

Hierarchy of Stream Functions and Restoration

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Overview of Presentation

- Stream Functions Pyramid
- Examples of how it works when thinking about flood control and aquatic life / restoration.
- Considerations for the Working Group

Stream Function Perspectives

Engineers



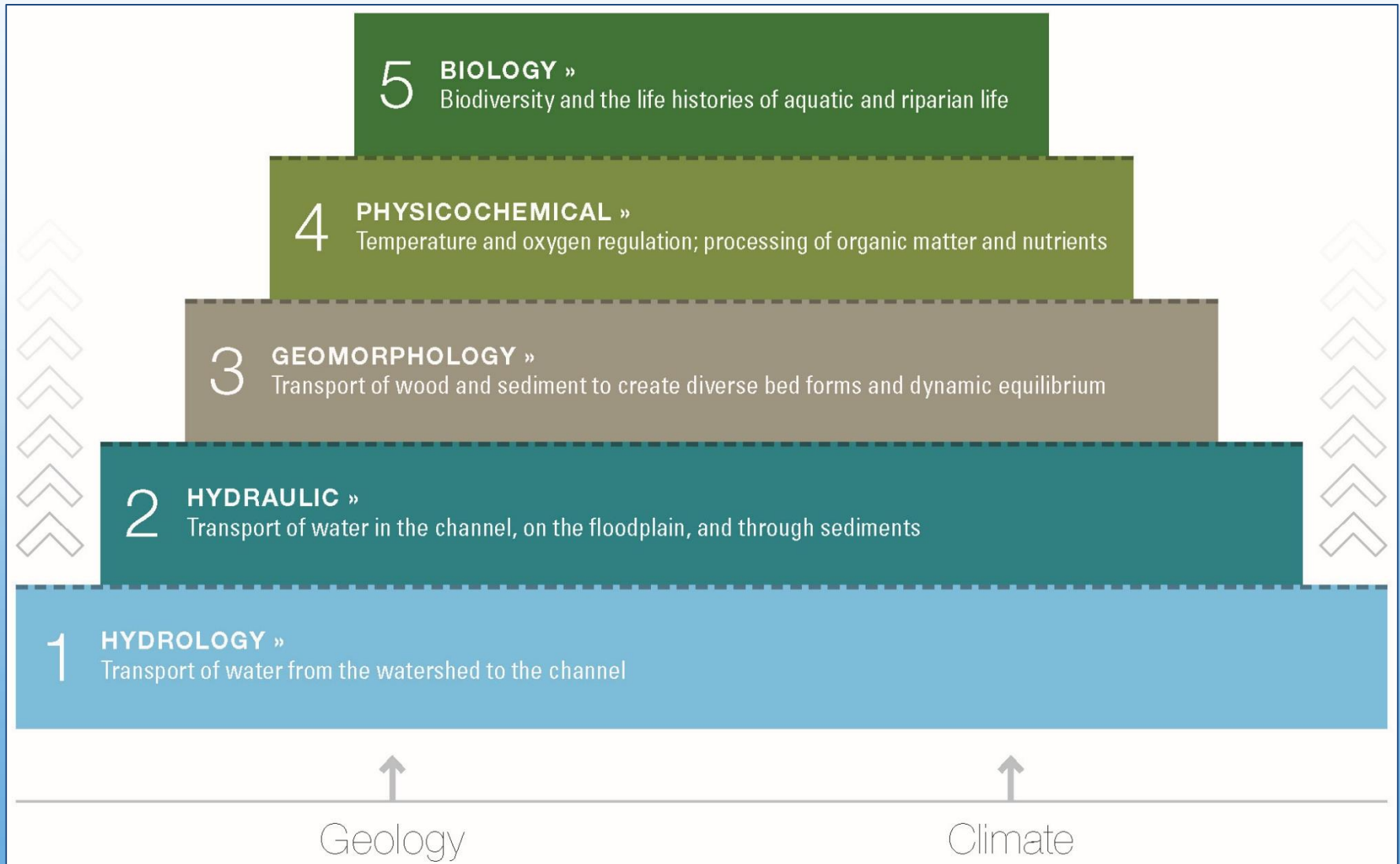
Geologists



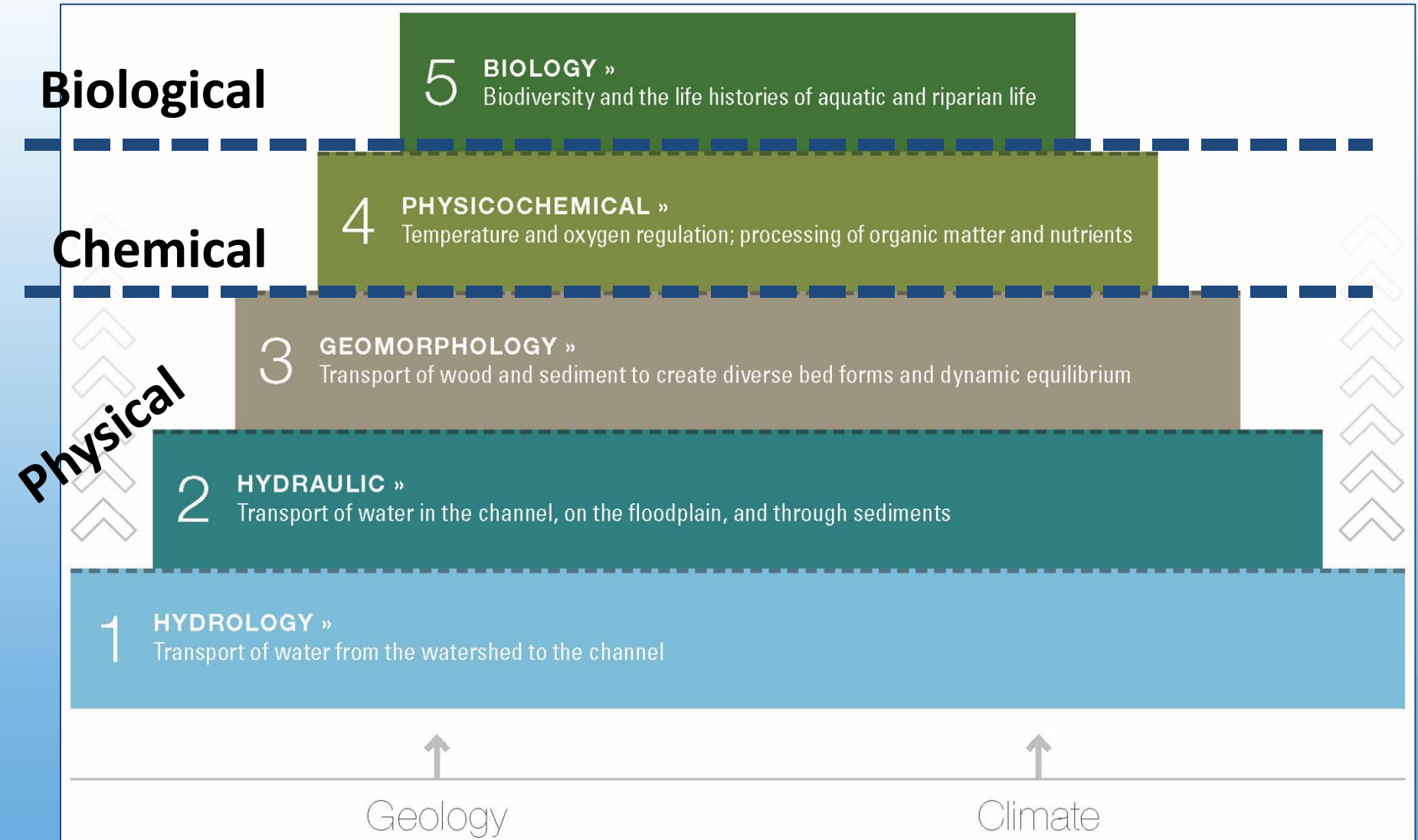
Ecologists



Stream Functions Pyramid



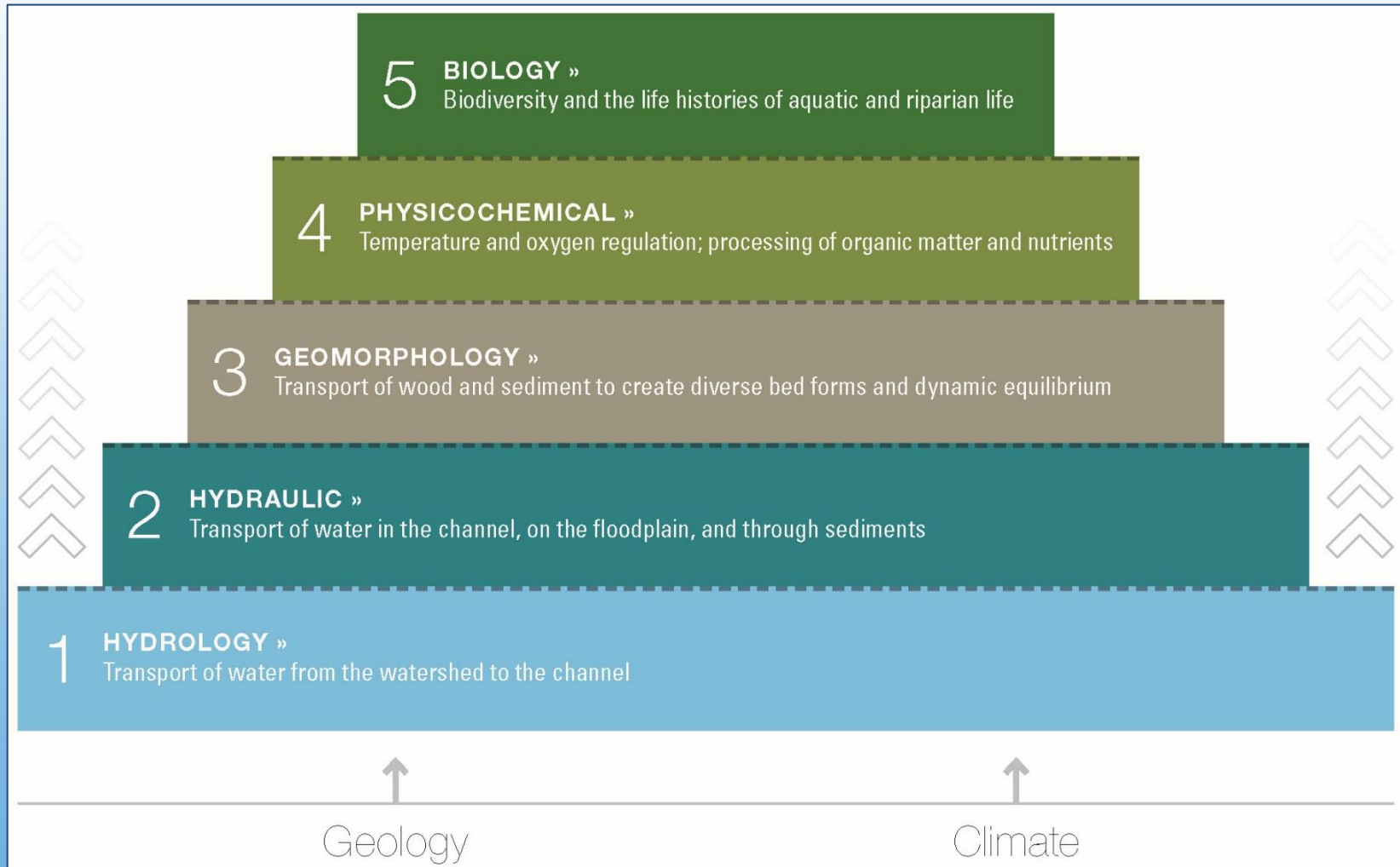
Function - The physical, chemical, and biological processes that occur in ecosystems.



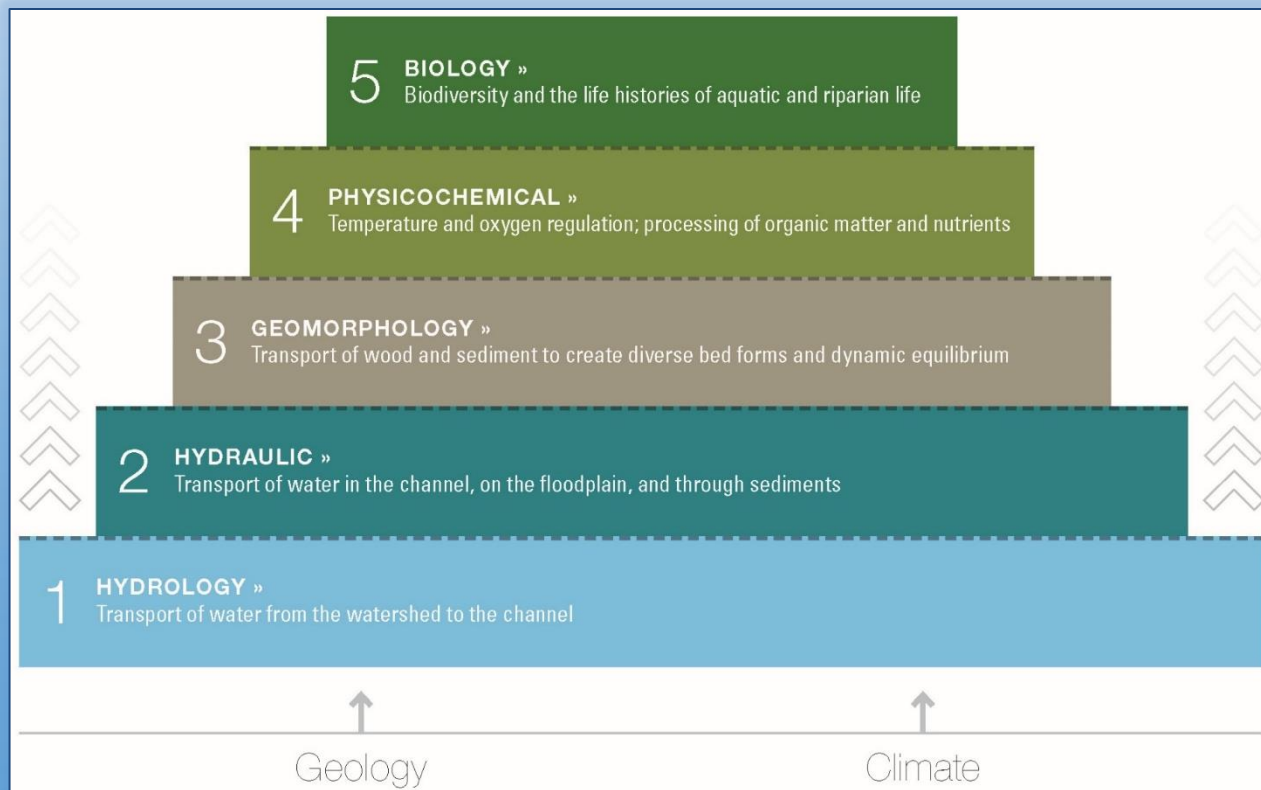
Effect



Cause



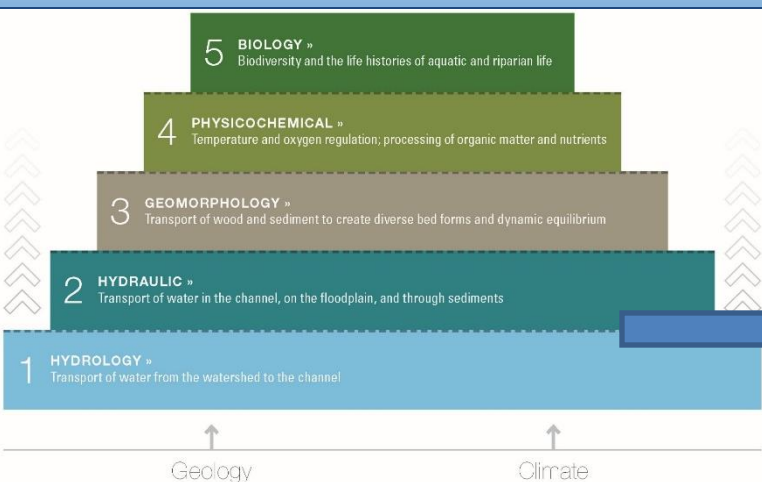
What happens when we manipulate functions in a watershed with and without considering this hierarchy?





Hydrology: Transport of water from the watershed to the channel

Hydraulics: Transport of water in the channel, on the floodplain, and through sediments.



This is our past

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 (*Degraded Rivers* by Ellen Wohl).

We will control the river!



No you won't!





Functions Impacted from Channelization

- Less Flooding
- 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.

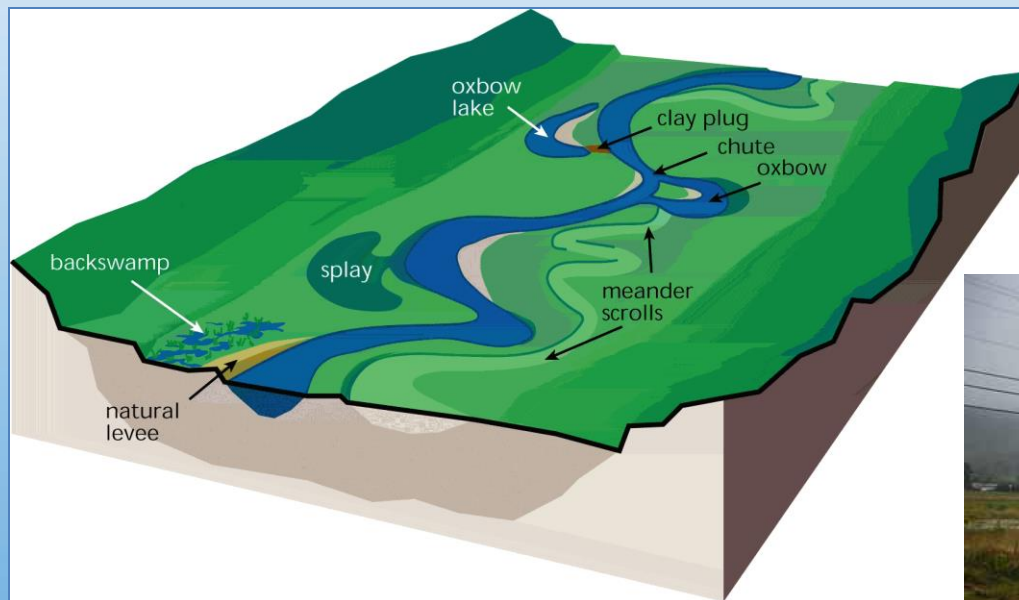
Kroes, D.E. and C.R. Hupp, 2010. The Effect of Channelization on Floodplain Sediment Deposition and Subsidence Along the Pocomoke River, Maryland. *Journal of the American Water Resources Association* 46(4):686-699.

Dams and Their Impoundments

- They do reduce downstream flooding, but..
 - They totally change the resource type from a stream (lotic) system to a lake (lentic) system.
 - This disrupts functions all the way through biology. Most lotic functions are lost.



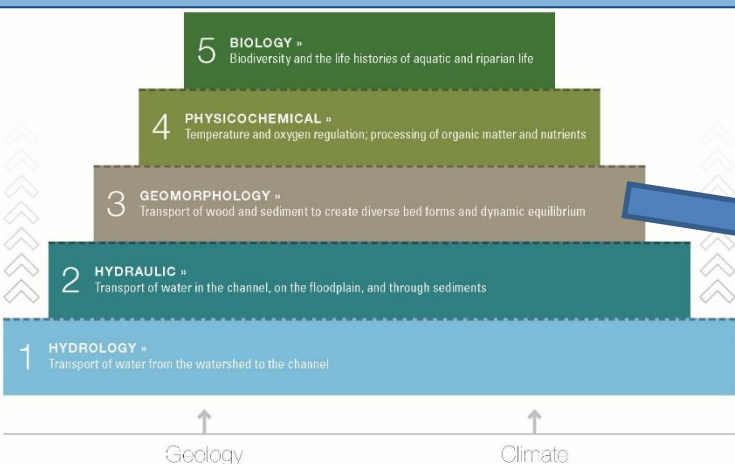
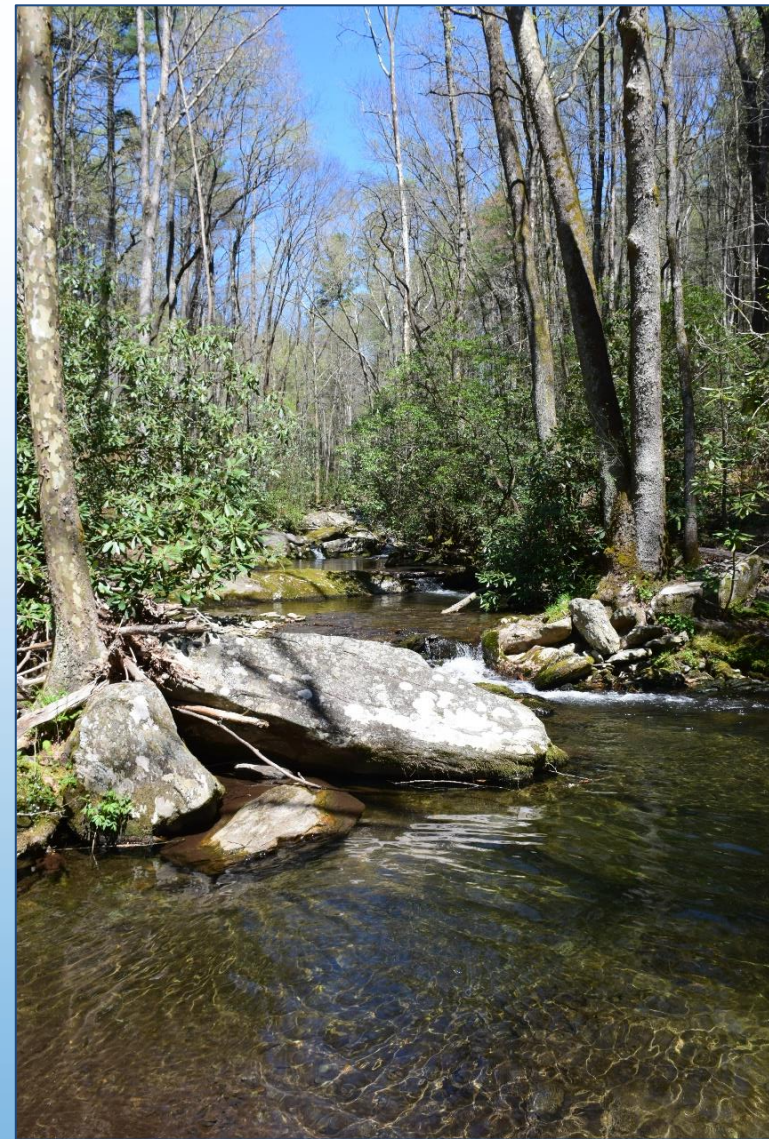
A key function is **floodplain connectivity**. It drives many of the higher order functions.



Stormwater Best Management Practices

- Reduce runoff while leaving the stream corridor intact.





Geomorphology: Transport of wood and sediment to create diverse bedforms and dynamic equilibrium.

What happens when geomorphology functions are ignored

Aggradation



Degradation



**Loss of
Habitat**



**Bank erosion /
sediment supply**



Key Metrics for Assessing Geomorphology

- Bedform Diversity (In-stream Habitat. Think riffles and pools)
- Riparian Vegetation (Channel and floodplain stability, habitat, organic matter contributions)
- Lateral Migration (Appropriate amount of streambank stability)

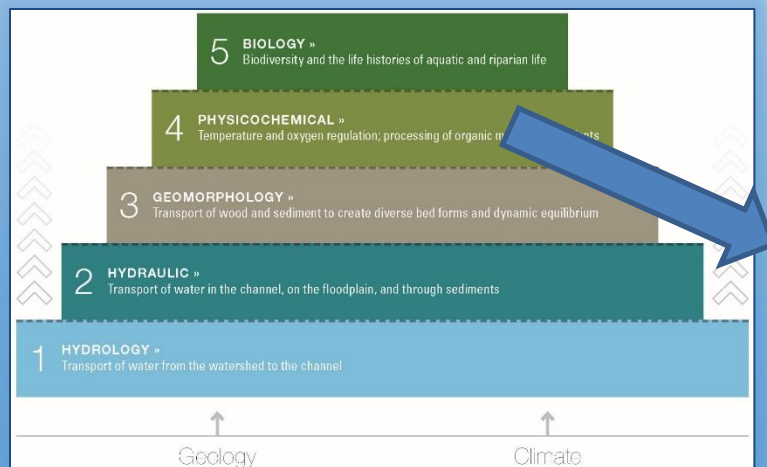
**Riparian
Vegetation**



Pool

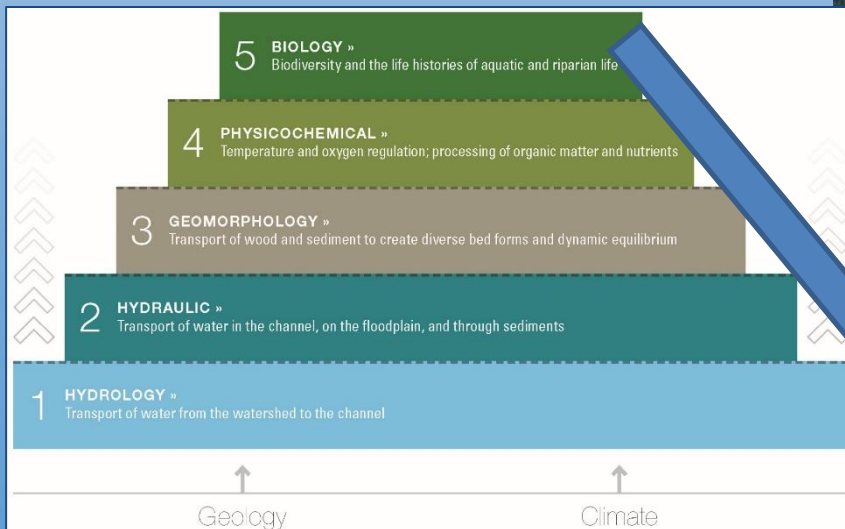
Riffle





Physicochemical. Temperature and oxygen regulation, processing of organic matter and nutrients.





Biology. Biodiversity and life histories of aquatic and riparian animal life.

If you want to provide flood protection for people AND support aquatic and riparian animal life, then...

- Give floodplains back to the stream/river.
- Reduce runoff from upland sources using stormwater BMPs and LID.
- Restore channelized streams, focus on floodplain connectivity, bedform diversity, riparian vegetation, and lateral stability.
- Preserve natural areas.