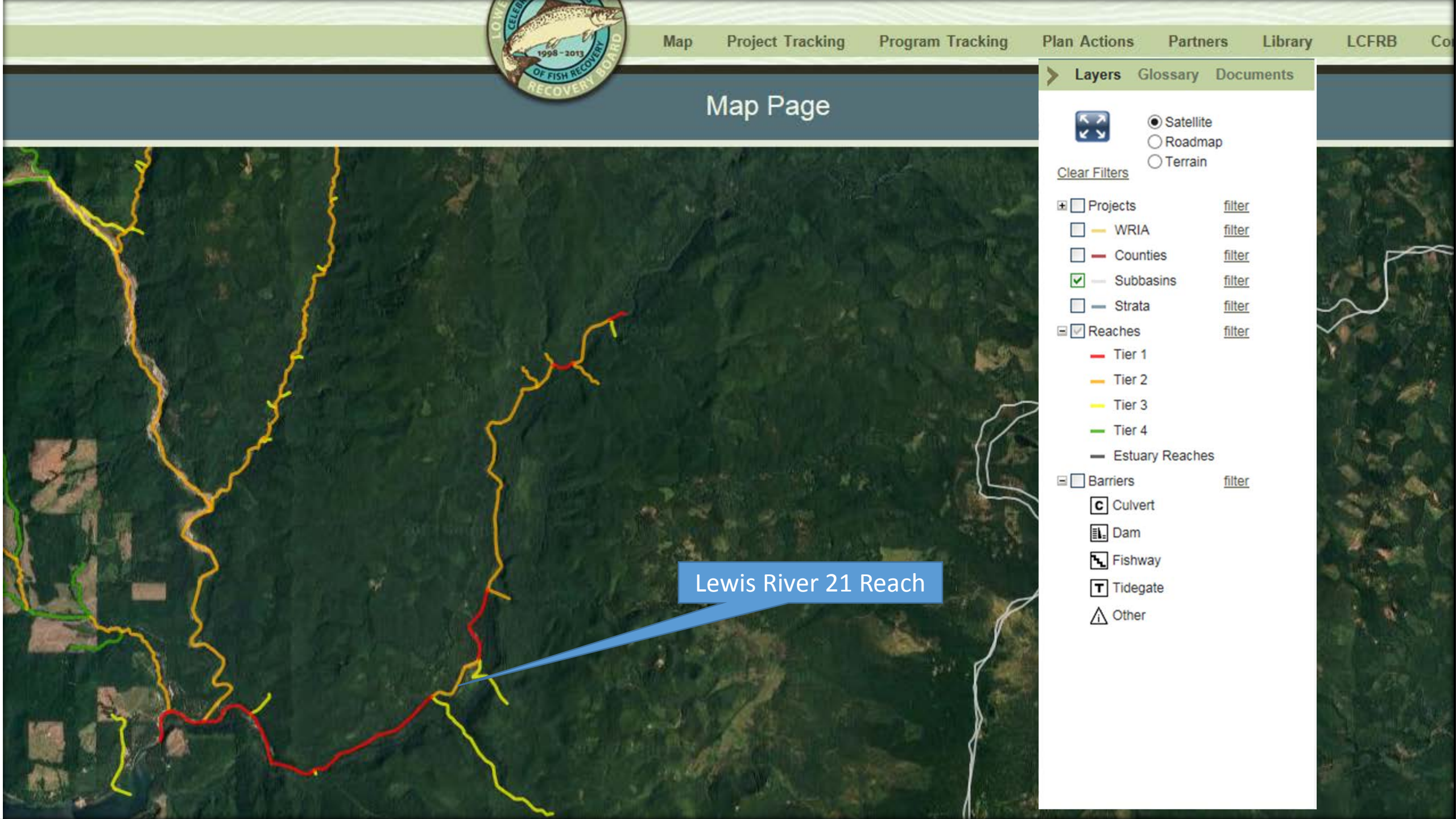
Lewis River 21 Phase II
Full Proposal Presentation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Fishway
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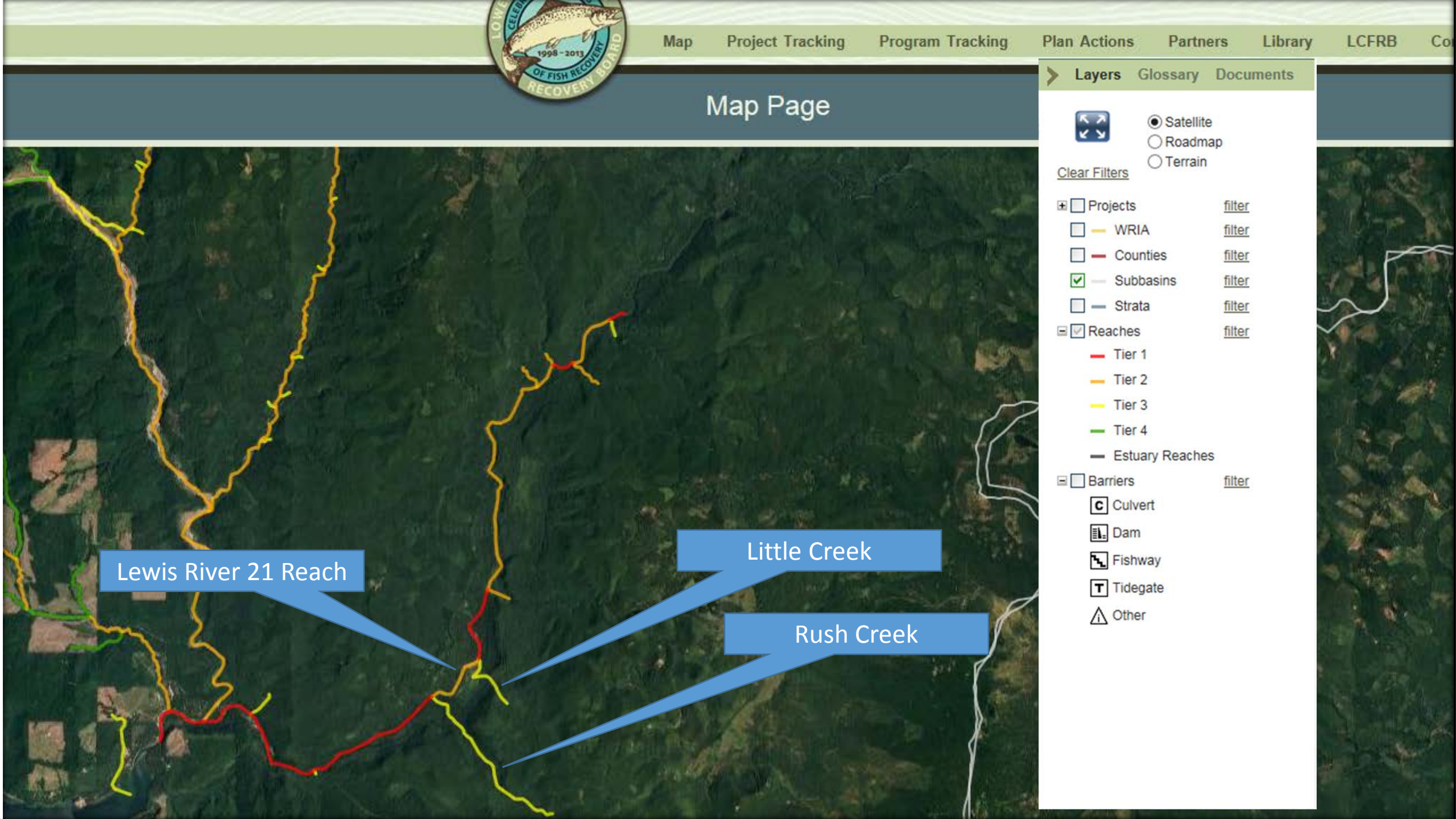
Other
Lewis River 21 Reach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Barriers
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Culvert
Dam
Fishway
Tidegate
Other
Lewis River 21 Reach
Little Creek
Rush Creek

Limiting Life History and Habitat Factors for Upper Lewis River Spring Chinook (LCFRB 2010)

- Limiting life history factors
  - Egg incubation and age 0 summer rearing
- Limiting habitat factors
  - Channel stability
  - Sediment
  - Key habitat

Limiting Life History and Habitat Factors for Upper Lewis River Spring Chinook (Cramer Fish Sciences 2016)

- **Limiting life history factors**
  - **Summer rearing in littoral zones and adult spawning**
- **Limiting habitat factors**
  - **EDT modeling indicated sediment load was a limiting factor for Lewis River 21 reach**

Limiting Life History and Habitat Factors for Upper Lewis River Spring Chinook (D.J. Warren and Associates, ICF International 2016)

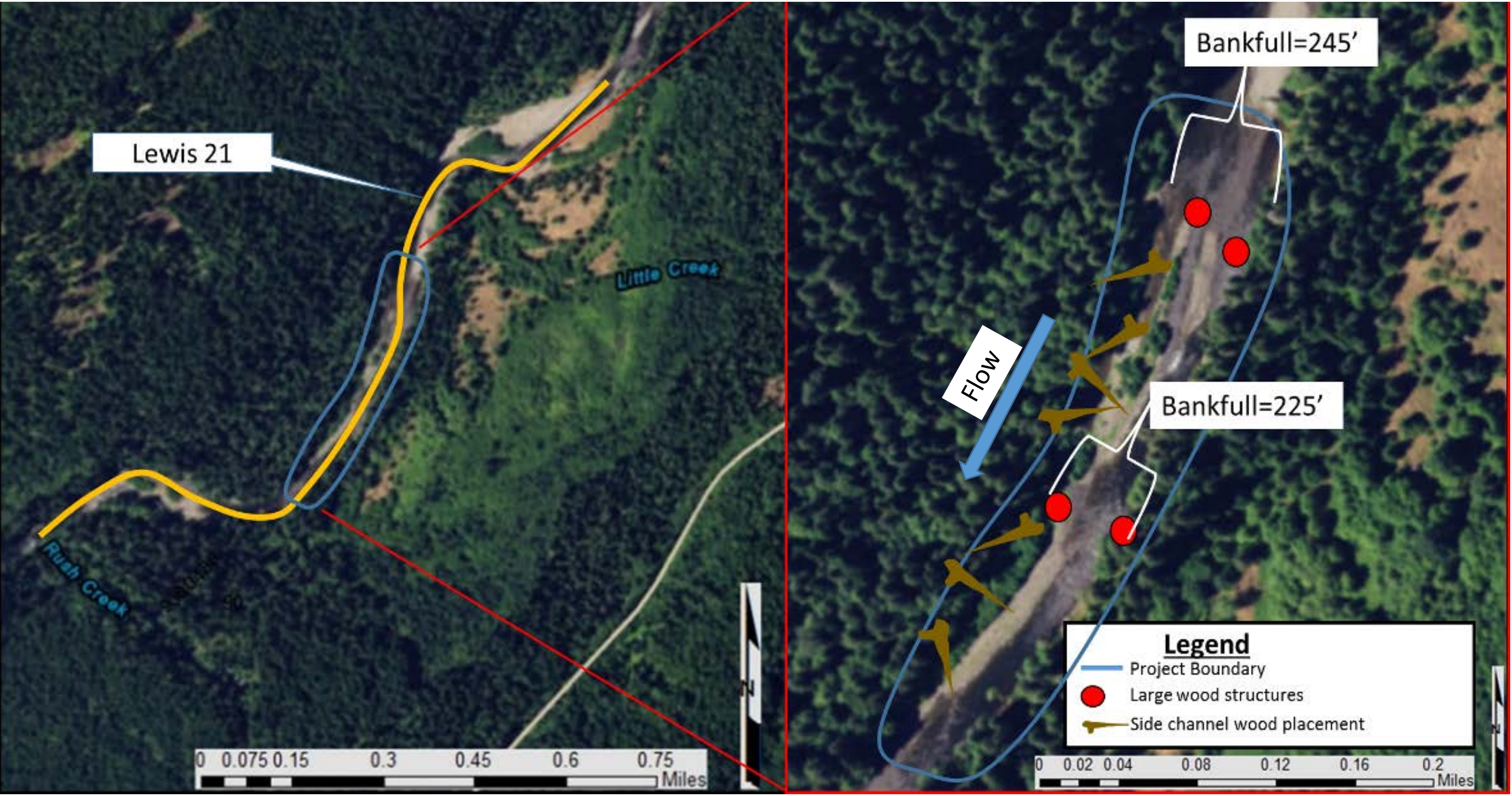
- **Limiting life history factors**
  - **Summer rearing**

- **Limiting habitat factors**
  - **Key Habitat – defined as**

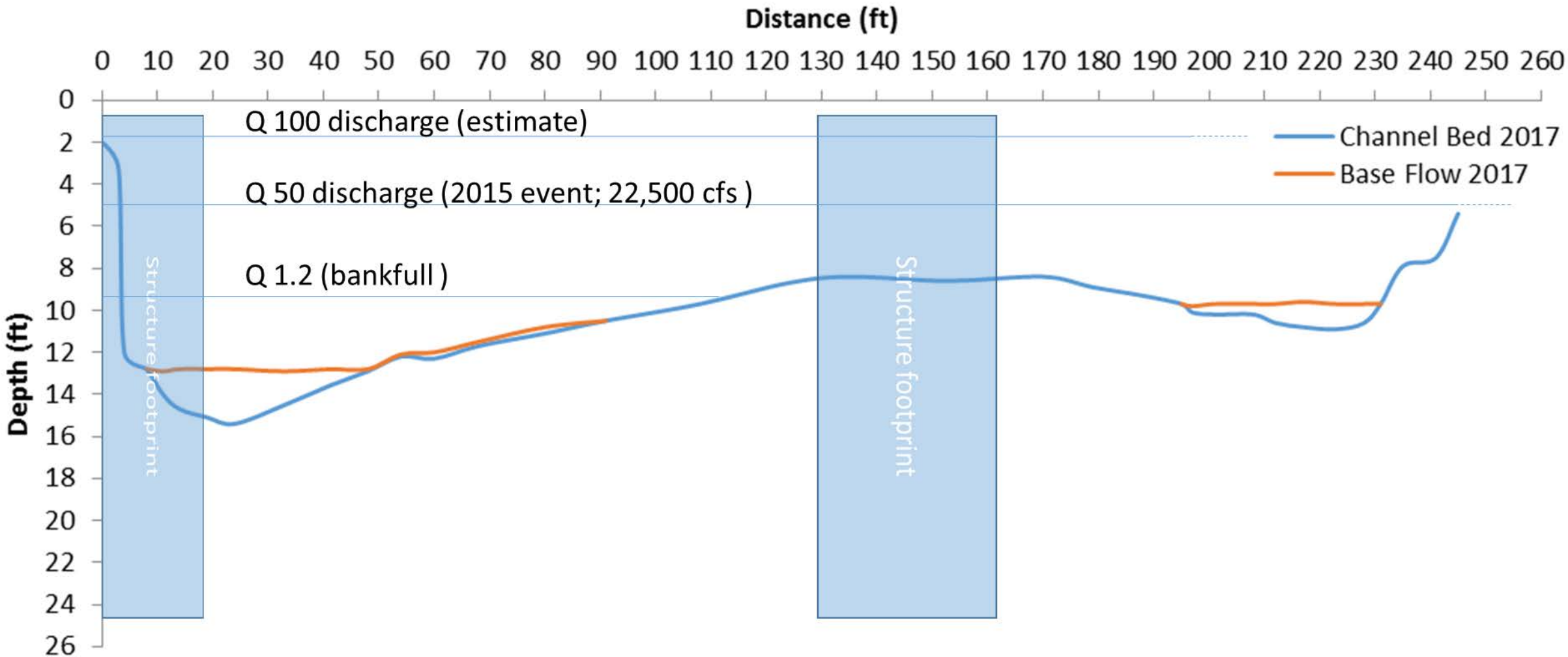
  “The relative quantity of the primary habitat type(s) utilized by the focus species during a life stage; quantity is expressed as percent of wetted surface area of the stream channel”.

Project Objectives

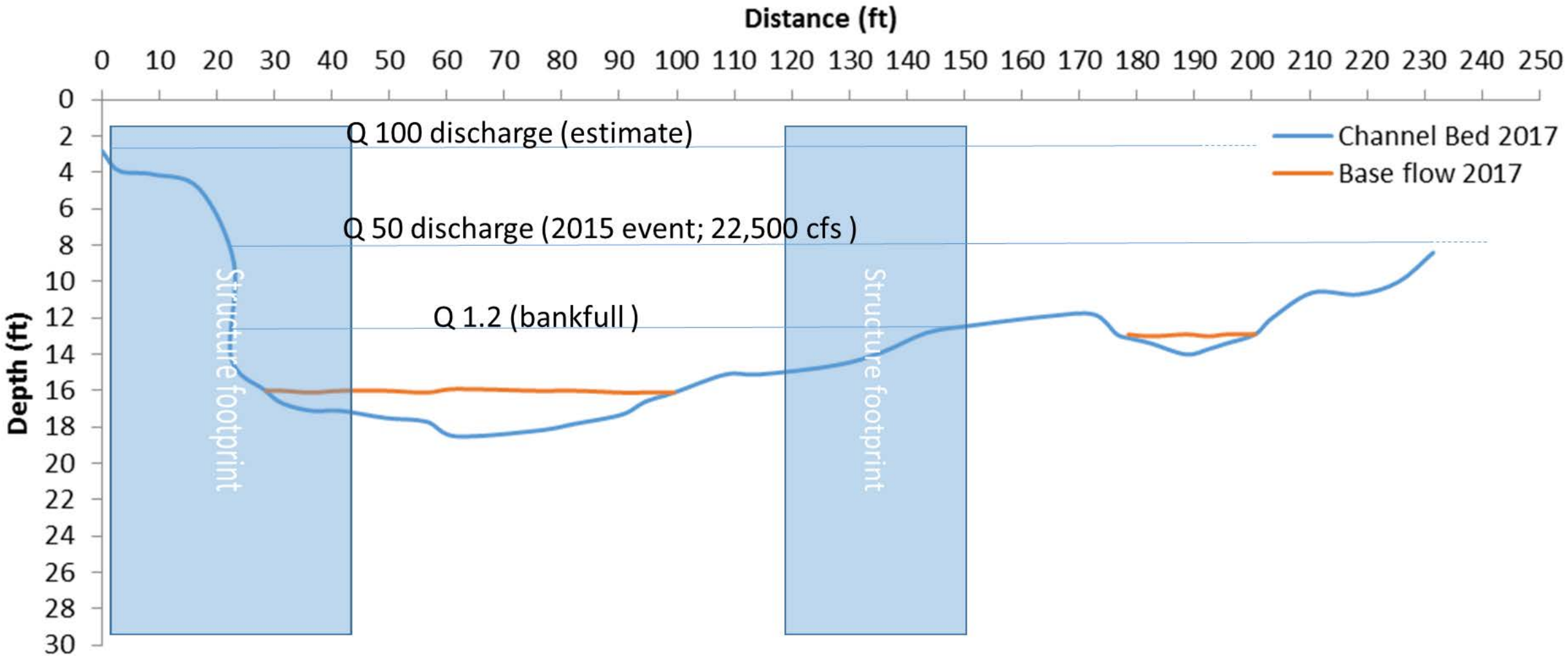
- **Stream Channel Habitat Structure**
  - Improve bank stability, sediment routing and sorting, pool formation and maintenance
- **Off Channel and Side Channel Habitat**
  - Improve summer and winter rearing habitat
- **Floodplain Function and Channel Migration Processes**
  - Improve high flow access to floodplain and allow for functional stream process evolution

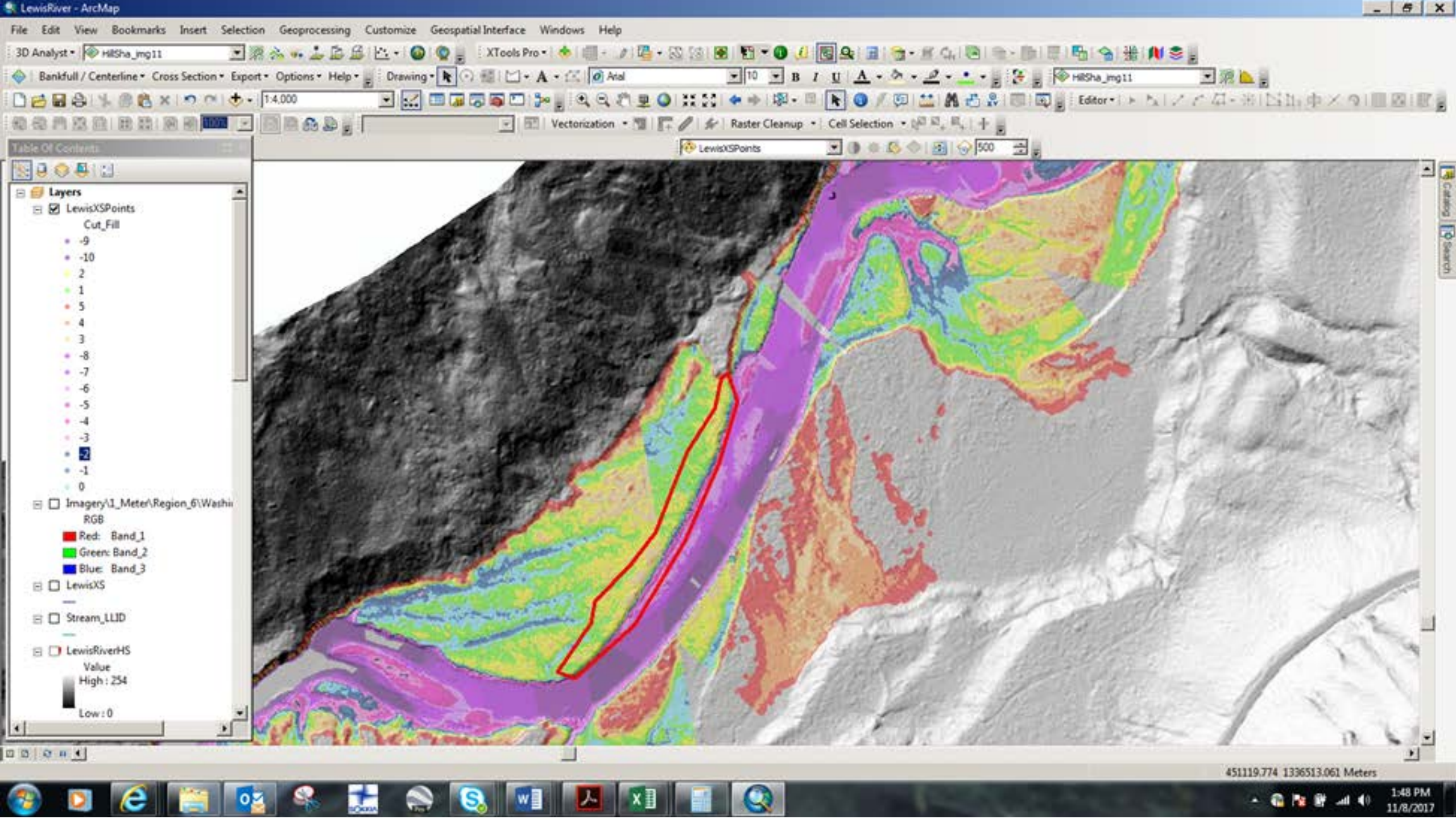

Lewis 21
Little Creek
Rush Creek
0 0.075 0.15 0.3 0.45 0.6 0.75
Miles
Bankfull=245’
Flow
Bankfull=225’
Legend
Project Boundary
Large wood structures
Side channel wood placement
0 0.02 0.04 0.08 0.12 0.16 0.2
Miles

LR 21 Phase II upstream Apex Jam



LR 21 Phase II downstream Apex Jam

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Structure Types

- **Margin Structure**
  - Provides habitat structure
  - Provides localized scour
- **Gravel Bar or Apex Structure**
  - Reduces cross-sectional area of channel and maintains side channel flow
  - Provides gravel deposition from reduced upstream hydraulic gradient when used in combination with structures on the margins of the channel.
  - Increases floodplain function

Addressing Potential Failure Modes

Using Niezgoda and Johnson (2007), Potential Failure Modes and Associated Design Checks are identified for each structure type.

A two-step method of incorporating uncertainty and risk in stream restoration design as a combination of design failure modes, effects analysis (Design Failure Mode and Effects Analysis), and risk quantification.

Reference:

Niezgoda, S.L., and *Johnson*, P.A. *2007*. Case study in cost-based risk assessment for selecting a stream restoration design method for a channel relocation project. Journal of Hydraulic Engineering, Vol. 133 (5), 468-481

Example of Margin Structure Design Checks

Treatment	*Potential Failure Mode*	*Potential Effects of Failure*	*Potential Causes or Mechanisms*	**Risk Priority #, (1-10, 1-low, 10-high)*	*Design Checks*
Margin Structures	Burial by Incoming Sediment	Project Not Effective	Insufficient Design and Placement Considerations	3	Allowable Shear Stress Check
	Rapid Lateral Migration	Property or Infrastructure Damage	Improper Design Specifications	5	Design Experience and Construction Oversight
	Erosion of opposite Bank	Minimal, some sediment input	Improper Design, Placement or Alignment	2	Design Experience
	Structure Displacement	Minimal, reduce design effectiveness	Improper Material Sizing, or Design	3	Use Largest Cost Effective Materials
	Excessive Scouring of Bed	Potential to cause structure failure	Improper Design	7	Follow Design Guidelines for Structures, Scour/

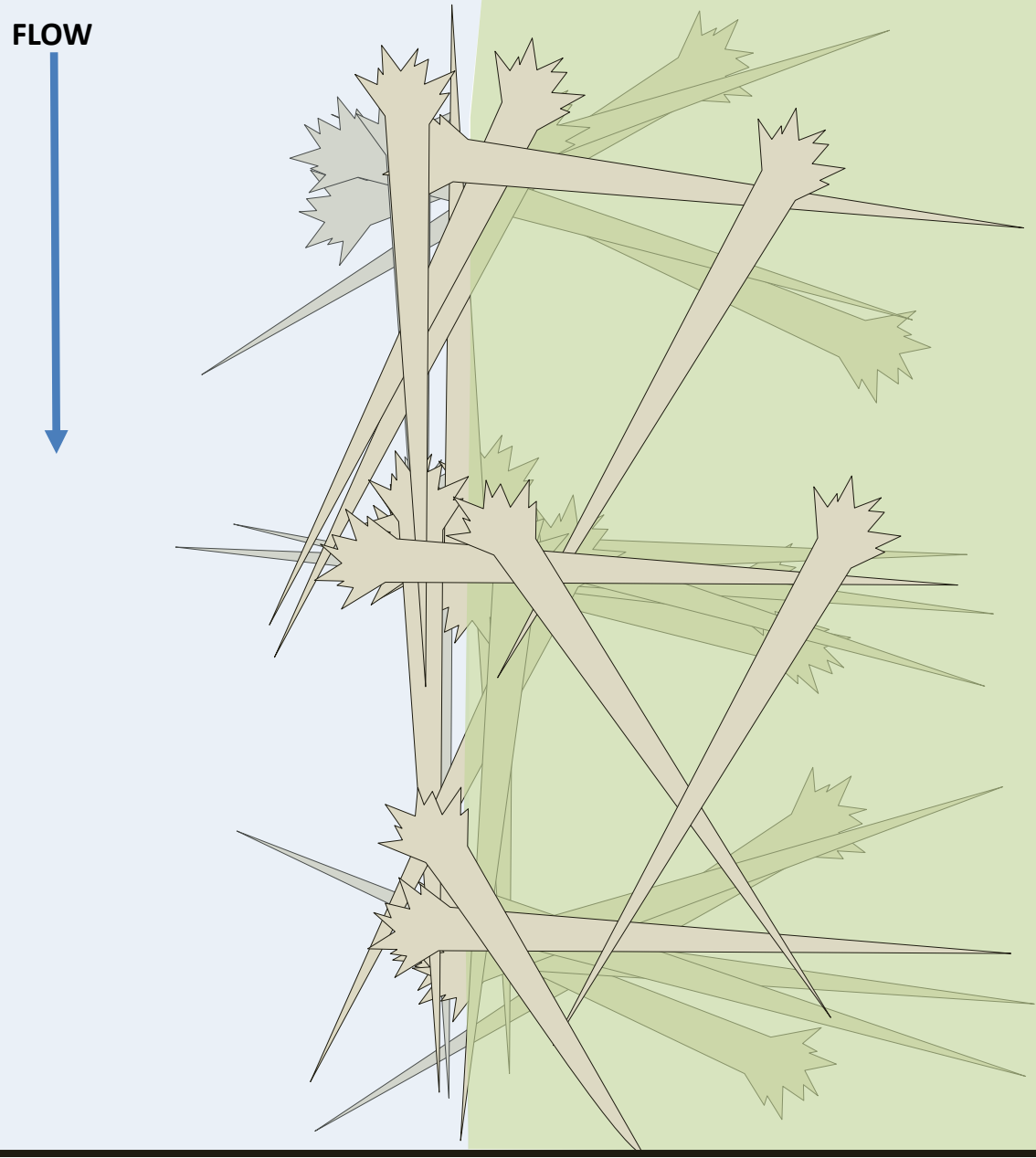
Lewis River 21 Design to reduce the risk of Structure Displacement for Margin Structures

- Key pieces (largest and longest LWD available) are used for soil and rock ballasted framework.

- Design concept has shown effectiveness on similar rivers in the Pacific Northwest. Each trenched key piece is anchored together to make a structural frame.

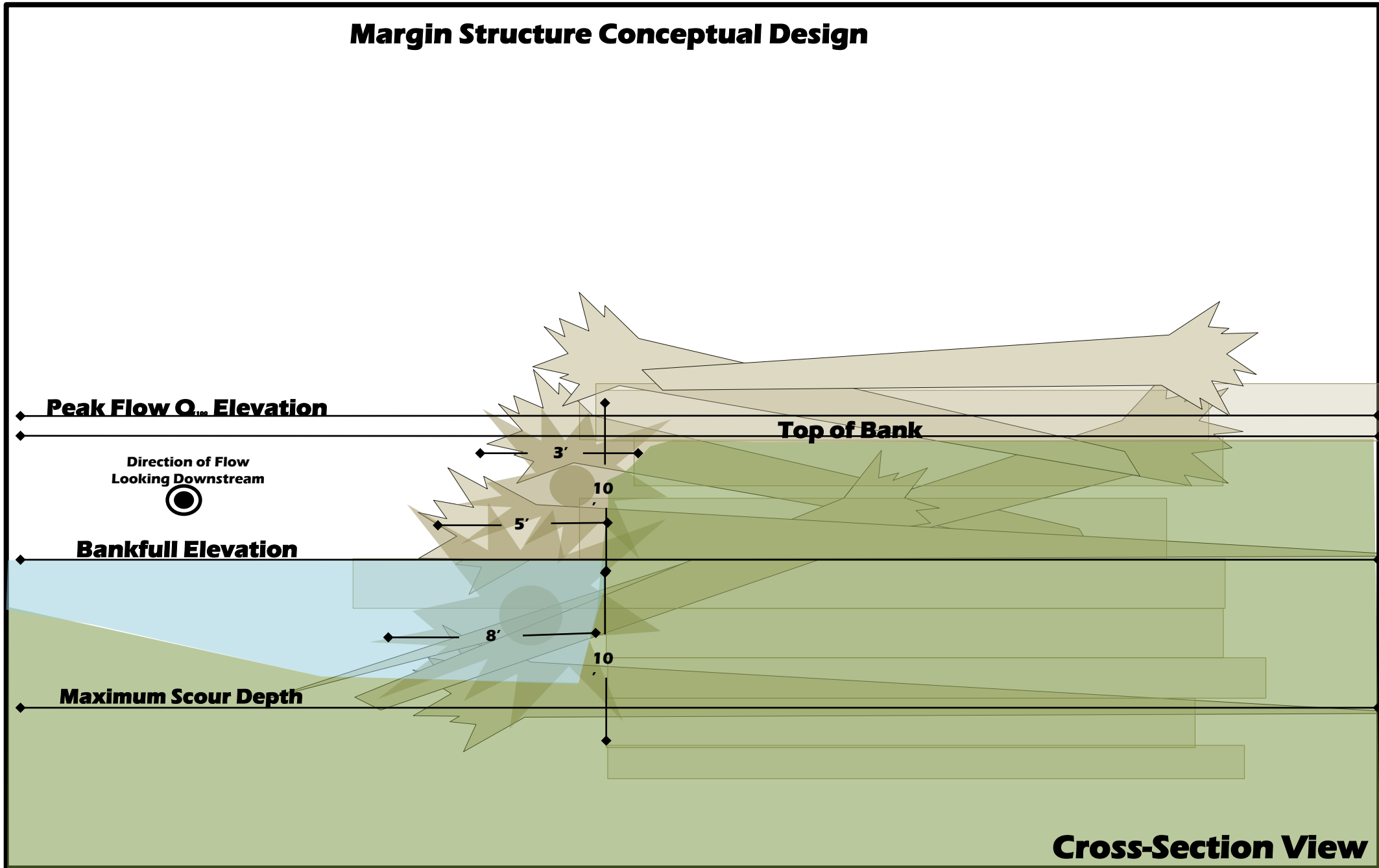
Margin Structure Conceptual Design

Structures 1a, 1b, 1c



Lewis River 21 Design to address the risk of Excessive Bed Scour for Margin Structures

- Structure depth will exceed max scour
- Proper location placement and design has shown to be effective in similar Pacific Northwest rivers.

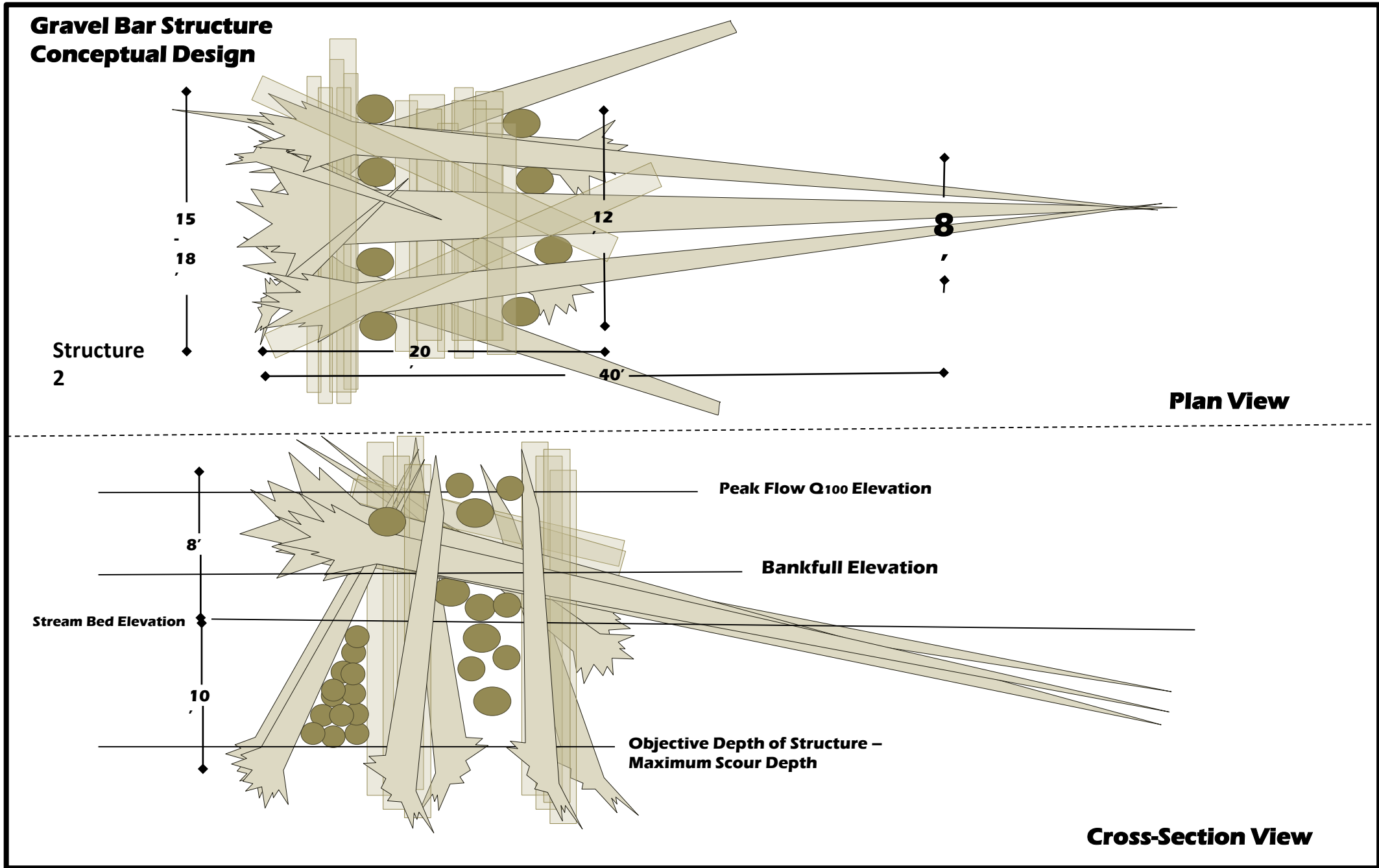


Example of Gravel Bar and Point Bar Structure Design Checks

Treatment	*Potential Failure Mode*	*Potential Effects of Failure*	*Potential Causes or Mechanisms*	**Risk Priority #, (1-10, 1-low, 10-high)*	*Design Checks*
Gravel Bar and Point Bar Structures	Burial by Incoming Sediment	Minimal	Insufficient Design Capacity	3	Allowable Shear Stress Check
	Rapid Lateral Migration	Property or Infrastructure Damage	Improper Design, Placement or Alignment	5	Design Experience and Construction Oversight
	Erosion of opposite Bank	Minimal, some sediment input	Improper Design, Placement or Alignment	2	Design Experience
	Structure Displacement	Potential to cause structure failure	Improper Design	7	Follow Design Guidelines for Structures

Lewis River 21 Design to reduce risk of Structure Displacement

- Structure depth will exceed max scour depth. Differing site conditions may require field
- Proper location placement and design has shown to be effective in similar rivers in the Pacific Northwest.



NF Lewis River Alcove and Side Channel Project (2016). Photo December 2017