# Northeast and Southeast Streamflow Duration Assessment Methods: Entrenchment Ratio and Slope

*Video Training*

*2025*

# The SDAMs are based on 12 indicators:

Nine (9) indicators are measured in the **field,** three (3) are **desktop-based**

Five (5) are shared by both SDAMs, plus:
- Two only used in NE SDAM
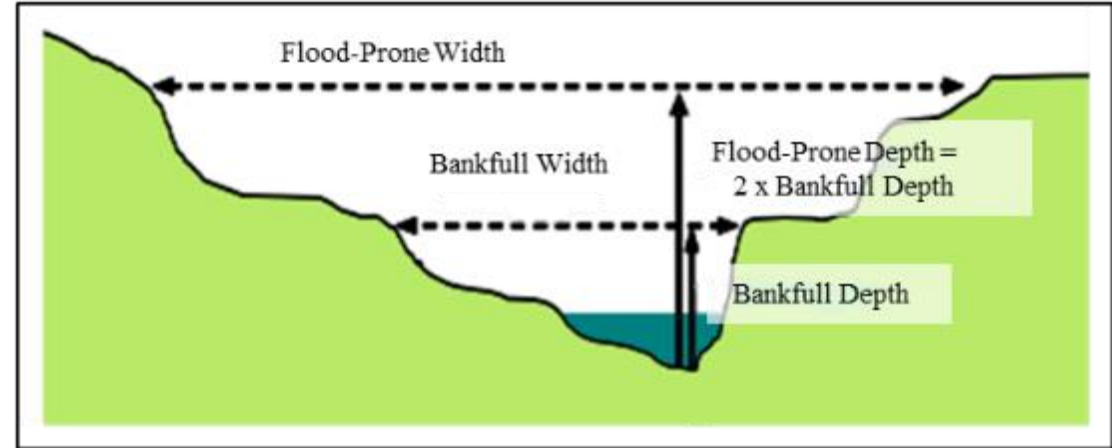- Five only used in SE SDAM

*In recommended order of data collection\**

1. Bankfull channel width
2. Entrenchment ratio (NE only)
3. Aquatic macroinvertebrate indicators
   - Benthic Macroinvertebrate Index (BMI) score
   - Total aquatic macroinvertebrate abundance (SE only)
5. Slope (NE only)
6. Shading
7. Prevalence of rooted upland plants in the streambed (SE only)
8. Particle size of stream substrate (SE only)
9. Prevalence of fibrous roots in the streambed (SE only)
10. Drainage area
11. Elevation
12. Average precipitation (May-July) (SE only)

\*Note: there is no #4 (1, 2, 3, 5) to account for the two different aquatic macroinvertebrate indicators.

# Entrenchment Ratio

- The entrenchment ratio compares the width of the flood-prone area to the width of the bankfull channel. It is a measure of vertical containment and is **associated** with flow duration.

- Entrenchment ratio = flood-prone width/bankfull width.
  - ➤ Flood-prone width = width at 2x bankfull maximum depth (or flood-prone depth).
  - ➤ Measure bankfull width and flood-prone width to the nearest 0.1 m.
  - ➤ Maximum entrenchment ratio: 2.5

- Measure or visually assess at the 3 locations used to determine bankfull width.



Flood-Prone Width

Bankfull Width

Flood-Prone Depth = 2 x Bankfull Depth

Bankfull Depth
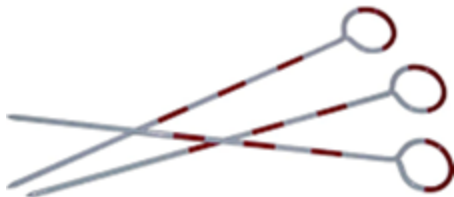
# Equipment options for measuring entrenchment ratio

## Widths

Open reel tape measure

Laser level
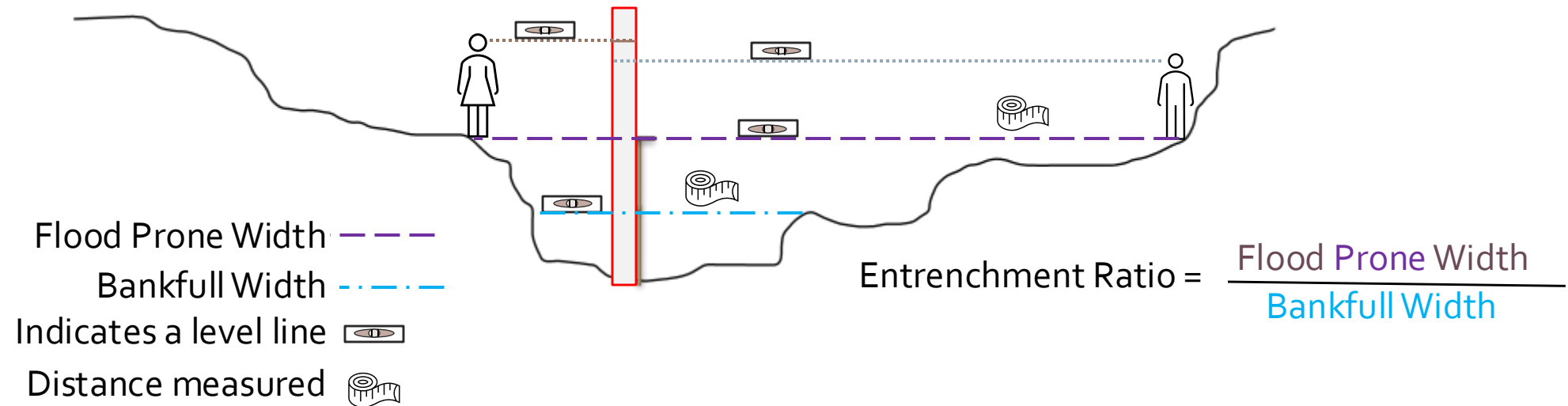
Range finder

Chaining pins

## Depths

Meter stick

Stadia rod

Range pole

Entrenchment ratio

# Approaches for Measuring Entrenchment Ratio

Marking eye height above flood prone depth and walking
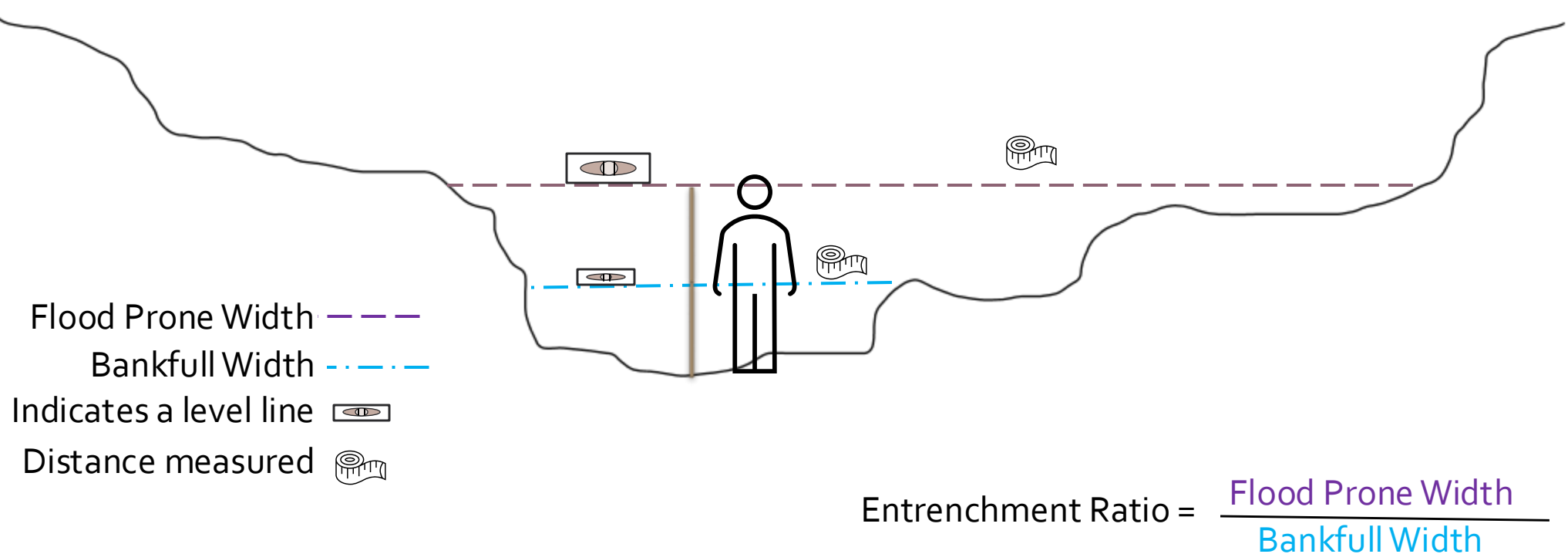out till **eyes** are level with marking

Eye height above flood prone
depth marked on stadia rod   ..........

..........   Eye height above flood prone
depth marked on stadia rod

Flood Prone Width  — — —
Bankfull Width  — · — · —
Indicates a level line  [eye icon]
Distance measured  [tape measure icon]

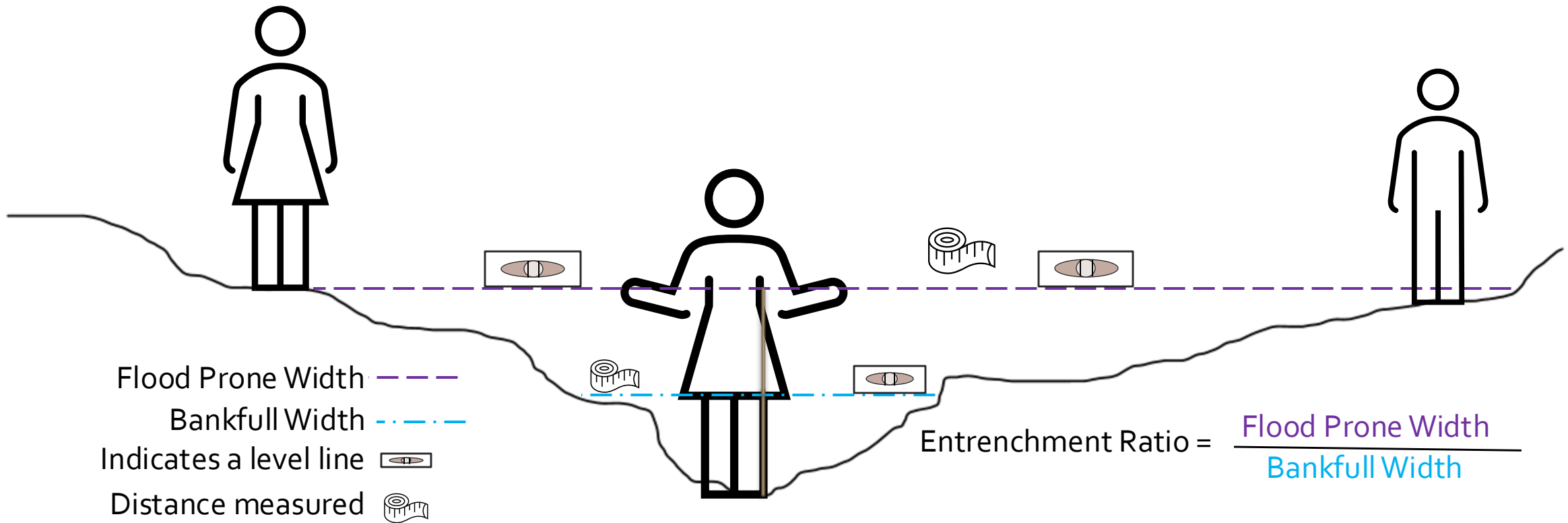Entrenchment Ratio =  $\dfrac{\text{Flood Prone Width}}{\text{Bankfull Width}}$

Entrenchment ratio

# Approaches for Measuring Entrenchment Ratio

Using an instrument to see where the ground intersects the flood prone depth



Flood Prone Width – – –
Bankfull Width –·–·–
Indicates a level line
Distance measured

$$\text{Entrenchment Ratio} = \frac{\text{Flood Prone Width}}{\text{Bankfull Width}}$$

# Approaches for Measuring Entrenchment Ratio

Holding measuring tape level at flood prone depth and extending measuring type till it intersects the ground surface
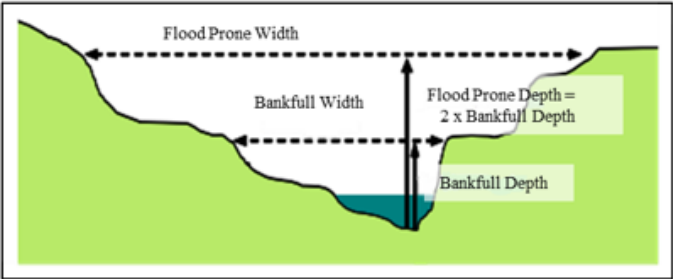
Flood Prone Width — — —
Bankfull Width —·—·—
Indicates a level line
Distance measured

$$\text{Entrenchment Ratio} = \frac{\text{Flood Prone Width}}{\text{Bankfull Width}}$$

Entrenchment ratio

# Record on the field form

- Used in NE SDAM; will be on combined and NE field form only.

## 2. Entrenchment ratio (NE only)

Measure at relatively straight section of reach avoiding pools and bends in the stream. Max entrenchment ratio value is 2.5. Entrenchment ratio of Locations 1+2+3 / 3 = Average entrenchment ratio.

| Average entrenchment ratio: | | Bankfull width (m) | Flood-prone width (m) | Entrenchment ratio (Flood-prone / Bankfull) | Check if flood-prone width is >2.5x bankfull width |
|---|---|---|---|---|---|
| | Location 1 | | | | |
| | Location 2 | | | | |
| | Location 3 | | | | |
| Notes on entrenchment ratio: | | | | | |

Entrenchment ratio

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- Five only used in SE SDAM

*In recommended order of data collection\**

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3. Aquatic macroinvertebrate indicators
   - Benthic Macroinvertebrate Index (BMI) score
   - Total aquatic macroinvertebrate abundance (SE only)
5. <span style="color:green">Slope (NE only)</span>
6. Shading
7. Prevalence of rooted upland plants in the streambed (SE only)
8. Particle size of stream substrate (SE only)
9. Prevalence of fibrous roots in the streambed (SE only)
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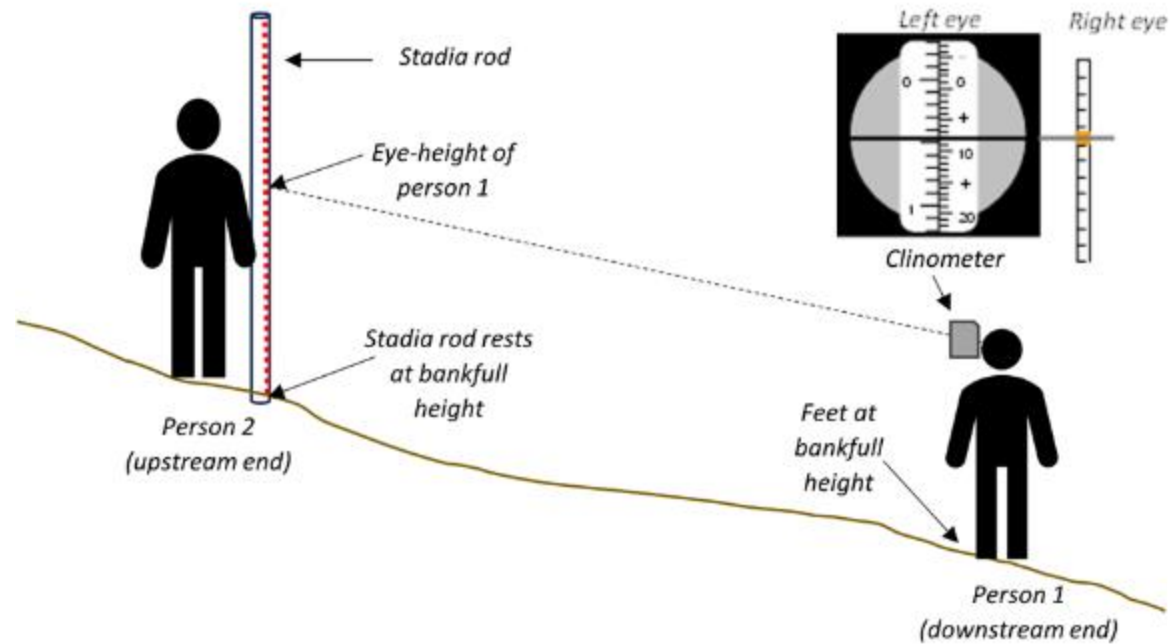
# Slope

May be measured using a clinometer, rangefinder or an autolevel.

- Generally, requires two people.

- Measurements are always positive (looking upstream from a downstream location) but may be very close to zero.

When using a clinometer:

- Keep both eyes open!

- One eye looks through the clinometer

  ➢ Take reading at the horizontal line

  ➢ Make sure you are recording slope in **percent** not **degrees**.

- The other eye looks for your eye-height some distance away



Left eye   Right eye

Stadia rod

Eye-height of person 1

Clinometer

Stadia rod rests at bankfull height

Person 2 (upstream end)

Feet at bankfull height

Person 1 (downstream end)

View in clinometer modified from "Field technique tips for measuring % slope" in *Forest Measurement* by Joan DeYong, used under CC 4.0. https://openoregon.pressbooks.pub/forestmeasurements

Slope

# Slope using a rangefinder

- Some rangefinders only display slope in degrees, to convert to percent use the following formula:
  - Tangent(slope in degrees) * 100 = % Slope

For example:
  - Tan(3.2 degrees)= 0.05847
  - 0.05847*100 = 5.847%
  - Rounded to the nearest half percent: 6%

# Slope

Keep it upright!

• Place rod at bankfull height

• Both practitioners should stand at bankfull height

• Do not stand in thalweg.

# Record on the field form

## 4. Slope

Using a clinometer or other device, record the slope at bankfull as a percent, up to the nearest half-percent. If multiple sights are needed to cover the entire reach, record each and calculate a weighted average to get slope:

1)_____% slope    _____% of reach

2)_____% slope    _____% of reach

3)_____% slope    _____% of reach

4)_____% slope    _____% of reach

Notes on slope:

- Slope is an NE indicator; will be on combined and NE field forms only.

- Video available showing how to assess slope in the field on the SDAM supporting materials website

# For more information about SDAMs:

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