Designing for Ecological Disturbance in River Restoration

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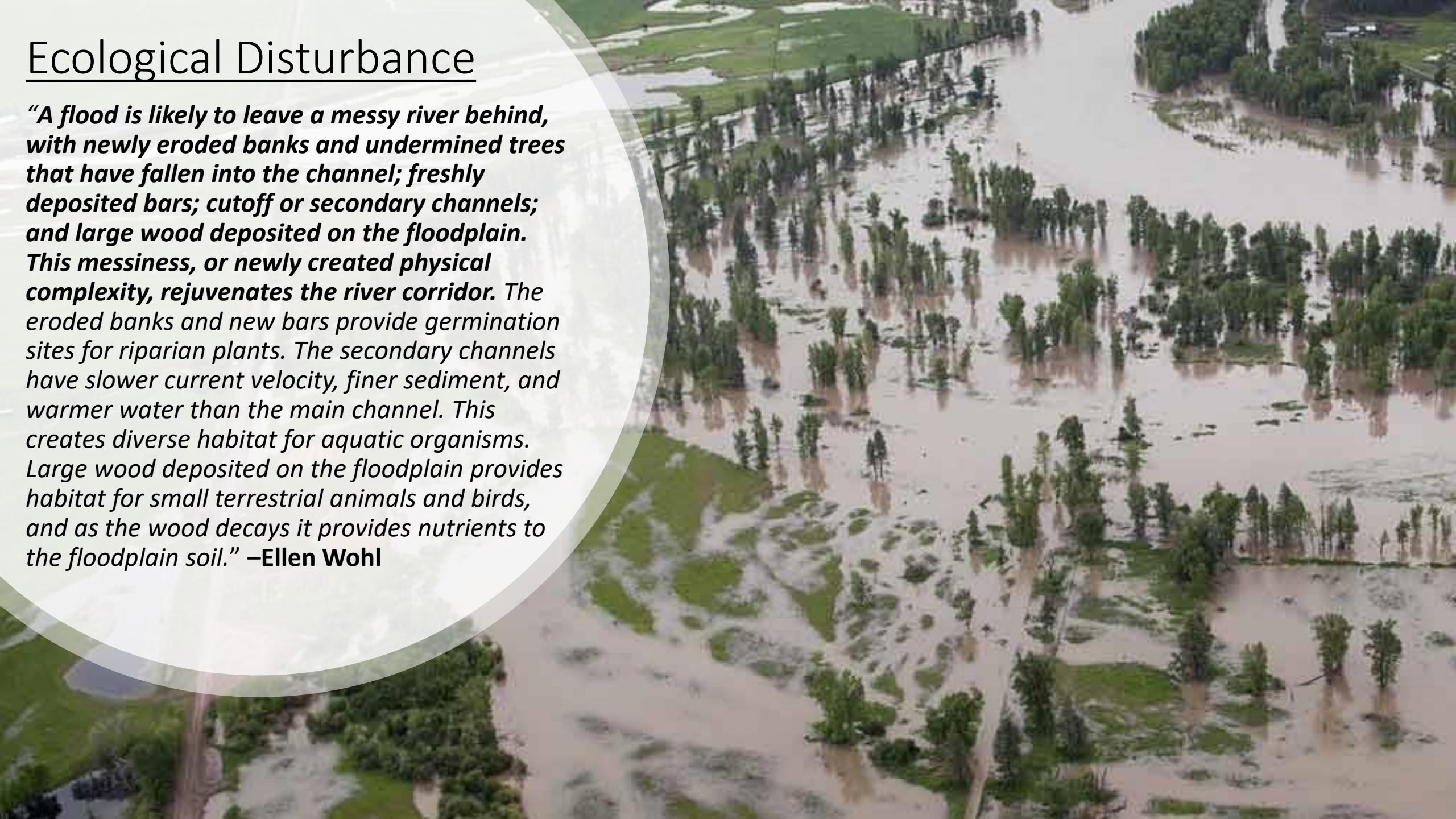
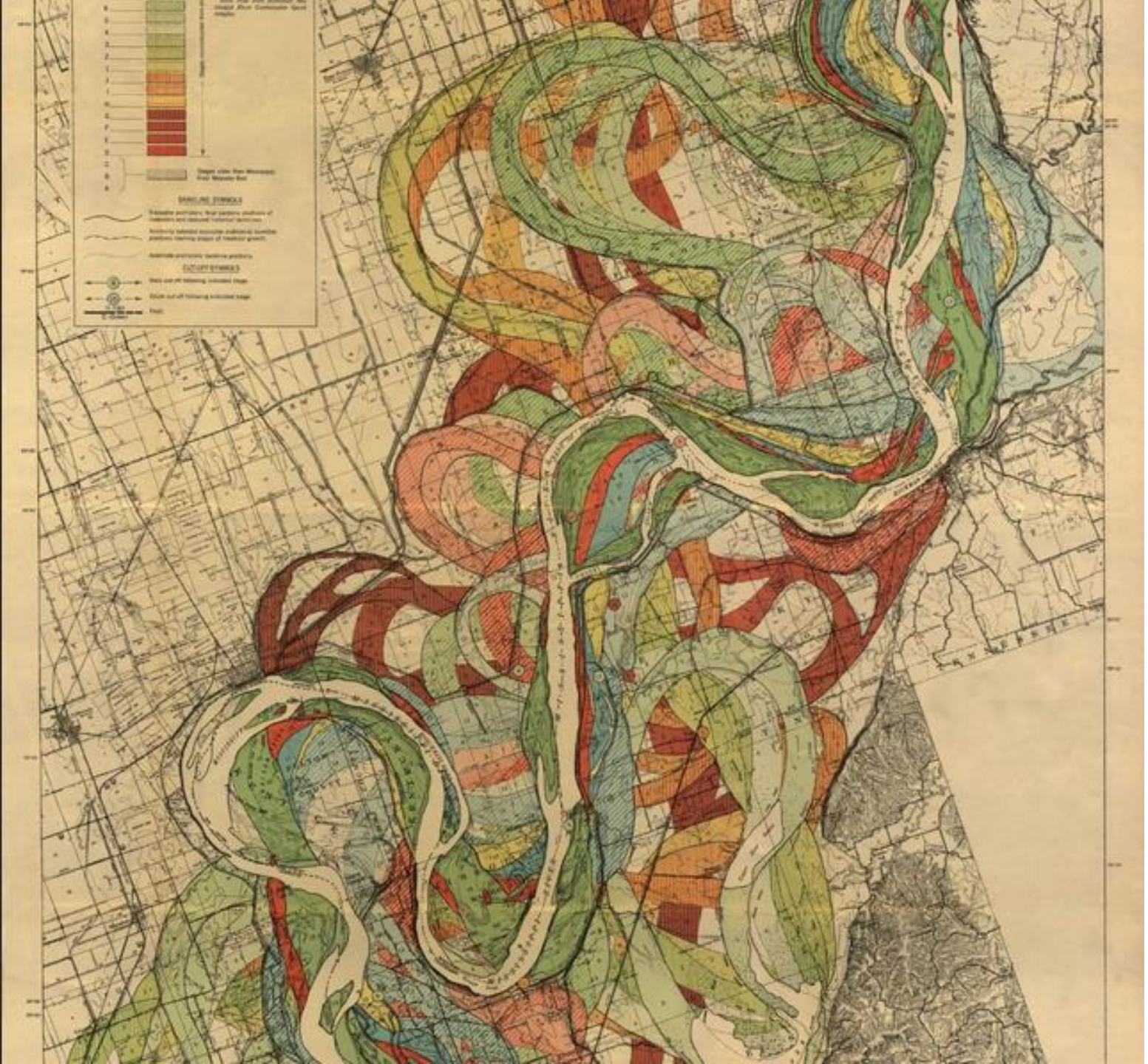
Ecological Disturbance

*"**A flood is likely to leave a messy river behind, with newly eroded banks and undermined trees that have fallen into the channel; freshly deposited bars; cutoff or secondary channels; and large wood deposited on the floodplain. This messiness, or newly created physical complexity, rejuvenates the river corridor.** The eroded banks and new bars provide germination sites for riparian plants. The secondary channels have slower current velocity, finer sediment, and warmer water than the main channel. This creates diverse habitat for aquatic organisms. Large wood deposited on the floodplain provides habitat for small terrestrial animals and birds, and as the wood decays it provides nutrients to the floodplain soil."* **–Ellen Wohl**



Benefits of Ecological Disturbance

- **Riparian plant regeneration**
- **Bank erosion**
  - **Wood/sediment supply**
  - **Wildlife habitat**
- **Topographic diversity**
  - **Floodplain**
    - **Plant diversity**
  - **Channel**
    - **Bedform/habitat diversity**
- **Sediment Transport**
  - **Riffle flushing**
  - **Bar creation**




LOS ANGELES RIVER, FLOOD OF 1926
SOUTH OF COMPTON BLVD, LOOKING SOUTHWEST

Channel Stability

Traditional Engineering

- No change/response equals stability

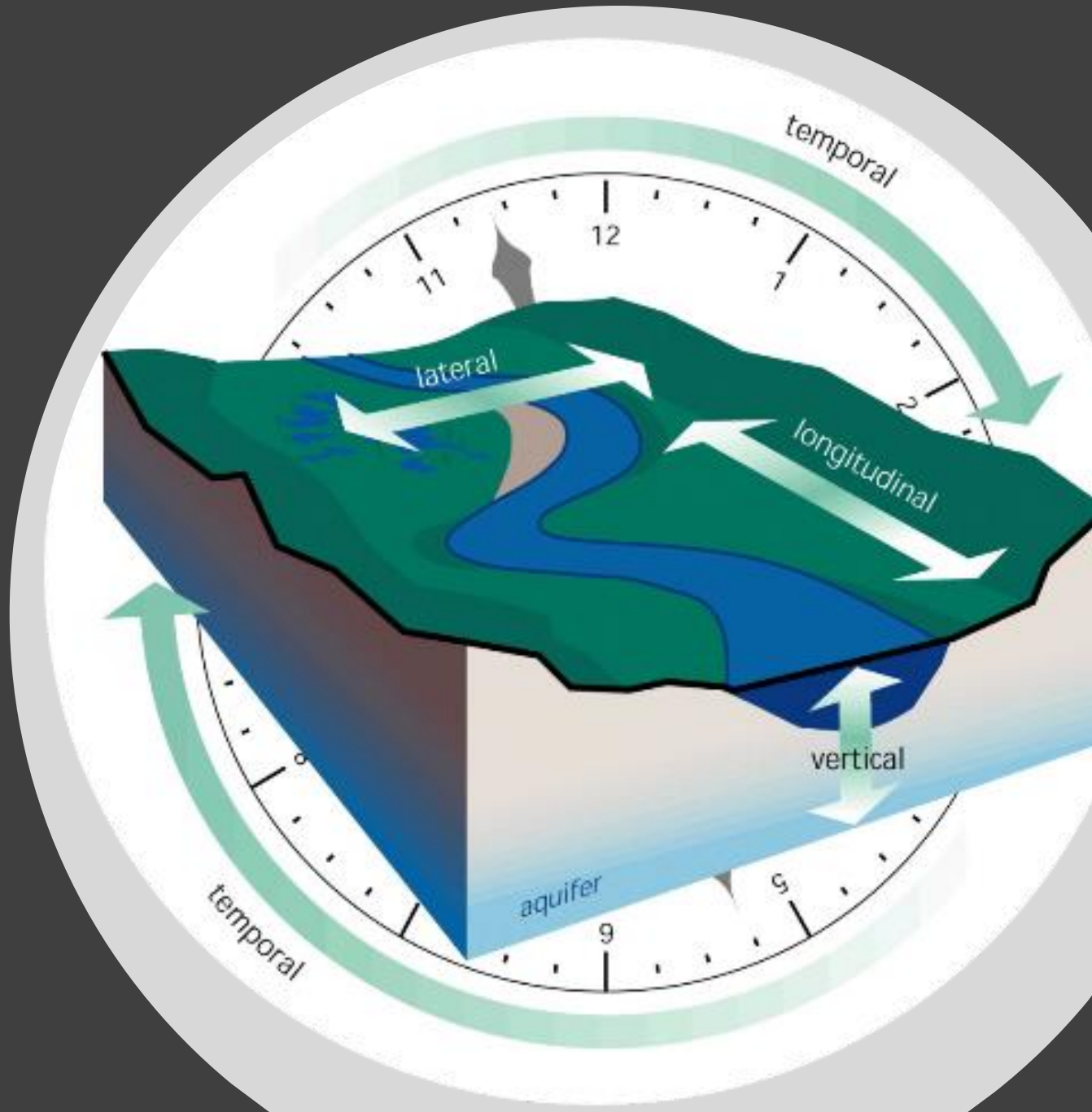
Fluvial Geomorphology

- The ability to change/ respond equals stability




Rivers adjust in four dimensions

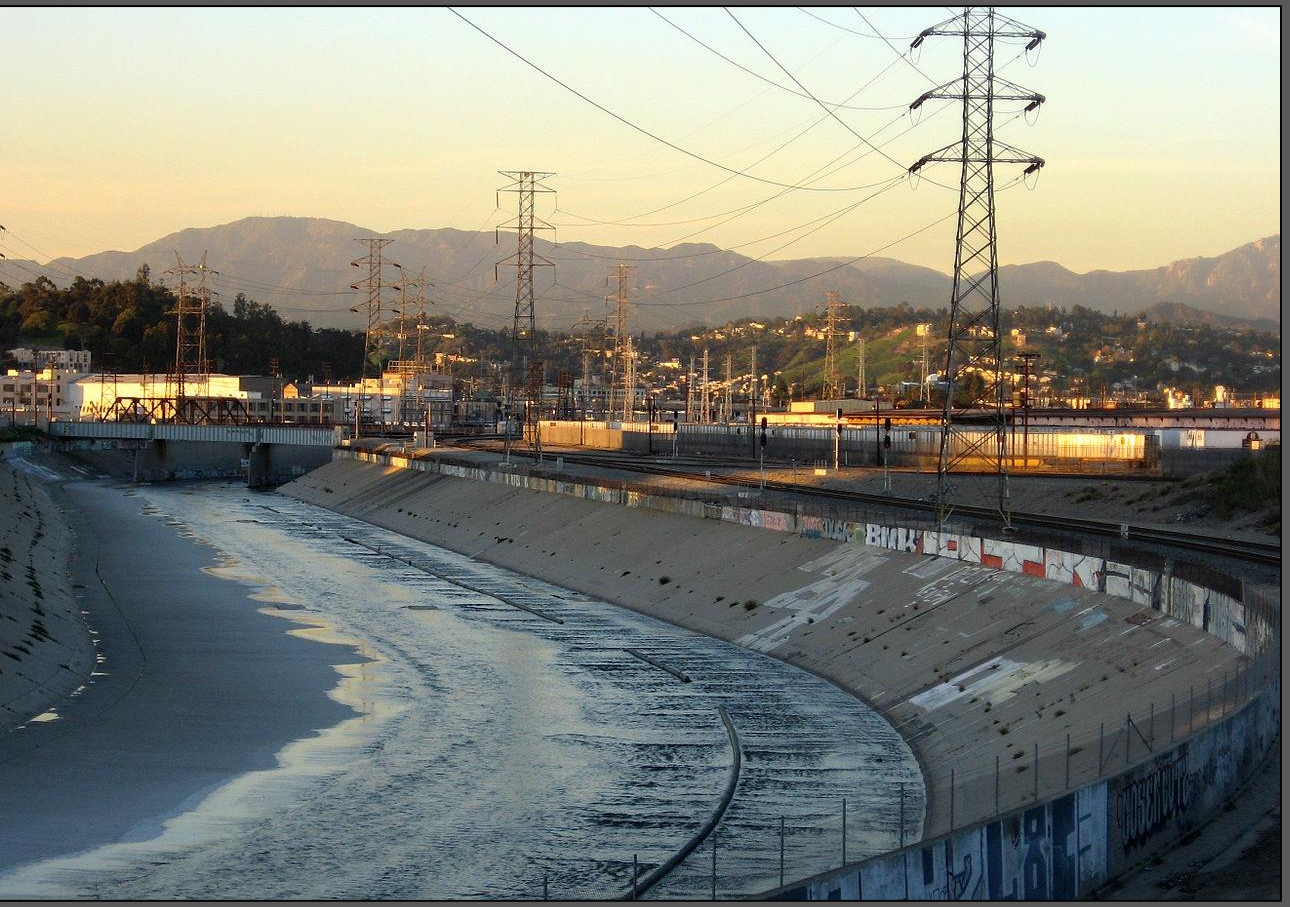
- Lateral
- Longitudinal
- Vertical
- Temporal



Temporal Channel Stability

Traditional Engineering
- Short-term

Fluvial Geomorphology
- Long-term



Does the traditional idea of stability = healthy?

That’s great….but we cannot allow for disturbance everywhere….

- **True, but more often than not, the opportunities are missed.**

So **HOW** do we design for disturbance?

Step One

- **Ask ourselves “How much room does the river have to move? Can we give it more room?”**

Constrained settings

- **Can we remove/move constraints?**
- **Use offset protection**
  - **Allows adjustment to a certain designated point**
  - **Buys you time**
  - **Allows for bank erosion**
- **Use wood and vegetation**
  - **Bank protection/roughness**
- **Connect floodplain**
  - **Dissipate energy**

Less Constrained Settings-
River Bluffs Open Space River Restoration Project

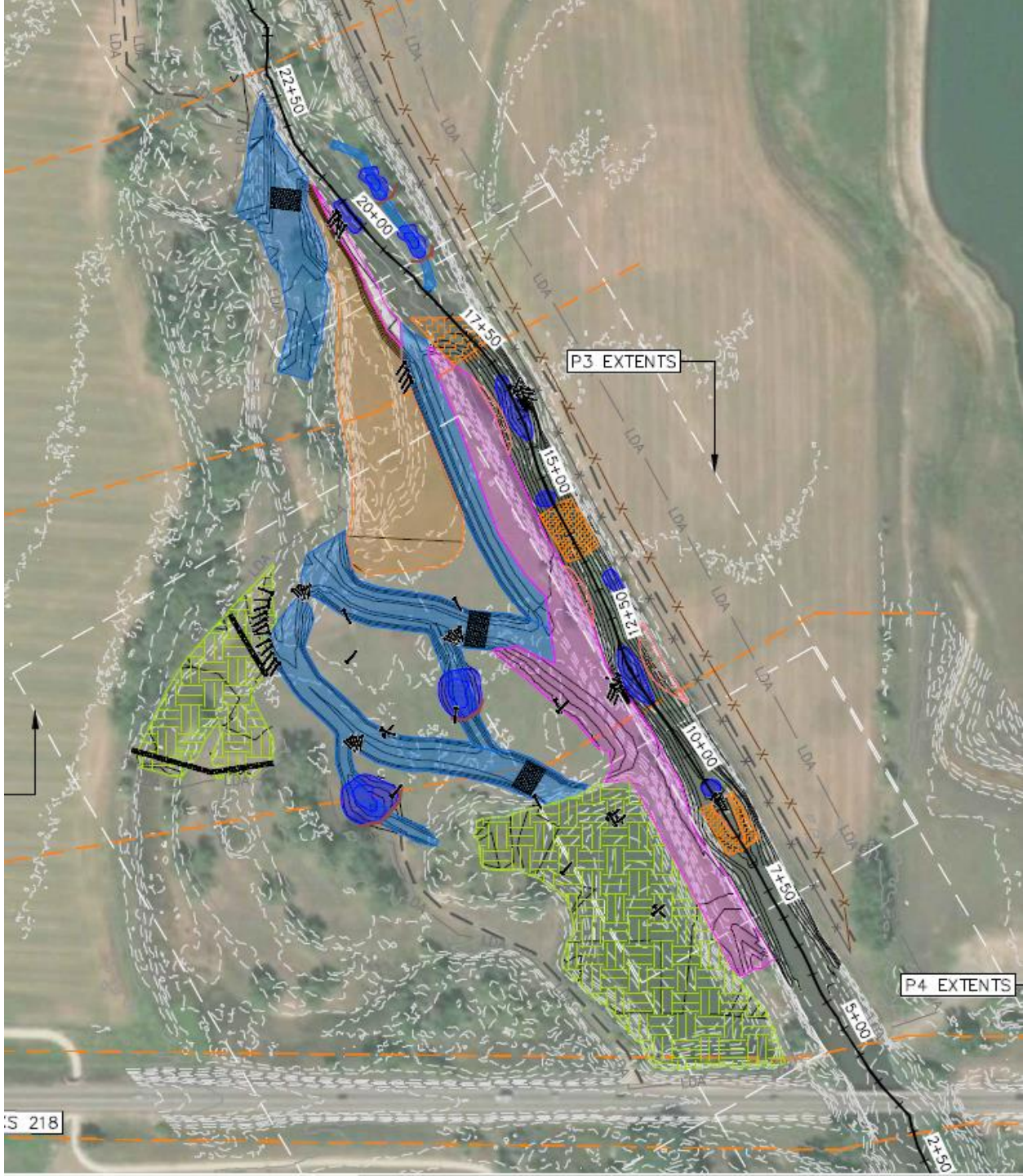
- **Cache la Poudre River near Windsor, CO**
- **¾ Mile Reach but worked focused on downstream half**
- **$1.3 million budget (~150k for design)**
- **Historically channelized and bermed in 50's**
- **Land on either side is leased out for agriculture**


Weld County Road 68

Project Goals

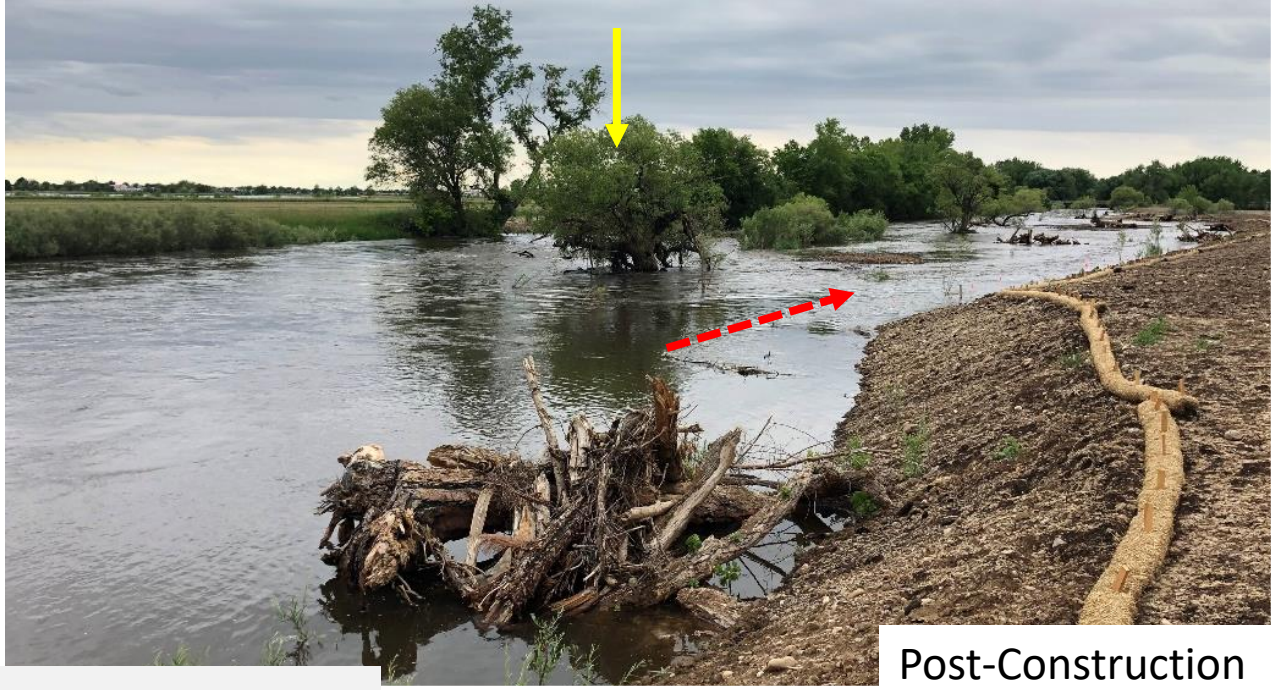
- Restore system processes
  - Allow for future adjustment/disturbance
  - Increase floodplain connection and narrow the channel to switch sediment transport processes
- Increase Riparian and Aquatic Habitat
  - Increased complexity/messiness
  - Plains Cottonwood Regeneration

How?



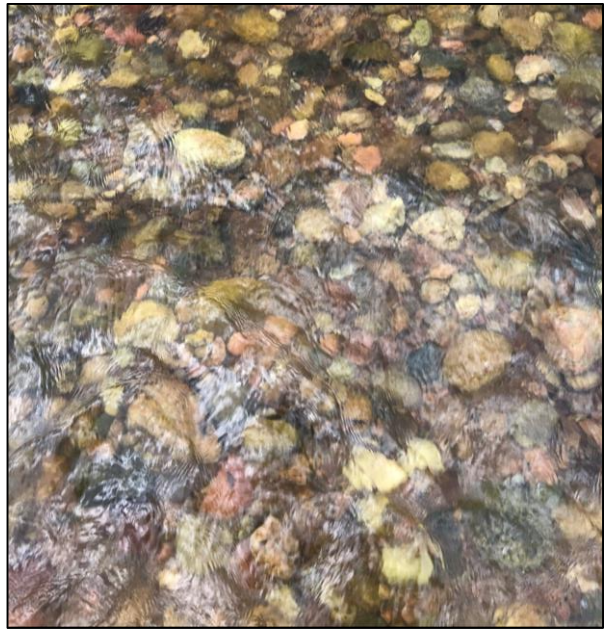
- Moved fences back
  - Provides the river long-term ability to adjust as needed
  - Future wood and sediment supply

Floodplain connection through benching, channel narrowing, and bar creation



Overflow Channels

Used system appropriate materials



Floodplain Wood

Channel Wood

Did the design work?

Annual Monitoring

- Repeat survey cross-sections and profile
- Photogrammetry
- Pebble counts (control-treatment)
- Wood Counts
- Vegetation Transects/Plots
- Fish Surveys (control/treatment)
- Macro-invertebrate sampling (control/treatment)

Cottonwood Recruitment

Takeaways

- Traditional view of channel stability has taken disturbance out of river restoration
- Disturbance plays a key role in river health and function
- It is possible to allow for, and to create disturbance in river restoration. Even in constrained environments.


Questions?