A Functions-Based Stream Assessment Method

To Support Compensatory Mitigation Decisions in Oregon

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Webinar for Agency Testers
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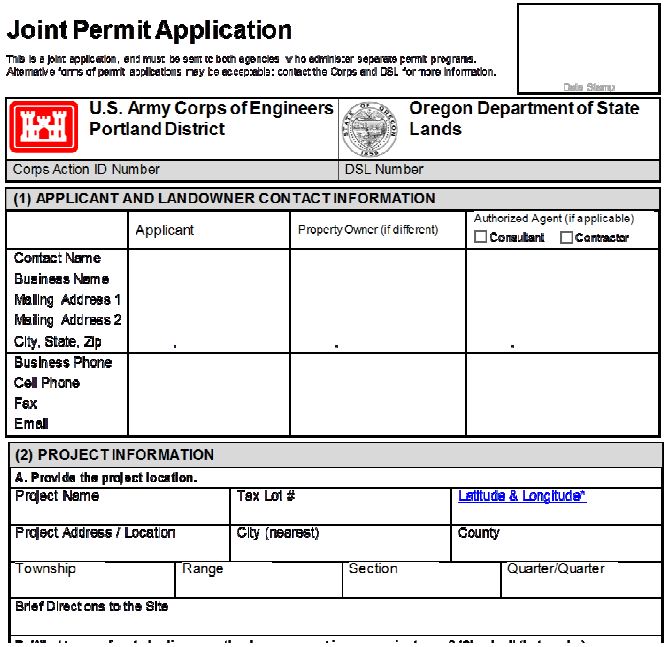
Presentation objectives:

Shared understanding of purpose, development history, and scientific underpinning of SFAM.

- Background on SFAM development
- Components of SFAM
  - Workbook - function & value measures, tabs
  - SFAM Map Viewer – functionality and SFAM Report
  - User Manual
  - Scientific Rationale
- SFAM implementation timeline

How is aquatic resource mitigation currently handled in Oregon?

- USACE and Oregon Department of State Lands collaboratively, but independently, administer a permit process to protect, conserve & provide for the best use of Oregon's aquatic resources. EPA co-administers the CWA 404 program with USACE.
- Mitigation is currently acreage-based; not relying on function assessments, not consistently mitigating for stream impacts, and not taking a watershed approach
- EPA, Corps, DSL have shared goals for improving the regulatory programs & mitigation outcomes



Joint Permit Application

This is a joint application, and must be sent to both agencies who administer separate permit programs. Alternative forms of permit applications may be acceptable; contact the Corps and DSL for more information.

Date Stamp

U.S. Army Corps of Engineers Portland District	Oregon Department of State Lands
Corps Action ID Number	DSL Number

(1) APPLICANT AND LANDOWNER CONTACT INFORMATION

	Applicant	Property Owner (if different)	Authorized Agent (if applicable) ☐ Consultant ☐ Contractor
Contact: Name Business Name Mailing Address 1 Mailing Address 2 City, State, Zip			
Business Phone Cell Phone Fax Email			

(2) PROJECT INFORMATION

A. Provide the project location.

Project Name	Tax Lot #	Latitude & Longitude*	
Project Address / Location	City (nearest)	County	
Township	Range	Section	Quarter/Quarter
Brief Directions to the Site			

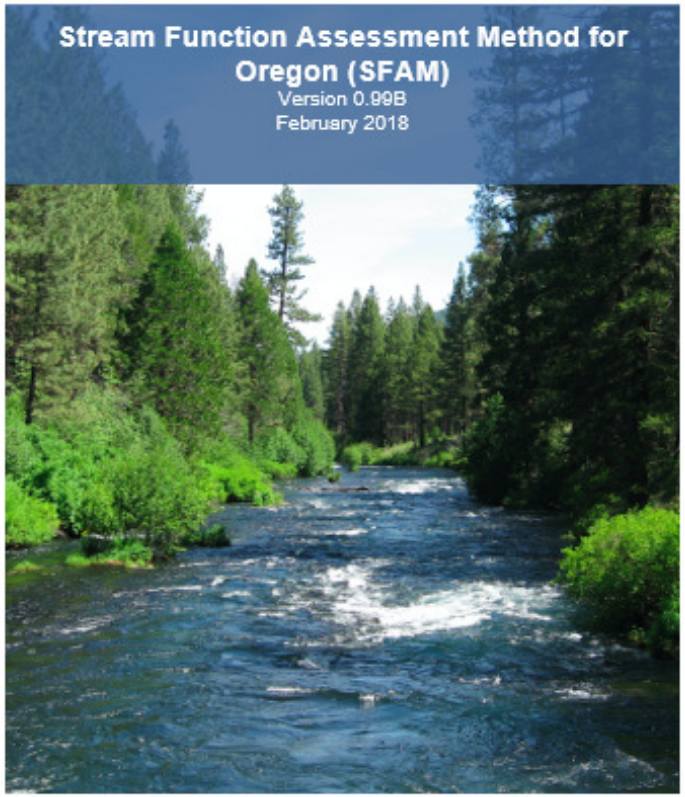
How will a stream function assessment method improve the mitigation process?

- Assist in determining ecological match for impacts
- Encourage applicants to strive for high degree of avoidance and minimization of impacts, and function/value replacement at mitigation sites
- Increase consistency in project evaluation
- Inform mitigation (restoration) designs
- Improve mitigation performance standards and outcomes
- Improve tracking of function/value gains and losses

What are the SFAM development objectives?

✓ *science-based* ✓ *rapid* ✓ *applicable statewide*
✓ *function-based* ✓ *repeatable*

- Designed and field tested to:
  - quantify <u>functions</u> and <u>values</u>
  - reflect landscape and watershed processes
- Applicable for non-regulatory purposes: assessment, restoration planning, project monitoring

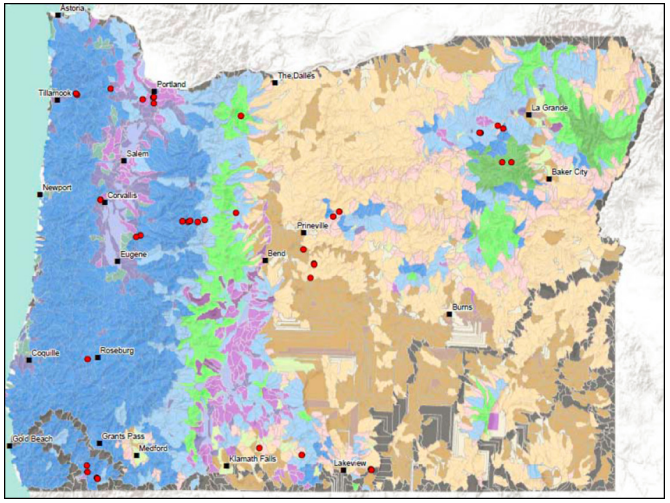


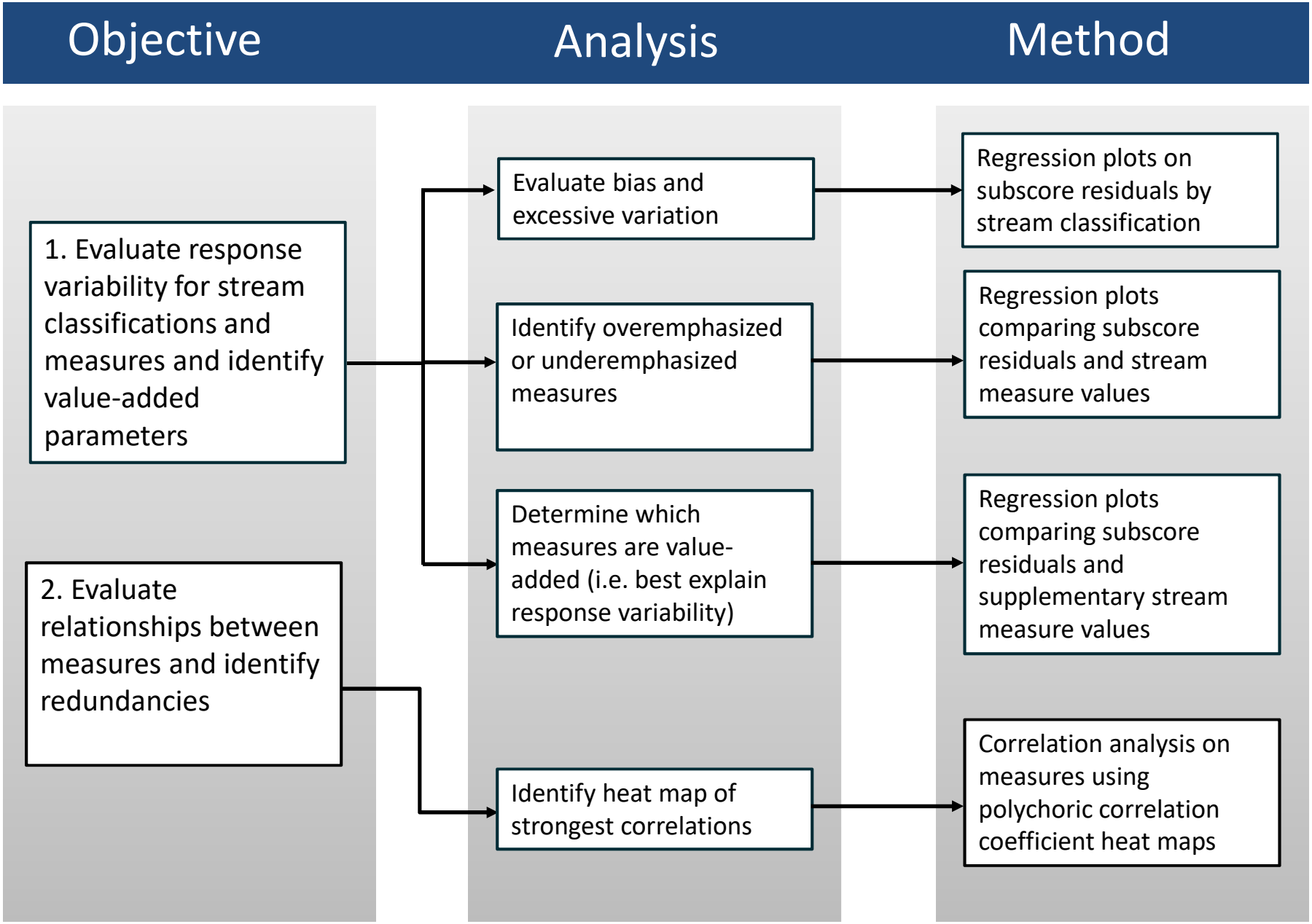
SFAM development history

2010-2013	- concept development - stream classification system development - initial method produced
2013-2014	- initial field testing
2014-2015	- revisions
2015-2016	- external review - statistical analysis
2016-2017	- revisions (models & measures) - statistical analysis - standard performance index development
2018	-pilot testing and final review

Initial Method: Field Testing

- Wet and dry seasons
- Range of streams and hydrologic landscapes
- Same field crew
  - Usability
  - Sensitivity
  - Repeatability
- Produced excellent QA/QC'd data set
- Provided BPJ evaluation of all stream functions
- Resulted in many improvements to SFAM





Statistical Analysis – First Round

Iterative Statistical Analysis

- Round one analysis, and extensive peer review, led to many significant improvements
- Round two, best-fit modeling using field data to:
  - test for improved accuracy of each function
  - improve measure weighting in function calculations
  - evaluate response variability between the (iteratively) revised SFAM models and BPJ
- Resulted in more revisions

Defining stream functions & values

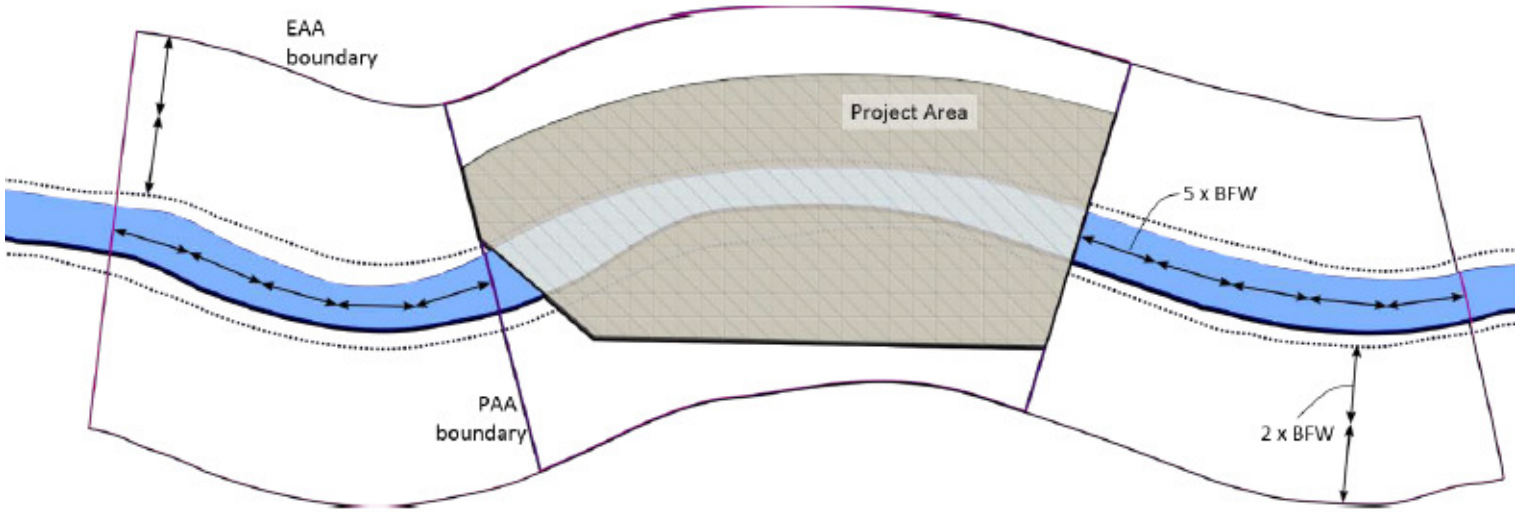
Function = *the processes that create and support a stream ecosystem*

Value = *the ecological and societal benefits that riverine systems provide*

- 11 functions were selected to represent the majority of stream and riparian processes necessary to sustain healthy stream ecosystems
- Each function has an associated value
- Functions are categorized within 4 functional groups

Function Group	Specific Functions/Values
Hydrologic	Surface Water Storage Sub/Surface Transfer Flow Variation
Geomorphic	Sediment Continuity Substrate Mobility
Biologic	Maintain Biodiversity Create and Maintain Habitat Sustain Trophic Structure
Water Quality	Nutrient Cycling Chemical Regulation Thermal Regulation

What is the assessment scale for SFAM?



<u>Assessment Area Delineations</u>:

Project Area (PA): Spatial extent of direct project impacts.

Proximal Assessment Area (PAA): Assessment area for functions likely to be directly affected by action in the PA. Includes the entire channel, both streambanks, riparian area, and upland adjacent to the PA.

Extended Assessment Area (EAA): Assessment area for functions that may be expressed at a reach scale.

Measuring stream functions

- Functions are difficult to directly measure within regulatory parameters, must be quantified using measures
- **16 measures** evaluate specific features characteristic of, or inherent to, the function and may indicate the extent to which a particular function is active

FUNCTION MEASURES:

- Natural cover
- Floodplain exclusion
- Wood
- Incision
- Embeddedness
- Overbank flow
- Wetland vegetation
- Plant composition (x3)
- Riparian buffer width
- Channel bed variability
- Lateral Migration
- Bank Erosion
- Bank Armoring
- Side Channels

Ecological function

Surface water storage

(ability to regulate discharge, replenish soil moisture, create low velocity habitat & refugia)

Function measures

- ✓ Quantifiable
- ✓ Rapid
- ✓ Repeatable
- ✓ Sensitive

side channels present?

variable channel bed?

incised channel?

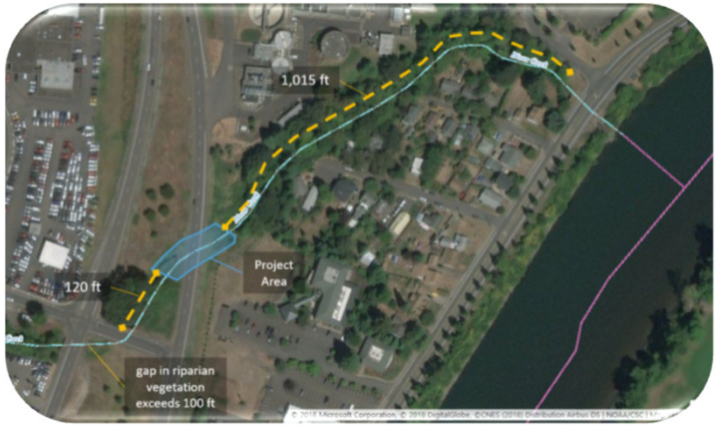
wood in stream?

. . .

Measuring stream values

- Values are assessed by evaluating the landscape context of a site (i.e. what is happening upstream & downstream)

- **16 value measures** determine the <u>opportunity</u> to provide a particular function and the <u>local significance</u> of that function

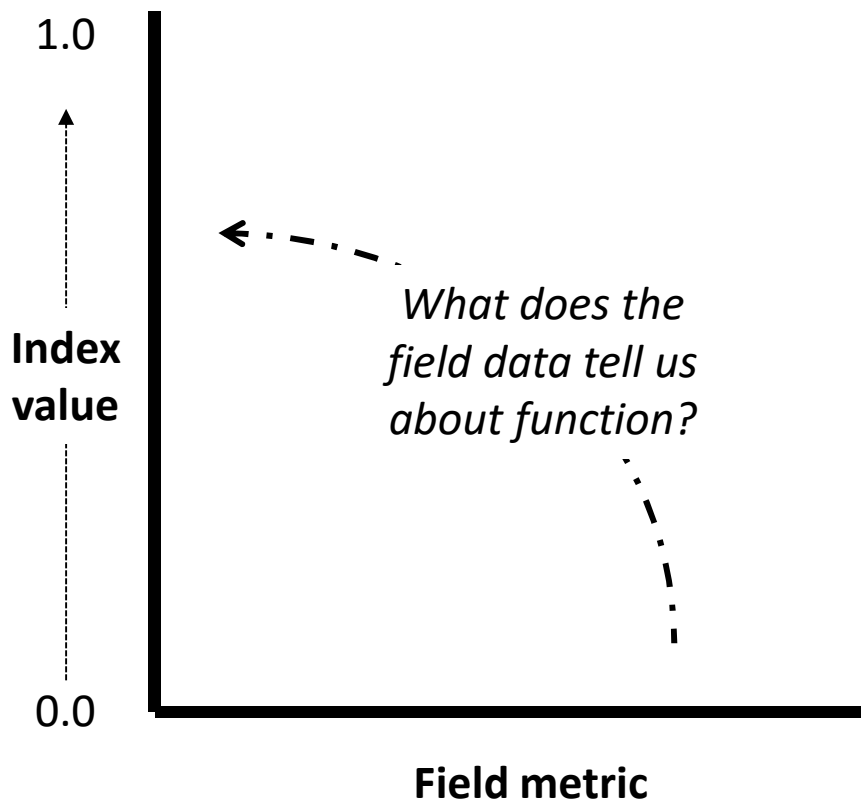


VALUE MEASURES:

- Rare Species
- Water quality impairments
- Protected areas
- Impervious area
- Riparian area
- Riparian continuity
- Downstream infrastructure
- Zoning
- Downstream flooding
- Impoundments
- Fish passage barriers
- Water source
- Land cover
- Watershed position
- Flow restoration needs
- Unique habitat features

How are function measures scored?

Standard performance indices were developed to translate measures' metrics (percentages, absolute values, ratios, etc.) into meaningful index values (scale of 0.0 – 1.0).



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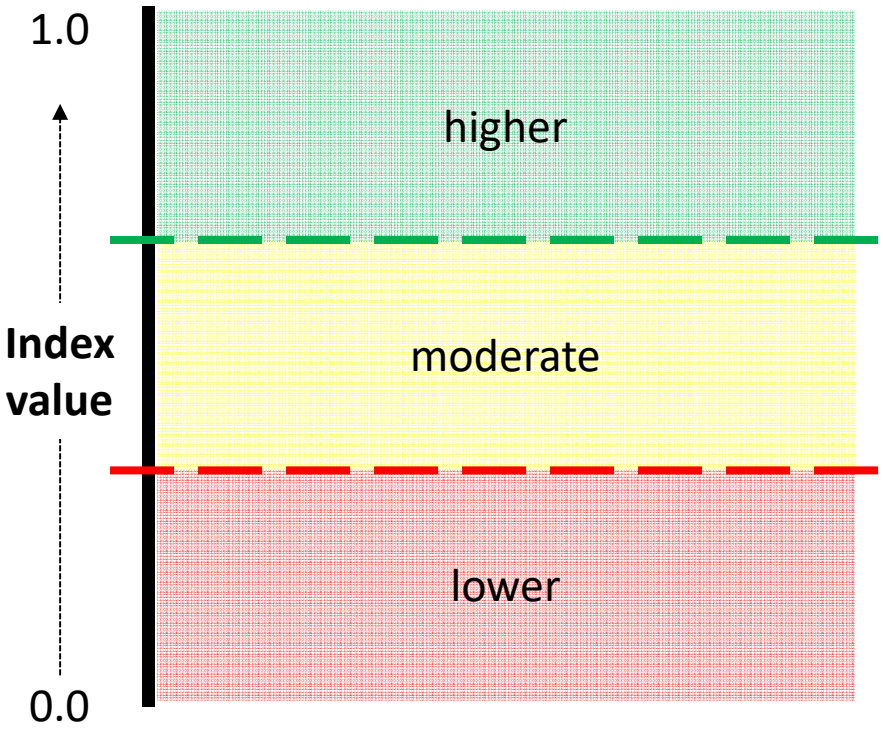

1. Set a standard index scale (give ecological meaning to the scores)

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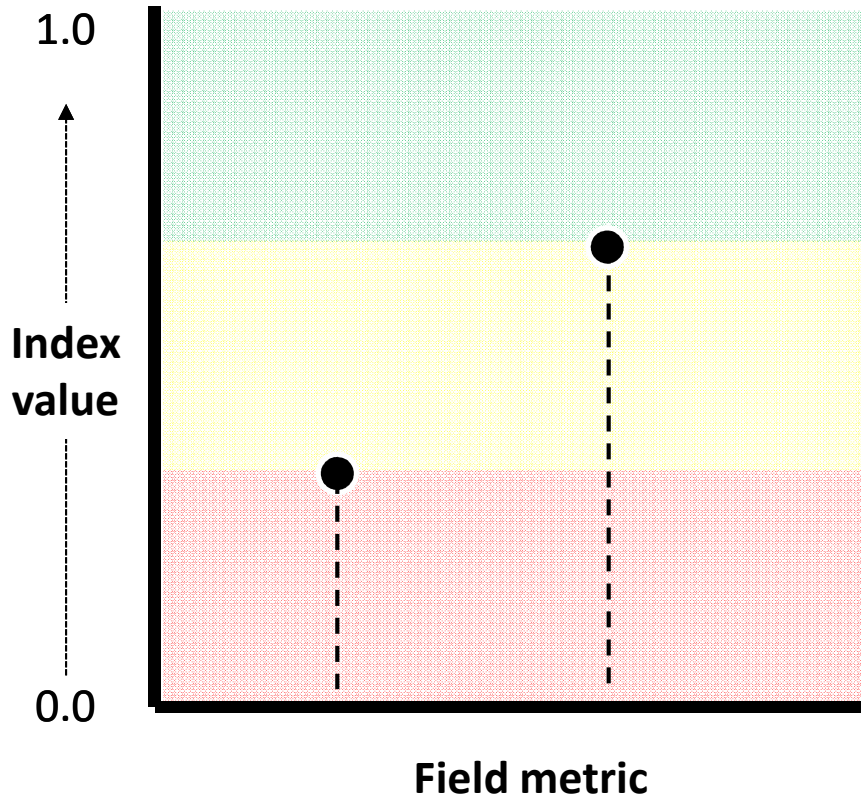

1. Set a standard index scale (give ecological meaning to the scores).

2. Look to literature and data to determine the metric values that correspond with the set thresholds.

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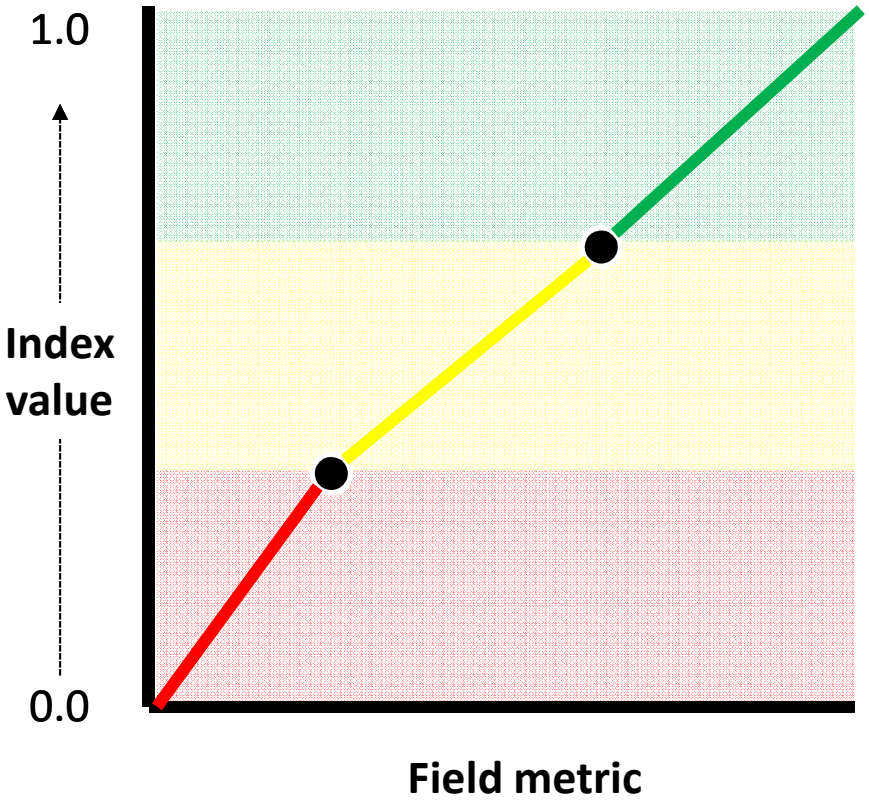
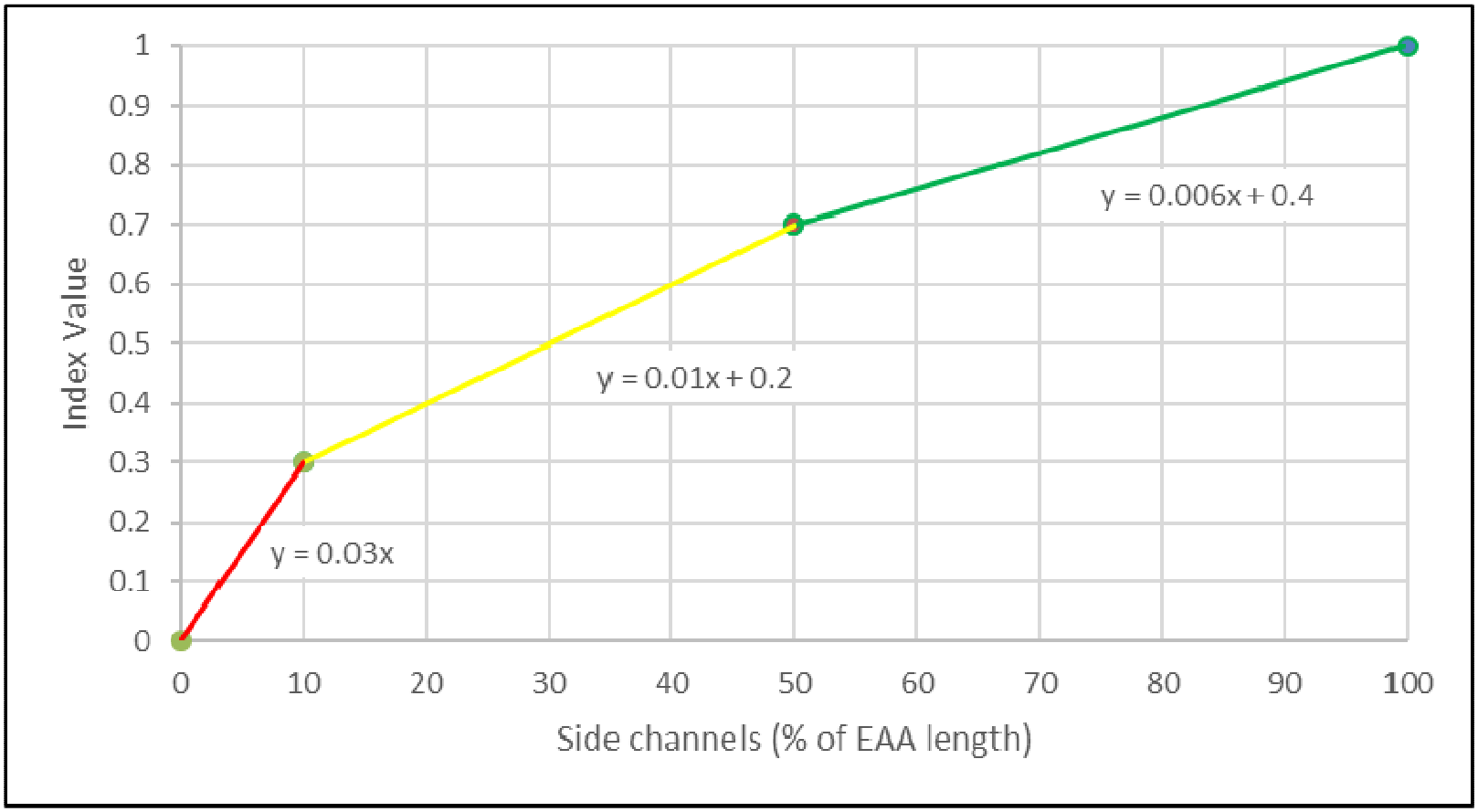


1. Set a standard index scale (give ecological meaning to the scores).
2. Look to literature and data to determine the metric values that correspond with the set thresholds.
3. Draw linear models between thresholds.

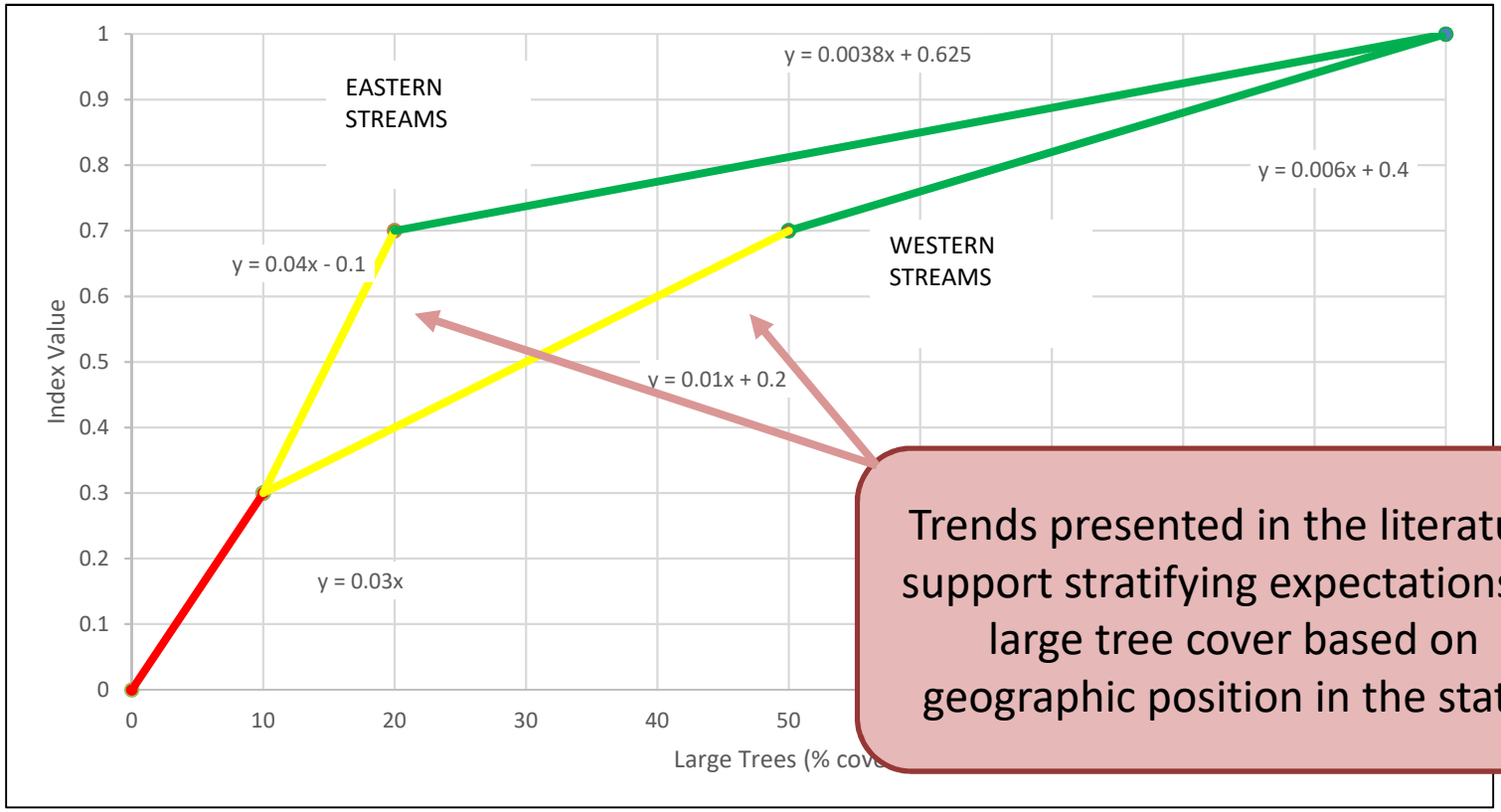
Example: Side Channels

What proportion of the Extended Assessment Area (EAA) length has side channels?



Example: Large Trees

What is the percent cover of large trees (dbh>20 inches) within the Proximal Assessment Area (PAA)?



Trends presented in the literature support stratifying expectations of large tree cover based on geographic position in the state.

Structure of formulas

- Measures often inform more than one function or value
- Some measures are weighted more heavily than others (determined through iterative statistical analysis)
- Formulas for each specific function and value produce a numerical *score* between 0.0 and 10.0.

Functions:

→ 0.0 = negligible function is being provided by the stream

→ 10.0 = stream is providing maximum function (as defined) given certain contextual factors (e.g. ecoregion, size)

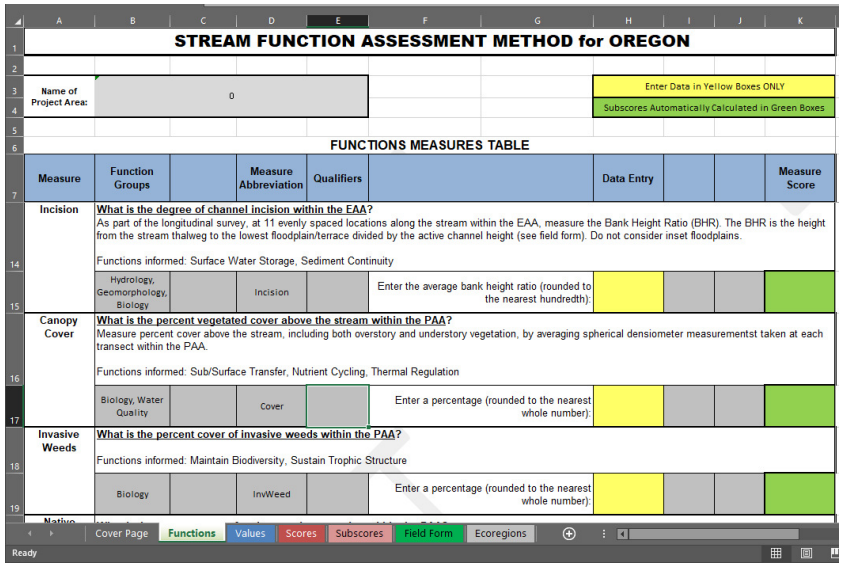
Values:

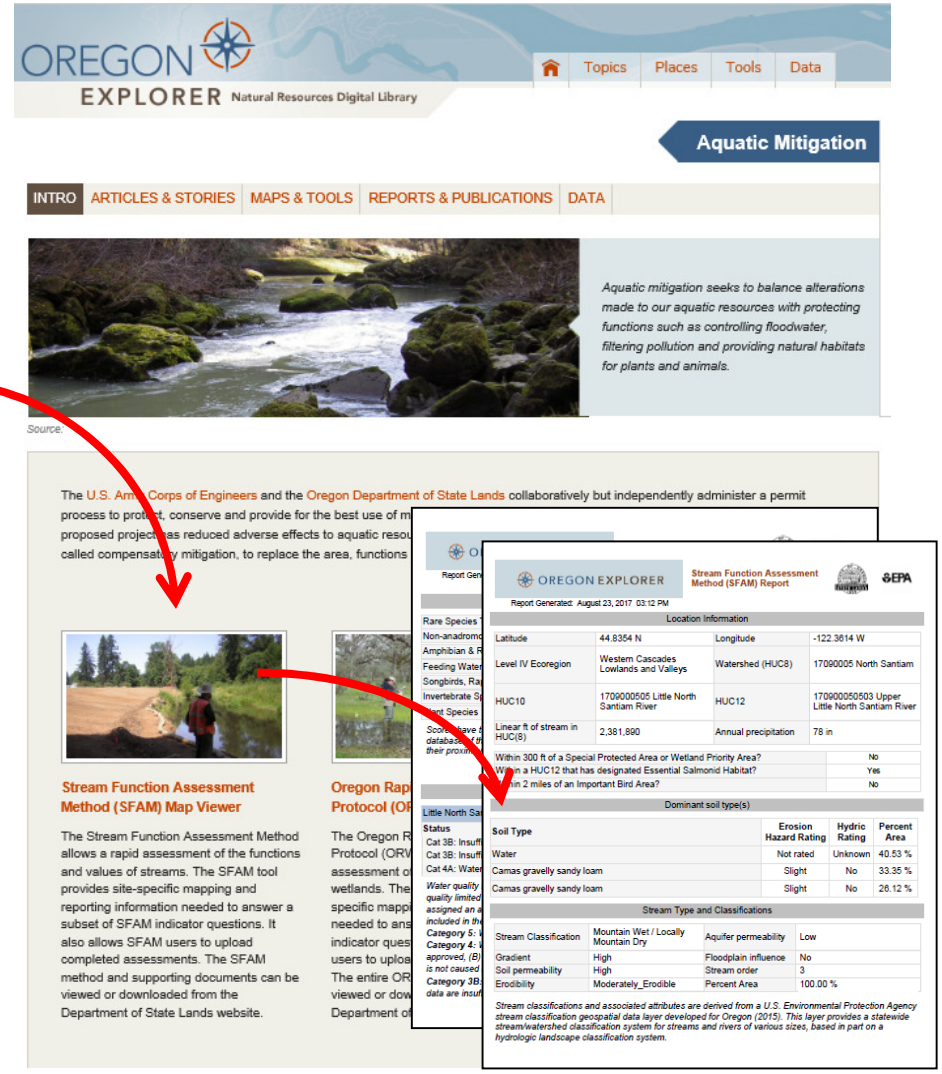
→ 0.0 = low opportunity for the site to provide a specific ecological function and, even if it did, the specific function would not be of particular significance given the context of the site

→ 10.0 = site has the opportunity to provide a specific function and it would be highly significant in that particular location

What are the components of SFAM?

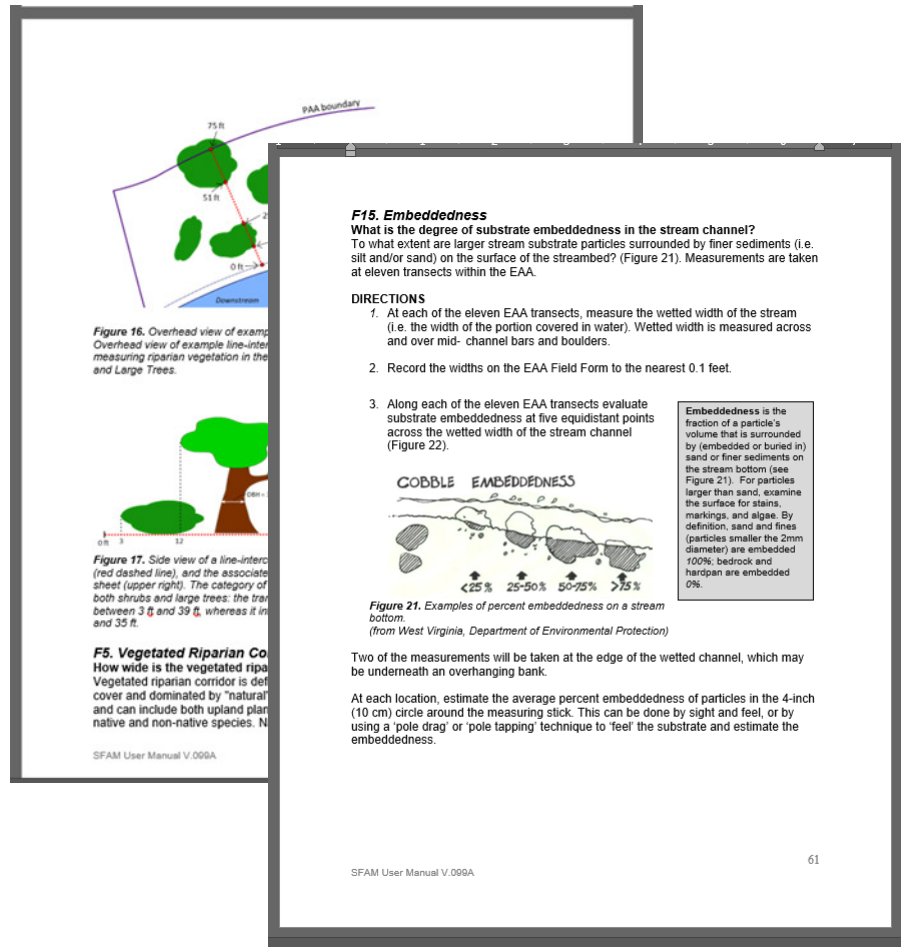
- Excel Workbook
- User Manual
- Scientific Rationale
- SFAM Map Viewer





SFAM User Manual

- Provides step-by-step instructions for both office and field components
- Includes diagrams and photos to visually explain field work steps
- Includes appendices with example data collection forms, order-of-operations cheat sheet, and instructions for using Map Viewer



F15. Embeddedness

What is the degree of substrate embeddedness in the stream channel?

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 21). Measurements are taken at eleven transects within the EAA.

DIRECTIONS

1. At each of the eleven 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.
2. Record the widths on the EAA Field Form to the nearest 0.1 feet.
3. Along each of the eleven EAA transects evaluate substrate embeddedness at five equidistant points across the wetted width of the stream channel (Figure 22).

Embeddedness is the fraction of a particle's volume that is surrounded by (embedded or buried in) sand or finer sediments on the stream bottom (see Figure 21). For particles larger than sand, examine the surface for stains, markings, and algae. By definition, sand and fines (particles smaller the 2mm diameter) are embedded *100%*; bedrock and hardpan are embedded *0%*.

Figure 21. *Examples of percent embeddedness on a stream bottom.*
(from West Virginia, Department of Environmental Protection)

Two of the measurements will be taken at the edge of the wetted channel, which may be underneath an overhanging bank.

At each location, estimate the average percent embeddedness of particles in the 4-inch (10 cm) circle around the measuring stick. 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.

SFAM User Manual V.099A

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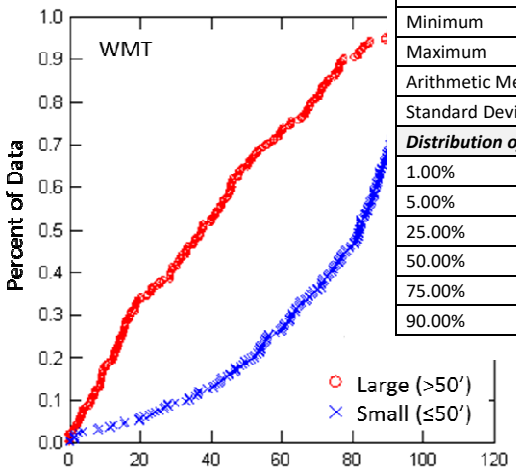
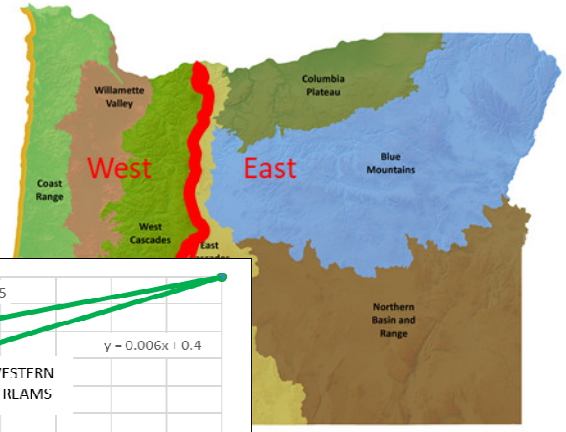
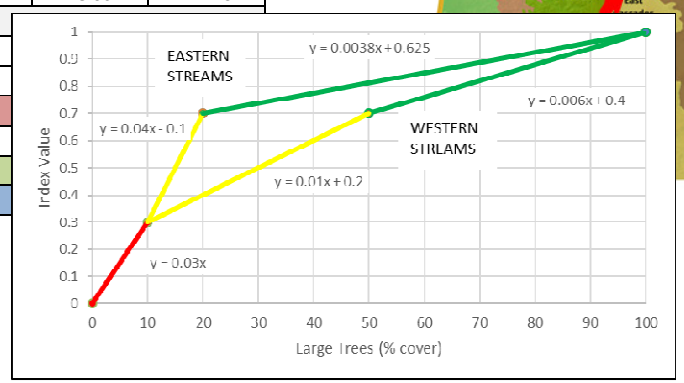
SFAM Scientific Rationale

- Document providing extensive information about performance indices, supporting scientific literature, and development processes
- Will be made available to users who want deeper understanding of tool & provides structural/functional background to facilitate future modifications



Natural Cover (%)				
Summary Statistics	***Western Mountains***		***Xeric***	
	Small (≤50')	*Large (>50')*	*Small (≤50')*	*Large (>50')*
Number of Sites	280	266	191	228
Minimum	0	0	0	0
Maximum	100	97.594	100	91.711
Arithmetic Mean	72.337	39.918	62.153	33.679
Standard Deviation	25.929	27.515	28.06	24.229
Distribution of Data				
1.00%	1.316	0		
5.00%	17.513	2.754		
25.00%	**55.882**	**14.973**		
50.00%	81.952	37.567		
75.00%	**92.246**	**62.567**		
90.00%	**98.262**	**77.54**		

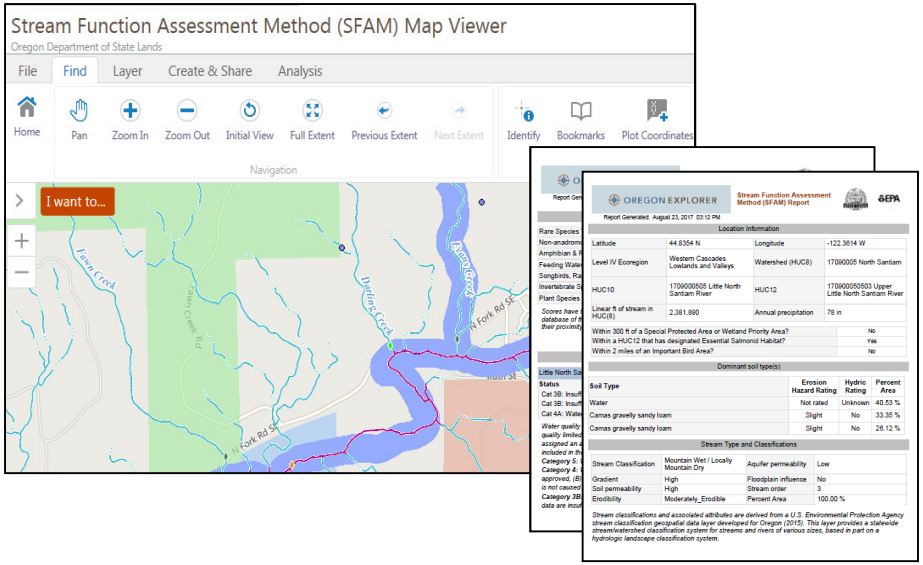


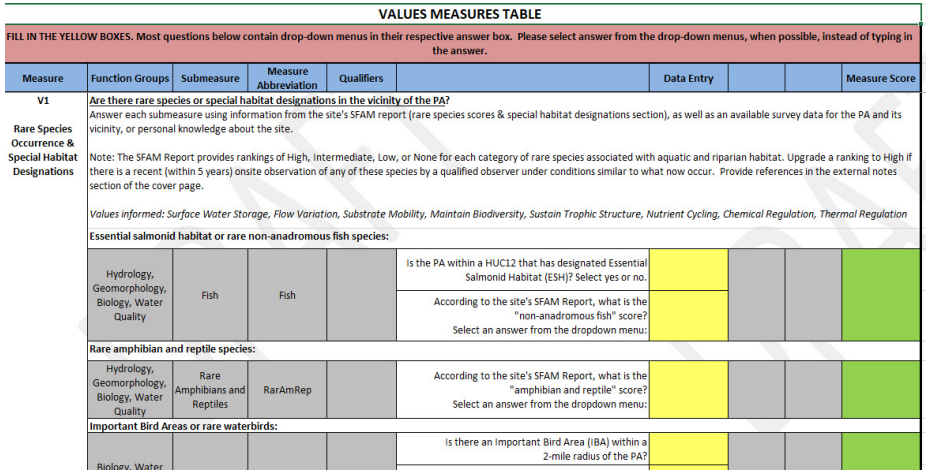


Conducting an SFAM assessment

Office component → Field component → Evaluate results

- Create site maps
- Produce an SFAM Report
- Complete 16 *values* measures using information from spatial data layers and SFAM Report





VALUES MEASURES TABLE

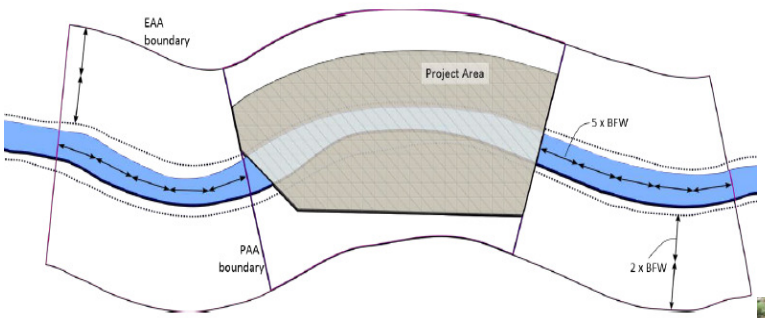
FILL IN THE YELLOW BOXES. Most questions below contain drop-down menus in their respective answer box. Please select answer from the drop-down menus, when possible, instead of typing in the answer.

Measure	Function Groups	Submeasure	Measure Abbreviation	Qualifiers		Data Entry			Measure Score
V1	**Are there rare species or special habitat designations in the vicinity of the PA?** Answer each submeasure using information from the site's SFAM report (rare species scores & special habitat designations section), as well as an available survey data for the PA and its vicinity, or personal knowledge about the site. Note: The SFAM Report provides rankings of High, Intermediate, Low, or None for each category of rare species associated with aquatic and riparian habitat. Upgrade a ranking to High if there is a recent (within 5 years) onsite observation of any of these species by a qualified observer under conditions similar to what now occur. Provide references in the external notes section of the cover page. *Values informed: Surface Water Storage, Flow Variation, Substrate Mobility, Maintain Biodiversity, Sustain Trophic Structure, Nutrient Cycling, Chemical Regulation, Thermal Regulation*								
Rare Species Occurrence & Special Habitat Designations	**Essential salmonid habitat or rare non-anadromous fish species:**								
	Hydrology, Geomorphology, Biology, Water Quality	Fish	Fish		Is the PA within a HUC12 that has designated Essential Salmonid Habitat (ESH)? Select yes or no.				
					According to the site's SFAM Report, what is the "non-anadromous fish" score? Select an answer from the dropdown menu:				
	Rare amphibian and reptile species:								
	Hydrology, Geomorphology, Biology, Water Quality	Rare Amphibians and Reptiles	RarAmRep		According to the site's SFAM Report, what is the "amphibian and reptile" score? Select an answer from the dropdown menu:				
	Important Bird Areas or rare waterbirds:								
	Biology, Water				Is there an Important Bird Area (IBA) within a 2-mile radius of the PA?				

Conducting an SFAM assessment

Office component → **Field component** → Evaluate results

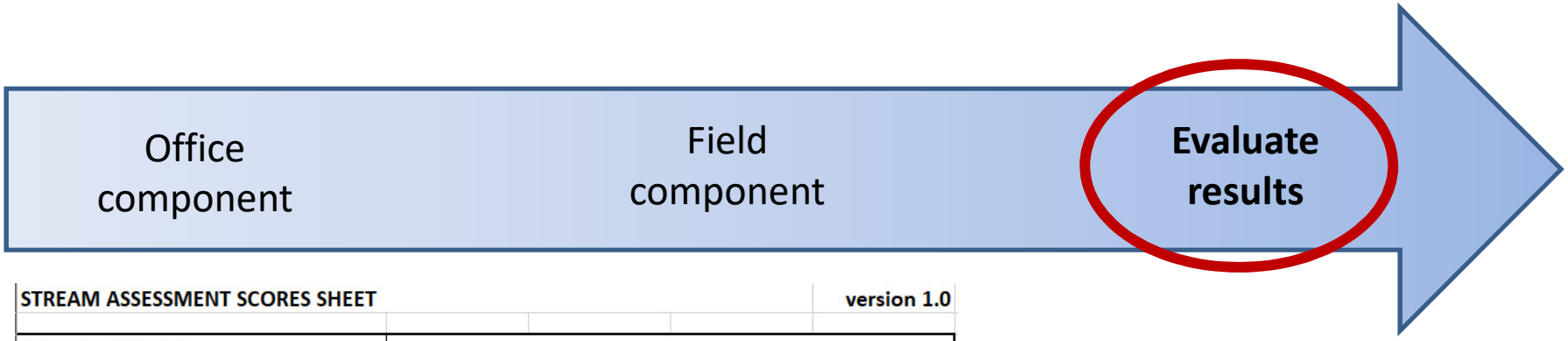
- Lay out assessment areas
- Complete 10 **PAA** *function* measures
- Complete 6 **EAA** *function* measures



FILL IN THE YELLOW BOXES. Most questions below require a numerical input. When possible, please select answer from the drop-down menus instead of typing in the answer.

Measure	Function Groups		Measure Abbreviation	Qualifiers		Data Entry			Measure Score
F1 Natural Cover	What is the percent natural cover above the stream within the PAA? Measure the percentage of cover above the stream, including both overstory and understory vegetation and overhanging banks, by averaging spherical densiometer measurements taken at each transect within the PAA. *Functions informed: Sub/Surface Transfer, Nutrient Cycling, Thermal Regulation*								
	Biology, Water Quality		Cover		Enter a percentage: *(round to nearest whole number)*				
F2 Invasive Vegetation	What is the percent cover of invasive vegetation within the PAA? Consider the Oregon Department of Agriculture Noxious Weed list and other sources of information, such as Oregon iMAPInvasives and iNaturalist. *Functions informed: Maintain Biodiversity, Sustain Trophic Structure*								
	Biology		InvVeg		Enter a percentage: *(round to nearest whole number)*				
F3 Native Woody Vegetation	What is the percent cover of native woody vegetation within the PAA? *Functions informed: Maintain Biodiversity, Create & Maintain Habitat*								
	Biology		WoodyVeg		Enter a percentage: *(round to nearest whole number)*				
F4 Large Trees	What is the percent cover of large trees (dbh>20in) within the PAA? *Functions informed: Maintain Biodiversity, Create & Maintain Habitat*								
	Biology		LgTree		Enter a percentage:				

Conducting an SFAM assessment



STREAM ASSESSMENT SCORES SHEET **version 1.0**

Project Area Name:				
Investigator Name:				
Date of Field Assessment:				
Latitude (decimal degrees):		Longitude (decimal degrees):		

SPECIFIC FUNCTIONS	Function Score	Function Rating	Value Score	Value Rating
Suface Water Storage (SWS)				
Sub/Surface Water Transfer (SST)				
Flow Variation (FV)				
Sediment Continuity (SC)				
Sediment Mobility (SM)				
Maintain Biodiversity (MB)				
Create and Maintain Habitat (CMH)				
Sustain Trophic Structure (STS)				
Nutrient Cycling (NC)				
Chemical Regulation (CR)				
Thermal Regulation (TR)				

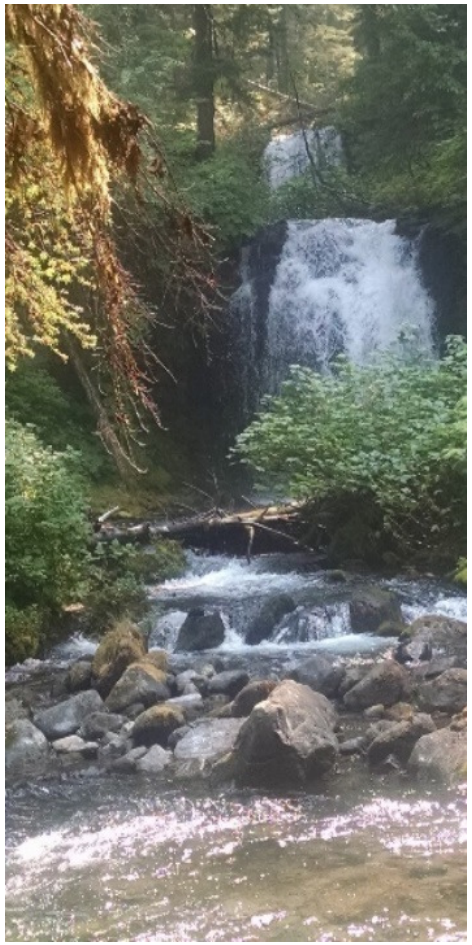
GROUPED FUNCTIONS	Function Group Score	Function Group Rating	Value Group Score	Value Group Rating
Hydrologic Function (SWS, SST, FV)				
Geomorphic Function (SC, SM)				
Biologic Function (MB, CMH, STS)				
Water Quality Function (NC, CR, TR)				

Each specific function is assigned a numerical score and a rating for both function and value

Groups are represented by the highest-functioning, highest-valued function in each thematic category.

Timeline for SFAM Completion & Implementation

- ODOT pilot application: Jan–Apr 2018
- Internal (agency) and targeted external reviews: Feb-May 2018
- Internal (agency) training: Spring 2018
- Revisions to beta: May-June 2018
- Public release & external training: June 2018
- Aquatic Resources Mitigation Framework will be implemented through ODSL rulemaking, February 2019



Additional SFAM Development Team Members

- ODSL: Charlotte Trowbridge
- Willamette Partnership: *Nicole Maness*
- CSS-Dynamac: *Rob Coulombe*
- ESA; Wolf Water Resources: *Nicole Czarnomski*

Additional SFAM Map Viewer Development Team Members

- Institute for Natural Resources/OSU: *Myrica McCune, Marc Rempel, Jimmy Kagan*
- ODSL: *Charlotte Trowbridge*

http://www.oregon.gov/dsl/WW/Pages/Aquatic-Resources-Mitigation-Framework.aspx