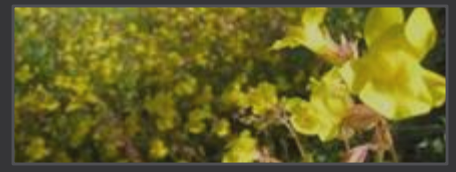
EPA United States Environmental Protection Agency

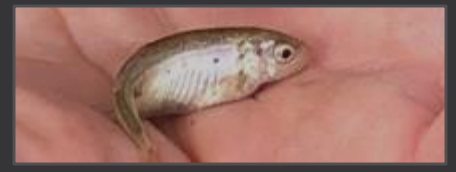
US Army Corps of Engineers

ERDC

The beta Streamflow Duration Assessment Method for the Arid West

Training materials



Introduction and background

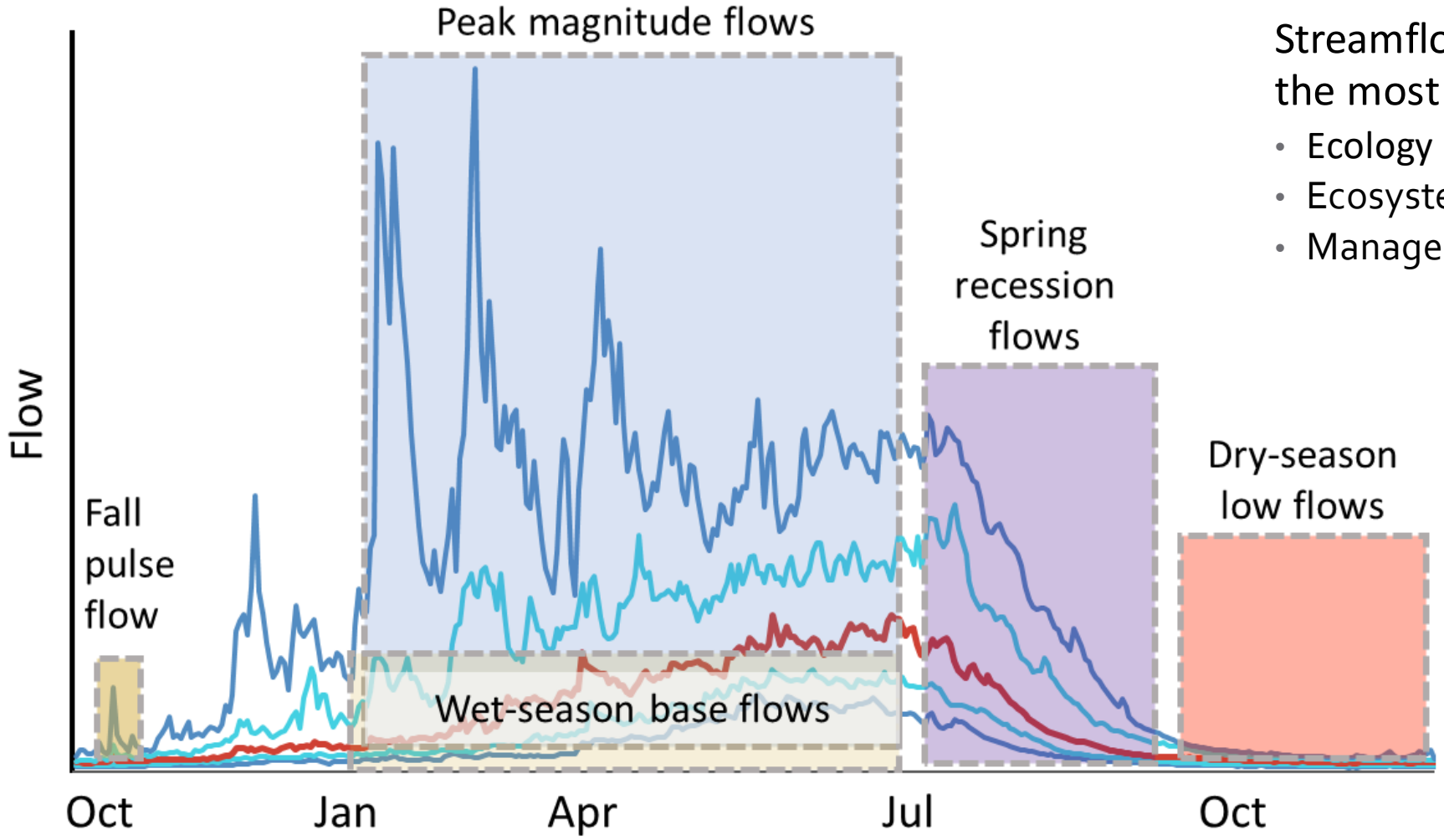
- Streamflow characteristics
- What are Streamflow Duration Assessment Methods (SDAMs)?
- SDAMs vs. Jurisdictional Determinations
- Streamflow duration classes
- Development of the SDAM for the Arid West (SDAM AW)
- Description of the SDAM AW

Streamflow is the movement of water in a channel

Streamflow is different from:

- Standing surface water
- Subsurface flow
- Seepage

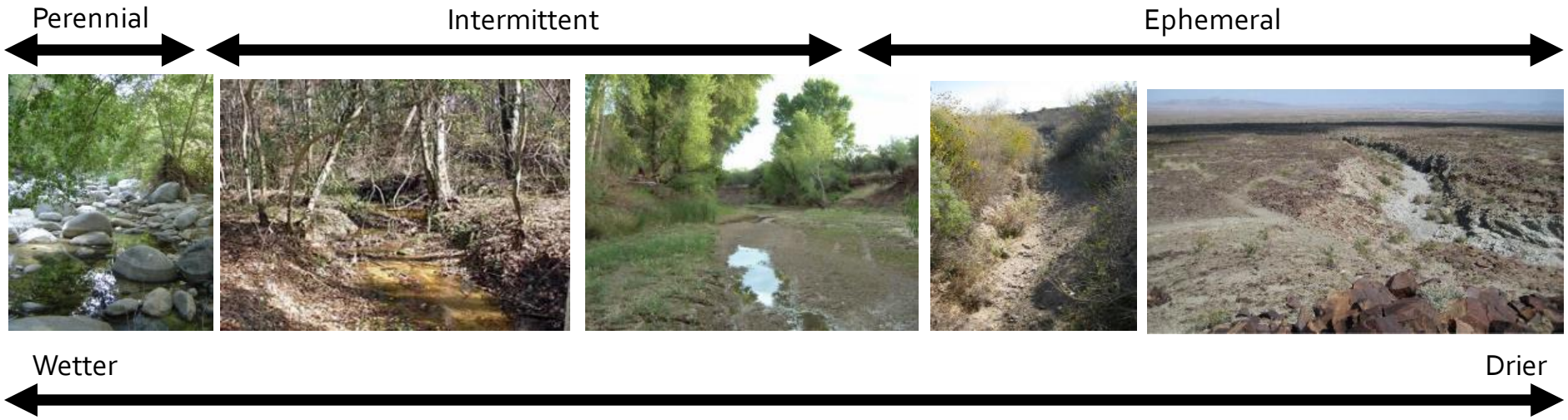
There are many ways to characterize streamflow



Streamflow duration is one of the most important!

- Ecology
- Ecosystem functions
- Management

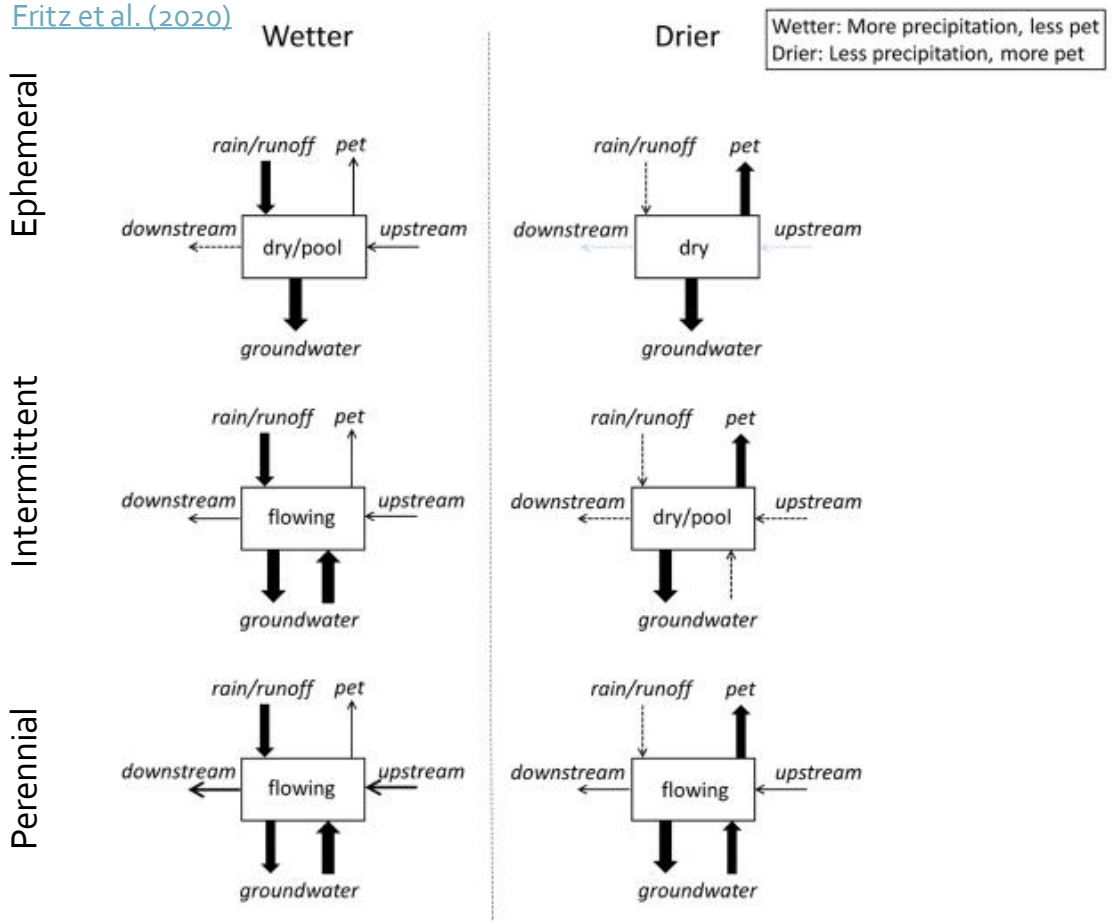
Streamflow duration exists on a continuum



- There are many terms to describe and classify this continuum
  - Three classes (perennial, intermittent, ephemeral) widely used in the US for academic and management purposes.
  - There are no universally accepted definitions for these classes, but they are generally assumed to reflect typical regimes at a reach over many years under present-day conditions.
- Multiple dimensions characterize the continuum
  - Length of flow
  - Predictability
  - Timing of flow
  - Etc.

Streamflow duration is dictated by changes in a reach's water inputs and outputs

Fritz et al. (2020)



Inputs:

- Discharge from upstream
- Discharge from groundwater
- Rainfall/runoff

Outputs:

- Discharge to downstream
- Groundwater percolation
- Potential evapotranspiration (pet)

What is a Streamflow Duration Assessment Method (SDAM)?

A rapid, field-based method of classifying the flow duration of a stream reach.

- Field-based: Based on observations of indicators, not on hydrological models.
- Rapid: Can be completed in a single site-visit. No long-term data collection required.

What are indicators?

- Easy to measure properties of an ecosystem that let us infer hard-to-measure properties
- Streamflow duration indicators
  - May include geomorphological, hydrological, or biological measures
  - May include controls (e.g., streambed substrate) or responses (e.g., biological organisms)
  - Indicators that reflect long-term conditions are favored over those that are more transient or reflect only recent conditions.

Why do we need streamflow duration assessment methods (SDAMs)?

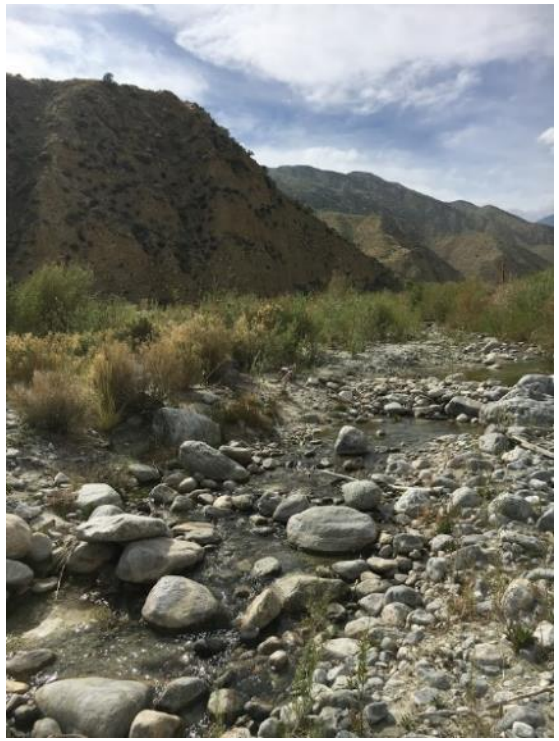
- Streamflow duration is one of the most ecologically important aspects of a stream's hydrology!
- Underpins several regulatory and management decisions (e.g., determining jurisdiction of the Clean Water Act)
- However, classification requires long-term hydrologic data that is only collected at a small number of sites (e.g., USGS stream gages)
- Rapid field-based streamflow duration assessment methods (SDAMs) can classify streams where the necessary hydrologic data are lacking

Streamflow duration assessment is *not* a jurisdictional determination under the Clean Water Act

- Jurisdictional determinations are based on current regulatory guidance and policy
- Jurisdictional determinations for some aquatic resources require timely streamflow duration information, which SDAMs can provide
- SDAMs do not constitute jurisdictional determinations by themselves
- SDAMs have other management and research applications

The SDAM AW was calibrated to classify stream-reaches into 3 categories

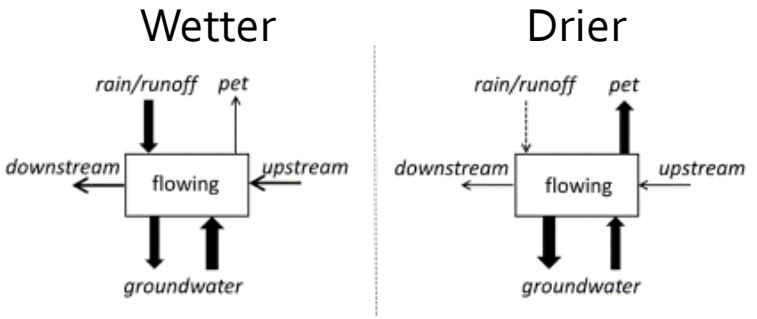
Perennial



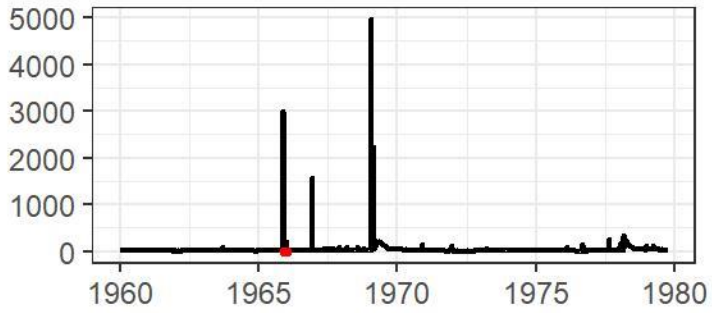
Intermittent

Ephemeral

Perennial streams



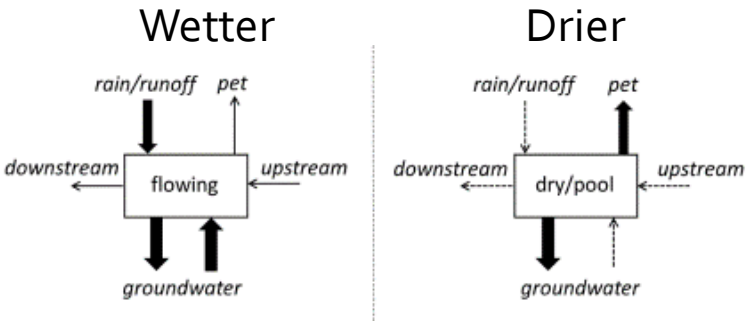
- *Perennial reaches* contain flowing water continuously during a year of normal rainfall, often with the streambed located below the water table for most of the year. Groundwater supplies the baseflow for perennial reaches, but the flow is also supplemented by stormwater runoff or snowmelt.



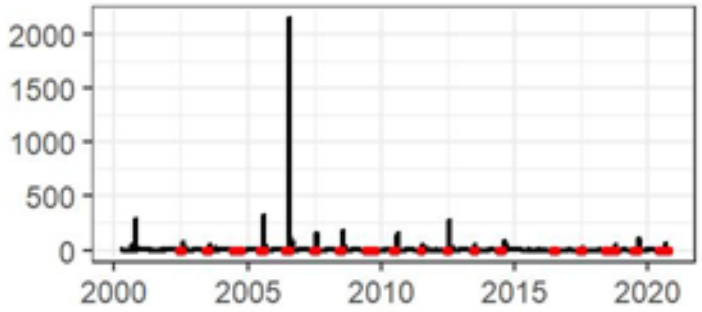
Whitewater River at Whitewater, CA (USGS 10256000)

(Red indicates zero flow)

Intermittent streams



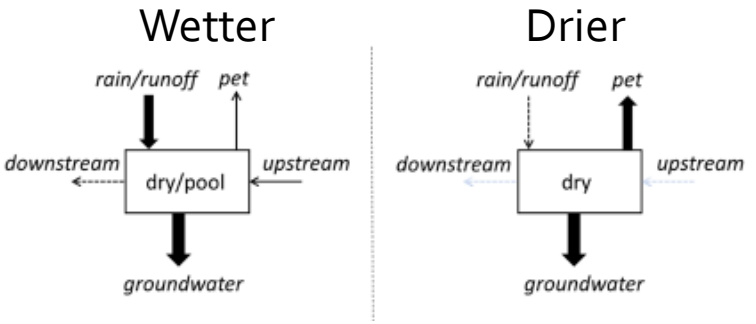
- *Intermittent reaches* are channels that contain flowing water for only part of the year, typically during the wet season, where the streambed may be below the water table and/or where the snowmelt from surrounding uplands provides sustained flow. The flow may vary greatly with stormwater runoff.



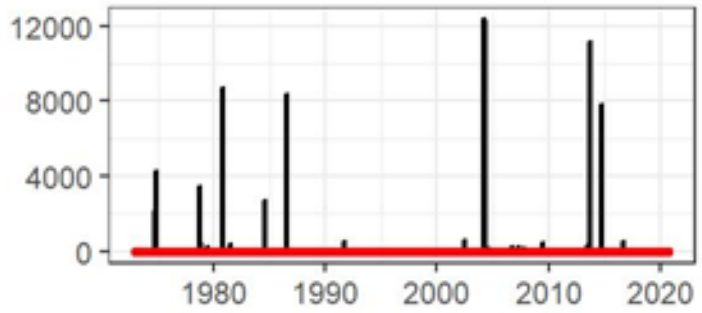
Babocomari River at Tombstone, AZ (USGS 09471400)

(Red indicates zero flow)

Ephemeral streams



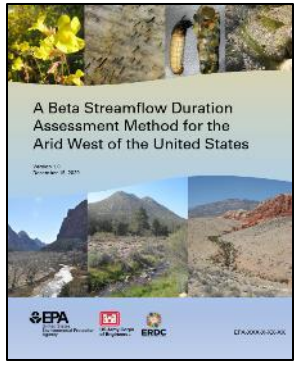
- *Ephemeral reaches* flow only in direct response to precipitation. Water typically flows only during and shortly after large precipitation events, the streambed is always above the water table, and stormwater runoff is the primary water source.



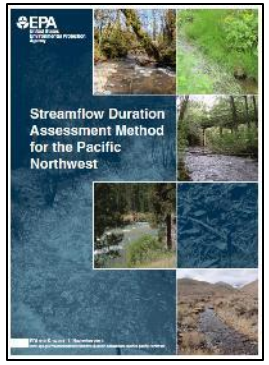
Dark Canyon at Carlsbad, NM (USGS 08405150)

(Red indicates zero flow)

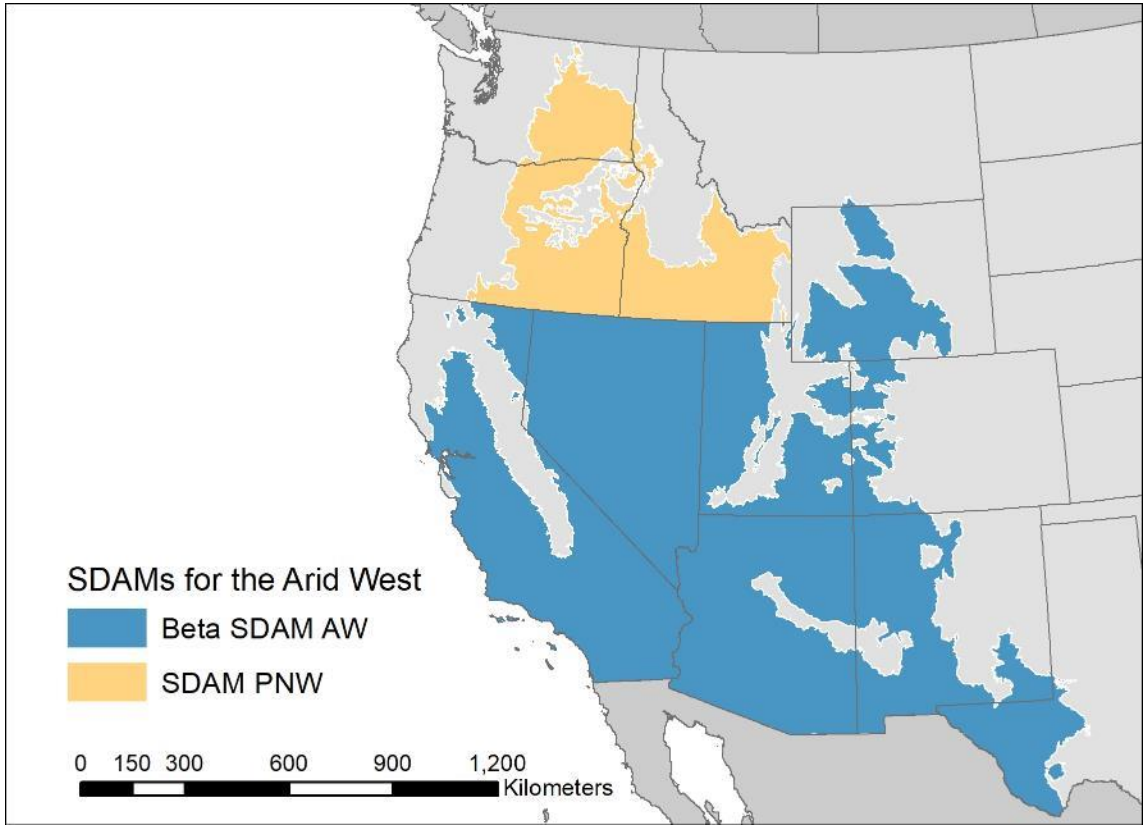
SDAMs for the Arid West



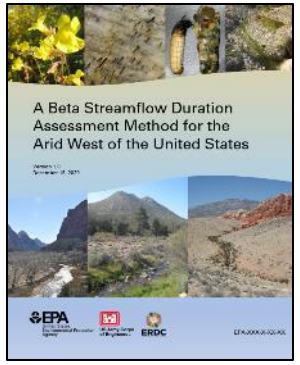
- This method covers most of the Arid West (AW), as defined in the Army Corps of Engineers National Wetland Plant List (NWPL)

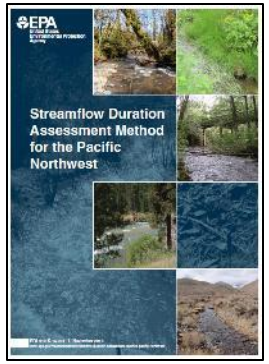


- Nadeau (2015) covers the Pacific Northwest (all of Washington, Oregon, and Idaho)

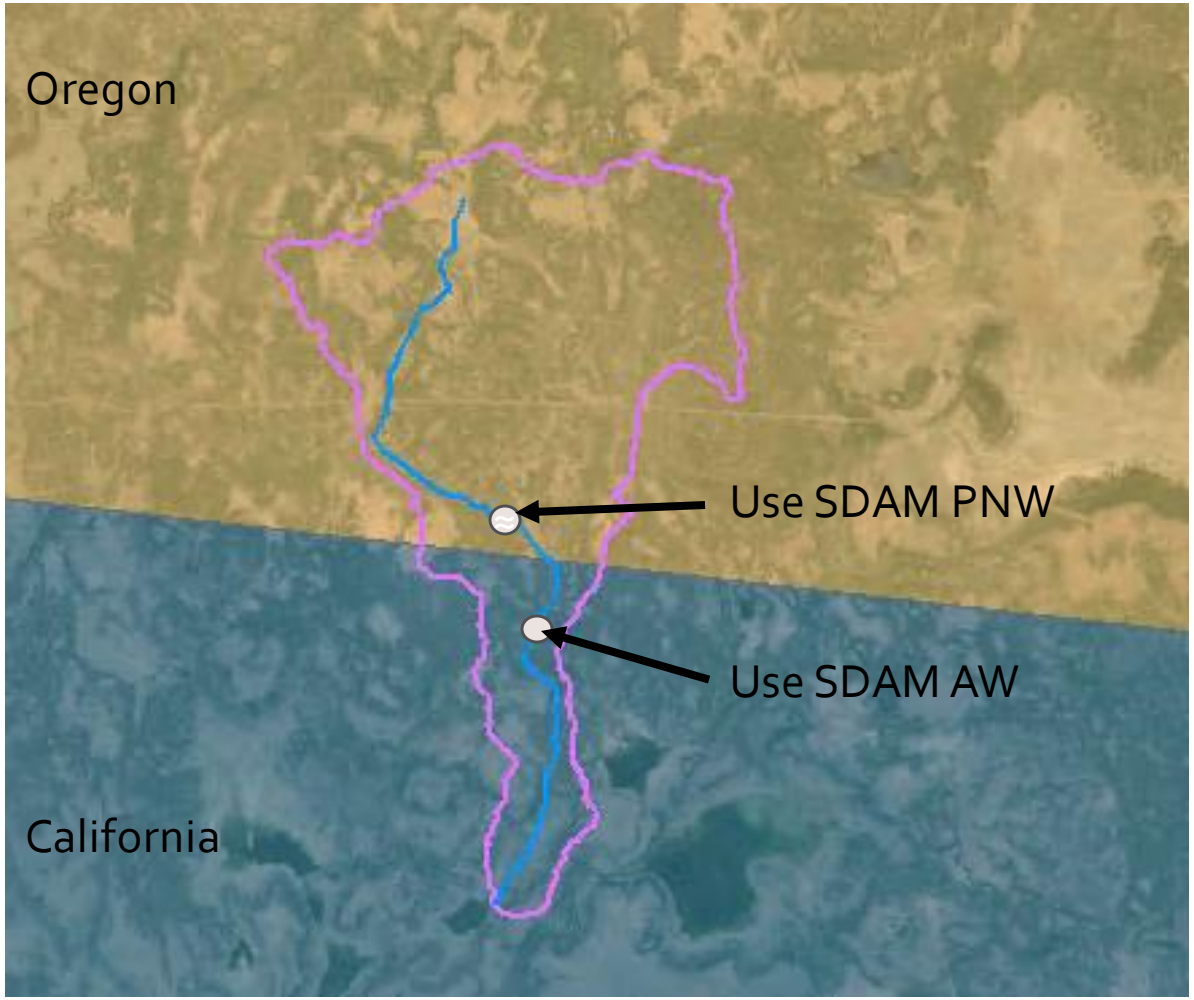


SDAMs for the Arid West





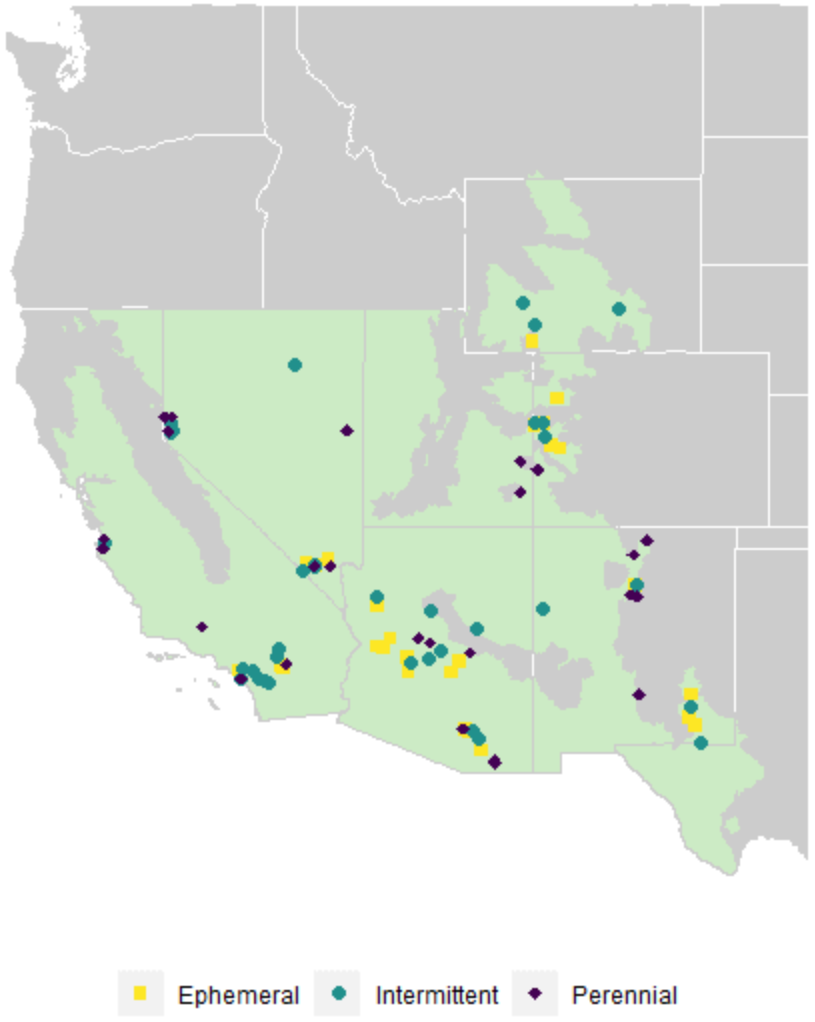
- The location of the assessment reach determines which SDAM to use
- The location of contributing catchment does not matter



Method development

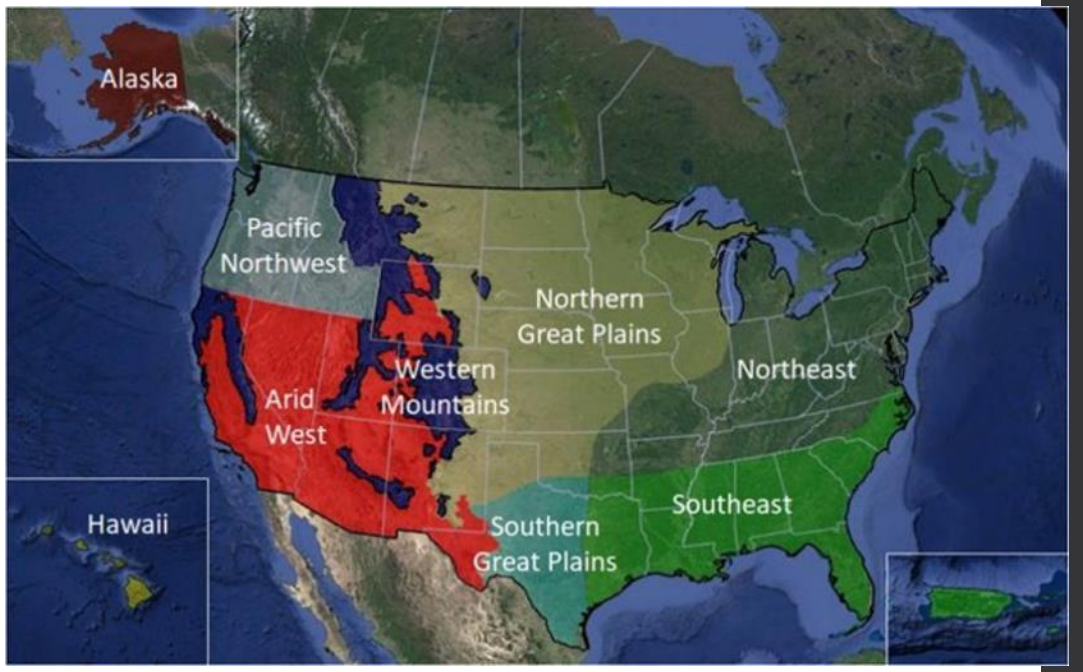
- Identify candidate indicators through review of technical literature (McCune and Mazor 2019)
  - 12 geomorphological (e.g., riffle frequency)
  - 14 hydrological (e.g., hydric soils)
  - 15 biological (e.g., fish abundance)
- Identify candidate study sites through literature review, reviewing hydrologic databases, and consulting local experts
- Collect indicators at 89 study sites
  - 30 ephemeral, 34 intermittent, 25 perennial
- Create machine learning statistical model to predict class from indicators
- Refine and simplify the final beta method

SDAM AW calibration sites



Why a "beta" method?

- Arid West is one of the first parts of a national effort.
- Beta method is based on a limited data set (one-quarter the number of sites vs. other regions)
- One-year trial period to gain feedback from practitioners. Additional data collection will occur throughout this period
- If you are interested in contributing to this data collection, contact streamflow-duration-assessment streamflow-duration-assessment@epa.gov for more information



The SDAM AW is based on 5 biological indicators:

1. How many hydrophytic plant species are there in the channel, or within a half-channel width of the channel?
   - None (0), few (1-2), or many (3+)
2. How many aquatic invertebrate individuals were collected?
   - None (0), few (1-19) or many (20+)
3. Is there evidence of aquatic stages of Ephemeroptera, Plecoptera, and Trichoptera taxa (EPT)?
   - Yes, No
4. Is there evidence of algal growth on the streambed?
   - Yes, No
5. Are there single indicators of intermittent or perennial streamflow duration?
   - Fish present, or algae cover ≥ 10%

The SDAM AW is a classification table

Use the table to obtain classification:

- Ephemeral
- Intermittent
- Perennial
- At least intermittent (i.e., not ephemeral)
- Need more information (confident classification not possible with beta method)

1. Hydrophytic plant species	2. Aquatic invertebrates	3. EPT taxa	4. Algae	5. Single indicators • fish present • algae cover > 10%	Classification
None	None	Absent	Absent	Absent	**Ephemeral**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
	Few (1-19)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
Few (1-2)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent		**Intermittent**
			Present		**At least intermittent**
		Present	Absent		**At least intermittent**
			Present		**Intermittent**
Many (3+)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent			**At least intermittent**
		Present			**Perennial**
	Many (20+)	Absent			**At least intermittent**
		Present			**Perennial**

Knowledge check!

Which of the following indicators are part of the SDAM AW? Select all that apply.

A. Aquatic invertebrates
B. Hydrophytic plants
C. Hydric soils
D. Riffle frequency
E. Valley slope
F. Algal cover on the streambed
G. Fish

The SDAM AW is based on 5 indicators:

1. Hydrophytic plant species
2. Aquatic invertebrate abundance
3. Presence of mayflies, stoneflies, or caddisflies
4. Algal cover on the streambed
5. Presence of single indicators (fish, or algal cover ≥10%)

Knowledge check!

Which of the following locations would be an appropriate place to use the SDAM AW? Select all that apply

A. Flagstaff, Arizona ← In Western Mountains region

B. Grand Junction, Colorado

C. Las Vegas, Nevada

D. Pocatello, Idaho ← In SDAM PNW region

E. Marfa, Texas

Knowledge check!

Which of these stream reaches fits the definition of **ephemeral**? Check all that apply.

A. A stream reach that flows only in direct response to rainfall and has no groundwater influence

B. A stream reach that is dry in the summer, but is sustained by snowmelt throughout the entire winter and spring, and sometimes early summer.

C. A stream reach that is dry for one month of the year in most years

D. A stream reach that flows for half of the year, but during the rest of the year is a stagnant pool

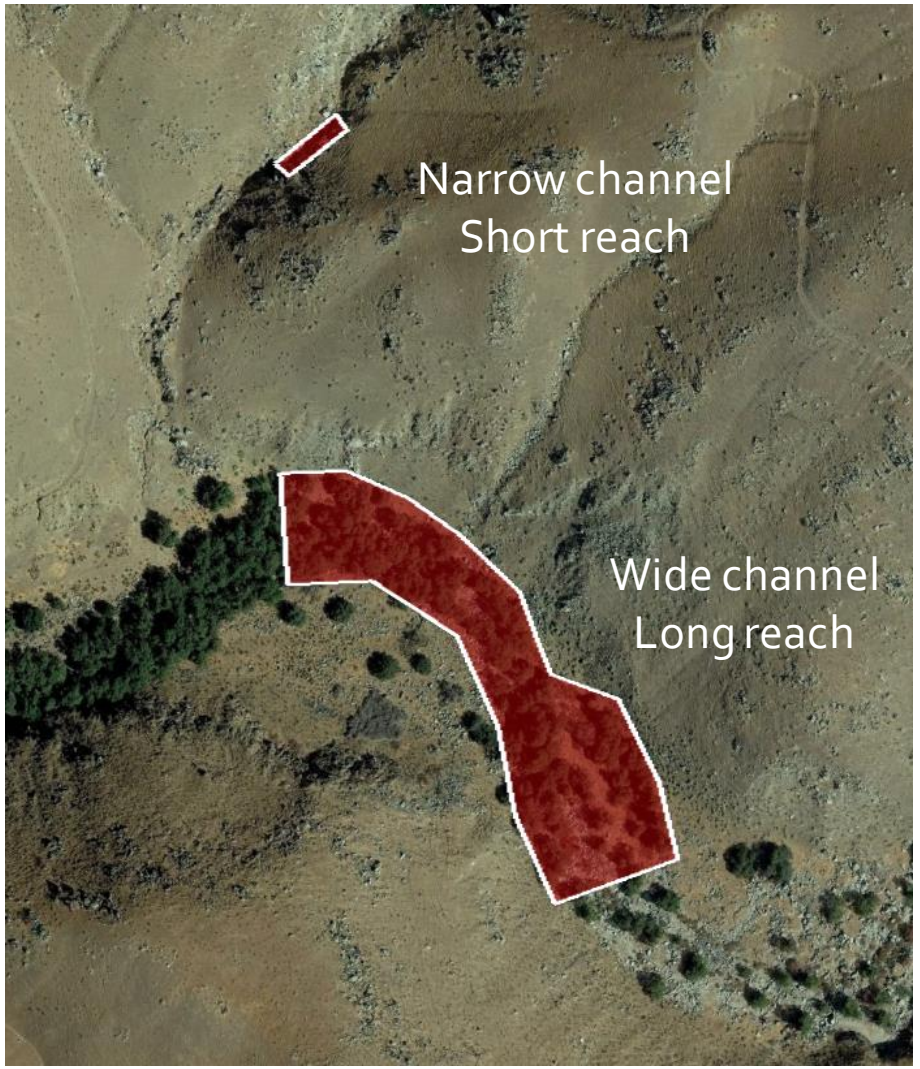
Ephemeral reaches flow only in direct response to precipitation. Water typically flows only during and shortly after large precipitation events, the streambed is always above the water table, and stormwater runoff is the primary water source.

Overview of the assessment process

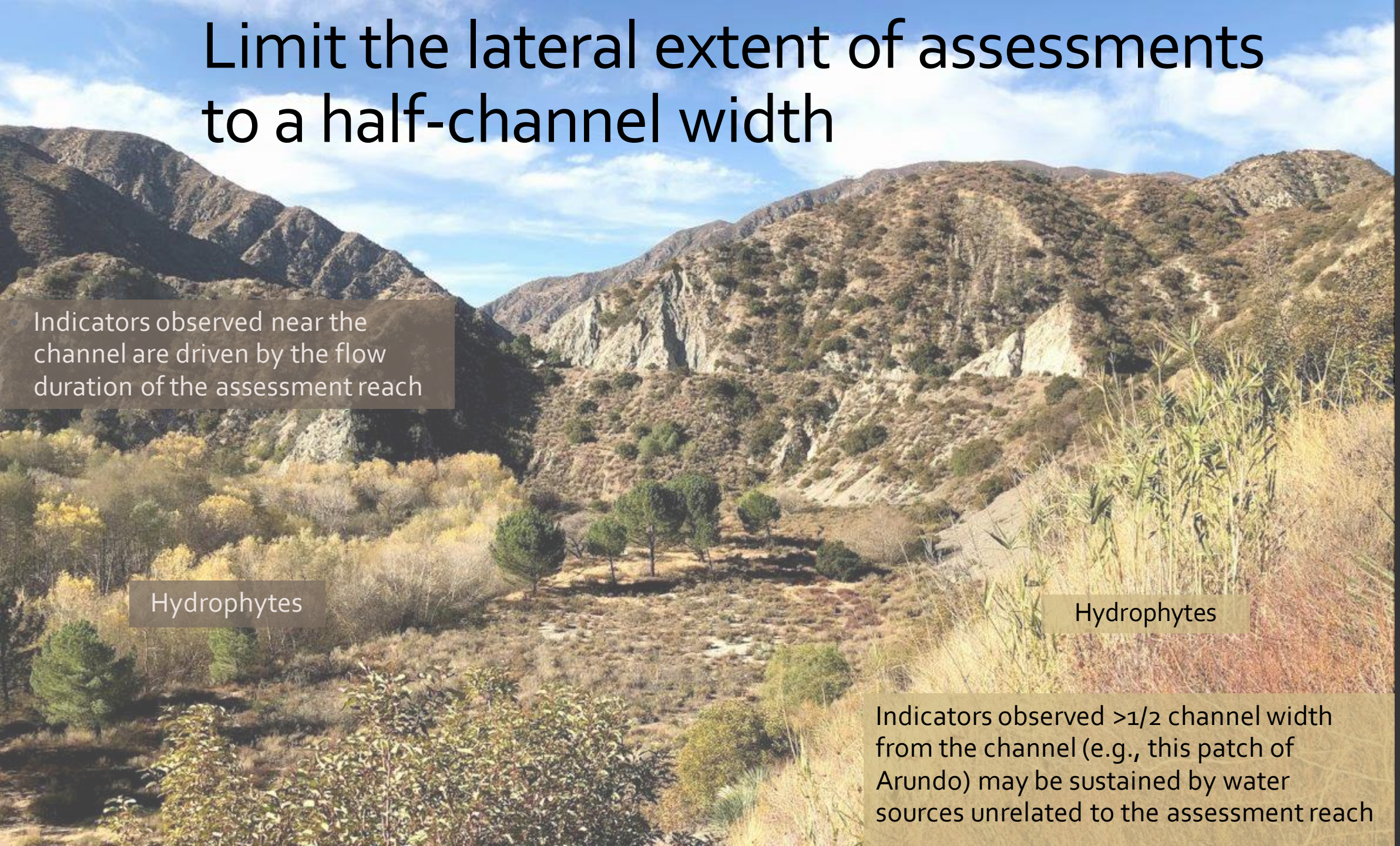
- Scales of assessment
- Spatial and temporal variability
- Created and modified natural streams
- Disturbed or altered streams

Scales of assessment

- Assessment reach length is based on mean channel width
  - Standard is 40 times mean width
  - No shorter than 40 m
  - No longer than 200 m
- Properly sized assessment reaches are needed to observe indicators



Limit the lateral extent of assessments to a half-channel width



Braided channels

- Include the whole channel in estimating assessment reach length
- Indicators may be observed in both primary (low-flow) and secondary channels

Spatial and temporal variability

Unconfined valley, sparse riparian growth

Confined valley, dense riparian growth

Changes in slope or valley confinement

Several factors influence variability in streamflow duration

These factors may affect measurement or interpretation of indicators

- Changes in stream size, watershed area, or discharge of water
- Changes in sediment loads
- Changes in land use or water management
- Local geological variability (e.g., fractured bedrock, landslides, colluvial deposits)
- Channel modification
- Severe water quality degradation

Where should you place your assessment reach?

- Where practical, assessments should have relatively uniform channel morphology.
- Focus on *drivers* of streamflow duration, such as valley gradient or width.
- Don't let presence of surface water influence placement!
- Avoid including major tributaries within assessment reach.
- 10-m buffer can reduce influence of road crossings and culverts, if appropriate.
- Reach placement and length may be modified to avoid trespass on private property.

Confined valley

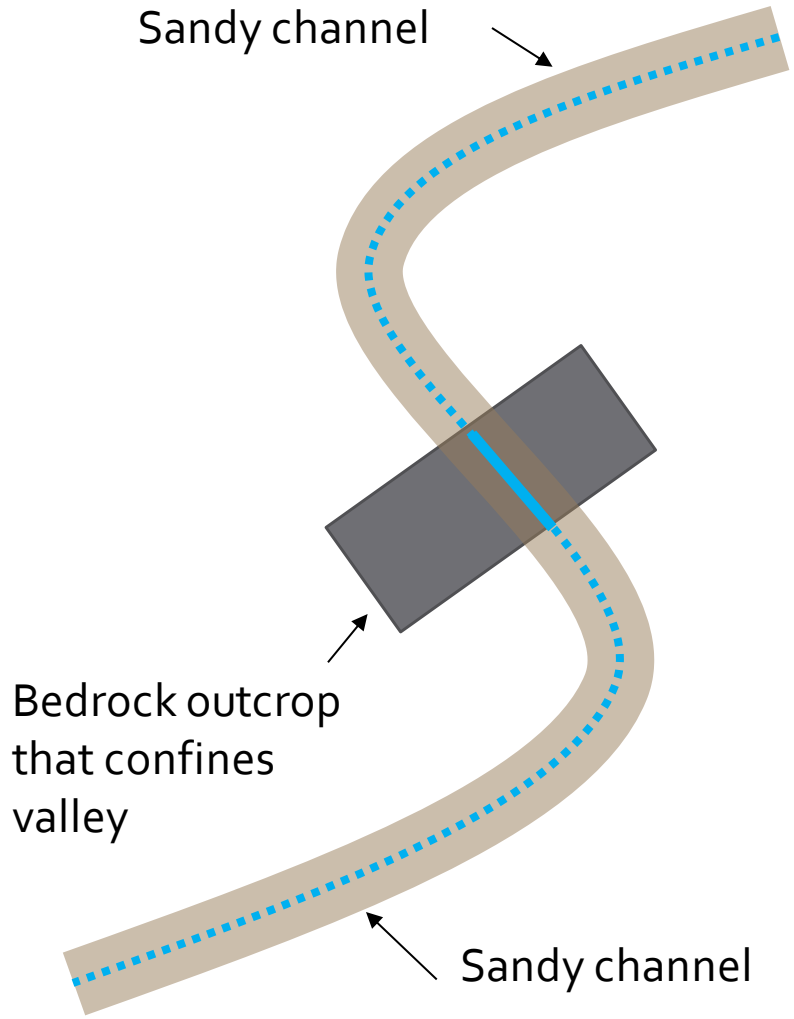
Sharp transition

Unconfined valley

Road crossings can locally alter flow

Where should you place your assessment reach?

- Some applications don't allow for discretion: Assess the reach within the specified project area.
  - This means that road crossings, tributaries, etc. may sometimes be included in an assessment reach.
- This may require assessing a relatively heterogenous reach with subsections exhibiting different flow duration.
- In these cases, portions with longer-duration flows tend to have *a larger influence* on the SDAM classification than portions with shorter-duration flows.



How many assessment reaches are needed?

- One is sufficient for small project areas, or project areas that have uniform channel morphology and lack transitions in drivers of streamflow duration.
- Multiple assessment reaches may be necessary for large project areas.
- Place assessment reaches to capture possible differences in streamflow duration.
  - Above and below major transitions in channel morphology
  - Above and below major tributaries
  - Above and below road crossings/culverts that alter local hydrology

Can you use the SDAM in created or modified channels?

Yes

- Concrete channels were included in method development

What about other long-term disturbances?

- Non-point source pollution, effluent discharge, habitat alteration, etc. may affect some indicators.
- Indicators include species that are tolerant of disturbance.
- Disturbances that change streamflow duration class (e.g., diversions, large discharges) will likely result in the new class being identified if sufficient time has passed.

Example tolerant indicators

Arundo

Calibaetis

Cladophoroa

What about short-term (pulse) disturbances?

- Veg clearing, grazing, floods, dam operations, re-grading, etc. can temporarily remove indicators from an assessment reach.
- Most indicators are resilient, but some may be harder to measure

What about short-term disturbances?

- Wait a few weeks and return, if possible
- Several indicators rebound quickly

When should you conduct assessments?

- The peak growing season is best because indicators are easiest to observe and measure
- Assessments can take place during dry or flowing conditions
- Streams recently influenced by scour are unsuitable because some indicators are difficult to measure

Knowledge check!

True or false: The SDAM AW can only be applied in stream reaches exhibiting surface flow

A. True

B. False

The SDAM AW may be applied in either wet or dry stream reaches

Knowledge check!

Which factors influence the strength of expression of streamflow duration indicators?

A. Transitions in valley confinement or gradient

B. Sediment loads

C. Watershed area

D. All of the above

All these factors may modify the strength of expression of streamflow duration indicators and may affect the placement of an assessment reach.

Knowledge check!

An assessment reach should normally be 40 times the mean channel width. Which of the following are appropriate reasons to use a shorter assessment reach? Select all that apply.

A. To avoid mixing wet and dry segments in a single assessment reach

B. To avoid trespassing on private property

C. To avoid including the confluence with a major tributary in the middle of the reach

D. To save time in the field

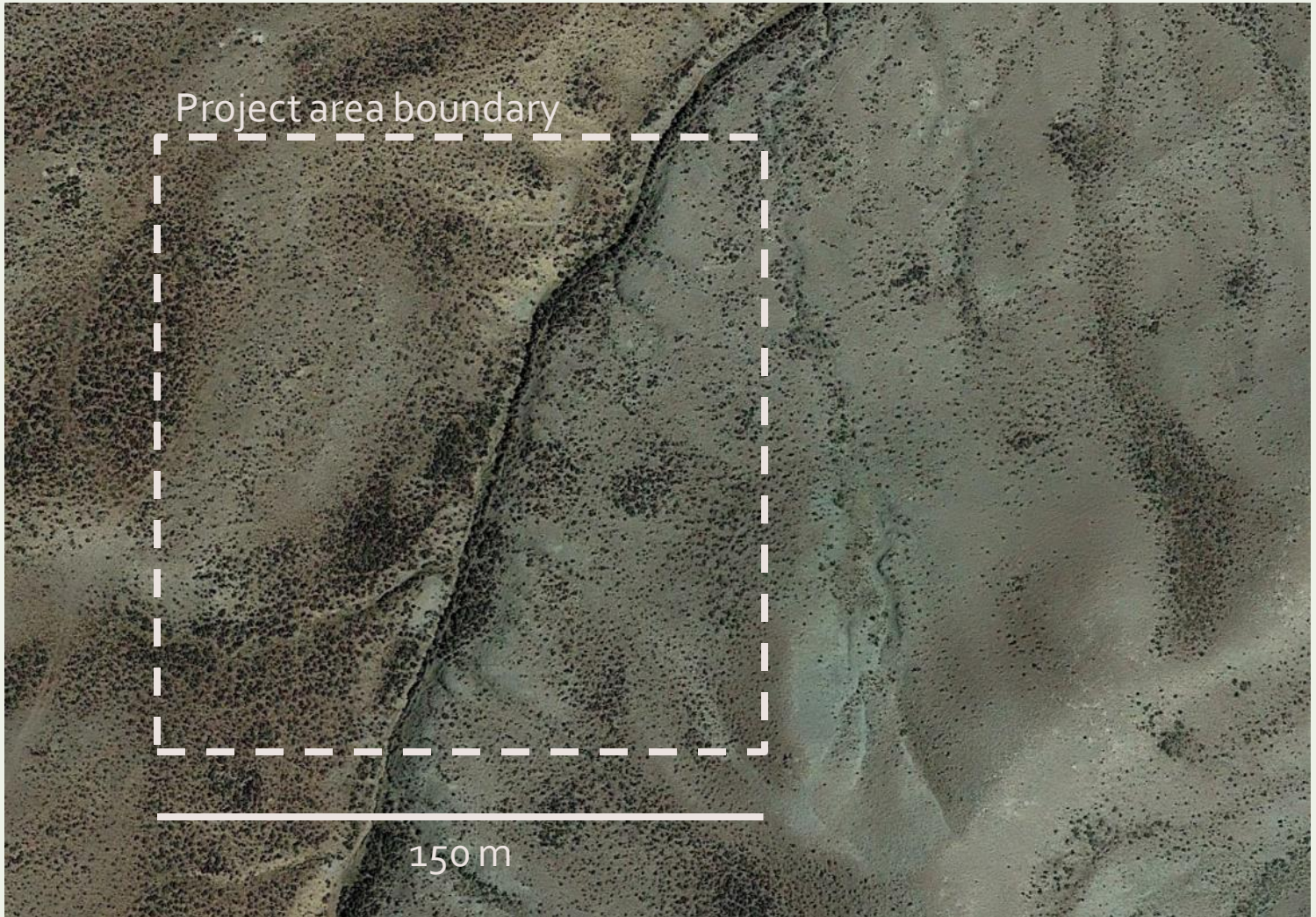
Assessment reach placement and length should consider private property boundaries, as well as drivers of streamflow duration.

They should not be modified based on presence or absence of surface water.

Discussion questions

How many assessment reaches do you expect to need?

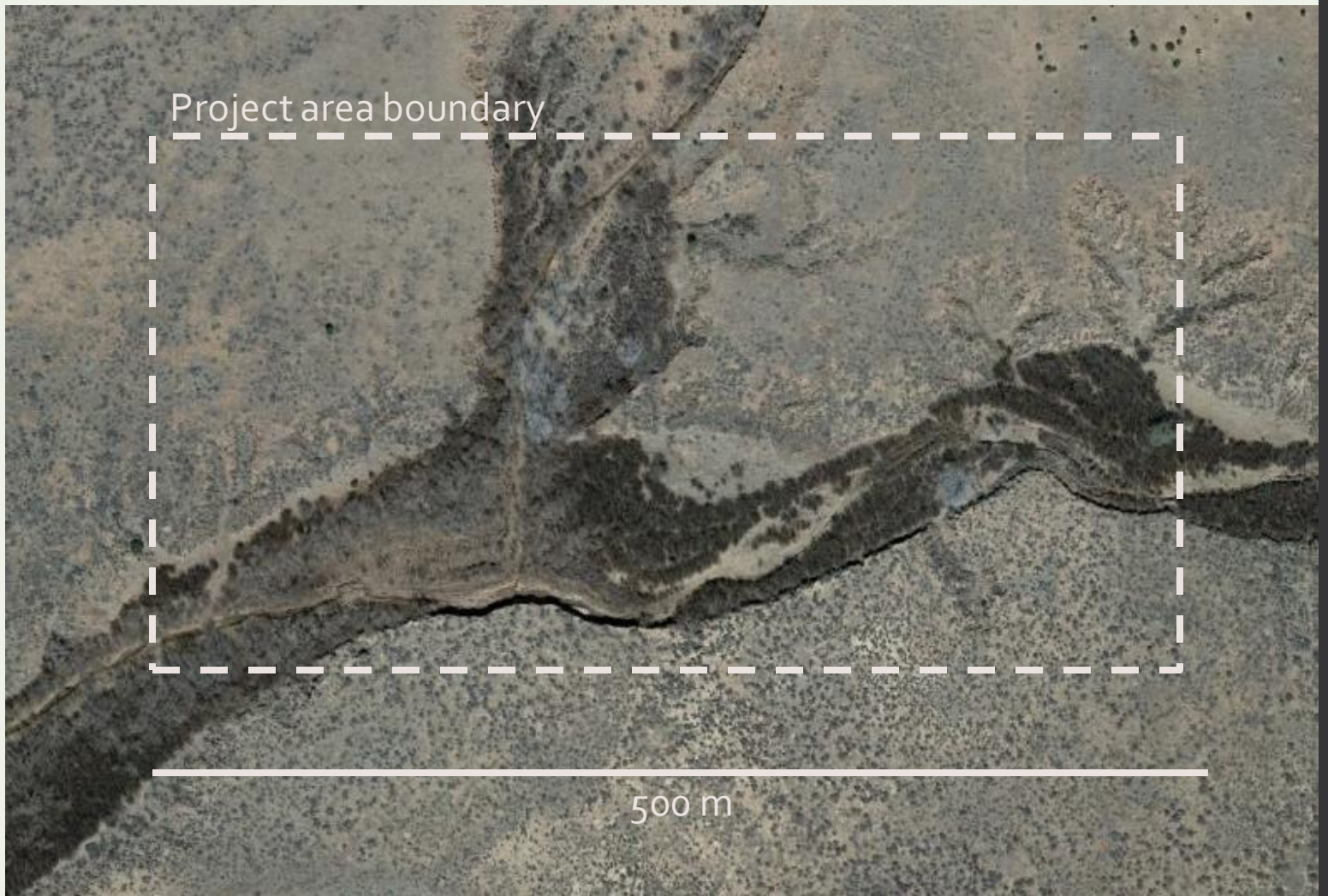
Where might you place it/them?



Discussion questions

How many assessment reaches do you expect to need?

Where might you place it/them?



Data collection

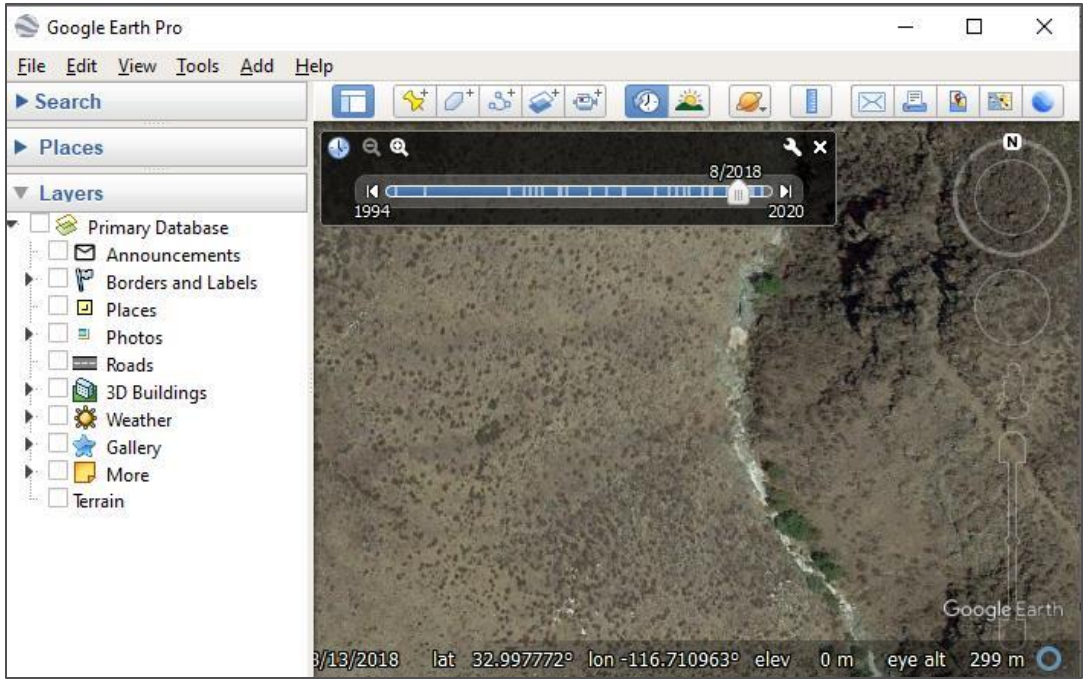
- Conduct desktop reconnaissance
- Prepare sampling gear
- Walk the reach
  - Determine assessment reach size and boundaries
- Measure indicators

Desktop reconnaissance

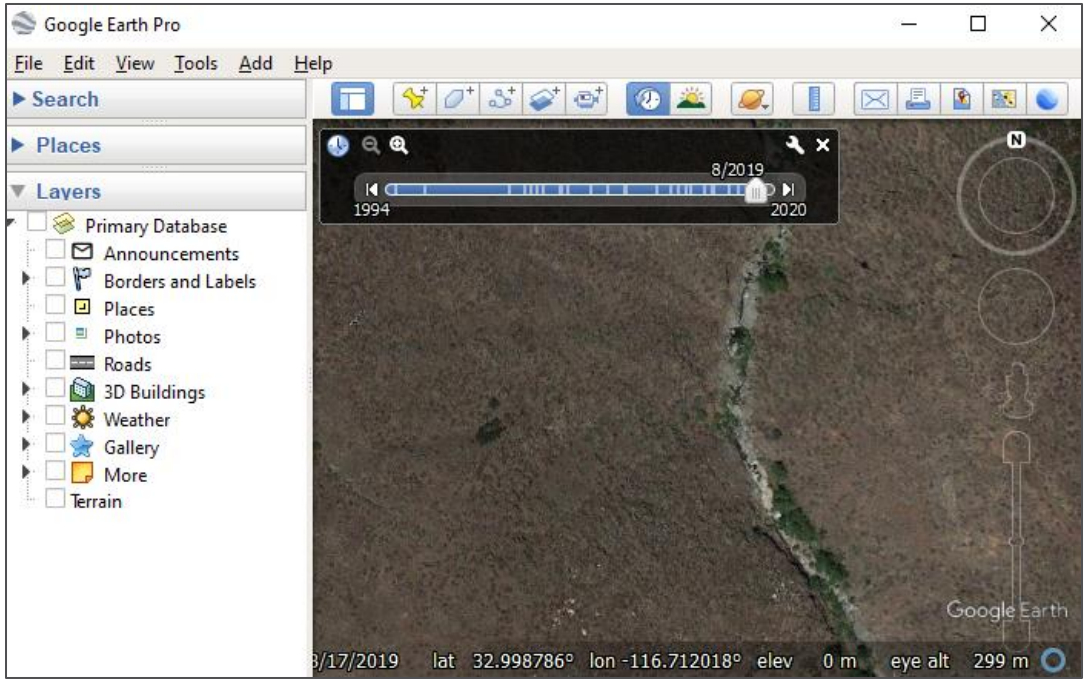
Before you step outside, gather the info you'll need!

- Determine access routes, property ownership, safety concerns
- Gauge field conditions
- Anticipate placement and number of assessment reaches required
- Find related data on flow, indicators
  - Regional plant lists, wildlife observations, bioassessment data, nearby stream gauges, etc.
- Identify local experts

Historical imagery can help a lot



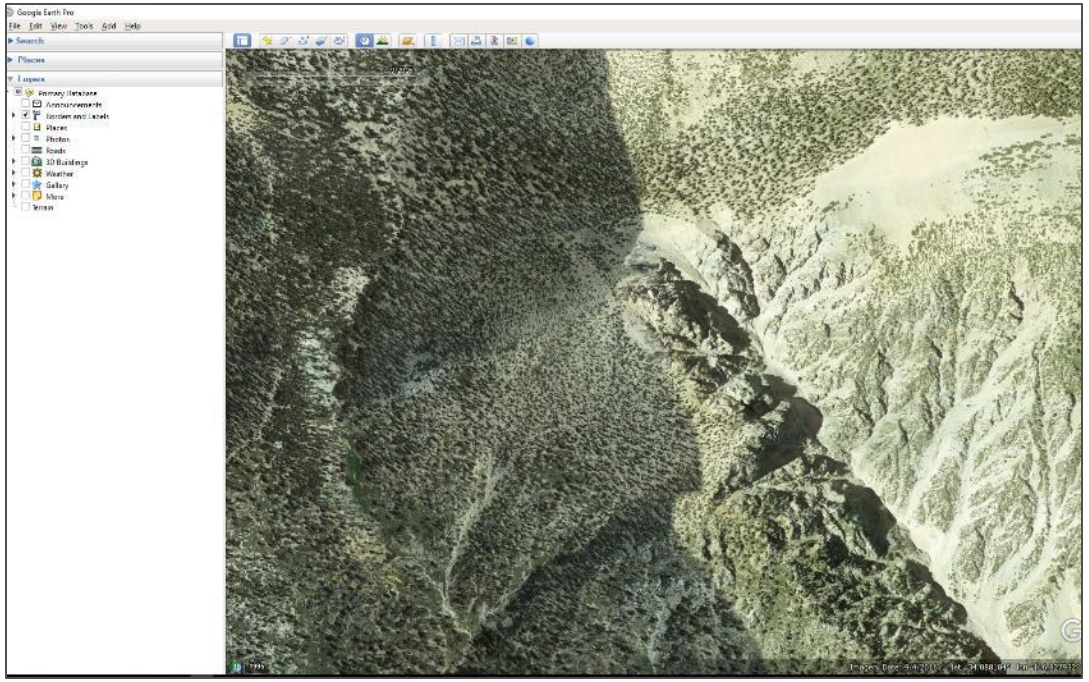
Aug 2018: Dry



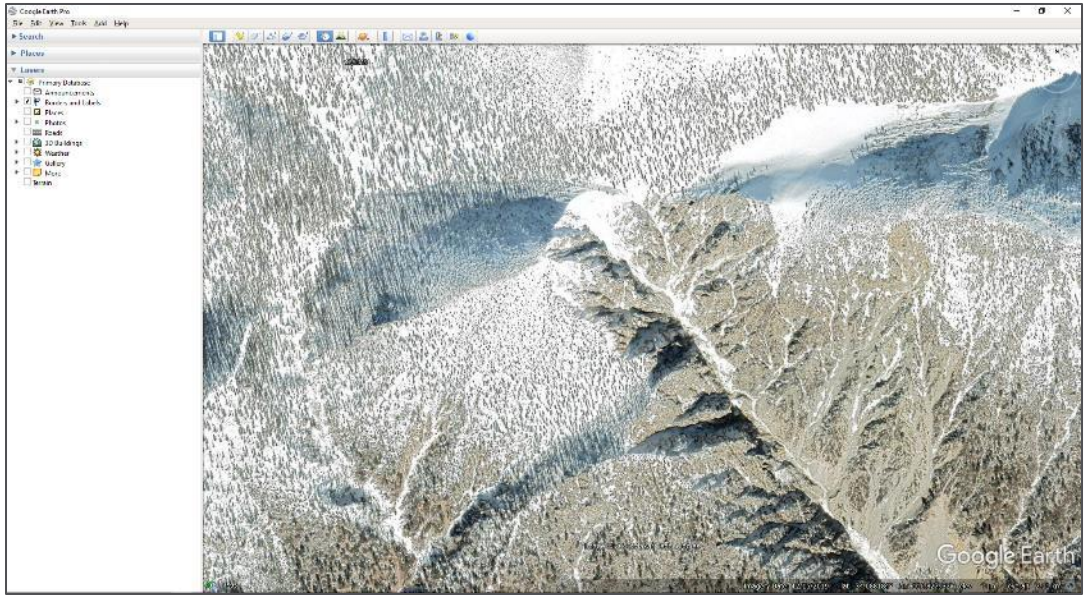
Aug 2019: Wet

Note: Dates reported in Google Earth are not always accurate

Historical imagery can help a lot



Sep 2016: No snow



Dec 2019: Snow

- Likely to prolong streamflow
- Presents challenges for field activities

Sampling gear

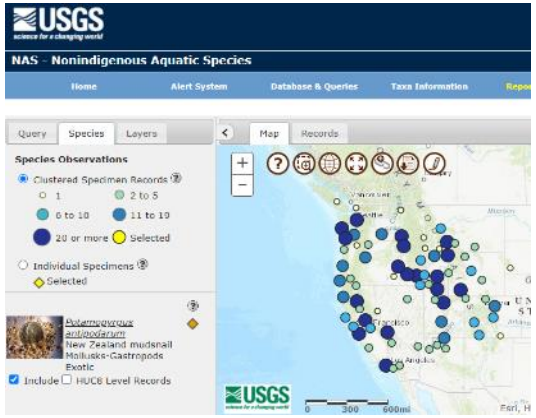
- Manual, field forms, clipboard, and notebook
- Site maps, aerial photographs (1:250 recommended)
- GPS (smartphone ok)
- Camera (smartphone ok)
- Tape measure
- Range finder
- D-frame kick net (Aquarium net ok in small streams)
- Material for sorting invertebrates: white tray, forceps, pipette/eye-dropper, tally counter
- Material for voucher collection, if appropriate (vials, ethanol, sample labels, sealable plastic bags)
- Hand lens
- Polarized lenses
- Hand trowel, shovel, or augur (to assist with observations of subsurface flow)
- Plant, invertebrate, fish, and amphibian ID guides
- Current version of National Wetland Plant List for Arid West
- First aid kit
- Personal field gear (boots/waders, hat, etc.)

Gear required for the SDAM AW may be carried by a single practitioner

Sampling gear

Make sure gear is cleaned before and after sampling to avoid spreading invasive species, fish/amphibian disease, etc.

USGS Nonindigenous Aquatic Species website
https://nas.er.usgs.gov/
USDA Invasive Species info:
https://www.invasivespeciesinfo.gov/



Walk the reach

- Determine if multiple assessment reaches are needed
- Start taking width measurements to estimate assessment reach length. We recommend 3 locations, e.g.:
  - At the downstream end
  - 15 m above the downstream end
  - 30 m above the downstream end
- Keep an eye out for fish, amphibians, and other furtive indicators
- Stay outside the water, if possible. Disturbance could hinder subsequent measurements.
- Determine appropriate reach boundaries
- Start site-sketch
  - Indicate access points, channel features, and location of indicators
  - Revise when assessment is complete

Measure bankfull width at 3 locations

Bankfull elevation is the transition between the channel and the floodplain.

In braided reaches, measure width of entire active channel

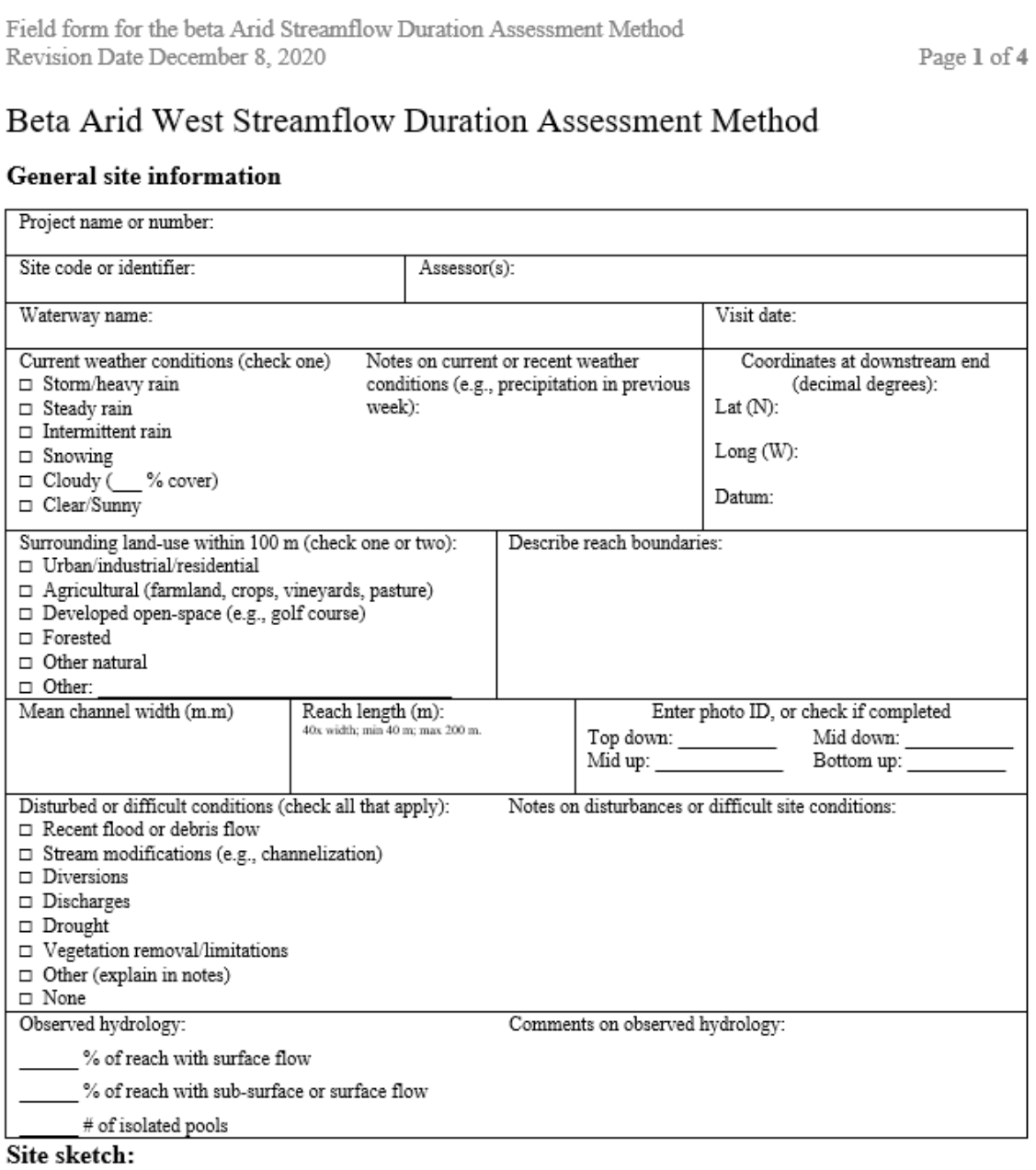
General site info

Descriptions of the assessment's location and date:

- Project name or number
- Site code/identifier
- Name of assessor(s)
- Waterway name
- Visit date
- Coordinates
- Channel width, reach length
- Reach boundary descriptions

Surrounding context:

- Weather conditions
- Surrounding land use (up to 2 categories)
- Disturbances



Field form for the beta Arid Streamflow Duration Assessment Method
Revision Date December 8, 2020 Page 1 of 4

Beta Arid West Streamflow Duration Assessment Method

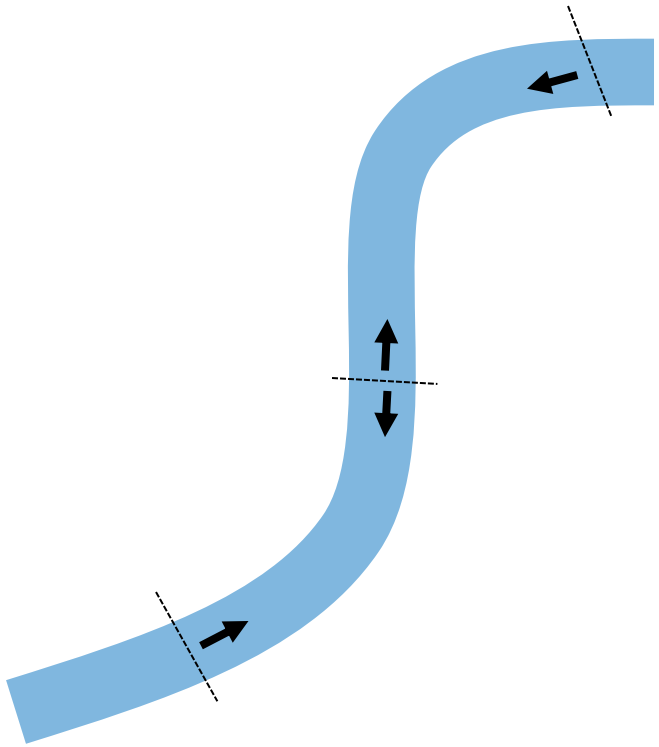
General site information

Project name or number:		
Site code or identifier:	Assessor(s):	
Waterway name:		Visit date:
Current weather conditions (check one) ☐ Storm/heavy rain ☐ Steady rain ☐ Intermittent rain ☐ Snowing ☐ Cloudy (___ % cover) ☐ Clear/Sunny	Notes on current or recent weather conditions (e.g., precipitation in previous week):	Coordinates at downstream end (decimal degrees): Lat (N): Long (W): Datum:
Surrounding land-use within 100 m (check one or two): ☐ Urban/industrial/residential ☐ Agricultural (farmland, crops, vineyards, pasture) ☐ Developed open-space (e.g., golf course) ☐ Forested ☐ Other natural ☐ Other: _____	Describe reach boundaries:	
Mean channel width (m.m)	Reach length (m): 40x width; min 40 m; max 200 m.	Enter photo ID, or check if completed Top down: _____ Mid down: _____ Mid up: _____ Bottom up: _____
Disturbed or difficult conditions (check all that apply): ☐ Recent flood or debris flow ☐ Stream modifications (e.g., channelization) ☐ Diversions ☐ Discharges ☐ Drought ☐ Vegetation removal/limitations ☐ Other (explain in notes) ☐ None	Notes on disturbances or difficult site conditions:	
Observed hydrology: _____ % of reach with surface flow _____ % of reach with sub-surface or surface flow _____ # of isolated pools	Comments on observed hydrology:	

Site sketch:

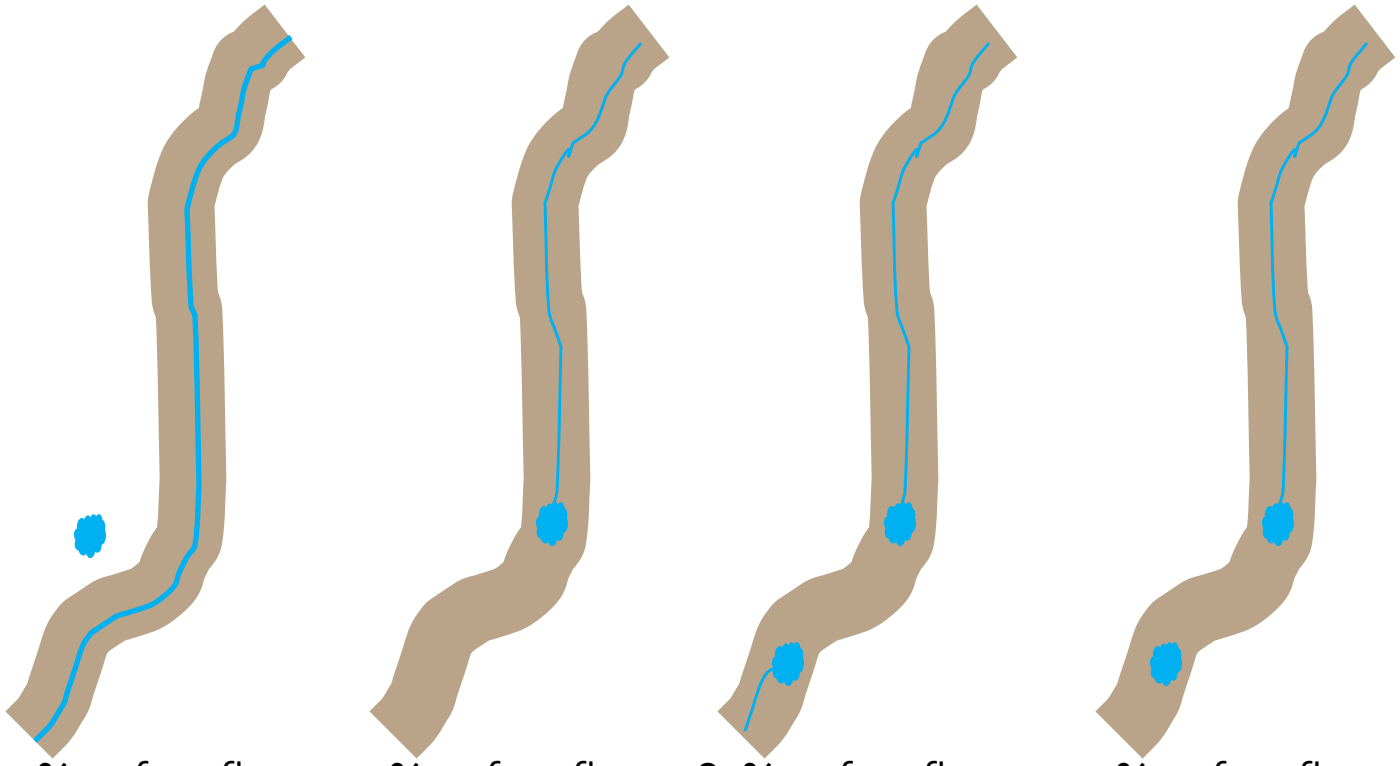
Photo documentation

- More is better!
- Some photos are required:
  - Top of assessment reach looking downstream
  - Middle of assessment reach, looking upstream
  - Middle of assessment reach, looking downstream
  - Bottom of assessment reach, looking upstream
- Other photos are strongly recommended:
  - Top/Plan view, if possible (e.g., from a bridge crossing)
  - Any indicators observed on the site
    - Plant species, aquatic invertebrates, algal mats, fish
  - Any supplemental information measurements (e.g., amphibians, iron-oxidizing bacteria, etc.)
  - Any disturbances that affect indicator measurement or interpretation
- Keep a log, or use designated spots on field form



Surface/Subsurface flow

- Estimate % of reach
  - with surface flow
  - With surface + subsurface flow
- Estimate # of isolated pools
  - In the channel (i.e., not floodplain)
  - Holding water at time of assessment
  - No connection to flowing surface water



100% surface flow
100% surface + subsurface flow
No isolated pools

70% surface flow
70% surface + subsurface flow
No isolated pools

80% surface flow
100% surface + subsurface flow
No isolated pools

70% surface flow
70% surface + subsurface flow
1 isolated pool

Knowledge check!

Which of the following features should be recorded as an isolated pool?

A. A depression in a channel that retains water at the time of the assessment, but has no surface flow at the inlet or outlet

B. A depression in a dry channel that could retain water, but has no surface water at the time of assessment

C. A depression in a channel with an outlet where surface water flows for several meters, but is dry at the inlet

D. A depression outside of the channel (e.g., on the floodplain) that retains water at the time of the assessment

Isolated pools occur within the channel, retain water at the time of visit, and are discontinuous with areas of surface flow within the assessment reach.

Knowledge check!

What should you determine during desktop reconnaissance?

A. Access routes to the site

B. Property boundaries and other features that may affect assessment reach placement

C. Likely field conditions and safety concerns at the site

D. Expected plant species

E. All of the above

Knowledge check!

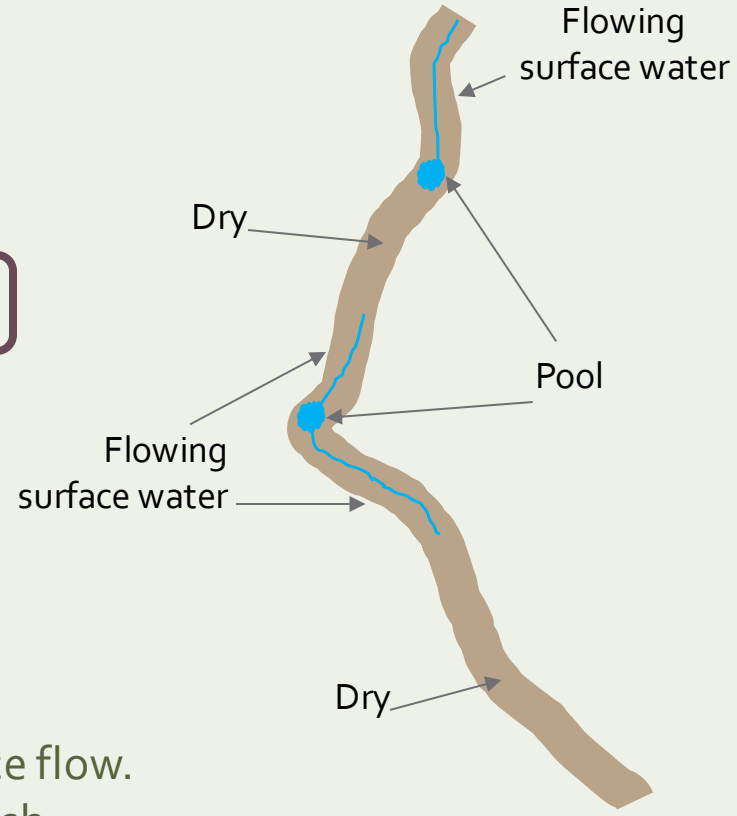
Which of the following correctly describes the hydrologic conditions of this site?

A. 50% surface flow, 50% surface + subsurface flow, no isolated pools

B. 50% surface flow, 70% surface + subsurface flow, no isolated pools

C. 50% surface flow, 70% surface + subsurface flow, 1 isolated pool

D. 50% surface flow, 100% surface + subsurface flow, no isolated pools



There is evidence of subsurface flow between the two areas with surface flow.
There's no evidence of subsurface flow in the bottom portion of the reach.
There are no pools isolated from areas with surface flow.

Discussion question

What are some helpful resources in your region you can turn to during desktop reconnaissance?

Discussion question

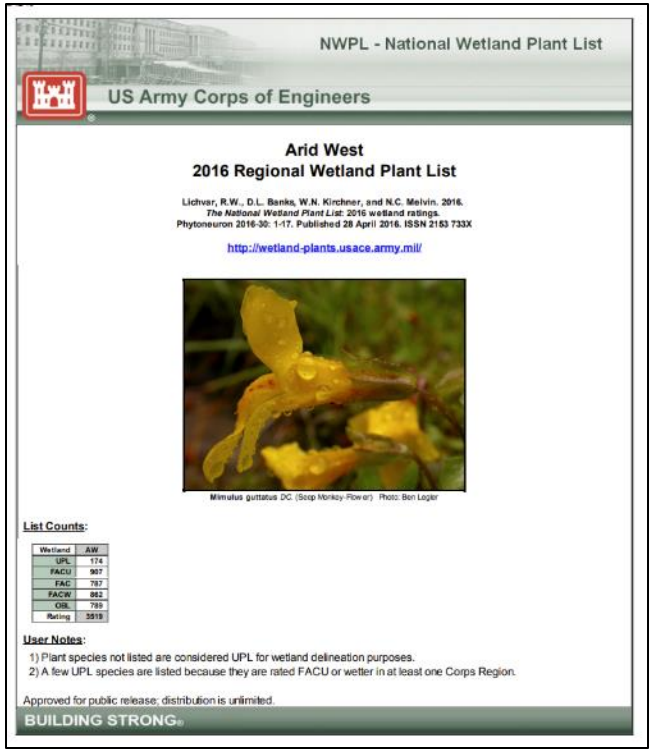
Imagine you see a section of a stream like this during your initial walk.

What do you notice? How will this affect your subsequent measurements? When you come back later, what will you investigate?

Hydrophytic plant species

How many hydrophytic plant species (up to 5) are found in the channel, or within a half-channel width of the channel?

- Only FACW and OBL count as hydrophytes for the SDAM AW
- Use the most up-to-date version of the Arid West National Wetland Plant list.
  - FACW and OBL plant species are equally important in the SDAM AW
- Do not count FAC, FACU, or UPL plant species
  - These may be treated as "hydrophytes" in some applications, but not the SDAM AW.
- Document **up to 5** hydrophytic plant species. You can focus on:
  - Dominant species
  - Species where you have the greatest confidence in the identification
- Why not just 3 species? Provide redundancy in case of misidentifications.



Hydrophytic plant species

Which ones to focus on?

- Where your identifications are the most confident
- Most dominant in the assessment area

Black willow (*Salix gooddingii*, FACW)

- Often a co-dominant riparian species

Scarlet monkeyflower (*Mimulus cardinalis*, FACW)

- Showy, conspicuous, memorable
- Hard to mistake for anything else!

Do these count as hydrophytes?

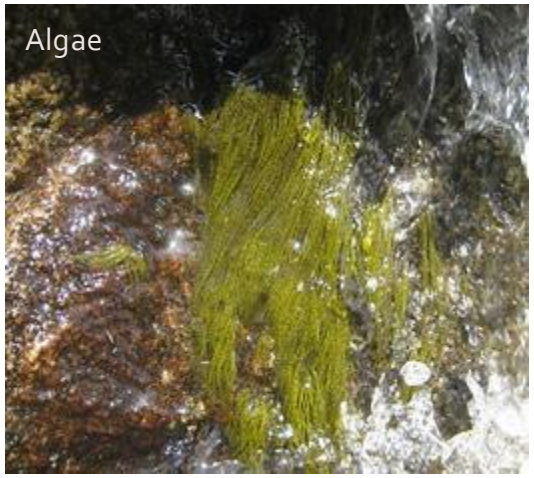
Yes!

NWPL includes all sorts of vascular plants (not just flowering plants)

Do these count as hydrophytes?

No!

NWPL only includes vascular plants



FAC doesn't count!

- Many FAC trees are conspicuous and cherished components of riparian communities in the Arid West
  - Cottonwoods (*Populus fremontii, P. deltoides*)
  - Some sycamores (*Platanus racemosa, P. occidentalis*)
  - Oaks (*Quercus* spp.)
- They do not count as hydrophytes in the SDAM AW
- This does not diminish their conservation value!

Keep an eye out for non-hydrophyte lookalikes!

Many FAC species are common in riparian zones, and certain species resemble common FACW or OBL species

Calif. fan palm
Washingtonia filifera
FAC

Washington fan palm
W. robusta
FACW

Desert willow
Chilopsis linearis
FAC

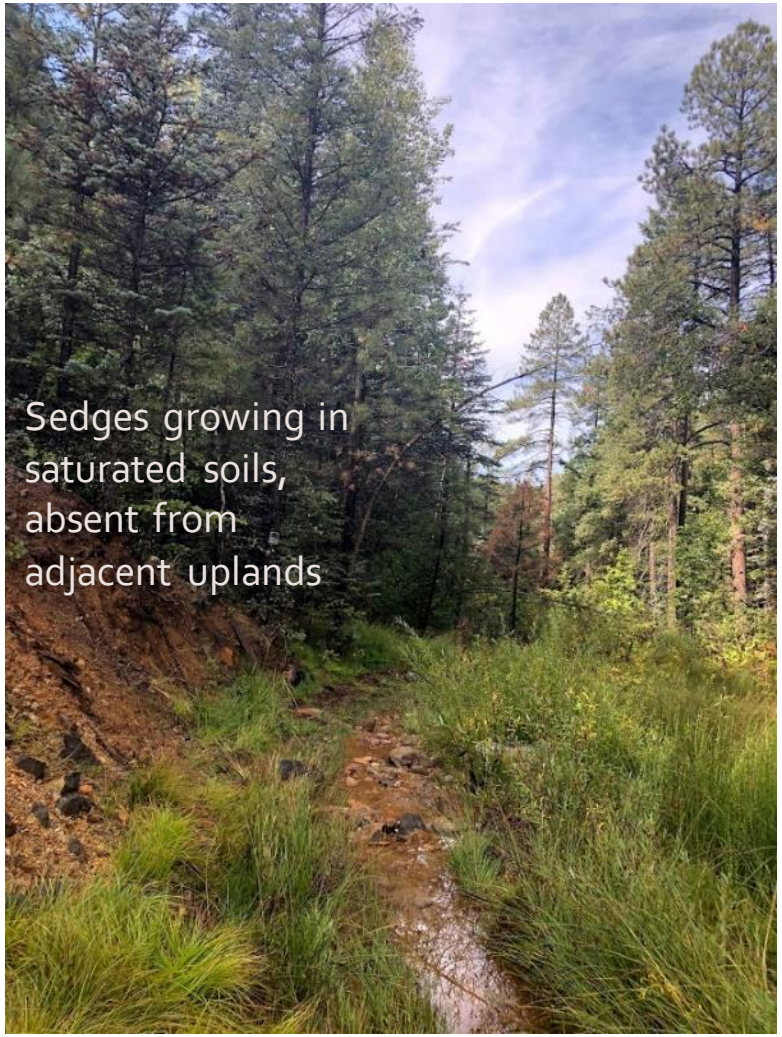
Seep willow
Baccharis salicifolia
FAC

Red willow
Salix laevigata
FACW

What if you don't know every plant species?

- We don't need a comprehensive vegetation survey
- Morpho-species are ok
- Look for likely hydrophytes:
  - Use context!
  - Abundant in riparian zone, but absent from surrounding uplands
  - Grows in saturated soils or in water
- **Photo documentation is essential** if you can't identify in the field.

Sedges growing in inundated areas



Sedges growing in saturated soils, absent from adjacent uplands

Take *helpful* photos of plants in the field

More is better!

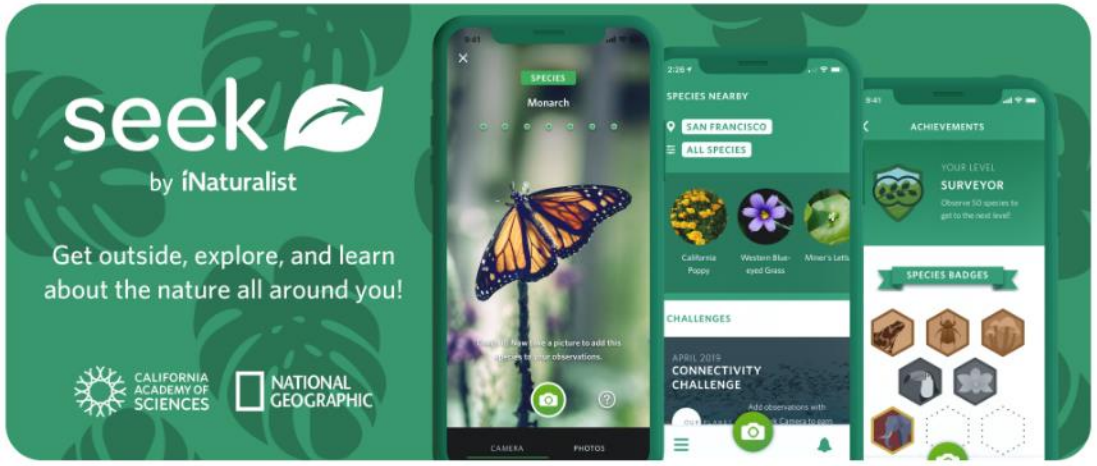
- At least one photo should show context
  - 5-10 feet away is often a good distance
- At least one photo should highlight diagnostic characters
- These characters vary among different groups of plants, but often include:
  - Leaf size, shape, color/texture (both sides!), and arrangement on stem
  - Flowers, if present
  - Seed pods/fruits/berries, if present
  - Bark
  - Branching patterns
  - Basal arrangement of leaves/stems
- Include your hand, penny, key, etc. to provide a size reference.

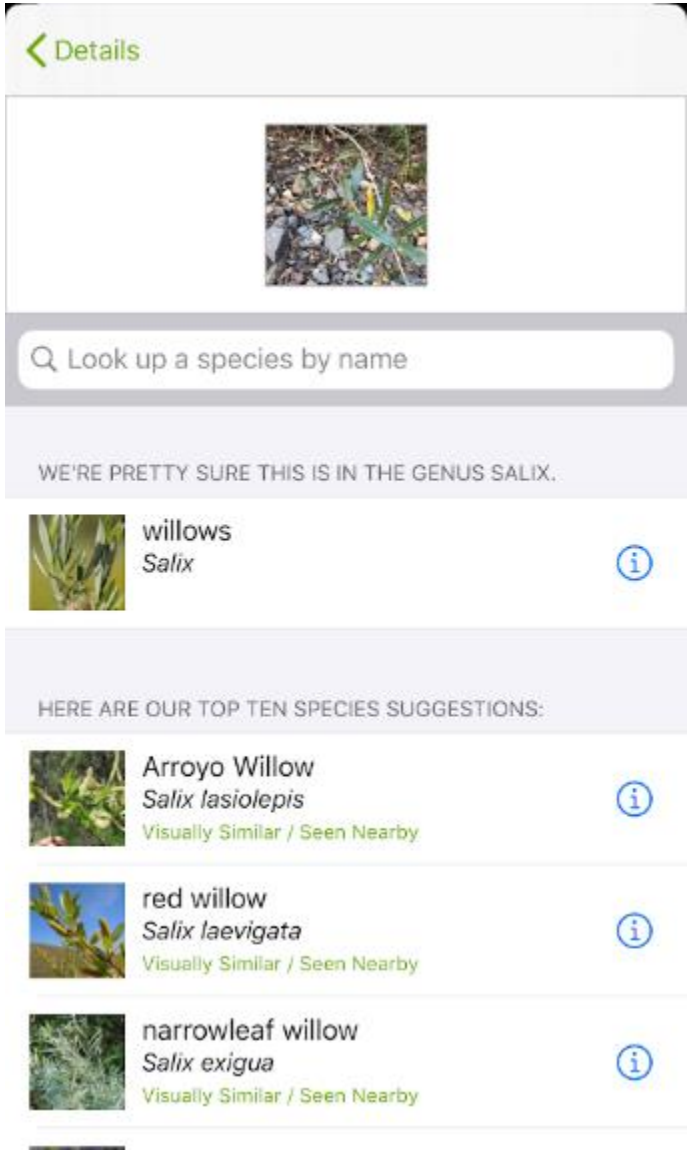
Context photo of an alder

Closeup of diagnostic characters (i.e., leaf shape, arrangement)

What if you don't know every plant species?

- Apps (e.g., Seek) provide identifications based on image recognition (a good starting point for beginners)
- Online communities (e.g., iNaturalist) also provides review by real people—a great way to interact with experts!





Learn to recognize common species

Common hydrophytes in development dataset:

Willows
- *Salix lasiolepis*
- *S. gooddingii*
- *S. laevigata*
- *S. exigua*

Alders
- *Alnus incana*
- *A. rhombifolia*
- *A. rubra*

Bulrushes

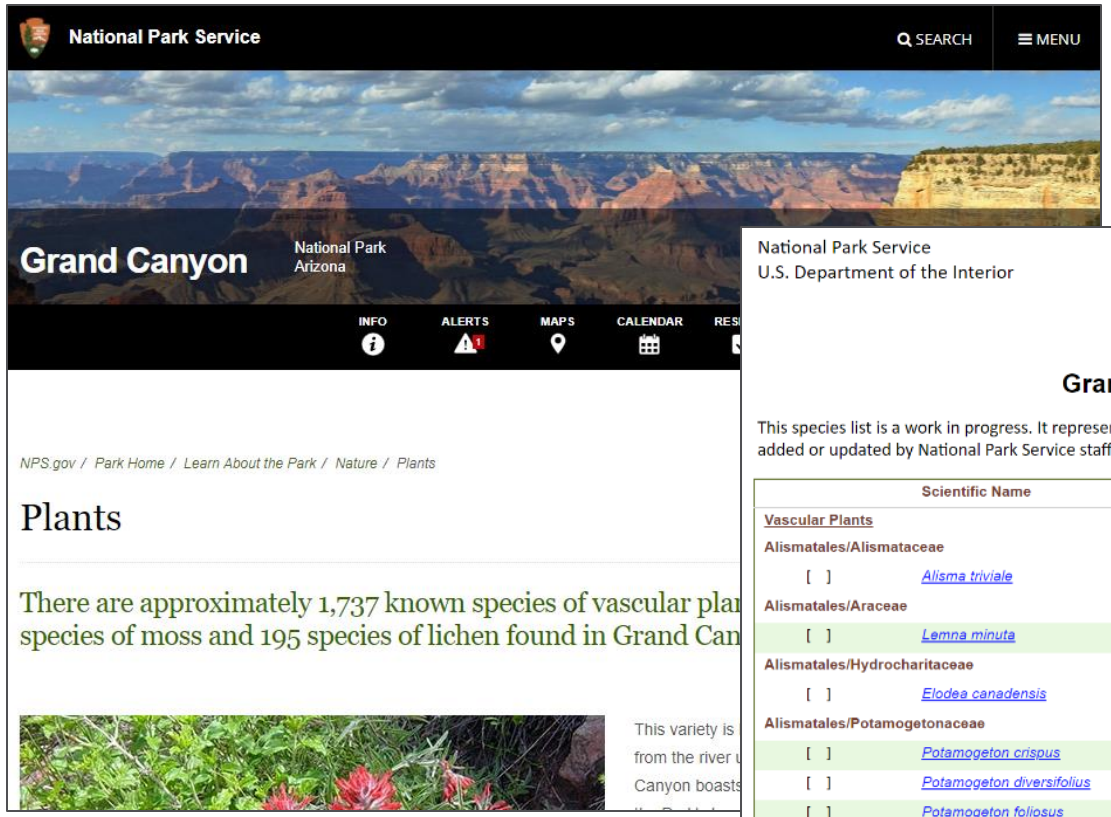
Arundo

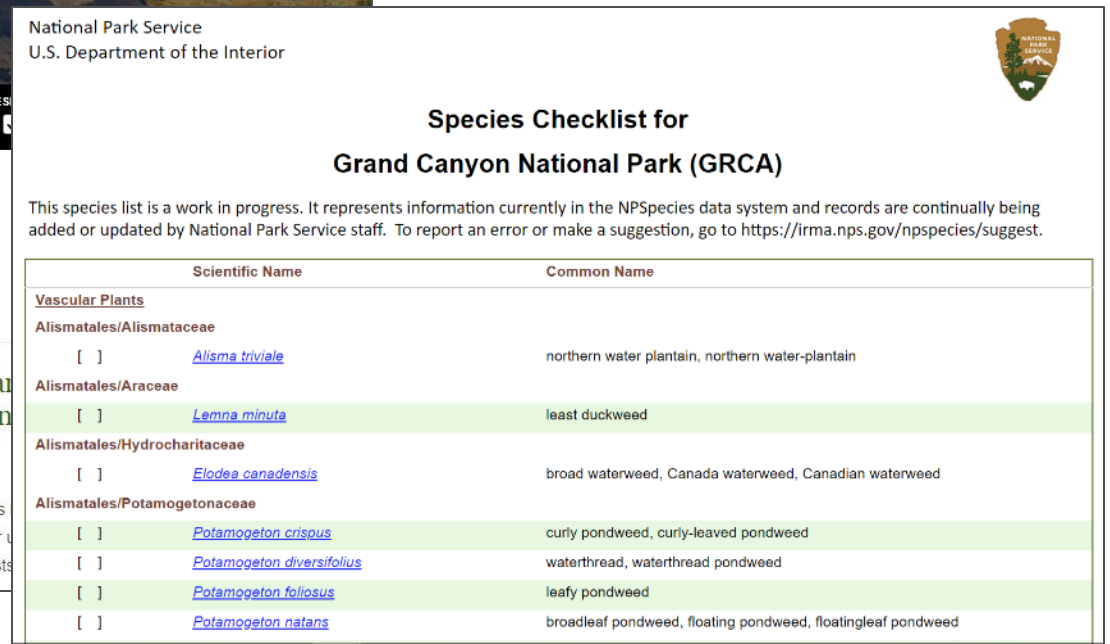
Cattails

Find regional floras to know what species to expect

Plant lists have likely been developed for nearby public lands (e.g., national parks).

State native plant societies may have other useful resources




National Park Service
U.S. Department of the Interior

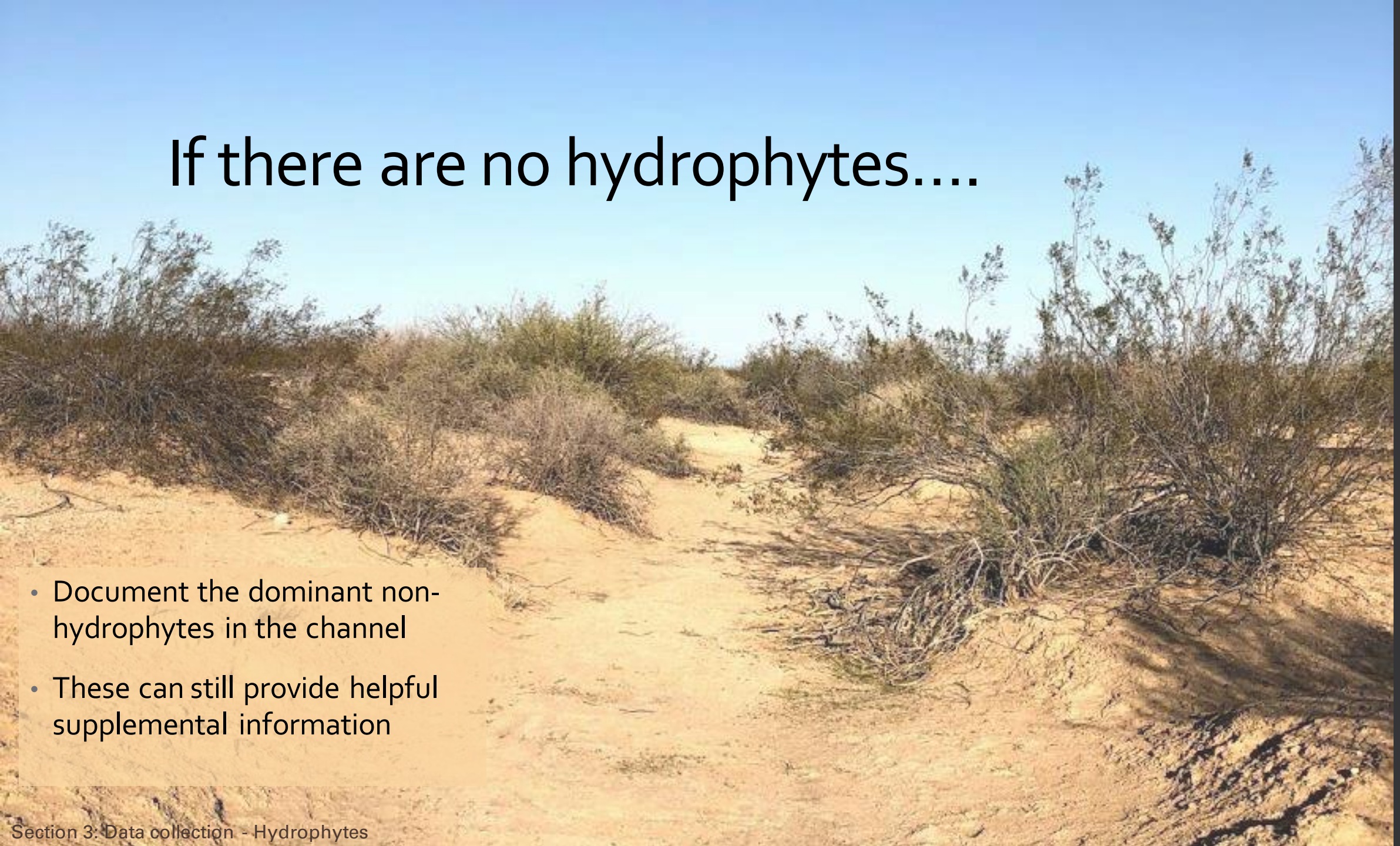
Species Checklist for

Grand Canyon National Park (GRCA)

This species list is a work in progress. It represents information currently in the NPSpecies data system and records are continually being added or updated by National Park Service staff. To report an error or make a suggestion, go to https://irma.nps.gov/npspecies/suggest.

	Scientific Name	Common Name
Vascular Plants		
Alismatales/Alismataceae		
[ ]	*Alisma triviale*	northern water plantain, northern water-plantain
Alismatales/Araceae		
[ ]	*Lemna minuta*	least duckweed
Alismatales/Hydrocharitaceae		
[ ]	*Elodea canadensis*	broad waterweed, Canada waterweed, Canadian waterweed
Alismatales/Potamogetonaceae		
[ ]	*Potamogeton crispus*	curly pondweed, curly-leaved pondweed
[ ]	*Potamogeton diversifolius*	waterthread, waterthread pondweed
[ ]	*Potamogeton foliosus*	leafy pondweed
[ ]	*Potamogeton natans*	broadleaf pondweed, floating pondweed, floatingleaf pondweed

If there are no hydrophytes….



- Document the dominant non-hydrophytes in the channel
- These can still provide helpful supplemental information

You can almost always find something growing

- Even in engineered (non-natural) channels!
- Don't leave without recording something about what's growing.
- Exceptions: Recently graded channels, certain concrete channels

Note unusual distributions: Isolated specimens

- Road crossing, culverts alter hydrology and can sustain hydrophytes locally
- If hydrophytes only occur in these areas (and nowhere else within the assessment reach), make sure to note this on the site sketch and other appropriate places on the field form.
- Typically covers less than 2% of assessment area, and all in one location (not dispersed throughout reach)

Note unusual distributions: Long-lived species in decline


Photo credit: USGS

- Suggests a long-term change in water availability
- Changes may be caused by natural variability (e.g., climatic cycles, earthquakes) or human activities (e.g., diversions)
- It may take many years (decades) for mature trees to die from lack of water

Note unusual distributions: Long-lived species only observed as seedlings

- Many riparian trees colonize rapidly after floods
- Seedlings may be widespread within the assessment reach.
- The lack of older specimens suggests that flows are insufficient to support these species

Record on the field form

1. Hydrophytic plant species

Record up to 5 hydrophytic plant species (FACW or OBL in the **Arid West** regional wetland plant list) within the assessment area: **within the channel or up to one half-channel width**. Explain in notes if species has an odd distribution (e.g., covers less than 2% of assessment area, long-lived species solely represented by seedlings, or long-lived species solely represented by specimens in decline), or if there is uncertainty about the identification. Enter photo ID, or check if photo is taken.

Check if applicable: ☐ No vegetation in assessment area ☐ No hydrophytes in assessment area

Species	Odd distribution?	Notes	Photo ID

Notes on hydrophytic vegetation:

Check these boxes if you don't observe any hydrophytes.

- Species name (or morpho-species description)
- Notes about distribution
- Photo IDs
- Notes about hydrophytes in general

Knowledge check!

True or false: The status of a plant species may change from region to region. For example, a FACW plant in the Arid West may be FAC in the Western Mountains.

A. True

B. False

Plant species may have different wetland indicator status in different regions.

Knowledge check!

Are species-level identifications required for hydrophytes? Select all that apply.

A. Yes. You cannot be sure of a plant's status as a hydrophyte without species-level identifications.

B. No. Within the Arid West, some genera exclusively contain hydrophytic plant species (e.g., *Alnus*). A genus-level ID is sufficient.

C. No. Contextual information with photo documentation can be sufficient to determine that a plant is a hydrophyte.

Species-level identifications are not necessary for streamflow duration assessment. Higher levels of identification may be sufficient.

Knowledge check!

Which of these may be considered hydrophytic plant species for the SDAM AW? Select all that apply.

A. Ferns

B. Sphagnum moss

C. Duckweed

D. Woody trees and shrubs

E. Filamentous algae

F. Grasses, sedges, and rushes

G. Liverworts

H. Horsetails

The National Wetland Plant List only includes vascular plants. Mosses and liverworts aren't included in the NWPL, although they may be used as wetland indicators in other applications.

Algae are used in a different indicator in the SDAM AW.

Knowledge check!

This plant is very common in riparian zones in southwestern deserts. Should it be treated as a hydrophyte?

A. Yes

B. No

This is red willow (*Salix laevigata*). Like most willows in the Arid West, it has a status of FACW.

Recognizing willows and other common hydrophytes is an essential skill for SDAM AW assessors

Knowledge check!

This plant is very common in riparian zones in southwestern deserts. Should it be treated as a hydrophyte?

A. Yes

B. No

This is desert willow (*Chilopsis linearis*), which is rated FAC.

Recognizing common non-hydrophytes (especially those that resemble hydrophytes) is an essential skill for SDAM AW practitioners.

Aquatic invertebrates

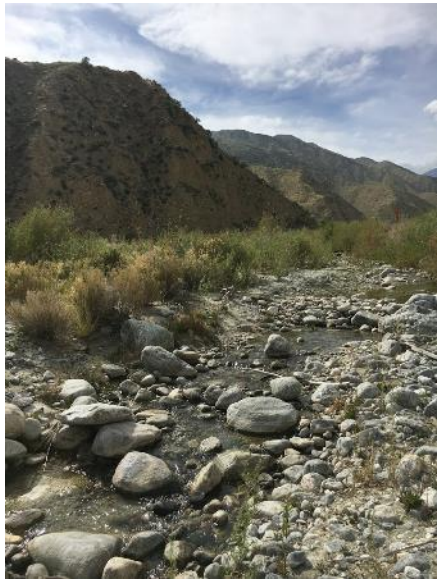
- How many aquatic invertebrate individuals are collected?
- Is there evidence of aquatic stages of Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa?

Photo credit: macroinvertebrates.org

Aquatic invertebrates

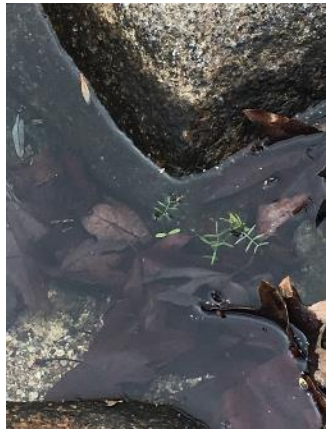
- Measured with a 15-minute search in at least 6 locations.
- Order-level identifications are needed to detect mayflies, stoneflies, and caddisflies
  - Sorting and ID time not counted towards the 15 minutes
  - Beginners should use a hand-lens or field microscope, but experienced assessors can make IDs with unaided eye.
- Do not differentiate between live organisms and non-living material (shells, casings, shed skins, etc.). All are counted.

Target all habitat types



Riffles

Pools



Leaf packs

Tree roots

Woody jams

Undercut banks

Use appropriate methods

Collecting aquatic invertebrates

In locations with flowing water:

- Start at downstream end and work upstream
- Place D-frame kick-net perpendicular to direction of local flow
  - Keep bottom flush with streambed
  - Make sure net is fully extended and unobstructed
- Stir up substrate with foot or hands in 1-ft^2 upstream of net opening
- Empty net contents into a white sorting tray with stream-water

Collecting aquatic invertebrates

In locations with still water:

- Place net in water
- Kick up substrate
- Rapidly move net through water, sweeping up suspended invertebrates

Collecting aquatic invertebrates

In woody jams, root mats, and undercut banks:

- Jab with a D-frame net

Collecting aquatic invertebrates

- Pick up and examine large cobbles or other substrate
- "Clingers" will be evident

May be visible, even without efforts to collect

This is only effective for a few taxa (e.g., black flies, snails).

A full 15-minute search is still necessary.

Sort in a tray

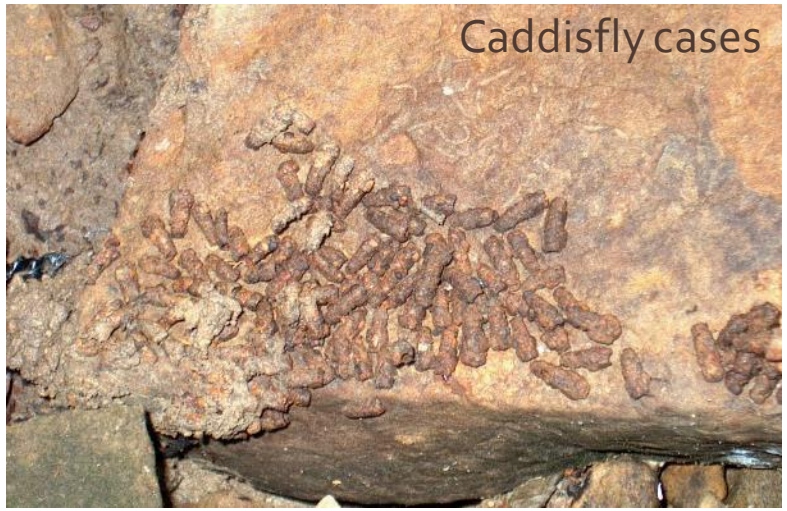
- Remove, tally, and ID aquatic invertebrates
- Feather-weight forceps, eye-droppers can help.
- White-backed tray makes it easier to see.
- Be patient: Some bugs will start moving and become obvious.
- Search for critters clinging to the net as well.
- Recommend collecting specimens to confirm identifications, if possible.

In partly dry streams

In completely dry streams

- Look for areas where water may have persisted
- Turn over cobbles and boulders
- Look at streamside vegetation or large boulders for shed skins

Shed larval skins (exuviae)



Living aquatic invertebrates can be found in dry streams!

Photo credit: Michael Bogan

Neohermes is a long-lived specialist in intermittent streams.

Ignore terrestrial lifestages

Watch for (semi-) terrestrial look-alikes

Terrestrial insect larvae
(tend to have leathery skin)

Terrestrial garden snail
(tend to have thicker shells)

Don’t count mosquito larvae

- Hang at water surface, with breathing tube at tip of abdomen
- Larvae and pupae can “wriggle” when water is disturbed
- Rapidly colonize and mature in standing water – Not meaningful as an indicator of streamflow duration.
- Presence may be documented in notes on field form.


Missouri Department of Conservation

Identify EPT taxa

Presence of these three insect orders is an indicator for the SDAM AW

- **E**phemeroptera (mayflies)
- **P**lecoptera (stoneflies)
- **T**richoptera (caddisflies)

Ephemeroptera larva
Image credit: Dieter Tracev

Plecoptera larva
Tracev Saxbv

Trichoptera larva
Tracev Saxbv

Field-based identification is possible with a little training

Field form contains helpful diagrams

Image credits: Integration and Application Network https://ian.umces.edu/

Mayflies

- Gills on sides of abdomen
- Two or three tail-like filaments (cerci)
  - Most have 3
  - Some species have 2
  - May be broken off or missing
- One tarsal claw at end of each leg
- Wingpads evident on mature larvae
- Many have a minnow-like appearance
  - Actively swim like fish in your sorting tray

CA DFW Digital Reference Library

Mayflies

- Many have a flattened appearance
- Typically found clinging to undersides of cobbles (not freely swimming)

CA DFW Digital Reference Library

Stoneflies

- Gills along thorax
- Wingpads evident
- Two (never 3) cerci
- Two tarsal claws
- Often found clinging to cobbles and other large substrate

CA DFW Digital Reference Library

Stoneflies

- Some have a roach-like appearance
- Some are more slender and elongated

CA DFW Digital Reference Library

Caddisflies

- Soft abdomen will gills along ventral side
- Head and thorax is partly or fully hardened (sclerotized)
- C-shaped body
- Anal hooks at end of abdomen
- Many live in cases made of silk and other material.
  - Pebbles

CA DFW Digital Reference Library

Caddisflies

Diversity of case types

All images from CA DFW Digital Reference Library, except where noted

Caddisflies

- Net-spinners build permanent silk retreats under cobbles, boulders, and other large substrate
- Look for pebbles stuck to cobbles with silk—there's often a bug inside!

Non-EPT look-alikes

- Similarities are superficial
- Hand lens or microscope may help learn to recognize differences

Record on the field form

2 and 3. Aquatic invertebrates

2. How many aquatic invertebrates are quantified in a 15-minute search?	**3. Is there evidence of aquatic stages of EPT (Ephemeroptera, Plecoptera and Trichoptera)?** Yes / No
Number of individuals quantified: ☐ None ☐ 1 to 19 ☐ 20 + (Do not count mosquitos) Photo ID:_____	 Ephemeroptera larva Image credit: Dieter Tracey  Plecoptera larva Tracey Saxby  Trichoptera larva Tracey Saxby

Notes on aquatic invertebrates:

- Notes about distribution
- Photo IDs
- Notes about aquatic invertebrates in general

Algal cover on the streambed

Are algae found on the streambed?

- Pigmented single- or multi-cellular life forms that derive energy through photosynthesis.
- Cyanobacteria, diatoms, and soft-bodied algae all count towards this indicator.
- Live *and* dead mats both count.
  - Live mats tend to be dull brown to bright green.
  - Films made of diatoms are golden-brown.
  - Dead/desiccated mats are brown to powdery-white.

What counts as algae?

Diatom biofilms

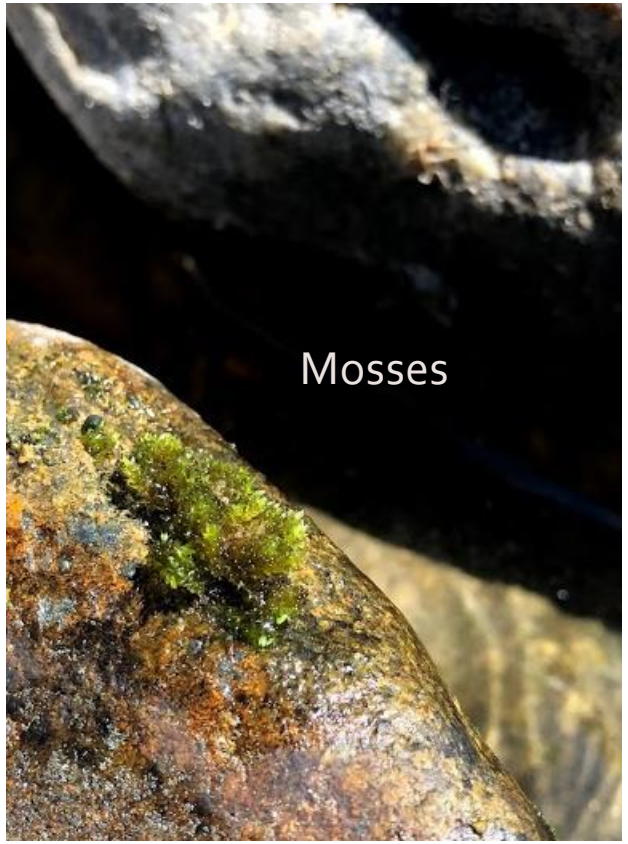
Green algae

Red algae

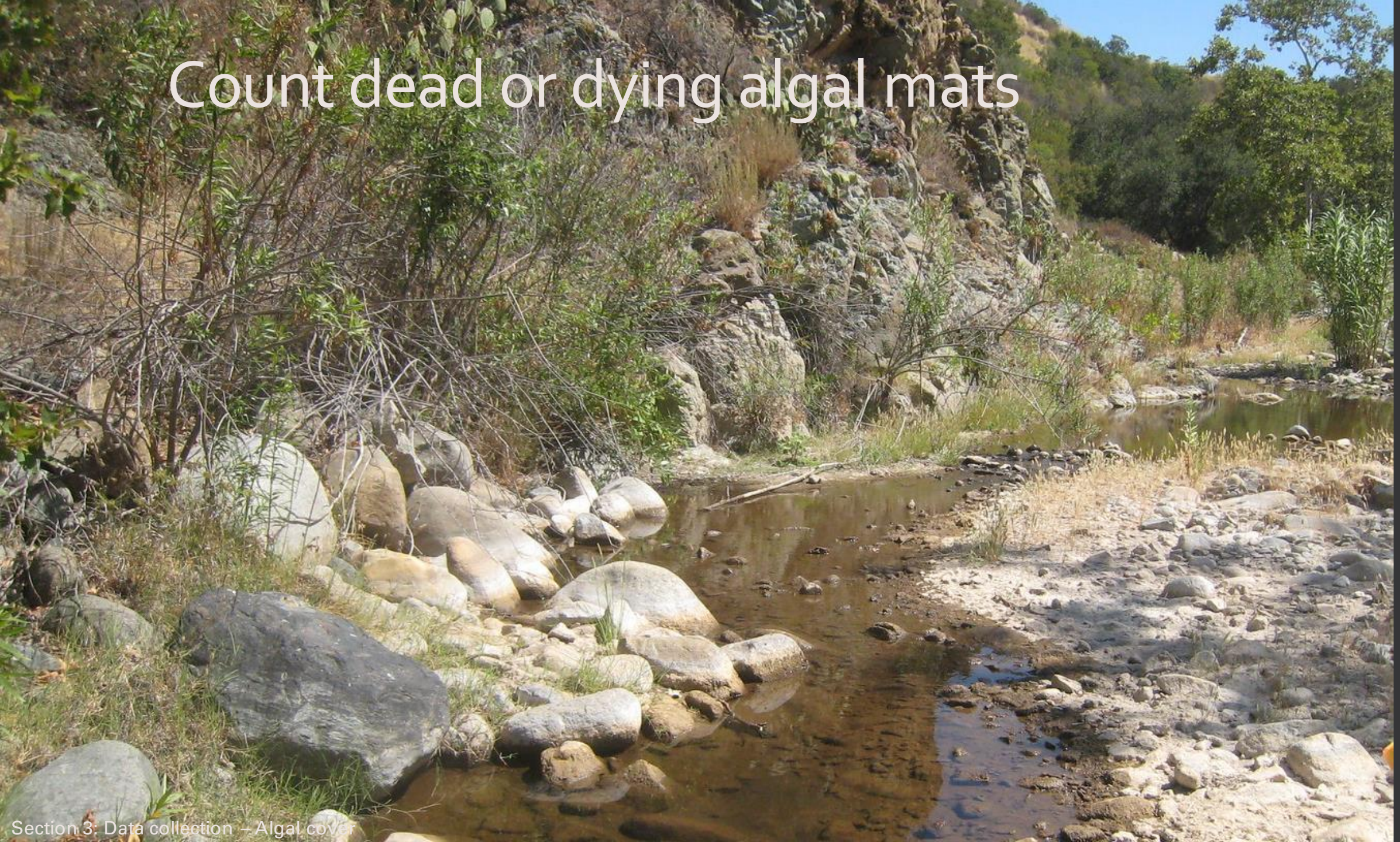
Cyanobacteria

Green algae

What doesn't count as algae?



Count dead or dying algal mats



Count dead or dying algal mats

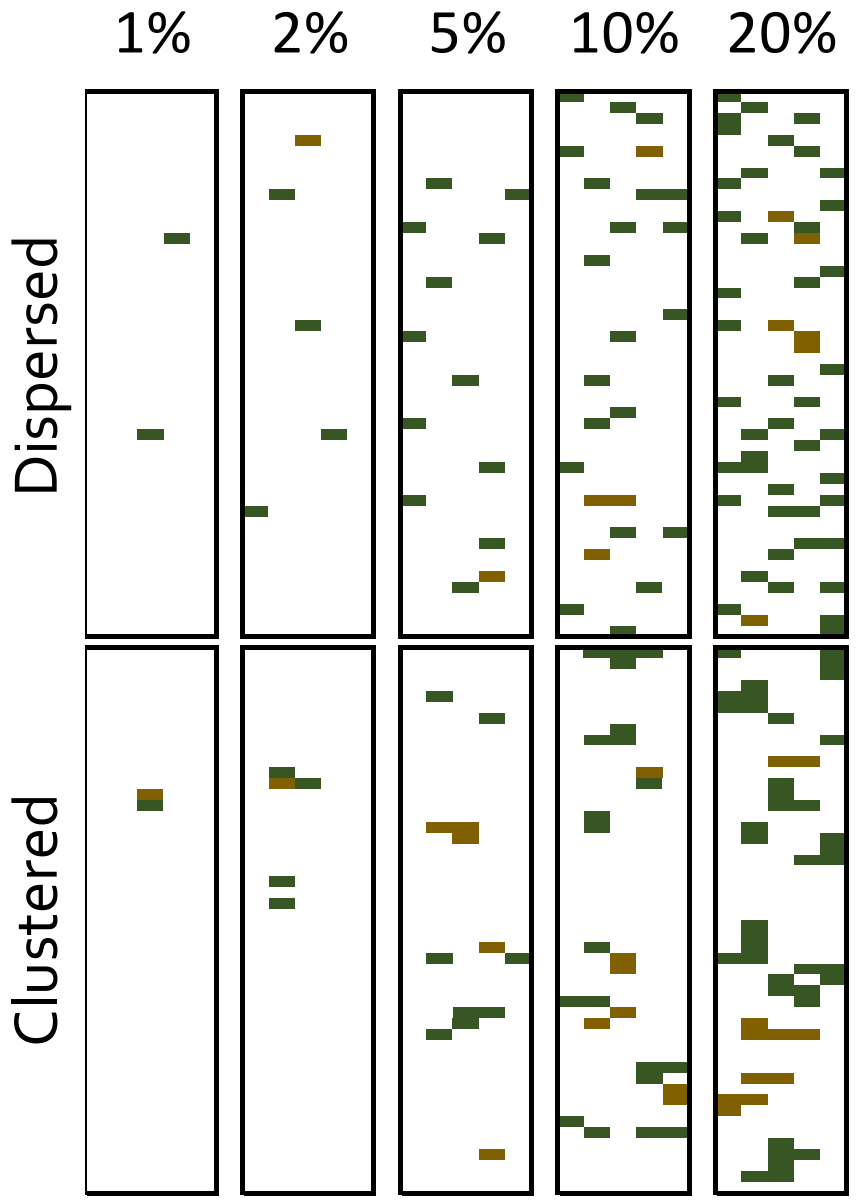
- Often appear as bleached, papery white deposits.
- Dead mats can persist after the cessation of flow (usually until next inundation).
- May cover large extent of assessment reach, or just in a few areas (e.g., former pools).
- Salt deposits may look similar; look under magnification if necessary.

Estimate cover of entire streambed

Low cover (<10%)

Flowing

Dry

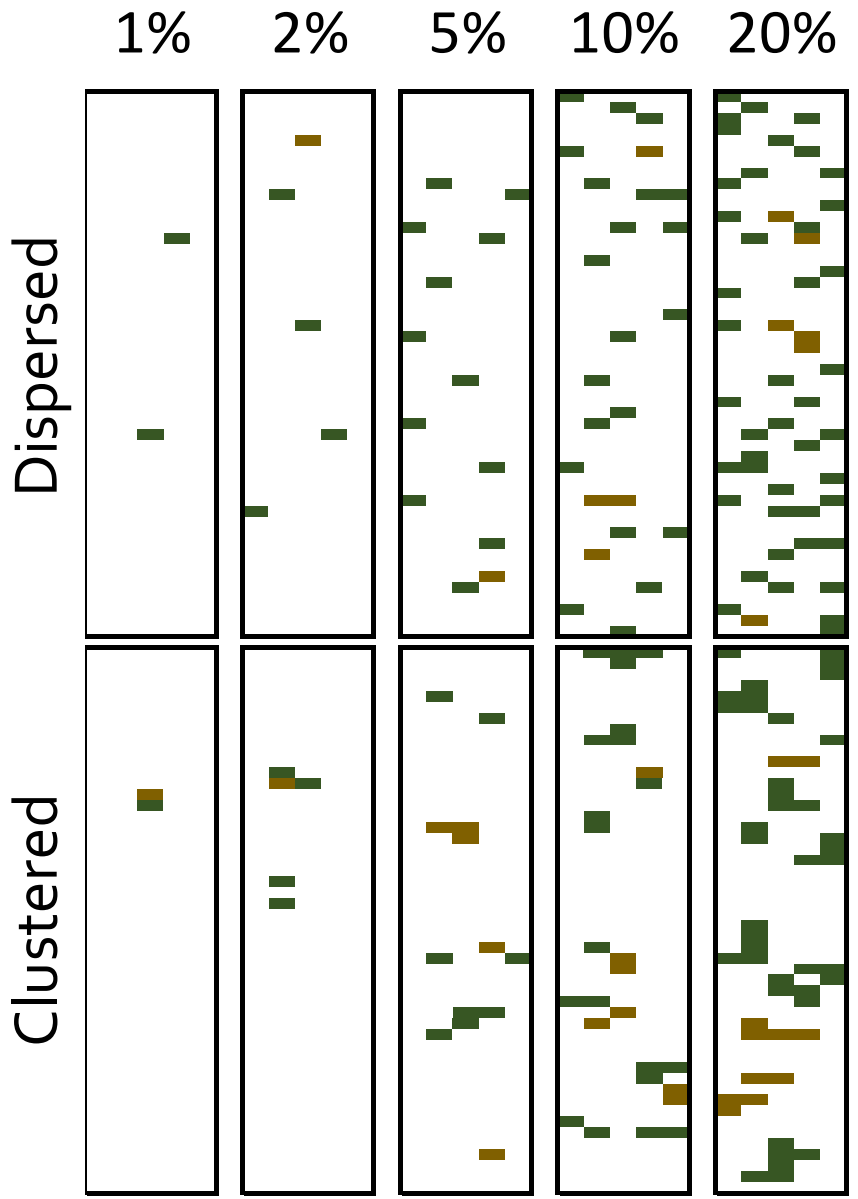


Estimate cover of entire streambed

High cover (≥10%)

Flowing

Dry



Upstream deposits vs. local growth

- Indicator is based on presumption of local growth. Look for signs that a mat was deposited from upstream sources:
  - Bunched up against boulders
  - Caught in snags
  - Above high-water mark
- Deposition of mats in ephemeral reaches downstream of ponds or intermittent/ perennial reaches may occur, particularly after wet years.
- If *all* algae appear to be deposited, note on field from.
  - These don't count as an indicator towards the SDAM AW, but may be treated as supplemental information
  - If mat looks like it got deposited *but then kept growing*, treat it as local growth.

Algal cover plays two roles in SDAM AW

- A "regular" indicator, used to determine the appropriate streamflow duration class.
- If cover is high (i.e., ≥10%), it's a "single" indicator that a reach is *At least intermittent*.
  - Again, only if there's evidence of *local growth*, and not strictly from upstream deposition.

Record on the field form

Check this box if all algae appear to have an upstream source (no local growth).

4. Algae Cover

Are algae found on the streambed? ☐ Check if *all* observed algae appear to be deposited from an upstream source.	☐ Not detected ☐ Yes, <10% cover ☐ Yes, ≥10% (check Yes in single indicator below)	Notes on algae cover:	Photo ID:

- Estimate cover in 3 categories:
  - None
  - <10%
  - ≥ 10%
- Photo IDs
- Notes about algae cover in general

If cover is high (i.e., ≥10%), fill out single indicator section as well.

Again, must have evidence of local growth.

Single Indicators

- Are single indicators of intermittent or perennial streamflow duration observed?
  - Fish
  - Algal cover ≥ 10%

Fish

- A "single indicator" of intermittent or perennial streamflow duration.
- Observations are made incidental to other elements of the SDAM AW.
- Polarized lenses can help see through water surface!
- Best observed during initial walk of the reach
- Dead fish don't count—but should be noted on the field form.
- With one exception (non-native mosquitofish), native and non-native fish are treated the same.

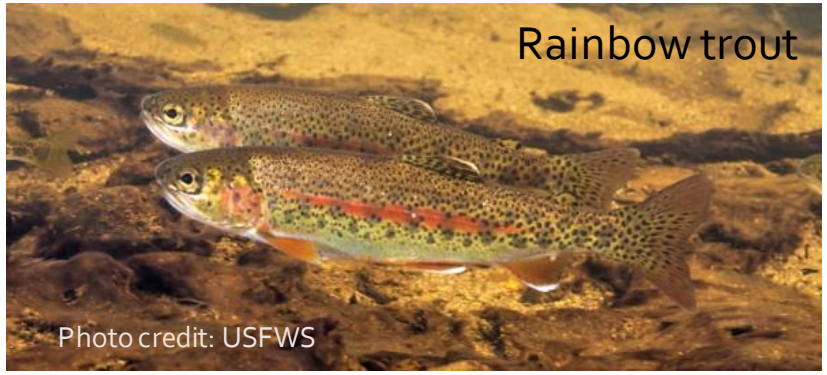
Mosquitofish

- Non-native mosquito fish (typically *Gambusia affinis*) are widely stocked in many waterbodies for vector control purposes.
- Their presence should be noted, but they do NOT count as a single indicator.
- *Gambusia* species native to the Arid West count the same as other fish species.
  - Many are protected!
  - Most species have small ranges in parts of Texas and New Mexico
  - Desktop recon can determine if they occur in your region.

Common fish in the Arid West

5 top species in 2013-2014 National Rivers and Streams Assessment data for the Xeric West:

- Speckled dace
- Common carp
- Rainbow trout
- Longnose dace
- Brown trout



Rainbow trout

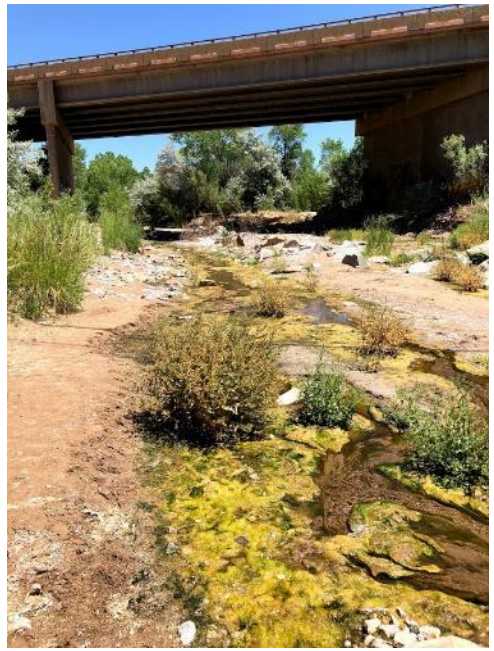
Photo credit: USFWS

Longnose dace

Image credit: Ellen Edmonson

Single indicators

- Fish presence and algal cover ≥10% are treated as single indicators:
  - They can override preliminary classifications of *Ephemeral* and *Need more information* with *At least intermittent*
- They are ***not*** an off-ramp to stop collecting data!
  - More precise classifications (e.g., Perennial, Intermittent) may be attained.
  - Other information provided by SDAM AW may be useful for making determinations



Record on the field form

5. Are single indicators observed?

Indicator	Present	Notes	Photo ID
Fish	☐ Yes ☐ No, no fish ☐ No, only non-native mosquitofish		
Algae cover ≥ 10%	☐ Yes ☐ No		

- Mosquitofish aren't treated as a single indicator
- Dead fish don't count, but they should be noted under supplemental information.
- Algae cover ≥ 10% only counts if there is evidence of local growth (vs strictly from upstream deposition)

Supplemental information

- Not a formal part of the SDAM AW, and not required to make a classification.
- Additional information may bolster evidence supporting a classification.
- If *Need more information* classification is obtained, supplemental information lends evidence that may improve the classification.
- We recommend that these be documented during any assessment.
  - Presence of aquatic or semi-aquatic amphibians and reptiles
  - Aquatic invertebrate families that prefer perennial streams
  - Presence of iron-oxidizing fungi and bacteria

(Semi-) Aquatic Amphibians and Reptiles

- Document any life stage encountered
  - Eggs
  - Larvae/Tadpoles
  - Juveniles
  - Metamorphs
  - Adults
- Document frog vocalizations, if heard

(Semi-) Aquatic Amphibians and Reptiles

- Snakes: Most species of garter
- Turtles: Pond turtle, mud turtles, and softshell turtles.

Invertebrate families that prefer perennial streams

- Requires family-level identification
- List derived by Xerces society for Pacific Northwest (Blackburn and Mazzacano 2012).
- Not fully validated for the Arid West (* indicates families known to occur in intermittent streams in the Arid West with some regularity)
- Vouchers recommended when you are unsure of family-level ID.

Mollusks	Snailes	Pleuroceridae Ancylidae Hydrobiidae
	Freshwater mussels	Margaritiferidae Unionidae
Insects	Caddisflies	Rhyacophilidae Philopotamidae* Hydropsychidae* Glossosomatidae
	Stoneflies	Perlidae Pteronarcyiidae
	Beetles	Elmidae* Psephenidae
	Dragonflies and damselflies	Gomphidae Cordulegastridae Calopterygidae
	Dobsonflies and fishflies	Corydalidae*

Iron-oxidizing fungi and bacteria

- Oily, iridescent or rust-colored sheen on the surface of stagnant water
- When stirred, it breaks up into jagged "torn" pattern, forms discrete islands (not like oil on water)
- Typically restricted to backwaters and seeps
- Can be very abundant in some circumstances

Knowledge check!

True or false: Only consider live algae when estimating algal cover

A. True

B. False

Live, dead, and dying algal cover all count as indicators of streamflow duration.

Knowledge check!

True or false: The SDAM AW requires Family-level identifications of aquatic invertebrates.

A. True

B. False

The SDAM AW requires Order-level identifications. Family-level identifications may be recorded to provide supplemental information.

Knowledge check!

True or false: Only consider larval stages of amphibians when recording supplemental information

A. True

B. False

Adult lifestages may also be aquatic, and their presence should be noted on the field form.

Knowledge check!

Which of the following insects are "EPT" taxa? Select all that apply.

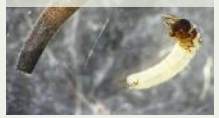
A, B, D, G, I, and M are EPT taxa

A Ephemeroptera: Ameletidae

B Plecoptera: Chloroperlidae

C Megaloptera: Corydalidae

D Trichoptera: Brachycentridae



E Diptera: Dixidae

F Coleoptera: Elmidae

G Ephemeroptera: Caenidae

H Diptera: Culicidae

I Trichoptera: Lepidostomatidae

J Diptera: Simuliidae

K Diptera: Tabanidae

L Coleoptera: Dytiscidae

M Trichoptera: Uenoidae

N Hemiptera: Notonectidae

O Odonata: Coenagrionidae

Photos are from the Digital Reference Library of California Benthic Invertebrates maintained by the Aquatic Bioassessment Lab of the California Department of Fish and Wildlife

Knowledge check!

How is supplemental information used in the SDAM AW? Check all that apply.

A. Additional information may bolster evidence supporting a classification.

B. Supplemental information is required to use the classification table.

C. If *Need more information* classification is obtained, supplemental information lends evidence that may improve the classification.

D. Supplemental information is required if the SDAM AW is inconclusive.

Supplemental information can be used to support a classification, or to improve a classification of *Need more information.*

Collecting supplemental information is not required at any point in SDAM AW assessments, but it is always recommended.

Discussion question

Where would you search for aquatic invertebrates in this dry stream reach?

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Data interpretation

Use the table to obtain classification:

- Ephemeral
- Intermittent
- Perennial
- At least intermittent (aka, not ephemeral)
- Need more information (aka, confident classification not possible)

1. Hydrophytic plant species	2. Aquatic invertebrates	3. EPT taxa	4. Algae	5. Single indicators • fish present • algae cover > 10%	Classification
None	None	Absent	Absent	Absent	**Ephemeral**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
	Few (1-19)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**
	Many (20+)	Absent	Absent	Absent	**Need more information**
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			Present	Absent	**Need more information**
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			Present		**At least intermittent**
		Present	Absent		**At least intermittent**
			Present		**Intermittent**
Many (3+)	None	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present		**At least intermittent**
	Few (1-19)	Absent			**At least intermittent**
		Present			**Perennial**
	Many (20+)	Absent			**At least intermittent**
		Present			**Perennial**

An example of obtaining a classification

Data reported

- Plants observed:
  - *Salix gooddingii*
  - *Populus fremontii*
  - *Typha* sp.
  - *Platanus wrightii*
  - *Ambrosia artemisiifolia*
- Aquatic invertebrates observed
  - Baetidae (10 larvae)
  - Dytscidae (3 larvae)
  - Glossomatidae (1 pupal case)
  - Simuliidae (10 larvae)
- Algal cover on the streambed: 3%
- Fish observed: None

An example of obtaining a classification

Data reported

- Plants observed:
  - *Salix gooddingii* (FACW)
  - *Populus fremontii*
  - *Typha* sp. (OBL)
  - *Platanus wrightii* (FACW)
  - *Ambrosia artemisiifolia*
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- Aquatic invertebrates observed
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  - Simuliidae (**10** larvae)
- Algal cover on the streambed: 3%
- Fish observed: None

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What type of changes would modify this outcome?

Data reported

- Plants observed:
  - *Salix gooddingii* (FACW) ← If this was really *S. laevigata*?
  - *Populus fremontii*
  - *Typha* sp. (OBL) ← If this was really 2 species of *Typha?*
  - *Platanus wrightii* (FACW) ← If this was really *P. racemosa?*
  - *Ambrosia artemisiifolia*
- Aquatic invertebrates observed
  - Baetidae (**10** larvae)
  - Dytscidae (**3** larvae)
  - Glossomatidae (**1** pupal case) ← If the crews didn't see this at all?
  - Simuliidae (**10** larvae)
- Algal cover on the streambed: 3% ← If this was 0% due to recent scour?
- Fish observed: None

1. Hydrophytic plant species	2. Aquatic invertebrates	3. EPT taxa	4. Algae	5. Single indicators • fish present • algae cover ≥ 10%	Classification
None	None	Absent	Absent	Absent	Ephemeral
				Present	At least intermittent
			Present	Absent	Need more information
				Present	At least intermittent
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		Present			Perennial
	Many (20+)	Absent			At least intermittent
		Present			Perennial

What does *At least intermittent* mean?

- Observed indicators are inconsistent with *Ephemeral*.
- Cannot distinguish between *Perennial* and *Intermittent* with high confidence.
- This classification is sufficient for some management decisions.
- Classification may be based on a single indicator alone.
- Somewhat common classification, often resulting when indicators are not strongly expressed.
- Observations of flow during a single well-timed site visit (e.g., peak of the dry season) may resolve whether the reach is intermittent or perennial.

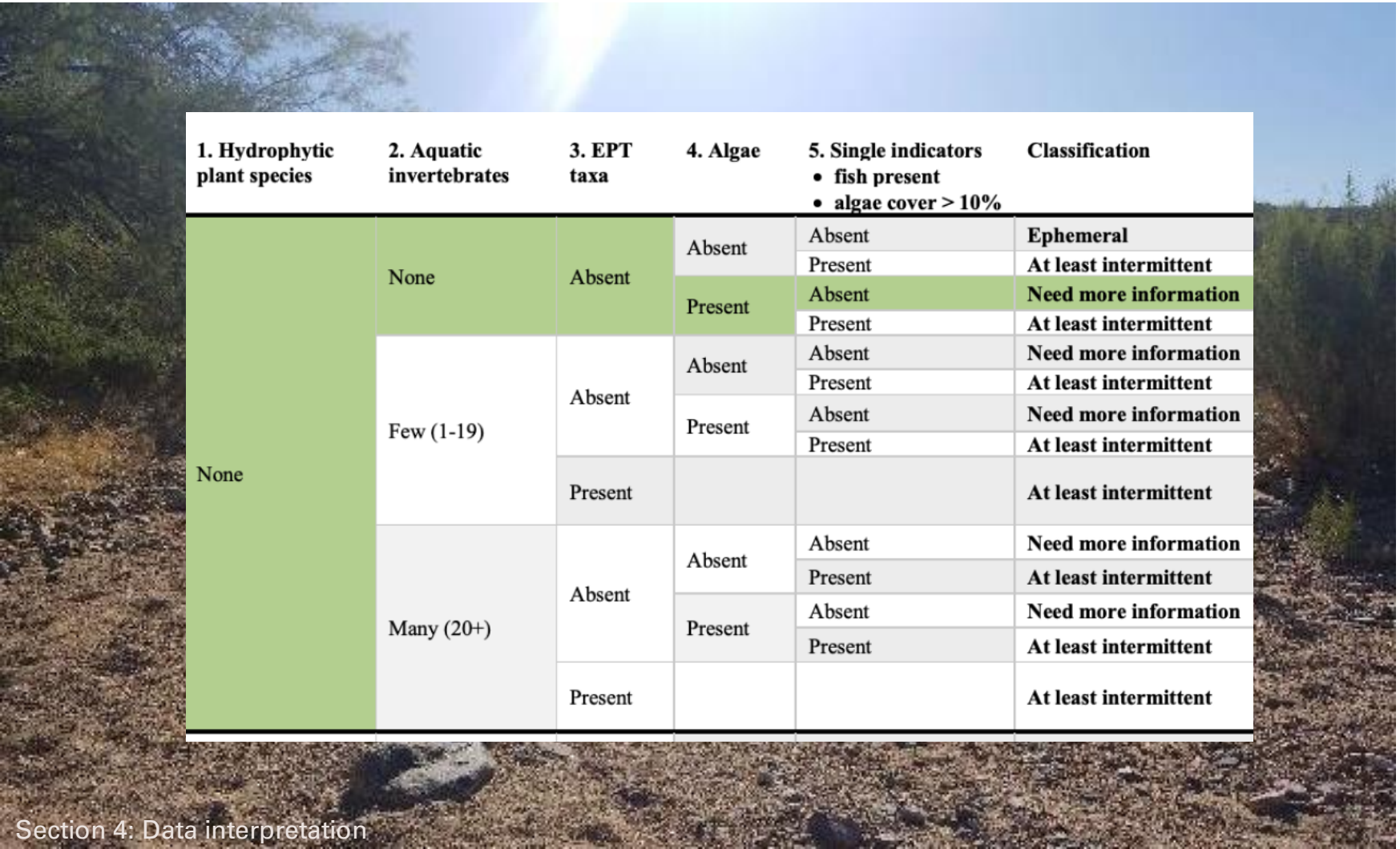
What does *Need more information* (NMI) mean?

This classification is rare (8% of development data set), and usually occurs in these two scenarios:

- Perennial status is ruled out, but you cannot distinguish between ephemeral and intermittent with confidence. For example:
  - Streams that rarely exhibit surface flows, but groundwater is sufficient to sustain a few hydrophytes.
- Truly perennial streams, but indicator expression is affected by severe disturbance. For example:
  - Effluent-dominated streams that cannot support EPT taxa.
  - Certain concrete channels with no vegetation.

Although field errors may be associated with a result of *Need more information*, this classification *does not mean* that the assessors did something wrong!

Example: Placeritas Canyon, AZ



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				Present	**At least intermittent**
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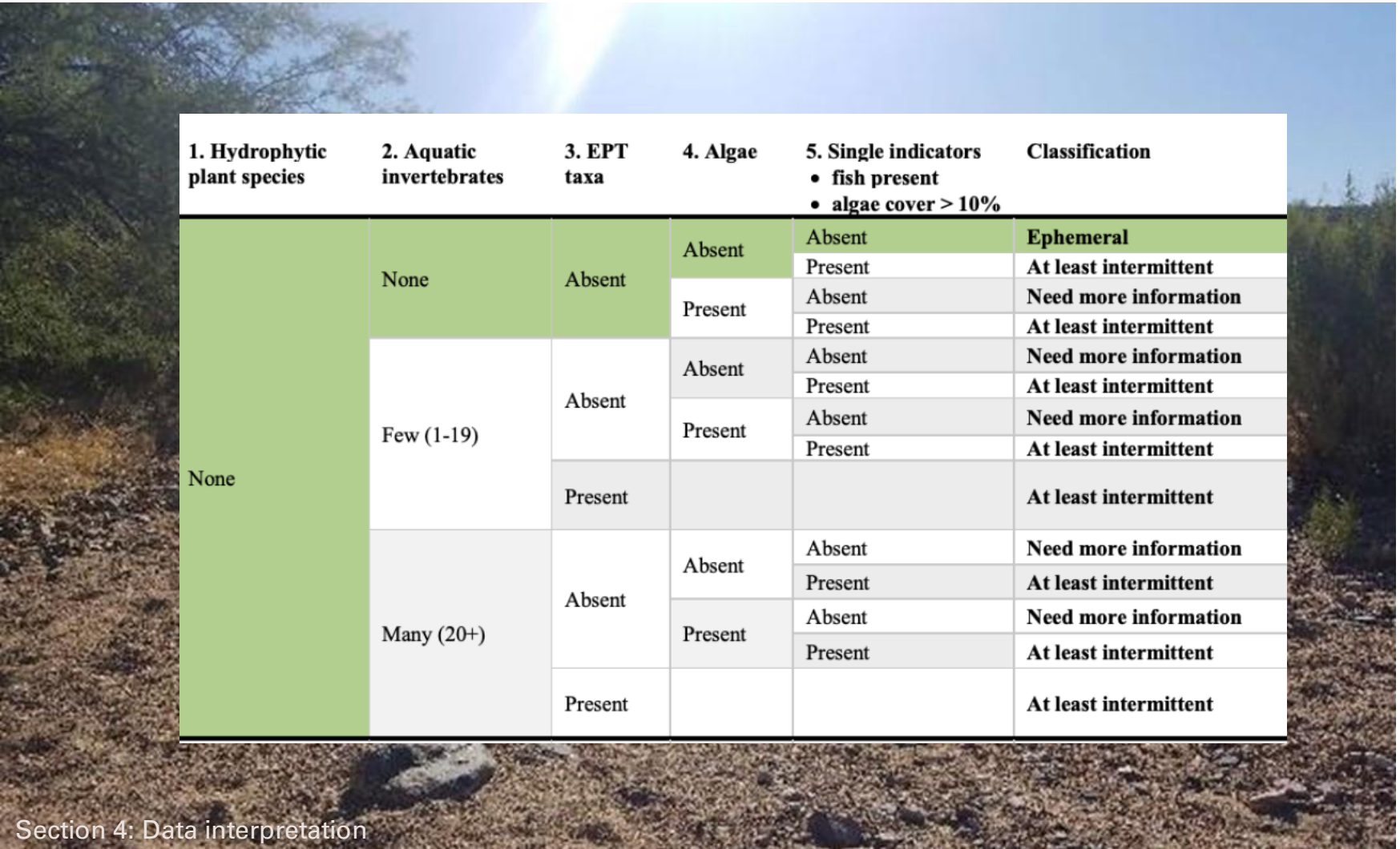
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**

- Truly ephemeral
- No hydrophytes, aquatic invertebrates observed
- Sparse algae noted.

Example: Placeritas Canyon, AZ



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None	None	Absent	Absent	Absent	**Ephemeral**
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	Many (20+)	Absent	Absent	Absent	**Need more information**
				Present	**At least intermittent**
			Present	Absent	**Need more information**
				Present	**At least intermittent**
		Present			**At least intermittent**

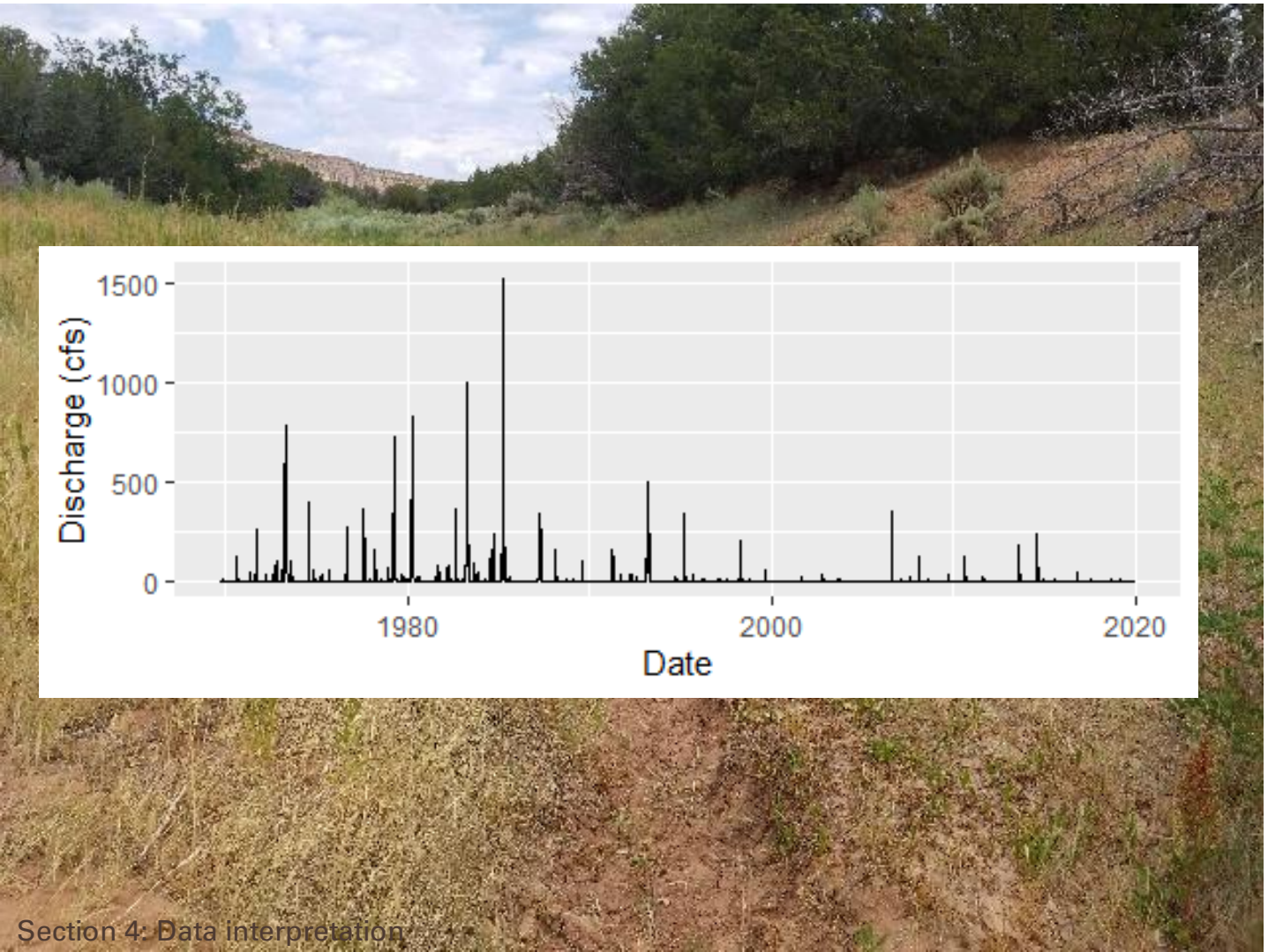
- Truly ephemeral
- No hydrophytes, aquatic invertebrates observed
- ~~Sparse algae noted.~~
- Field forms noted heavy grazing pressure.
- "Algae" was really just a cow patty.
- Correcting the data yielded the correct classification.

Example: Zuni River, NM

1. Hydrophytic plant species	2. Aquatic invertebrates	3. EPT taxa	4. Algae	5. Single indicators • fish present • algae cover > 10%	Classification
None	None	Absent	Absent	Absent	Ephemeral
				Present	At least intermittent
			Present	Absent	Need more information
				Present	At least intermittent
	Few (1-19)	Absent	Absent	Absent	Need more information
				Present	At least intermittent
			Present	Absent	Need more information
				Present	At least intermittent
		Present			At least intermittent
	Many (20+)	Absent	Absent	Absent	Need more information
				Present	At least intermittent
			Present	Absent	Need more information
				Present	At least intermittent
		Present			At least intermittent
Few (1-2)	None	Absent	Absent	Absent	Need more information
				Present	At least intermittent
			Present		At least intermittent
	Few (1-19)	Absent	Absent		Intermittent
			Present		At least intermittent
		Present			At least intermittent
	Many (20+)	Absent	Absent		Intermittent
			Present		At least intermittent
		Present	Absent		At least intermittent
			Present		Intermittent

- Only two hydrophytes observed:
  - Willow
  - Rush
- IDs were verified from photos and correct
- No other indicators noted

Example: Zuni River, NM



- USGS gage suggests long-term reduction in flow.
- Site may be transitioning from intermittent to ephemeral.

Following up a *Need more information (NMI)* classification

Several options may provide greater insight:

- Evaluate supplemental information collected during the assessment
- Conduct additional evaluations at the same site
- Conduct additional evaluations at nearby sites
- Review historical aerial imagery
- Conduct site revisits during appropriate wet/dry seasons

Following up an *NMI* classification

Evaluate supplemental information collected during the assessment

- Presence of aquatic life stages of amphibians or reptiles
- Presence of aquatic invertebrates that prefer perennial streams
- Presence of iron-oxidizing fungi and bacteria

In general, these indicate longer-duration flows.

Following up an *NMI* classification

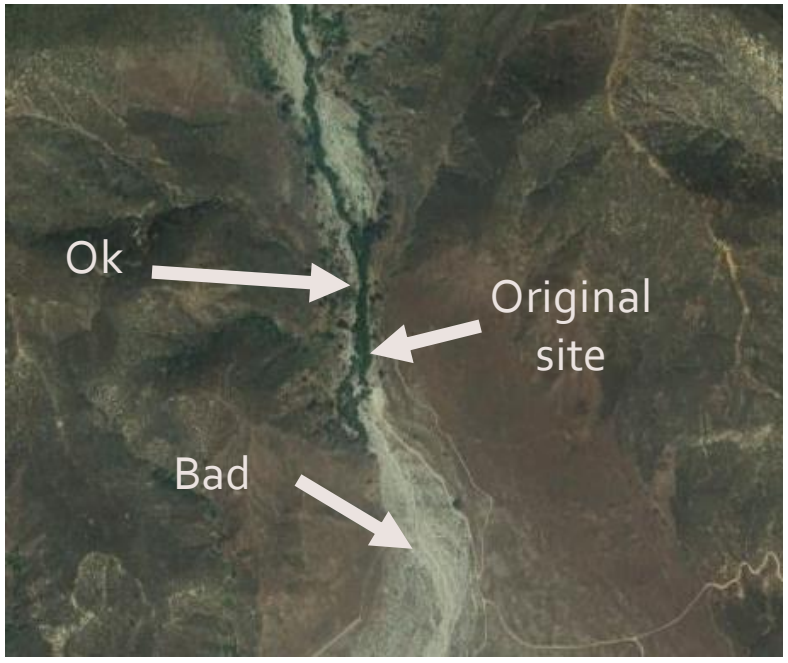
Conduct additional evaluations at the same site

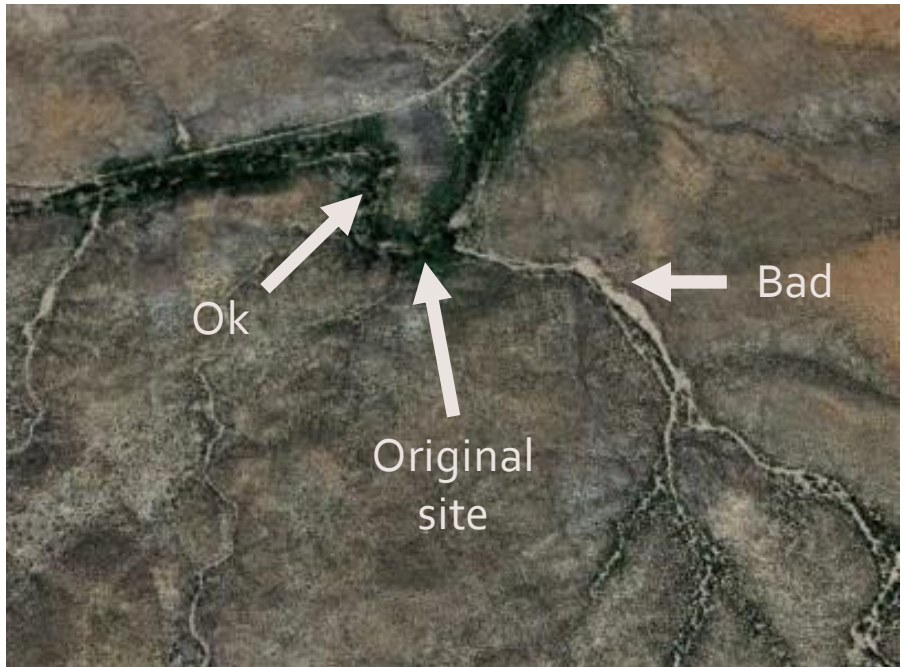
- Was site-visit influenced by a storm? Or by transient disturbance (e.g., recent vegetation removal or re-grading)?
- Sometimes, waiting even a few weeks after these events can produce much clearer information.
- Hydrophytic plants may be more evident/easier to identify in a different season.

Following up an *NMI* classification

Conduct additional evaluations at nearby sites

- Indicators may be easier to measure at nearby reaches.
- New reaches should be connected longitudinally, and they must be similar in terms of drivers of streamflow duration (e.g., similar watershed area, valley confinement, underlying geology, etc.).





Following up an *NMI* classification

Review historical aerial imagery

Following up an *NMI* classification

Conduct site revisits during appropriate wet/dry seasons

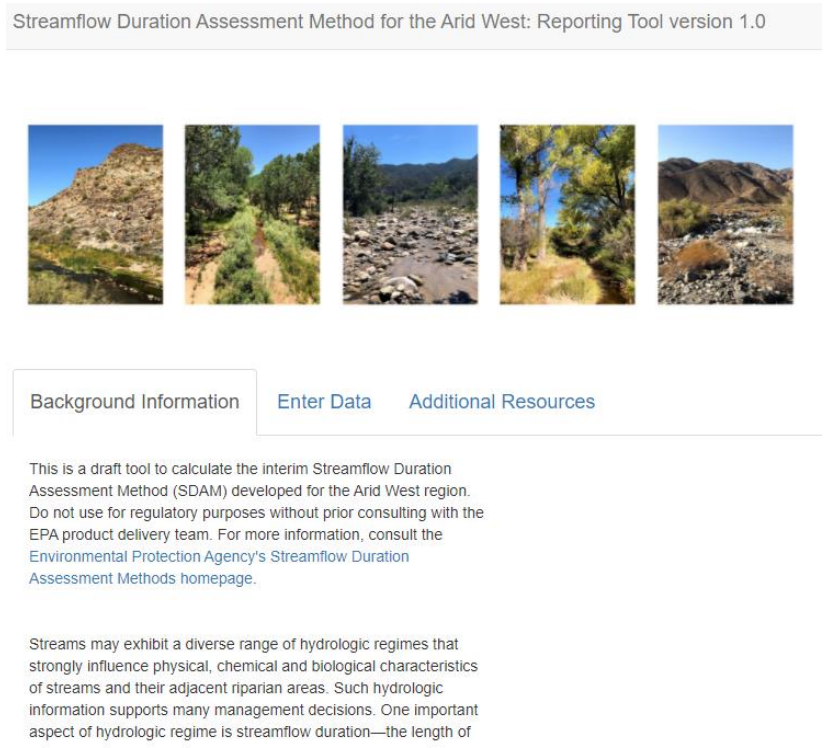
- Flow at peak of dry season may suggest perennial or long-duration intermittent stream reaches
- Dry channels at peak of wet season may suggest ephemeral reaches
- Timing depends on region. For example:
  - Mediterranean California has wet winters and dry summers. Summer/Fall flow usually rules out ephemeral status.
  - Sonoran Desert has summer Monsoon period.

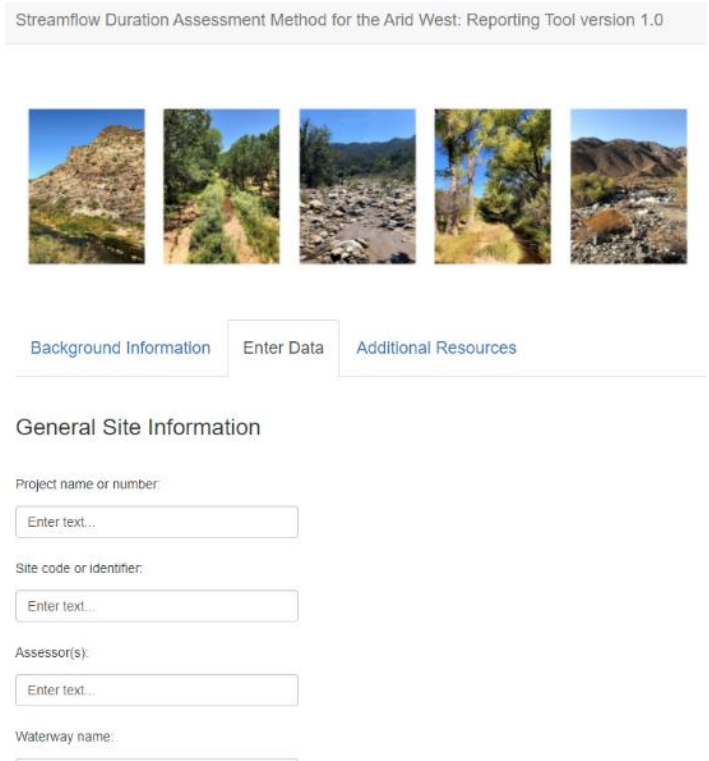
Preparing a report

- Online Report Generating Tool allows reporting of data in a standardized format:

https://sccwrp.shinyapps.io/beta_awsdam_report/

- Upload data + photos to create a PDF that contains final classification.





Standard report in PDF format

Report is generated on your desktop

No automated data submission to the EPA or other agency.

Streamflow Duration Assessment Method for the Arid West
Classification Report
Reporting Tool version 1.0

Report generated on: January 03, 2021

Classification:

Perennial

General Site Information

Site code or identifier:
Site 1
Project name or number:
Example
Assessor(s):
R. Mazor
Waterway name:
Little Creek
Visit date:
12/20/2020
Current weather conditions:
Clear/Sunny
Notes on current or recent weather conditions:
Enter text...
Location:
34.40047 N, -111.92881 W
Datum:
NAD83
Surrounding land use within 100 m:

1. Hydrophytic plant species	2. Aquatic invertebrates	3. EPT taxa	4. Algae	5. Single indicators • fish present • algae cover > 10%	Classification
None	None	Absent	Absent	Absent	Ephemeral
			Present	Absent	Need more information
				Present	At least intermittent
		Present	Absent	Absent	Need more information
				Present	At least intermittent
	Few (1-19)	Absent	Absent	Absent	Need more information
				Present	At least intermittent
		Present	Present	Absent	Need more information
				Present	At least intermittent
					At least intermittent
	Many (20+)	Absent	Absent	Absent	Need more information
				Present	At least intermittent
			Present	Absent	Need more information
				Present	At least intermittent
		Present			At least intermittent
Few (1-2)	None	Absent	Absent	Absent	Need more information
			Present	Present	At least intermittent
	Few (1-19)	Absent	Absent		Intermittent
			Present		At least intermittent
		Present			At least intermittent
	Many (20+)	Absent	Absent		Intermittent
			Present		At least intermittent
		Present	Absent		At least intermittent
			Present		Intermittent
Many (3+)	None	Absent	Absent	Absent	Need more information
			Present	Present	At least intermittent
	Few (1-19)	Absent			At least intermittent
		Present			Perennial
	Many (20+)	Absent			At least intermittent
		Present			Perennial

Ends at large cottonwood, starts 10 m below bridge
Mean channel width (m):
1.5
Reach length (m):
60
Disturbed or difficult conditions:
None
Notes on disturbances or difficult site conditions:
Enter text...
Observed hydrology:
Percent of reach with surface flow:
100
Percent of reach with surface and sub-surface flows:
100
Number of isolated pools:
0
Comments on observed hydrology:
Enter text...

Site Photos

Top of reach looking downstream:

Middle of reach looking upstream:

Middle of reach looking downstream:

Bottom of reach looking upstream:

Site Sketch

Hydrophytic Vegetation

Hydrophytic species found in or near the channel:
3+ species
Notes on hydrophytic vegetation:
Enter text...

Figure 2: Alnus rhombifolia

Figure 3: Typha

Figure 4: Mimulus guttatus

Aquatic Invertebrates

Number of individuals observed:
20+
Are EPT present?
Yes
Notes on aquatic invertebrates
No photos taken

Algae Cover

Cover of live or dead algae in the streambed:
No, <10% cover
NA

Notes on algae cover:
Enter text...

Single Indicators

Fish:
No fish observed
Algae cover:
No, <10% cover

Supplemental Information

Enter text...

Getting more info about SDAMs

Contact your regional coordinator!

- Want to provide feedback on the beta method?
- Want to learn about development of the final method, or methods for other regions?
- https://www.epa.gov/streamflow-duration-assessment