Streamflow Duration Assessment Methods: Method Development for the Great Plains

Video Training

2024

Great Plains SDAM Region

- This method covers the Northern and Southern Great Plains as defined by Wohl et al. 2016 (*Synthesizing the Scientific Foundation for Ordinary High-Water Mark Delineation in Fluvial Systems*) on the eastern border.

  - ➤ Regions identified based on differences in climate, dominant native vegetation type, hydrology, geology, and topography.

- And the U. S. Army Corps of Engineers Regional Supplements to Wetland Delineation Manual on the western border.

- The Great Plains (GP) are primarily prairies, with woodlands present along river courses and in distinctive microclimates. Relatively drier than the neighboring eastern regions and flatter than the neighboring western regions.
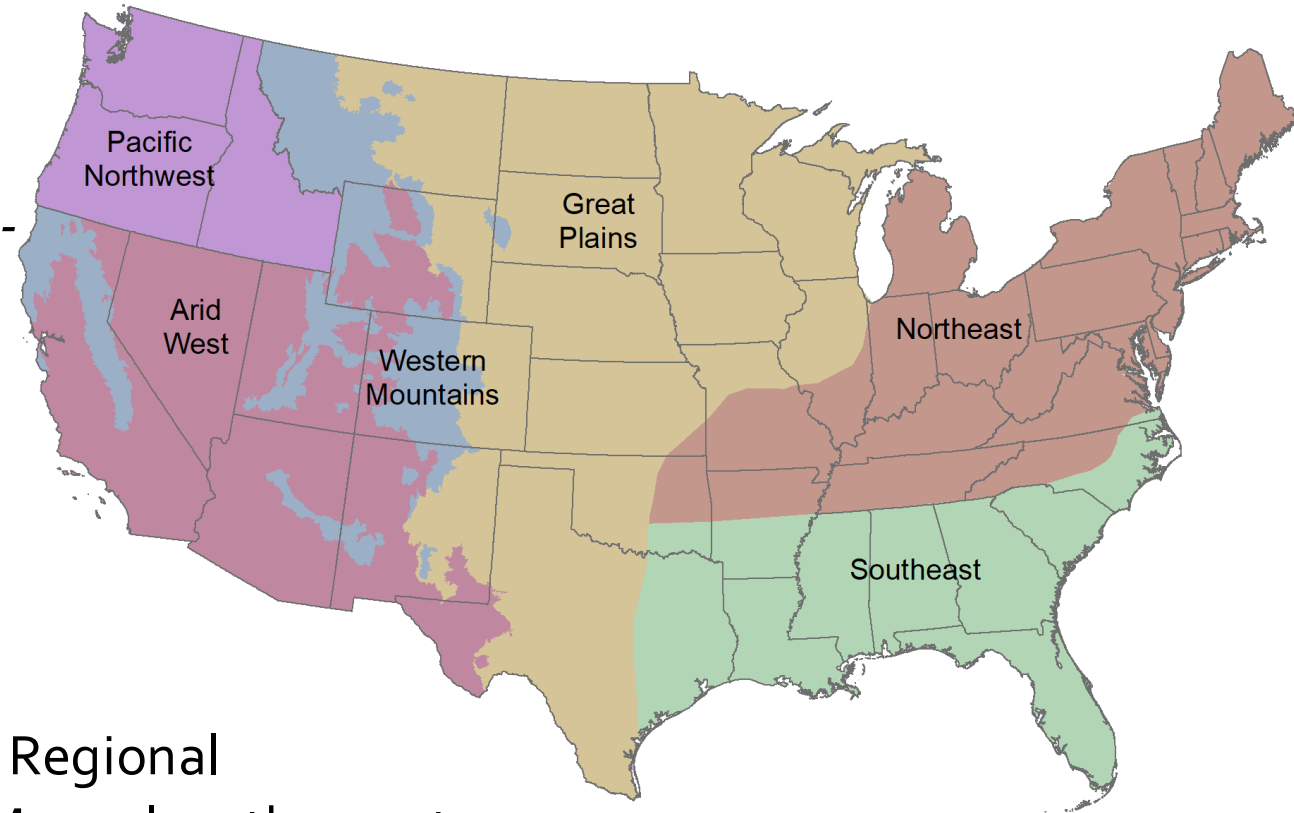
Method development

- Form a Regional Steering Committee of EPA and Corps staff.

- Identify candidate indicators through review of technical literature (James et al. 2022) and existing SDAMs (e.g., NMED 2011)

  - ➢ Geomorphological (e.g., slope, sinuosity)

  - ➢ Hydrological, both direct and indirect (e.g., presence of baseflow [direct], organic debris lines or piles [indirect])

  - ➢ Biological (e.g., fish presence, presence of perennial indicator taxa)

  - ➢ Geospatial indicators and additional field indicators with available data identified during analysis stage.

- Identify candidate study reaches through literature review, reviewing hydrologic databases, and consulting local experts.

Beta method

- Collect indicator data at 293 study reaches; 251 reaches ultimately used to calibrate the beta model.

  ➢ 71 ephemeral, 100 intermittent, 80 perennial.

  ➢ Flow class determined using loggers or streamgages at 72% of these (181); 152 reaches instrumented with loggers were re-visited up to 4 times (total 692 site-visits).

- Create machine learning statistical model(s) to predict class from 95 candidate indicators.

- Refine and simplify the final beta method.

- Published in September 2022 and followed by a more than one year trial period to garner feedback from user community.

Final method

- Additional data collected from additional visits of established sites, and some not initially used for development of the beta method.

- 268 reaches with up to six visits each ultimately used to calibrate the final model (shown below).
  - 72 ephemeral, 103 intermittent, 93 perennial.
  - Flow class determined using loggers or streamgages at 229 sites.

SDAM GP calibration sites

- Create machine learning statistical model(s) to predict class from 97 candidate indicators.

- Refine and simplify the final method based on agency experience with beta method and public comment.

- Publish final method, web app, and trainings.
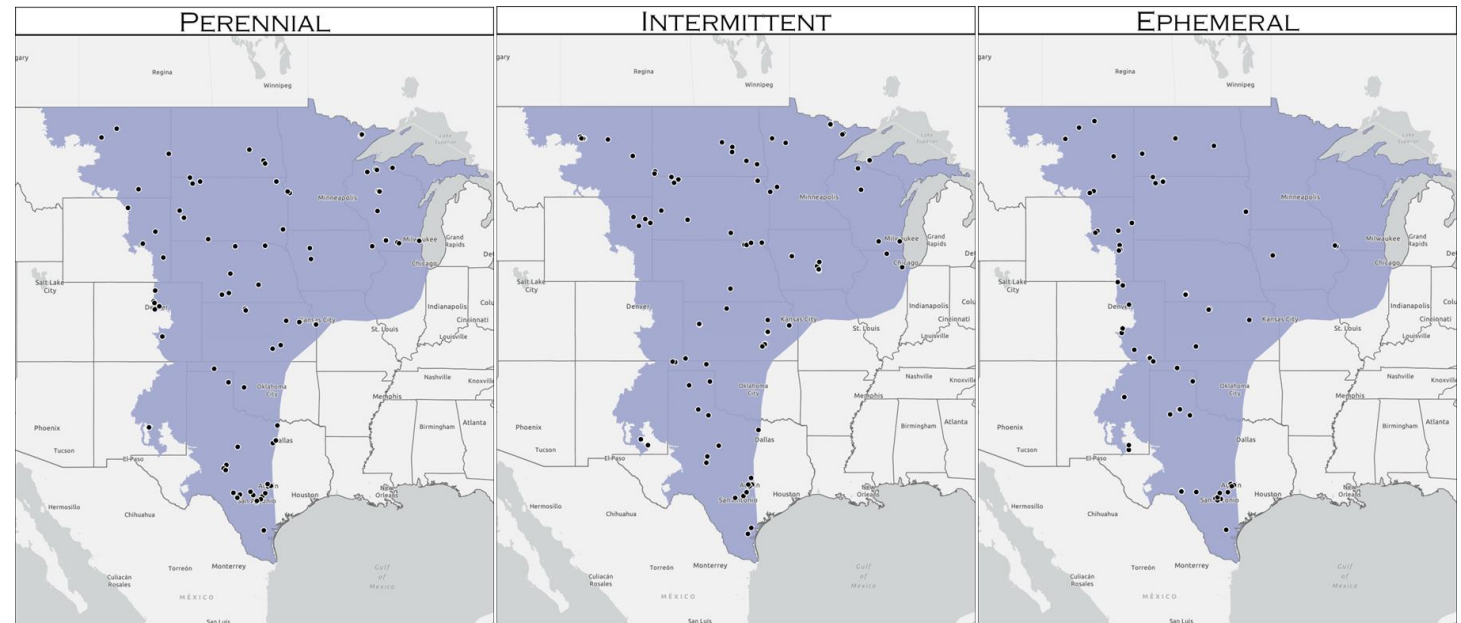
The GP SDAM is based on 8 indicators:

All eight indicators are measured in the **field**:

Biological indicators
- Total aquatic macroinvertebrate abundance
- Number of hydrophytic plant species
- Presence/absence of rooted upland plants in the streambed
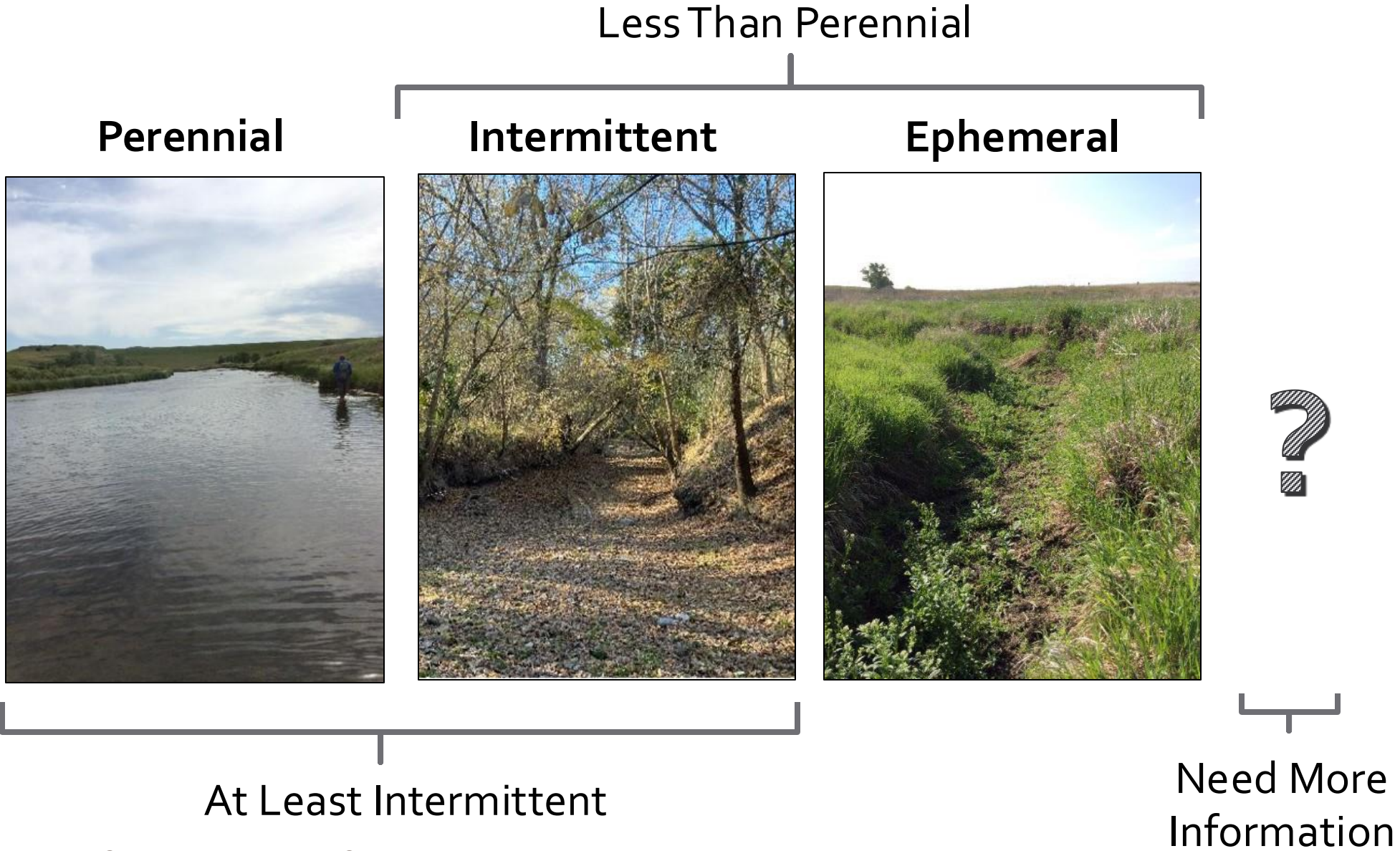- Differences in vegetation

Geomorphological indicators
- Bankfull channel width
- Riffle-pool sequence
- Particle size or stream substrate sorting
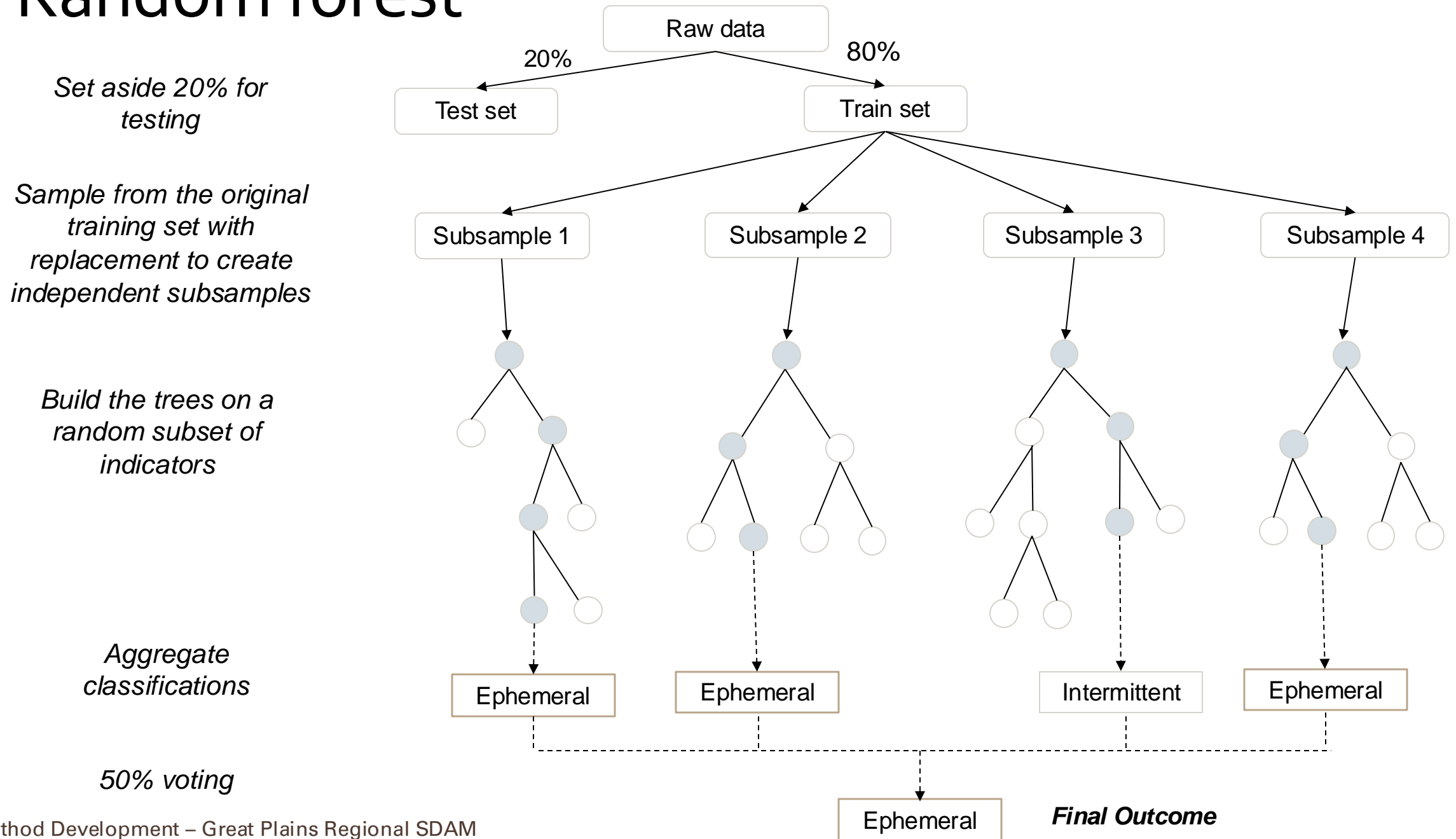- Sediment on plants or debris

Classifications are based on outputs from a statistical model

- A web application is required to obtain classifications for this and all other SDAMs developed through this effort.

- The web application automatically determines which SDAM is appropriate for a set of coordinates.

- The web application runs a statistical model to interpret field data provided by the user to obtain one of six possible classifications:
  - Ephemeral
  - Intermittent
  - Perennial
  - At least intermittent
  - Less than perennial
  - Needs more information

# SDAMs classify stream reaches into 3 main categories

Less Than Perennial

Perennial **Intermittent** **Ephemeral**

?

At Least Intermittent

Need More Information

Random forest

Set aside 20% for testing

Sample from the original training set with replacement to create independent subsamples

Build the trees on a random subset of indicators

Aggregate classifications

50% voting

Raw data

20% → Test set

80% → Train set

Subsample 1   Subsample 2   Subsample 3   Subsample 4

Ephemeral   Ephemeral   Intermittent   Ephemeral

Ephemeral   *Final Outcome*

Six outcomes

- Perennial (P)
- Intermittent (I)
- Ephemeral (E)
- At least intermittent (ALI)
- Less than perennial (LTP)
- Needs more info (NMI)
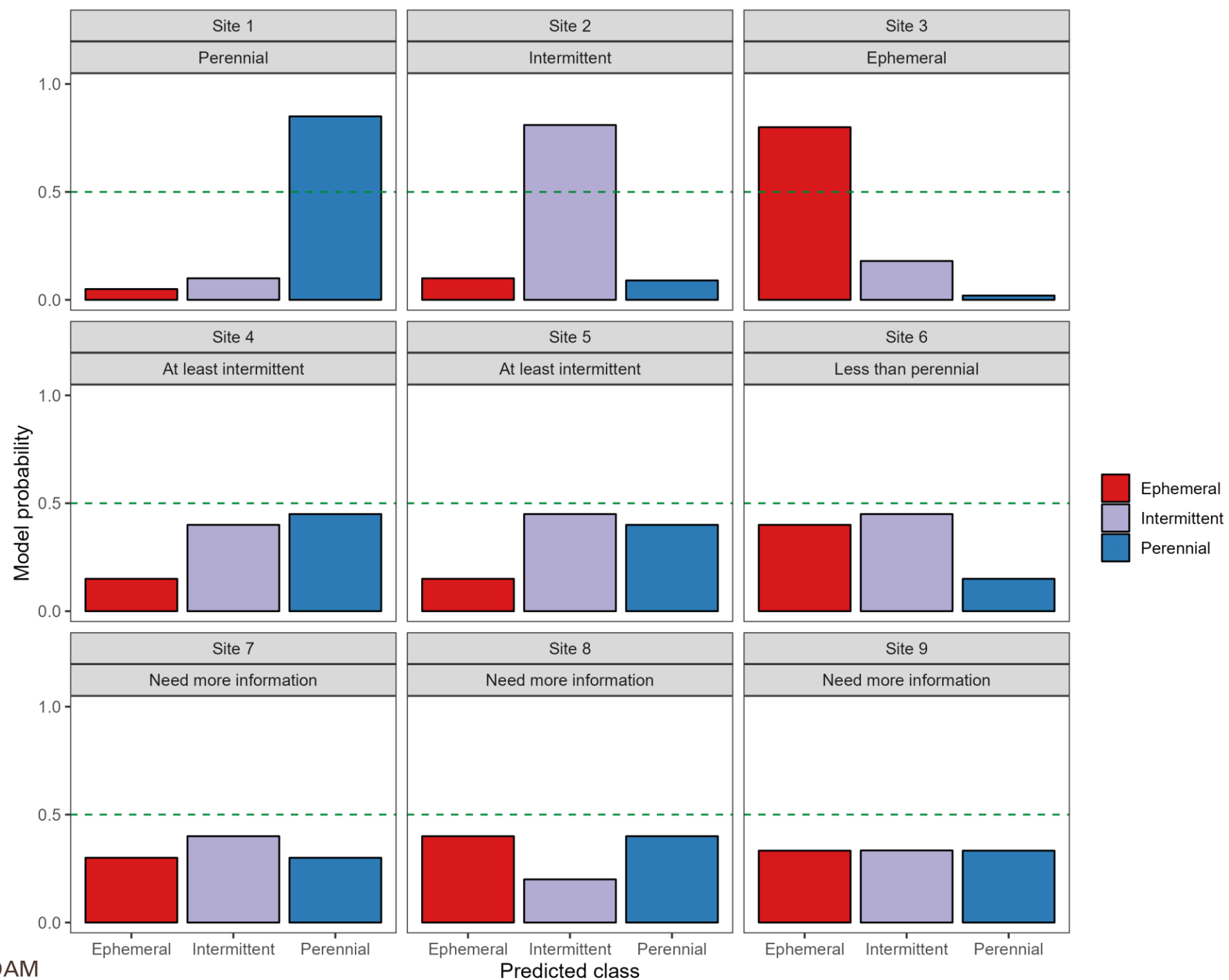
Knowledge check!

Which of the following indicators are used in the GP SDAM ? Select all that apply.

A. Total aquatic macroinvertebrate abundance

B. Bankfull channel width

C. Algal cover on the streambed

D. Sinuosity

E. Hydrophytic plants

F. Fish

G. Differences in vegetation

H. Riffle-pool sequence

The GP SDAM is based on 8 indicators, including the 5 circled answers, plus:

- Presence/absence of rooted upland plants in the streambed
- Particle size or stream substrate sorting
- Sediment on plants or debris

For more information about SDAMs visit

https://www.epa.gov/streamflow-duration-assessment