Meeting Objectives

Questions:

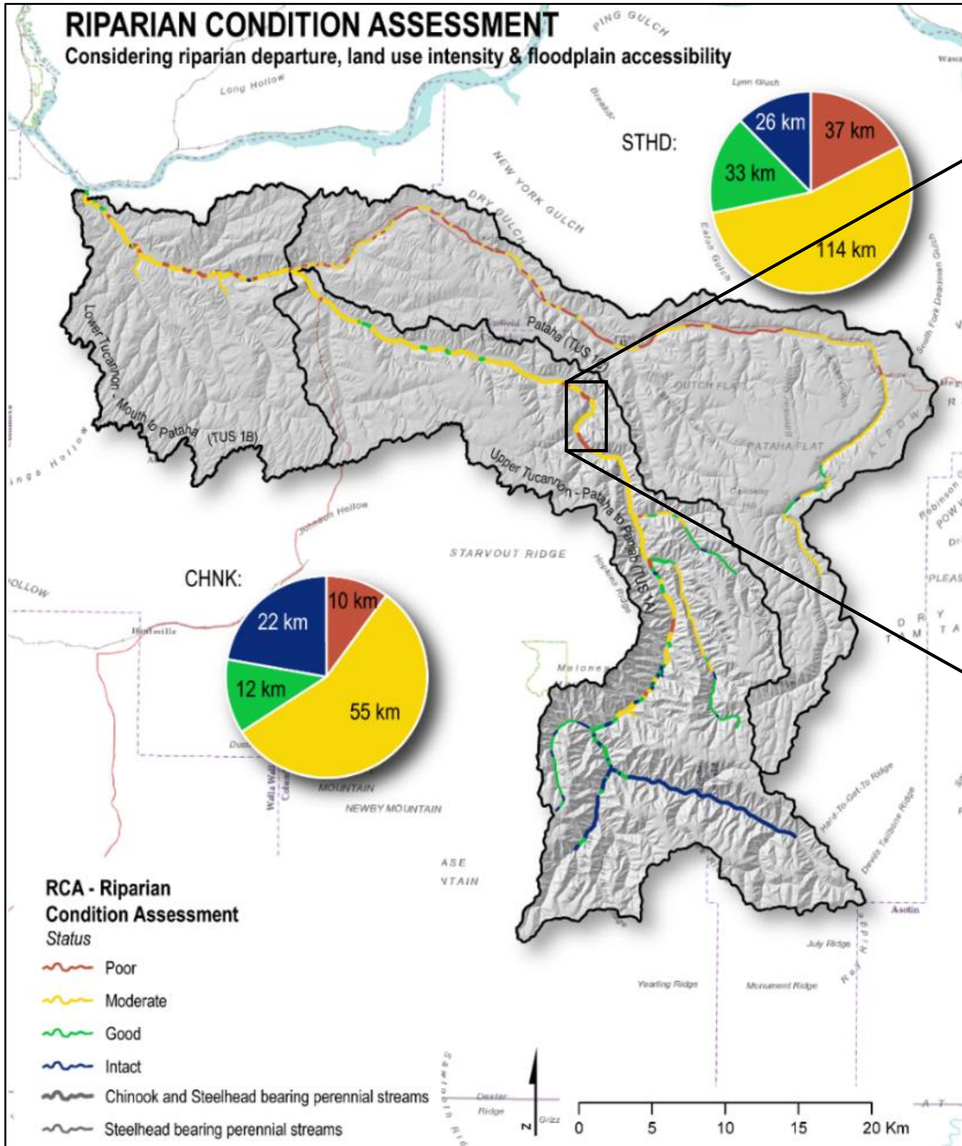
- ❑ How do we show the impact of the habitat restoration effort?

- ❑ Will the monitoring data we are collecting provide information on changes to the identified ecological concerns in the Tucannon?
    - Riparian
    - Confinement
    - LWD Reflecting Complexity
    - Temperature
    - Flows
    - Barriers/Screens

- ❑ How do we get to these work products to help tell the story?
    - Life cycle assessment
    - Habitat suitability index
    - Life cycle mortality assessment and juvenile abundance estimates

Riparian Condition

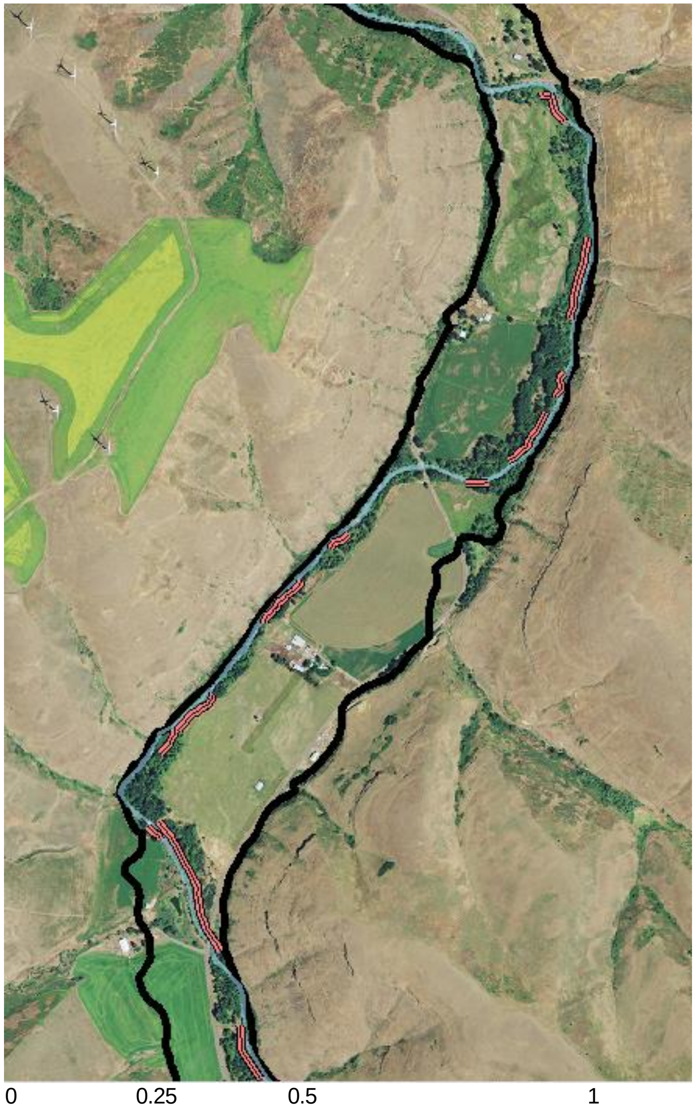
Goal: Increase riparian function to 75% of maximum



- Define valley bottom extent
- Within valley bottom, compare existing riparian veg and historical
- Departure from historic conditions
- Confinement based on historic versus existing valley bottom extent
- Riparian + Confinement = CONDITION

Channel Confinement

Reduce channel confinement/increase floodplain connectivity so that no more than 30% river length is unnaturally confined.



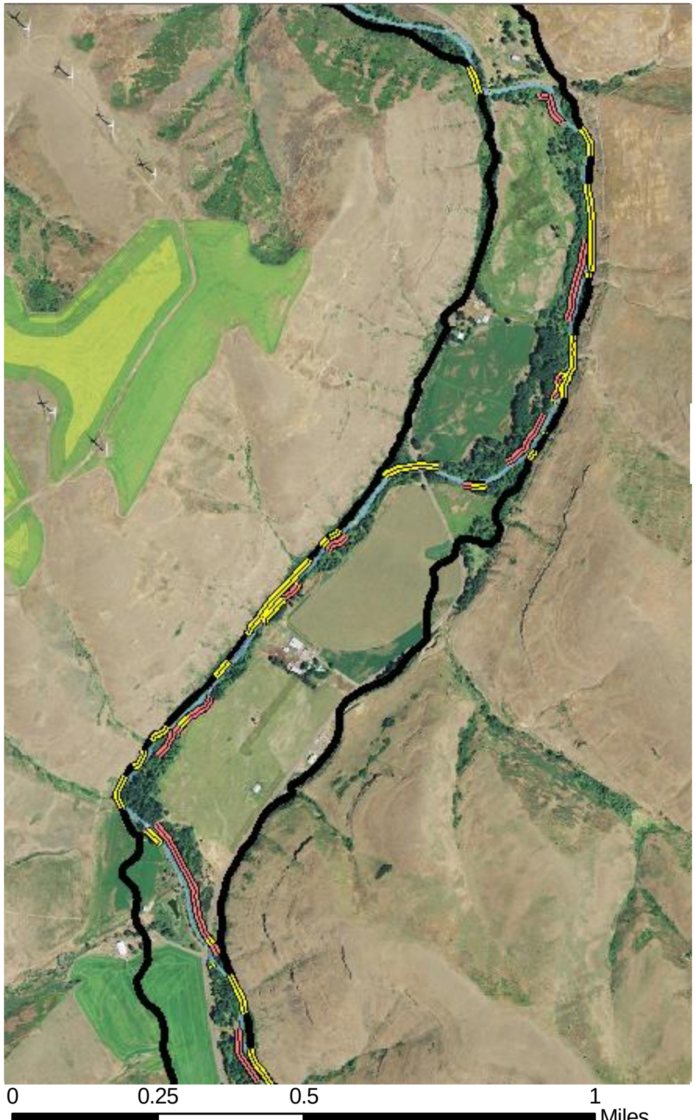
Existing Levees

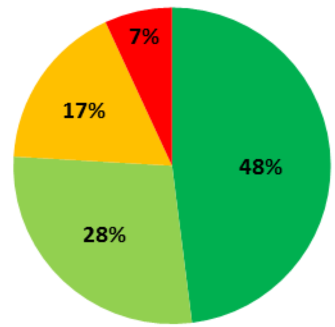
Bankfull Channel

Valley Bottom

Channel Confinement

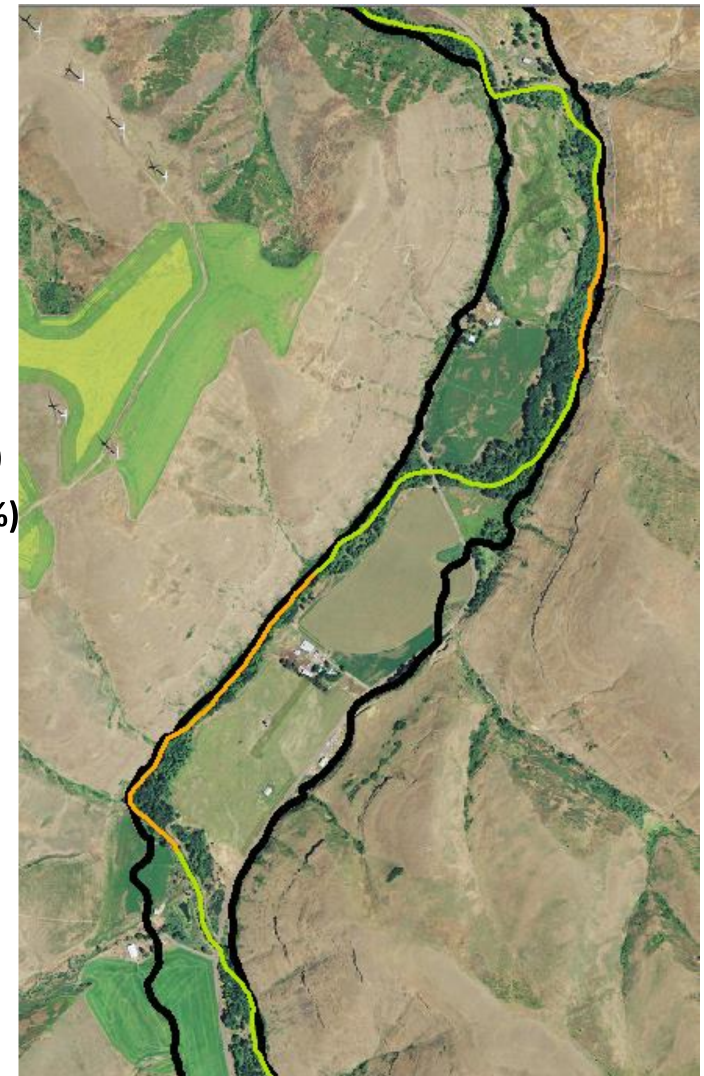
Goal: Reduce channel confinement/increase floodplain connectivity so that no more than 30% river length is unnaturally confined.





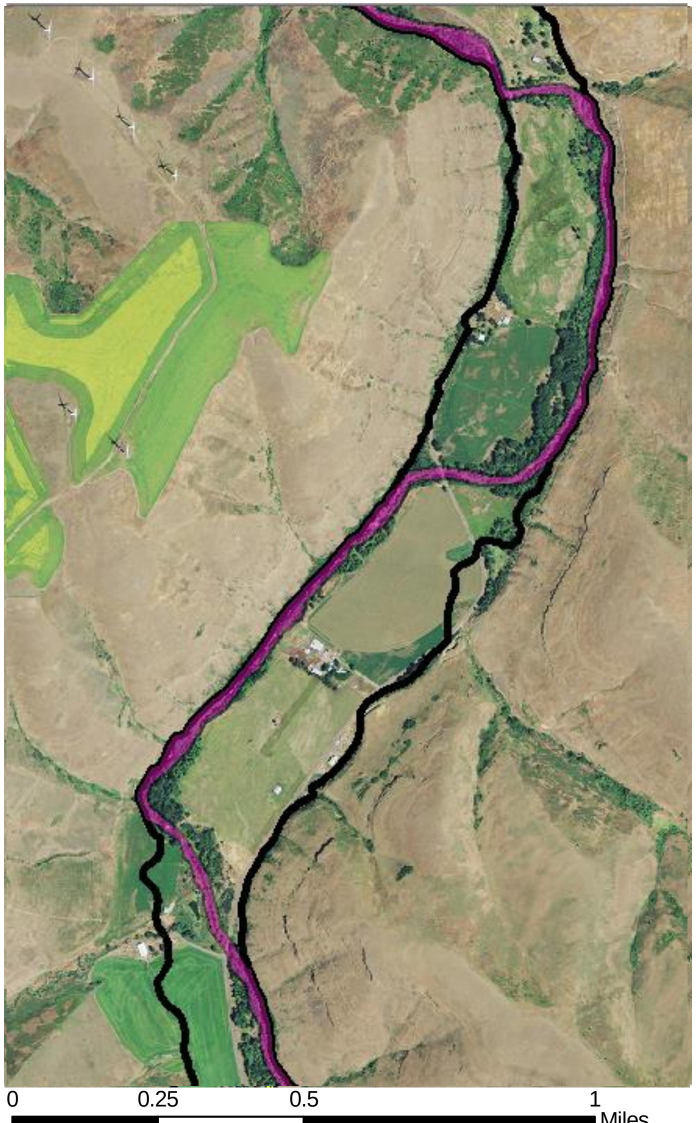
- Unconfined (0-9%)
- Partly Confined (10-49%)
- Mostly Confined (50-89%)
- Confined (90-100%)

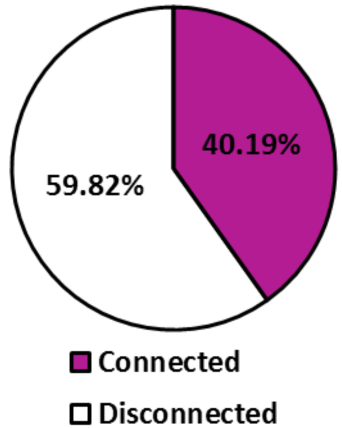
- Confinement Margins
- Existing Levees
- Bankfull Channel
- Valley Bottom

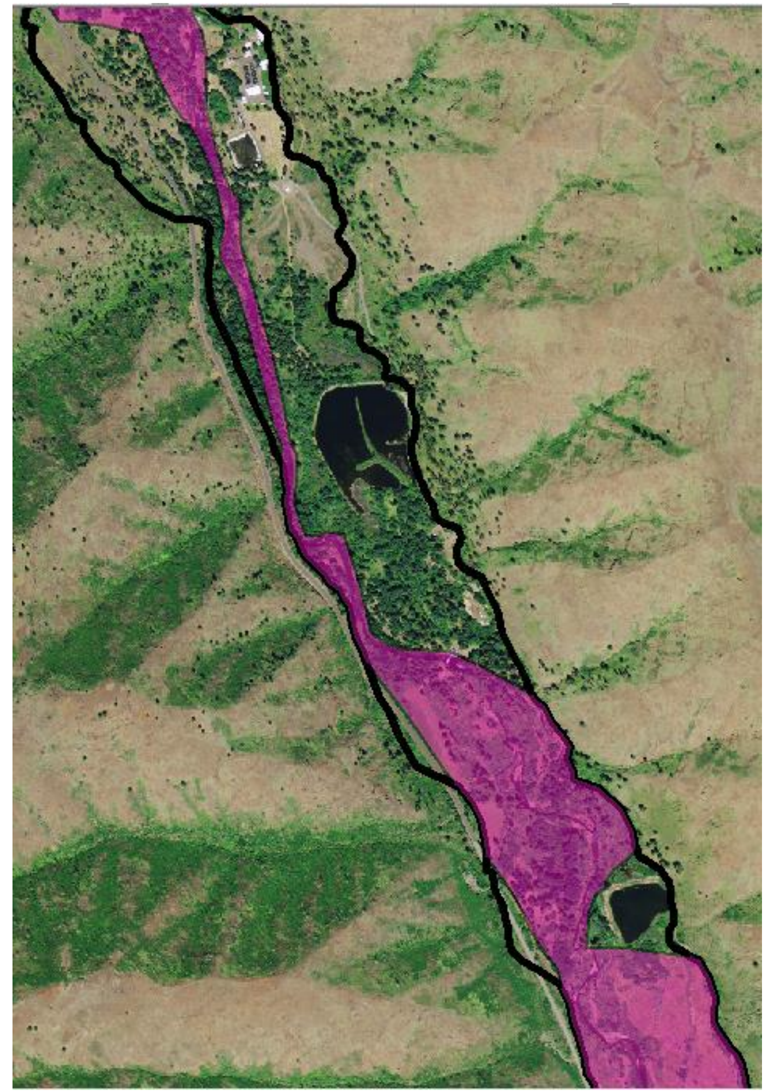


Channel Confinement as Floodplain Connectivity/Fragmentation

Goal: Reduce channel confinement/increase floodplain connectivity so that no more than 30% river length is unnaturally confined.

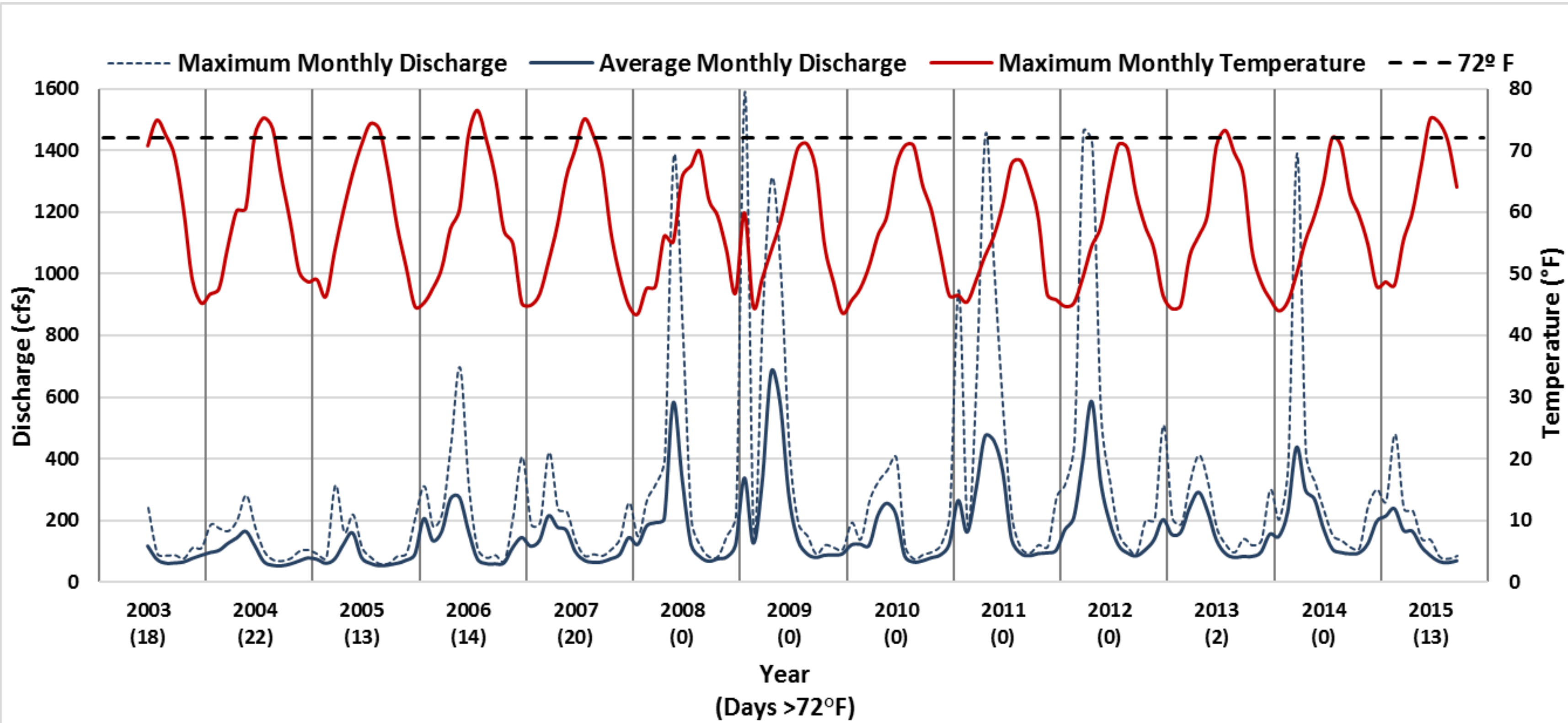






Water Temperature – Flows

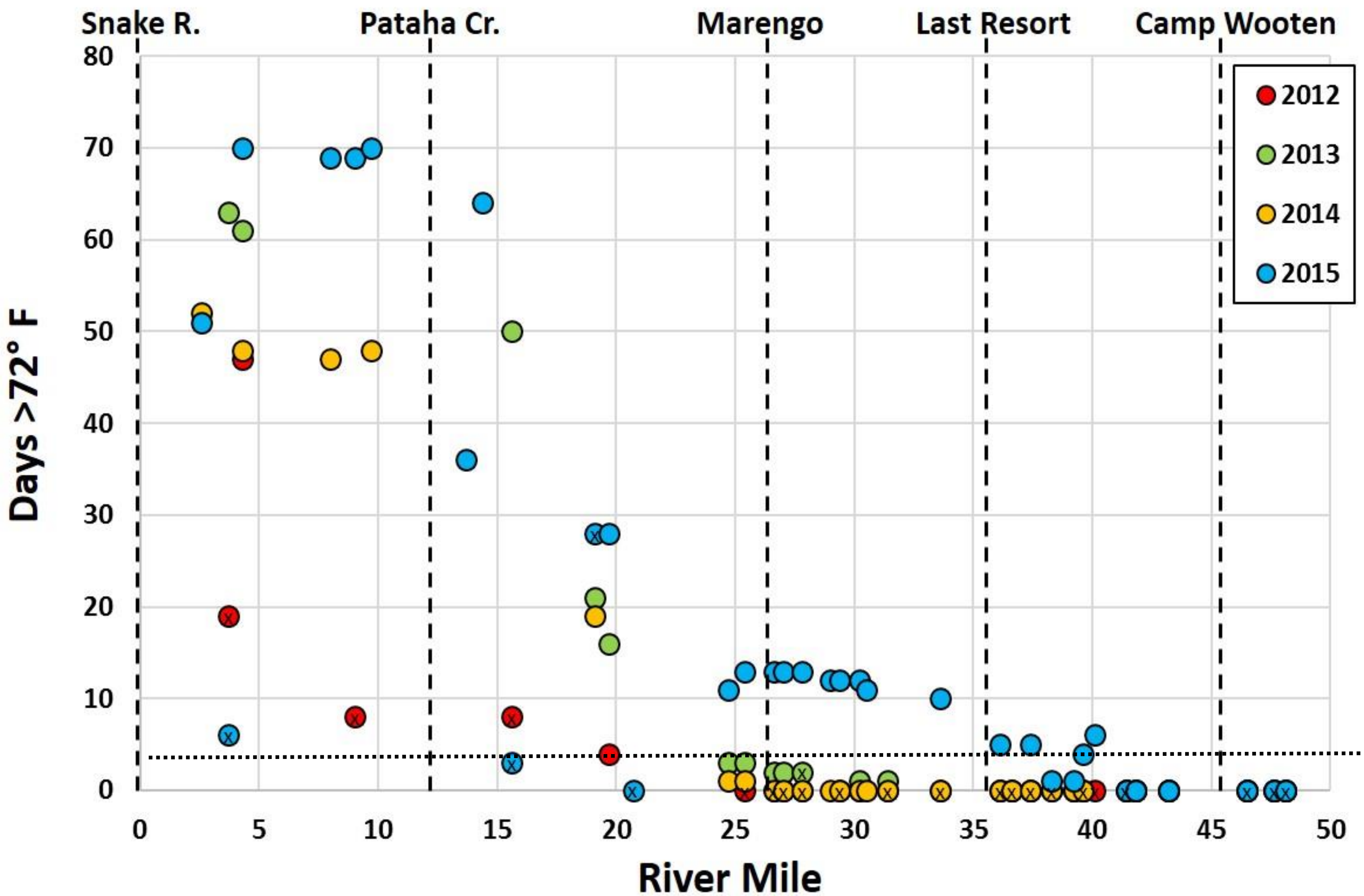
Goal: <4 days >72°F



Monthly max (blue dashed line) and average discharge (solid blue line), maximum water temperature (red), and number of days water temperature exceeded 72° at Marengo gauge.

Water Temperature

Goal: <4 days >72°F



Restoration Goal:
<4 days >72°F

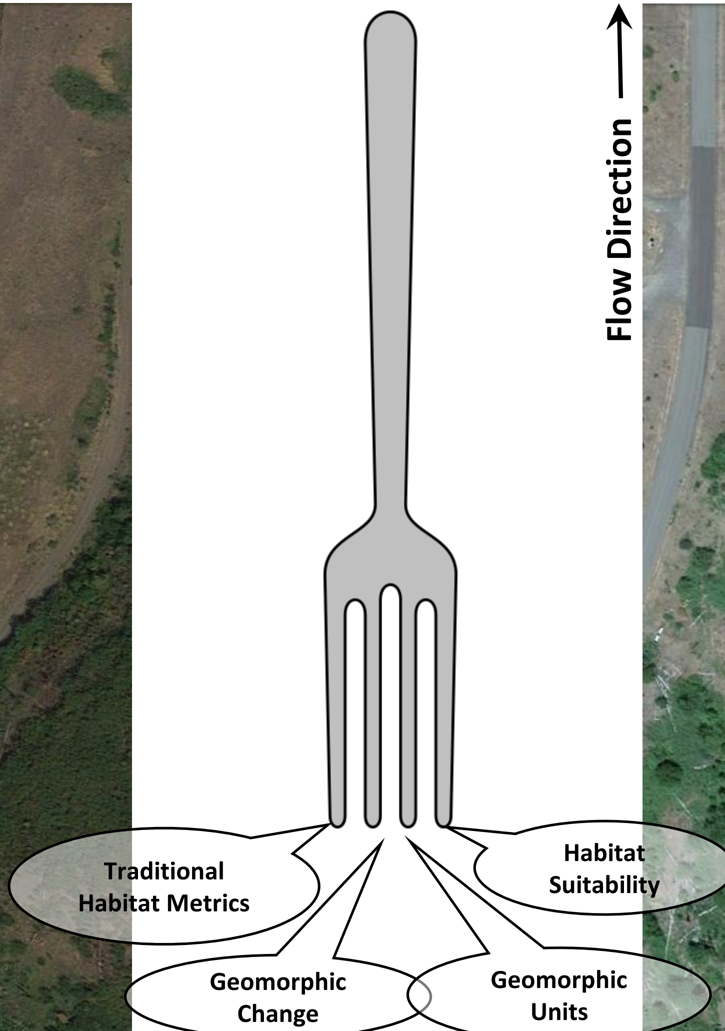
Number of days water temperature exceeded 72° F
at CHaMP sites from 2012-2015 by river mile.

LWD Leading To Habitat Complexity

Pre Treatment (2015)

Flow Direction

Project Area 11



Multiple Lines of Evidence

Post Treatment (2017)

Flow Direction

Indicators of Complexity Derived from CHaMP Surveys

Pre Treatment (2015)

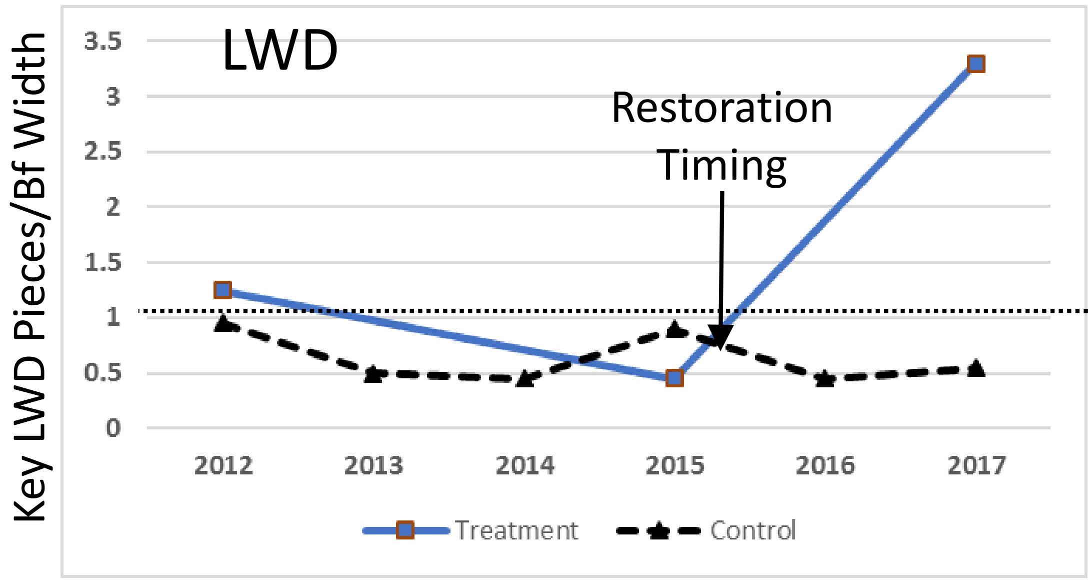
Post Treatment (2017)

Elevation
High
Low

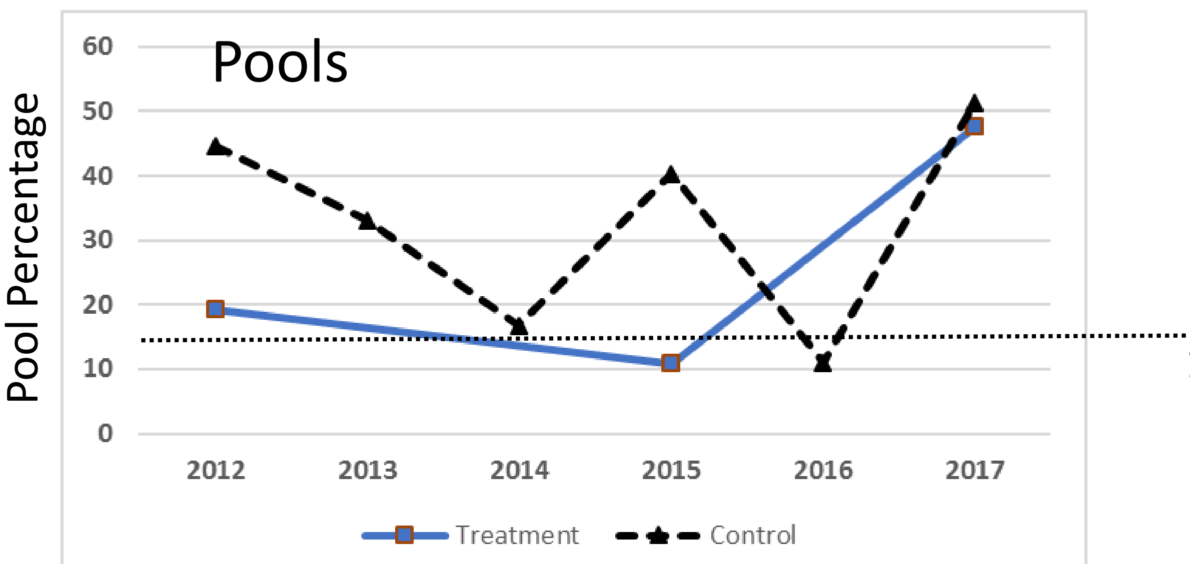
Water Depth
Deep
Shallow

Indicators of Complexity
Large Wood and Pools

PA 11 CHaMP Site vs Control



Restoration Goal:
>1* Key Piece/bankfull width
*or is it 2?

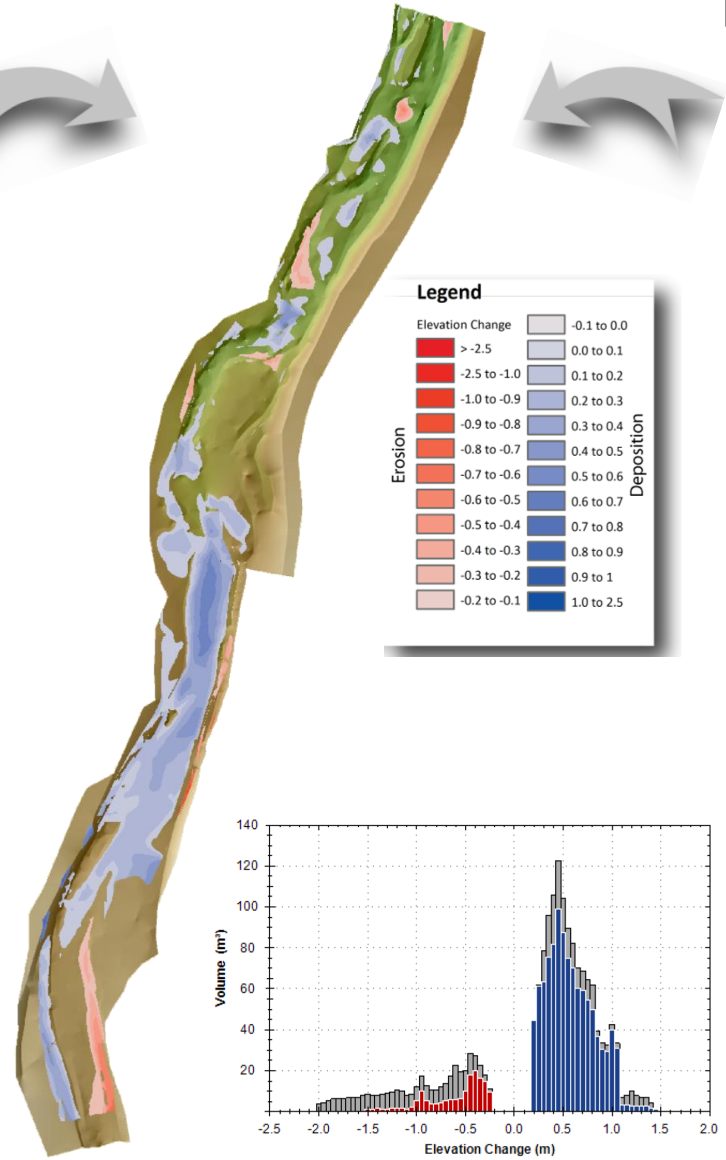


Restoration Goal:
15% of stream area

Indicators of Complexity
Geomorphic Change Detection

Pre Treatment (2015)

Flow Direction

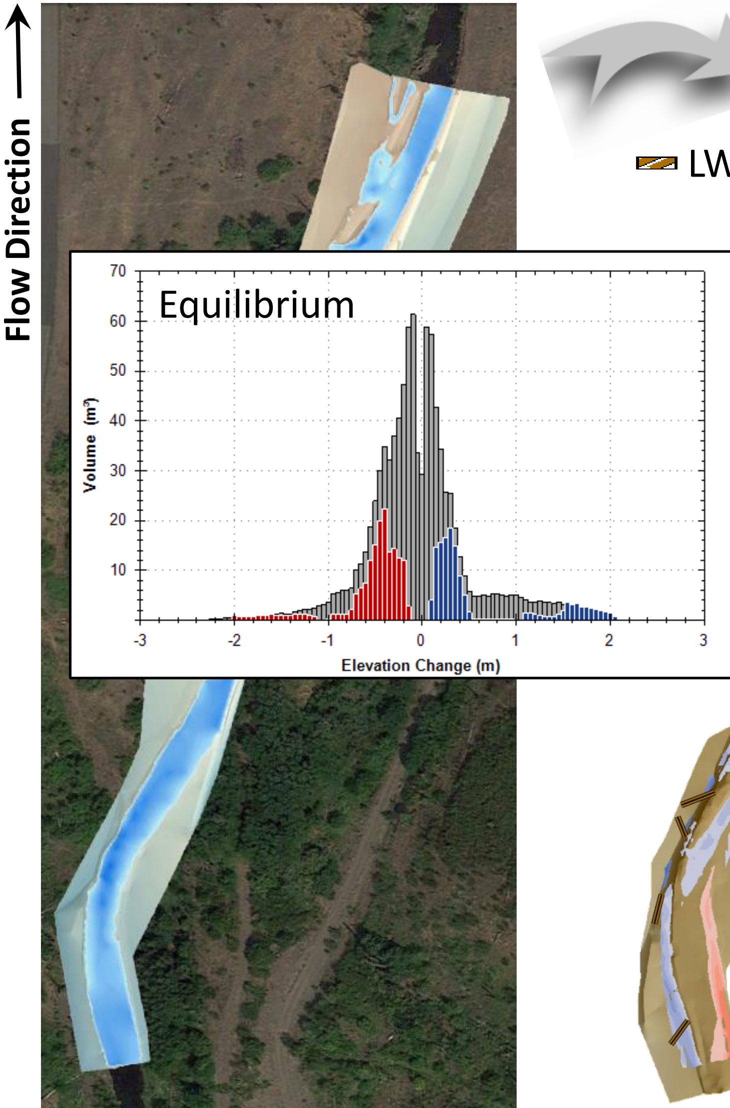


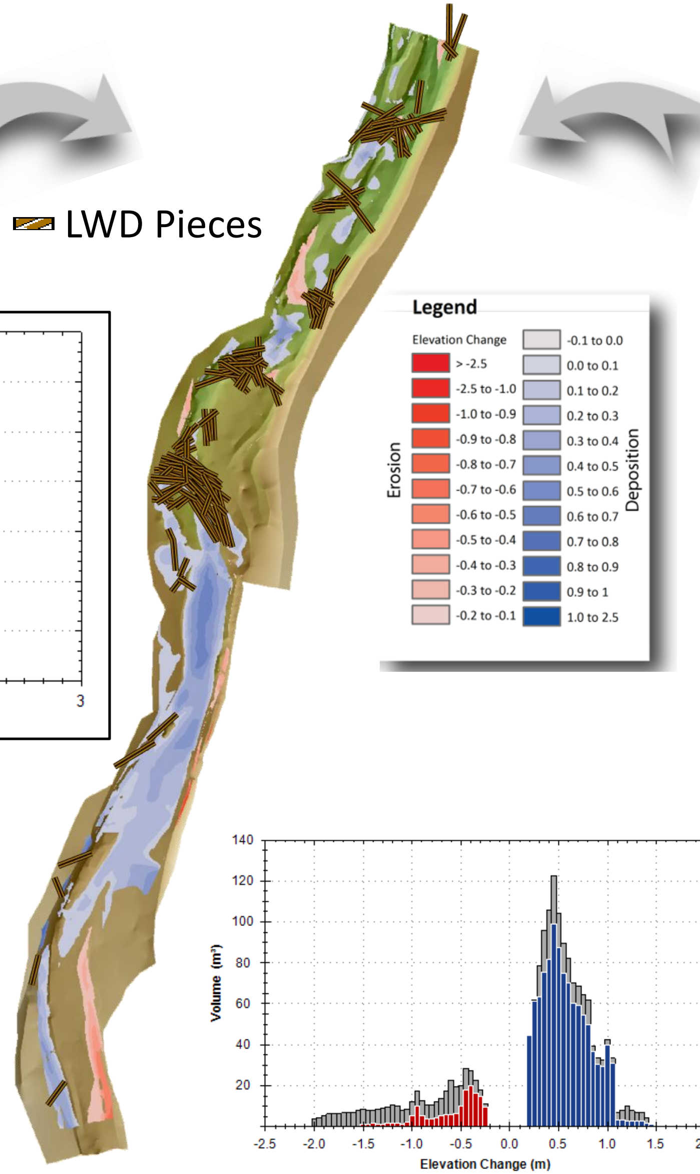
Post Treatment (2017)

Flow Direction

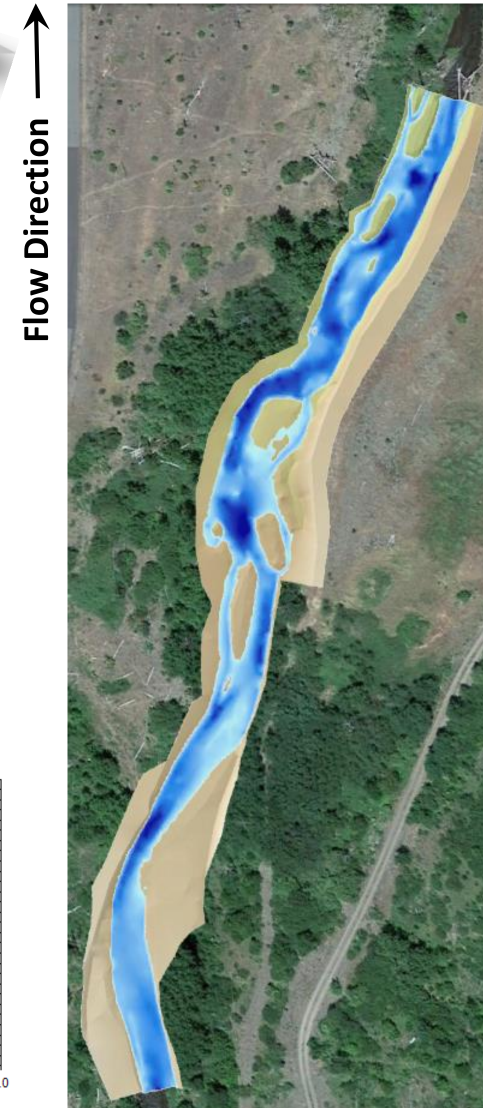
Indicators of Complexity
Geomorphic Change Detection

Pre Treatment (2015)

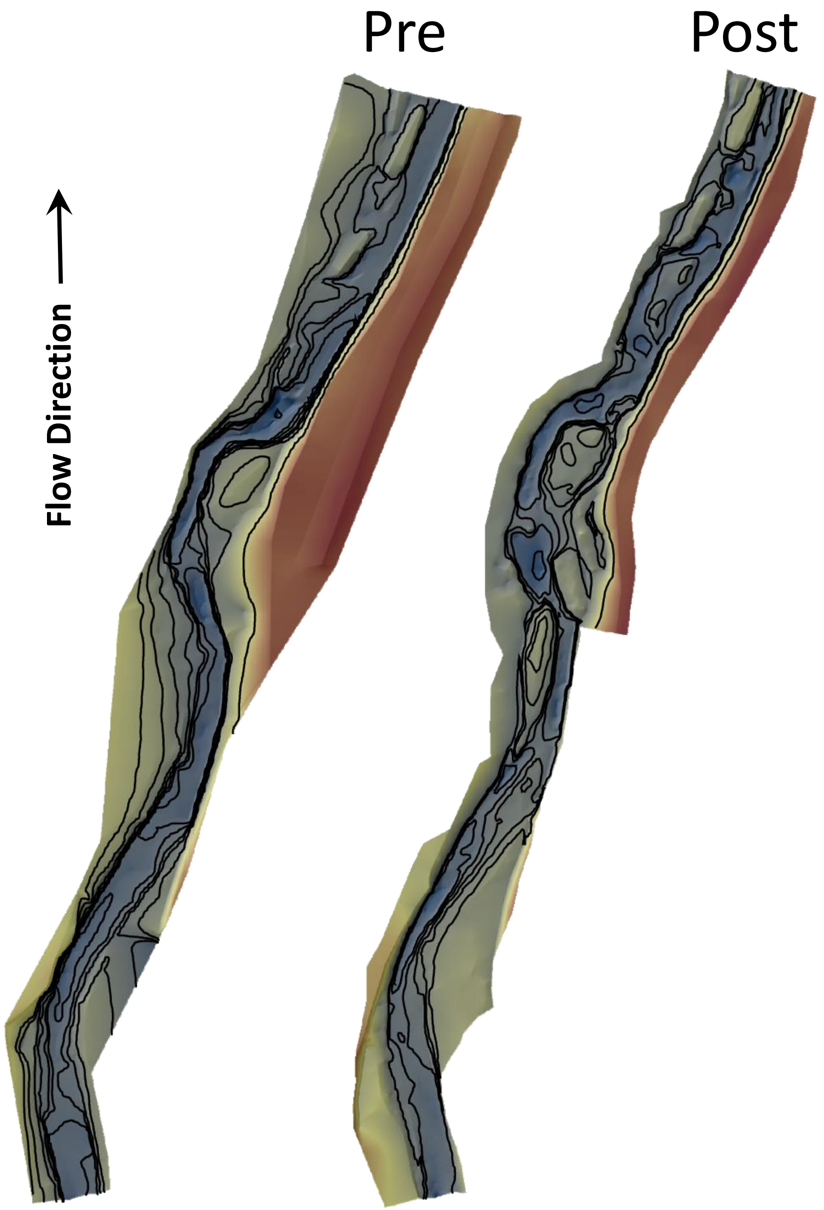




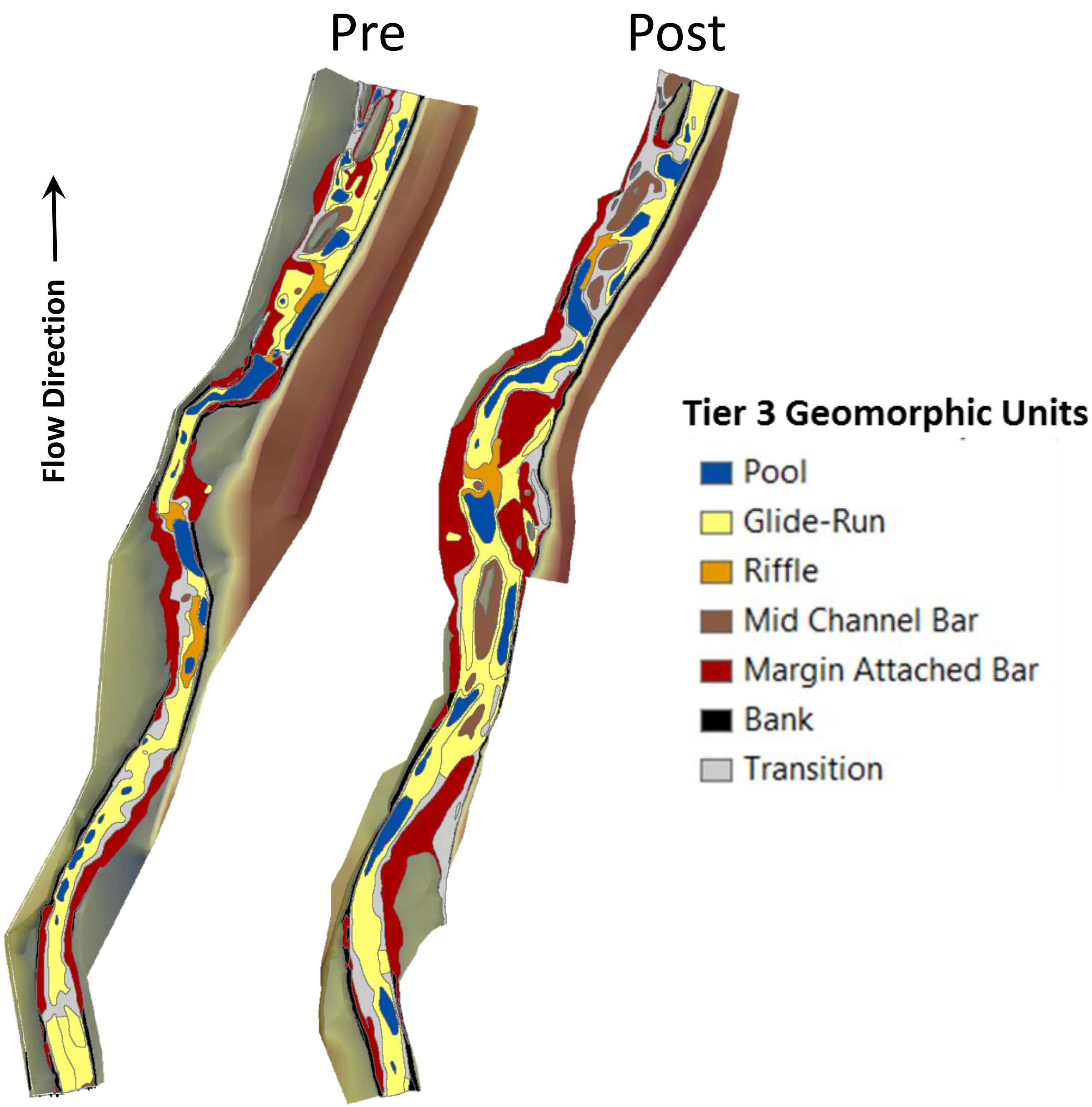
Post Treatment (2017)

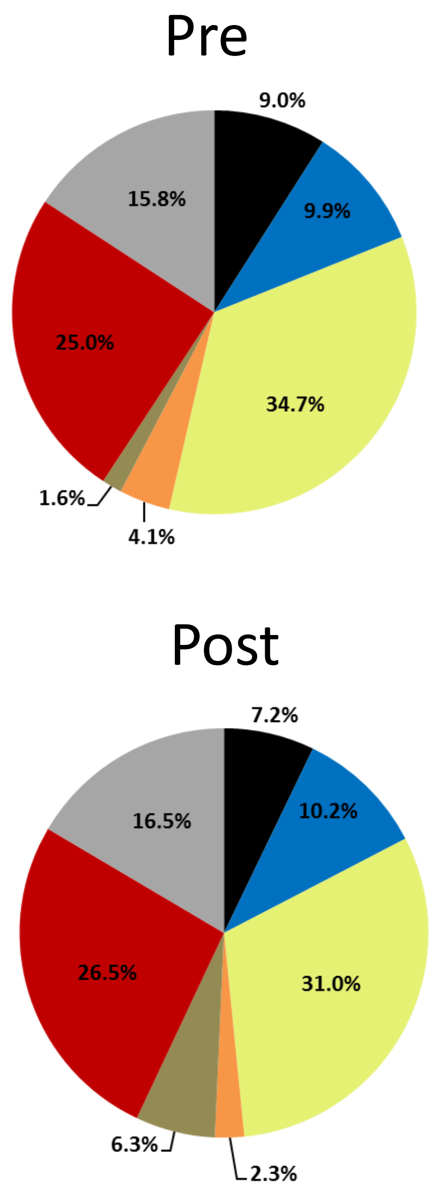


Indicators of Complexity
Geomorphic Units

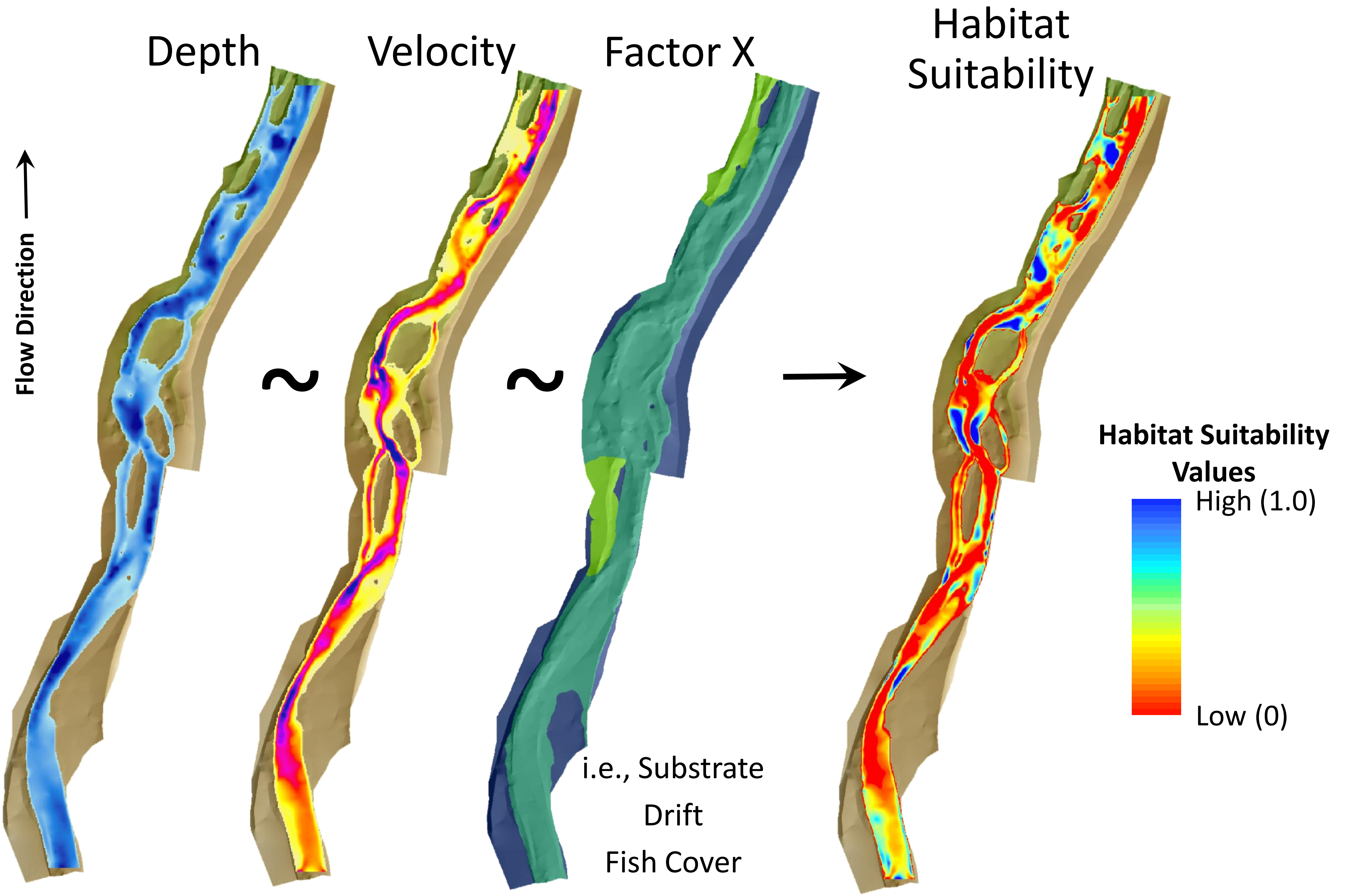


Indicators of Complexity
Geomorphic Units





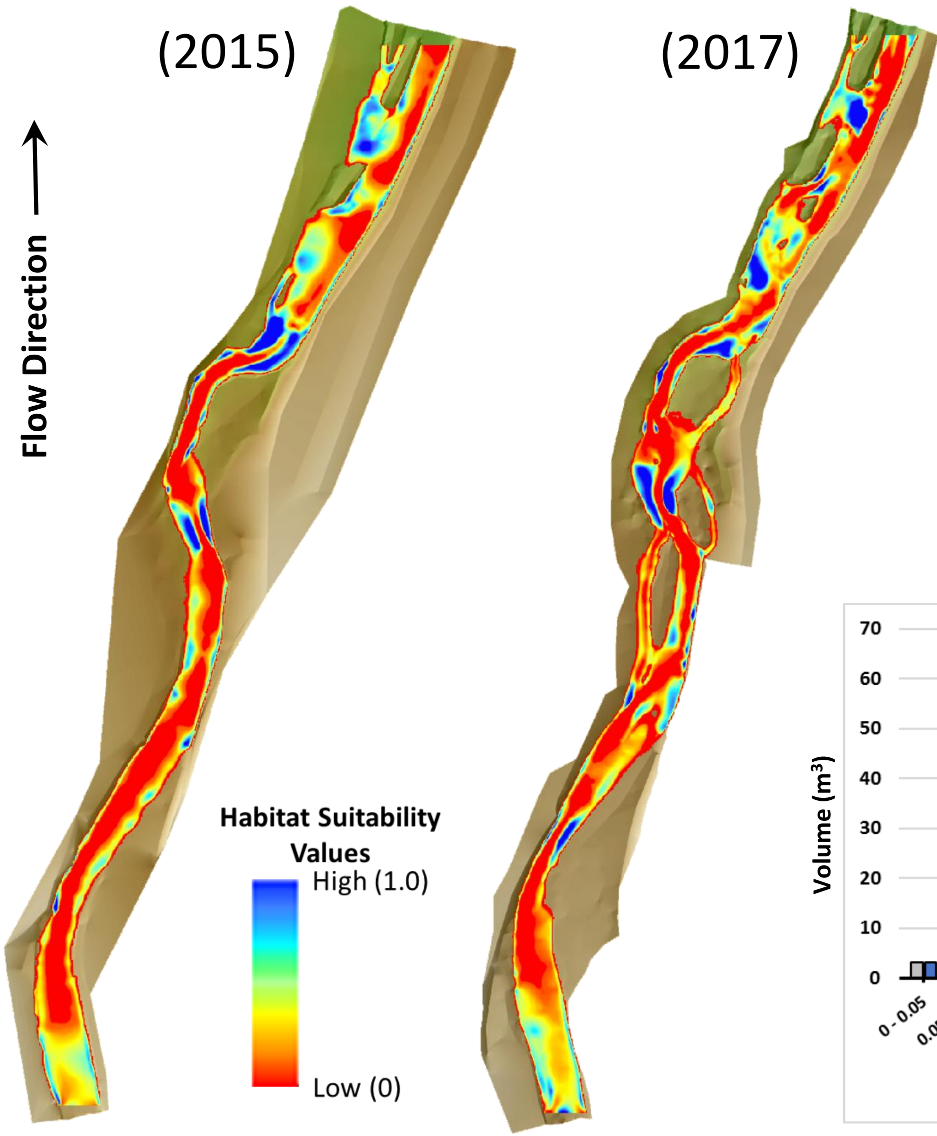
Does Complexity Lead to Better Habitat?
Habitat Suitability Models

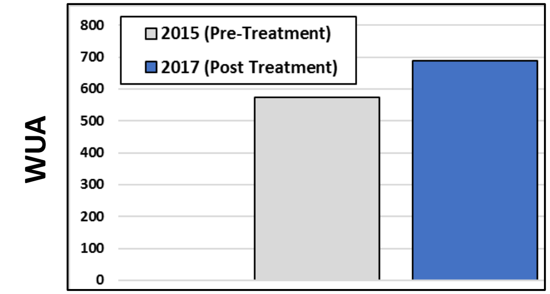


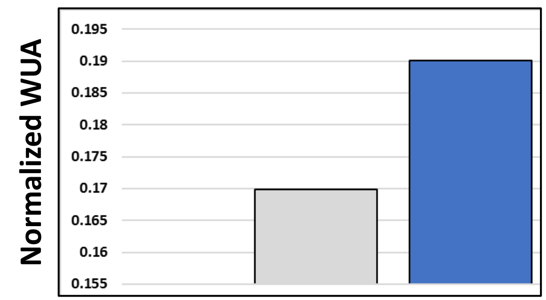
Does Complexity Lead to Better Habitat? Habitat Suitability Models

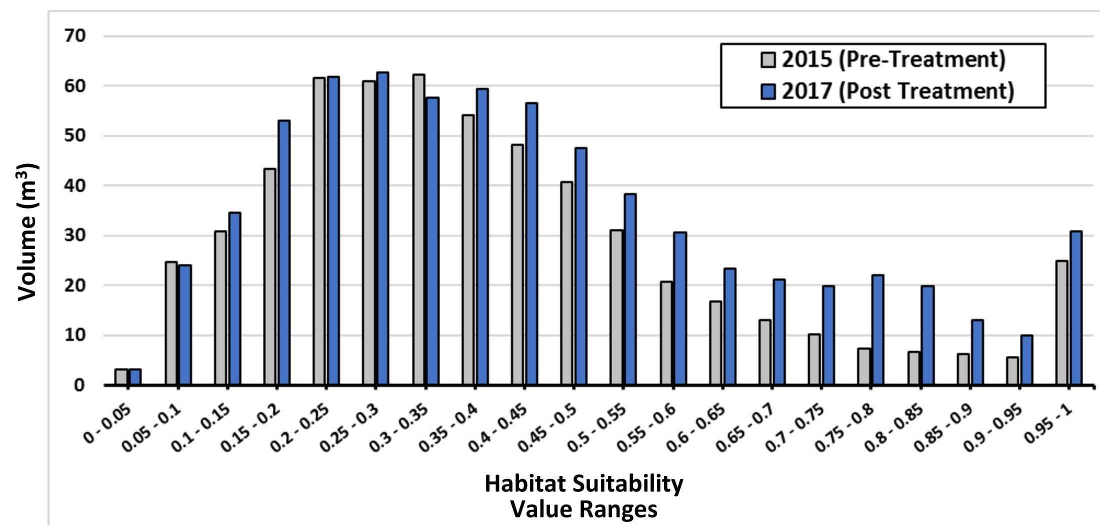
Pre Treatment (2015)

Post Treatment (2017)



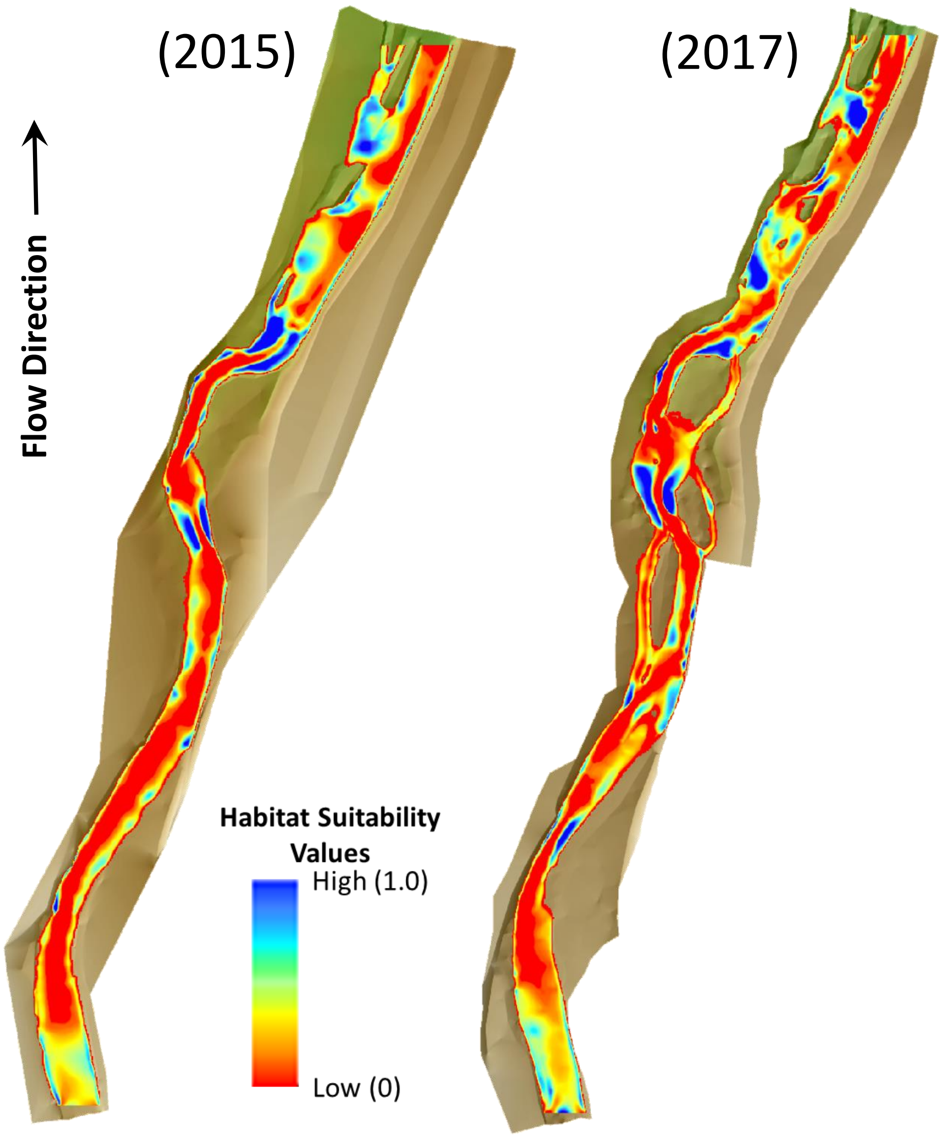






Does Complexity Lead to Better Habitat?
Habitat Suitability Models

Pre Treatment (2015) | Post Treatment (2017)



Types of Habitat Suitability Models (each can be ran by species and life stage)

- **Habitat Suitability Indices (HSI)**
- **Fuzzy Inference System (FIS)**
- **Net Rate of Energy Intake (NREI)***
  - **Mechanistic model which takes into account Bioenergetics:**
    - **Velocity**
    - **Food Resources (Drift)**
    - **Temperature**

End goal of these models is to estimate Carrying Capacity

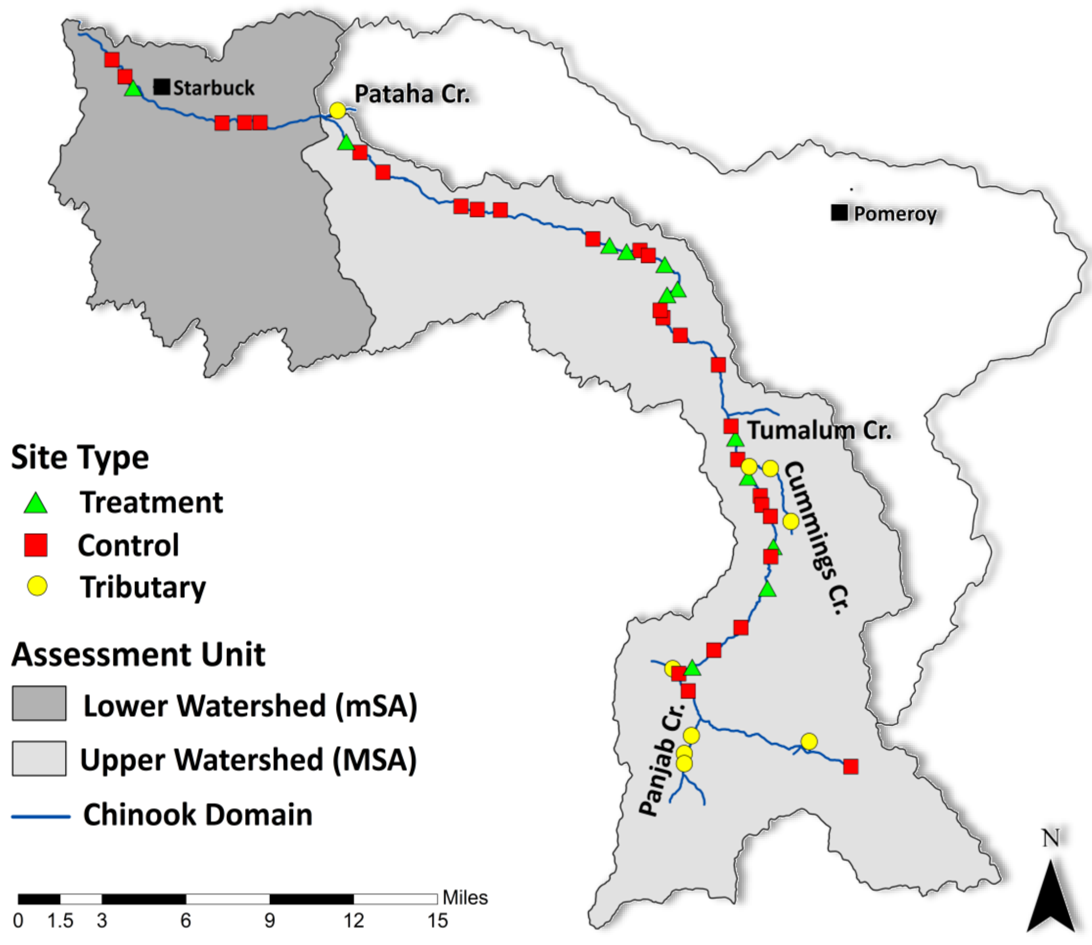
Status and Trends

Any of these results can be rolled up to provide Assessment Area or watershed status and trends

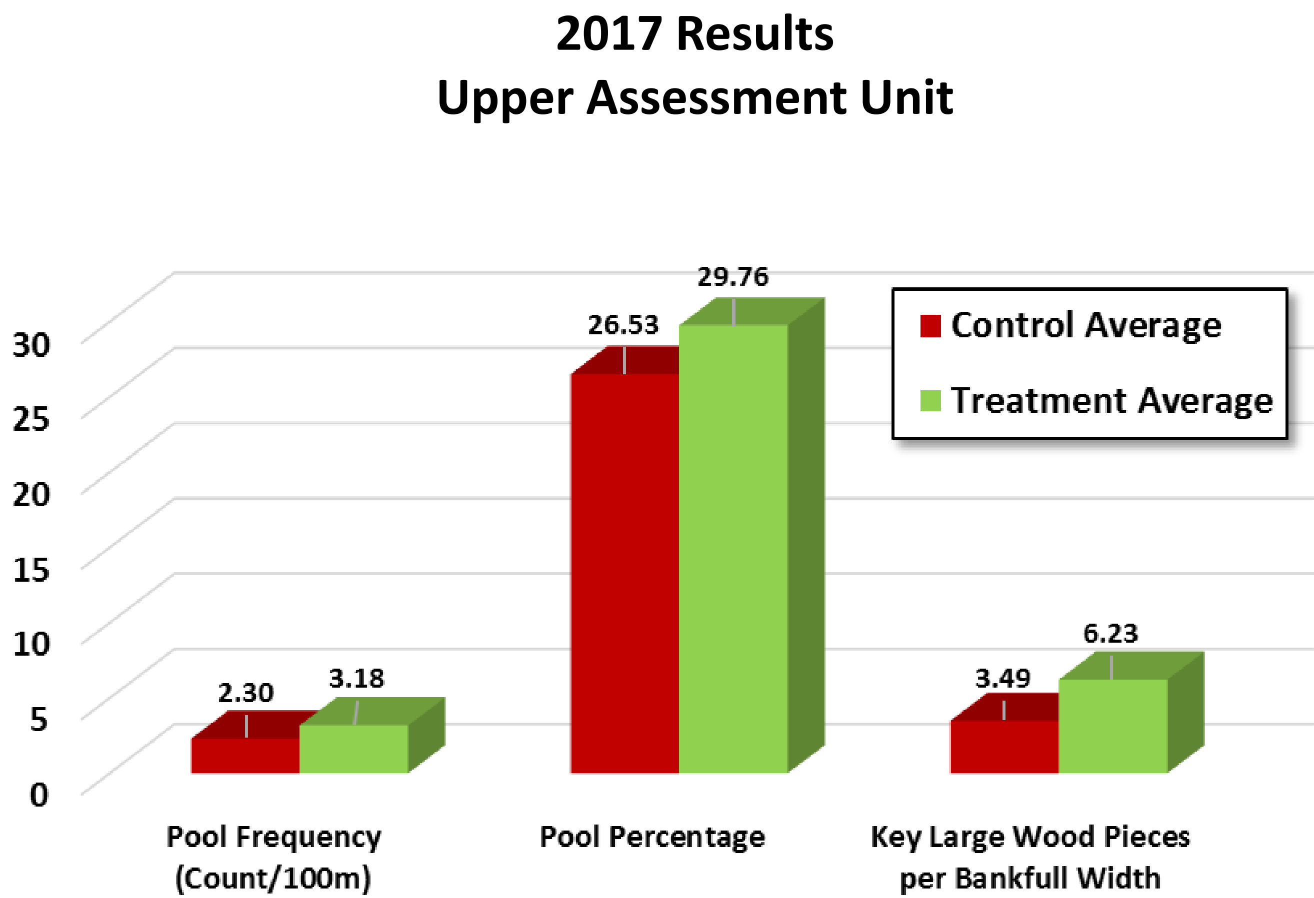
- 50 sites, 180+ unique visits
- 41 Mainstem sites
- 9 Tributary sites

Mainstem sites:

- 14 Treatment sites (13 w/ post treatment results)
- 27 Control sites



Indicators of Complexity
Large Wood and Pools



Review

Questions:

❑ How do we show the impact of the habitat restoration effort?

- Use multiple approaches to best answer each question (i.e. spatial data and field data) at multiple scales (Project Area → Watershed)

❑ Will the monitoring data we are collecting provide information on changes to the identified ecological concerns in the Tucannon?

- **Riparian** – Yes but not necessarily in the short run
- ✓ **Confinement** – Yes. Need to more explicitly define goals (confinement vs fragmentation)
- ✓ **LWD Reflecting Complexity** – Yes, using multiple lines of evidence
- ✓ **Temperature**
- Flows
- Barriers/Screens

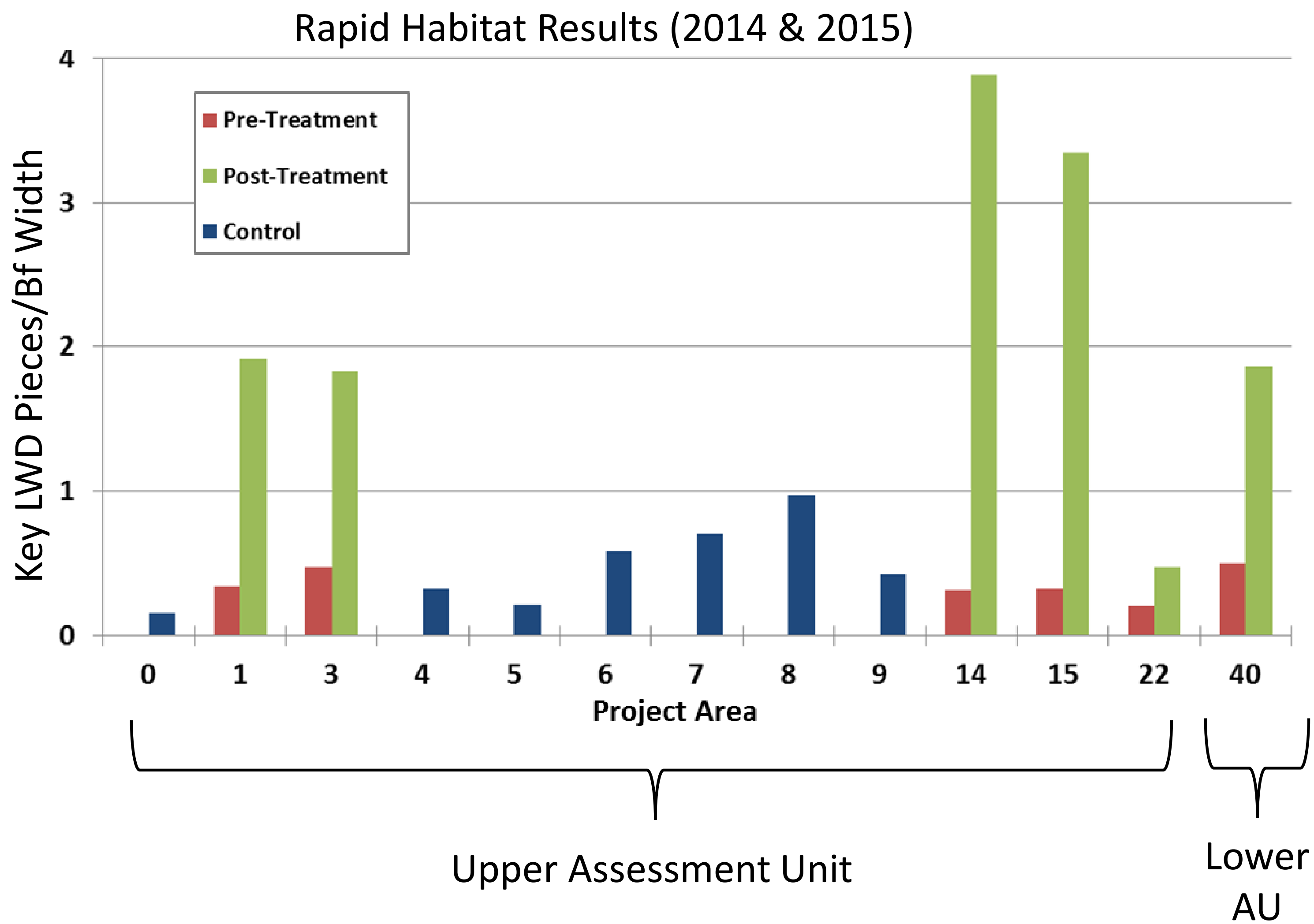
❑ How do we get to these work products to help tell the story?

- Life cycle assessment
- ✓ **Habitat suitability index**
- Life cycle mortality assessment and juvenile abundance estimates

Thank You

Additional Slides

Indicators of Complexity Derived from Rapid Habitat Surveys



Tier 1 Classification

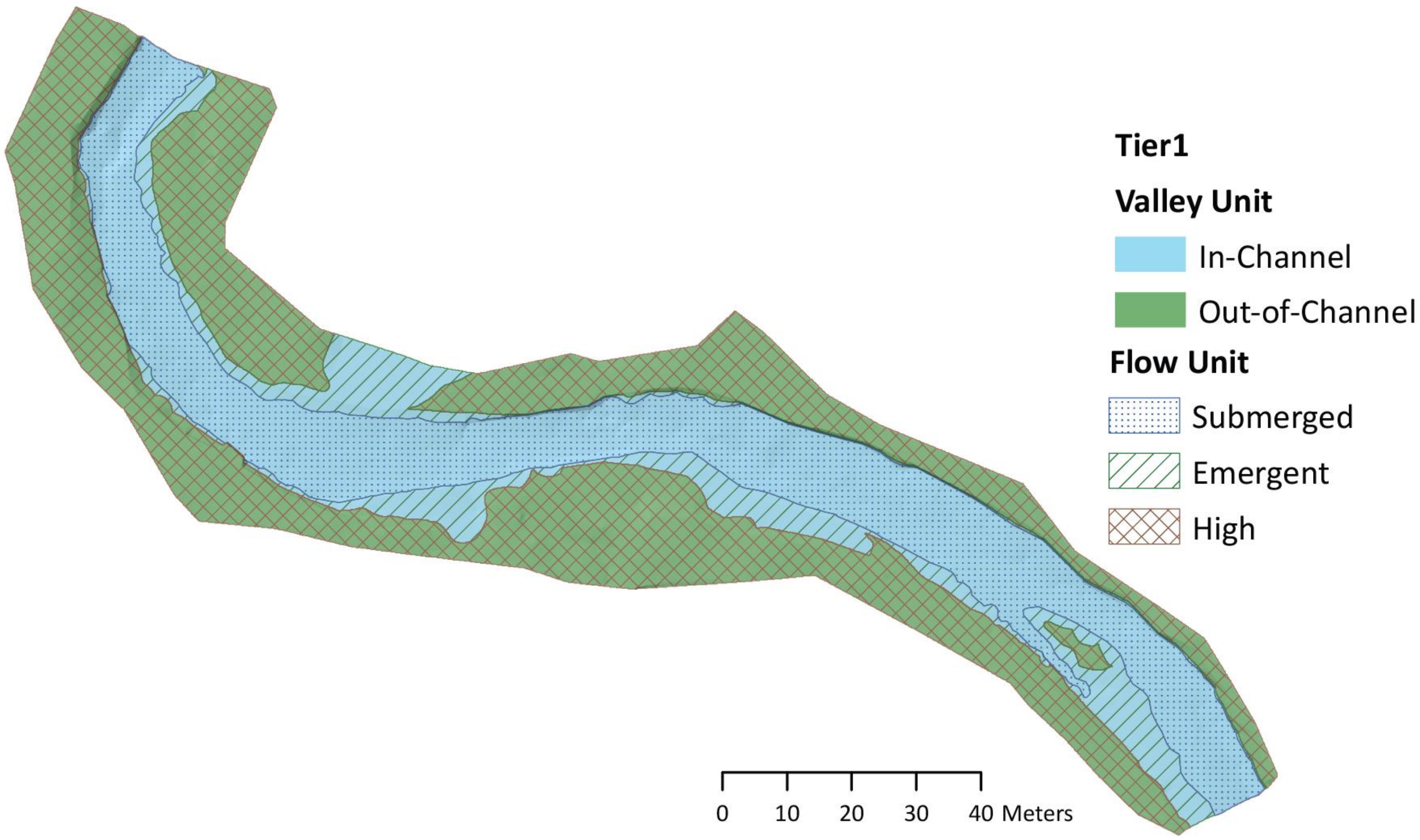
Valley Unit (Wheaton et al, 2015)

- Evidence Layers: Bankfull polygon
- Valley Units:
    - In-Channel (within bankfull extent)
    - Out-of-Channel (outside bankfull extent)

Flow Unit (Belletti et al, 2017; Rinaldi et al, 2015)

- Evidence Layers: Bankfull polygon, Water Extent polygon
- Flow Units:
    - Submerged (within wetted extent)
    - Emergent (within bankfull extent but not wetted)
    - High (outside bankfull extent)

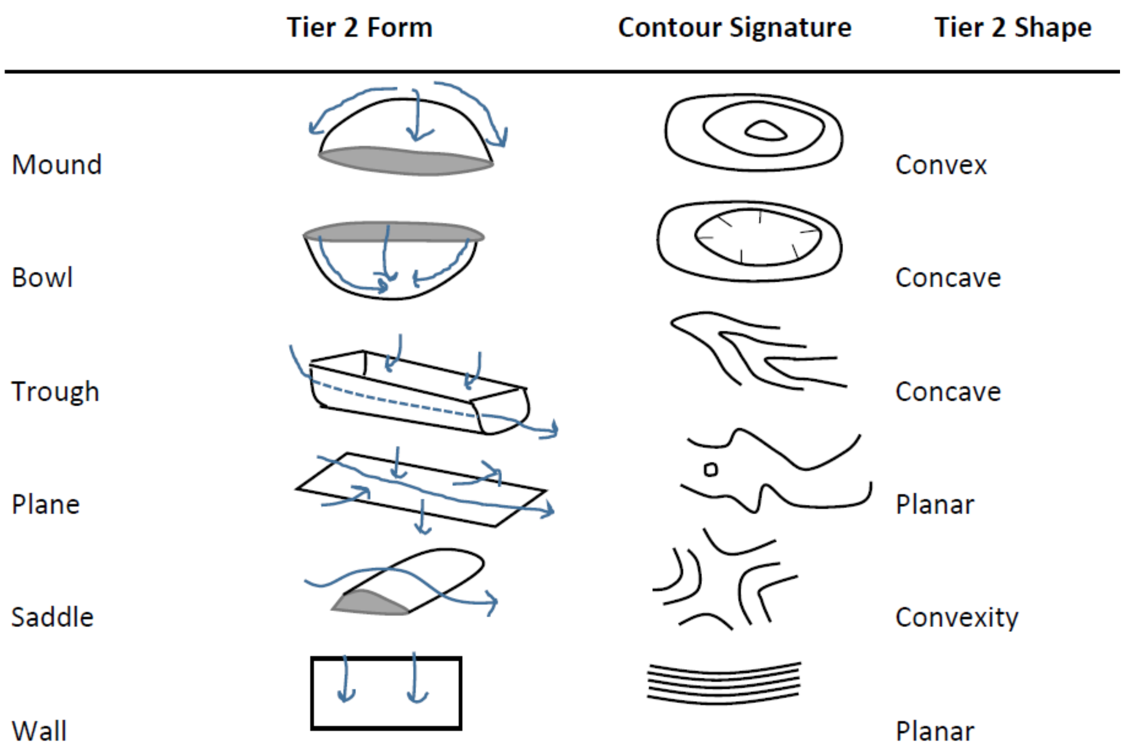
Tier 1 Classification



Tier 2 Classification

Unit Shape and Form (Wheaton et al, 2015)

- Classes:
  - Convexity (Mound, Mound Transition, Saddle)
  - Planar (Plane, Wall)
  - Concavity (Bowl, Bowl Transition, Trough)



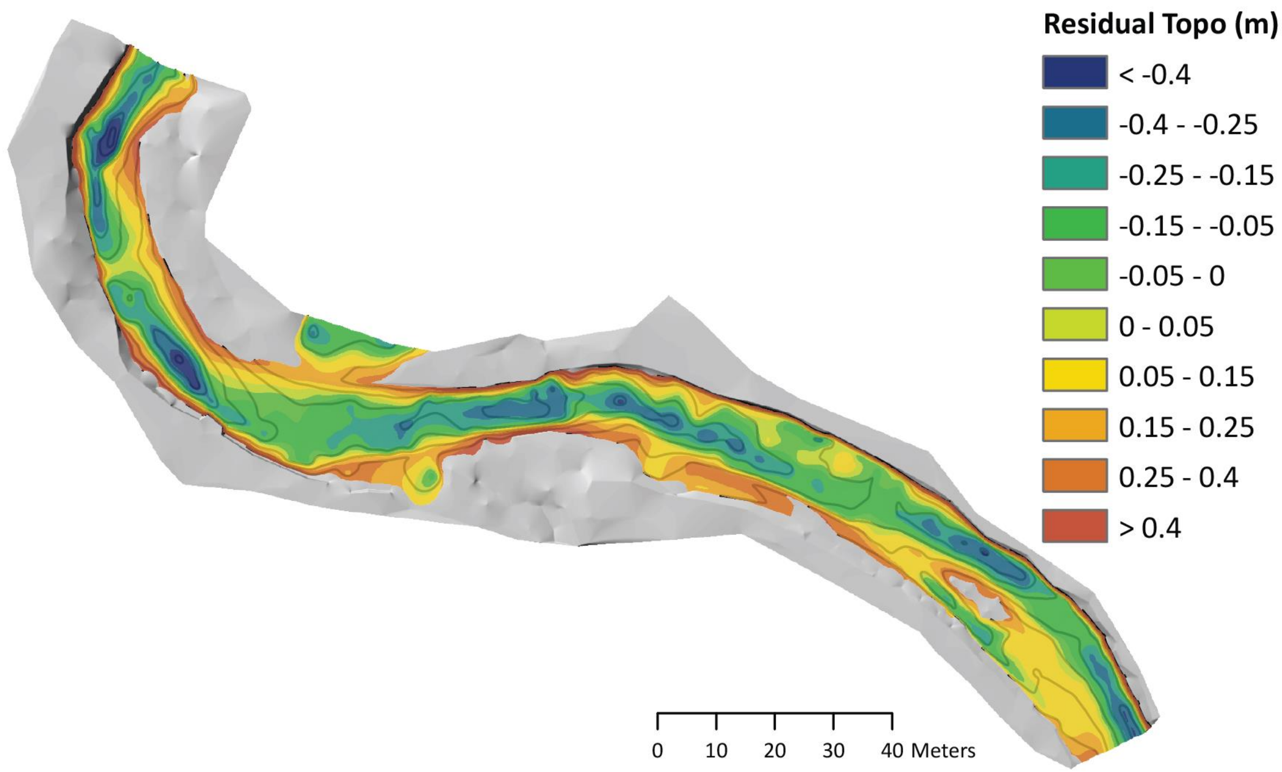
Tier 2 Classification

- **Evidence Layers:** Residual Topography, Residual Pools, DEM Slope, DEM Contours, Thalweg
- Convexity:
  - Mound: high ++ residual topography
  - Mound Transition: + residual topography but nearing 0
  - Saddle: identified from contours
- Planar:
  - Plane: residual topography ~ 0
  - Wall: high slope cells along channel margin
- Concavity:
  - Bowl: high -- residual topography and residual pool
  - Bowl Transition: - residual topography and residual pool
  - Trough: - residual topography but not residual pool

Tier 2 Evidence Layers

Residual Topography (Sofia et al, 2014; Tarolli et al, 2012)

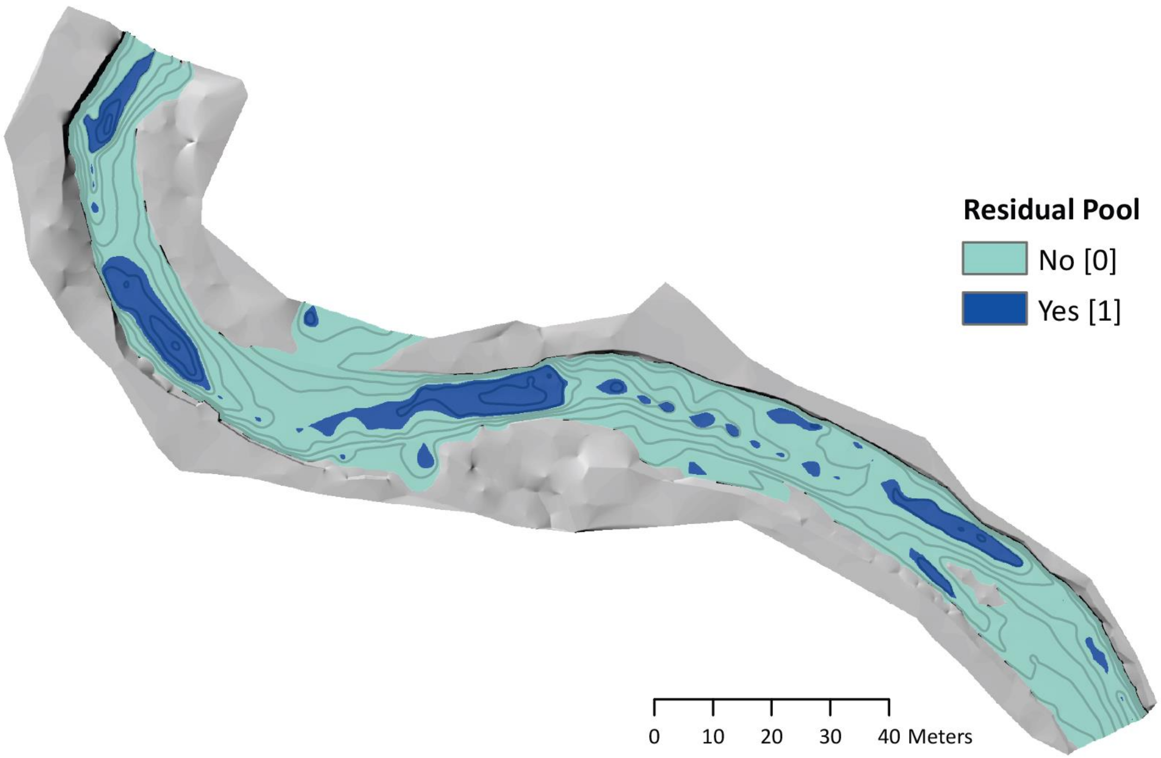
- Fit trend (Z_{Mean}) surface to DEM
- $Z_{Residual} = Z_{DEM} – Z_{Mean}$
- Statistical breaks in distribution used to classify all forms except saddles



Tier 2 Evidence Layers

Residual Pools

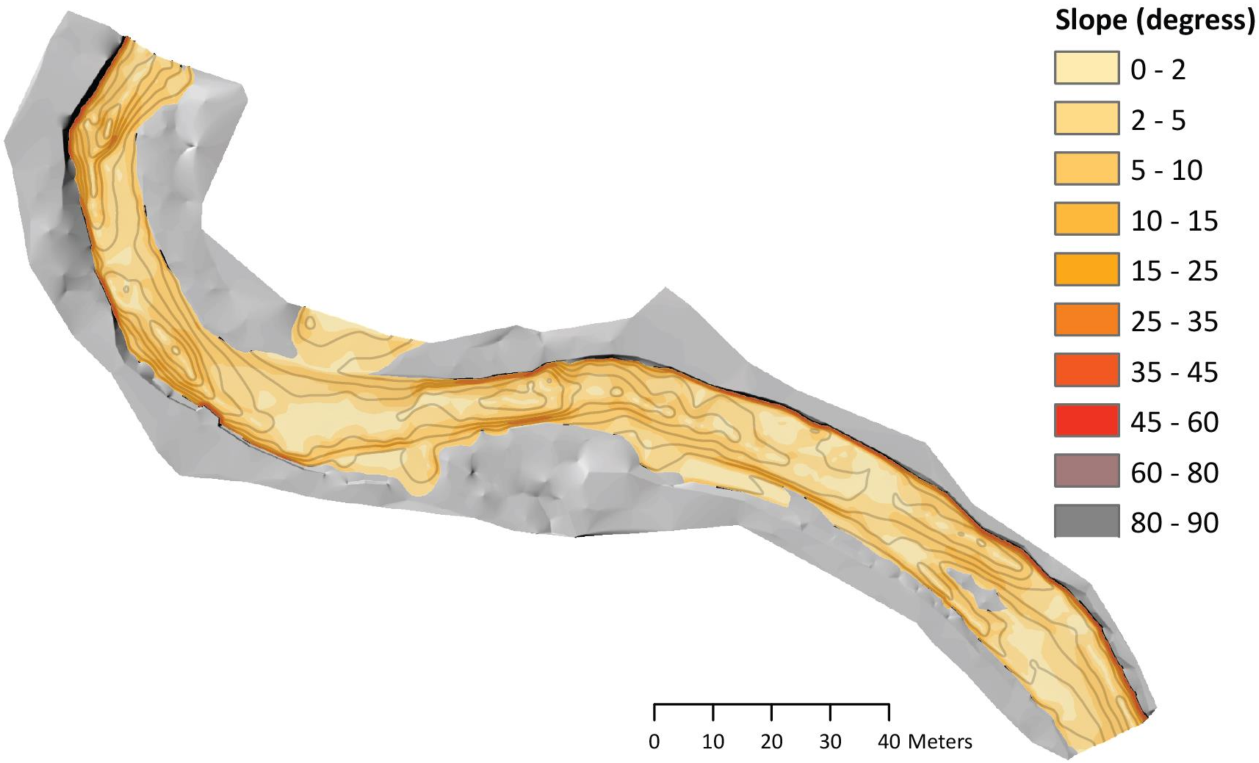
- Fill DEM until reaches a pour point
- Represents features that are concave laterally and longitudinally
- Used along with residual topography to classify Bowls



Tier 2 Evidence Layers

DEM Slope

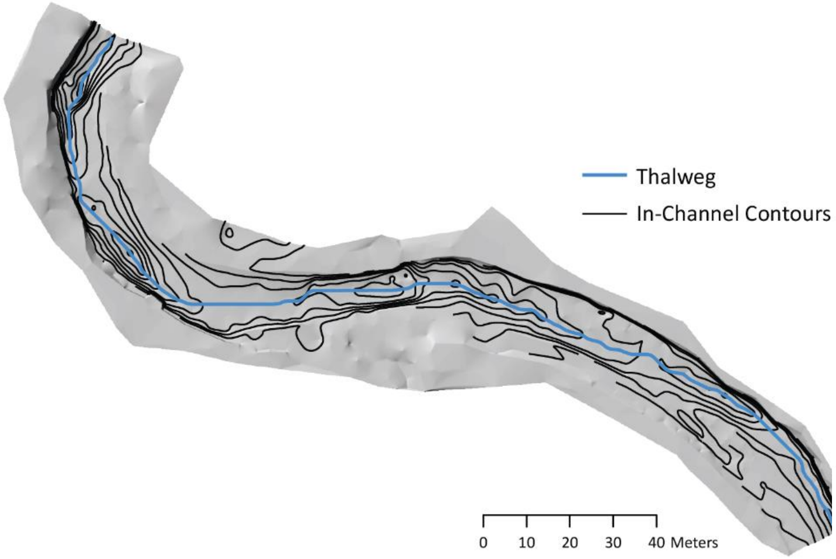
- Used along with residual topography to classify Walls

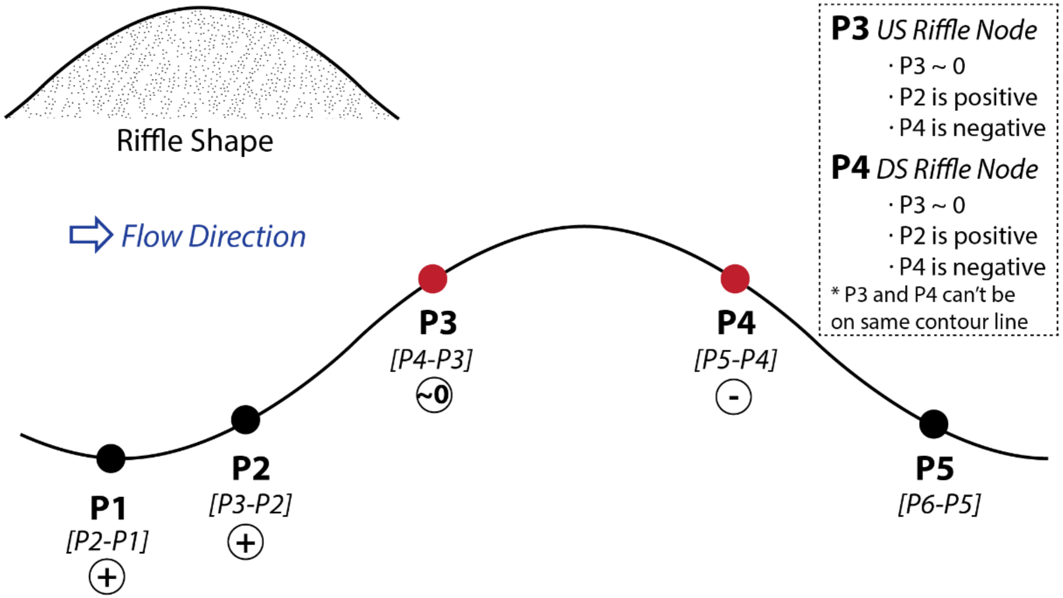


Tier 2 Evidence Layers

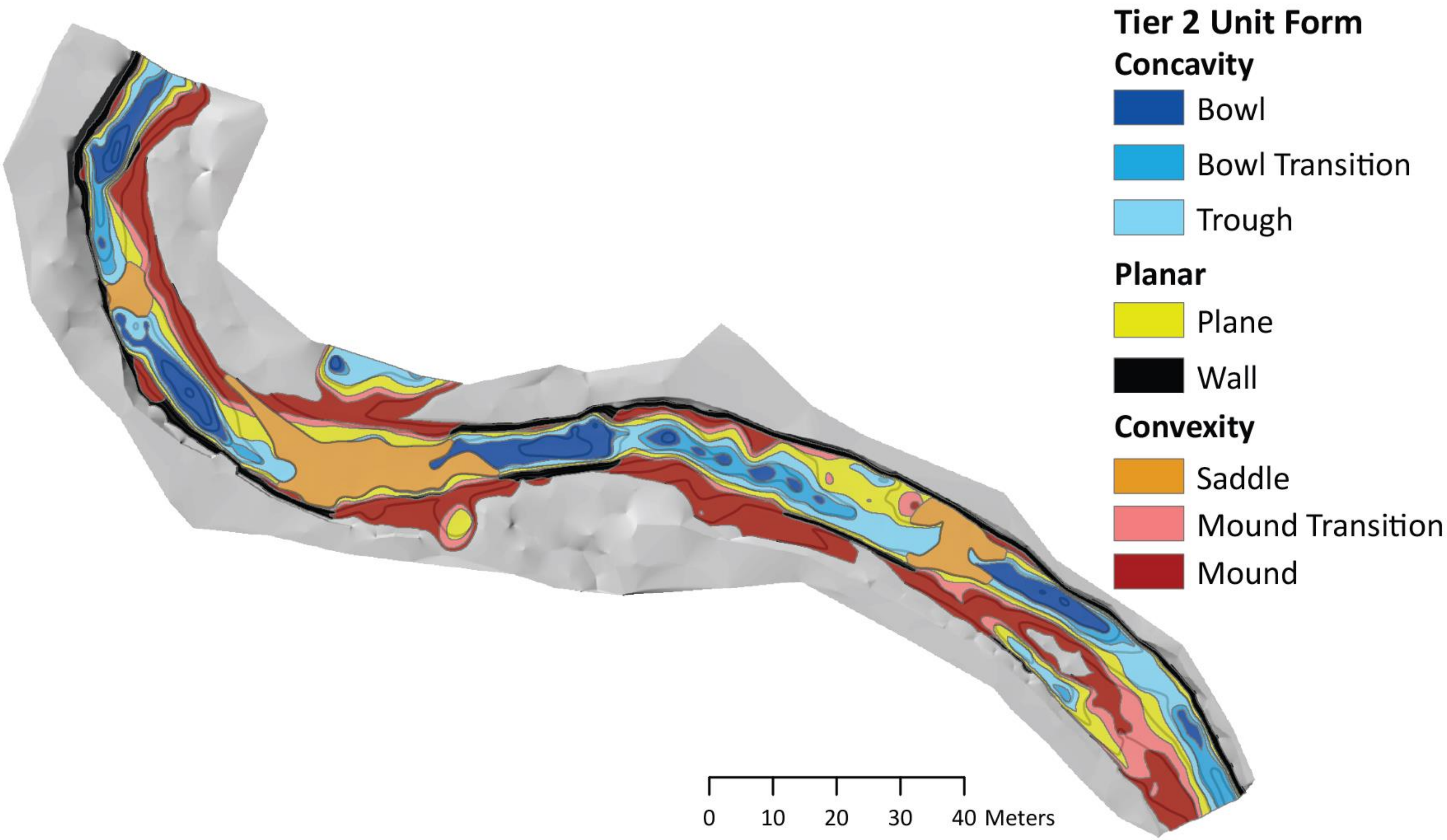
Contours + Thalweg

- Used to identify saddles (i.e., riffles)





Tier 2 Classification



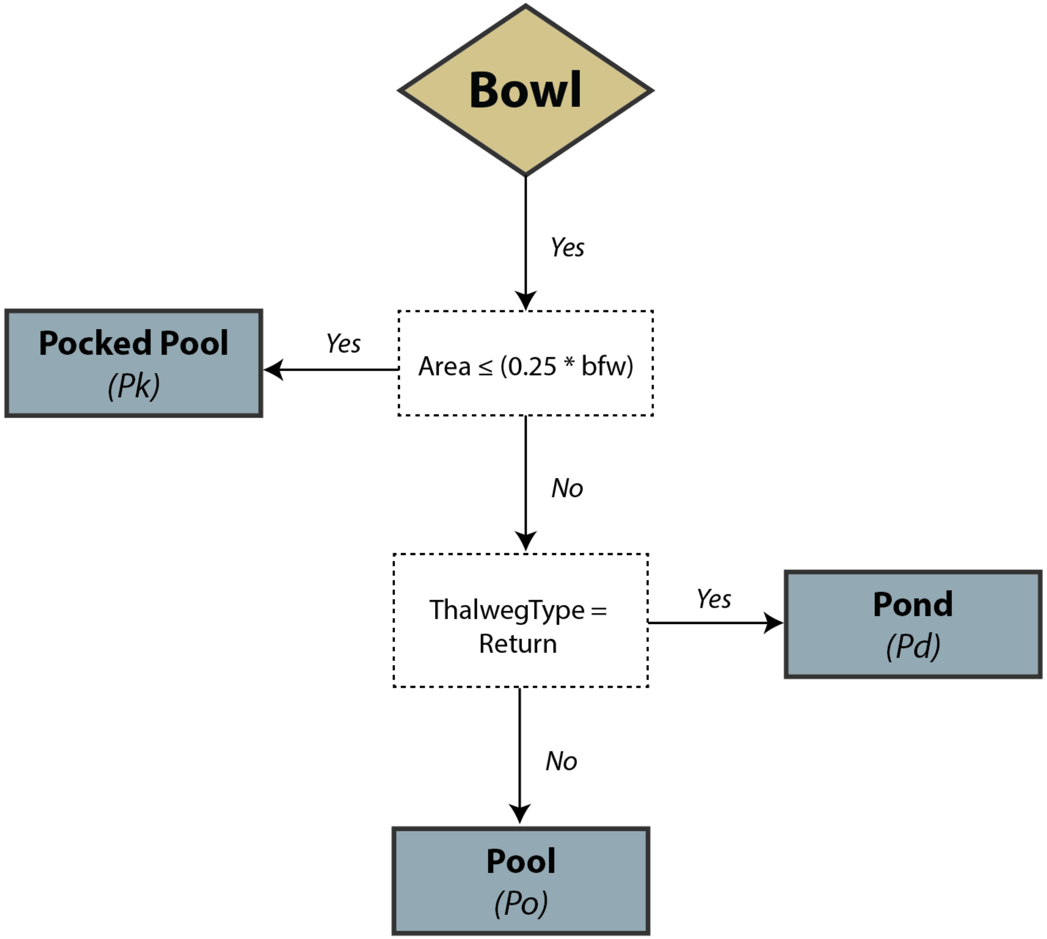
Tier 3 Classification

Calculate metrics for each Tier 2 form unit:

- Position (margin attached, mid-channel, channel spanning)
- Orientation (longitudinal, diagonal, transverse)
- Bankfull Surface Slope
- BFW Ratio (unit width / bfw)
- Channel Type (e.g., main, cut-off, return)
- Elongation Ratio (metric indicating how elongated/skinny unit is)

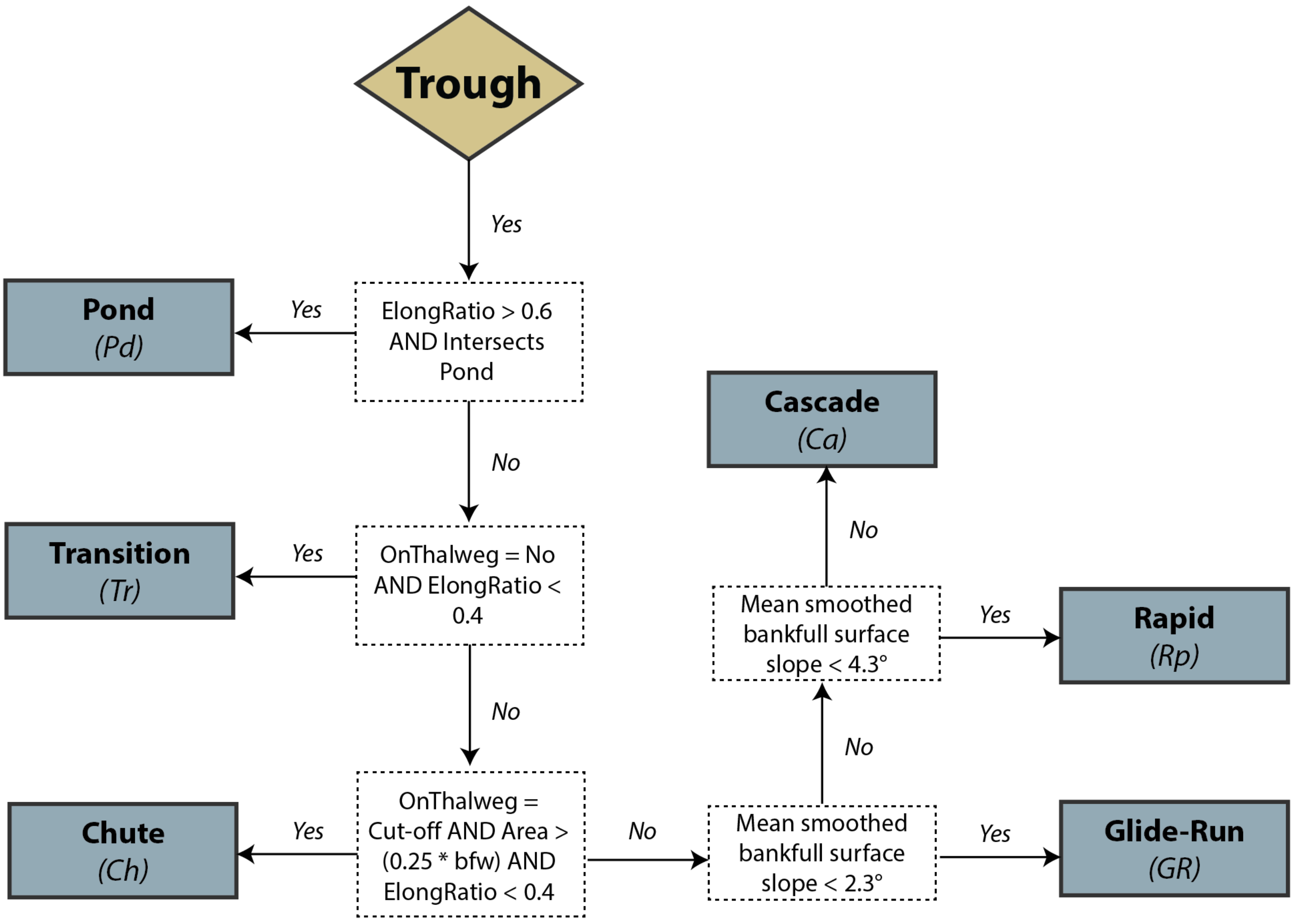
Tier 3 Classification Keys

GUT Tier 3 GU Key: *Bowls*



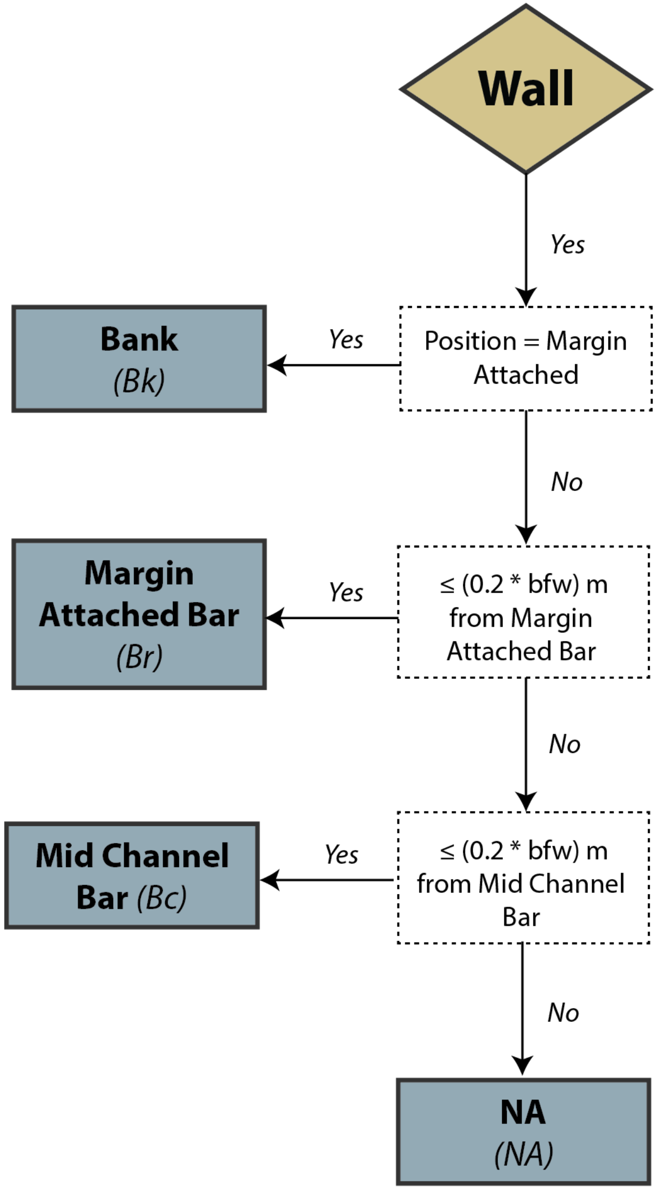
Tier 3 Classification Keys

GUT Tier 3 GU Key: *Troughs*

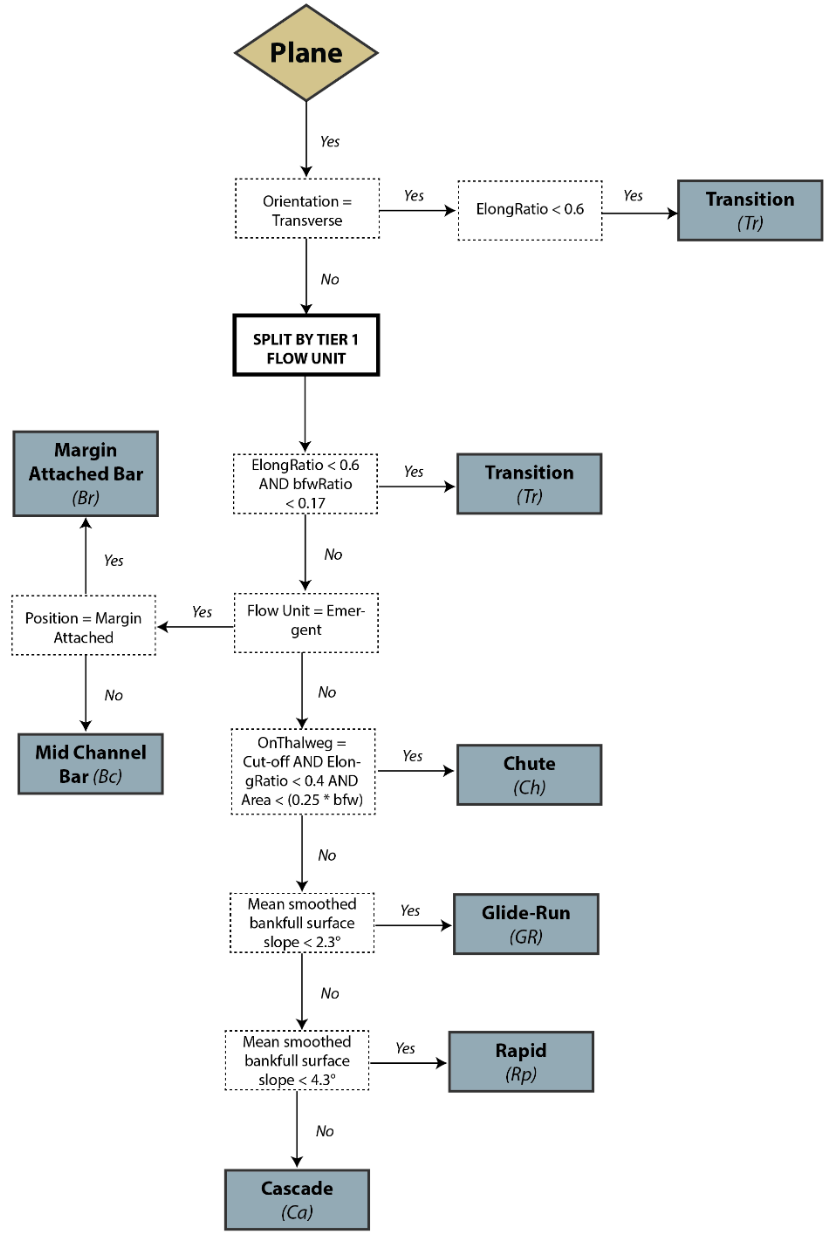


Tier 3 Classification Keys

GUT Tier 3 GU Key: *Walls*

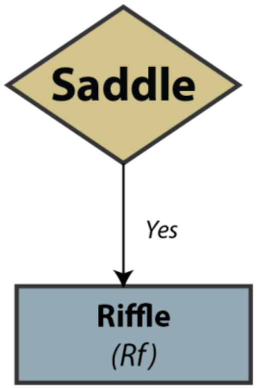


GUT Tier 3 GU Key: *Planes*

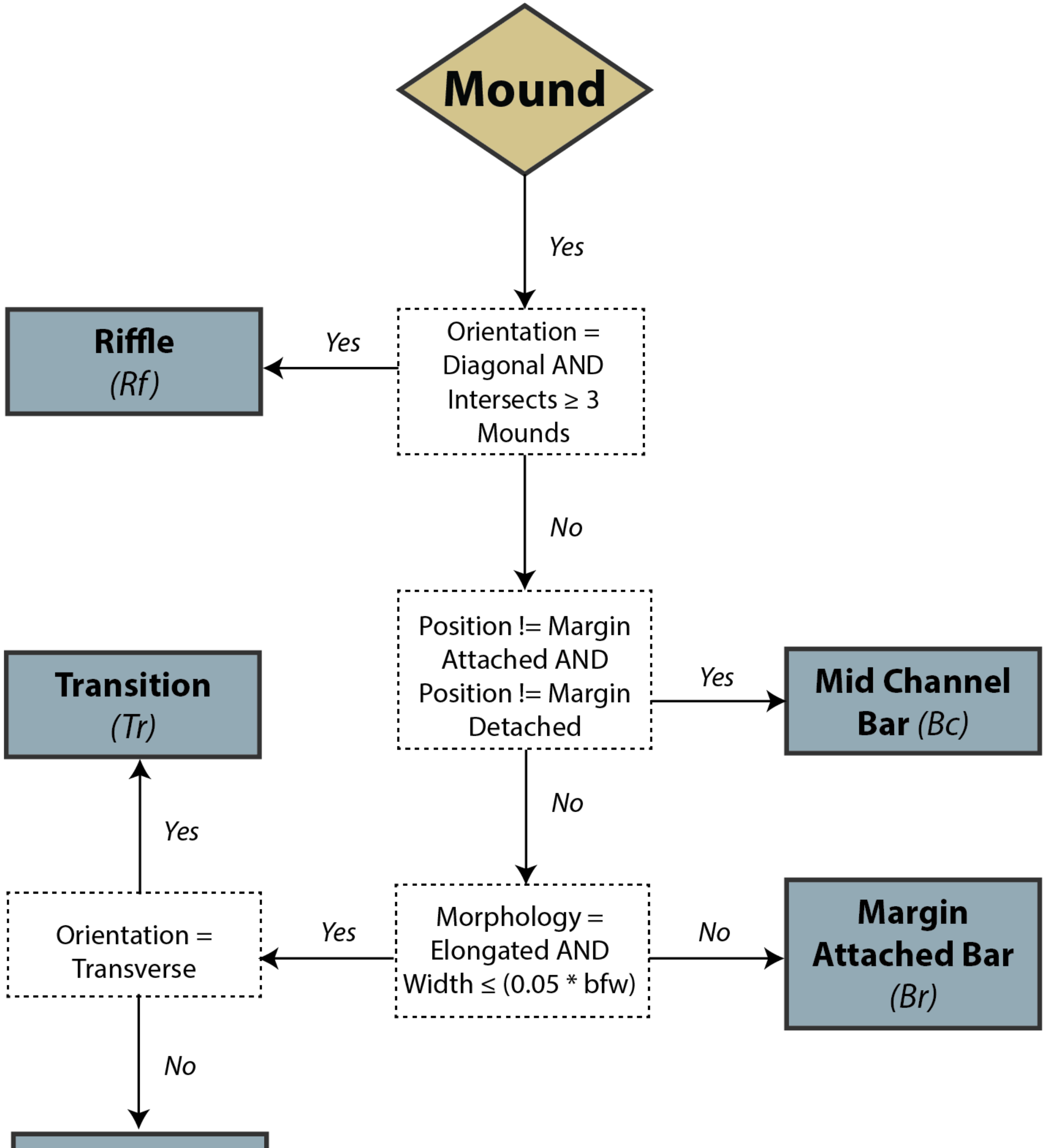


Tier 3 Classification Keys

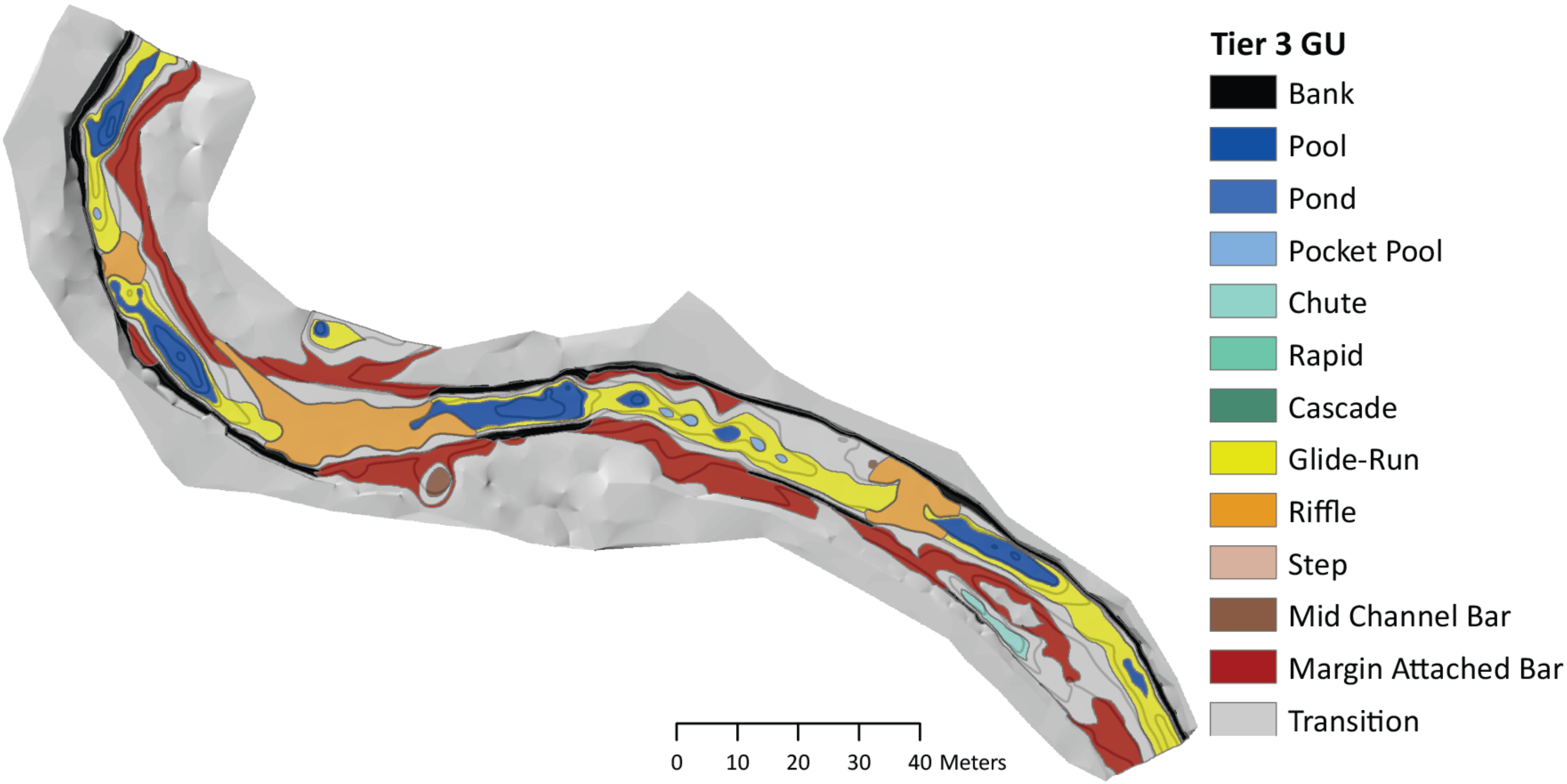
GUT Tier 3 GU Key: *Saddles*



GUT Tier 3 GU Key: *Mounds*



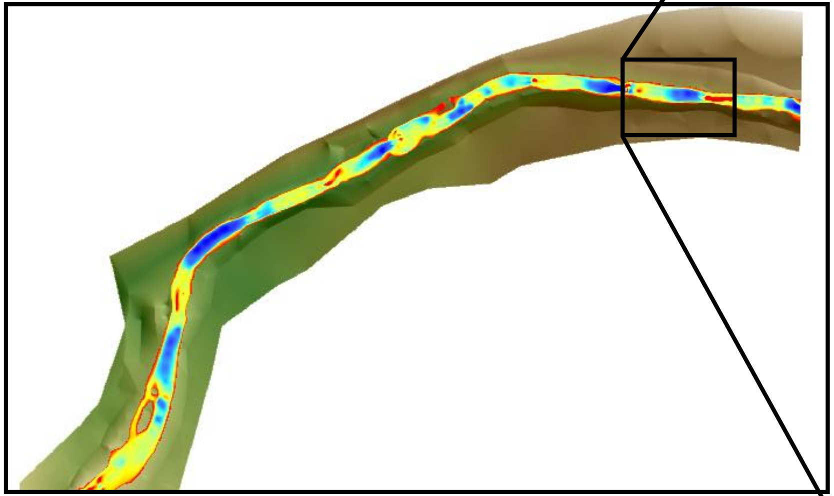
Tier 3 Classification

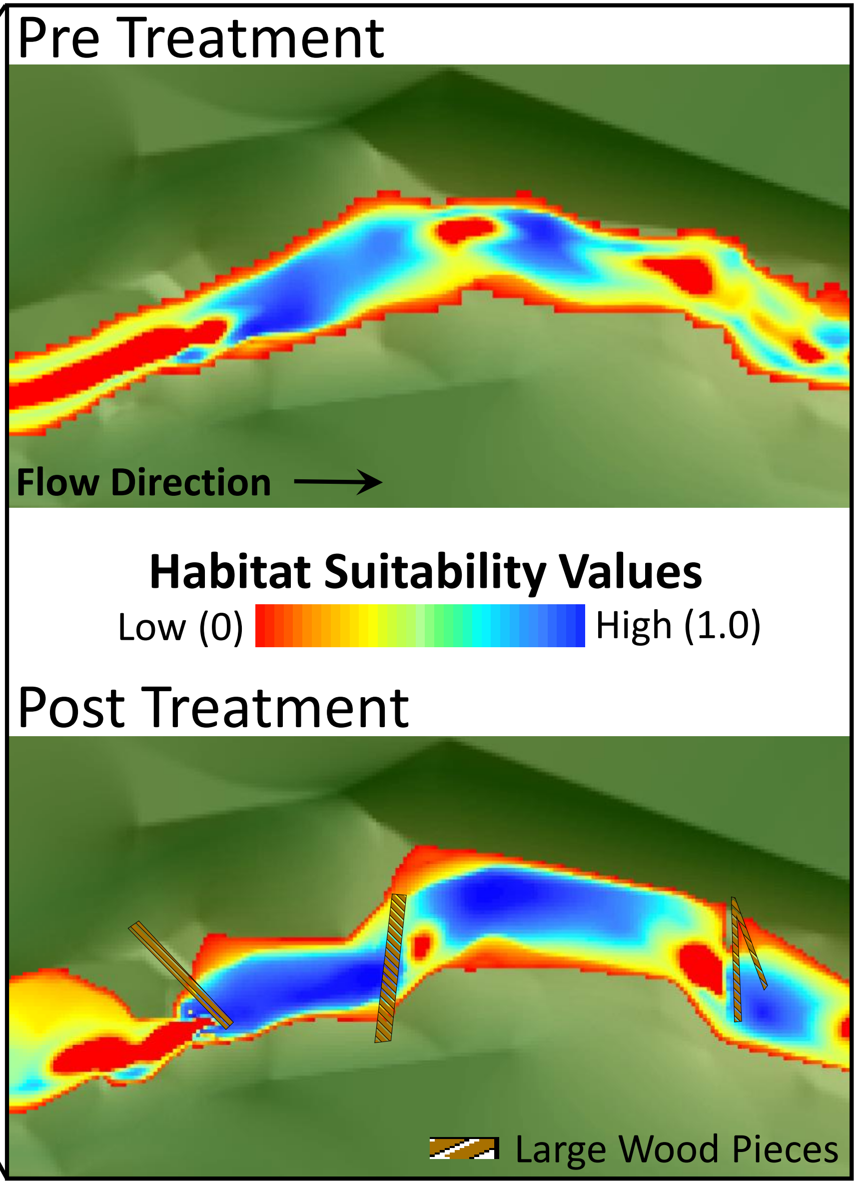


Habitat Suitability Model Outputs

Spatial Results:

- Continuous HSI values on a 0.10 x 0.10m cell basis





Habitat Suitability Model Outputs

Site Summary Metrics:

- Weighted Usable Area (WUA)

$$WUA = \sum_{i=1}^{n} Suitability_i * Area_i$$

- Normalized WUA
  - WUA/Area
  - standardized, easier to compare among sites/basins

Individual Cell Area = 0.1 x 0.1 = 0.01 m^2

WUA = ((0.439 x 0.01) + (0.426 x 0.01) + 0.354 x 0.01) + (0.336 x 0.01) + (0.238 x 0.01) + (0.211 x 0.01))

= **0.02004**

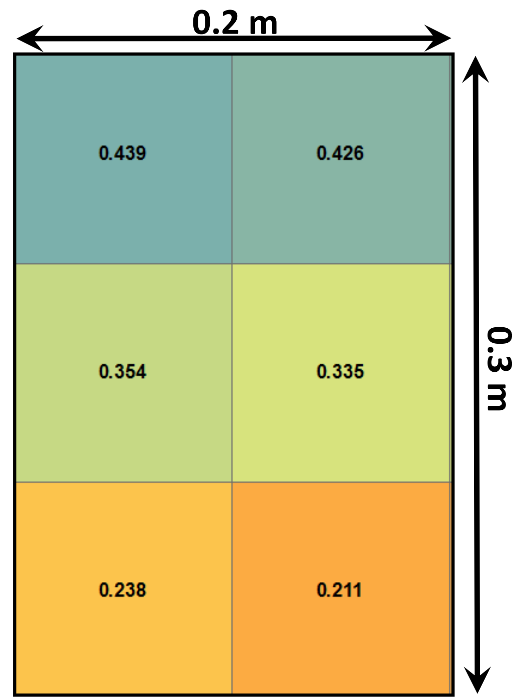
Habitat Suitability Model Outputs

Site Summary Metrics:

- Weighted Usable Area (WUA)

$$WUA = \sum_{i=1}^{n} Suitability_i * Area_i$$

- Normalized WUA
  - WUA/Area
  - standardized, easier to compare among sites/basins



Total Area = 0.2 x 0.3 = 0.06 m^2

WUA = 0.02004

NWUA = 0.02004/0.06 = **0.334**

Goals & Objectives
Ecological Concerns

Restoration Goals (Lower and Upper Tucannon Assessment Units)

Ecological Concern	Target	Metric Description
Water Temperature	< 4 days > 72 F	summer water temperature
Large Woody Debris	> 1 key piece/width	$\geq$ 0.3 m diameter and $\geq$ 6 m long
Riparian Condition	> 40 to 75% of max	riparian cover
Channel Confinement	<25 to 50%	confinement of stream bank length

In addition, we need to see a 17% improvement in overall habitat conditions as identified by the gap analysis in the 2008 FCRPS BiOp

Eco
Logical
Research