FIELD APPLICATION OF THE STREAM FUNCTIONS ASSESSMENT AND RAPID INDEX (SFARI)

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EMRRP Webinar Series
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U.S. ARMY

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ERDC
ENGINEER RESEARCH & DEVELOPMENT CENTER

ABOUT SFARI

What is SFARI?

A rapid, function-based stream assessment performed in the field in about one day. The rapid tier of STAF.

Who is the audience?

USACE planners, biologists, ecologists, and engineers on ecosystem assessment and restoration studies.

What is the value?

Defensible scores for 20 stream functions, comparable across sites, alternatives, and time.



TIERS FOR ASSESSMENT

	SCREENING	RAPID	DETAILED
Project phase	Scoping and site screening	Design and alternatives	Final design and monitoring
Score	Qualitative, good to poor	Semi-quantitative, lines of evidence	Quantitative, reference curves
Time per site	Minutes to hours	Hours to a day	Days to a week
Effort	GIS and existing data	Focused field work	Field work, modeling, lab
Training	Low	Low to moderate	Moderate to high

TIERS FOR ASSESSMENT

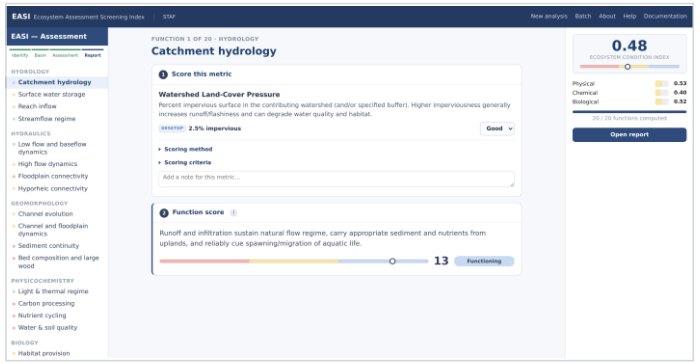
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DID YOU TRY THE SCREENING TIER?

Ecosystem Assessment Screening Index (EASI)



Drop a point



Review the scores



Open the report



SANGAMON RIVER, ILLINOIS

0.48

At risk

Physical	**0.53**
Chemical	**0.40**
Biological	**0.52**

EASI scored the reach from your desk.

SFARI adds field work to assess condition.

WHAT WE WILL COVER TODAY

TODAY

- Prepare for a field day
- Build a reference expectation
- Score metrics as evidence
- Assign and explain function scores
- Record the assessment in the app

NOT TODAY

- 20 stream functions *(Webinar 1)*
- All SFARI metrics *(ERDC Tech Report)*
- Detailed regional models, reference curves, calibration
  (Webinar 3 – Sept 22)

We will cover a few example functions today.
The evaluation process is the same for all 20 functions.

WHY SFARI IS NEEDED

We compiled and analyzed **188 stream assessment methods** across the U.S.
Some **consistent gaps**:

Under 5%

cover the full set of stream functions

72%

were built for one region or one stream type

52%

document no reference condition

Under 30%

address water quality or fish passage

SFARI: nationally applicable, 20 functions every time, has a reference for every site.

Stepchinski et al., 2025

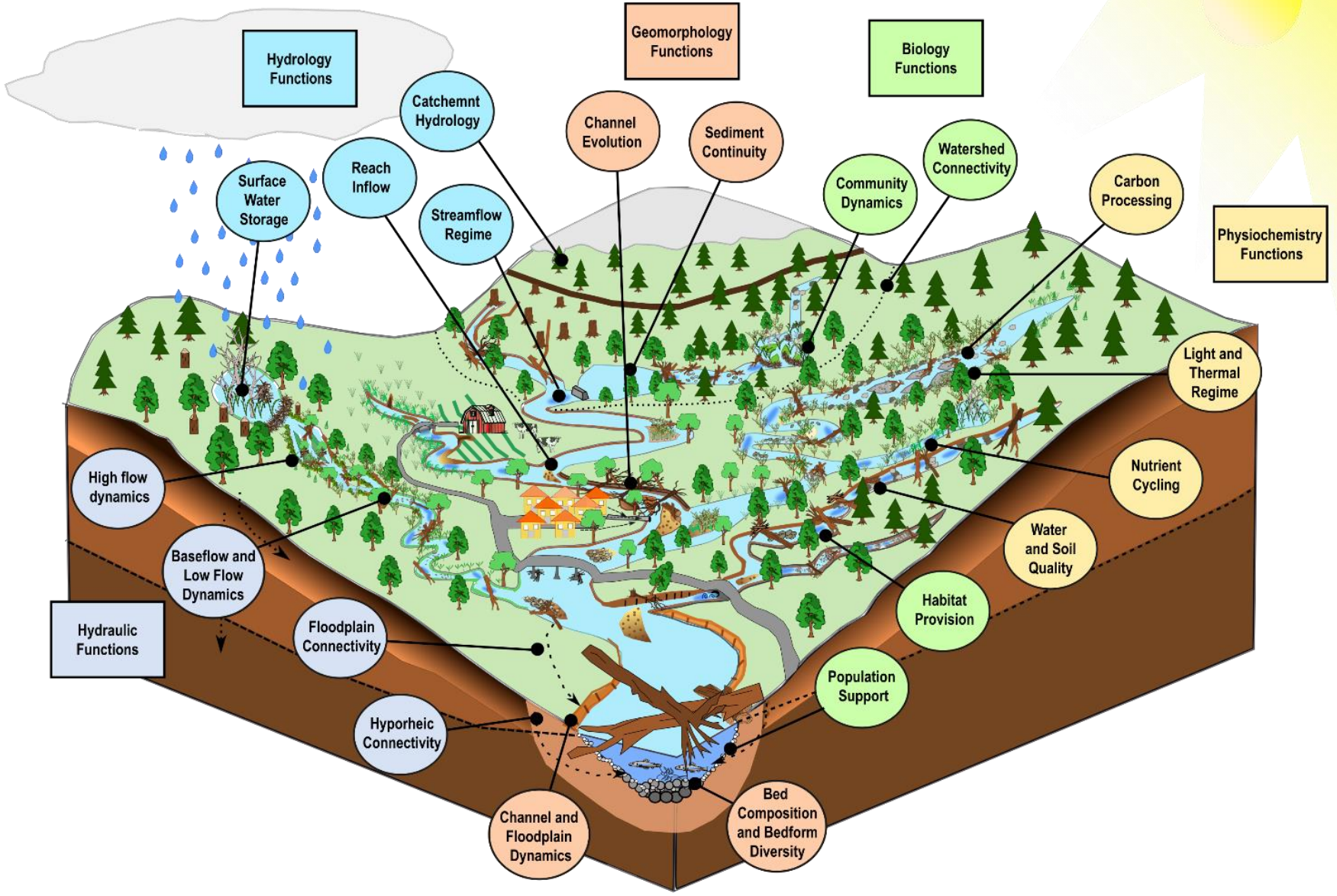
THREE PRINCIPLES FOR USING SFARI

1. **SFARI does not replace your expertise. It structures it.**

2. **Judgment is grounded in shared metrics and documented evidence.**

3. **The goal is transparent reasoning, not identical scores.**

FUNCTIONS


Hydrology Functions
Geomorphology Functions
Biology Functions
Physiochemistry Functions
Hydraulic Functions
Surface Water Storage
Reach Inflow
Streamflow Regime
Catchemnt Hydrology
Channel Evolution
Sediment Continuity
Community Dynamics
Watershed Connectivity
Carbon Processing
Light and Thermal Regime
Nutrient Cycling
Water and Soil Quality
Habitat Provision
Population Support
Bed Composition and Bedform Diversity
Channel and Floodplain Dynamics
Hyporheic Connectivity
Floodplain Connectivity
Baseflow and Low Flow Dynamics
High flow dynamics

HOW SFARI WORKS

What does it measure?	**5** functional categories	**20** functions	**80** metrics
Which streams are supported?	**Wadeable streams**		
How long does it take?	**2 to 4 hours** per reach		
What equipment is required?	**None**		

See August 2025 EMRRP webinar: SFARI
See August 2026 EMRRP webinar: STAF

HOW SFARI WORKS

METRICS

Short statements scored on a Likert scale

Your lines of evidence

FUNCTIONS

20 functions, each scored 0 to 15 by you

Your judgment

OUTCOMES

Physical, Chemical, and Biological sub-indices

The rollup

ECI

One Ecosystem Condition Index from 0 to 1

The reported score

See August 2025 EMRRP webinar: SFARI
See August 2026 EMRRP webinar: STAF

THE SFARI WORKFLOW

1. **Define the reach** — Office
2. **Review desktop data** — Office
3. **Set the reference expectation** — Office/Field
4. **Score the metrics** — Field
5. **Weigh the evidence** — Field
6. **Assign function scores** — Field
7. **Document the reasoning** — Field
8. **Enter and review in the app or spreadsheet** — Office

WHAT IS REFERENCE CONDITION?

It is not the same for all sites and settings.

What does strong performance look like for this type of stream in this setting?

Nearby higher quality reaches	Regional stream examples	Gage and monitoring data
Historical maps and imagery	Landscape and watershed context	Ecological knowledge and experience

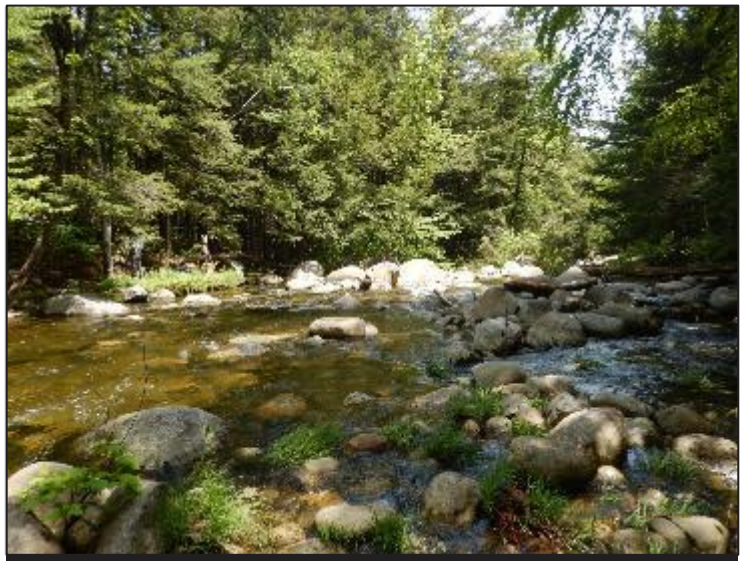
When reference condition cannot be identified

- **Build a site-specific expectation from the functions**
- **Record where you are uncertain**

WHAT DOES “NATURAL” MEAN?



Mink Brook, NH



Hubbard Brook, NH



North Fork Wolf Creek, OR

Protected does not automatically mean reference quality.
Match the reference to: stream type, region, and disturbance history

PREPARING FOR THE FIELD DAY

BEFORE YOU GO

- Desktop review
- Reference expectation
- Field forms
- Land access and parking

ON ARRIVAL

- Mark reach start and end with GPS
- Reach length: 20x bankfull width
- Record date, weather, and stage vs. bankfull
- Note anything that could bias what you see

WHILE YOU WALK

- Get in the water: bed material, bank toe, hyporheic signs
- Write the evidence next to each score
- Photograph everything you score

SITE 1: MINK BROOK, NH



Mink Brook in Hanover, New Hampshire

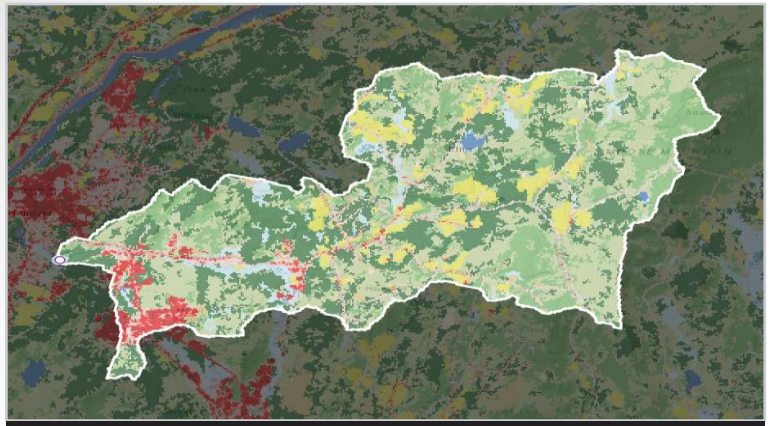
Stream order	**3rd**
Drainage area	**43 km²**
Forested watershed	**78%**
Channel	**Pool riffle, gravel and cobble**
Reach	**About 200 m**

From Screening Tier: **ECI 0.78**

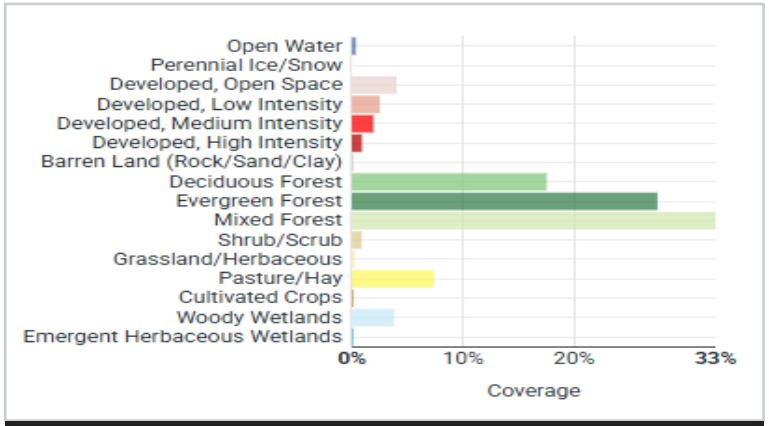
SFARI uses desktop and field evidence.

GD

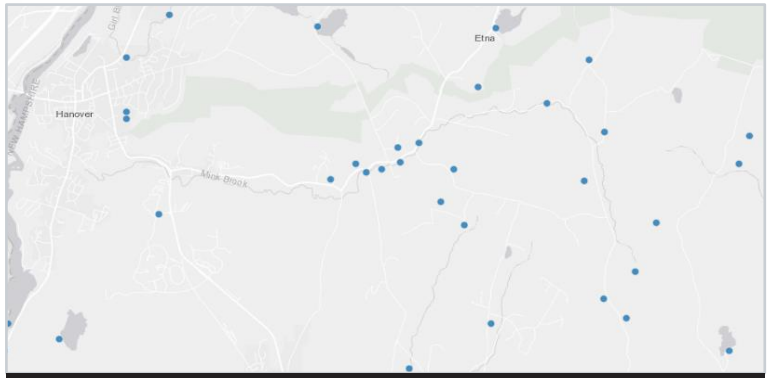
DESKTOP REVIEW IS FIRST



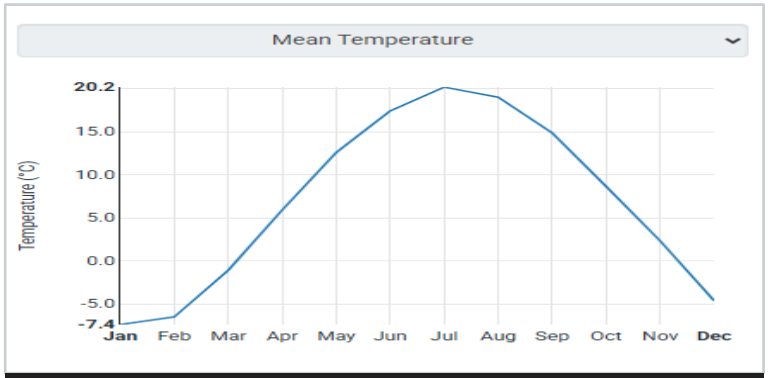
Land cover



78% forest



Dam inventory



Climate normals

About one hour, before the visit

- Scores 26 of the 80 metrics
- Sets the reference expectation

Data sources: StreamStats, Model My Watershed, EnviroAtlas, gage records

The SFARI web app pulls the desktop metrics for you and gives you the field forms

THE FIELD FORM

Five pages with twenty functions. This is one of them.

Floodplain Connectivity: Frequent overbank flows reduce flood peaks, support riparian vegetation, create off-channel refugia, and extend nutrient processing time.	**Floodplain Complexity** [F, F]**:** Floodplain/off-channel features stay diverse/connected at moderate floods, reflecting minimal loss.	
	Entrenchment Ratio (ER) [C, F]**:** Channel is not deeply incised; moderate floods access a broad floodplain, matching reference conditions.	
	Channel Condition [C, F]**:** Stable, not heavily dredged/incised, allowing normal overbank flows/meanders unless dredging is expected per reference.	
	Lateral Floodplain Inundation [F, D]**:** 1–2 yr floods routinely access the floodplain, matching reference inundation patterns.	
Score:	Notes/Other Metrics:	

The function, in one sentence

The metrics, written as statements.

Score each metric, then the function

C channel, **F** floodplain or field, **W** watershed, **D** desktop.

FUNCTION 1: FLOODPLAIN CONNECTIVITY

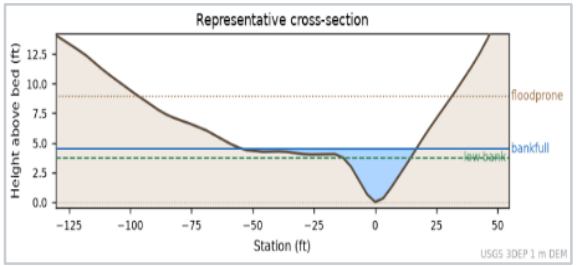
HYDRAULICS

Can flood flows still reach and use the floodplain?



Mink Brook, channel and floodplain

- Floodplain Complexity
- Entrenchment (ER)
- Channel Condition
- Lateral Floodplain Inundation



Above 2.2, open floodplain

Below 1.4, entrenched

POLL 1: SCORE THE METRIC

POLL



Channel Condition

"Stable, not heavily dredged/incised, allowing normal overbank flows/meanders unless dredging is expected per reference."

You have 15 seconds.

Score based on what you see.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable

OUR SCORES AND OUR REASONING



Floodplain complexity	Agree
Entrenchment ratio	Strongly Agree
Channel condition	Strongly Agree
Lateral inundation	Agree

Scoring steps

1) *Pick the band*
2) *Start mid-range*
3) *Shift up or down with the evidence*
4) *Record the logic in the notes*

Functioning (11 to 15)

At Risk (6 to 10)

Non-Functioning (0 to 5)

Function score

13 **(Functioning)**

FUNCTION 2: LIGHT AND THERMAL REGIME

PHYSICOCHEMISTRY

You cannot see temperature. You can see what controls it.



Continuous canopy over the channel

On the desktop

Wide riparian zone with canopy cover along the reach

In the field

Deep shade at midday, cool water on a summer day

14 Functioning.

Riparian canopy cover · Stream temperature · Algal growth · Thermal refugia

CAN YOU BRING YOUR OWN DATA OR DO MORE?

Have your own data for a metric or function?

Use it as another line of evidence.

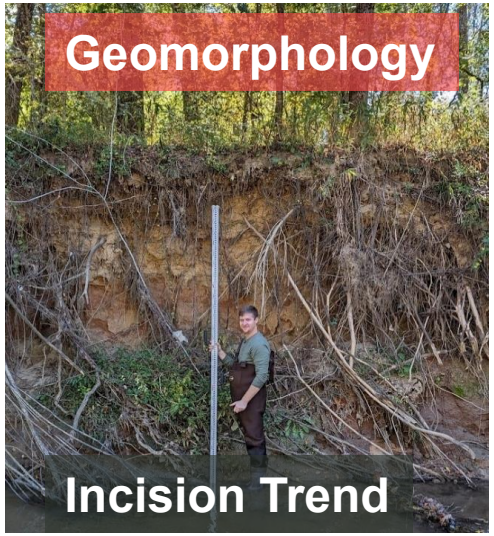
Want to sample a metric that matters at your site?

Yes. Weigh it more heavily in the function score.

Why do more?

More lines of evidence, stronger confidence.





WHY SCORES VARY

We notice different evidence

We hold different references

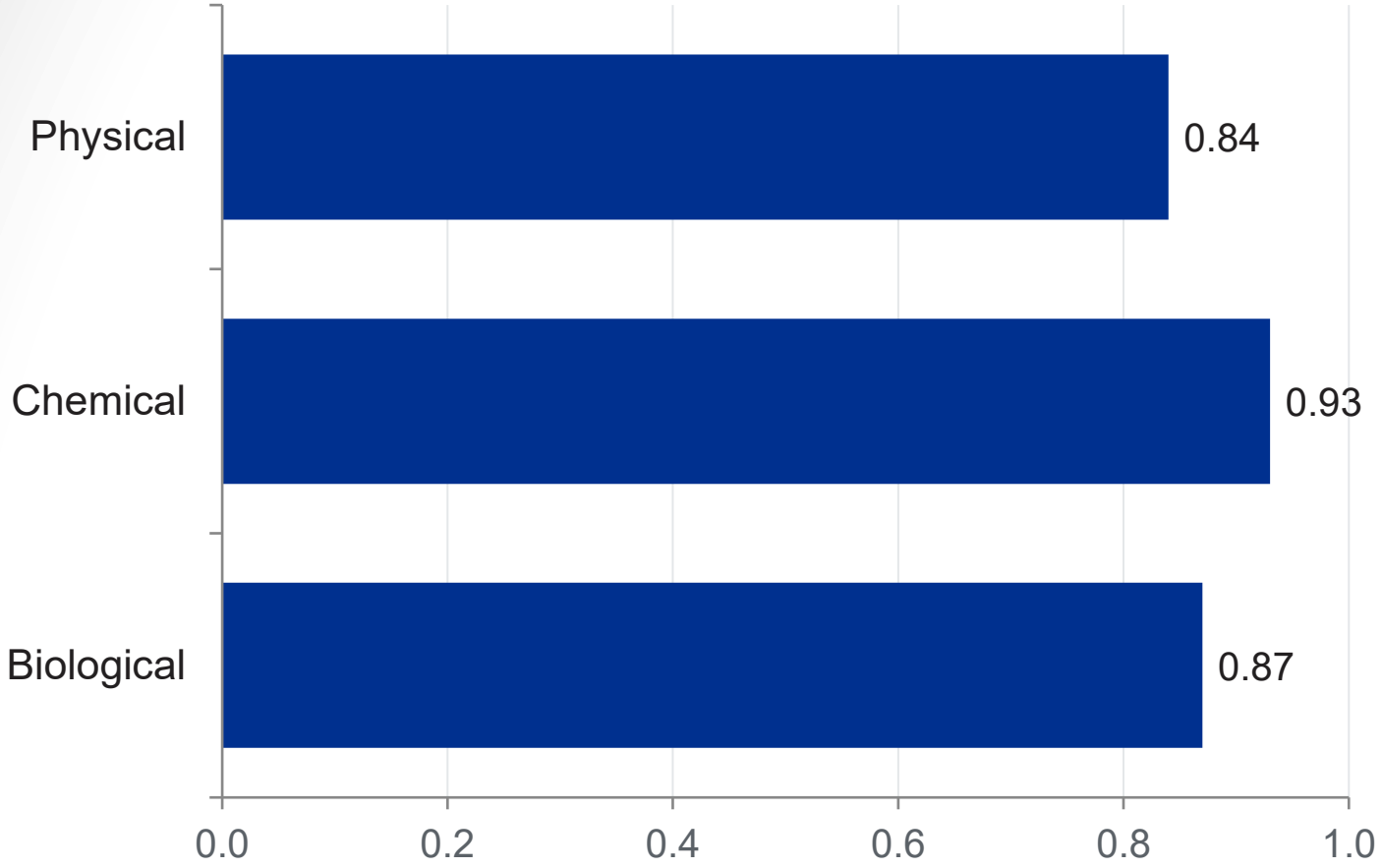
We weigh evidence differently

We bring different experience

The useful question is:

Can explain our score from the evidence?

MINK BROOK RESULTS



Ecosystem Condition Index

0.88

FUNCTIONING

SITE 2: COWART CREEK, TEXAS



Cowart Creek in Friendswood, Texas

Stream order	**2nd**
Drainage area	**35 km²**
Developed watershed	**69%**
Setting	**Gulf Coastal Plain**
Channel	**Straightened and incised**

From Screening Tier: **ECI 0.32**

SFARI uses desktop and field evidence.

POLL 3: SCORE THE METRIC

POLL



Channel Condition

"Stable, not heavily dredged/incised, allowing normal overbank flows/meanders unless dredging is expected per reference."

Function: Floodplain Connectivity

You have 15 seconds.

Score based on what you see.

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree	Not Applicable

THE REFERENCE CHANGES WITH THE STREAM

Not judged against

A New England trout stream

Cold, steep, forested, and gravel bedded.
Wrong stream type and wrong region.

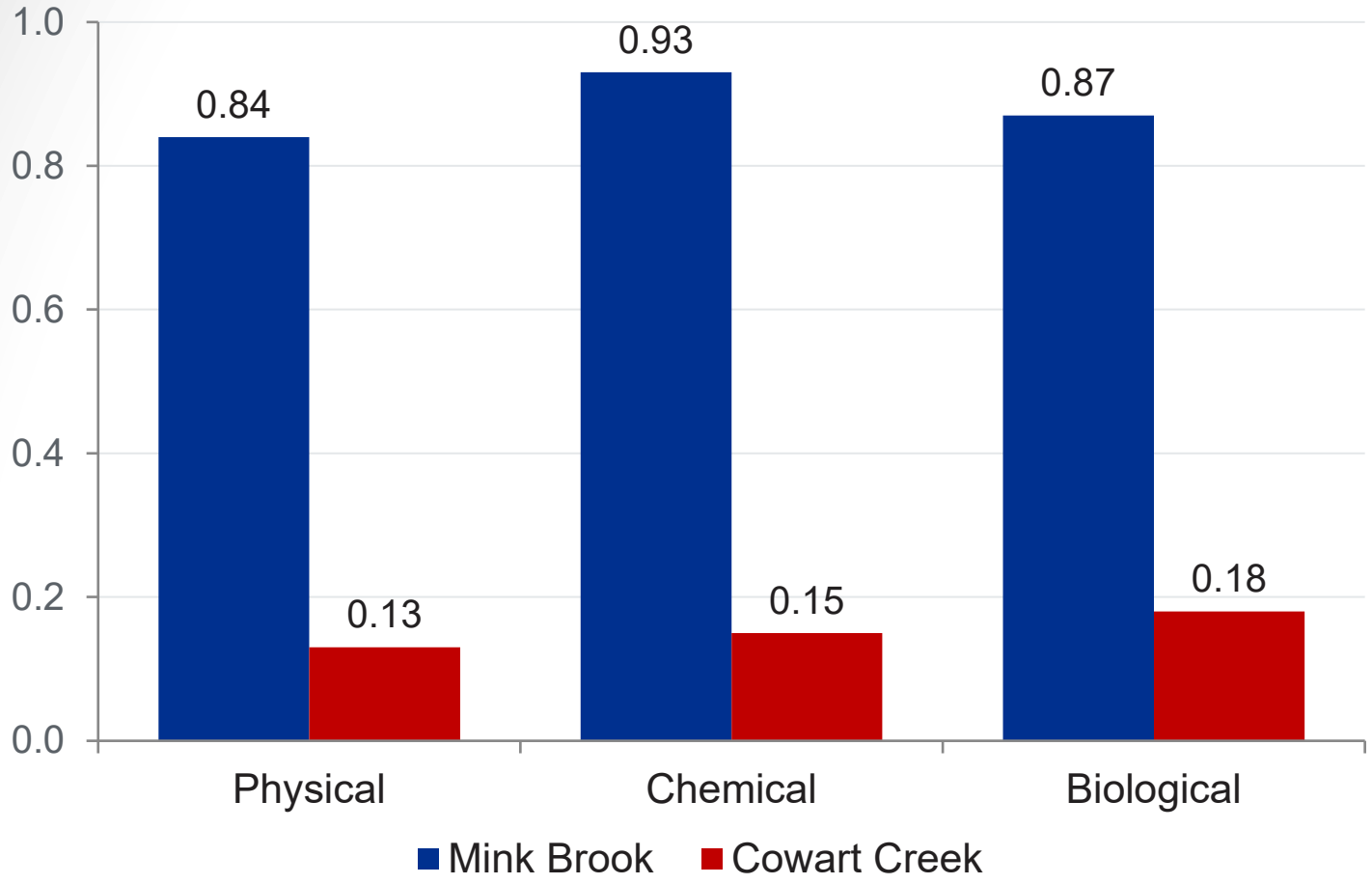
Judged against

A healthy Gulf Coastal Plain stream

Low gradient and sinuous, with a connected floodplain, vegetated banks, and shaded runs.

Cowart Creek fails against its own reference.
That is what makes the score fair.

TWO STREAMS, ONE METHOD



0.88 Functioning

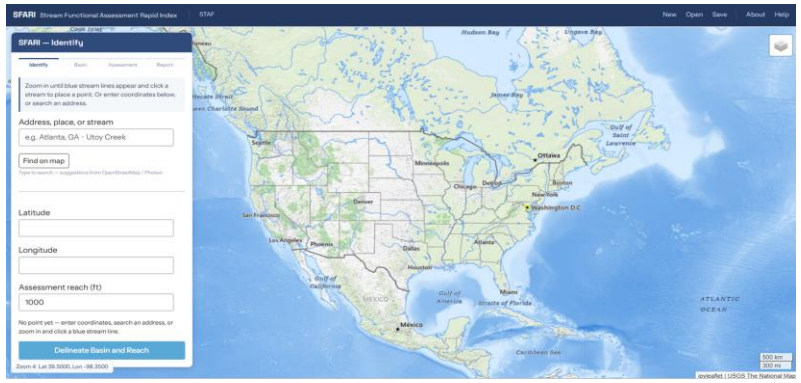
Mink Brook, NH

0.15 Non-Functioning

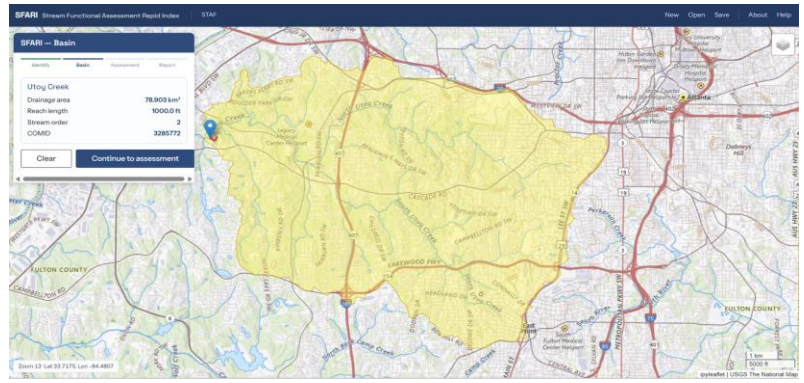
Cowart Creek, TX

THE SFARI WEB APPLICATION

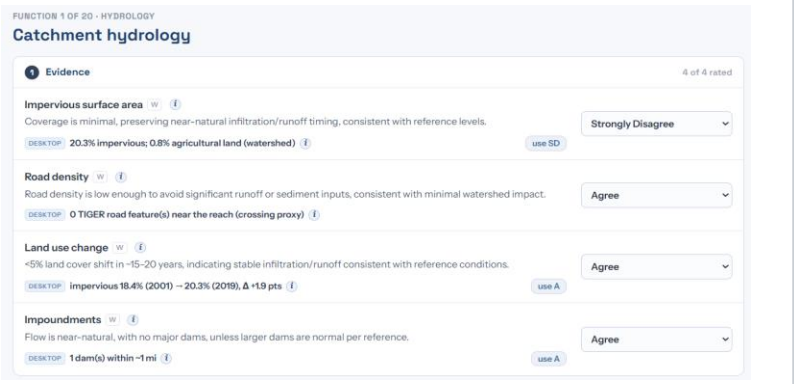
Identify | **Basin** | **Assessment** | **Report**



Identify the reach on the map



The app delineates the basin and reach



Each metric with its evidence



The function score and its suggestion

BEFORE YOU LEAVE

Download the field forms from the app.

WHEN YOU RETURN

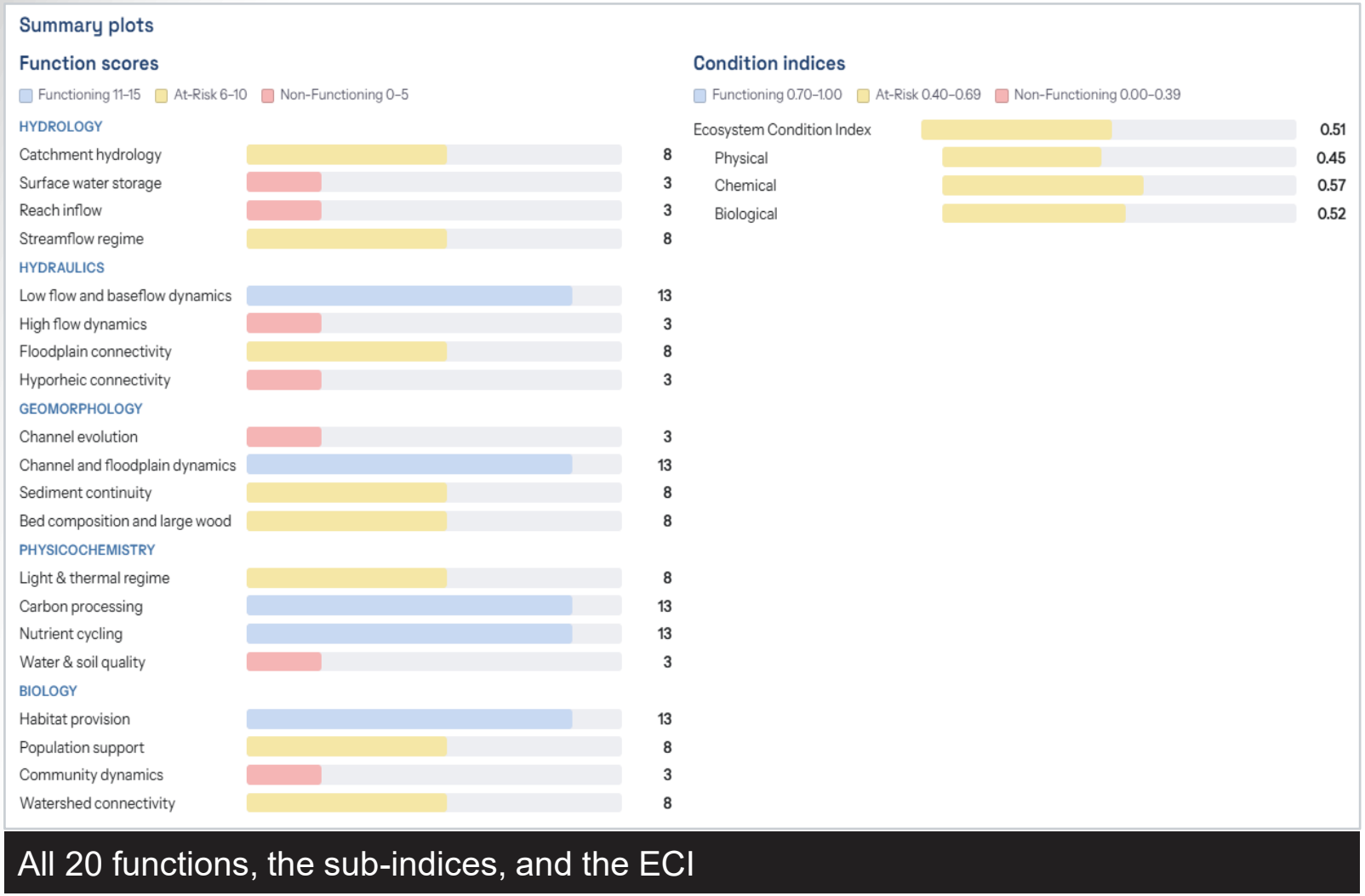
Enter Likert scores, notes, and photos. The desktop evidence is already there.

WHAT IT WILL NOT DO

It will not score the function for you. That stays with the assessor.

GM

THE ASSESSMENT REPORT



All 20 functions, the sub-indices, and the ECI

- All 20 function scores with bands
- The three outcome sub-indices
- The Ecosystem Condition Index
- Your notes, carried through
- Save and export

Prefer a spreadsheet? The calculator workbook produces the same rollup offline.

USING ECI IN PLANNING STUDIES

One consistent measure of ecological change across project alternatives.

Existing condition

Score the reach as it is today.

→

Project alternative

Score the same 20 functions for each alternative.

→

Change in ECI

The difference between the two.

→

Compare Alternatives

Rank the alternatives by lift and use as decision input.

CONDITION AND THE SCALE OF THE BENEFIT

Pair the change in ECI with the extent of the improvement.

Quality (Change in ECI) × **Quantity (e.g., acres)** → **Magnitude of benefit**

Parallel logic

Quality times quantity is used for habitat units.

Important difference

ECI measures broad ecosystem condition, not habitat suitability for one species.

UPCOMING IN THIS WEBINAR SERIES

- **Detailed Assessment with STAF (September 22)**
  - Using regionally tailored assessments, with two regional examples.



PUBLICATIONS

Stepchinski, L.M., McKay, S.K., and Menichino, G.T. 2025. **Review of Stream Assessments for Evaluating Ecological Impacts and Benefits**. U.S. Army Engineer Research and Development Center. https://dx.doi.org/10.21079/11681/49710

Stepchinski, L.M., McKay, S.K., Harris, A.E., and Menichino, G.T. **A Review of Stream Assessment Methods in the United States**. 2025. Journal of the American Water Resource Association. https://doi.org/10.1111/1752-1688.70056

Stepchinski, L.M., McKay, S.K., and Menichino, G.T. **A Synthesis and Inventory of Stream Functions.** River Research and Applications. In Review.

Stepchinski, L.M., McKay, S.K., and Menichino, G.T. **A Tiered Approach to Developing Function-Based Stream Assessments**. JAWRA. In Review.

Stepchinski, L.M., David, G.C., Wiest, S.R., Menichino, G.T. **Stream Functions Assessment and Rapid Index (SFARI)**. ERDC/TR. Vicksburg, MS: US Army Engineer Research and Development Center. In Review.

Stepchinski, L.M., David, G.C., Wiest, S.R., Menichino, G.T. **Ecosystem Assessment Screening Index (EASI)**. ERDC/TR. Vicksburg, MS: US Army Engineer Research and Development Center. In Review.

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- For information on EMRRP, please contact the program manager, Dr. Franz Lichtner (Franz.J.Lichtner@erdc.usace.army.mil), or consult https://emrrp.el.erdc.dren.mil/.



THANK YOU

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Upcoming webinars:

Detailed Stream Assessment using STAF: Developing and applying regionally tailored assessments: *September 22*

Try out STAF:

https://usace-wrises.github.io/staf/

EMRRP

https://emrrp.el.erdc.dren.mil/