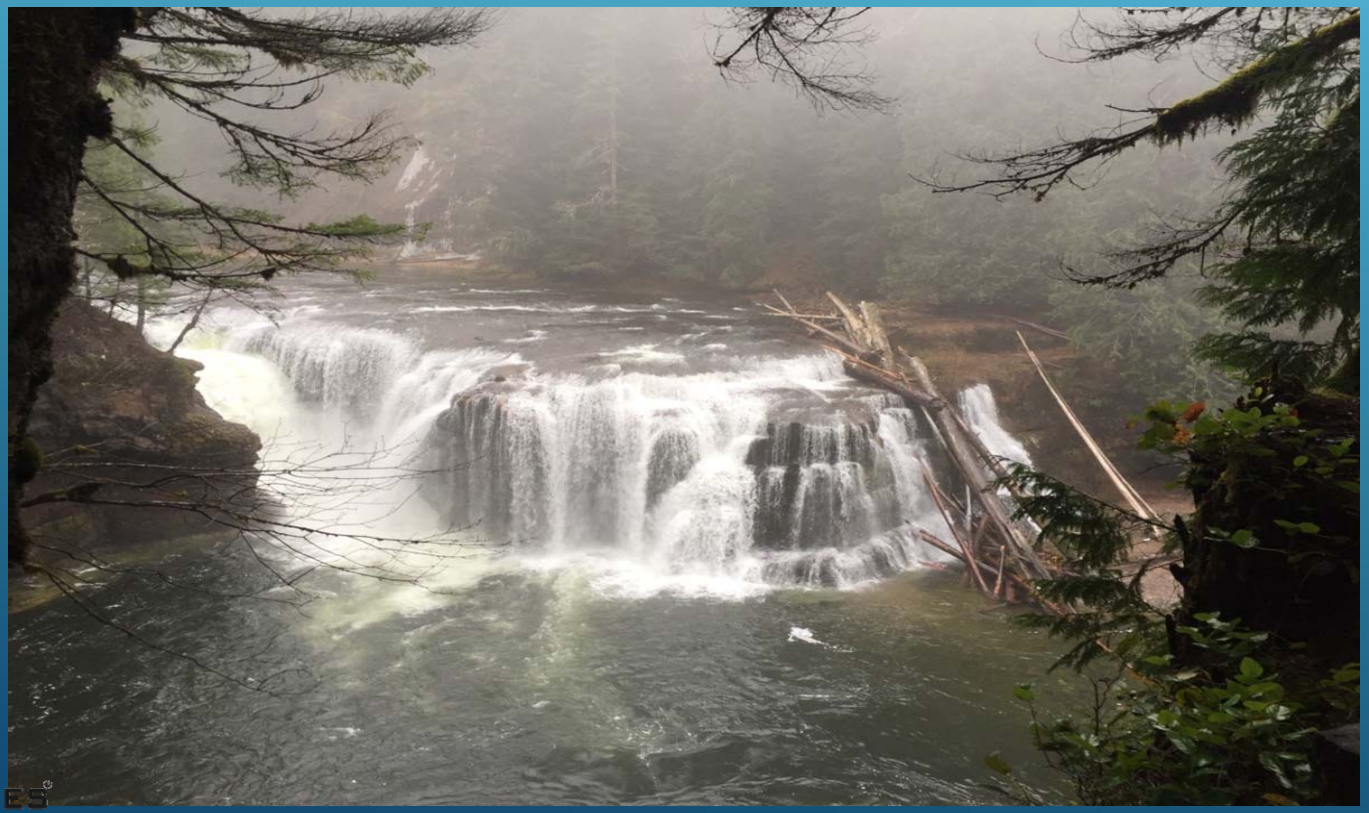
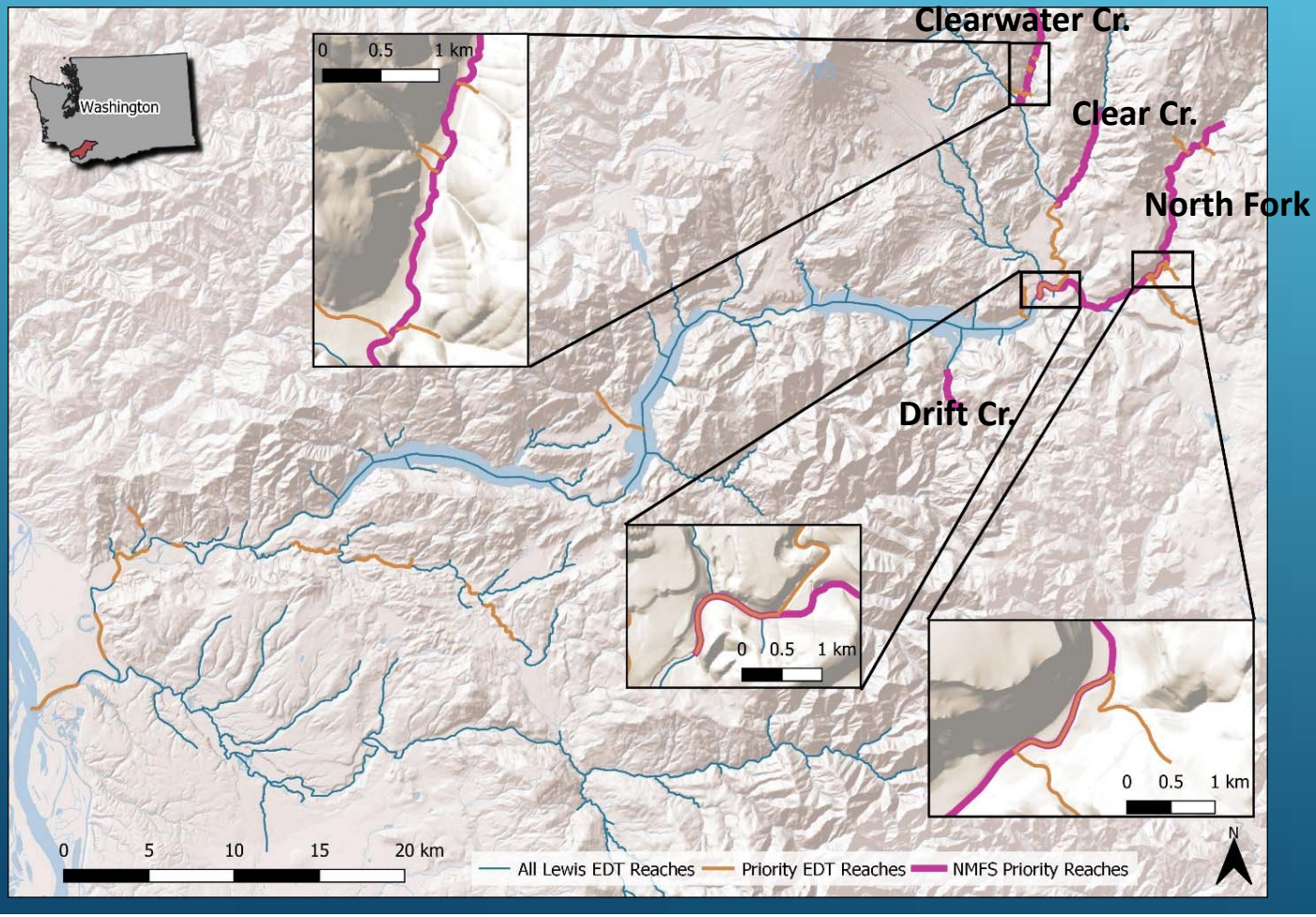
Draft Lewis River Basin Implementation Monitoring Plan

for the In Lieu restoration Plan

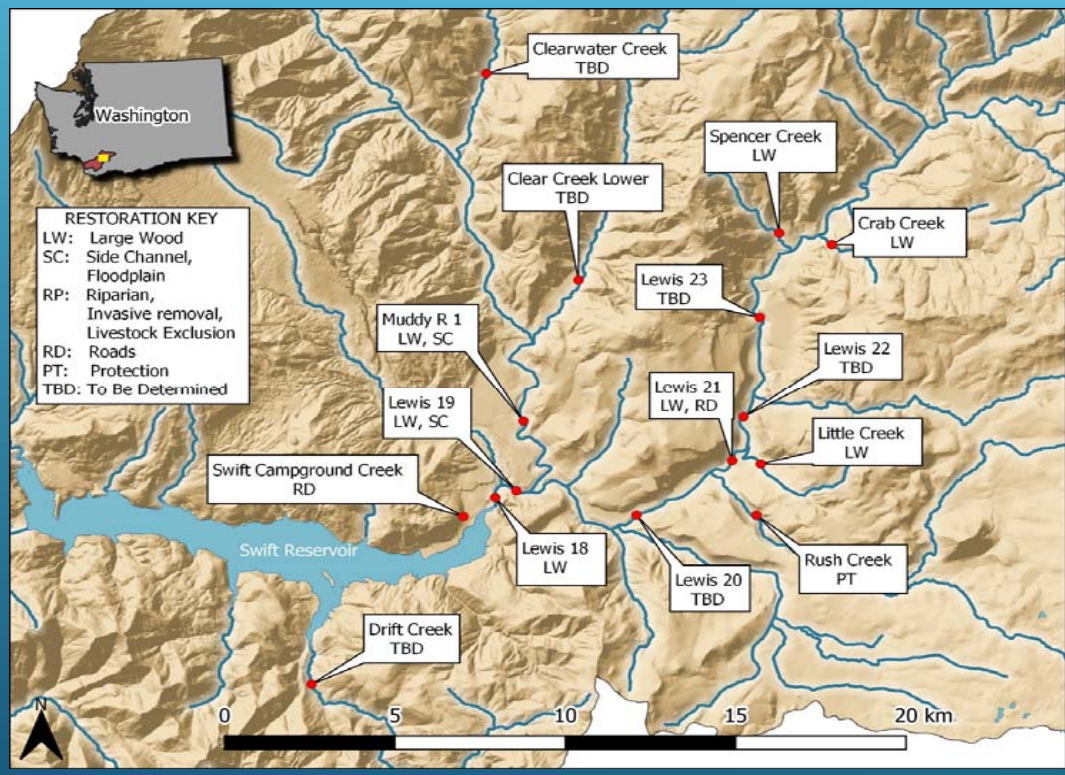


In Lieu Habitat Restoration Plan



Initial Proposed Restoration Treatments

- Floodplain restoration to create and reconnect side channels
- Large wood (LW) placement to increase pools, complexity, & cover
- Riparian planting to increase shade and organic material
- Road removal or restoration to reduce instream sediment



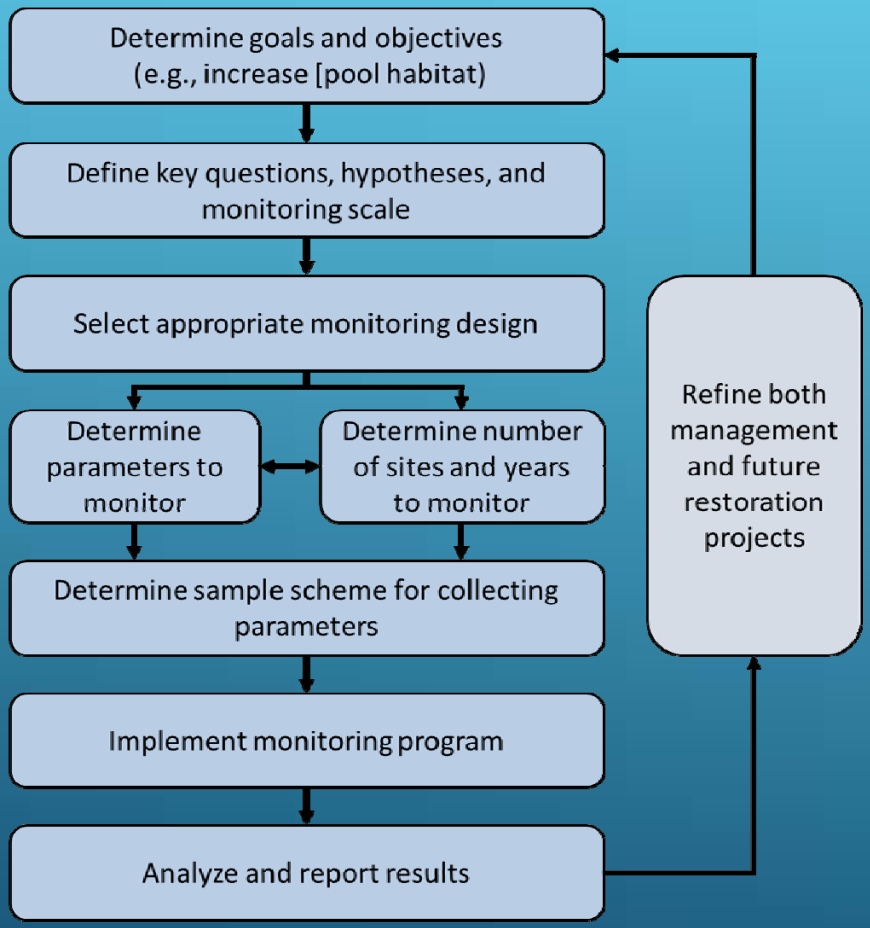
Implementation Monitoring

Monitoring types	Objectives	Examples
Implementation (compliance)	**Determines if project was implemented as planned**	**Did contractor place number and size of logs as described in plan?**
Effectiveness	**Determines if actions had desired effects on watershed, physical processes, or habitat**	**Did pool area increase?**
Validation	Evaluates whether the hypothesized cause and effect relationships between restoration action and response (physical or biological) were correct	Did change in pool area lead to desired change in fish or biota abundance?

* Status and trend monitoring can also provide useful information on project effectiveness

Outline – Monitoring Plan

- Goals
- Questions
- Design(s)
- Parameters
- Implementation
- Reporting
- Next steps



Roni and Beechie 2013

Goals

- In Lieu Plan (ILP)
  - Increase adult Chinook salmon, coho salmon, and winter steelhead abundance in the North Fork of the Lewis River
  - Achieve genetically viable, self-sustaining, naturally reproducing, harvestable populations above Merwin Dam greater than minimum viable populations.

- ILP Monitoring Program
  - **Determine whether restoration projects were built as intended and have met their design and physical habitat objectives, both at the project level and reach scale.**

Monitoring Questions

- **Large wood and floodplain projects**
  - Implementation - Was each project implemented as originally designed and if not, why? Did each project have the desired physical response within the target time frame, e.g., 3-5 years post-treatment?
  - Effectiveness - Is the suite of projects implemented across a reach (~2 to 10 kilometers in length) leading to desired improvements in physical habitat (pool and side channel area) across response reaches?

Validation Monitoring

- Large wood and floodplain projects
  - Validation Monitoring? For LW and floodplain restoration projects, has the number of juvenile fish increased in restored vs. unrestored reaches in summer or winter? (Validation Monitoring)

Monitoring Questions

- **Road removal or restoration projects**
  - Implementation - Was each project implemented as originally designed and if not, why?
  - Effectiveness - Have fine sediment levels, fine sediment infiltration, residual pool depth, and scour improved in downstream response reaches 3-5 years after road removal?
- **Riparian planting projects**
  - Is the number, location, and species of plantings consistent with the proposal and planting plan? If not, why?
  - What is the planting survival rate in years 3 and 5?
  - Has riparian cover, structure, and shade improved since project implementation?

Monitoring Approaches and Designs

Strength	Multiple before-after control-impact (mBACI)	Extensive post-treatment (EPT)	Intensively monitored watershed (IMW)	Hybrid
Can examine interannual variation in response?	Yes	No	Yes	Yes
Provides info on why some projects are more effective than others?	Yes	Yes	No	Yes
Results are broadly applicable?	Yes	Yes	No	Yes
Requires standardized data collection?	Yes	Yes	Yes	Yes
Length of monitoring (years)	5+	1-3	15+	3+
Cost (low, medium, or high)	H	M	H	M
Level (scale) of inference	Project & Program	Program	Program	Program

Selected Designs and Replication

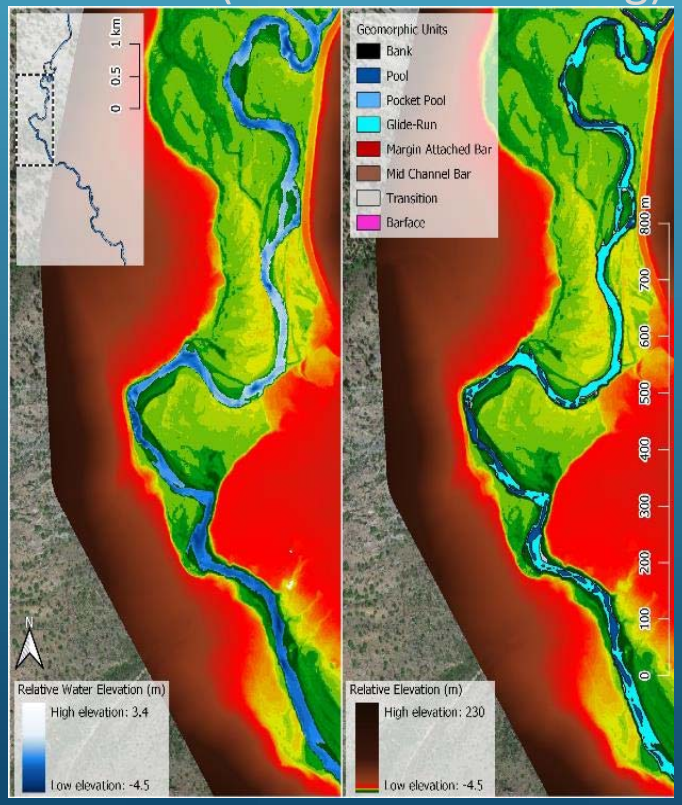
Restoration type	Question	Design	Scale	Years	Sites
Large wood	Implementation	BA	Project (site)	-1, 1	All (10+)
	Effectiveness	BACI	Reach	-1, 3, 5	All (10+)
	Validation	EPT	Reach	5	All (10+)
Floodplain	Implementation	BA	Project (site)	-1, 1	All (10+)
	Effectiveness	BACI	Reach	-1, 3, 5	All (10+)
	Validation	EPT	Reach	5	All (10+)
Road removal	Implementation	BA	Project (site)	-1, 1	All
	Effectiveness	BA	Reach	-2, -1, 3, 5, 10	All
Riparian planting	Implementation	BA	Project (site)	-1,1	All
	Effectiveness	BA	Reach	-1,3, 5, 7, 10	All

Parameters and Protocols

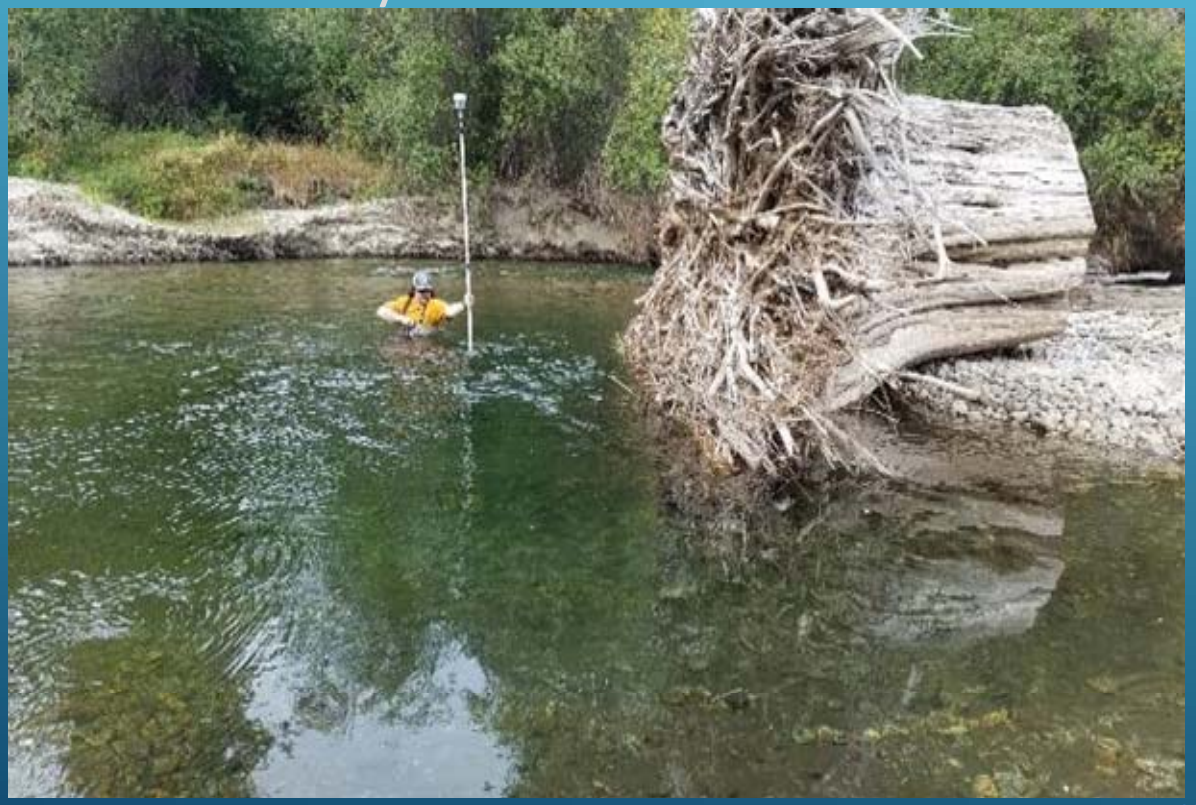
Restoration Type	Survey type (protocol)	Parameters and metrics
Large wood placement	Large wood	Number, length, width, volume, location, function
	Channel morphology and topography	Habitat type (e.g., pool, riffle, glide, cascade), area, and volume, residual pool depth
	Snorkel surveys	Juvenile fish abundance by species (fish/m^2) (Summer and Winter)
Floodplain restoration	Large wood	Number, length, width, volume, location, function
	Channel morphology and topography	Habitat type, area, and volume, residual pool depth; MQI, change in DEM, geomorphic change, GUT; side channel length, area, number of junctions, ratio, wetted area at bankfull flow
	Snorkel surveys	Juvenile fish abundance by species (fish/m^2) (Summer and Winter)
Road removal	Channel Morphology/Long-profile	Residual pool depth, Long-profile habitat survey
	Sediment (egg boxes, bulk samples, pebble counts)	Percent fines bulks samples, depth to fines (V*), scour and fine sediment infiltration, sediment size
Riparian planting	Plant survival	Planting survival, growth, browse damage

Methods – Remote sensing + traditional methods

- Lidar (drone or fixed wing)

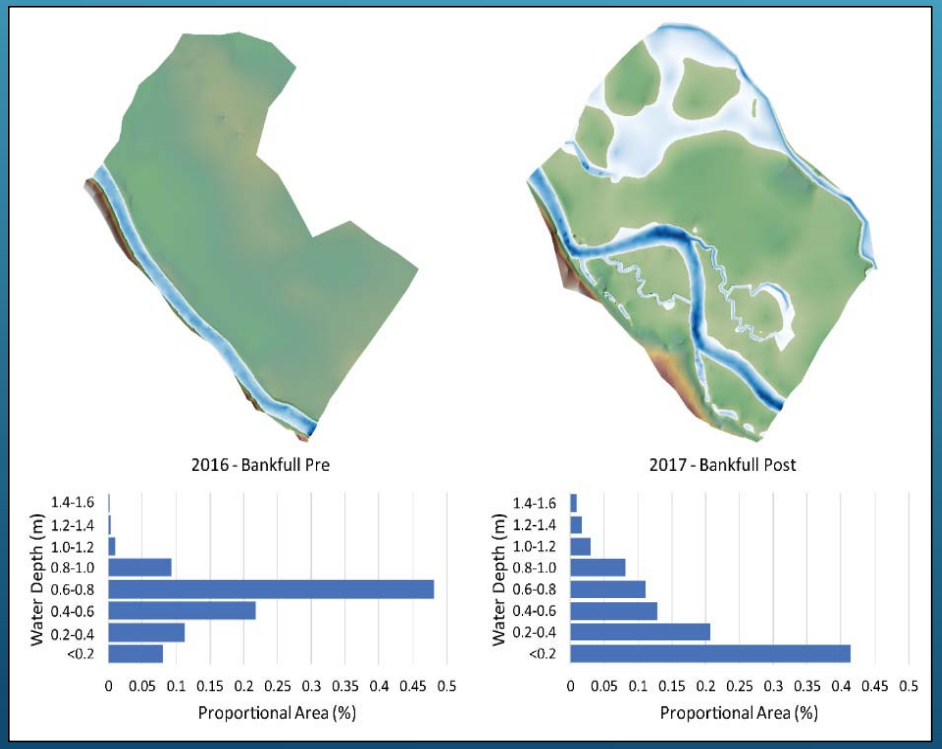


- Field surveys

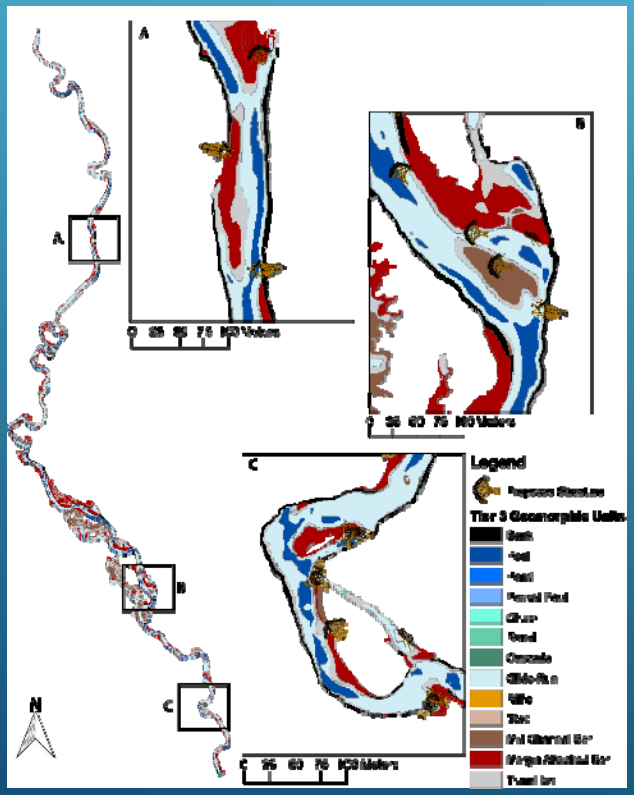


Example - Examining Topographic Data

- Geomorphic Change Tool



- Geomorphic Unit Tool



Data Analysis and Reporting

- BA and BACI
  - Mixed effects BACI model
- EPT
  - ANOVA/paired t-test
  - Correlation analysis
- Annual reports
  - Executive summary
  - Background
  - Methods
  - Results
  - Discussion
  - Adaptive management recommendations
  - References

Next Steps

- Finish Lewis River In Lieu Plan (ILP)
  - Select location and type of restoration (finish ILP)
  - Monitoring design in part dependent on specifics of ILP
- Finalize design based on specifics of ILP
- Refine field methods and sampling methods
- Begin collecting baseline/pre-project data