StreamMechanics

Site Selection and Design for Stream Mitigation

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Stream Mechanics

The Association of State Wetland Managers
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NCTC

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Our Relationship with the River

- From 1820 to 1970, more than 200,000 miles of streams and rivers were channelized to reduce flooding, provide drainage for agriculture, and improve navigation

Wohl, E.E., 2004. Disconnected Rivers, Linking Rivers to Landscapes. Yale University, New Haven, Connecticut.

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Functions Lost from Channelization

- Less water and sediment storage on previous floodplain
- Loss of bed form diversity (habitat)
- Increased incision and widening (erosion)
- Loss of fish species and biomass

Darby, S.E. and C.R. Thornes, 1992. Impact of Channelization on the Mimmshall Brook, Hertfordshire, UK. Regulated Rivers 7:193-204.

Hupp, C.R., 1992. Riparian Vegetation Recovery Patterns Following Stream Channelization: A Geomorphic Perspective. Ecology 73:1209-1226.

Kroes, D.E. and C.R. Hupp, 2010. The Effect of Channelization on Floodplain Sediment Deposition and Subsidence Along the Pocomoke River, Maryland. Journal of the American Water Resources Association 46(4):686-699.

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Regulatory Definition of Stream Restoration

"Restoration means the manipulation of the physical, chemical, or biological characteristics of a site with the goal of returning **natural/historic functions** to a former or degraded aquatic resource."

- Re-establishment
- Rehabilitation

2008 Federal Mitigation Rule: 33 C.F.R. § 332/40 C.F.R. § 230

What is restoration?

- Restoring lost functions

OR

- Restoring to a pre-disturbed condition

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Source: Michael Baker Corporation

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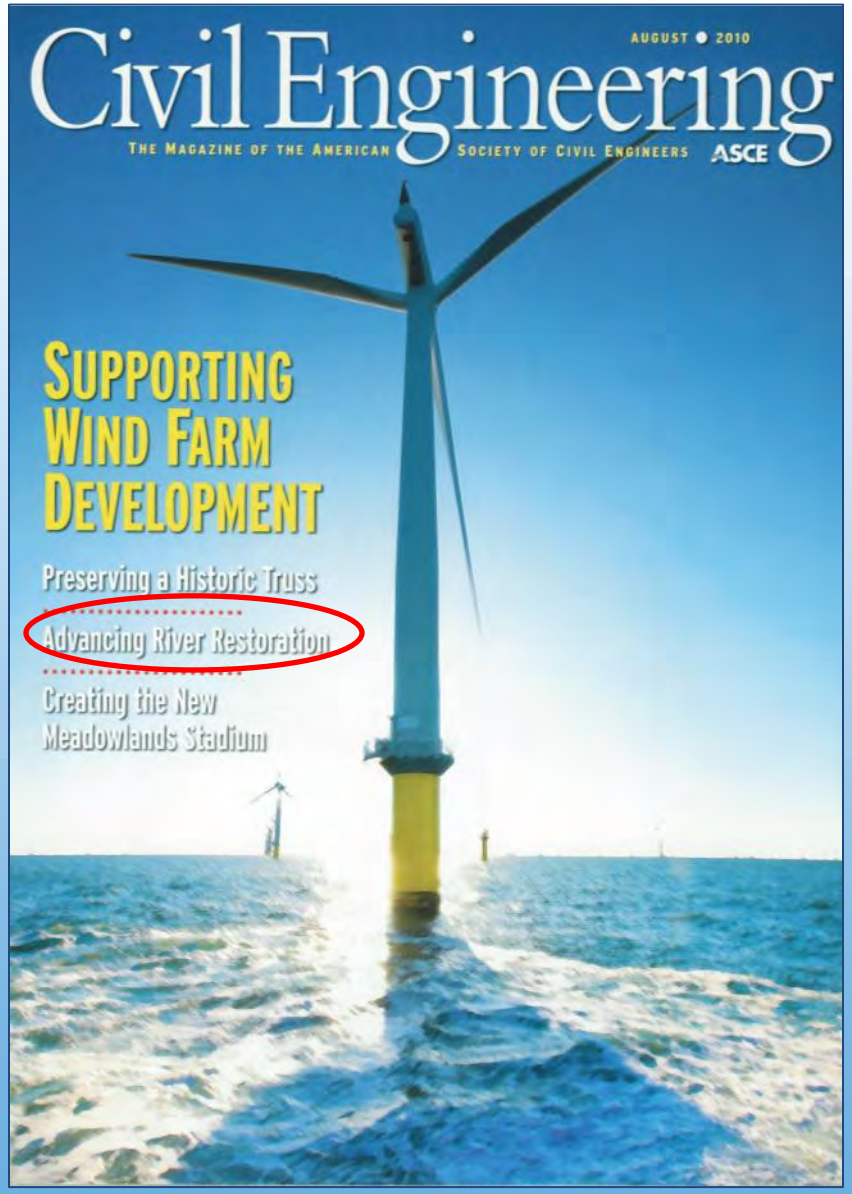

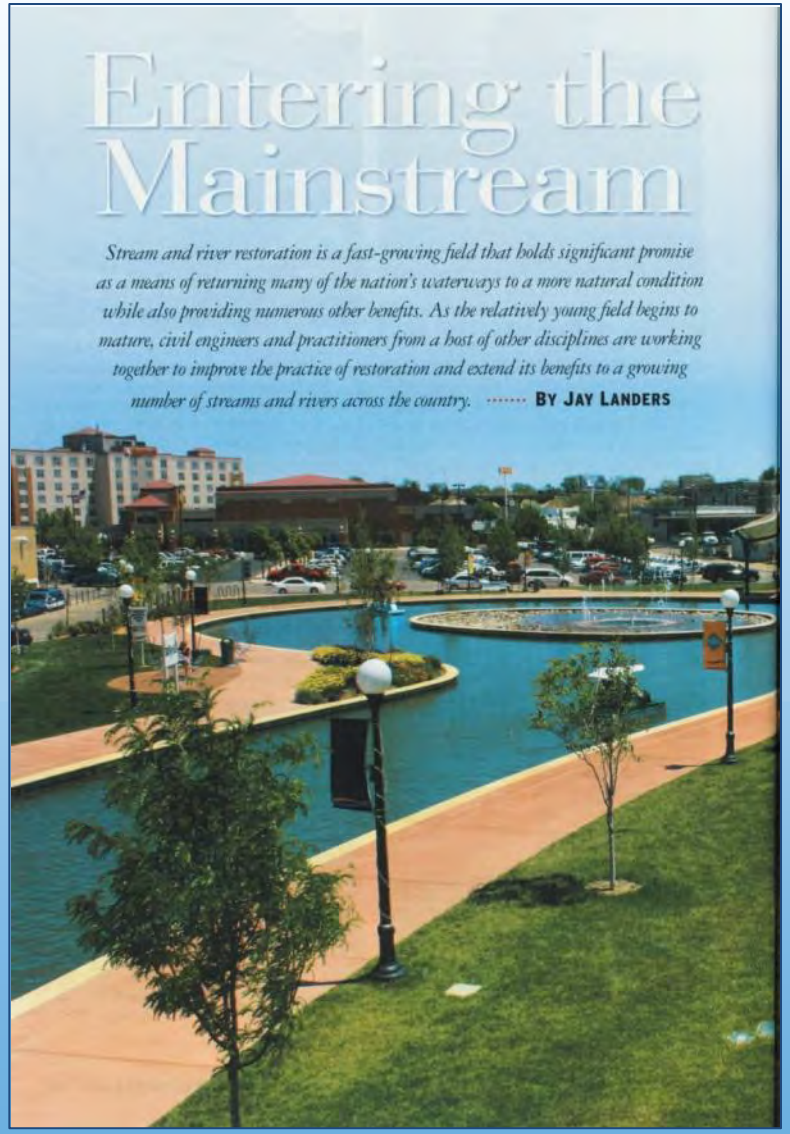

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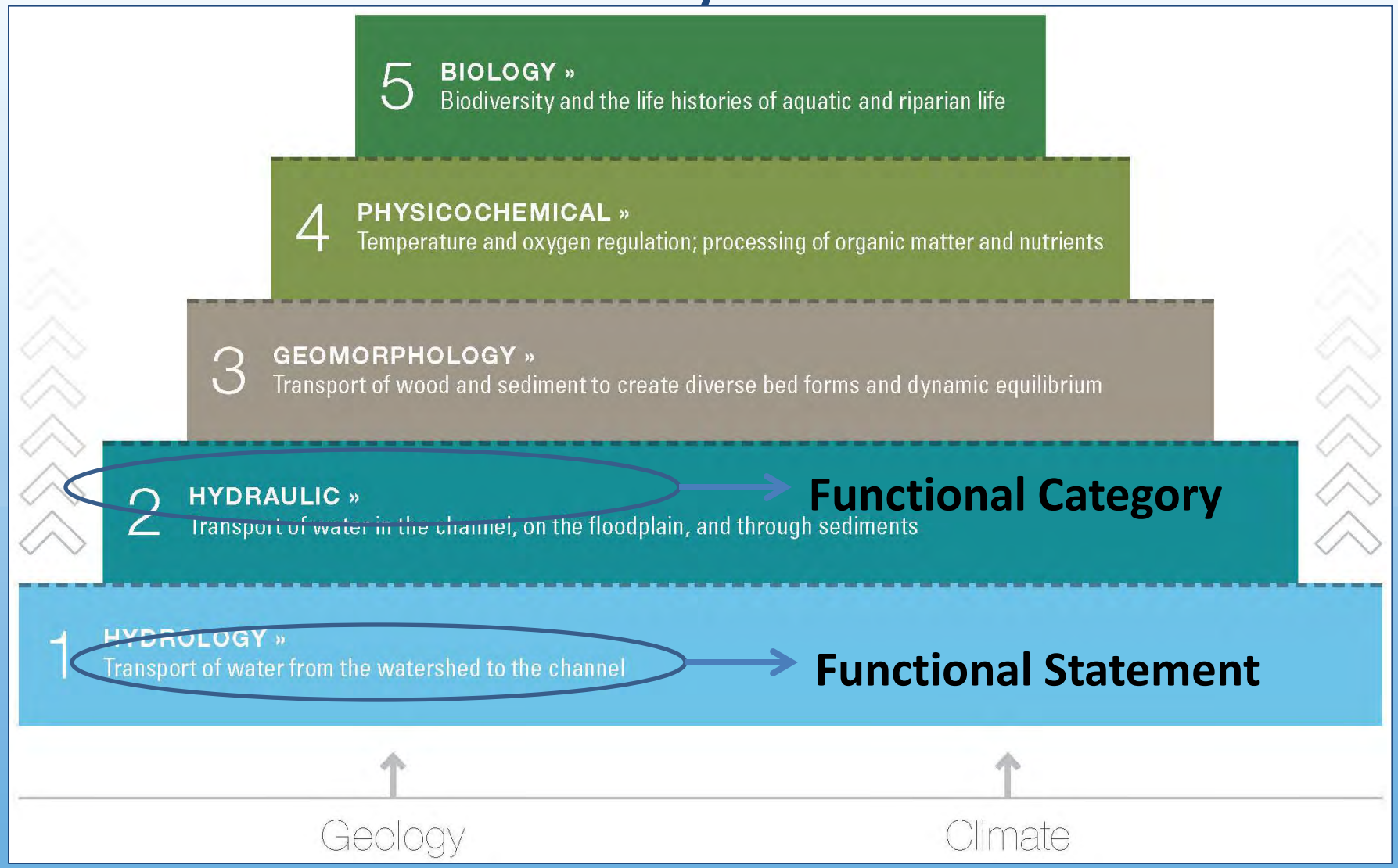
Stream Functions Pyramid: Broad Level



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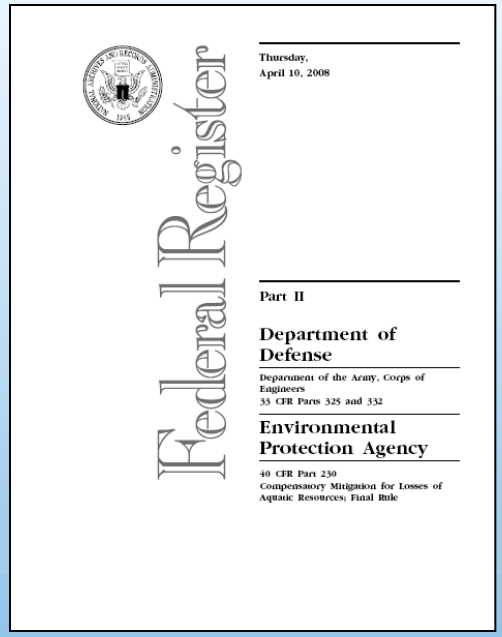
Idea Guided By Mitigation Rule

- Quantify lost functions at proposed impact site and “functional lift” at proposed mitigation site
  - Based on a functional/conditional assessment
- “Credit” reflects difference between restored condition and baseline condition
- Performance standards



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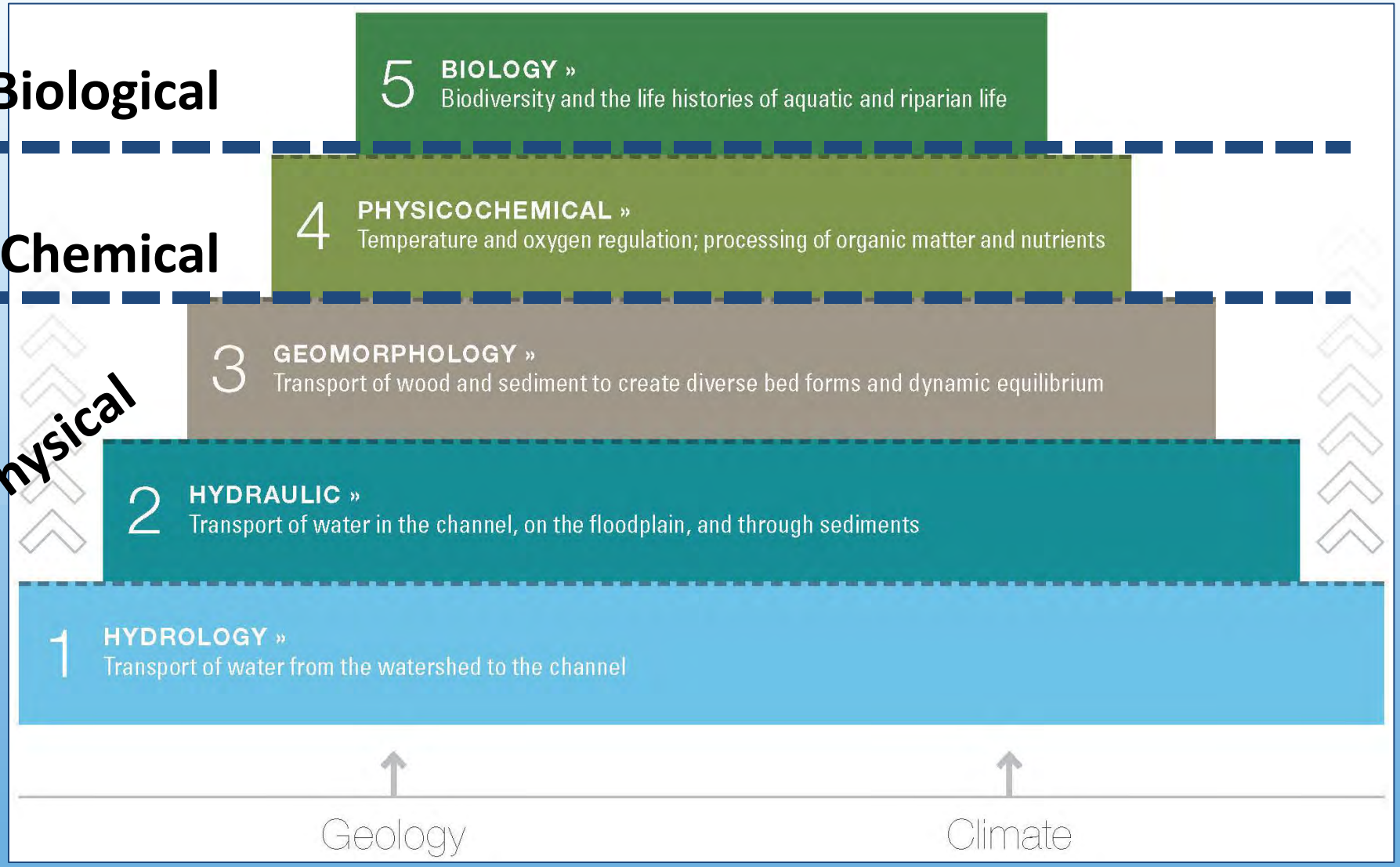
Function - The physical, chemical, and biological processes that occur in ecosystems.



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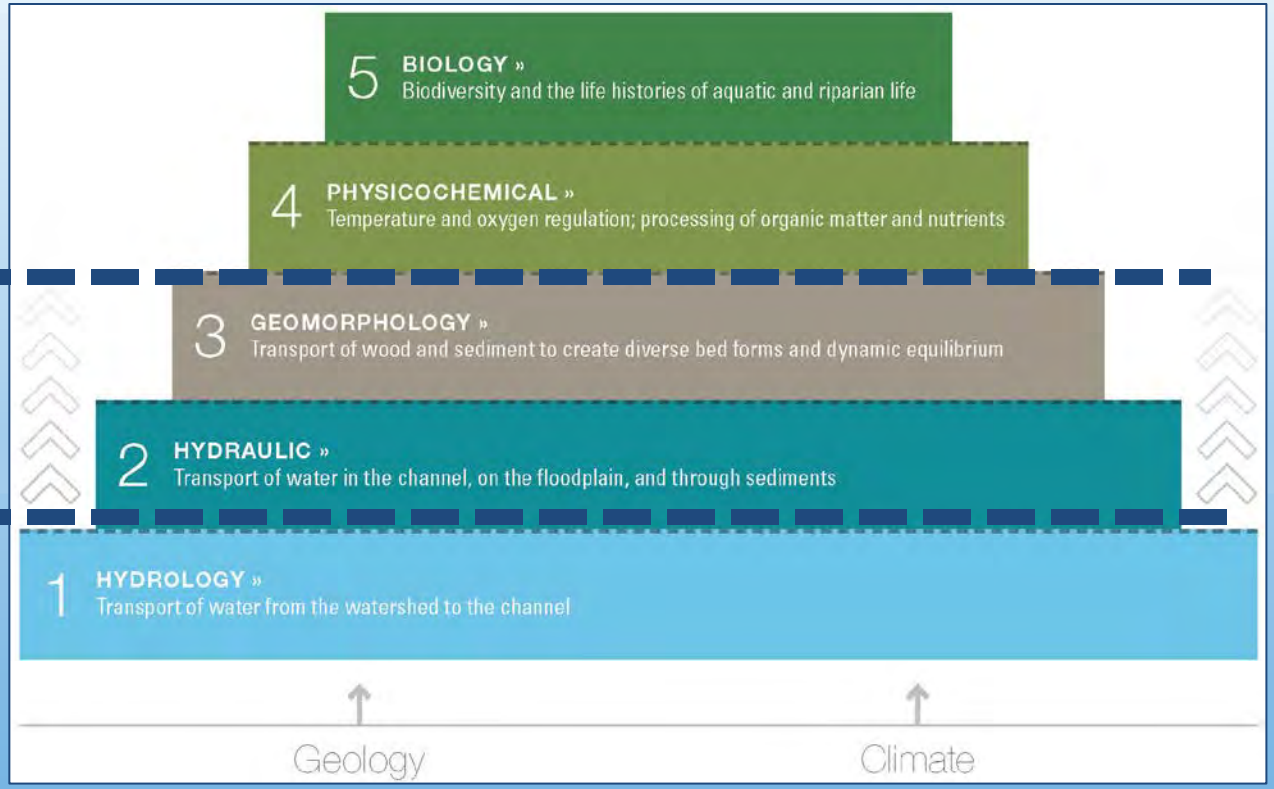
Stream Functions Pyramid

Site Selection

Reach Scale Improvements

Generally Independent Variables.



May be altered in headwater streams.

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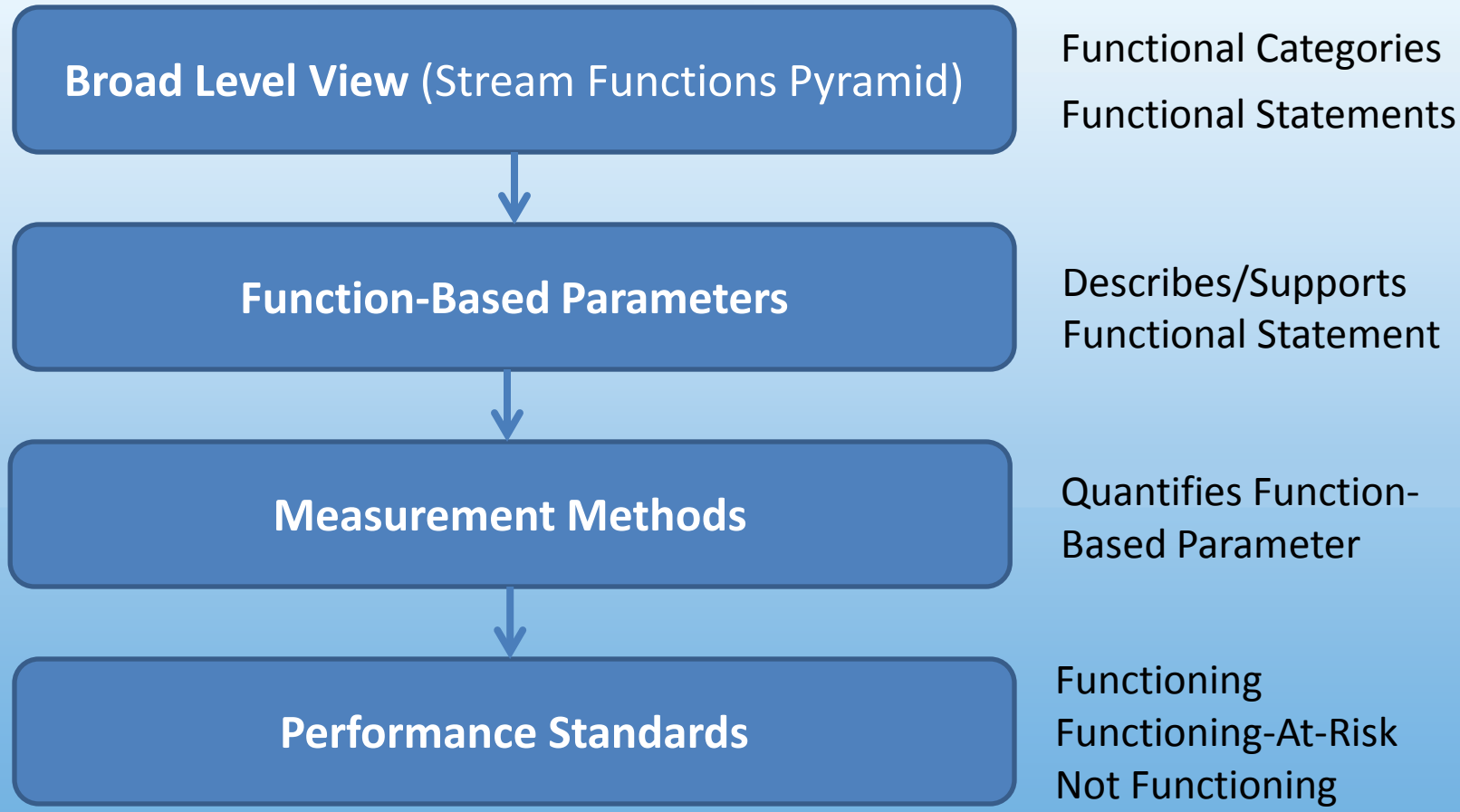
Stream Functions Pyramid Framework



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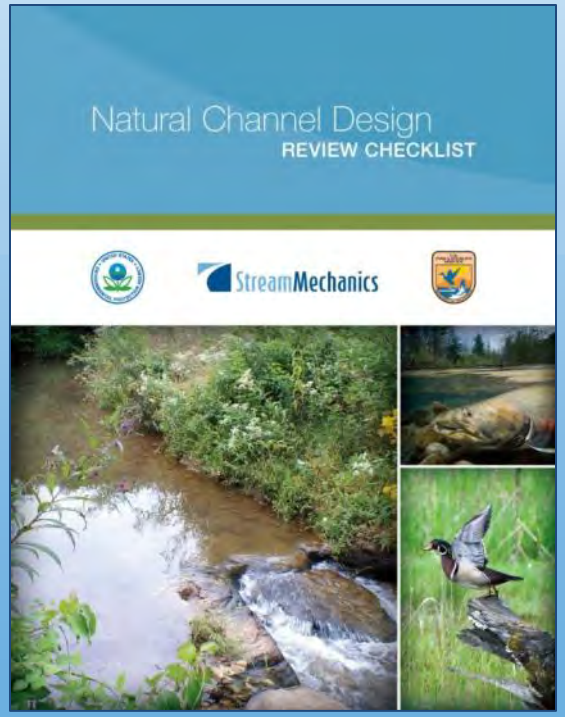
For More Information

- **Download Documents**
  - www.stream-mechanics.com
  - http://water.epa.gov/lawsregs/guidance/wetlands/wetlandsmitigation_index.cfm



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Site Selection

- Onsite
  - "Should I stay or should I go?"
- Offsite
  - What makes a good mitigation site?
  - What makes a bad mitigation site?

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The Answer – “It Depends”

The Key to Life –
“Know what it Depends On”

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+

=

Functional Loss

+

=

More Functional Loss

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On Site Selection Criteria

- Can “no net loss” of functions be achieved?
  - Functions and stream length are not the same thing
- Is the valley width sufficient?
- Are regulations compatible with the restoration approach?

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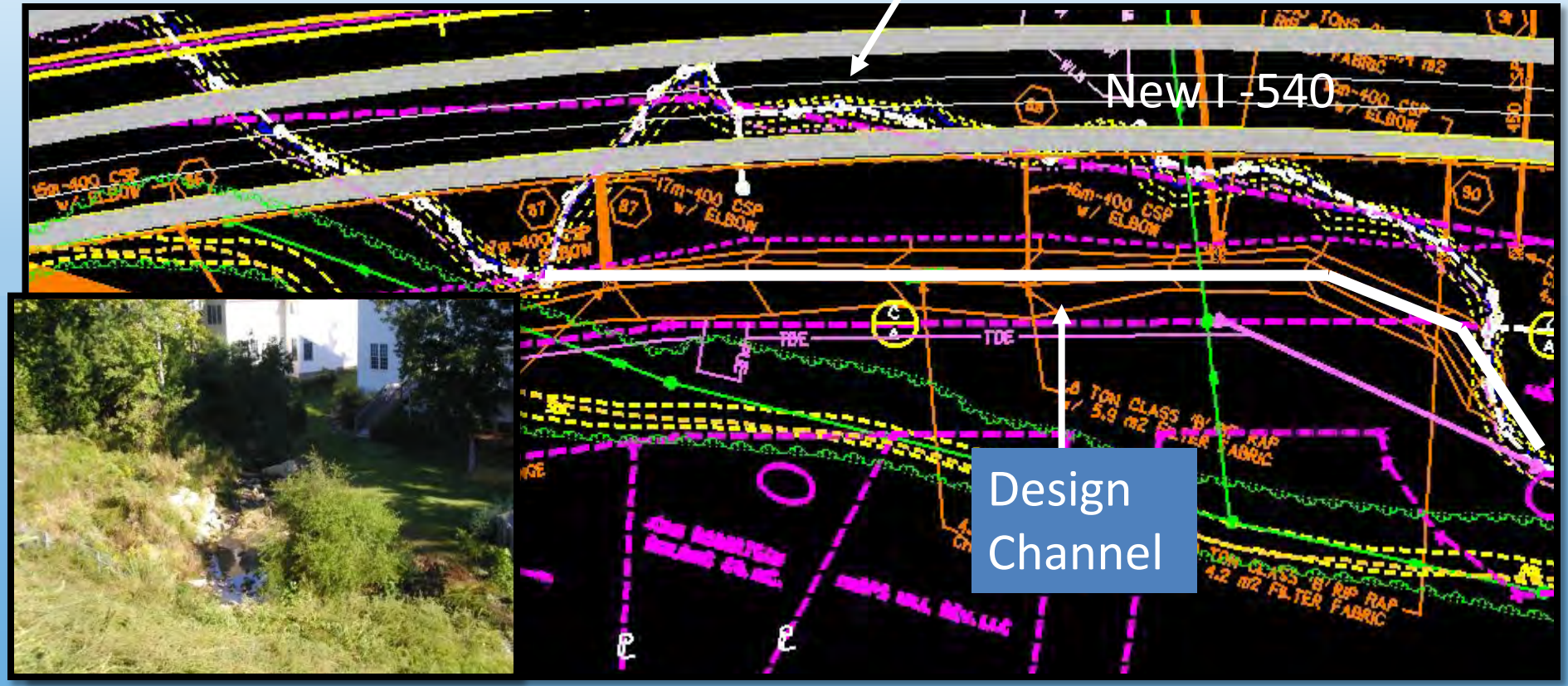
Transportation Example – Run Away



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Transportation Example: Stay and be happy

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Coal Mining Sites

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A Case for Onsite

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Offsite Selection “Issues”

- Watershed Approach
- Service Area
- Willing Landowners
- Land Cost
- Land Protection

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How do I know if this is a good site?

- Watershed Condition
  - What is the health of the upstream watershed?
- Project Reach Condition
  - Baseline function-based assessment
- Constraints
- Restoration Potential
  - What is the highest level of restoration that can be achieved based on the watershed condition, reach condition, and constraints?

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Source: Michael Baker Corporation

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How do I know if this is a bad site?

The goals do not match the restoration potential.

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When is it okay to “restore” one side of the stream … and when is it not okay?

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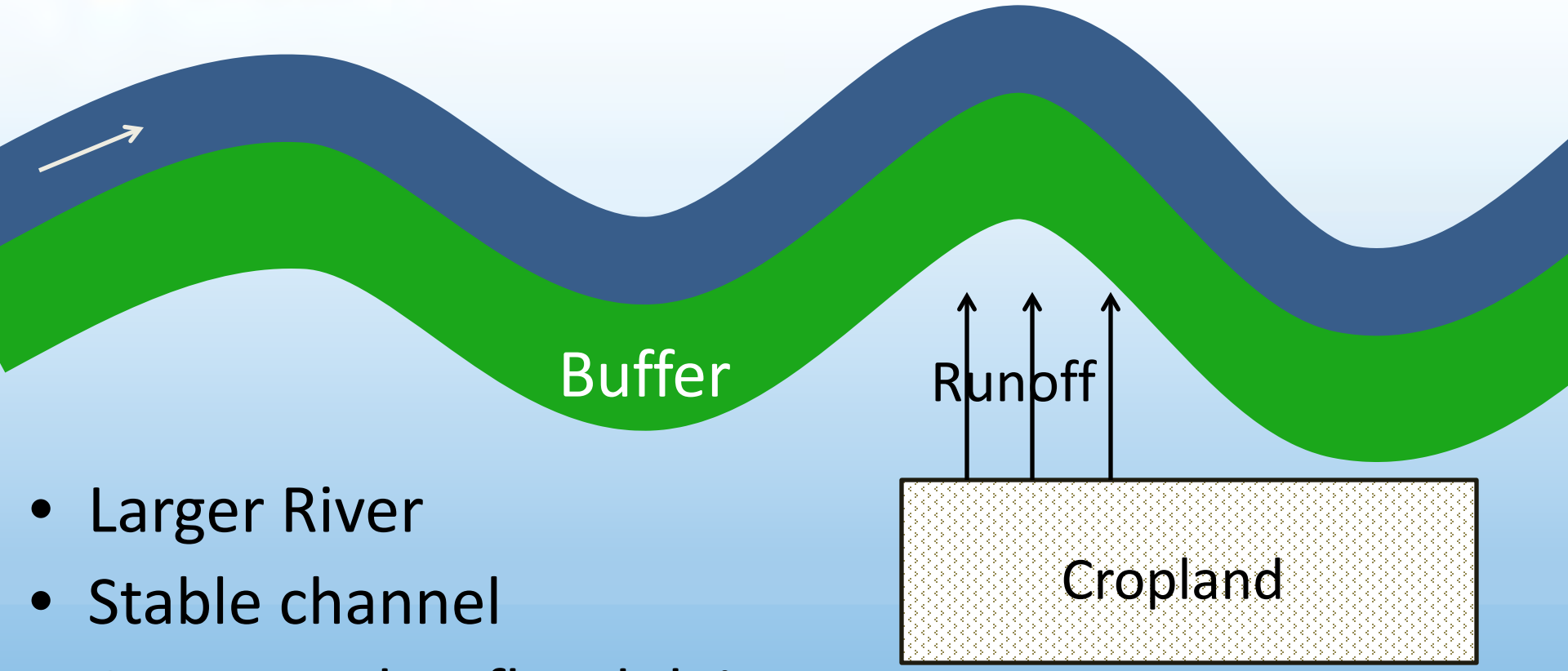
Okay



- Larger River
- Stable channel
- Connected to floodplain
- Treat runoff from adjacent sources
- Landscape connectivity

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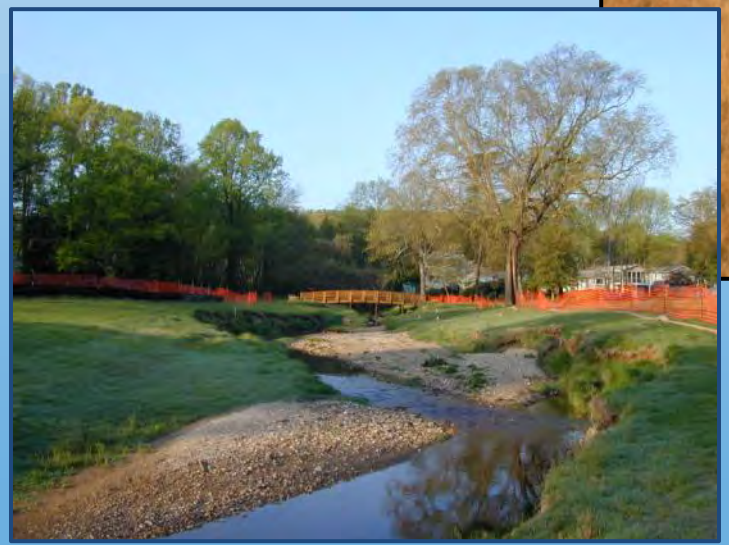
Not Okay

- Most projects, especially mitigation
- Unstable geometry
- Incised
- System-wide adjustments
- Changing watershed conditions



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Stream Restoration Approaches

- Natural Channel Design
- Valley Restoration
- Re-generative Design
- Large Woody Debris
- Dam Removal

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Natural Channel Design

- Founded by Dave Rosgen
- Typical Design Goal
  - Stable channel that transports water and sediment without aggrading or degrading
  - Looks natural, e.g., no concrete or rip rap

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Source: Michael Baker Corporation

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Excavated Floodplain

Source: Michael Baker Corporation

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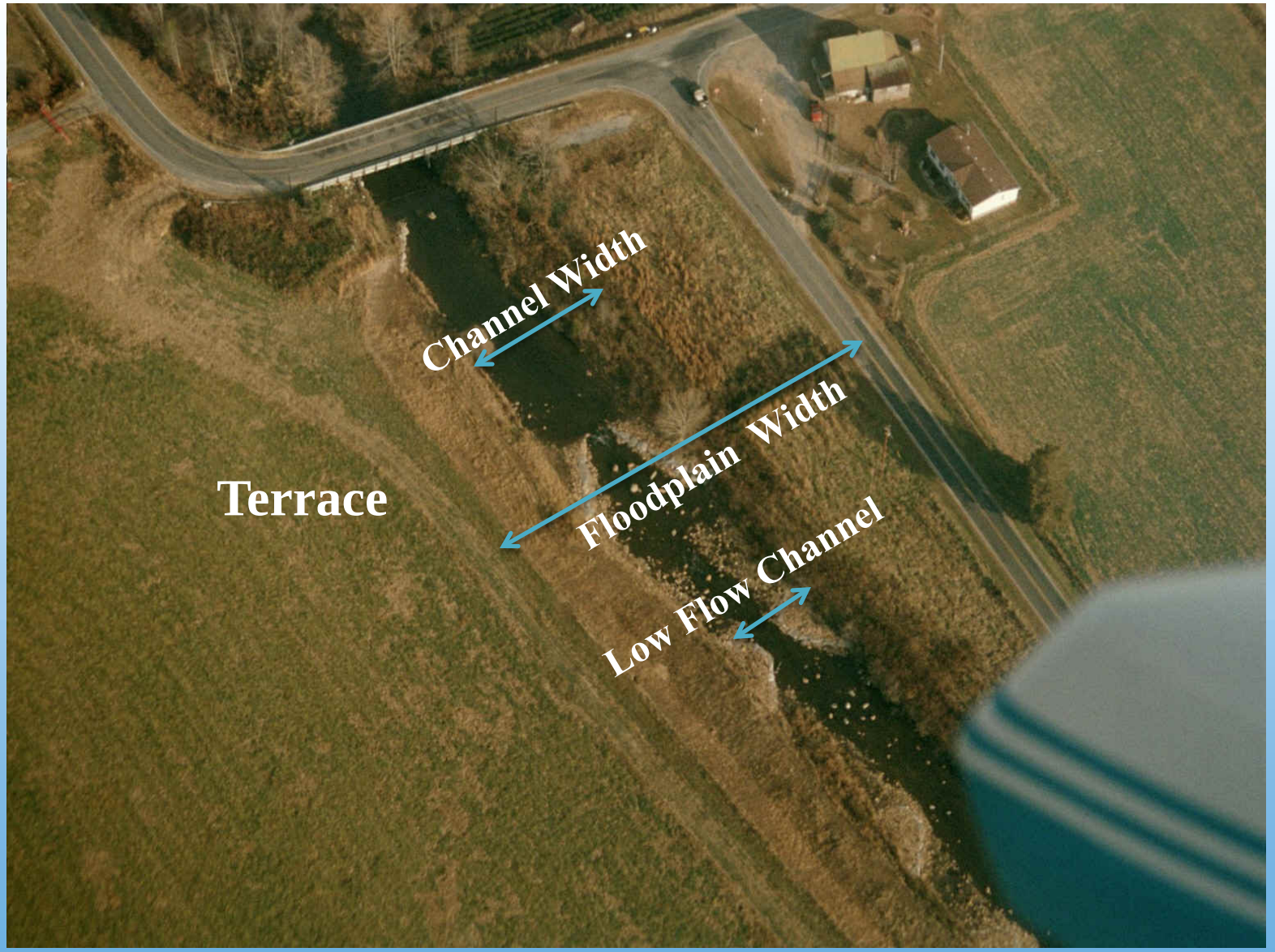

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Valley Restoration

- Developed By Art Parola
- Typical Design Goals
  - Reclaim a valley to prevent channel incision and encourage groundwater/surface water interaction
  - Keep channel as small as possible
  - Little to no sediment transport
  - Restore to pre-disturbed conditions
- Also pioneered by practitioners in the NC Coastal Plain

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Valley Restoration

Coming Soon!

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Regenerative Design

- Developed By Keith Underwood
- Biohabitats
- Applied in different settings
  - Ephemeral channels (stormwater outfalls)
  - Perennial streams to create wetland streams
- Stormwater BMP

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Regenerative Design

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Large Woody Debris Design

- Popular in Pacific Northwest
- Used to raise streambeds, create bed form and bed material diversity.
- Salmonid focus

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Dam Removal

- Typical Design Goals
  - Remove barrier for fish and other species
  - Remove unsafe dam structures
  - Restore riverine functions

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Right Tool – Right Problem

Tools

Problems

Restoration Approaches

Stream Impairment

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Thank You!