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inc.

Floodplain Restoration with Large Wood

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Overview:

1. Functions of large wood in rivers and floodplains
2. Human impacts on large wood dynamics
3. Design considerations
4. Project examples

1. Functions of large wood in rivers and floodplains

Wood Supports Stream Processes

- Channel complexity
- Development of multi-thread channels
- Margin & floodplain roughness
- Floodplain connectivity
- Pool scour
- Sediment sorting

Milo McIver , Oregon

Wood Supports Ecological Functions

Cover

Habitat complexity

Velocity refuge

Trapping spawning gravels

Macroinvertebrate production

Retaining organics

Riparian succession

Milo McIver , Oregon

Natural Distribution of Large Wood

Recruitment: How does wood get into the stream?

- individual tree-fall due to mortality of riparian tree
- Large disturbance events: floods, fires, insect outbreaks, disease, landslides, and debris flows

Retention: how does wood stay in the channel? How long does it stay?

- Size/complexity of wood
  - Intact rootwad
  - “key pieces”
  - Bank erosion
- Size/complexity of channel
  - bank protrusions, islands, gravel deposits, boulders, other wood pieces, bends
  - Straightened, incised, armored

2. Human impacts on large wood dynamics

A. Riparian-source areas

B. Recruitment

C. Retention

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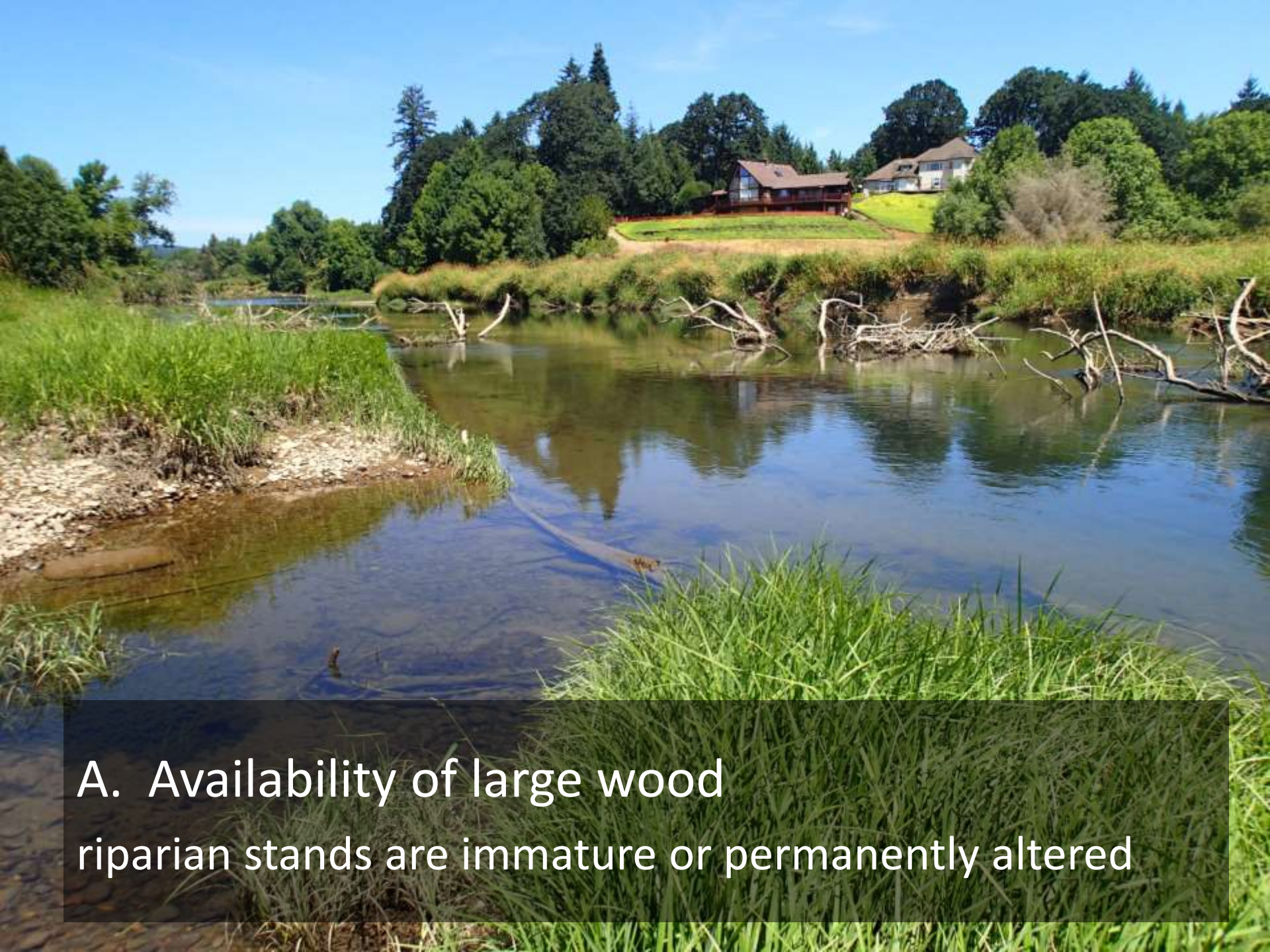


A. Availability of large wood

riparian stands are immature or permanently altered

B. Recruitment of large wood

ability of streams to erode their banks, avulse, and fully access their channel migration zones has been limited or eliminated

C. Retention of large wood

processes that are needed to retain wood in channels are altered due to channelization, removal of key pieces, and loss of complexity

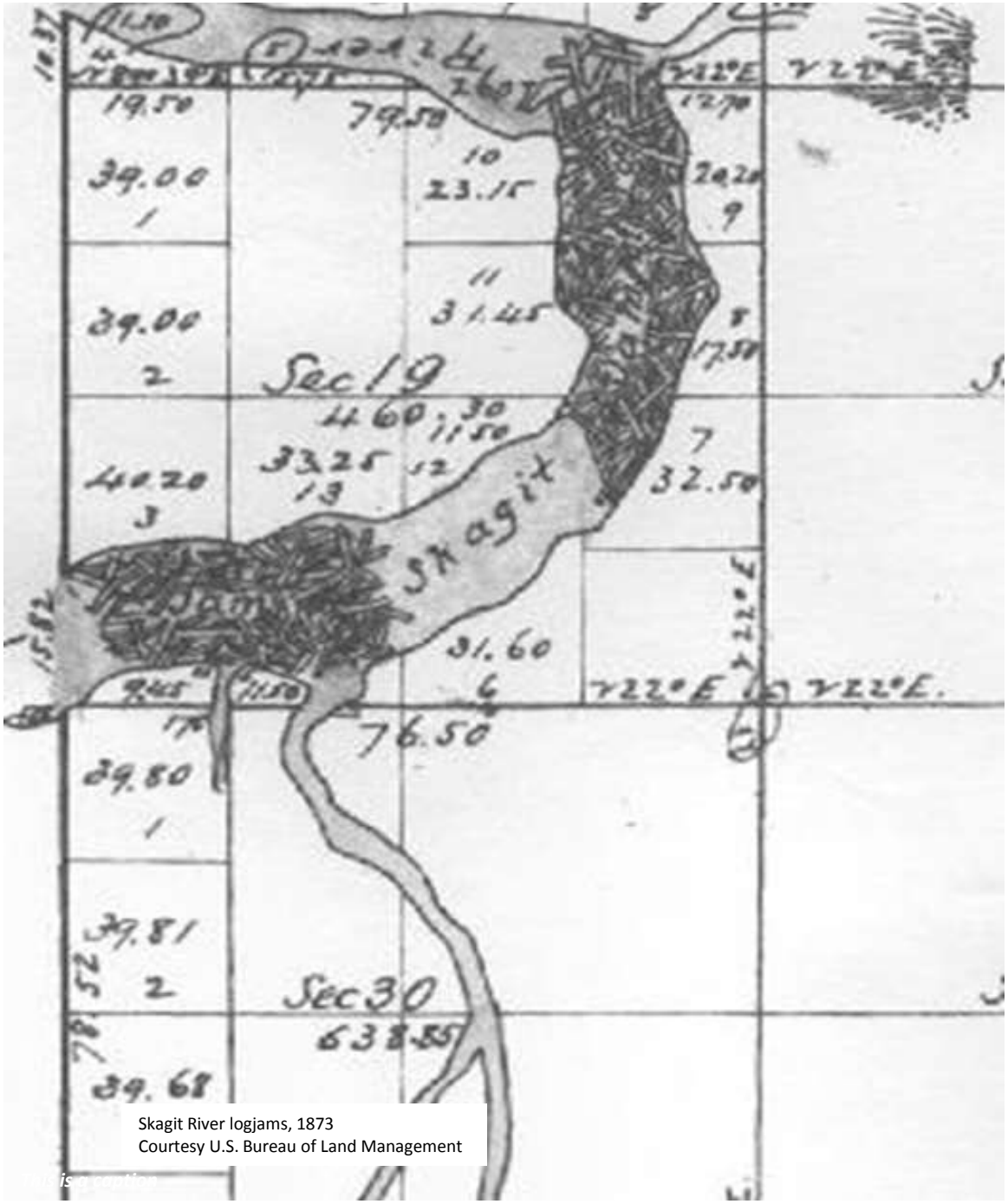
What happened?

- Riparian clearing
- Log drives
- Snagging
- Channel alterations

Leads to possible misperceptions of “what rivers look like”

Natural Condition

Altered Condition



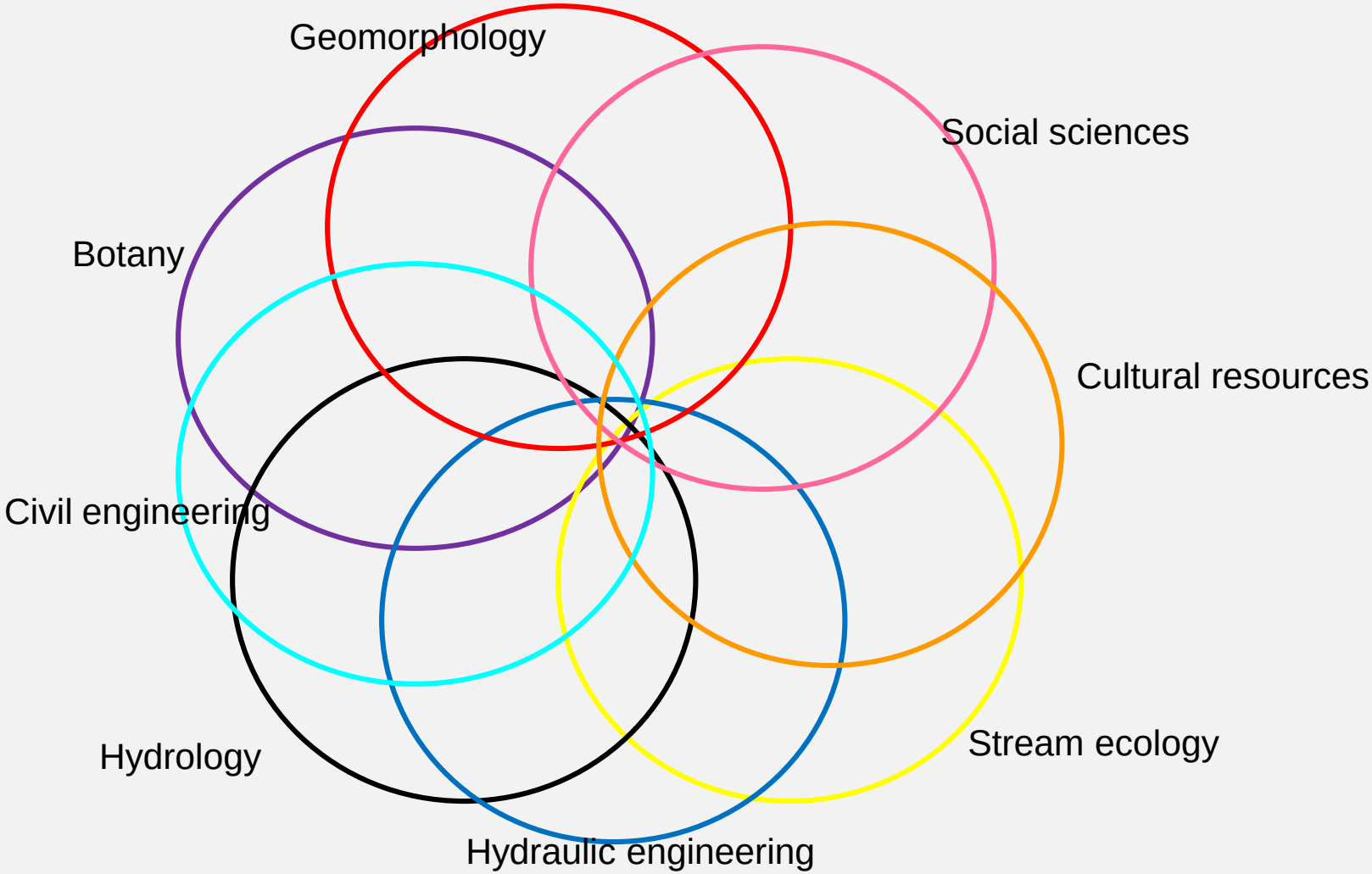
Skagit River logjams, 1873
Courtesy U.S. Bureau of Land Management

How do we know there is less wood today?

- historical maps
- snagging records
- anecdotal accounts
- reference/analog sites

3. Design considerations of large wood projects

River restoration is multifaceted



Abundant information and study across many disciplines

- *Water Resources Research*
- *Journal of Geophysical Research – Earth Surface*
- *Geomorphology*
- *Journal of Hydraulic Engineering*
- *River Research and Applications*
- *Earth Surface Processes and Landforms*
- *Geological Society of America Bulletin*
- *International Journal of River Basin Management*
- *Regulated Rivers: Research and Management*
- *Science*
- *Restoration Ecology*
- *Environmental Management*
- *Hydrological Sciences Bulletin*
- *American Journal of Science*

Use of large wood may be appropriate where:

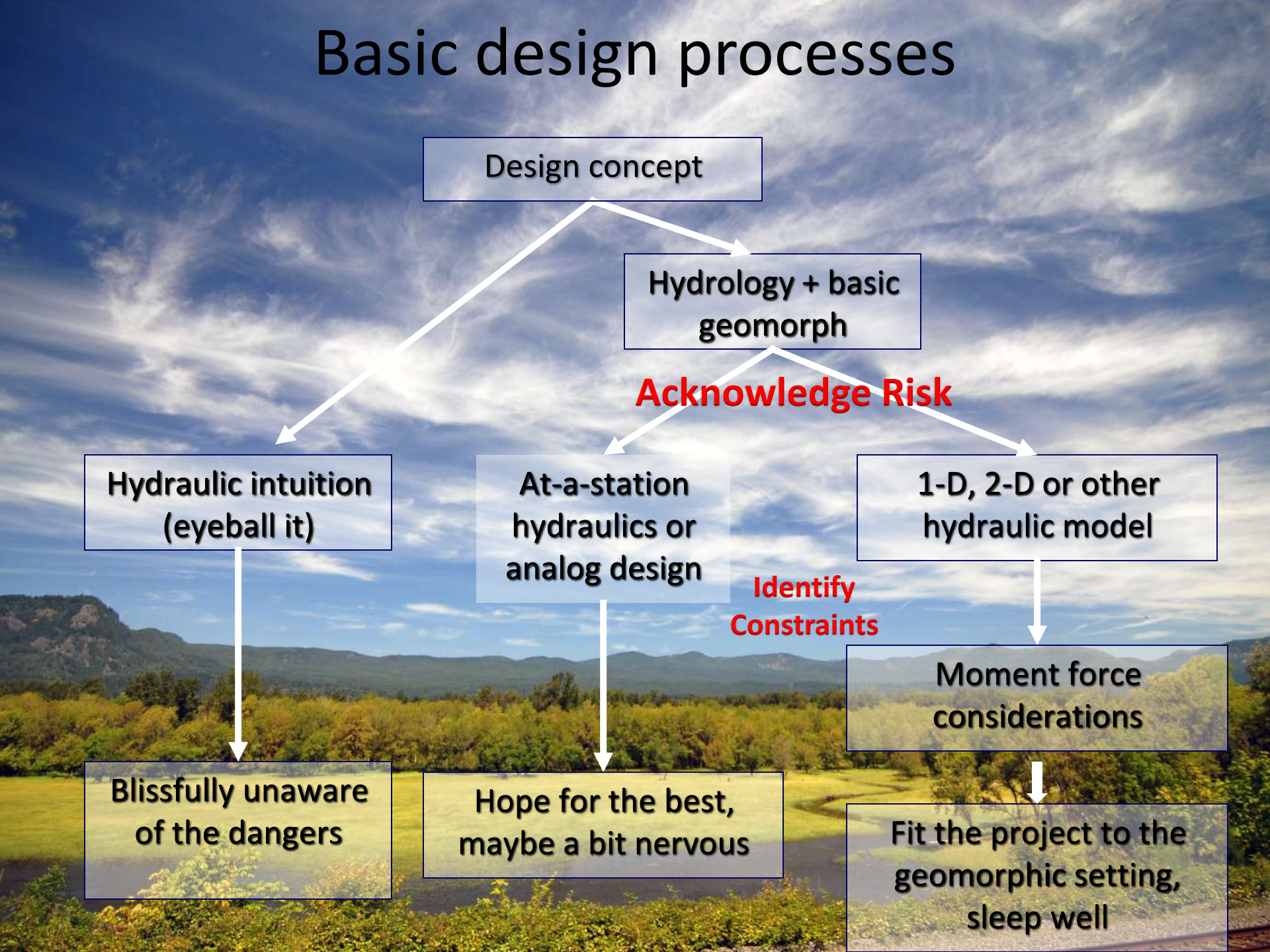
- Channel/floodplain process or biological need identified
- Past wood removal
- Riparian zone has limited near-term sources
- Upstream recruitment is lost
- Channel retention reduced
- Constraints limit restoration of recruitment and retention

Clackamas River, OR

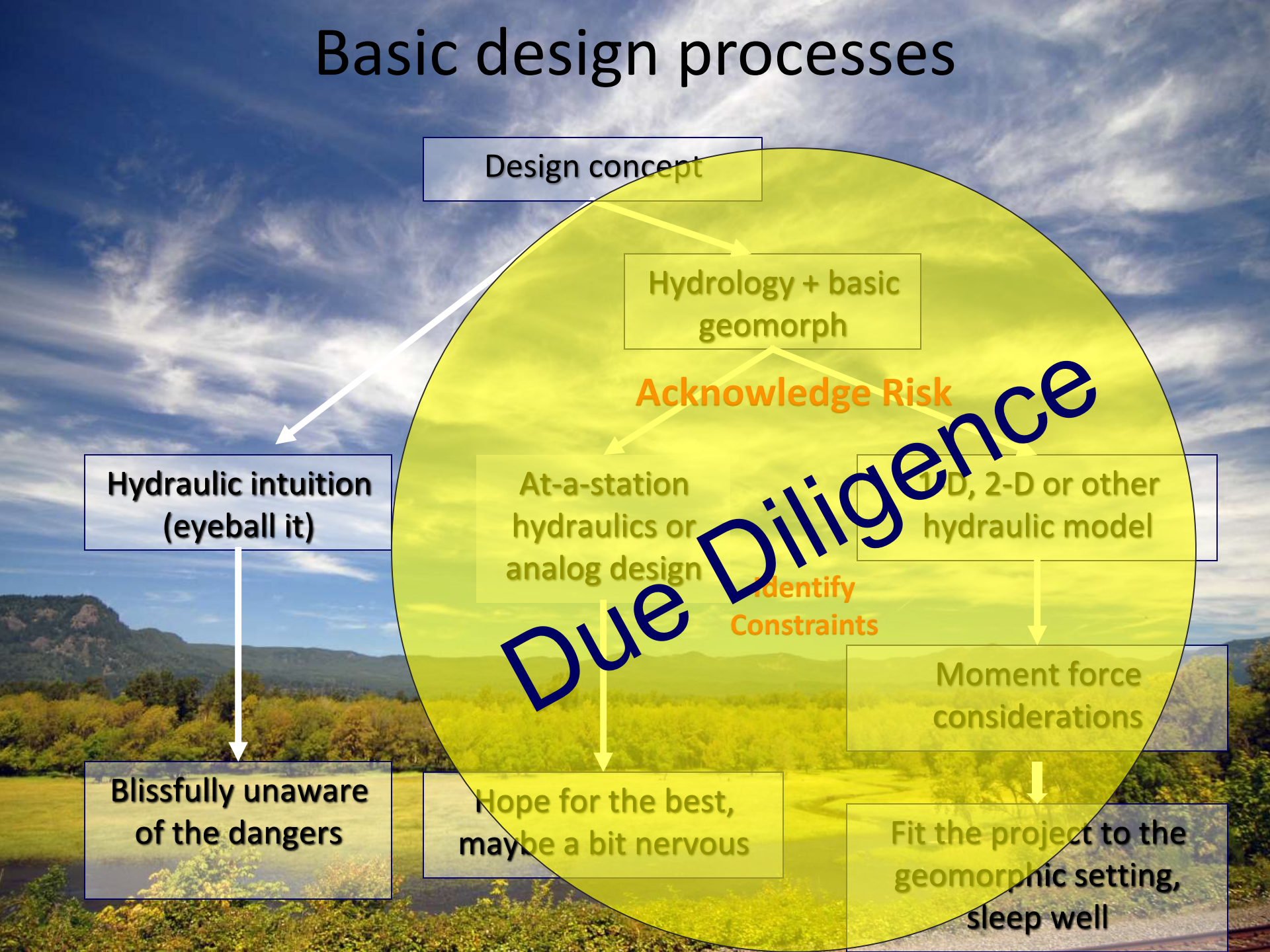
Use of large wood may not be appropriate where:

- High channel instability
- Placement would impair natural processes
- Placement would create risk to human safety or property
- Existing wood recruitment and retention are intact

Basic design processes



Basic design processes

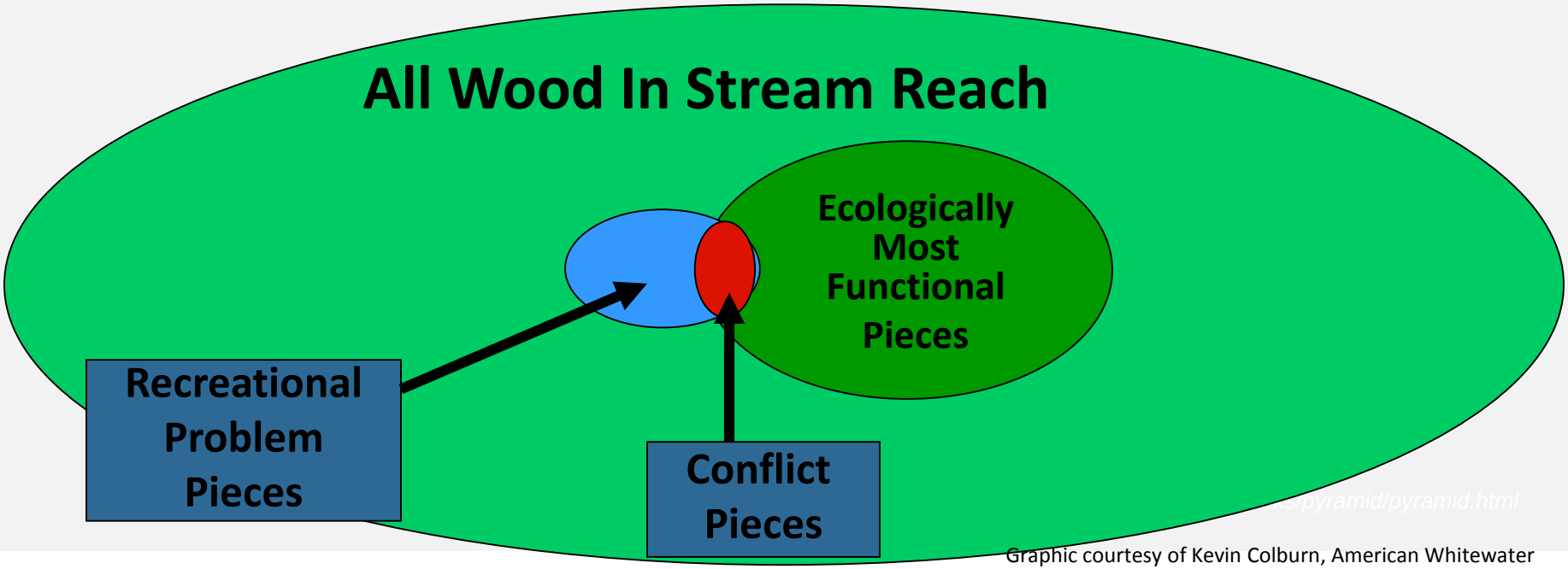


Design Challenge: Balancing risk and other goals

- Risk to habitat
- Risk to infrastructure and property
  - Hydraulic impacts
  - Erosion
  - Infrastructure damage
  - Factors of safety
- Risk to public safety
  - Recreation
  - User groups
  - Flooding and erosion hazards
- Uncertainty of technique

Integrate public safety into design process

- Consider public safety early in design
- Engage stakeholders throughout design
- Document decisions – due diligence
- Be concerned about hazards and safety issues, but not intimidated by them



Graphic courtesy of Kevin Colburn, American Whitewater

Design consideration: Site selection

Tepee Creek, WA

Design consideration: Size of structure

Klickitat River, WA

West Fork Hood River, OR

Design consideration: Placement and orientation

Klickitat River, WA

Design consideration: Brush packing

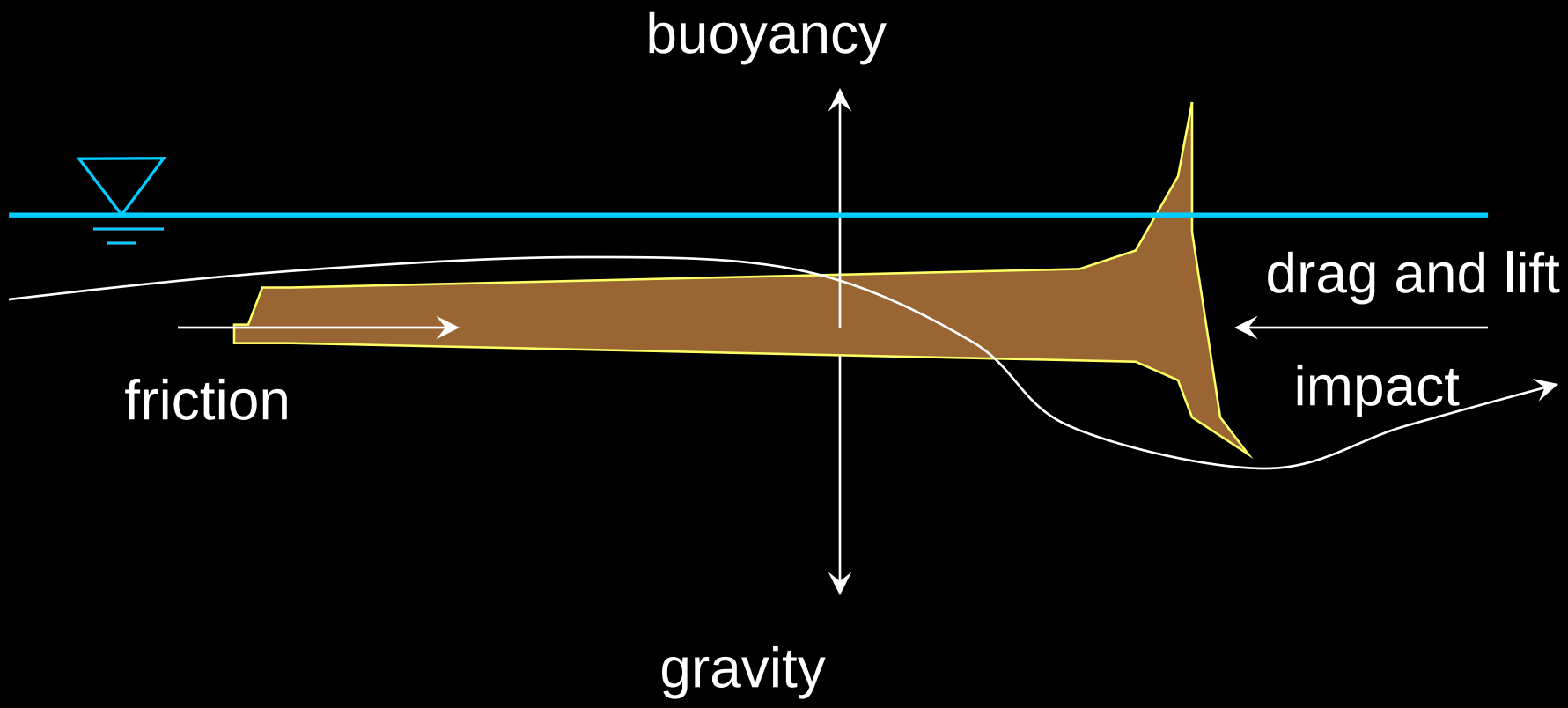
Salmon Creek, WA

Design consideration: Materials

- Whole trees
- Trees with rootwads
- Green trees
- Sources

Wood removed from Swift Reservoir, Lewis River, WA

Design consideration: stability of large wood



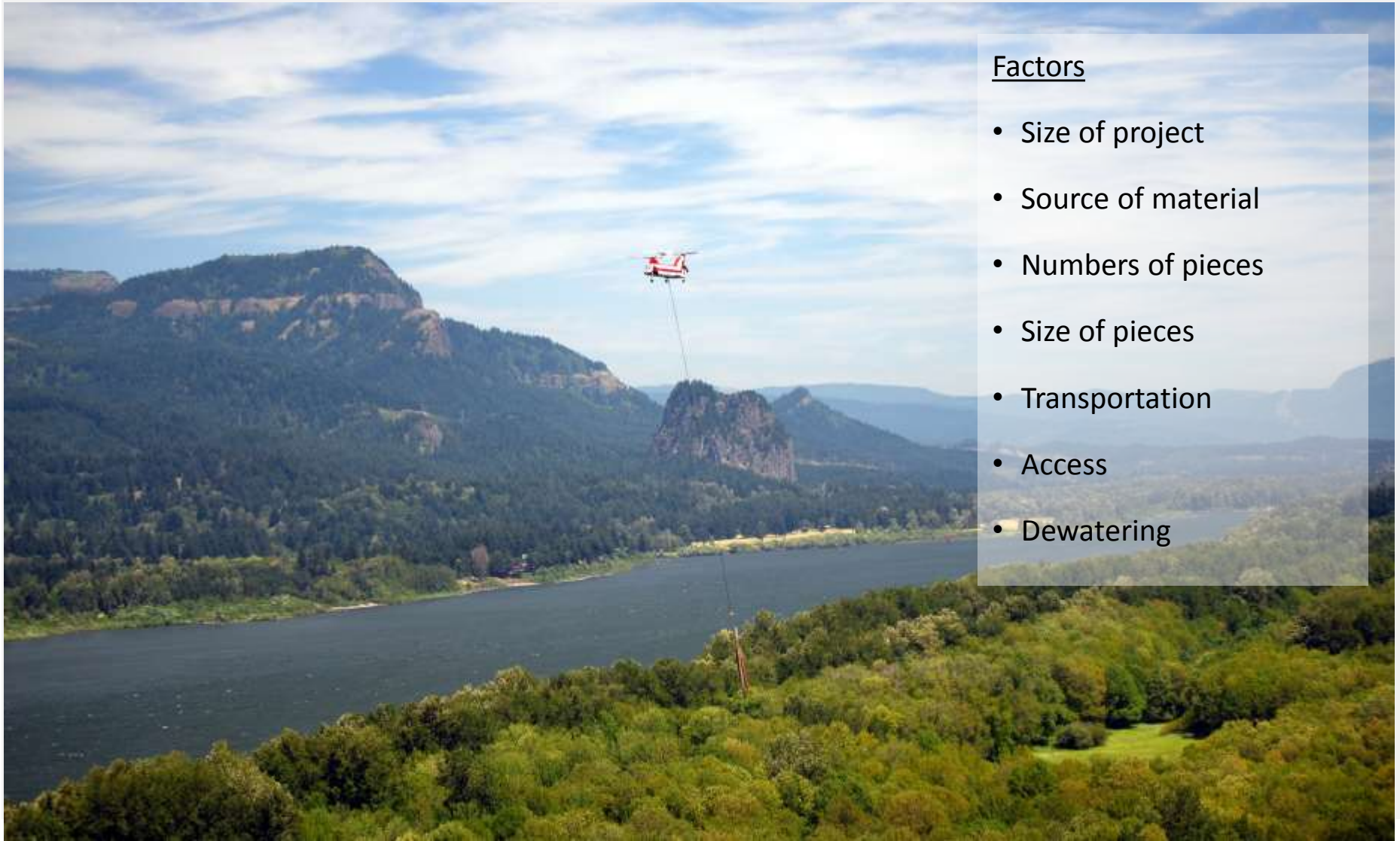
Design consideration: Anchoring

Project consideration: Permitting

- Streamline permit
- FEMA No-Rise policy
- Public safety (signage)

Lewis River, WA

Project consideration: Cost estimation



Factors

- Size of project
- Source of material
- Numbers of pieces
- Size of pieces
- Transportation
- Access
- Dewatering

Construction considerations

- Access
- Sequencing
- Staging & material management
- Dewatering / bypass
- Erosion control
- Planting
- Buoyancy/ballast

Project consideration: Monitoring and maintenance

- Based on goals and objectives
- Implementation effectiveness
  - Use by target species
  - Performance
- Movement not necessarily failure

Kelley Creek

Long-term riparian function is very important!!

4. Large wood restoration projects

Small cover wood structures or individual pieces

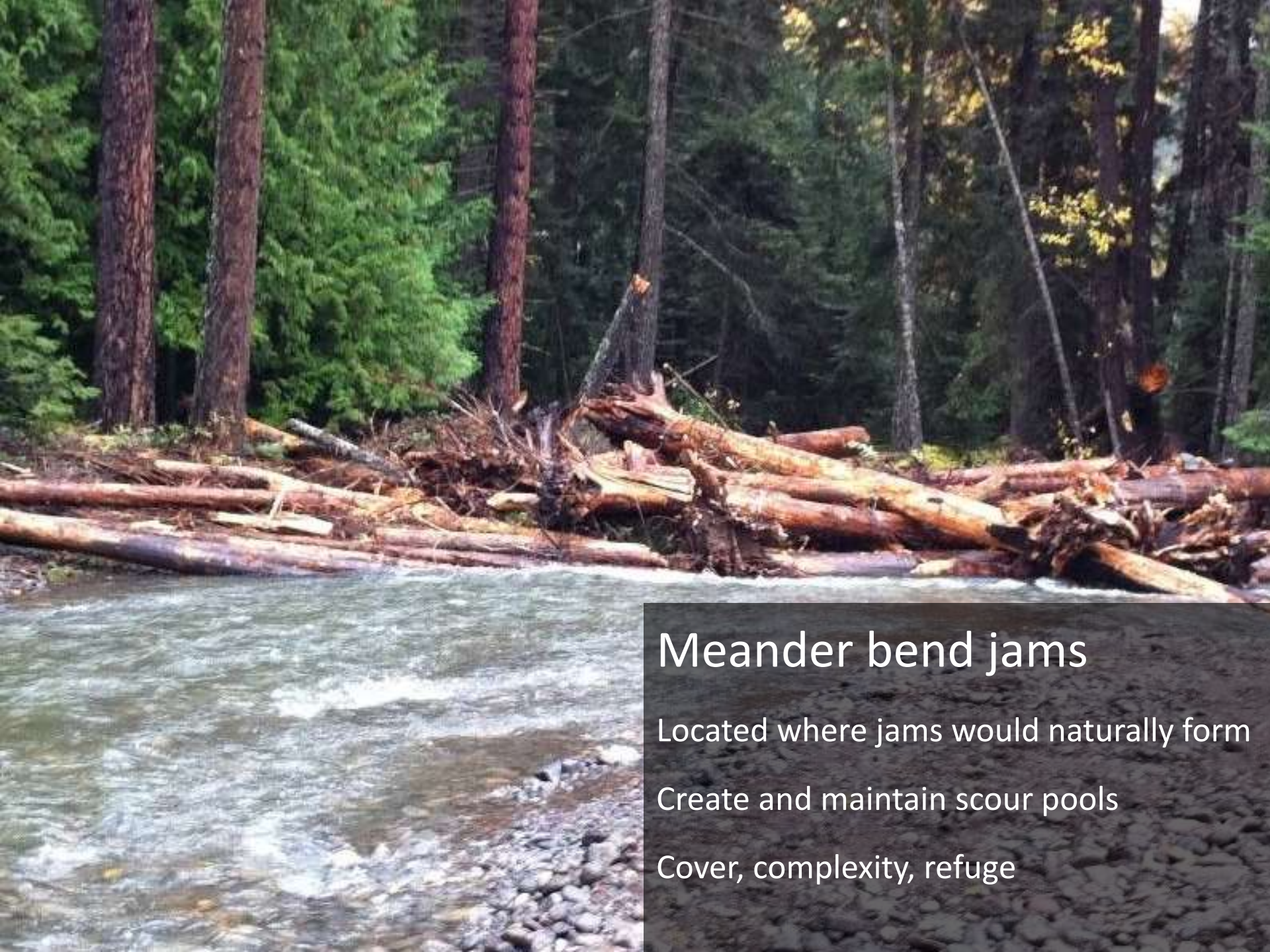
- Focus is on cover, complexity, and velocity refuge
- Minimal geomorphic influence

Margin complexity

- Address cleared banks and riparian zones
- Localized cover, complexity, refuge
- Minimal geomorphic influence

Coarse wood

- Bundle wood if possible
- Place to depth of scour
- Min. embedment length 10 feet
- Low energy systems only
- Consider vegetatively reproducing plants



Meander bend jams

Located where jams would naturally form

Create and maintain scour pools

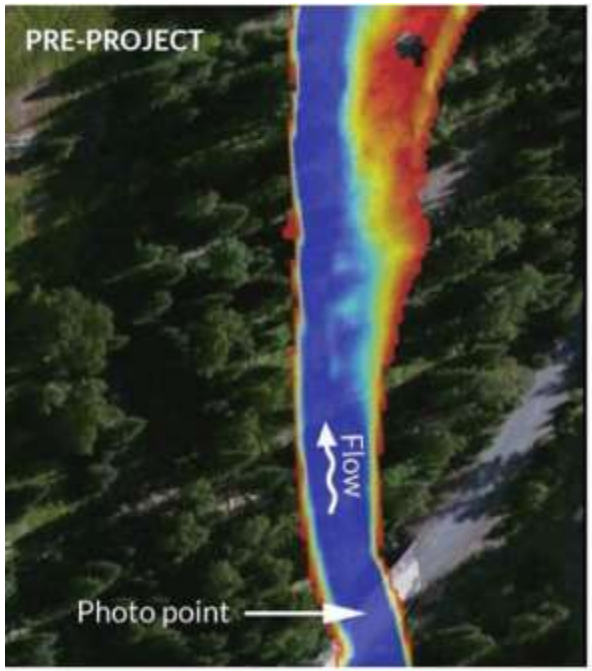
Cover, complexity, refuge

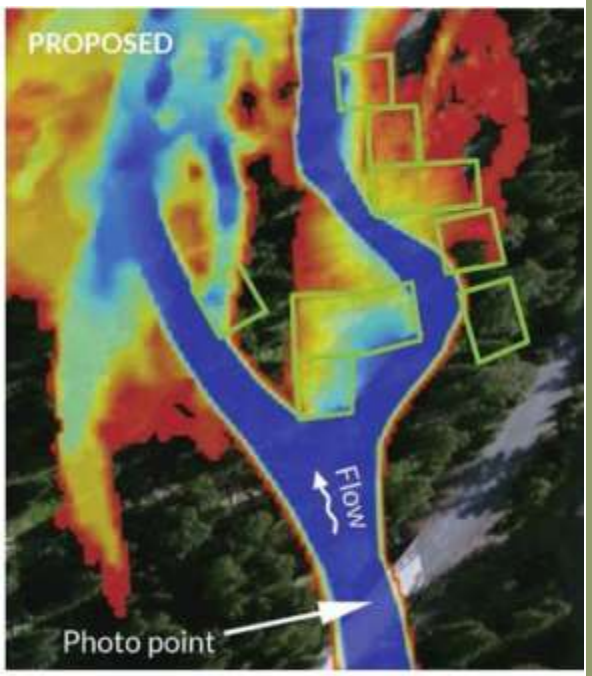
Bar apex jam

- Located where jams would naturally form
- Create and maintain split flow conditions
- Sediment deposition
- Sometimes limited fish use during low flow periods

Bar apex jam

Example: Bar apex jam to create habitat, protect island head and split flow

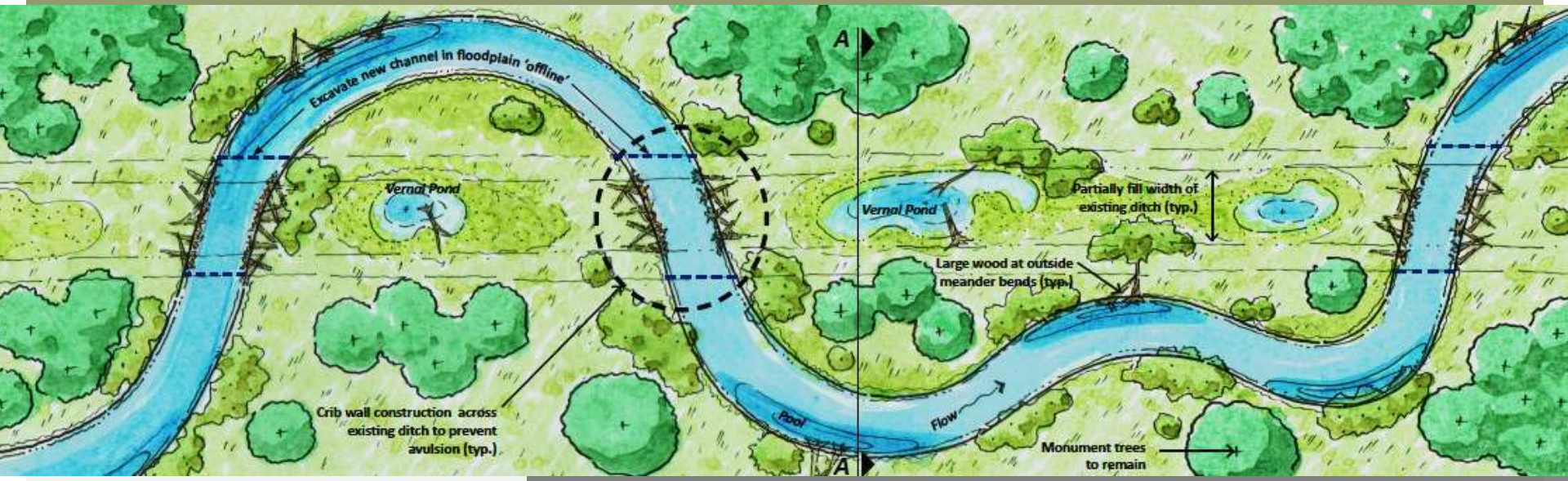




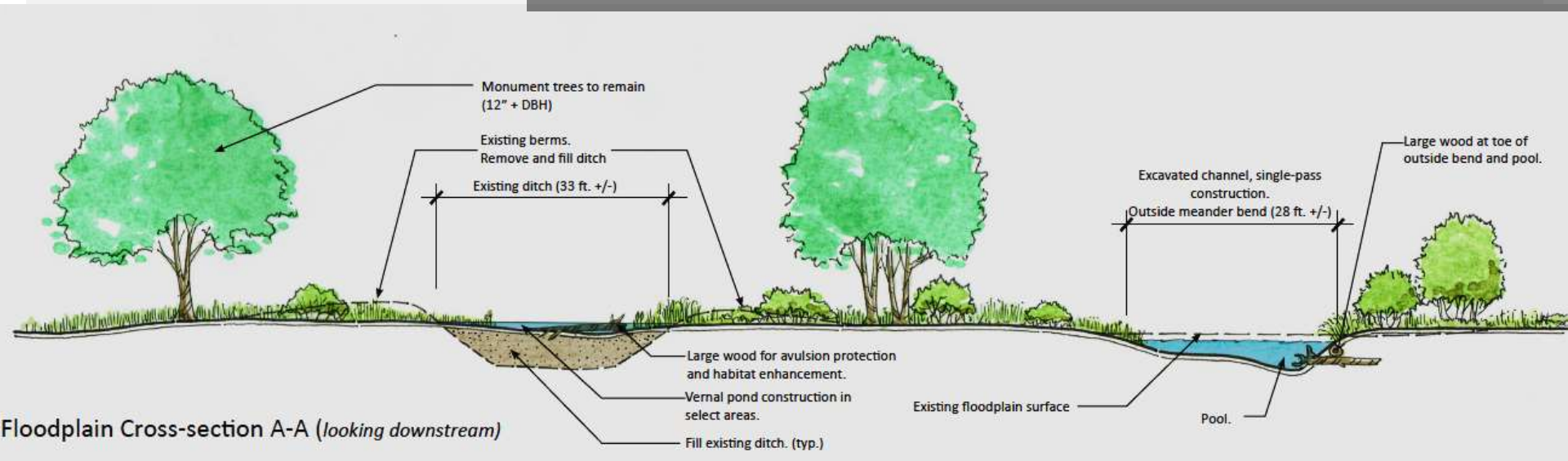
Toe stability

- Wood placement for habitat and toe stability
- Experimental bench areas to monitor sediment accumulation rates

Ditch remeander



- Avulsion protection – avoid recapturing the old channel
- Floodplain roughness – control what overbank flows can do



Floodplain Cross-section A-A (*looking downstream*)

Cribwall stabilization

- Good in sand or erodible soils
- Need to be OK with the Lincoln-log aesthetic
- Can incorporate live wood
- Consider decay

Deflectors (variety of purposes)

- Infrastructure protection
- Shift or direct stream energy
- Also provides cover, complexity, and refuge

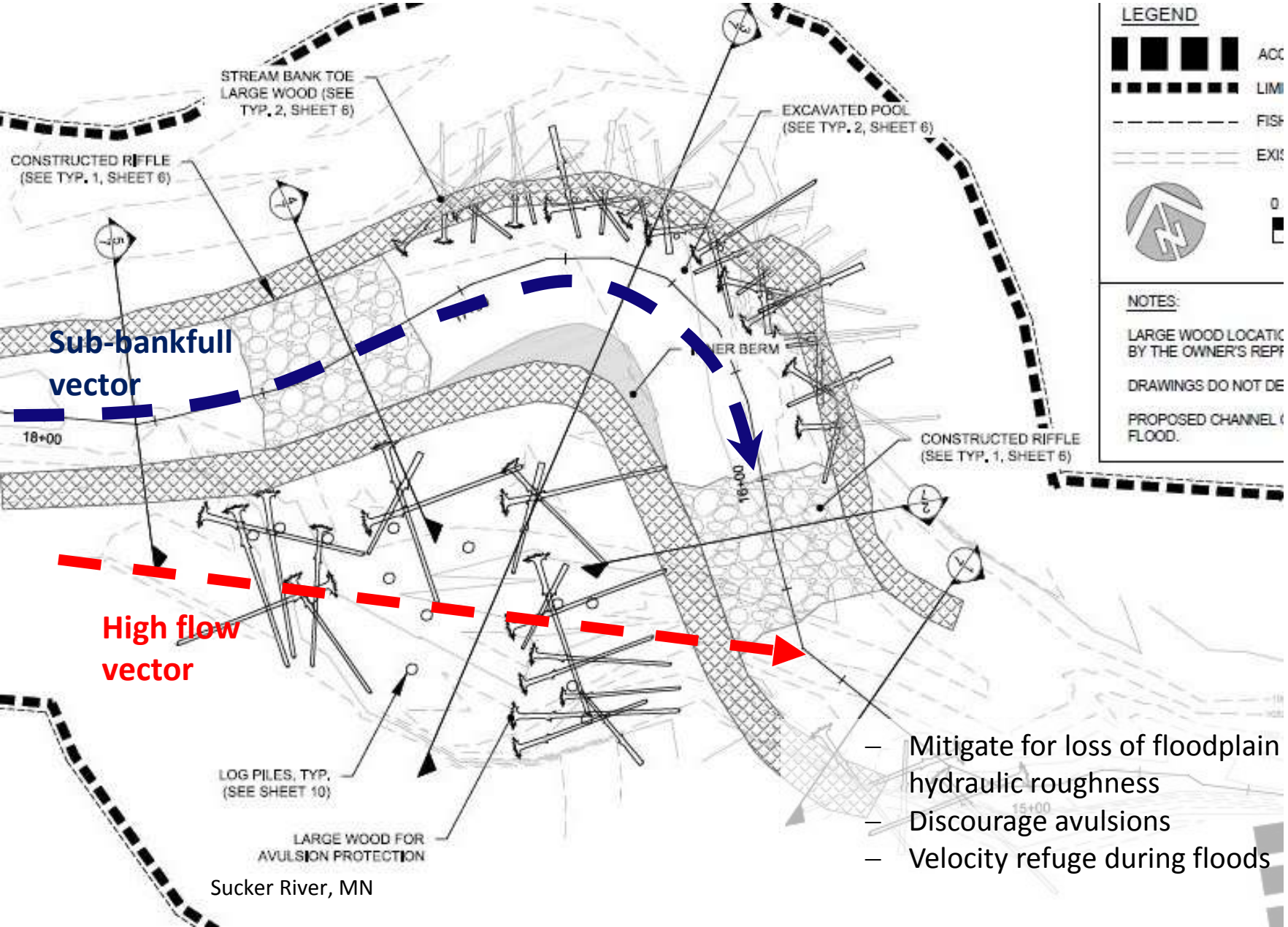
Before

Klickitat River

Structures to trap wood

- Requires a large wood supply from upstream
- Can use less wood in jam
- Positioning and configuration is important
- May need to provide stability for anticipated amount of accumulatio
- Uncertainty in outcome

Floodplain Roughness



- Mitigate for loss of floodplain hydraulic roughness
- Discourage avulsions
- Velocity refuge during floods

Sucker River, MN

Floodplain Roughness

Sucker River, MN

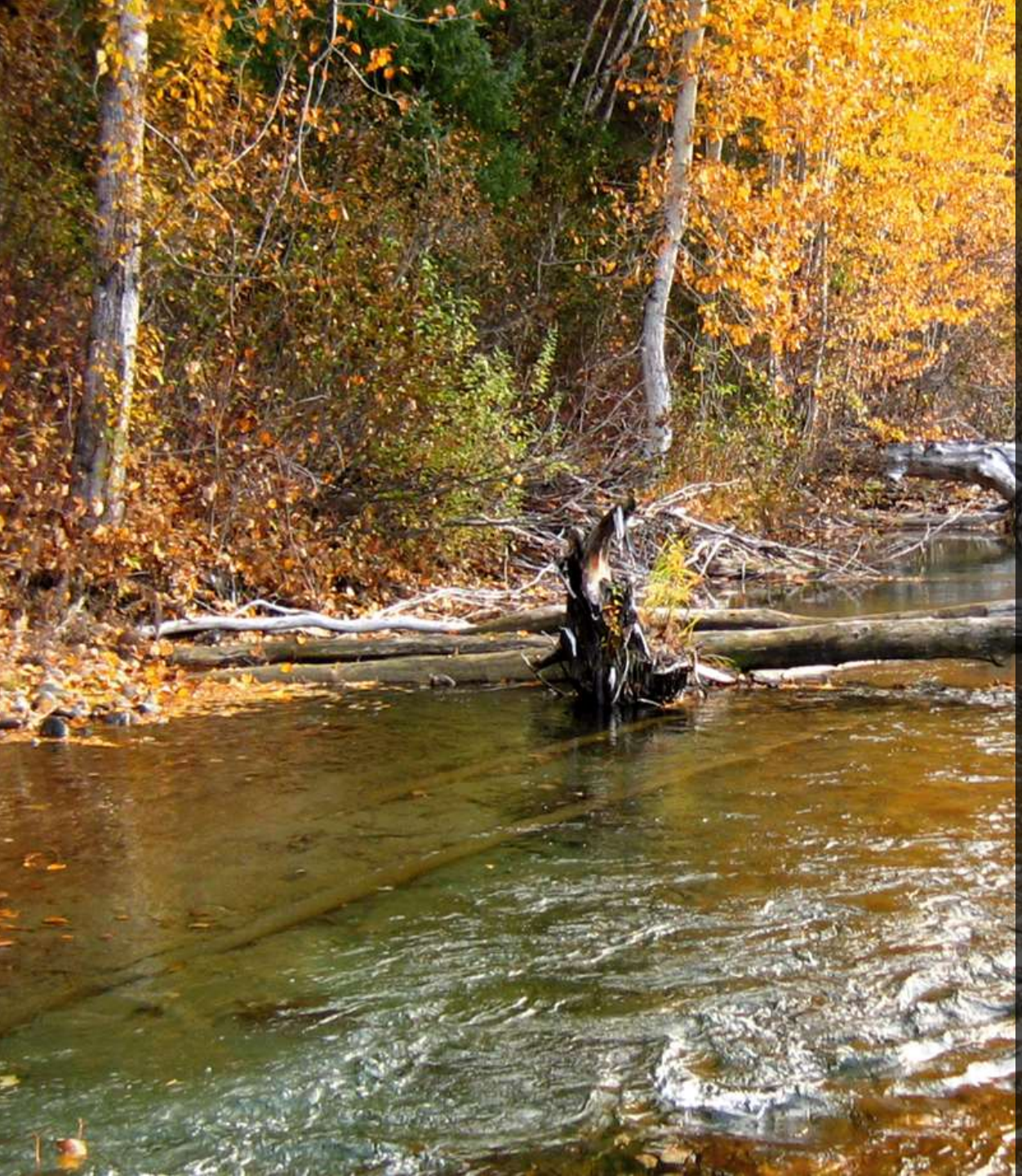
Wood in tidal reaches

- Buoyant force
- Reverse flows
- Wet/dry vs. decay

Sensitive area protection

Wood can be used to provide protection of:

- Side channel entrance and exits
- Channel mouth areas
- Sensitive areas (e.g. spawning)



Thank you

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