess the dominant zoning designation with the floodplain downstream of the PA. Consider the distance from the PA to either the next largest water body or 2 miles downstream, whichever is less. Visually examine the aerial imagery provided in the NFHL map to determine whether the dominant land use is developed (e.g., commercial, industrial, residential); agriculture or rural residential; or forest, open space, or public lands. In many locations, the existing land use reflects the underlying zoning. However, in areas that may experience significant development, the zoning may be quite different than the current land use. For projects located in such areas, consult the parcel viewer for the county in which the project is located to determine the zoning. Links to the parcel maps for each Idaho county are found at https://experience.arcgis.com/experience/6b5a52900b2e42908fbd813ce423adaa/.

V8. Frequency of Downstream Flooding

What is the frequency of downstream flooding?
Informs SWS value.

Determine the frequency of flooding within 2 miles downstream of the PA that affects infrastructure (i.e., affects use or causes economic loss). Infrastructure includes, but is not limited to, buildings, bridges, utilities and row crops. Flooding history may be documented in a city or county floodplain management plan or may be known by the local water management agency or landowner. Additional information may also be found at FEMA's Flood Map Service Center (https://msc.fema.gov/portal/search#searchresultsanchor) which contains flood maps and other flood risk information for communities across the country.

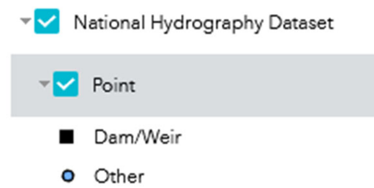
V9. Impoundments

What is the prevalence of impoundments within 2 miles upstream and/or downstream of the Project Area that are likely to cause shifts in timing or volume of

water?

Informs SWS, FV, SC, SM, and CMH values, and FV function.

Load the National Hydrography Dataset from https://apps.nationalmap.gov/viewer/. You may need to click the layer list at the top of the map to select this layer. Deselecting the other features within this dataset may make the point features clearer.



Determine whether there are any dams or weirs within 2 miles upstream or downstream of the PA. Check for other impoundment types by assessing aerial imagery. The fish passage barrier dataset discussed in V10 below may also contain data on impoundments. If users are aware of an unmapped impoundment within 2 miles of the PA, provide this information in the Assessment Notes section on the Cover Page tab and include these impoundments when answering the question.

Definitions of small versus large impoundments will vary depending on the size of the stream and local hydrology. A decision on whether the impoundment is small or large could be made using the following descriptions:

- **Small:** impound on average less than 30% of the total annual discharge, low profile (i.e., fish passable for the stream of interest, e.g., three feet or less), or span only a portion of the channel.
- **Large:** impound greater than 30% of the total annual discharge, generally are not fish passable, or span the entire channel.

For example, a run-of-river dam may be considered a small impoundment, whereas a flood control dam would be considered a large impoundment. Instream irrigation ponds may be considered either small or large impoundments, depending on size and amount of water impounded. If an impoundment is being operated for variable flow releases, it may still be considered a large impoundment if retaining greater than 30% of total annual discharge.

A majority of impoundments upstream will influence hydrology at the PA, especially if they are large impoundments. Impoundments downstream of the PA will only affect local hydrology if the impoundment backwaters the site (even temporarily during high flow events) or encourages sediment deposition at or just downstream of the PA that can aggrade the channel.

V10. Fish Passage Barriers

Are there man-made fish passage barriers within 2 miles upstream and/or downstream of the Project Area?

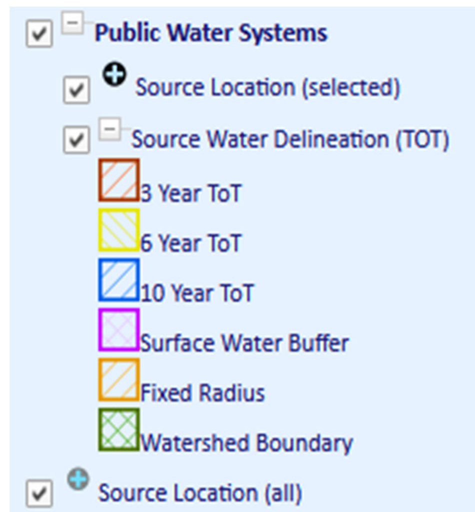
Informs MB and STS values.

Information on fish passage barriers in Idaho can be found in a GIS layer maintained by IDFG (https://data-idfggis.opendata.arcgis.com/datasets/9c52918f3a3645a586b1a93852c2bdb3/explore). Zoom to your site using the search bar or the zoom button at the right of the map. There is no scale bar on this online map viewer, so you may need to consult other online mapping sources that have scales and measuring tools (e.g., Google Earth™) to estimate 2 miles both upstream and downstream of the PA.

If there are any barriers within 2 miles upstream or downstream of the PA, click on the barrier in the map viewer to determine whether the blockage is complete, partial, or unknown. The blockage status is found in an attribute called BLOCKAGEEX. The available codes are 1 (complete blockage), 2 (partial blockage), or 99 (unknown). If there are multiple barriers, answer for the one with the most restricted level of passage (e.g., blocked). If qualified users are aware of unmapped fish passage barriers within 2 miles of the PA, provide this information in the Assessment Notes section on the Cover Page tab and include these barriers when answering the question.

V11. Water Source

Is there an area that is of special concern for drinking water sources within 2 miles downstream of the Project Area?
Informs SST, NC, and CR values.



The data for this value measure comes from two sources: IDEQ's Source Water Assessment and Protection GIS layer and EPA's Sole Source Aquifer GIS layer. The Source Water Assessment and Protection layer (https://mapcase.deq.idaho.gov/swa/default.html?SRCID=E0007305) includes the location of drinking water sources and groundwater and surface water areas that potentially contribute to those drinking water sources. After locating your PA on the map, using the Zoom In button or the search box, look for any of the following within 2 miles downstream of the PA: Source Location, 3 Year ToT (Time of Travel), 6 Year ToT, 10 Year ToT, or Surface Water Buffer.

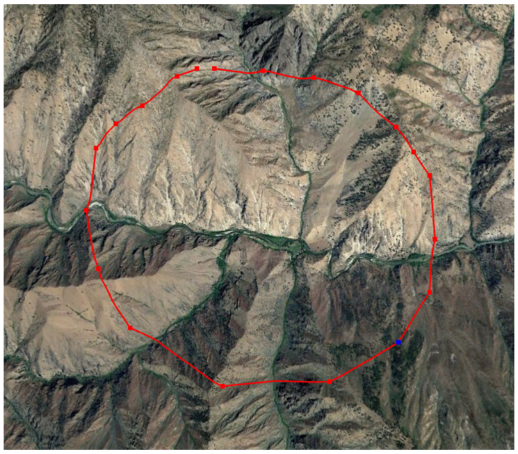
Use the Sole Source Aquifer layer (https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=9ebb047ba3ec41ada1877155fe31356b) to determine whether there are sole source aquifers within 2 miles downstream of the PA.

V12. Surrounding Land Cover

What are the land cover types surrounding the Project Area?
Informs MB and SST values.

The broad categories of land cover types (i.e., unmanaged vegetation, managed vegetation, and no vegetation) used for this value measure can generally be distinguished using aerial imagery (e.g., Google Earth™). A 2-mile diameter circle can be approximated in Google

Earth™ using the Path tool on the toolbar. Once a rough circle is drawn using a series of connected points, the "circle" can be adjusted by clicking on any of the nodes and dragging it to a new location. The path can be saved and then evaluated using the ruler to determine if the diameter is approximately 2 miles.



Once the circle is the correct size, visually estimate the proportion of each cover type within the circle and enter the amounts into the appropriate cell. Note that the values must sum to 100%.

V13. Riparian Continuity

What is the longitudinal extent of intact riparian area that is contiguous to the Project Area?

Informs MB, CMH, STS, NC, CR, and TR values.

Use aerial imagery (e.g., Google Earth™) to determine the longitudinal extent of intact riparian area that is contiguous to the PA in either the upstream or downstream direction, whichever is greater (but not including the PA itself) and whichever side of the stream has the greatest longitudinal extent. Intact refers to a riparian area with forest or otherwise unmanaged (i.e., natural) perennial cover appropriate for the basin that is at least 15 feet wide. Contiguous means there are no gaps greater than 100 feet in forested cover or unmanaged perennial cover. See **Figure 4.7**.

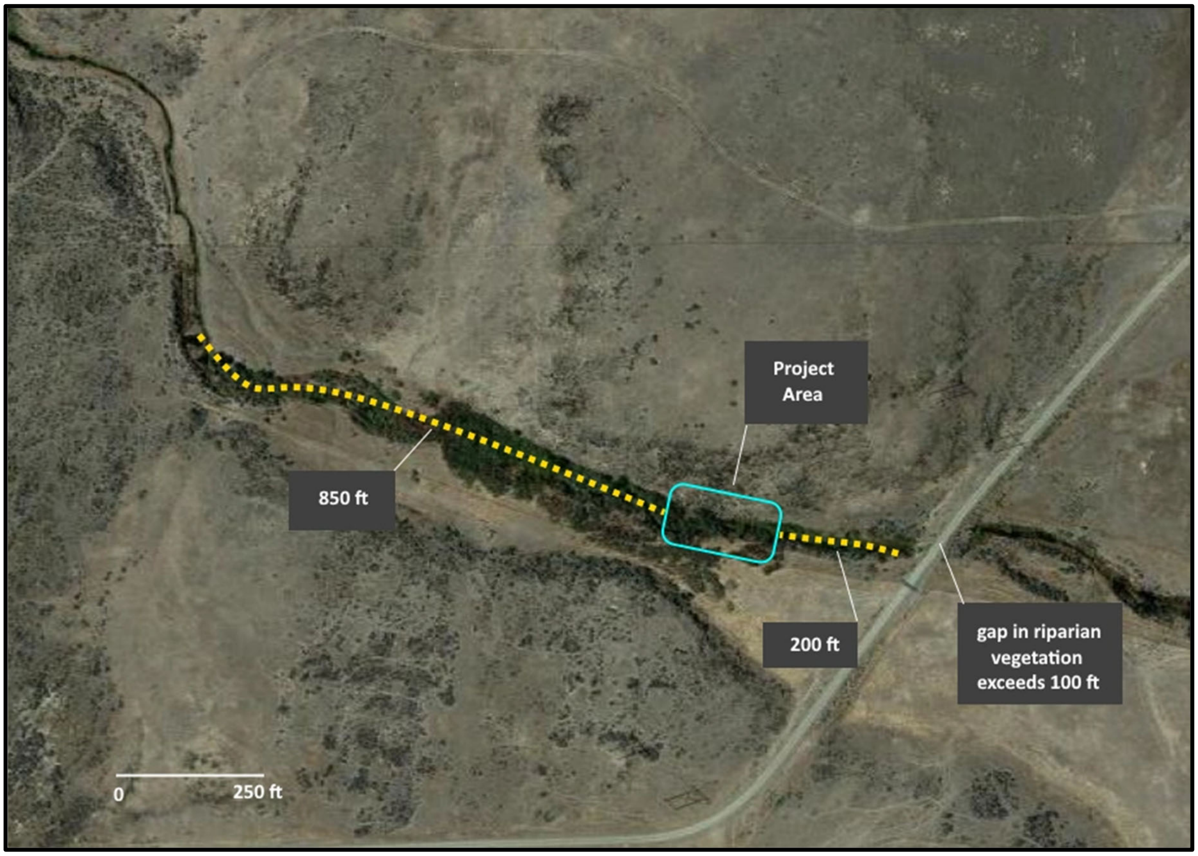


Figure 4.7. Example of an assessment for Riparian Continuity
Intact riparian vegetation extends 200 feet upstream of the PA (blue polygon) and extends 850 feet downstream of the PA.

V14. Watershed Position

What is the relative position of the Project Area in its HUC8 watershed?
Informs SC, NC, and CR values.

The PA's position in its watershed can be determined using the USGS National Map Viewer (https://apps.nationalmap.gov/viewer/). After locating your approximate project area, select the National Hydrography Dataset and Watershed Boundary Dataset layers from the layer list. Zoom out to an extent that allows you to view the entirety of the HUC8. Determine which end of the HUC is the "bottom" by looking at the direction of the "V" formed where streams join. The "V" points toward the bottom of the watershed.

- If the PA is (a) closer to the watershed's outlet than its upper end and (b) closer to the large stream/river exiting the watershed's outlet than it is to the boundary of the watershed, select "lower 1/3."
- If the PA is (a) closer to the watershed's upper end than its outlet and (b) closer to the watershed's boundary than its large stream/river, select "upper 1/3."
- If neither of the above conditions are met, select "middle 1/3."

V15. Flow Restoration Needs

Is the PA on a stream reach listed as a Protected Water or Minimum Flow water by

the Idaho Department of Water Resources?
Informs FV and CMH values.

The information for this value measure can be found in three datasets: Minimum Stream Flow, National Wild and Scenic Rivers System, and Aquifer Recharge District Maps. The Minimum Stream Flow dataset (https://gis.idwr.idaho.gov/portal/home/webmap/viewer.html?useExisting=1&layers=28d7ff1b24744ea79630a70a017b4aaa) identifies stream reaches with designated minimum stream flows necessary to preserve desired stream values, including fish and wildlife habitat, aquatic life, navigation and transportation, recreation, water quality, and aesthetic beauty, as provided for in Idaho Code (Title 42, Chapter 15). The National Wild and Scenic Rivers System dataset (https://www.rivers.gov/idaho.php) includes approximately 900 miles of Idaho rivers designated under the Wild and Scenic Rivers Act created by Congress in 1968. The Aquifer Recharge District Map (https://idwr.idaho.gov/water-rights/aquifer-recharge-districts/map/) shows the boundaries of approved aquifer recharge districts. At the present time, there is only one active recharge district, in the Lower Snake River watershed. Additional information about hydrologic projects that might involve aquifer recharge can be found at https://idwr.idaho.gov/water-data/projects/.

4.5 Conduct Preliminary Assessment of Field Measures

One value measure (Unique Habitat Features) and five function measures (Vegetated Riparian Corridor Width, Exclusion, Fish Passage Barriers, Side Channels, and Lateral Migration) benefit from a preliminary estimate in the office that is later confirmed in the field. Instructions for preliminary office estimates are provided below, and information for confirming the answers in the field is provided in **Section 5**.

V16. Unique Habitat Features

Are there rare aquatic habitat features within the EAA that are not common to the rest of the drainage area?
Informs SM, MB, CMH, and TR values.

This question must be answered in the field, but the user can check for any mapped wetlands, seeps, springs, and tributaries that could potentially contribute colder water in the EAA and in the drainage area using available datasets. The presence of log jams and/or braided or multiple channels can be assessed visually using aerial imagery.

To determine if there are wetlands in the floodplain, consult the National Wetlands Inventory mapper (https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/). If there are wetlands within the EAA, you can assess whether they comprise 30% or more of the floodplain using the floodplain data source described above in the V6 section.

Identifying waterbodies that could contribute colder water is important if the stream reach within your EAA is listed as impaired because of elevated temperature. Such impaired waterbodies can be identified using IDEQ's water quality mapping tool, as described above in the V2 section. Check for tributaries entering the EAA by using the National Hydrography Dataset described above in the V14 section. Since not all aquatic habitat has been mapped, look for tributaries, seeps, or springs entering the EAA in the field. Whether those contributing waterbodies are cooler than the assessment reach will need to be determined in the field.

F5. Vegetated Riparian Corridor Width

What is the average width of the vegetated riparian corridor within the PAA?
Informs NC and CR functions.

An intact vegetated riparian corridor is defined as one typified by largely undisturbed ground cover and dominated by "natural" species. Natural does not necessarily mean pristine and can include both upland plants and species with wetland indicator status, and native and non-native species. Natural does not include pasture or cropland, recreational fields, recently harvested forest, pavement, bare soil, gravel pits, or dirt roads. Note that relatively small features, such as a narrow walking trail, that likely have negligible effects on water quality can be included within the vegetated riparian corridor width.

In the office, use aerial imagery to estimate the average vegetated riparian corridor width of both sides of the channel within the PAA, up to a maximum distance of 330 feet from the bankfull edge. These data can then be entered into the PAA Field Form worksheet and verified during the field visit.

F6. Fish Passage Barriers

Is there a man-made fish passage barrier in the PAA?
Informs MB and CMH functions.

Select an answer from the drop-down menu in the PAA Field Form worksheet. Man-made barriers to fish passage can include structures such as dams, culverts, weirs/sills, tide gates, bridges and fords that can block physical passage or can create unsuitable conditions for passage (e.g., high velocity). The level of passage provided can first be researched in the office using the data source described above in V10 (**Section 4.4**), then confirmed in the field. Do not include natural barriers. If more than one barrier is present, answer for the one with the most restricted level of passage (e.g., blocked).

F7. Floodplain Exclusion

What percent of the floodplain has been disconnected within the PAA?
Informs SWS and CMH functions.

For alluvial rivers, the floodplain is defined by a distinct break in slope at valley margins, a change in geologic character from alluvium to other, indications of historical channel alignments within a valley, or as 100-year flood limit. See more information on this measure in **Section 5**.

Steps in the office

1. Determine floodplain extent by looking at topography maps, FEMA flood maps, hydraulic model outputs, or a combination of these resources. It may, however, only be possible to evaluate small streams and/or streams with heavy cover while in the field.
2. Estimate the floodplain area within the PAA.

3. Identify elements that would disconnect the floodplain from the river or stream.
4. Estimate the amount of floodplain area within the PAA that is likely disconnected and record on the PAA Field Form.
5. Confirm estimates in the field.

F12. Side Channels

What proportion of the EAA length has side channels?
Informs SWS, SST, MB, and CMH functions.

Side channels include all open conveyances of water, even if the channel is plugged (i.e., there is no above-ground flow to/from the main channel) on one end. If both ends are plugged, do not count as a side channel. See more information on this measure in **Section 5**.

Steps in the office

1. Determine floodplain extent by looking at the local topography, FEMA flood maps, aerial imagery during the time of the year with higher flows, local knowledge, or a combination of these resources. It may only be possible to evaluate small streams and streams with heavy cover while in the field.
2. Using these resources, evaluate the floodplain and determine whether side channels are present in the EAA.
3. Mark the approximate location of the start and end points of each side channel on the Site Map.
4. Confirm the presence of side channels in the field following the directions for F12 in **Section 5.**
5. Once back in the office, transfer the data into the EAA Field Form worksheet and the percent of the EAA length with side channels will be calculated:

   (sum of side channel lengths ÷ mainstem length) × 100

F13. Lateral Migration

What percent of both sides of the channel is constrained from lateral migration?
Informs SC function.

Constraints on lateral migration of the channel within 2x BFW or 50 feet (whichever is greater) includes bank stabilization and armoring, bridges and culverts, diversions, roads paralleling the stream and any other intentional structures or features that limit lateral channel movement whether intentionally or not. For cross-channel structures (diversions, bridges, culverts, etc.), record 4x the BFW as the length constrained on both sides of the channel. For linear features, record the length on each side of the channel. For segmented bank features, such as bendway weirs or log jams acting in concert, record the effective length of stabilization on each side of the channel affected. It is acceptable to include relevant armoring that is recorded in the Bank Armoring question. See more information on this measure in **Section 5**.

In the office, use aerial imagery to identify and map all constraints to lateral migration as defined above on both sides of the channel within the EAA, up to a maximum distance of 330 feet from the bankfull edge.

5 Field Component Instructions

The field component of an SFAM assessment uses direct onsite measurements and observations to generate scores for the ecological functions provided by the site.

The field component involves visiting as much of the site as is safely and legally possible, and then filling out the field forms and verifying, as needed, responses from the office component. If you cannot access the entire assessment area, you must rely more on aerial imagery, maps, other office information, field indicators, and discussions with the landowner and other knowledgeable sources.

The field component of SFAM is designed to be completed by two people in approximately one day (not including travel to and from the site). More time may be needed for large projects or projects that include multiple streams.

In addition to the detailed instructions below, an "Order of Operations" quick-reference list has been developed to guide your work in the field by providing the basic order of data collection steps (**Appendix 1**).

5.1 Preparation for Site Visit

Schedule the field visit at a time best suited for data collection. The wet season is the recommended time to conduct an assessment, preferably after significant flow events that will leave signs of the extent of high water across the site but not during a high flow event that could prevent data collection efforts. However, the assessment may be conducted at any time of year. If possible, visit the PA at least once during the driest time of the year and once during the wet season.

Download and Print:

1. The Site Layout Field Form, PAA Field Form, and the EAA Field Form from the Excel Workbook; and
2. Plant lists and references, including **Appendix 4**, Plant Species Considered Invasive in Idaho. A useful field guide for invasive plant species is Idaho's Noxious Weeds (10th edition), published by the University of Idaho Extension.
3. You may also want to print the StreamStats Report, as well as the list of questions from the office component that require confirmation in the field.

Assemble the equipment and gear listed in **Table 5.1.**

Table 5.1. SFAM Field Equipment and Gear

Required	**Equipment**
	Calculator
	Camera
	Clinometer
	Densiometer
	Field tape measures (3) (U.S. customary units; at least one 300 feet in length)
	Flagging tape
	GPS
	Measuring stick(s) (a pole or wading staff with marked increments in decimal feet works very well; recommend 5 feet in length)
	Stadia rod(s) (recommend 25 feet in length; 16 or 18 feet will also work)
	Stake flags (11) (optionally marked from 1-11 or A-K)
	Documents
	Site Map
	A hard copy of the following forms from the SFAM Workbook: • **Site Layout Field Form** • **PAA Field Form** • **EAA Field Form**
	Aerial image of the assessment area that includes the floodplain and riparian corridor
	Gear
	Clipboard
	Writing instruments
	Waders
	Safety gear (lifejacket, first aid kit, cell phone, etc.)
Optional	Plant lists and references
	Laptop with SFAM Excel Workbook
	Laser rangefinder (recommended for non-wadeable streams or sites with large Project Areas)
	Raingear
	Right-angle level or a tube to aid in determining overhead riparian cover along transects

5.2 Preliminary Reconnaissance

Once at the site, walk the entire site. Identify boundaries delineated on the Site Map and explore any concerns you have about site accessibility. Exploring a site, including the floodplain with accessible terrain, could take one to three hours. There are specific site attributes that should also be identified during the preliminary reconnaissance, such as fish passage barriers (F6) and evidence of overbank flow (F10). Instructions for evaluating site attributes that may have been identified during the preliminary reconnaissance are provided in subsections below for each function.

5.3 Locate Assessment Area Boundaries and Collect Data

The first step towards evaluating field measures is to locate assessment area boundaries and transects. The length and distance between each transect varies with the size of the site, as described below.

Tip: *As you walk through the site to set up the assessment areas, it might be helpful to have Global Positioning System (GPS) coordinates of the corners of the PAA and EAA. In addition, tagging GPS coordinates and flagging each of the transect locations could facilitate data collection efforts.*

Tip: *The left and right banks of a stream are identified by looking downstream.*

Tip: *Photos of the assessment areas are highly recommended. Photos taken at the PA mid-point from the center of the stream looking both upstream and downstream are helpful. If a larger stream or PA is being assessed, additional photos showing the riparian area, the PAA, and EAA, are recommended.*

The steps for identifying assessment area boundaries are as follows:

Step 1. Lay out the Proximal Assessment Area (PAA):

a. Identify the PA boundaries. The PA is the spatial extent of direct impact (e.g., removal, fill, grading, planting, etc.) that a project (e.g., permitted action, mitigation, restoration) will have on a stream and surrounding area. For example, a hypothetical restoration project plans to plant willow along 100 feet of streambank, including area on both sides of the stream (**Figure 5.1, panel a**). In a different example, a hypothetical development project plans to construct a pipeline across the stream, which will create a strip of ground disturbance 20 feet wide (**Figure 5.1, panel b**). Projects with multiple areas of impact that are part of a larger project should be considered one PA under most circumstances. Refer to **Section 3.5** for additional guidance.

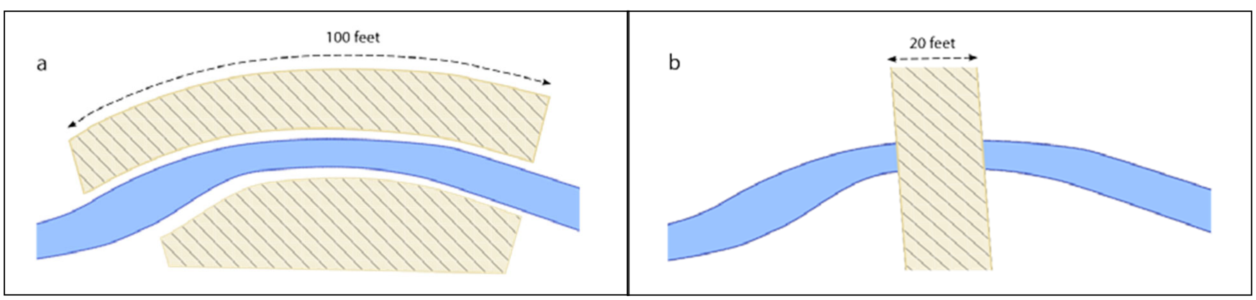
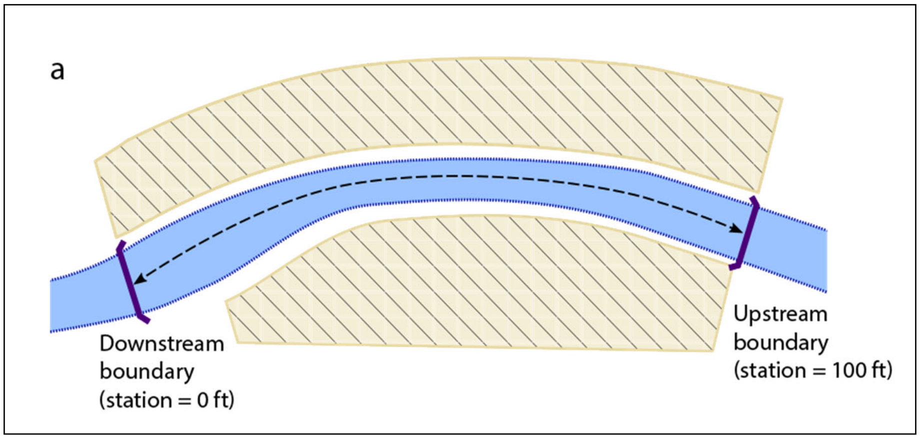


Figure 5.1. Example Project Areas

b. Identify the upstream and downstream (i.e., longitudinal) boundaries of the PAA. The PAA longitudinal boundaries are at the upstream and downstream extent of the PA, or 50 feet of stream length centered on the PA, whichever is the greater stream length (**Figure 5.2**).



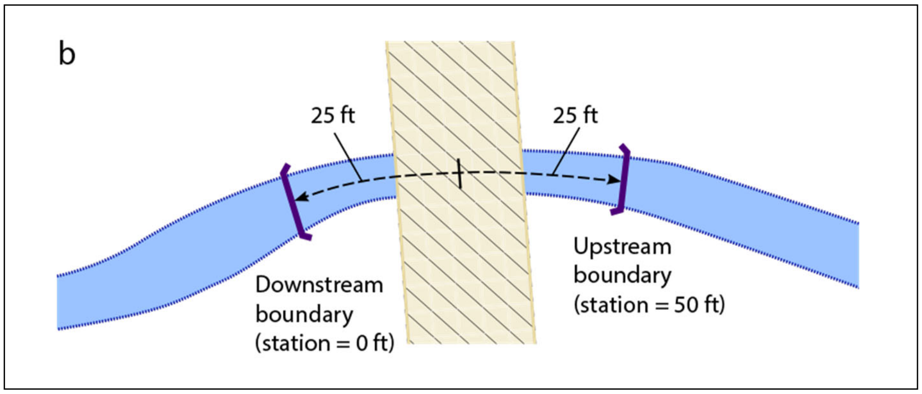


Figure 5.2. Longitudinal extent of Proximal Assessment Area

c. Using a measuring tape, locate the center of the PAA and measure the bankfull channel width (BFW) ("BFW 2" in **Figure 5.3**).

d. At two additional locations ("BFW 1" and "BFW 3" in **Figure 5.3**) equidistant between the PAA center and the PAA upstream and downstream boundaries, measure BFW. Flag all three of the locations where you measured BFW as these are also the locations of the three transects you will establish to collect data in the PAA.

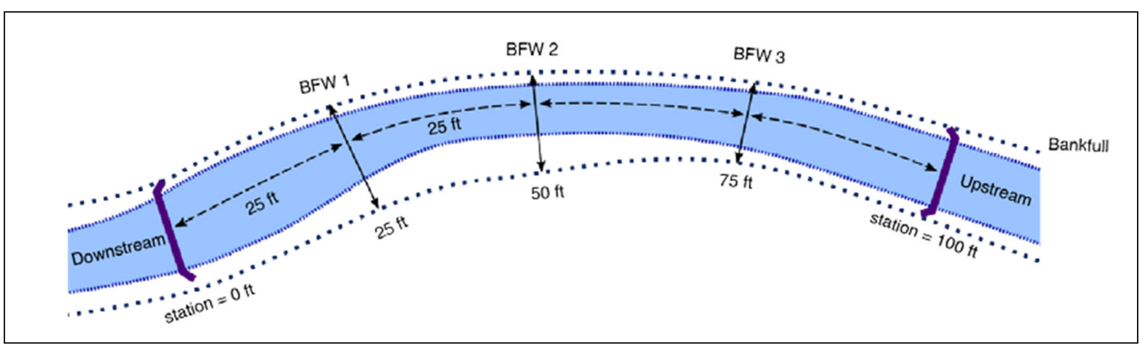


Figure 5.3. Bankfull width measurements for a hypothetical 100-foot PA.

e. Locate the lateral boundaries of the PAA at a distance of 2 × the average BFW or 50 feet from the stream edge (bankfull edge), whichever is greater, on each side of the stream (**Figure 5.4**).

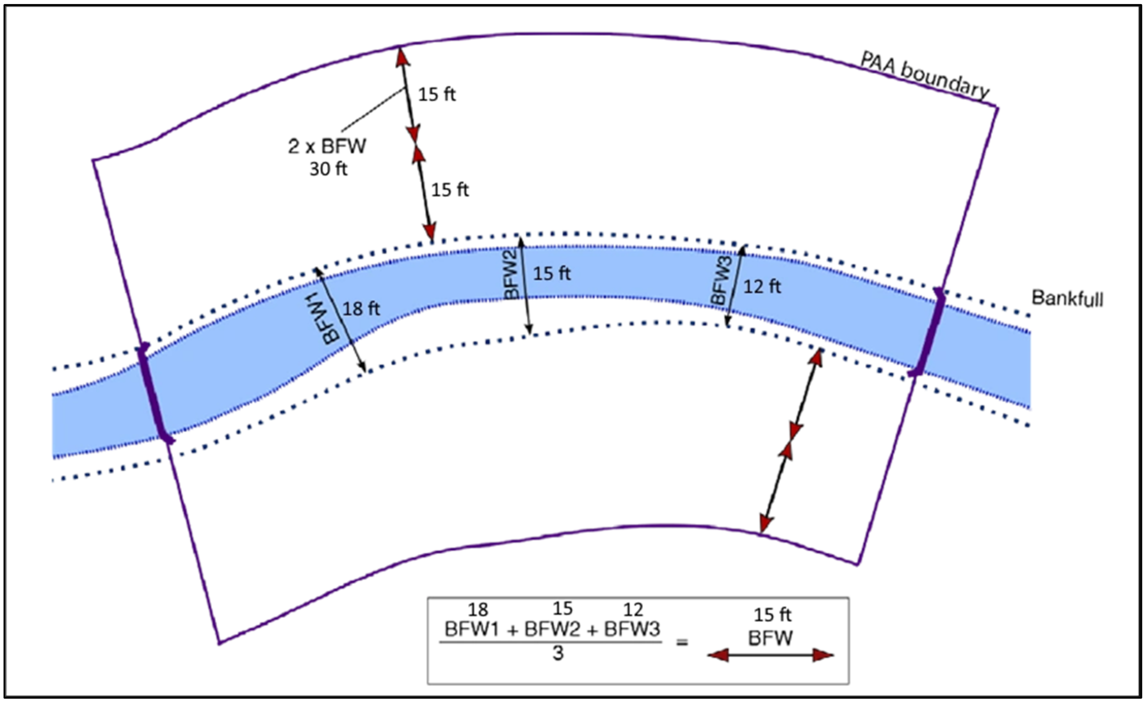


Figure 5.4. Lateral extent of the Proximal Assessment Area

Step 2. Collect Proximal Assessment Area Data

a. Complete transect assessments at the three locations where BFW measurements were made and collect data on:

- Natural Cover (Cover, F1)
- Invasive Vegetation (InvVeg, F2)
- Native Woody Vegetation (WoodyVeg, F3)
- Large Trees (LgTree, F4)
- Vegetated Riparian Corridor Width (RipWidth, F5)

The three plant composition measures (Invasive Vegetation, Native Woody Vegetation, and Large Trees) can be assessed simultaneously.

b. Confirm the presence/absence of features that were preliminarily identified in the office for the following:

- Fish Passage Barriers (Barriers, F6)
- Exclusion (Exclusion, F7)

c. Complete longitudinal assessments by laying a measuring tape from the downstream to upstream boundaries of the PAA and record the start and stop locations of each of the following:

- Bank Armoring (Armor, F8)
- Bank Erosion (Erosion, F9)
- Overbank Flow (OBFlow, F10)
- Wetland Vegetation (WetVeg, F11)

Additional details on how the data for each function are to be collected and recorded in the PAA Field Form are provided later in this section.

Figure 5.5 shows the locations for data collection in the PAA.

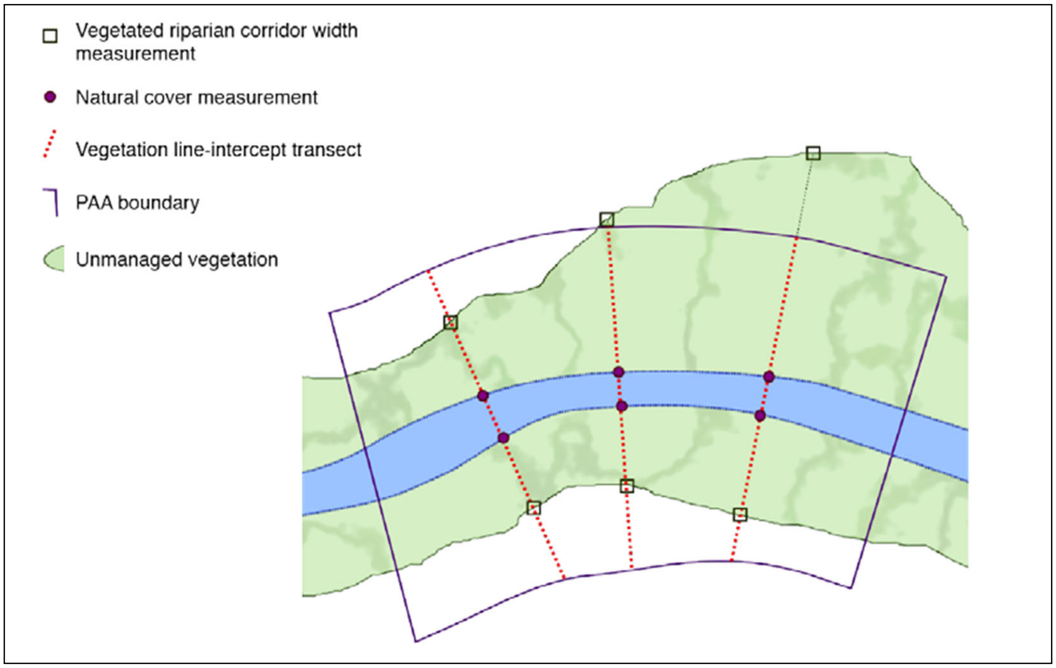


Figure 5.5. Measurements collected for the Proximal Assessment Area.

Vegetated Riparian Corridor Width and Natural Cover are measured at specific locations in the PAA (dark green squares and red circles, respectively). Invasive Vegetation, Native Woody Vegetation, and Large Trees are all measured along set line-intercept transects (red dashed lines). The longitudinal features (Barriers, Exclusion, Armoring, Erosion, Overbank Flow, and Wetland Vegetation) are not measured at specific locations rather, they are documented wherever they occur within the PAA.

Step 3. Lay out the Extended Assessment Area

a. Locate the upstream and downstream EAA boundaries by multiplying the average BFW by 5 and measuring that distance upstream and downstream from the PAA upper and lower boundaries, respectively (**Figure 5.6**).

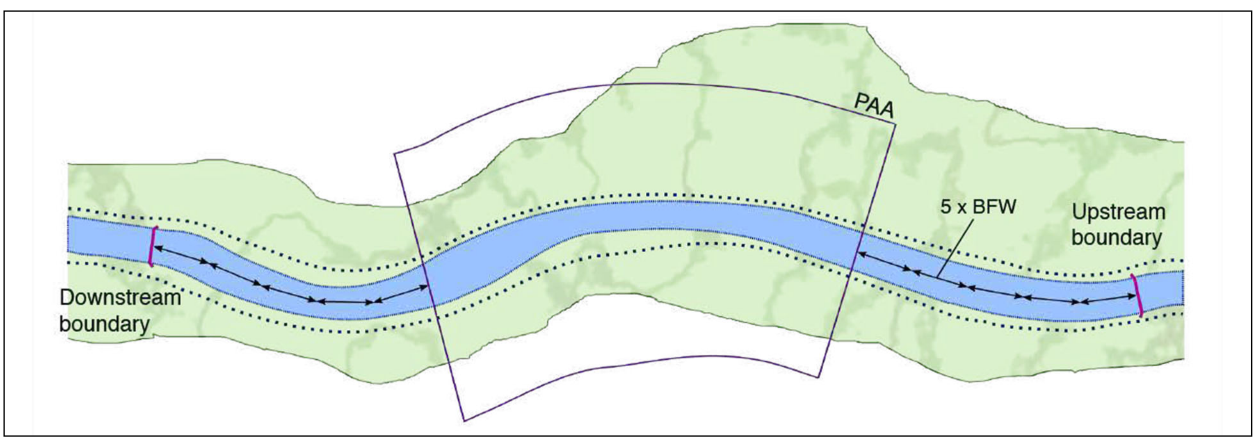


Figure 5.6 Longitudinal extent of Extended Assessment Area

b. Locate the lateral boundaries of the EAA. They are the same distance from the stream edge (bankfull) as for the PAA above (i.e., 2 × the average BFW or 50 feet, whichever is greater). Note that the EAA contains the entire PAA (i.e., the PAA is part of the EAA) (**Figure 5.7**).

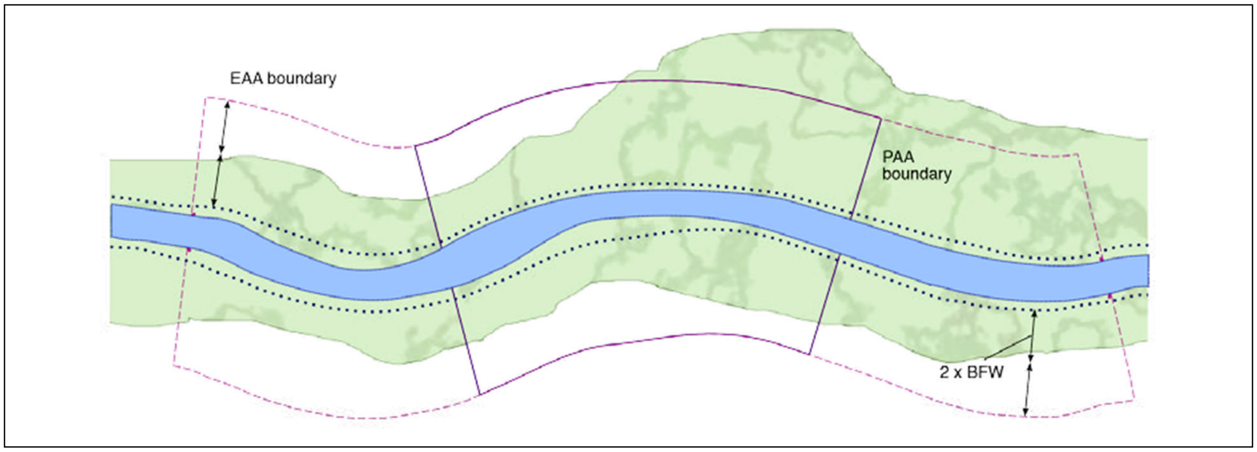


Figure 5.7. Lateral extent of the Extended Assessment Area

c. Locate 11 EAA transect locations by dividing the total EAA length by 10. The distance between each transect is 0.1 × the total EAA length. Include the downstream and upstream EAA boundaries. The location of each transect should be identified using a tape measure and flagged. For example, if the total EAA length is 250 feet, the first transect is at the EAA downstream boundary, the second is 25 feet upstream from the lower boundary, and so forth. The 11th and final transect is at the upstream EAA boundary (**Figure 5.8**).

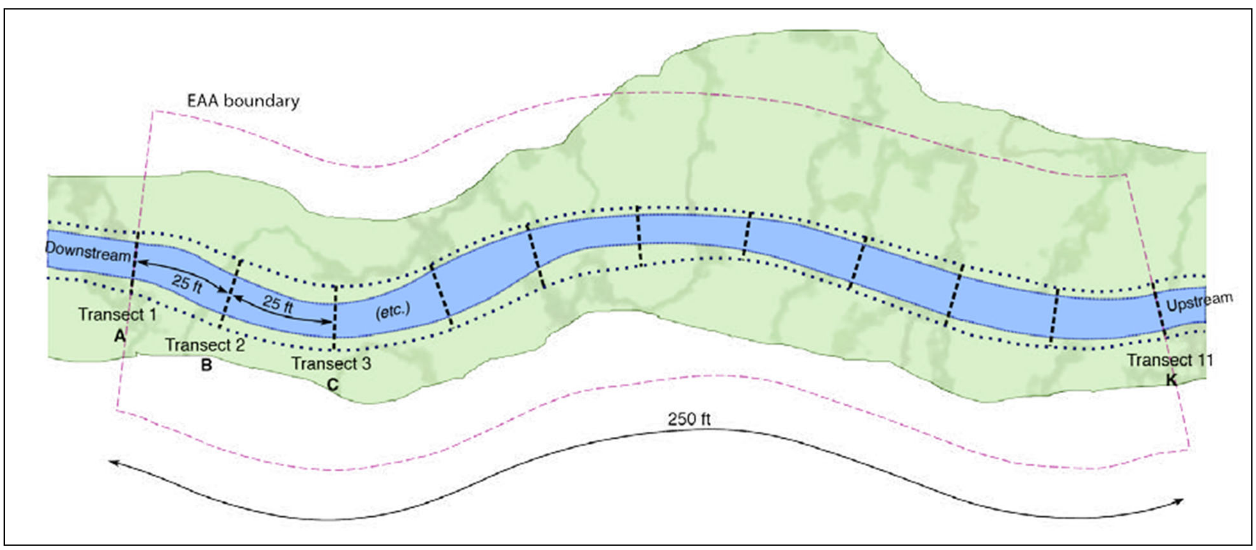


Figure 5.8. Locate Extended Assessment Area transects

In this example, the total EAA length is 250 feet so the distance between the 11 EAA transects is 25 feet.

Step 4. Collect Extended Assessment Area Data

a. Beginning at the downstream end of the EAA (i.e., "Transect A"), and at each subsequent EAA transect, record measurements on the EAA Field Form for:

- Incision (Incision, F15)
- Embeddedness (Embed, F16)
- Channel Bed Variability (BedVar, F17) – wetted width

b. While moving between transects, record nine evenly spaced measurements for:

- Channel Bed Variability (BedVar, F17) – thalweg depth

Tip: *Thalweg depth is measured on each of the 11 transects and at nine equidistant points between each transect for a total of 100 measurements.*

c. While moving from the downstream end of the EAA to its upstream end, record observations and measurements for:

- Side Channels (SideChan, F12)
- Lateral Migration (LatMigr, F13)
- Wood (Wood, F14)

Figure 5.9 shows the locations for data collection in the EAA.

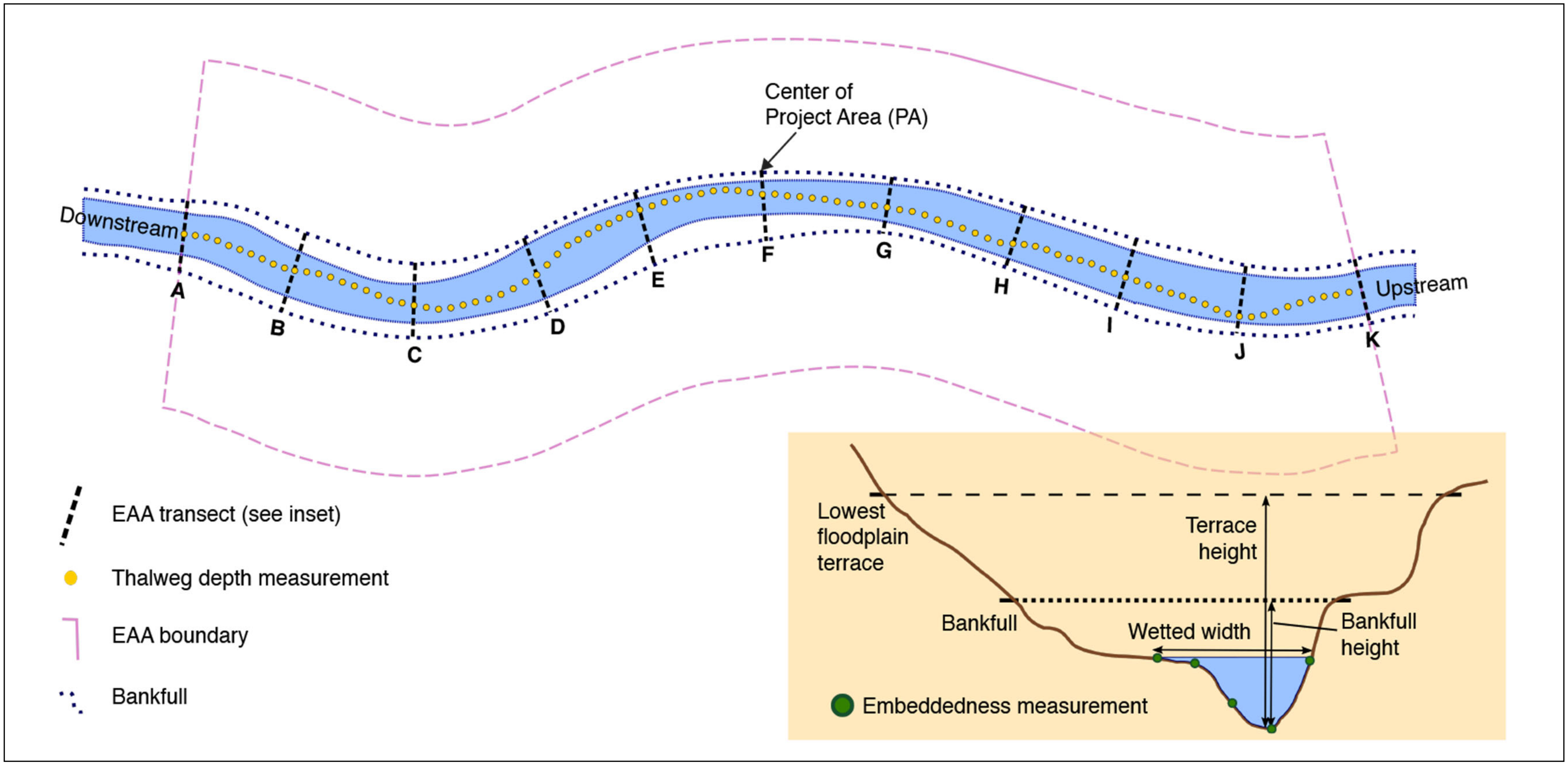


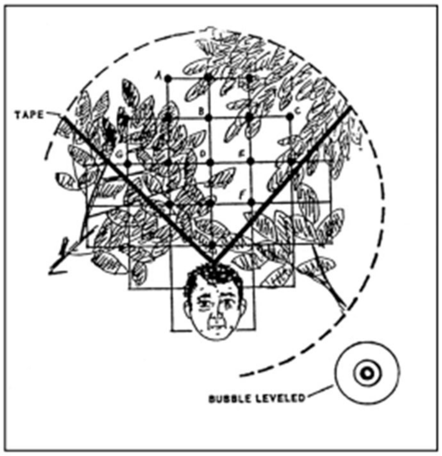
Figure 5.9. Measurements collected for the EAA.

Incision (i.e., bankfull height and terrace height), Embeddedness, and Channel Bed Variability (i.e., wetted width and thalweg depth) are measured at specific locations along or between each transect in the EAA. The longitudinal features (Side Channels, Lateral Migration, and Wood) are not measured at specific locations, rather, they are documented wherever they occur within the Extended Assessment Area.

F1. Natural Cover

What is the percent natural cover above the stream within the PAA?
Informs STS, NC, and TR functions.

Measure the percentage of cover above the stream, including overstory and understory vegetation, and overhanging banks, by averaging spherical densiometer measurements taken at each transect within the PAA.



Use a spherical densiometer (model A convex type) (Lemmon 1957). Mark the densiometer with a permanent marker or tape exactly as shown in **Figure 5.10** to limit the number of square grid intersections read to 17. Densiometer readings can range from 0 (no canopy cover) to 17 (maximum canopy cover). Obtain two measurements at each cross-section transect, at the water's edge nearest each bank, for a total of six measurements.

Figure 5.10. Densiometer markings.

From Mulvey et al., 1992 as used in USEPA 2013. Note the positioning with the bubble level and face reflected in the apex of the "V". In this example, 10 of 17 intersections (all but A through G) are covered with canopy, giving a densiometer reading of 10.

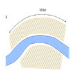
Directions

1. While at the water's edge and facing the streambank, hold the densiometer level (using the bubble level) 1 foot above the water surface with your face reflected just below the apex of the taped "V", as shown in **Figure 5.10**. Concentrate on the 17 points of grid intersection on the densiometer that lie within the taped "V". If the reflection of a tree, branch, leaf, overhanging root, or part of the bank itself overlies any of the intersection points, that particular intersection is counted as having cover. Do not count cover by artificial structures. However, do not shift measurement locations to avoid artificial structures.

2. For each of the six measurement locations (i.e., left and right banks for three transects), record the number of intersection points (maximum=17) that are covered by vegetation or banks. If measurements are being taken in winter when leaves of deciduous woody vegetation are not fully expressed, count all grid intersections that lie within the branches of the woody vegetation (i.e., zone of influence).

3. Enter the data on the PAA Field Form. Once back in the office, transfer the data into the PAA Field Form worksheet and the average percent natural cover will be calculated.

Dry Channels – For dry channel assessments, the cover measure is taken at the left and right margins (toe of bank) of the streambed (at 1-foot height) rather than at the water's edge.



Undercut Banks – Cover provided by the streambank is included in this measure. If the densiometer can be physically placed at the normal 1-foot elevation under the bank at stream edge, then that is where the measure is taken. If the densiometer cannot be placed under the cut bank due to problems with access, then take the measurement over the water as close to the water's edge as possible.

Crossings - The percent natural cover for any measurement location that occurs under a bridge or in a culvert (or under any other 'non-natural' structure) can be assumed to be 0. Therefore, the data entry for the densiometer reading at that location will be 0.0.

F2, F3, F4. Invasive Vegetation, Native Woody Vegetation, & Large Trees

What is the percent cover of: a) Invasive Vegetation, b) Native Woody Vegetation, and c) Large Trees?

Informs MB, STS, and CMH functions.

Conduct a line-intercept survey[2] along each of the three transects in the PAA to evaluate riparian vegetation composition. This method will be used to collect data for three functional groups of vegetation (rather than recording plants to species): invasive vegetation, native woody vegetation, and large trees (only those trees with a diameter at breast height [DBH] greater than 20 inches).

Note that cover from large, native trees will be counted twice; once as native woody vegetation and once as large trees. If vegetation is dead but expected to regrow (e.g., dormant perennial vegetation or recently sprayed vegetation that is likely to regrow) then it should be counted.

Directions

1. Extend a tape measure along the transect. Vegetation transects begin at the bankfull boundary and extend perpendicular away from the stream channel to the lateral boundary of the PAA (2 × BFW), on each side of the stream channel.
2. Walking along the transect, observe where vegetation intercepts the tape. These points of interception are typically called "starts" (when you enter into a plant's cover) and "stops" (when you emerge from cover). Record all "start" and "stop" interceptions using 0.1-foot precision for three vegetation functional groups: invasive vegetation, native woody vegetation, and large trees (DBH > 20 inches). Reference **Appendix 4** (Plant Species Considered Invasive in Idaho) for guidance. Note that different functional groups may overlap: a given location along the line may intersect cover from native woody vegetation, large trees, and invasive vegetation.

[2] Instructions and diagrams for completing a line-transect survey are taken from http://oregonstate.edu/instruct/bot440/wilsomar/Content/HTM-perarea.htm#Intercept

Calculations for the line-intercept method are illustrated in **Figure 5.11**. In this example, the transect line extends 75 feet from bankfull to the PAA boundary, and the points of interception with relevant riparian vegetation are from 12 feet to 29 feet, and from 51 feet to 75 feet where the transect ends. Cover beyond the end of the PAA is not included.

The extent of vegetation cover is based on “zone of influence” rather than the location of individual leaves or stems (**Figure 5.12**). To assess tree canopy interception, look directly upwards, perpendicular to the measuring tape. Using this method, a "start" is when the line enters the zone and a "stop" is when the line emerges from the zone. If a building or other man-made structure occurs along the transect, it is not considered cover. Move past the structure and continue collecting transect data on the opposite side of the structure to the end of the transect.

3. Repeat this process at each of the three PAA transects.

4. Enter the start/stop information into the PAA Field Form. Once back in the office, transfer this data into the PAA Field Form worksheet and the average percent cover for each functional group will be calculated:

(total length of cover for the functional group/total length of all transects) × 100

Collecting data for this measure is best done with two people: one estimating extent of vegetation cover and one recording results on the datasheet.

Scope out which trees fall in the “large tree” category before starting the transect. Ensure you are sighting “straight up” - perpendicular to the tape. A right-angle level or a tube that one person looks through while the other ensures it is vertical are helpful aids.

DBH refers to the tree diameter measured at 4.5 feet above the ground. DBH can be measured quickly with a flexible measuring tape wrapped around the circumference of the tree at this height. If using a metal measuring tape, a “large tree” will have a circumference > 62.8 inches at breast height.

Sites with Limited Access - *For sites where accessing the other side of the stream is not feasible, limit the transects to a single side.*

Crossings - *These should be evaluated as described even if the transect falls on top of a road. This may result in 0% cover in any/all of the vegetation categories.*

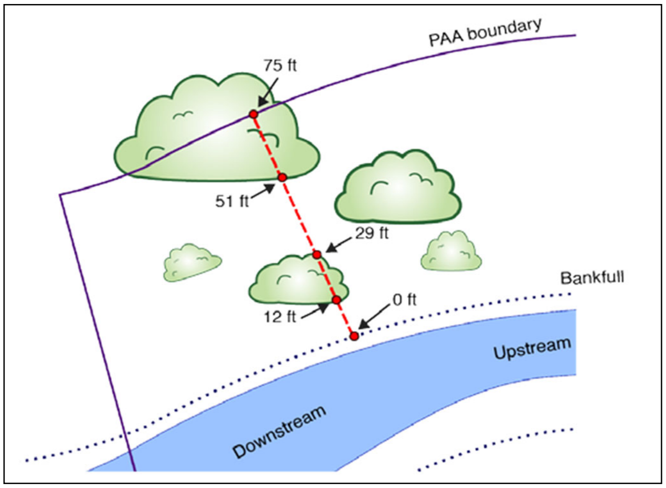


Figure 5.11. Overhead view of example line-intercept transect.
The red dashed line shows the location of Transect 1 on the right bank measuring riparian vegetation as Invasive Vegetation (not Weeds), Native Woody Vegetation, and/or Large Trees.

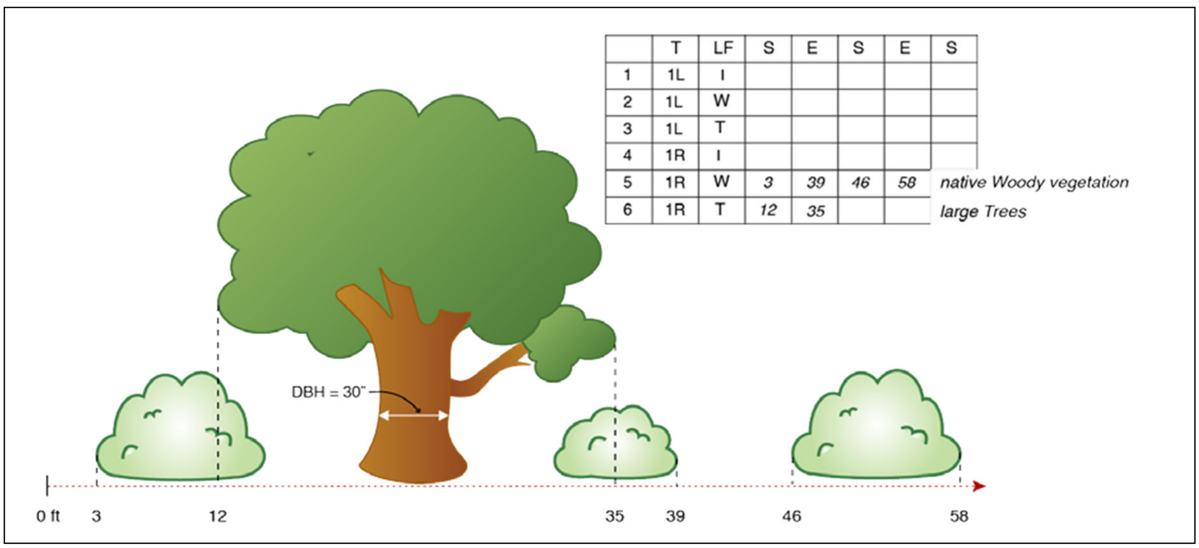


Figure 5.12. Side view of a line-intercept transect.
The red-dashed line represents the transect, and the associated recorded measurements are shown on the field datasheet (inset). Because the Native Woody Vegetation category ("W" in the field datasheet) includes both shrubs and trees, here the transect intercepts Native Woody Vegetation continuously between 3 feet and 39 feet, but intercepts Large Trees ("T" in the field datasheet) only between 12 feet and 35 feet.

F5. Vegetated Riparian Corridor Width

How wide is the vegetated riparian corridor throughout the PAA?

Informs NC and CR functions.

Vegetated riparian corridor is defined as one typified by largely undisturbed ground cover and dominated by "natural" species. Natural does not necessarily mean pristine and can include both upland plants and species with wetland indicator status, and native and non-native species. Natural does not include pasture or cropland, recreational fields, recently harvested forest, pavement, bare soil, gravel pits, or dirt roads. Note that relatively small features, such as a narrow walking trail, that likely have negligible effects on water quality can be included within the riparian corridor width.

Directions

1. Estimate the answer to this question in the office prior to field visit if possible. Riparian corridor extent can be estimated by looking at aerial imagery, but should be confirmed in the field.
2. At each PAA transect, record the width of the riparian corridor in feet, up to a maximum possible distance of 330 feet from the bankfull edge (**Figure 5.13**). Use aerial imagery to look for vegetation breaks if onsite measurements are not possible.
3. Enter the values on the PAA Field Form. Once back in the office, transfer the data into the PAA Field Form worksheet and the average width will be calculated.

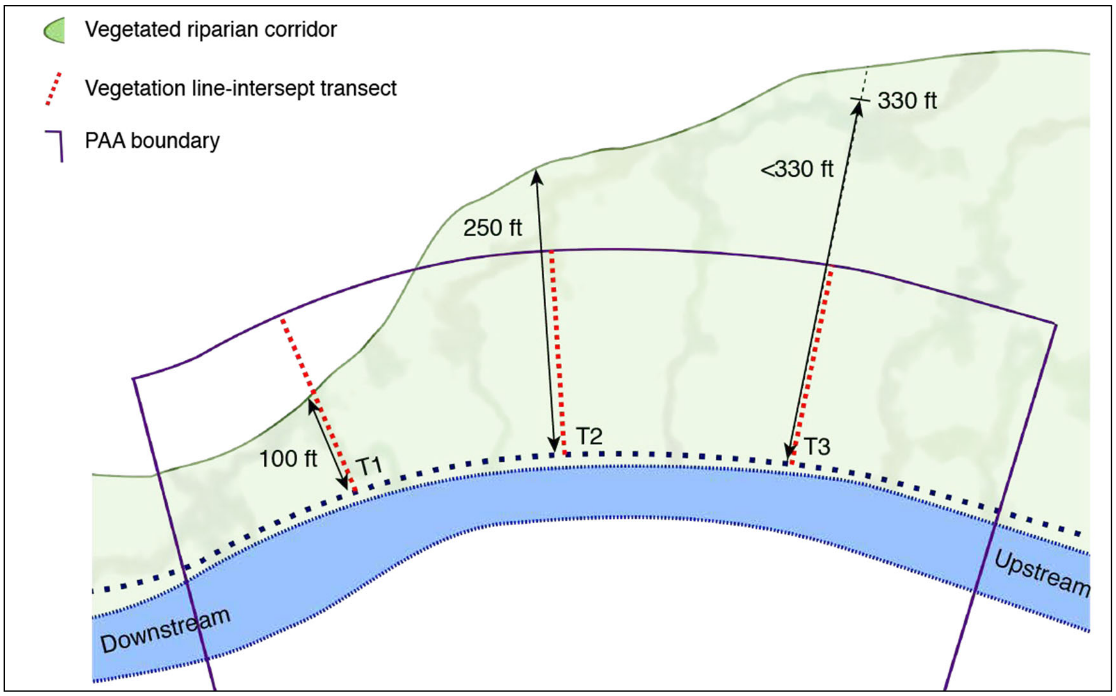


Figure 5.13. Vegetated Riparian Corridor Width measurements.
Note that vegetated riparian corridor widths may be greater than the lateral extent of the PAA (T2, T3), but are not measured beyond 330 feet (T3) for the purposes of SFAM.

Sites with Limited Access - *For sites where accessing the other side of the stream is not feasible, limit the field data collection along transects to a single side. Use aerial imagery to estimate width on the other side.*

Proximal Assessment Area (PAA) – Longitudinal Survey

Assess the following measures throughout the entirety of the PAA.

F6. Fish Passage Barriers

Is there a man-made fish passage barrier in the PAA?

Informs MB and CMH functions.

Select an answer from the drop-down menu in the PAA Field Form (Blocked, Partial, None/Unknown). Man-made barriers to fish passage can include structures such as dams, culverts, weirs/sills, tide gates, bridges and fords that can block physical passage or can create unsuitable conditions for passage (e.g., high velocity). The level of passage provided can first be researched in the office, as previously described in V10 (**Section 4.4**), then confirmed in the field. Do not include natural barriers. If more than one barrier is present, answer for the one with the most restricted level of passage (e.g., blocked).

F7. Floodplain Exclusion

What percent of the floodplain area has been disconnected within the PAA?
Informs SWS and CMH functions.

For alluvial rivers, the floodplain is defined by a distinct break in slope at valley margins, a change in geologic character from alluvium to other, indications of historical channel alignments within a valley, or as the 100-year flood limit.

Disconnection refers to any portion of the floodplain area no longer inundated due to levees, channel entrenchment, roads or railroad grades, or other structures (including buildings and any associated fill) within the PAA. All barriers should be included when estimating disconnection, even if the barrier is not present during all flood stages (e.g., a barrier up to the 25-year flood, but not during the 100-year flood); except where the structure is expressly managed for floodplain function and inundation.

Determining Floodplain Extent

The floodplain is defined as the area that would be inundated during the 100-year flood flow if no constructed barriers were present; therefore, it may be useful to gain an understanding of the flow record for this site. (Flow estimates can be found using StreamStats or other tools.) For example, if a levee was built within the floodplain, the area beyond the levee and up to the extent of the historic floodplain should be included in the percentage of floodplain area that is disconnected. Areas outside of natural barriers (e.g., landslide deposits) should not be included as part of the inundation area.

Directions

1. Answer this question in the office prior to field visit if possible. Floodplain extent can be estimated by looking at the local topography, FEMA flood maps, hydraulic model outputs, local knowledge, or a combination of these resources. It may, however, only be possible to evaluate small streams and/or streams having dense cover while in the field.
2. Estimate the floodplain area within the PAA.
3. Identify elements that would disconnect the floodplain from the river or stream (see text box below for examples).
4. Estimate the percent of floodplain area within the PAA that is disconnected and record on the PAA Field Form (**Figure 5.14**).

5. Confirm estimates in the field.

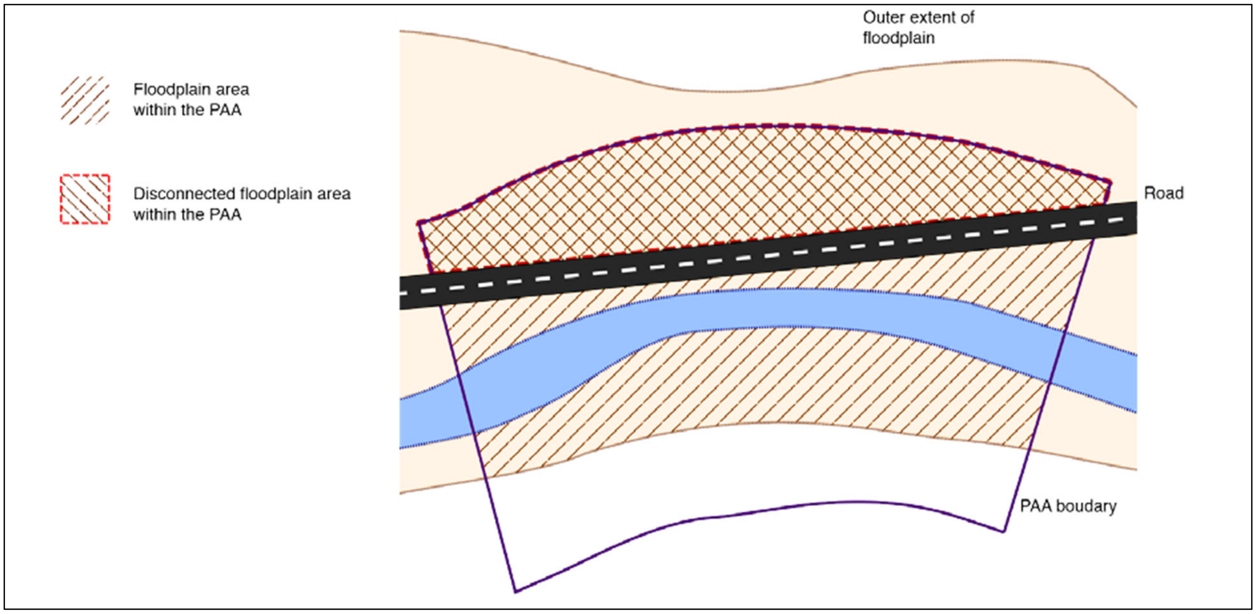


Figure 5.14. Example of floodplain exclusion.
This example shows a road blocking access to part of the floodplain. In this example, about 40% of the PAA floodplain area is disconnected.

Determining elements that disconnect the floodplain

Disconnection can be estimated based on the presence of structures that require tree clearing (e.g., buildings) or infrastructure or barriers that cross the site (e.g., roads, power lines (stations), levees), however, the floodplain may be tree covered and difficult to observe directly from aerial imagery. If the floodplain cannot be easily observed using available imagery and data in the office, observations should be made in the field to verify. Note: All barriers should be included when estimating disconnection, even if the barrier is not present during all flood stages (e.g., a barrier to the 25-year flood, but not during the 100-year flood).

Estimating disconnection

Consider whether a barrier blocks flows entering the entire floodplain area, or only a portion of the floodplain (i.e., a road that is set back allowing some, but not all, of the floodplain to be accessed).

F8. Bank Armoring

What percentage of the banks are armored?
Informs SM function.

What percentage of the streambank has been stabilized using rigid methods to permanently prevent meandering processes? Examples of armoring include gabion baskets, sheet piles, rip rap, large woody debris that covers the entire bank height, and concrete. Bank stabilization approaches that return bank erosion to natural rates and support meandering processes are not counted as armoring. For example, many bioengineering practices such as large woody debris placed along the bank toe, and in-stream structures that use native vegetation as cover on the streambanks. Percent armoring is calculated as the sum of the armored lengths of the left and right banks, divided by the sum total of both banks within the PAA (i.e., twice the total PAA length).

Calculating bank stabilization

Include the length of both continuous armoring treatments and the channel length between treatments acting in concert.

Bank armoring is any practice that permanently prevents natural lateral migration/meandering processes.

Bank stabilization is a practice that returns excessive bank erosion rates to normal rates. These practices typically use minimal amounts of toe protection with natural vegetative cover on the streambanks and should not be counted as armoring.

Directions:

1. As part of the PAA longitudinal survey, record the starting and ending points (relative to the start [0 feet] of the PAA) of armored streambank. Do this for both the left and right banks.
2. Enter this information into the PAA Field Form. Once back in the office, transfer this information to the PAA Field Form worksheet and the percent of banks armored will be calculated:

((length of armoring on right bank + length of armoring on left bank) ÷ (2 × total PAA length)) × 100

F9. Bank Erosion

What percentage of the bank is actively eroding or recently (within previous year or high flow) eroded?
Informs SC function.

Bank erosion is indicated by vertical or near vertical streambanks that show exposed soil and rock, evidence of tension cracks, active sloughing, or largely void of vegetation or roots capable of holding soil together. Percent eroding is calculated as the sum of the eroded lengths of the left and right banks, divided by the sum total length of both banks within the PAA (i.e., twice the total PAA length).

> **Signs of erosion**
> Clear evidence of erosion includes banks that are slumping or where tension cracks have formed and blocks can fall away from the bank. Often where banks are actively eroding, fine roots are exposed. Additional evidence includes undermining of trees, fences, buildings, bridge abutments, or other structures. If the channel is armored and the armor is not being compromised by additional erosion, then it should not be considered an eroding section of bank. If the bank is free from vegetation, but does not appear to be eroding at a rapid pace and displaying indicators such as those above, then it does not get included in this measure.

Directions

1. Record the starting and ending points (relative to the start of the PAA) of eroding streambank. Do this for both left and right banks.
2. Enter this information into the PAA Field Form. Once back in the office, transfer this information to the PAA Field Form worksheet and the percent of streambanks eroding along the PAA will be calculated:

$$((\textbf{eroding length on right bank} + \textbf{eroding length on left bank}) \div (2 \times \textbf{total PAA length})) \times 100$$

F10. Overbank Flow

Does the stream interact with its floodplain?
Informs SWS, SST, STS, NC, and CR functions.

Is there evidence of fine sediment deposition (sand or silt) on the floodplain, organic litter wrack on the floodplain or in floodplain vegetation, or scour of floodplain surfaces, extending more than 0.5 × BFW onto floodplain on <u>either</u> the right or left bank floodplain within the PAA? Do not include evidence from inset floodplains developing within entrenched channel systems.

If the abutting land use limits the opportunity to observe evidence of overbank flow, is there other credible information that would indicate regular (at least every two years) overbank flow in the PAA? Examples of "other credible information" include first-hand knowledge, discharge/stream gauge measures, etc. Note the evidence on the Cover Page.

Directions

1. During the preliminary reconnaissance and when conducting the vegetation surveys and longitudinal surveys, search for evidence of overbank flow in the PAA. Note areas of overbank flow evidence on the site map and determine if it extends more than 0.5 × BFW away from the bankfull boundary.

2. Record a yes or no response on the PAA Field Form in the first cell. Once back in the office, select "yes" or "no" from the dropdown menu to link the answer into the Functions tab.

Sites with Limited Access *- For sites where accessing both sides of the stream is not feasible, limit the data collection to a single side.*

F11. Wetland Vegetation

Are there wetland indicator plants adjacent to the channel and/or in the floodplain?
Informs SST, MB, STS, NC and CR functions.

Determine if vegetation in the riparian area of the PAA has a wetland indicator status of obligate or facultative wet.

Directions

1. Walk the PAA within the floodplain, or if no floodplain, walk the channel banks and make note of any plants having wetland indicator status of obligate or facultative wetland.
2. Determine if any wetland plants are present more than 0.5 × BFW from the bankfull edge.

For purposes of measuring the distance from the bankfull edge, measure to the center of the rooted stem of identified wetland plants. For example, a tree must have the center of the tree trunk more than 0.5 × BFW away from the bankfull edge to be included.

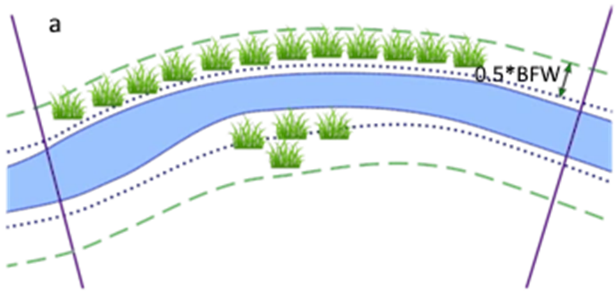
3. If there are wetland plants located beyond 0.5 × BFW, then determine if they are also distributed along more than 70% of the length of the PAA on at least one side of the stream. Distribution can be continuous or discontinuous (**Figure 5.15**).
4. Record yes or no responses to steps 1-3 on the PAA Field Form in the first cell. Once back in the office, select "yes" or "no" from the dropdown menu in the second cell for steps 1-3 to link the answer to the Functions tab.

Reference the National Wetland Plant List for wetland plant indicator status: http://wetland-plants.usace.army.mil/nwpl_static/index.html

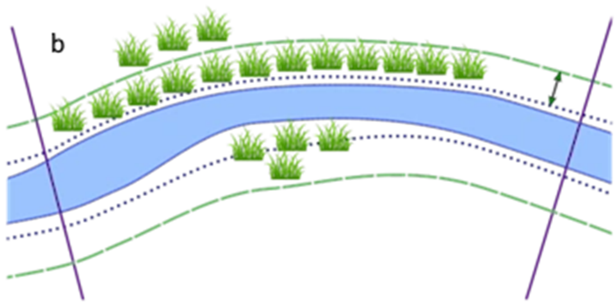
There are two wetland regions in Idaho: "Western Mountains, Valleys and Coast" (WMVC) and "Arid West" (AW).

A custom plant list can be created using the menu at the left of the screen, using region and wetland rating (OBL for obligate and FACW for facultative wetland) as filters.

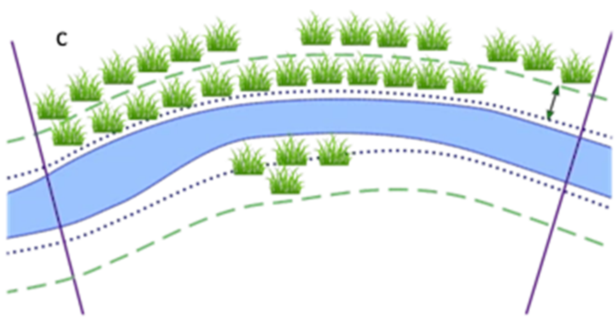
Sites with Limited Access *- For sites where accessing both sides of the stream is not feasible, limit the data collection to a single side.*



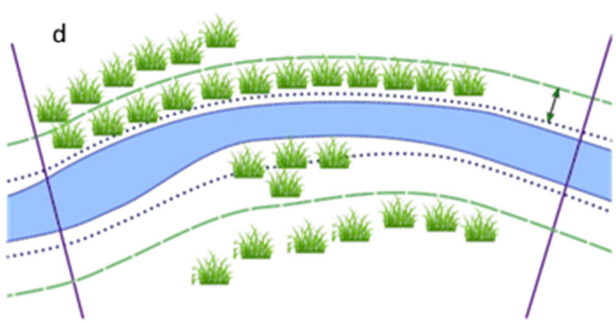
1. Are there wetland plants present in the PAA?	YES
2. If yes, are any wetland plants located more than 0.5*BFW from the bankfull edge?	NO
3. If yes, are the wetland plants that are located beyond 0.5*BFW distributed along >70% of the length of the PAA?	--



1. Are there wetland plants present in the PAA?	YES
2. If yes, are any wetland plants located more than 0.5*BFW from the bankfull edge?	YES
3. If yes, are the wetland plants that are located beyond 0.5*BFW distributed along >70% of the length of the PAA?	NO



1. Are there wetland plants present in the PAA?	YES
2. If yes, are any wetland plants located more than 0.5*BFW from the bankfull edge?	YES
3. If yes, are the wetland plants that are located beyond 0.5*BFW distributed along >70% of the length of the PAA?	YES



1. Are there wetland plants present in the PAA?	YES
2. If yes, are any wetland plants located more than 0.5*BFW from the bankfull edge?	YES
3. If yes, are the wetland plants that are located beyond 0.5*BFW distributed along >70% of the length of the PAA?	YES

Figure 5.15. Examples of different configurations of wetland vegetation within the Proximal Assessment Area and associated responses to the questions on the field datasheet.

In (a), wetland vegetation is present in the PAA, but located only right along the channel. In (b), some wetland vegetation is located farther back from the channel. In (c) and (d), wetland vegetation is located farther back from the channel (> 0.5 × BFW) for at least 70% of the length of the PAA; all on one side of the stream in (c), and split between both sides of the stream in (d).

Extended Assessment Area – Longitudinal Survey

Assess the following three measures throughout the entirety of the EAA.

F12. Side Channels

What proportion of the EAA length has side channels?

Informs SWS, SST, MB, and CMH functions.

Side channels include all open conveyances of water, even if the channel is plugged (i.e., there is no above-ground flow to/from the main channel) on one end. If both ends are plugged, do not count as a side channel. A side channel that exists due to an instream island has less flow by volume relative to the main channel.

Identifying side channels Inundation frequency or duration of water in the side channels is not a determining factor.

Note that side channels are not within the bankfull channel of the main channel (i.e., there must be an area of land that is above bankfull separating the side channel from the main channel). Water flowing around a dry bar is not a side channel.

Directions

1. Answer this question in the office prior to field visit, if possible (see **Section 4.5**). It may only be possible to evaluate small streams and streams with dense cover while in the field.
2. Using the map of the assessment area, evaluate the floodplain and determine whether side channels are present.
3. Record the approximate location of the start and end points of each side channel on the EAA Field Form (see **Figure 5.16**).
4. Once back in the office, transfer the data into the EAA Field Form worksheet and the percent of the EAA length with side channels will be calculated:

(sum of lengths with side channels ÷ total EAA length) × 100

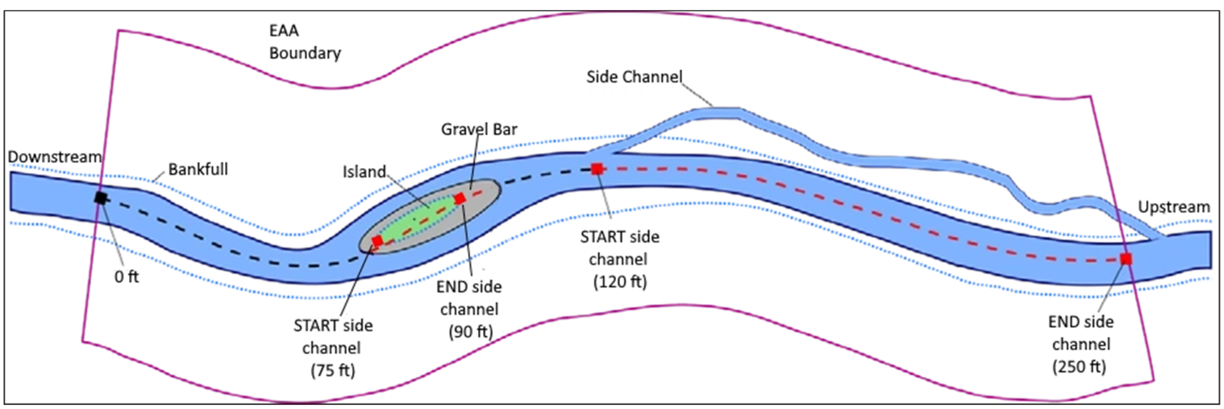


Figure 5.16. Measuring side channels within the Extended Assessment Area

In this example, 145 feet of the total 250 feet length of the EAA (i.e., 58%) includes side channels (including the multiple channels flowing around the island).

F13. Lateral Migration

What percent of both sides of the channel is constrained from lateral migration?
Informs SC function.

Constraints on lateral migration of the channel within 2 × BFW or 50 feet (whichever is greater) include bank stabilization and armoring, bridges and culverts, diversions, roads paralleling the stream and any other intentional structures or features that limit lateral channel movement whether intentionally or not. For cross-channel structures (diversions, bridges, culverts, etc.), record 4x the BFW as the length constrained on both sides of the channel or the actual length constrained by the structure, whichever is greater. For linear features, record the length on each side of the channel. For segmented bank features, such as bendway weirs or log jams acting in concert, record the effective length of stabilization on each side of the channel affected. It is appropriate to include relevant armoring that is recorded in the Bank Armoring question; these measures are not double-counted in SFAM.

While bank armoring is a subset of lateral migration constraints, these measures are not interchangeable as used in SFAM:

- Data for each measure is collected at different scales, PAA and EAA, respectively.
- Bank armoring informs the Substrate Mobility function, while lateral migration informs the Sediment Continuity function.
- There is no redundancy/ double counting as they inform different functions.

Directions

1. Identify and map all constraints to lateral migration as defined above. This should be done initially during the office component using aerial imagery (see **Section 4.5**) and confirmed while conducting the onsite longitudinal survey of the EAA.
2. Record the location of the start and end points of constraints in the EAA Field Form. Do this for both left and right banks.
3. Once back in the office, transfer the information into the EAA Field Form worksheet and the percent of the EAA that is constrained will be calculated:

   (sum of constraints for each bank ÷ (2 × EAA length)) × 100

F14. Wood

What is the frequency of large wood in the bankfull channel?
Informs SWS, MB, and CMH functions.

What is the frequency (pieces per 328 feet [100 m] of channel) of independent pieces of wood, defined here as woody material with a diameter of at least 4 inches (10 cm) and a length of 5 feet (1.5 m) within the EAA? This means that at least 5 feet of the piece of wood must be larger than 4 inches in diameter (i.e., a circumference > 12.5 inches). To be counted, wood must have at least some part of its qualifying length (> 4 inches diameter) located within the bankfull channel and lying below the bankfull elevation. Independent pieces include all those individual pieces that meet size criteria either separate from or within log jams. Exclude any wood that has been intentionally anchored to or within channel banks (using spikes, cables, ballast, etc.) for the purpose of preventing bank erosion (armoring). Live trees (i.e., trees that are standing, rooted, with or producing foliage) are not considered “wood” for this measure. Trees that are fully or partially fallen, have an exposed root wad, show evidence of being removed from the soil, or show other signs of dying (e.g., bare branches) are counted as “wood.”

Directions

1. As part of the longitudinal survey, tally the total number of large wood pieces for the entire EAA. It may be helpful to record the approximate ‘station’ (distance from the downstream end of the EAA) of each piece of large wood meeting the above criteria to prevent double-counting.
2. Record the tally on the EAA Field Form. Once back in the office, enter the total count into the EAA Field Form worksheet and the large wood frequency of the stream will be calculated.

Figure 5.17. An example of a live tree in the bankfull channel.
This would not be considered as “wood.”

Extended Assessment Area – Transect Survey

Assess the following measures within the EAA. Incision, Embeddedness, and Wetted Width data are collected on the 11 lateral transects; Thalweg Depth data are collected on each transect plus at nine evenly spaced locations between the transects (**Figure 5.9**).

F15. Incision

What is the degree of channel incision within the EAA?
Informs SWS, SC, and CMH functions.

At each of the 11 transects within the EAA, measure the Bank Height Ratio (BHR). The BHR is the height from the stream thalweg to the level of the first terrace of the valley floodplain divided by the bankfull height. Do not consider inset floodplains. Note that in a well-connected/non-incised stream, the first terrace height and bankfull height are equal.

Directions

1. Observe both streambanks and identify the first terrace of the valley floodplain. If the first terrace is lower on one bank, select this bank to assess. Have one person stand on this bank and locate both the bankfull elevation and the elevation of the first terrace of the valley floodplain.

2. Have a second person position a stadia rod in the thalweg and hold the rod with the numbers facing the person on the bank.

3. The person on the bank will use a clinometer to site the bankfull height and the floodplain terrace height.

4. Record the bankfull height and floodplain terrace height for each transect in the EAA Field Form to the nearest 0.1 feet. Once back in the office, transfer the data into the EAA Field Form worksheet and the average bank height ratio will be calculated.

Bankfull height refers to the vertical height from the streambed in the thalweg to the bankfull elevation.

First terrace of the valley floodplain refers to the first major depositional surface at or above the bankfull elevation, whether or not it is an active floodplain. Inset floodplains on incised streams are not considered the first terrace of the valley floodplain.

Thalweg refers to the flow path of the deepest water in a stream channel. The thalweg profile is a longitudinal survey of maximum flow path depth, which may not always be found at mid-channel (and may not always be the absolute deepest point in every channel cross-section).

If the stream is in a 'V' shaped valley and the stream banks simply extend uphill indefinitely without reaching a floodplain or terrace, record the floodplain height as equal to the bankfull height and note this on the field forms.

Crossings - If the intended transect location for measuring bankfull height and floodplain height (to calculate BHR) are inaccessible because they fall in a culvert or under a bridge crossing, measure(s) for BHR can be taken at the upstream or downstream edge of the culvert or bridge and used as a proxy to estimate the BHR for all of the transects within the culvert. In this case, the height of the road surface (above the streambed) would be equal to the 'lowest floodplain terrace' height.

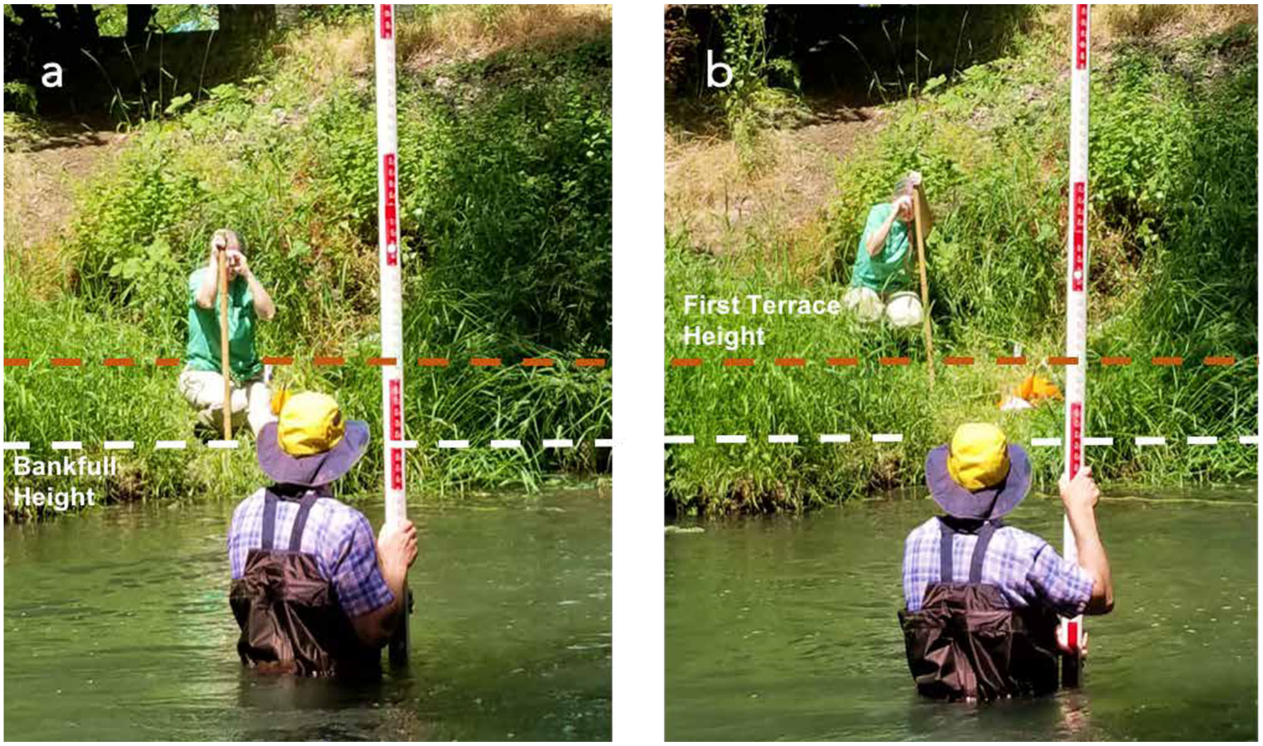


Figure5.18. Using a clinometer to site the bankfull height (a) andthe first terraceofthe valley floodplain (b)

F16. Embeddedness

Whatisthedegreeofsubstrateembeddednessinthestreamchannel?

InformsFV,SM,and CMH functions.

To what extent are larger stream substrate particles surrounded by finer sediments (i.e., silt and/or sand) on the surface of the streambed (**Figure 5.19**). Measurements are taken at 11 transects within the EAA.

Wetted width measurements should be taken across (and including) any mid-channel bars and boulders.

Embeddedness is the fraction of a particle's volume that is surrounded by sand or finer sediments on the stream bottom (see **Figure 5.19**). For particles larger than sand, examine the surface for stains, markings, and algae. By definition, sand and fines (particles smaller than 2 mm diameter) are embedded ***100%***; bedrock and hardpan are embedded ***0%***. Unnatural surfaces (e.g., concrete or metal) should be recorded as **100%** embedded.

Directions

1. At each of the 11 EAA transects, measure the wetted width of the stream (i.e., the width of the portion covered in water). Wetted width is measured across and over mid-channel bars and boulders. Note that wetted width measurements are a submeasure for Channel Bed Variability.
2. Record the wetted width measurements on the EAA Field Form to the nearest 0.1 feet.
3. Along each of the 11 EAA transects evaluate substrate embeddedness at five equidistant points across the wetted width of the stream channel (**Figure 5.20**).
4. At each location, estimate the percent

embeddedness of particles in the 4-inch (10 cm) circle around the measuring stick on each transect plus at nine evenly spaced locations between the transects. This can be done by sight and feel, or by using a ‘pole drag’ or ‘pole tapping’ technique to ‘feel’ the substrate and estimate the embeddedness.

5. On the EAA Field Form, record the percent (0, 25, 50, 75, or 100) that best describes the degree of embeddedness at each point. Two of the measurements are taken at the edge of the wetted channel, which may be underneath an overhanging bank.

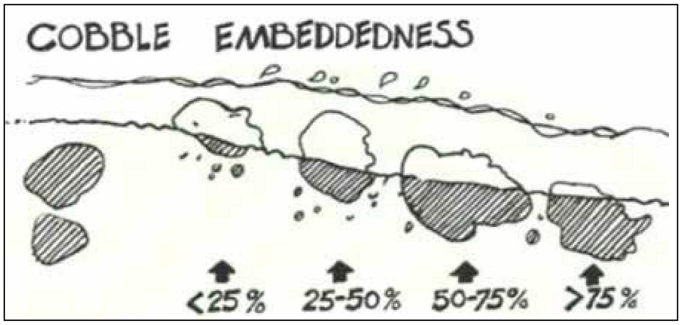


Figure 5.19. Examples of percent embeddedness on a stream bottom
(from West Virginia, Department of Environmental Protection).

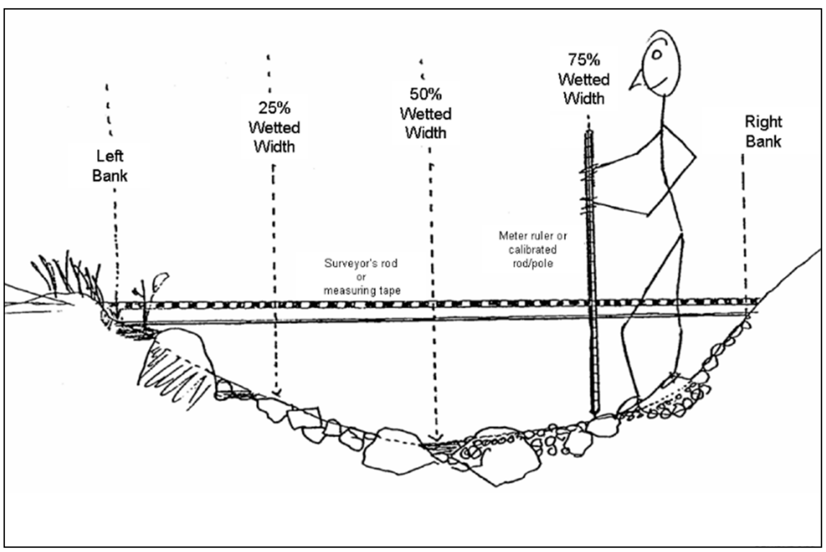


Figure 5.20. Substrate embeddedness measurement locations
(from EPA, 2013)

6. Once back in the office, transfer the data to the EAA Field Form worksheet and the average percent embeddedness will be calculated.

Dry Channels – For dry channel assessments, substitute the wetted-width measurement with a streambed width measurement. Instead of measuring the width of the wetted portion of the stream, the width of the entire streambed (from toe of the right bank to toe of the left bank) is used. If any portion of the stream bed within the EAA is dry, then the ‘dry channel’ method must be used for all of the transects even if there is water in the channel in parts of the EAA.

Multiple Channels - If the wetted channel is split by a mid-channel bar, the five embeddedness sample points are centered between the wetted width boundaries regardless of the mid-channel bar in between. Consequently, some embeddedness measures may be taken from dry places on the bar.

Crossings - Under many bridges and in some culverts, it will still be possible to measure the substrate embeddedness. When circumstances prevent the direct observation of embeddedness, it may be possible to assume or infer the values for the transects in the culvert or under the bridge. For example, if a culvert clearly has a uniform metal or concrete bottom (streambed) with no alluvial substrate then the embeddedness measures should be recorded as "100." For a transect location where embeddedness cannot be measured or reasonably assumed (as described above) then the entry should be left blank.

F17. Channel Bed Variability

Is the channel bed variable?

Informs SWS, SST, FV, SM, MB, CMH, NC, and CR functions.

Channel bed variability submeasures include variation in wetted channel width and stream thalweg depth along the EAA.

Directions

Wetted width

At each of the 11 EAA transects, wetted widths have previously been recorded on the EAA Field Form for Embeddedness. Once back in the office, transfer the data into the EAA Field Form worksheet and the coefficient of variation for wetted width will be calculated.

Dry Channels – For dry channel assessments, substitute the wetted width measurement with the streambed[3] width measurement as described for Embeddedness dry channel assessments; enter these in the EAA Field Form worksheet to calculate the coefficient of variation for wetted width.

Crossings - There may be a few circumstances where the observed values for depth and width can be assumed even if the transect locations are not directly accessible. If a stream is flowing through a uniform culvert, the width and depth measures within the culvert can likewise be assumed to be uniform. If width or depth measures are unknowable (not accessible or reasonably assumed) then those entries should be left blank.

[3] In a cross-section, the 'streambed' lies between the 'toe' of the left and right streambanks. The streambed margin is at the transition between the streambed and toe of the bank and is often characterized by a distinct break in slope and change in substrate composition or structure.

Thalweg depth

1. Determine the appropriate sampling interval by dividing the total length of the EAA by 100.
2. Beginning on the first EAA transect (downstream boundary of the EAA), take a thalweg depth measurement using a calibrated pole or rod. Measure the deepest point within the stream's deepest flow path (from the substrate surface to the water surface). Read the depth on the side of the rod to avoid inaccuracies due to the wave formed by the rod in the moving water. Work upstream towards the second EAA transect taking an additional nine thalweg depth measurements at the determined sampling interval. Repeat this process along the longitudinal extent of the EAA, resulting in a total of 100 data points (no measurement is taken at the upstream EAA boundary).
3. Record the thalweg depths on the EAA Field Form to the nearest 0.1 feet. Once back in the office, transfer data into the EAA Field Form worksheet and the coefficient of variation for thalweg depth will be calculated.

If the thalweg is too deep to measure directly, stand in shallower water and extend the stadia rod or pole at an angle to reach the thalweg. Hold the rod at a 45-degree angle, determined using a clinometer resting on the upper surface of the rod. The thalweg depth equals 70% of the reading on the rod at the water surface.

For deeper depths, use the same procedure with a calibrated line as the measuring device. Tie a weight to one end of the line and toss the weight into the deepest channel location. Draw the string up tight and hold it at a 45-degree angle, determined using a clinometer resting on the upper surface of the string. The thalweg depth equals 70% of the length of the line that is underwater.

If a direct measurement cannot be obtained, make the best estimate you can of the thalweg depth. Note on the SFAM Cover Page that it is an estimated measurement.

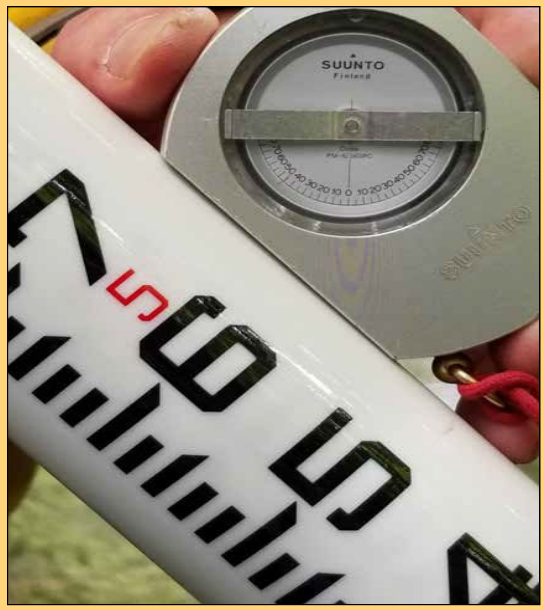


Figure 5.21 Using a clinometer to hold a stadia rod at a 45-degree angle

Dry Channels – For dry channel assessments of thalweg depth, each water depth measurement is substituted with a 'depth' measured from the thalweg to the level of the streambed margin at the toe. Conceptually, the intent is to measure thalweg depths that are equivalent to 'water-depths' when the streambed is completely covered with water. Refer to description of 'streambed' above. If any portion of the streambed within the EAA is dry, then the 'dry channel' method must be used for all of the transects even if there is water in the channel in parts of the EAA.

Multiple Channels - If a stream has multiple channels within the assessment area, collect all thalweg depth data from the largest (by volume) channel.

6 Instructions for Entering, Interpreting, and Reporting the Data

6.1 Post-Site Visit Data Entry

All information and data collected during the office and field components of an SFAM assessment must be entered into the Workbook on the Cover Page, Values tab, Site Layout Field Form, PAA Field Form, and EAA Field Form. Some data entry requires inputting information (e.g., name of project area, elevation, percent cover of large trees in the PAA, etc.), while some requires selecting the appropriate response (e.g., “yes” or “no”) or a category (e.g., “A”, “B”, “C”, or “D”) from a drop-down menu (indicated by an arrow on the lower right-hand corner of the yellow data entry cell when it is selected).

The Functions tab is linked to the Cover Page and the Field Forms. The data entry and measure score columns will automatically populate once all required data is entered into the Cover Page and Field Forms. If required information is left blank there will be error messages in the functions sheet (**Figure 6.1**).

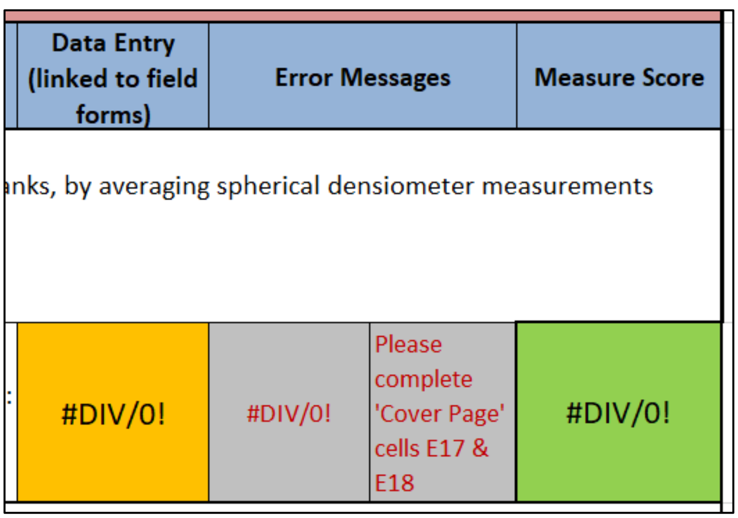


Figure 6.1. Example of error message in the SFAM Workbook.

Data Entry for Long Project Areas (PA > 1000 feet)

When the PA is longer than 1000 feet, additional PAA transects are needed to represent Natural Cover, Vegetated Riparian Corridor Width, and vegetation in the riparian area (Invasive Vegetation, Native Woody Vegetation, and Large Trees). The maximum distance between transects should be 250 feet. Data for nine additional transects can be entered in the Extra Transects or Data tab of the SFAM Workbook. Hand-calculate the average “% of Transect” numbers from Column AX for each vegetation type (InvVeg, WoodyVeg, LgTree). Enter the results for each measure, to the nearest whole number, into the Functions tab. This change will result in an alert message in Column I of the Functions tab for these measures, indicating that the answer was manually entered and is no longer linked to the field form (**Figure 6.2**).

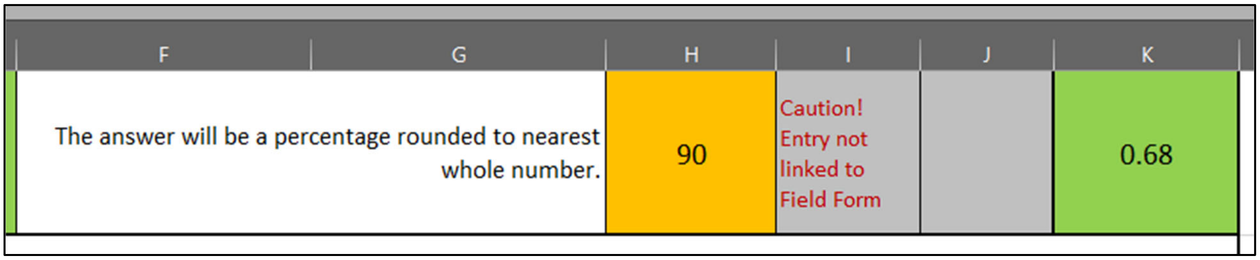


Figure 6.2. Example of a message in the Functions tab when a link to a field form has been broken

Data Entry When Using SFAM Predictively

When using the SFAM Workbook predictively to estimate outcomes of proposed activities some field data will need to be adjusted (see **Section 7.0** for details). There are two approaches to making these changes. The first option is to make changes to the PAA and EAA Field Forms that reflect the predicted site conditions. The second option is to overwrite the answers in the Functions tab. This change will result in an alert message in Column I of the Functions tab indicating that the answer was manually entered and is no longer linked to the Field Forms (**Figure 6.2**). It is necessary to enter the correct type of data for the function score to be calculated accurately. A description of the type of data necessary for each answer is in Column F/G.

6.2 Final Steps and Interpreting Outputs

When all inputs have been entered in the Workbook, the scores for the functions and values will calculate automatically and appear in the Scores and Subscores tabs. SFAM produces several different outputs. They are described in **Table 6.1.**

Table 6.1 SFAM Outputs

Output	Description
Function Score	Numerical score between 0.0 and 10.0. A score of 0.0 indicates that negligible function is being provided by the stream whereas a score of 10.0 indicates that the stream is providing maximum function (as defined) given certain contextual factors (e.g., ecoregion, size).
Value Score	Numerical score between 0.0 and 10.0. A score of 0.0 indicates that there is low opportunity for the site to provide a specific ecological function and that, even if it did, the specific function would not be of particular significance given the context of the site. Conversely, a value score of 10.0 indicates that a site has the opportunity to provide a specific function and that it would be highly significant in that particular location. A value score results from two subscores: **Opportunity subscore:** represents the set of circumstances that makes it favorable for the site to be able to provide a specific set of functions, predicted in part by what is upslope and upstream of the Project Area. **Significance subscore:** represents the importance of a specific function (or set of functions) being provided at a particular location, predicted by what is adjacent to (floodplains) and downstream of the site (that may be affected by the function being provided at the site), and by how unique or rare the function or the aquatic resource type is in the landscape.
Function & Value Ratings	To facilitate conceptual understanding, numerical scores are translated into ratings of Low, Moderate, or High. The numerical thresholds for each of these rating categories are consistent across all functions except Fish Passage Barriers, such that scores of <3.0 are rated "Low," scores ≥3.0 but ≤7.0 are rated "Moderate," and scores that are >7.0 are rated "High."
Group Scores & Ratings	Each specific function, and its associated value, is included in one of the four functional groups: hydrologic, geomorphic, biologic, and water quality functions. Group scores/ratings provide a summary of the degree to which each group of processes is present at a site. Groups are represented by the "highest" function with the "highest" associated value among the 2-3 functions that comprise each group. The score sheet in the SFAM Workbook is programmed to select the highest-rated function with the highest-rated associated value within each group. This hierarchical selection system ensures that thematic functional groups are represented by the highest performing and highest valued ecological function. If multiple functions are equally ranked in the selection hierarchy, the function with the highest numerical function score is selected.

If you wish to see how specific measures contributed to each function or value score or rating, click on the cell next to each measure on the Subscores tab (i.e., Measure Score, Function Score, Opportunity Subscore, Significance Subscore or Value Score) to see the formula that is used to calculate that score.

6.3 Evaluating Results

Once you have a complete set of computed SFAM scores, a trained professional should review the results. If the scores and ratings do not match best professional judgment, review the equation for a particular function or value as well as the SFAM Scientific Rationale to see how the score was determined. If there is a measure that the data collector noted as problematic (perhaps because part of the EAA was not accessible, or could not be viewed during a preferred time of year), you can change the value entered on the data entry cell and then check the Scores tab to see what effect that had. If you still question the results, provide your rationale in the space provided in the Assessment Notes section on the Cover Page. If you disagree with the assumptions of how a score was calculated, explain why that assumption is not appropriate for the stream reach or site being assessed and provide supporting information in the Assessment Notes section of the Cover Page (add additional sheets if needed).

6.4 Submitting Your SFAM Assessment

Submission of an SFAM assessment should include the following items for regulatory purposes:

1. A completed Workbook (check with the agencies for submittal instructions)
   - Electronic file with the permit number(s), if applicable, or the site name in the filename;
   - Printed sheets from the Workbook, consisting of the Cover Page, Values, Functions, Scores, PAA Field Form, and EAA Field Form.
2. A site map illustrating the approximate PA, PAA and EAA boundaries.
3. Photographs of the stream and riparian area within the PA, PAA, and EAA, are recommended, but not required.

Up to four SFAM assessments may be necessary for a project for regulatory purposes:

1. Current state at the impact site.
2. Predicted state at the impact site assuming that the proposed project is authorized and constructed.
3. Current state at the proposed compensatory mitigation site.
4. Predicted state at the proposed compensatory mitigation site, assuming that the proposed actions are authorized and constructed.

Current state should be assessed at the time that field work is conducted. An exception may be if the site was recently and significantly disturbed; consult with agency staff if this is the case.

Predicted state should be assessed using a reference site if available, or by assuming the site has had time to adjust to a variety of flow conditions and planted vegetation has time to mature (see **Section 7**).

6.5 Troubleshooting SFAM

If Workbook cells contain error messages such as “#DIV/0!” or “#VALUE”, there is likely an error or blank in an input cell that needs to be corrected. The Subscores tab may help determine which measure entry has the error.

7.0 Informing Restoration Design and Predicting Functional Change with SFAM

While SFAM is designed to assess current stream function and values, it can also be used to inform restoration design and predict stream function. This can be accomplished by:

1. Conducting a baseline SFAM assessment.
2. Evaluating the baseline SFAM function and value scores/ratings to identify stream characteristics which can be targeted for restoration.
3. Designing restoration actions that will improve stream function and services provided.
4. Using the SFAM Workbook as a calculation tool to predict outcomes of proposed activities.

Below, a hypothetical stream and two restoration scenarios are used to illustrate how to use SFAM to inform restoration and predict functional change. Restoration Scenario #1 is a relatively simple restoration targeting two highly valued but underperforming stream functions. Restoration Scenario #2 is a more comprehensive and complex restoration project.

Step 1. Baseline Assessment

The first step is to conduct an SFAM baseline assessment for the stream reach being considered for restoration. This includes completing both office and field components and entering all data into the SFAM Workbook.

The hypothetical stream reach used for describing the restoration scenarios below is an urban/residential stream set in the Teton River basin in Eastern Idaho. The stream is relatively incised; has partially armored banks (to prevent bank erosion from encroaching on adjacent residential properties built on the floodplain); has a riparian area with a mixture of invasive vegetation and some native woody vegetation; has some limited wetland vegetation growing near the stream edge, but not on the floodplain. The average stream width is 13 feet along the 150 feet project area length.

The baseline assessment for this site was completed following the SFAM office and field protocols found in previous sections of this User Manual, resulting in the following function and value scores/ratings (**Figure 7.1**) prior to any impact or restoration activities.

SPECIFIC FUNCTIONS	Function Score	Function Rating	Value Score	Value Rating
Surface Water Storage (SWS)	2.08	Lower	7.42	Higher
Sub/Surface Water Transfer (SST)	1.52	Lower	0.00	Lower
Flow Variation (FV)	7.86	Higher	4.63	Moderate
Sediment Continuity (SC)	6.45	Moderate	2.57	Lower
Sediment Mobility (SM)	4.43	Moderate	6.75	Moderate
Maintain Biodiversity (MB)	2.78	Lower	5.40	Moderate
Create and Maintain Habitat (CMH)	3.83	Moderate	4.33	Moderate
Sustain Trophic Structure (STS)	2.89	Lower	5.26	Moderate
Nutrient Cycling (NC)	3.04	Moderate	3.00	Moderate
Chemical Regulation (CR)	2.13	Lower	3.00	Moderate
Thermal Regulation (TR)	6.66	Moderate	8.38	Higher

Figure 7.1. Baseline SFAM function and value scores/ratings excerpted from the Scores tab.

Step 2. Evaluate the Baseline Assessment Function and Value Scores/Ratings

The output of the SFAM baseline assessment displayed on the Scores tab (Figure 7.1) can be used to identify opportunities for improving stream function and increasing the ecosystem services provided by the stream reach. Recall that the scores/ratings for the 11 SFAM stream functions represent how well the stream is performing each function at the reach/site scale. These scores/ratings can be altered by on-site activity (impacts or restoration). In SFAM, values generally describe the broader landscape context within which the function provides services valued by society. Thus, value measure inputs and resultant value scores at a particular site will generally not be affected by on-site impacts or restoration activities; we will assume this to be the case for the following scenarios.

The value ratings resulting from the baseline assessment for all 11 functions are listed on the Scores tab. A ‘higher’ value rating indicates that the assessment reach has both the opportunity to provide that particular function and that function is locally significant (need for the ecosystem services proved by that function is high). Functions with a ‘higher’ *value* rating and ‘lower’ or ‘moderate’ *function* rating should be primary targets for restoration activities (e.g., Figure 7.1, Surface Water Storage) because they are of high local value and there is opportunity to improve that stream function and the associated services it provides. Restoration Scenario #1 provides a relatively simple example of this. Restoration Scenario #2 illustrates this principle using a more comprehensive and extensive restoration project.

<u>*Restoration Scenario #1*</u> – Targets only those functions with ‘lower’ or ‘moderate’ function ratings that are highly valued (i.e., ‘higher’ rated values):

The baseline assessment results in **Figure 7.1** show that two functions, Surface Water Storage (SWS) and Thermal Regulation (TR), have ‘higher’ value ratings. The function ratings for SWS and TR are ‘lower’ and ‘moderate,’ respectively. Because the value ratings for SWS and TR are ‘higher’ and there is room for improvement for both functions (‘lower’ and ‘moderate’ function ratings), they are targeted for restoration activities in this scenario.

<u>*Restoration Scenario #2*</u> – Targets all functions with value ratings that exceed the corresponding function rating:

The baseline assessment results in **Figure 7.1** indicate there are five functions with value ratings that exceed the corresponding function rating (e.g., Maintain Biodiversity (MB) has a ‘moderate’ value rating and a ‘lower’ function rating). Additionally, SWS, TR, Sustain Trophic Structure (STS) and Chemical Regulation (CR) all have value ratings that exceed their corresponding function rating. The restoration design in this scenario will include elements targeting improvement in all five of these functions.

Step 3. Use SFAM to Inform Restoration Design

SFAM informs the elements to include in restoration design by identifying which stream attributes are underperforming and could be improved to increase stream function. SFAM does not replace the judgment of a reasonable and experienced practitioner who must design a restoration project that will achieve improvements to stream attributes identified by SFAM as contributing to improved function. Neither does SFAM replace a well implemented restoration project; practical implementation is still in the purview of restoration practitioners who must consider and apply standard practices of the stream and river restoration industry.

Identifying SFAM measures to improve through restoration activities

In SFAM, function measures are field metrics that allow a quantitative assessment of specific stream attributes that represent a particular stream function and the extent to which that function is active (see the SFAM Idaho Scientific Rationale document Section 2, Figure 2.1). Once stream functions have been selected for improvement using the baseline assessment as described, the SFAM Subscores tab can be used to identify the specific measures that contribute to those functions. Restoration activities can then be designed to improve the identified measures.

SFAM function measures are assigned an index value between 0.0 and 1.0, with 1.0 indicating ‘higher’ functioning. Index values are determined using the data collected in the field assessment (or from the office component for value measures) and the standard performance index for that measure (see **Section 4.1** of the SFAM Idaho Scientific Rationale document for details) and are displayed in the green cells on the Functions tab in the SFAM Workbook and listed by function on the Subscores tab. Any measure with an index value less than 1.0 can potentially be improved with restoration activities, which could in turn improve stream function and increase function scores. Measure index values for all 11 SFAM functions can be found in the Subscores tab of a completed SFAM Workbook.

To identify specific measures to include in restoration design, open the Subscores tab of the SFAM Workbook, locate the functions previously targeted for improvement and identify contributing measures with an index value (score) less than 1.0.

<u>*Restoration Scenario #1*</u> – Identify all measures that contribute to the targeted functions SWS and TR which have index values less than 1.0:

FUNCTIONS			
Function	Measure Name	Measure Score	Function Score
SWS	OBFlow	0.00	2.08
	Incision	0.42	
	Exclusion	0.00	
	BedVar	0.36	
	Wood	0.36	
	SideChan	0.00	
TR	Cover	0.67	6.66

Figure 7.2 SFAM measure and function scores for SWS and TR functions excerpted from the Subscores tab of the baseline assessment.

The SWS function has six contributing measures (**Figure 7.2**). All measures for this function have index scores less than 1.0; thus, improvement to any of these measures will increase the SWS function score. Because the TR function has only one measure (Cover), the restoration design must include activities that will increase natural cover, and thus the Cover measure score, to improve the TR function rating. For the SWS function, any (or all) of the six measures could be included in restoration design to help improve the SWS function score.

There are many factors to consider when deciding which measure(s) to address to improve stream function, including: cost, time, and practicality of a particular restoration design element given access or other site constraints. In this scenario, the project sponsor has determined that while OBFlow, Incision, Exclusion, and SideChan could all be addressed to improve stream function, because accomplishing those improvements would require reconnection of the stream to its floodplain and expensive earth-moving work, they will not address those restoration elements in this project. Rather, the project sponsors decide that placement of large wood to improve the Wood measure would be the most cost-effective way to improve the SWS function, and that a relatively limited amount of streamside vegetation planting to increase natural cover (Cover measure) would increase the TR function in a meaningful way.

Determining the effect of restoration design elements on SFAM outputs

To begin, it is important to understand the underlying physical and ecological characteristics contributing to each function measure. To do this, review 1) the measure description and data collection instructions in the SFAM User Manual, and 2) the detailed description of the scientific underpinning for that measure that can be found in **Section 4.2** of the SFAM Idaho Scientific Rationale document. In the current scenario, determining restoration activities to improve the Wood and Cover measures is relatively straightforward: to improve the Wood measure, additional instream wood meeting the described criteria must be placed, and to improve the Cover measure additional natural stream cover (shading) needs to be achieved.

Determining how much appropriately sized wood to place in the stream can be informed by evaluating the Wood measure index score resulting from the baseline assessment using the standard performance index for the measure in the SFAM Scientific Rationale document (**Section 4.2(n)**). Simply put, conduct some "what if" exercises using the completed baseline assessment in the SFAM Workbook as a tool.

For example, the baseline assessment (**Figure 7.3**) identified that there was 1 piece of wood in the 280-foot EAA (1.17 per 328 feet). This resulted in an index value of 0.36 (**Figure 7.3**). "What if" 12 pieces of wood of the appropriate size were added to the PAA for a total of 13 pieces in the

EAA? This can be evaluated by changing the Wood measure entry from '1' to '13' on the EAA field form worksheet to calculate a new Wood measure input (15.23 pieces per 328 feet) which will auto-populate the orange cell in the Functions worksheet for the Wood measure (**Figure 7.4**). The resulting index value for the Wood measure is 0.84, which in turn results in an increase in the SWS function rating from 'lower' to 'moderate.'

F14 Wood	<u>**What is the frequency of large wood in the bankfull channel within the EAA?**</u> Report the frequency (pieces per 328 feet [100m] of channel) of independent pieces of wood, defined here as woody material with a diameter of at least 4 inches (10cm) and a length of 5 feet (1.5m) within the EAA. This means that at least 5 feet of the piece of wood must be larger than 4 inches in diameter (i.e. a circumference > 12.5 inches). Independent pieces include all those individual pieces that meet size criteria either separate from or within log jams. To be counted, wood must have some part of its length within the bankfull channel. Exclude any wood that has been intentionally anchored to or within the channel banks (using spikes, cables, ballast, etc.) for the purpose of preventing bank erosion (armoring). *Functions informed: Surface Water Storage, Maintain Biodiversity, Create & Maintain Habitat*								
	Hydrology, Biology		Wood	XERsmall	**Enter the frequency (pieces per 328 ft) of wood in the channel:** *(round to nearest hundredth)*	1.17			0.36

Figure 7.3. Baseline data entry (1.17) and index value (0.36) for the Wood measure.

F14 Wood	<u>**What is the frequency of large wood in the bankfull channel within the EAA?**</u> Report the frequency (pieces per 328 feet [100m] of channel) of independent pieces of wood, defined here as woody material with a diameter of at least 4 inches (10cm) and a length of 5 feet (1.5m) within the EAA. This means that at least 5 feet of the piece of wood must be larger than 4 inches in diameter (i.e. a circumference > 12.5 inches). Independent pieces include all those individual pieces that meet size criteria either separate from or within log jams. To be counted, wood must have some part of its length within the bankfull channel. Exclude any wood that has been intentionally anchored to or within the channel banks (using spikes, cables, ballast, etc.) for the purpose of preventing bank erosion (armoring). *Functions informed: Surface Water Storage, Maintain Biodiversity, Create & Maintain Habitat*								
	Hydrology, Biology		Wood	XERsmall	**Enter the frequency (pieces per 328 ft) of wood in the channel:** *(round to nearest hundredth)*	15.23			0.84

Figure 7.4. Data entry change for the "what if" exercise adding 12 pieces of wood

The same process can be used to inform how much natural cover planting is needed. Completing a "what if" exercise for the Cover measure shows that increasing natural cover in the Proximal Assessment Area (PAA) from 68% (baseline assessment) to 95% would increase the Cover measure index value enough to result in increasing the TR function rating from 'moderate' (baseline assessment) to 'higher.'

<u>*Restoration Scenario #2*</u> - Identify all measures that contribute to the targeted functions SWS, MB, STS, CR, and TR which have index values less than 1.0.

Again, using the Subscores tab of the SFAM Workbook and the same process as described above for Restoration Scenario #1, all measures that could potentially improve the targeted functions are identified; there are ten (**Table 7.1**). In this scenario, most of the function measure scores identified that have index values less than 1.0 (OBFlow, Incision, Exclusion, Armor, WetVeg, WoodyVeg, SideChan and RipWidth) are largely a result of armoring and other structures related to streamside development that disconnect the stream from its floodplain. Therefore, removal of these impediments to floodplain access and restoration of those areas will greatly improve stream function; these actions are a significant aspect of this restoration scenario.

As with Restoration Scenario #1, specific restoration design elements are informed by evaluating the physical changes needed to improve each of these ten measures. The evaluation includes reviewing the measure description, baseline assessment index value, and in some cases, "what if" exercises for each of these measures to evaluate the effect of possible actions on targeted functions. Combining this information with knowledge of the project site, professional experience, potential constraints to restoration activities, and cost considerations results in the following proposed restoration elements for our second scenario:

- Removal of all armoring and constraints to lateral migration within 100 feet of the stream in the PAA (which encompasses all the 100-year floodplain).
- Reshaping the stream banks in the PAA, providing better stream connection to the floodplain.
- Construction of an approximately 150 feet (54% of the EAA length) side channel to carry water during the wet season.
- Placement of 12 additional pieces of large in-stream wood in the PAA.
- Construction of three in-channel pools in the PAA.
- Planting woody and herbaceous wetland plants within 50 feet of the stream in the PAA.
- Removing invasive plants and implementing a program to control invasive vegetation in the PAA.
- Creating and managing all area within 100 feet of the stream in the PAA as a 'natural' riparian area.

Step 4 describes how to project changes to function measure inputs and predict the overall outcome of these restoration activities on stream function as determined by SFAM.

Table 7.1. Restoration Objectives and Design Elements for Restoration Scenarios.

	Restoration Scenario #1	**Restoration Scenario #2**
Target Functions	SWS, TR	SWS, MB, STS, CR, and TR
Target measures (contribute to the target function and have a baseline index value less than 1.0)	Wood, Cover	OBFlow, Incision, Exclusion, BedVar, Wood, SideChan, InvVeg, WoodyVeg, WetVeg, RipWidth
Proposed restoration design elements improving the targeted functions	Placement of 12 additional pieces of wood; streamside planting of woody shrubs and forbs to provide 27% additional natural cover.	Removal of all armoring and constraints to lateral migration within 100 feet of the stream (which encompasses all of the 100-yr floodplain); Reshaping the stream banks, providing better stream connection to the floodplain; Construction of a 150 feet long (54% of the EAA length) side channel to carry water during the wet season; Placement of 10 pieces of large wood in-stream; Construction of three in-channel pools in the PAA; Planting woody and herbaceous wetland plants within 50 feet of the stream; Removing invasive plants and implementing a program to control invasive vegetation; Creating and managing all area within 100 feet of the stream as a 'natural' riparian area.

Step 4. Use SFAM to Predict Restoration Outcomes

To predict the outcome of restoration activities on stream function, use the SFAM baseline assessment as a tool in which to make predictive changes to the function measure inputs. The SFAM Workbook will calculate the resulting changes to the function scores and ratings. Recall that SFAM value measures are largely landscape-scale based and are not expected to change with most restoration projects. They are assumed constant for this exercise, as are all baseline assessment

Cover Page inputs.

As seen above in Restoration Scenario #1 with the Wood measure example (**Figure 7.3** and **Figure 7.4**) the SFAM Workbook can be used to evaluate changes in SFAM outputs resulting from changes in SFAM function measure inputs. It can also be used to evaluate changes to groups of measures or to evaluate projections over time as restoration elements develop (e.g., trees and shrubs mature, providing more cover and shade). Using each of our two scenarios, below we predict changes to function measure inputs 10 years post-restoration and calculate the associated changes to function scores/ratings.

Predicting changes to measure inputs

Restoration Scenario #1 - Use the projected measure input values, determined above during the "what if" exercise, for Wood and Cover:

1) Additional wood placement, 13 total pieces (12 added pieces plus one piece identified in baseline assessment) for a measure input value of 15.23 (pieces per 328 feet).
2) Native shrub and forb planting for stream-side cover, such that projected (ten-year) Cover is 95%.

Restoration Scenario #2– Determining projected function measure inputs for this scenario is more complicated than for Restoration Scenario #1.

Based on the target functions, associated measures, and restoration elements identified in Step 3 above (**Table 7.1**), Restoration Scenario #2 is an extensive restoration which aims to reconnect the stream with its floodplain, rehabilitate the riparian community, and increase in-channel complexity. Implementation of this restoration plan is expected to result in the following specific function measure input changes. Any measure not mentioned is assumed to stay at the baseline assessment value.

- Reduce Armor from 54% to 0%
- Reduce LatMig from 13% to 0%
- Reduce Exclusion to below 20%
- Increase Wood from 1.17 to 15.23 pieces per 100 m (328 ft)
- Increase SidChan from 0% to 54%
- Increase RipWidth from 27 feet to 100 feet
- Increase Cover from 68% to 95%
- Increase WoodyVeg from 46% to 60%
- Reduce InVeg from 54 to 0%
- Reduce Incision (BHR) from 1.75 to 1.30
- Increase BedVar depth variation from 0.31 to 0.42
- Increase BedVar width variation from 0.27 to 0.40
- Decreased incision and increased channel complexity are expected to result in much more frequent floodplain inundation events and therefore direct observations of overbank flow (i.e., OBFlow = "yes")
- Increase the extent of riparian Wetland Vegetation beyond 0.5 × BFW to achieve wetland plant distribution along more than 70% of the length of the PAA

Projecting the above expected values for specific function measures ten years post-restoration requires a clear understanding of how each of the measures are assessed and scored using SFAM, a well-designed and executed restoration plan, and knowledge about how stream and riparian structure is likely to change in response to the restoration actions for the restored stream reach within its landscape context.

For many function measures, projecting the 10-year post-restoration SFAM inputs is relatively straightforward based on the restoration design, assuming the design is implemented as planned. For example, the plan above includes "removal of all armoring and structures that restrict the stream's access to the floodplain," therefore projecting that Armor, LatMig and Exclusion will be at or near 0% is reasonable. Similarly, designs for SideChan and RipWidth call for a riparian buffer width of 100 feet and a 150 feet-long SideChan (54% of the EAA length). These projections can be entered directly into the Field Forms or Functions tab of the SFAM Workbook. For projecting the Wood measure, it is helpful to use the EAA Field Form worksheet to calculate the needed input (pieces per 328 feet) for the SFAM Functions tab. This can be done by entering the number of pieces of wood expected to be within the EAA following restoration activities. This scenario assumes that all the placed and existing wood would remain in the PAA after ten years. It might be reasonable to expect that some of the placed wood would be lost from the reach, in which case the projections should include only the wood pieces that are expected to remain in the EAA after ten years. Alternatively, the restoration design could account for expected losses of wood by replacing any lost wood such that the target amount of 13 pieces is maintained after ten years.

For the more data-driven function measures (i.e., vegetation cover and physical habitat measures) one approach for projecting input values to use for a ten-year post-restoration prediction is to use the Field Form worksheets from the baseline assessment and, based on the restoration design and best professional judgement, enter adjusted data for function measures that are consistent with expected restoration outcomes. For example, in the current scenario the restoration plan includes constructing three pools within the PAA to increase channel bed variability (BedVar measure). If the anticipated depth of those pools is between 2 and 2.5 feet, a new thalweg depth coefficient of variation (CV) can be estimated by replacing several of the baseline assessment depth measurements with estimated measurements consistent with the expected pools. **Figure 7.5** highlights predicted thalweg depth changes, and resultant predicted CV, from constructing three pools in the PAA; the predicted CV is then entered as the value for the thalweg depth submeasure (BedVar measure) in the predicted SFAM Workbook.

Baseline thalweg depths:

Thalweg Depth (F17)

Record the thalweg depth at 10 equidistant points between each cross-channel transect while moving upstream.

Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10
0.8	1	0.9	0.9	0.9	0.7	0.9	0.8	0.6	0.7
0.6	0.4	0.7	0.8	0.7	0.8	0.8	1	1	1
0.6	0.6	0.7	1	0.9	0.9	1	0.8	0.8	0.6
1	1.4	1.3	1	1	0.7	0.6	0.6	0.6	0.4
1	0.8	1	1	1	0.9	1.3	1.7	1.8	1
0.8	0.6	0.6	0.8	0.8	0.7	0.9	1	0.9	1.4
0.8	0.5	0.6	0.6	0.6	0.7	0.9	1	0.6	0.7
1	1.1	0.9	0.6	1.2	1.2	1	1	0.6	0.7
0.7	0.9	0.8	1.5	0.9	0.8	0.6	0.6	0.9	1.2
0.8	0.6	0.8	0.8	0.6	1.3	1.6	1.4	1.2	1.3

Baseline calculated CV

Thalweg Depth - CV (F17)
0.31

Predicted thalweg depths:

Thalweg Depth (F17)

Record the thalweg depth at 10 equidistant points between each cross-channel transect while moving upstream.

Depth 1	Depth 2	Depth 3	Depth 4	Depth 5	Depth 6	Depth 7	Depth 8	Depth 9	Depth 10
0.8	1	0.9	0.9	0.9	0.7	0.9	0.8	0.6	0.7
0.6	0.4	0.7	0.8	0.7	0.8	0.8	1	1	1
0.6	0.6	0.7	1.5	2	2.4	2	1.4	0.8	0.6
1	1.4	1.3	1	1	0.7	0.6	0.6	0.6	0.4
1	0.8	1	1	1.5	2	2	1.9	1.8	1
0.8	0.6	0.6	0.8	0.8	0.7	0.9	1	0.9	1.4
0.8	1.4	1.5	2	2.2	2	1.5	1	0.6	0.7
1	1.1	0.9	0.6	1.2	1.2	1	1	0.6	0.7
0.7	0.9	0.8	1.5	0.9	0.8	0.6	0.6	0.9	1.2
0.8	0.6	0.8	0.8	0.6	1.3	1.6	1.4	1.2	1.3

Predicted CV

Thalweg Depth - CV (F17)
0.42

Figure 7.5 Baseline and predicted thalweg depth measurements and calculated coefficient of variation (CV) values.

Excerpted from SFAM EAA Field Form worksheets. Yellow cell entries have been changed from the baseline measurements to estimated measurements representing the additional pools in the restored stream.

Another approach for projecting input values can be used when there is insufficient information available to predict field measurement changes as described above. The approach is to assume a categorical standard performance index rating (lower, moderate, higher) for a projected measure, and enter a corresponding value for that measure resulting in a standard performance index value at the mid-point of the predicted index rating category. Recall that each function measure is translated into an index value using scientifically based standard performance indices (See **Section 4.1** of the SFAM Idaho Scientific Rationale document) for a description of standard performance indices). Index values 0-<0.3 represent 'lower', 0.3-0.7 'moderate', and >0.7-1.0 'higher' contribution to function. Thus, the mid-point of each of these standard performance index categories equals 0.15, 0.5, and 0.85 for 'lower', 'moderate' and 'higher,' respectively. To project a function measure value using these performance categories, the measure input that corresponds with a mid-point index value (0.15, 0.5, or 0.85) needs to be entered into the function measure cell (yellow) in the Functions tab of the SFAM Workbook. The appropriate input can be identified using the standard performance index graphs and equations in the SFAM Idaho Scientific Rationale document (**Section 4.2**), or by simply changing the input value in the measure input cell until the target index value (0.15, 0.5 or 0.85) is displayed in the green "measure score" box.

Predicted SFAM Outputs

To calculate predicted SFAM outputs, use the completed baseline assessment SFAM Workbook as a template and change the affected function measure input values as described above. Be sure to save this as a new SFAM Workbook (check 'Predicted' box on the Workbook Cover Page). Once function measure inputs are changed, the function scores will be calculated automatically and available on the Scores tab.

Figure 7.6 summarizes the changes to the function measures and resulting outputs (scores/ratings) for each predicted assessment compared with the baseline assessment.

Restoration Scenario #1 (added Wood and Cover) improved four of the 11 Functions (SWS, MB, STS and TR) from 'lower' functioning to 'moderate' functioning and increased the total sum of all function scores from 44.5 to 51.1, a 14.8% increase.

The comprehensive floodplain reconnection and riparian restoration of Restoration Scenario #2 predicts that all functions will now have a 'higher' rating and raised the sum of all function scores to 93.61, more than double the baseline score of 44.61.

SFAM input (entered into 'Function' page):	Baseline	Scenario #1	Scenario #2
F1 Cover	68	95	95
F2 InvVeg	54	54	0
F3 WoodyVeg	46	46	60
F4 LgTree	14	14	14
F5 RipWidth	27	27	100
F6 Barriers	None	None	None
F7 Exclusion	>80%	>80%	<=20%
F8 Armor	54	54	0
F9 Erosion	12	12	0
F10 OBFlow	No	No	Yes
F11 WetVeg Q1	Yes	Yes	Yes
F11 WetVeg Q2	No	No	Yes
F11 WetVeg Q3	No	No	Yes
F12 SideChan	0	0	54
F13 LatMigr	13	13	0
F14 Wood	1.17	15.23	15.23
F15 Incision	1.75	1.75	1.3
F16 Embed	7	7	7
F17 BedVar (wet width)	0.27	0.27	0.4
F17 BedVar (depth)	0.31	0.31	0.42
Calculated Function ratings (scores):	**Baseline**	**Scenario #1**	**Scenario #2**
Suface Water Storage (SWS)	Lower (2.08)	Moderate (3.05)	Higher (8.02)
Sub/Surface Water Transfer (SST)	Lower (1.52)	Lower (1.52)	Higher (8.30)
Flow Variation (FV)	Higher (7.86)	Higher (7.86)	Higher (8.65)
Sediment Continuity (SC)	Moderate (6.45)	Moderate (6.45)	Higher (8.92)
Sediment Mobility (SM)	Moderate (4.43)	Moderate (4.43)	Higher (8.38)
Maintain Biodiversity (MB)	Lower (2.78)	Moderate (3.59)	Higher (7.55)
Create and Maintain Habitat (CMH)	Moderate (3.83)	Moderate (4.32)	Higher (7.44)
Sustain Trophic Structure (STS)	Lower (2.88)	Moderate (3.41)	Higher (9.41)
Nutrient Cycling (NC)	Moderate (3.04)	Moderate (3.63)	Higher (8.51)
Chemical Regulation (CR)	Lower (2.13)	Lower (2.13)	Higher (8.24)
Thermal Regulation (TR)	Moderate (6.66)	Higher (9.61)	Higher (9.61)

Figure 7.6 Predicted SFAM measure inputs and function outputs (ratings and scores) for Restoration Scenarios #1 and #2 relative to baseline assessment
Yellow indicates a projected change in measure input due to restoration activity and green highlights predicted change in function rating.

8.0 References

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9.0 Appendices

Appendix 1. Field Work Order of Operations

This quick-reference list can help guide your work in the field by providing the basic order of data collection steps. Read through the entire list before beginning your work. Reference the appropriate sections of the User Manual to find more information for specific instructions.

1. Survey the entire site
2. Locate the boundaries of the Project Area
3. Measure bankfull width at three designated areas within the Project Area
4. Establish Proximal Assessment Area boundaries (based on bankfull width measurements)
5. Lay out three survey transects (at same locations where bankfull width was measured)
6. Work along each of the three transects to collect data for:
    a. Natural Cover (F1)
    b. Invasive Vegetation (F2)
    c. Native Woody Vegetation (F3)
    d. Large Trees (F4)
    e. Vegetated Riparian Corridor Width (F5)
7. Survey the entire Proximal Assessment Area to collect data for:
    a. Fish Passage Barriers (F6)
    b. Exclusion (F7)
    c. Bank Armoring (F8)
    d. Bank Erosion (F9)
    e. Overbank Flow (F10)
    f. Wetland Vegetation (F11)
8. Establish Extended Assessment Area boundaries (based on bankfull width measurements)
9. Determine the appropriate transect interval (i.e., distance between each of 11 transects)
10. Moving downstream to upstream in the Extended Assessment Area, collect data for:
    a. Side Channels (F12)
    b. Lateral Migration (F13)
    c. Wood (F14)
    d. it is most efficient to collect data for these three measures at the same time you collect the transect data detailed in Step #11
11. At each of the 11 transects, collect data for:
    a. Wetted Width - submeasure of Channel Bed Variability (F17). This measurement should be collected first as it is used to determine the sampling interval for the embeddedness measure
    b. Incision (F15)
    c. Embeddedness (F16)
    d. Thalweg depth - submeasure of Channel Bed Variability (F17). This measurement is collected on each transect plus at nine evenly spaced locations between the transects

Appendix 2. Wetland-Associated Animal Species of Greatest Conservation Concern in Idaho

Source: Idaho State Wildlife Action Plan 2023. Prepared by Idaho Department of Fish and Game. January 2023 (Appendix 5, filtered for wetland and aquatic habitat types). https://idfg.idaho.gov/swap

Category	Common Name	Scientific Name
Fish	Bear Lake Sculpin	Cottus extensus
Fish	Bear Lake Whitefish	Prosopium abyssicola
Fish	Bonneville Cisco	Prosopium gemmifer
Fish	Bonneville Cutthroat Trout	Oncorhynchus clarkii utah
Fish	Bonneville Whitefish	Prosopium spilonotus
Fish	Bull Trout	Salvelinus confluentus
Fish	Burbot	Lota lota
Fish	Chinook Salmon (Snake River fall-run ESU)	Oncorhynchus tshawytscha
Fish	Chinook Salmon (Snake River spring/summer run ESU)	Oncorhynchus tshawytscha
Fish	Mountain Whitefish	Prosopium williamsoni
Fish	Northern Leatherside Chub	Lepidomeda copei
Fish	Pacific Lamprey	Entosphenus tridentatus
Fish	Sockeye Salmon (Snake River ESU)	Oncorhynchus nerka
Fish	Steelhead (Snake River Basin DPS)	Oncorhynchus mykiss irideus
Fish	White Sturgeon	Acipenser transmontanus
Fish	Wood River Sculpin	Cottus leiopomus
Fish	Yellowstone Cutthroat Trout	Oncorhynchus clarkii bouvieri
Amphibian/Reptile	Columbia Spotted Frog (Great Basin population)	Rana luteiventris
Amphibian/Reptile	Common Gartersnake	Thamnophis sirtalis
Amphibian/Reptile	Northern Leopard Frog	Rana pipiens
Amphibian/Reptile	Western Toad	Anaxyrus boreas
Amphibian/Reptile	Woodhouse’s Toad	Anaxyrus woodhousii
Mammal	Grizzly Bear (Selkirk–Cabinet population)	Ursus arctos horribilis
Mammal	Hoary Bat	Lasiurus cinereus
Mammal	Little Brown Myotis	Myotis lucifugus
Mammal	Moose	Alces alces
Mammal	Silver-haired Bat	Lasionycteris noctivagans
Mammal	Townsend’s Big-eared bat	Corynorhinus townsendii
Mammal	Western Small-footed Myotis	Myotis ciliolabrum
Mammal	Yuma Myotis	Myotis yumanensis
Raptor/Songbird	Common Nighthawk	Chordeiles minor
Raptor/Songbird	Great Gray Owl	Strix nebulosa
Raptor/Songbird	Greater Sage-Grouse	Centrocercus urophasianus
Raptor/Songbird	Mountain Quail	Oreortyx pictus
Raptor/Songbird	Olive-sided Flycatcher	Contopus cooperi

Category	Common Name	Scientific Name
Raptor/Songbird	Sharp-tailed Grouse	Tympanuchus phasianellus
Raptor/Songbird	Short-eared Owl	Asio flammeus
Raptor/Songbird	Trumpeter Swan	Cygnus buccinator
Raptor/Songbird	Wilson's Warbler	Cardellina pusilla
Waterbird	American Bittern	Botaurus lentiginosus
Waterbird	Black Tern	Chlidonias niger
Waterbird	California Gull	Larus californicus
Waterbird	Caspian Tern	Hydroprogne caspia
Waterbird	Cinnamon Teal	Anas cyanoptera
Waterbird	Clark's Grebe	Aechmophorus clarkii
Waterbird	Common Loon	Gavia immer
Waterbird	Eared Grebe	Podiceps nigricollis
Waterbird	Franklin's Gull	Leucophaeus pipixcan
Waterbird	Harlequin Duck	Histrionicus histrionicus
Waterbird	Long-billed Curlew	Numenius americanus
Waterbird	Northern Pintail	Anas acuta
Waterbird	Ring-billed Gull	Larus delawarensis
Waterbird	Sandhill Crane	Antigone canadensis
Waterbird	Western Grebe	Aechmophorus occidentalis
Waterbird	White-faced Ibis	Plegadis chihi
Invertebrates	Banbury Springs Limpet	Idaholanx fresti
Invertebrates	Bliss Rapids Snail	Taylorconcha serpenticola
Invertebrates	Bruneau Hot Springsnail	Pyrgulopsis bruneauensis
Invertebrates	Columbia River Tiger Beetle	Cicindela columbica
Invertebrates	Desert Valvata	Valvata utahensis
Invertebrates	Gillette's Checkerspot	Euphydryas gillettii
Invertebrates	Mission Creek Oregonian	Cryptomastix magnidentata
Invertebrates	Pilose Crayfish	Pacifastacus gambelii
Invertebrates	Raptor Fairy Shrimp	Branchinecta raptor
Invertebrates	Shortface Lanx	Fisherola nuttalli
Invertebrates	Shortspire Pondsnail	Ladislavella idahoensis
Invertebrates	Snake River Physa	Physella natricina
Invertebrates	Snake River Pilose Crayfish	Pacifastacus connectens
Invertebrates	Suckley Cuckoo Bumble Bee	Bombus suckleyi
Invertebrates	Western Bumble Bee	Bombus occidentalis
Invertebrates	Western Pearlshell	Margaritifera falcata
Invertebrates	Western Ridged Mussel	Gonidea angulata
Invertebrates	Yellow Bumble Bee	Bombus fervidus

Appendix 3. Rare Plants of Idaho That Are Commonly Wetland Indicators

Source: Idaho's Species Conservation Status list (https://idfg.idaho.gov/species/taxa/list), filtered for Idaho state rank (SRANK) of S1 (critically imperiled), S2 (imperiled), or S3 (rare or uncommon). The resulting list was then trimmed to species with wetland indicator status of FAC (facultative, equally likely to occur in wetlands or non-wetlands), FACW (facultative wetland, usually occur in wetlands), or OBL (obligate, occurs almost always in wetlands) using USACE's National Wetland Plant List (2020 NWPL, v. 3.5; https://wetland-plants.usace.army.mil/nwpl_static/v34/home/home.html). The NWPL was limited to the regions that occur in Idaho, which are AW (Arid West) and WMVC (Western Mountains, Valleys, and Coast).

Scientific Name	Common Name
Acorus americanus	Sweetflag
Allenrolfea occidentalis	Iodine Bush
Allium madidum	Swamp Onion
Allium validum	Tall Swamp Onion
Ammannia robusta	Grand Redstem
Andromeda polifolia	Bog-rosemary
Angelica kingii	Nevada Angelica
Antennaria arcuata	Meadow Pussytoes
Asclepias incarnata	Swamp Milkweed
Asplenium trichomanes	Maidenhair Spleenwort
Astragalus diversifolius	Meadow Milkvetch
Astragalus leptaleus	Park Milkvetch
Bacopa rotundifolia	Roundleaf Water-hyssop
Betula pumila	Swamp Birch
Bidens beckii	Beck's Water-marigold
Blechnum spicant	Deer-fern
Botrychium ascendens	Triangular-lobed Moonwort
Botrychium crenulatum	Crenulate Moonwort
Botrychium lunaria	Common Moonwort
Botrychium simplex	Least Moonwort
Calamagrostis tweedyi	Cascade Reedgrass
Callitriche marginata	Winged Water-starwort
Cardamine constancei	Constance's Bittercress
Carex aboriginum	Indian Valley Sedge
Carex abrupta	Abrupt Sedge
Carex buxbaumii	Buxbaum's Sedge
Carex californica	California Sedge
Carex chordorrhiza	String-root Sedge
Carex comosa	Bristly Sedge
Carex crawei	Craw Sedge
Carex flava	Yellow Sedge

Scientific Name	Common Name
Carex hendersonii	Henderson's Sedge
Carex idahoa	Idaho Sedge
Carex incurviformis	Maritime Sedge
Carex lachenalii	Artic Hare's-foot Sedge
Carex lacustris	Lake-bank Sedge
Carex leptalea	Bristle-stalked Sedge
Carex limosa	Mud Sedge
Carex livida	Pale Sedge
Carex pallescens	Pale Sedge
Carex podocarpa	Short-stalk Sedge
Carex rostrata	Beaked Sedge
Carex sheldonii	Sheldon's Sedge
Carex sychnocephala	Many-headed Sedge
Carex tenera	Slender Sedge
Carex vernacula	Native Sedge
Chrysosplenium tetrandrum	Northern Golden-carpet
Cicuta bulbifera	Bulb-bearing Waterhemlock
Claytonia multiscapa	Yellow Spring Beauty
Cleomella plocasperma	Alkali Cleomella
Corallorhiza wisteriana	Wister Coral-root
Corydalis caseana	Sierra Corydalis
Crassula aquatica	Water Pygmyweed
Cyperus bipartitus	Shining Flatsedge
Cyperus odoratus	Rusty Flatsedge
Cypripedium parviflorum	Small Yellow Lady's-slipper
Damasonium californicum	Fringed Waterplantain
Diphasiastrum alpinum	Alpine Clubmoss
Dodecatheon dentatum	White Shooting-star
Downingia bacigalupii	Bacigalupi's Downingia
Downingia insignis	Harlequin Calicoflower
Drosera intermedia	Spoon-leaved Sundew
Dryopteris cristata	Crested Shield-fern
Elaeagnus commutata	American Silverberry
Eleocharis elliptica	Slender Spike-rush
Eleocharis mamillata	Soft-stem Spikerush
Epilobium palustre	Swamp Willow-weed
Epipactis gigantea	Giant Helleborine
Erigeron humilis	Low Fleabane
Eriophorum viridicarinatum	Green Keeled Cotton-grass
Eryngium alismifolium	Inland Coyote-thistle

Scientific Name	Common Name
Euthamia graminifolia	Flat-top Fragrant-goldenrod
Gaultheria hispidula	Creeping Snowberry
Gentianella propinqua	Four-parted Gentian
Geocaulon lividum	Northern Comandra
Gymnosteris parvula	Small-flowered Gymnosteris
Heteranthera dubia	Grassleaf Mud-plantain
Howellia aquatilis	Water Howellia
Hydrophyllum occidentale	California Waterleaf
Hypericum majus	Large Canadian St. John's-wort
Isoetes minima	Midget Quillwort
Juncus brevicaudatus	Narrow-panicle Rush
Juncus bryoides	Moss Rush
Juncus hallii	Hall's Rush
Juncus hemiendytus	Herman's Dwarf Rush
Juncus tiehmii	Tiehm's Rush
Kobresia simpliciuscula	Simple Kobresia
Lepidium davisii	Davis' Peppergrass
Limosella acaulis	Southern Mudwort
Lomatogonium rotatum	Marsh Felwort
Ludwigia polycarpa	Many-fruit False-loosestrife
Lycopodiella inundata	Northern Bog Clubmoss
Maianthemum dilatatum	False Lily-of-the-Valley
Mertensia bella	Oregon Bluebells
Mimulus alsinoides	Chickweed Monkeyflower
Mimulus breviflorus	Short-flower Monkeyflower
Mimulus ringens	Allegheny Monkeyflower
Mitella nuda	Naked Bishop's-cap
Muhlenbergia glomerata	Marsh Muhly
Orogenia fusiformis	Turkey-peas
Oxalis trilliifolia	Trillium-leaved Wood-sorrel
Parnassia kotzebuei	Kotzebue's Grass-of-Parnassus
Petasites frigidus	Arctic Butter-bur
Phlox idahonis	Clearwater Phlox
Phlox kelseyi	Kelsey's Phlox
Picea glauca	White Spruce
Plantago eriopoda	Saline Plantain
Platanthera obtusata	Small Northern Bog-orchid
Platanthera orbiculata	Round-leaved Rein-orchid
Pogogyne floribunda	Profuseflower Mesamint
Pogogyne serpylloides	Thyme-like Mesamint

Scientific Name	Common Name
Porterella carnosula	Western Porterella
Potamogeton diversifolius	Water-thread Pondweed
Potentilla drummondii	Drummond's Cinquefoil
Potentilla plattensis	Platte River Cinquefoil
Primula alcalina	Alkali Primrose
Primula incana	Jones' Primrose
Psilocarphus brevissimus	Round Woolly-heads
Psilocarphus oregonus	Oregon Woolly-heads
Psilocarphus tenellus	Slender Woolly-heads
Pyrrocoma hirta	Tacky Goldenweed
Pyrrocoma racemosa	Clustered Goldenweed
Ranunculus pygmaeus	Pygmy Buttercup
Rhynchospora alba	White Beakrush
Ribes wolfii	Wolf's Currant
Romanzoffia sitchensis	Sitka Mistmaiden
Rubus bartonianus	Bartonberry
Rubus pubescens	Dwarf Red Blackberry
Rubus spectabilis	Salmonberry
Sagittaria rigida	Sessile-fruit Arrowhead
Salicornia rubra	Red Glasswort
Salix candida	Hoary Willow
Salix farriae	Farr's Willow
Salix glauca	Gray Willow
Salix pedicellaris	Bog Willow
Salix pseudomonticola	False Mountain Willow
Sanicula marilandica	Black Snake-root
Saxifraga adscendens	Ascending Saxifrage
Saxifraga cernua	Nodding Saxifrage
Scheuchzeria palustris	Pod Grass
Schoenoplectus subterminalis	Water Clubrush
Scirpus cyperinus	Wool-grass
Spiranthes diluvialis	Ute Ladies' Tresses
Spiranthes porrifolia	Western Ladies' Tresses
Streptopus streptopoides	Kruhsea
Sullivantia hapemanii	Purpus' Sullivantia
Symphyotrichum boreale	Rush Aster
Tauschia tenuissima	Leiberg's Tauschia
Teucrium canadense	American Germander
Thalictrum dasycarpum	Purple Meadow-rue
Trichophorum alpinum	Hudson's Bay Bulrush

Scientific Name	Common Name
Trichophorum pumilum	Rolland Bulrush
Trientalis europaea	Arctic Starflower
Trientalis latifolia	Western Starflower
Trifolium douglasii	Douglas' Clover
Utricularia gibba	Humped Bladderwort
Utricularia intermedia	Flatleaf Bladderwort
Utricularia ochroleuca	Northern Bladderwort
Vaccinium oxycoccos	Bog Cranberry
Vallisneria americana	Tapegrass

Appendix 4. Plant Species Considered Invasive in Idaho

Source: Invasive Species of Idaho (https://invasivespecies.idaho.gov/terrestrial-plants). Maintained by the Idaho State Department of Agriculture

Scientific Name	Common Name	Category
TERRESTRIAL SPECIES		
Cytisus	scotch broom (example)	Statewide Prohibited Genera
Genista	French broom (example)	Statewide Prohibited Genera
Spartium	Spanish broom (example)	Statewide Prohibited Genera
Chameacytisus	tagasaste (example)	Statewide Prohibited Genera
Heracleum mantegazzianum	giant hogweed	Statewide Early Detection Rapid Response (EDRR)
Galega officianalis	goatsrue	Statewide EDRR
Centaurea iberica	Iberian starthistle	Statewide EDRR
Impatiens glandulifera	policeman's helmet	Statewide EDRR
Centaurea calcitrapa L.	purple starthistle	Statewide EDRR
Zygophyllum fabago	Syrian beancaper	Statewide EDRR
Hieracium piloselloides	tall hawkweed	Statewide EDRR
Carduus cinereus	Turkish thistle	Statewide EDRR
Hieracium glomeratum	yellow devil hawkweed	Statewide EDRR
Centaurea virgata ssp. squarrosa	squarerose knapweed	Statewide EDRR
Imperata cylindrica	cogon grass	Statewide EDRR
Hyoscyamus niger	black henbane	Statewide Control List
Polygonum bohemicum	Bohemian knotweed	Statewide Control List
Solanum rostratum	buffalobur	Statewide Control List
Crupina vulgaris	common crupina	Statewide Control List
Isatis tinctoria	dyer's woad	Statewide Control List
Polygonum sachalinense	giant knotweed	Statewide Control List
Polygonum cuspidatum	Japanese knotweed	Statewide Control List
Sorghum halepense	johnsongrass	Statewide Control List
Nardus stricta	matgrass	Statewide Control List
Centaurea pratensis	meadow knapweed	Statewide Control List
Salvia aethiopis	Mediterranean sage	Statewide Control List
Carduus nutans	musk thistle	Statewide Control List
Hieracium aurantiacum	orange hawkweed	Statewide Control List
Sonchus arvensis	perennial sowthistle	Statewide Control List
Acroptilon repens	Russian knapweed	Statewide Control List
Cytisus scoparius	scotch broom	Statewide Control List
Anchusa arvensis	small bugloss	Statewide Control List
Echium vulgare	vipers bugloss	Statewide Control List
Hieracium caespitosum	yellow hawkweed	Statewide Control List

Scientific Name	Common Name	Category
Cirsium arvense	Canada thistle	Statewide Containment List
Linaria dalmatica ssp. dalmatica	Dalmatian toadflax	Statewide Containment List
Centaurea diffusa	diffuse knapweed	Statewide Containment List
Convolvulus arvensis	field bindweed	Statewide Containment List
Berteroa incana	hoary alyssum	Statewide Containment List
Cynoglossum officinale	houndstongue	Statewide Containment List
Aegilops cylindrica	jointed goatgrass	Statewide Containment List
Euphorbia esula	leafy spurge	Statewide Containment List
Milium vernale	milium	Statewide Containment List
Leucanthemum vulgare	oxeye daisy	Statewide Containment List
Lepidium latifolium	perennial pepperweed	Statewide Containment List
Carduus acanthoides	plumeless thistle	Statewide Containment List
Conium maculatum	poison hemlock	Statewide Containment List
Tribulus terrestris	puncturevine	Statewide Containment List
Lythrum salicaria	purple loosestrife	Statewide Containment List
Chondrilla juncea	rush skeletonweed	Statewide Containment List
Tamarix spp.	saltcedar	Statewide Containment List
Onopordum acanthium	scotch thistle	Statewide Containment List
Centaurea stoebe	spotted knapweed	Statewide Containment List
Senecio jacobaea	tansy ragwort	Statewide Containment List
Bryonia alba	white bryony	Statewide Containment List
Lepidium draba	whitetop	Statewide Containment List
Centaurea solstitialis	yellow starthistle	Statewide Containment List
Linaria vulgaris	yellow toadflax	Statewide Containment List
AQUATIC SPECIES		
Egeria densa	Brazilian elodea	Statewide EDRR
Hydrocharis morsus-ranae	common/European frogbit	Statewide EDRR
Cabomba caroliniana	fanwort	Statewide EDRR
Azolla pinnata	feathered mosquito fern	Statewide EDRR
Salvinia molesta	giant salvinia	Statewide EDRR
Hydrilla verticillata	hydrilla	Statewide EDRR
Netellopsis obtusa	starry stonewort	Statewide EDRR
Myriophyllum heterophyllum	variable-leaf milfoil	Statewide EDRR
Trapa natans	water chestnut	Statewide EDRR
Eichhornia crassipes	water hyacinth	Statewide EDRR
Nymphoides peltata	yellow floating heart	Statewide EDRR
Phragmites australis	common reed	Statewide Control List
Myriophyllum spicatum	Eurasian watermilfoil	Statewide Control List
Myriophyllum aquaticum	parrotfeather milfoil	Statewide Control List
Butomus umbellatus	flowering rush	Statewide Control List

Scientific Name	Common Name	Category
Iris pseudacorus	yellow flag iris	Statewide Containment List
Potamogeton crispus	curlyleaf pondweed	Statewide Containment List

Appendix 5. Online Resources Used for Idaho SFAM

The online resources in this appendix are listed in the order they appear in this User Manual.

Name	Organization	Website	Use in SFAM	Downloadable GIS Data?
Google Earth	Google	https://www.google.com/earth/versions/	Site map, V5, V12, V13, F5, F12, F13	No
Aerial Imagery	Microsoft	http://www.bing.com/maps/	Site map, V5, F5, F12, F13	No
StreamStats	USGS	https://streamstats.usgs.gov/ss	Cover page, V4	Yes
National Map Viewer	USGS	https://apps.nationalmap.gov/viewer/	Cover page, V1	Yes
Pacific Northwest Hydrologic Landscapes	USEPA	https://pasteur.epa.gov/uploads/268/PNW_HLs_41.5x36_v2_300dpi_060415.pdf	Cover page	No
Pacific Northwest Hydrologic Landscapes	USEPA	https://gaftp.epa.gov/EPADataCommons/ORD/HydrologicLandscapes/pnw_hydrologic_landscape_class.zip	Cover page	Yes
Geological Map of Idaho	Idaho Geological Survey	https://www.idahogeology.org/product/m-9	Cover page	Yes
Geological Map of Idaho	Idaho Geological Survey	https://www.idahogeology.org/WebMap/	Cover page	No
National Hydrography Dataset	USGS	https://apps.nationalmap.gov/viewer/	Cover page, V9, V14	Yes
Streamflow Duration Assessment Method for the Pacific Northwest	USEPA	https://www.epa.gov/measurements/streamflow- duration-assessment-method-pacific-northwest	Cover page	No
Level III Ecoregions	USEPA	https://idaho-epscor-gem3-uidaho.hub.arcgis.com/datasets/3a21a75ffc8244f6a1c85a19b8ff7713_0/explore	Cover page	Yes
Level III Ecoregions	USEPA	https://gaftp.epa.gov/EPADataCommons/ORD/Ecoregions/id/id_eco_lg.pdf	Cover page	No
Idaho State Wildlife Action Plan	IDFG	https://idfg.idaho.gov/swap	V1	No
Idaho Rare Plant List	Idaho Native Plant Society	https://idahonativeplants.org/rare-plants-list/	V1	No

Name	Organization	Website	Use in SFAM	Downloadable GIS Data?
Idaho Generalized Fish Distribution	IDFG	https://data-idfggis.opendata.arcgis.com/datasets/generalized-fish-distribution/explore	V1	Yes
305(b) Integrated Report Mapper	IDEQ	https://www.deq.idaho.gov/water-quality/surface-water/monitoring-and-assessment/	V1, V2	Yes
Protected Resources App	NOAA	https://www.webapps.nwfsc.noaa.gov/portal/apps/webappviewer/index.html?id=7514c715b8594944a6e468dd25aaacc9	V1	Yes
Idaho Crucial Habitat	IDFG	https://www.arcgis.com/apps/mapviewer/index.html?layers=01a6b9de82214764b8443416fabae6f5	V1	No
Idaho Species Diversity Database	IDFG	https://idfg.idaho.gov/species/	V1	Yes
Idaho Amphibian and Reptile iNaturalist Project	iNaturalist	https://www.inaturalist.org/projects/idaho-amphibian-and-reptile-inaturalist-project	V1	Yes
Idaho Reptiles	iNaturalist	https://www.inaturalist.org/guides/3184	V1	No
Idaho Amphibians	iNaturalist	https://www.inaturalist.org/guides/3183	V1	No
Important Bird Areas	Audubon Society	https://gis.audubon.org/portal/apps/sites/?_gl=1*v33xif*_ga*MTY1ODY5NDcyMS4xNjc4OTE4NTY5*_ga_X2XNL2MWTT*MTY4MDA0NDM3My4zLjEuMTY4MDA0NDQ4MS4yMS4wLjA.#/nas-hub-site/pages/data-review	V1	No
Idaho Species	iNaturalist	https://www.inaturalist.org/places/idaho	V1	No
Botany Publications - Idaho Natural Heritage Program	IDFG	https://idfg.idaho.gov/content/page/botany-publications-idaho-natural-heritage-program	V1	No
Idaho Conservation Sites	IDFG	https://www.arcgis.com/home/webmap/viewer.html?useExisting=1&layers=b1314f8e41c5483283637e1a7e37ae91	V3	No
National Flood Hazard Layer Viewer	FEMA	https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd	V6, V7, F7, F12	No
Idaho County Parcel Maps	State of Idaho	https://experience.arcgis.com/experience/6b5a52900b2e42908fbd813ce423adaa/	V7	No

Name	Organization	Website	Use in SFAM	Downloadable GIS Data?
Flood Map Service Center	FEMA	https://msc.fema.gov/portal/search#searchresultsanchor	V8	No
Fish Barriers	IDFG	https://data-idfggis.opendata.arcgis.com/datasets/9c52918f3a3645a586b1a93852c2bdb3/explore	V10, F6	Yes
Source Water Assessment and Protection	IDEQ	https://mapcase.deq.idaho.gov/swa/default.html?SRCID=E0007305	V11	Yes
Sole Source Aquifers	USEPA	https://epa.maps.arcgis.com/apps/webappviewer/index.html?id=9ebb047ba3ec41ada1877155fe31356b	V11	No
Idaho Minimum Stream Flow	IDWR	https://gis.idwr.idaho.gov/portal/home/webmap/viewer.html?useExisting=1&layers=28d7ff1b24744ea79630a70a017b4aaa	V15	No
National Wild and Scenic Rivers System	USFWS	https://www.rivers.gov/idaho.php	V15	No
Idaho Aquifer Recharge District Map	IDWR	https://idwr.idaho.gov/water-rights/aquifer-recharge-districts/map/	V15	Yes
Idaho Hydrologic Projects	IDWR	https://idwr.idaho.gov/water-data/projects/	V15	No
National Wetland Inventory	USFWS	https://fwsprimary.wim.usgs.gov/wetlands/apps/wetlands-mapper/	V16	Yes
National Wetland Plant List	USACE	http://wetland-plants. usace.army.mil/nwpl_static/index.html	F11, Appendix 3	No
Idaho’s Species Conservation Status list	IDFG	https://idfg.idaho.gov/species/taxa/list	Appendix 3	No

Appendix 6. Sample Field Forms

SFAM IDAHO Proximal Area Assessment (PAA) Field Data Form	Version 1.0	Assessment Timing:	Current conditions
Project Area Name: Cda Office Little NF Cda river	Date: 8/25/2022	Assessor: Rob Coulombe, Ryan Ramsey	

Print this form to take to the field. Only the defined print area is needed (i.e. not the data calculation columns). After collecting data in the field, transfer data into the Excel worksheet below using drop-down menus where available. Cells in the "Calculations" section and on the "Functions" tab will populate automatically.

What is the longitudinal length of the PAA?	**Natural Cover (F1):** Record densiometer readings from both left and right banks at each transect.				**See F2-F4 below**
		T1	T2	T3	
	Left	0	0	1	
100	Right	7	8	16	

Riparian Corridor (F5): Record the width (ft) of the riparian corridor at each PAA transect. If > 330 ft, enter 330.				**Barriers (F6):** Does a man-made structure limit fish passage (barrier, partial, unknown, none)?	**Exclusion (F7):** What % of the 100-yr floodplain is excluded due to features (<=20%, >20-40%, >40-80%, >80%)?
	T1	T2	T3	None	>20-40%
Left	330	330	330		
Right	0	0	0		

Invasive Vegetation (F2), Native Woody Vegetation (F3), and Large Trees (F4): For each of the three vegetation classes, record the start and end positions (distance from bankfull, to the nearest 0.1ft) of each occurrence along the length of the transect. Transects run perpendicular to the stream edge, from the bankfull edge to the lateral boundary of the PAA.

What is the length of the transect (ft)?	130

Vegetation transects are conducted on both banks. If it is physically or legally unfeasible to access one side, indicate which side was surveyed by selecting Left or Right from the dropdown menu.

Transect	Vegetation Class	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End	Start	End
1 (left)	InvVeg	0	4	8.1	9	10.2	13	17.5	18	19	20.1	22	85				
	Native WoodyVeg	0	17	32	42	47	130										
	LgTree																
1 (right)	InvVeg	0	0.8	3.6	4.6	15	15.6	54	57.1								
	Native WoodyVeg	70	130														
	LgTree																
2 (left)	InvVeg	0	14.5	19.4	23.2	25.2	46.3	52	54.7	57.1	60.8						
	Native WoodyVeg	0	3.6	6.5	7.2	9	11.2	25	130								
	LgTree																
2 (right)	InvVeg	58	59.4														
	Native WoodyVeg	57	58.6	75	130												
	LgTree																
3 (left)	InvVeg	0	5.3	6.5	15.2	16.5	38.4	58	63.4								
	Native WoodyVeg	0	13.5	15.2	26	37.5	130										
	LgTree																
3 (right)	InvVeg	0	2	45	65												
	Native WoodyVeg	0	50	85	130												
	LgTree	0	50														

Armor (F8) and Erosion (F9): Record start and end locations (ft) of bank armoring features and bank erosion evidence along the length of the PAA.

	Start	End	Start	End	Start	End	Start	End
Armoring (left)								
Armoring (right)	0	100						
Erosion (left)								
Erosion (right)								

Overbank Flow (F10): Is there evidence of overbank flow at least 0.5 × BFW from the bankfull edge? *(yes or no)*	NO
Wetland Vegetation (F11): Are there FACW or OBL wetland plants on the banks or in the floodplain? *(yes or no)*	YES
If yes, answer the following questions: If no, enter N/A	
→ Are any located > 0.5 × BFW from the bankfull edge?	YES
→ ...for more than 70% of the PAA length?	YES

SFAM IDAHO Extended Area Assessment (EAA) Field Data Form **Version 1.0** **Assessment Timing:** Current conditions

Project Area Name: Cda Office Little NF Cda river Date: 8/25/2022 Assessor: Rob Coulombe, Ryan Ramsey

Print this form to take to the field. Only the defined print area is needed (i.e. not the data calculation columns). After collecting data in the field, transfer data into the Excel worksheet below using drop-down menus where available. Cells in the "Calculations" section and on the "Functions" tab will populate automatically..

What is the total longitudinal length of the EAA (ft)?	750

Wood (F14): Tally each piece of wood along the EAA that measures > 4" diameter and is at least 5' long. You can record the location of the wood to avoid double counting.

0, 49, 230, 230 ,350, 350

Total = 6

Side Channels (F12) and Lateral Migration (F13): Record start and end locations (ft) of adjacent side channels and evidence of constraints to lateral migration along the length of the EAA.

	Start	End	Start	End	Start	End	Start	End	Start	End
Side channels (either side)	0	750								
Constraints to lateral migration (left)										
Constraints to lateral migration (right)	0	750								

Unique Features (V16): Note the presence of any unique habitat features throughout the EAA including, but not limited to: log jams, braided channels, >30% wetlands in floodplain, springs, seeps, cold water inputs, etc.

> 30 % wetlands

		Wetted Width (F17)	**Incision (F15)**		**Substrate Embeddedness (F16)**					**Thalweg Depth (F17)**									
		Record width and height at each cross-channel transect (round to nearest 0.1 ft).			Record % embeddedness (to the nearest quartile: 0, 25, 50, 75, 100) at 5 equidistant points along each cross-channel transect.					Record the thalweg depth at 10 equidistant points between each cross-channel transect while moving upstream.									
EAA Transect	Feet from EAA lower boundary	Wetted width	Bankfull height	Lowest floodplain height	Embed1	Embed2	Embed3	Embed4	Embed5	Depth1	Depth2	Depth3	Depth4	Depth5	Depth6	Depth7	Depth8	Depth9	Depth10
A	0	75	1.1	1.1	0	0	0	0	100	0.8	1	1	1.1	1.4	1.6	2	2.1	2.6	2.8
B	75	60.5	3.3	3.3	0	0	0	0	100	3	3.1	2.9	2.6	2.5	2.4	2	1.6	2.5	1.6
C	150	63.8	5.5	6.8	0	0	0	0	100	4.5	5.3	6	6.3	6.6	6.7	6.4	6.6	6.4	6.1
D	225	45.7	8.1	10.2	0	0	0	0	100	6.7	6.3	5.8	5	5.8	6	5.8	5.3	5.2	6.5
E	300	41.5	7.8	10	0	0	0	0	0	5.8	5.2	5.6	5.3	5.4	5.3	5.1	4.7	4.9	4.9
F	375	34.2	7.9	12	0	0	0	0	0	6	5.5	4.2	4.6	4.2	4.5	4.6	4.3	4.9	4.8
G	450	48.4	5.1	6.4	0	0	0	0	100	4	3.7	3	2.2	1.8	1.5	1.5	1.3	1.1	1.1
H	525	61.4	3.9	5	0	0	0	0	0	1.2	1.2	1.1	1.4	1.5	1.6	1.8	1.9	2.1	2.1
I	600	34	4.1	5.4	0	0	0	0	0	2.5	2.6	2.8	2.8	2.6	2.6	2.3	2.4	2	2.1
J	675	63.2	4.2	4.6	0	0	0	0	100	2	1.7	1.6	1.5	1.3	1.3	1.4	1	0.4	0.8
K	750	62.9	2.5	2.5	100	0	0	0	100										