Assessing Stream Functions and Conditions – Challenges and Solutions

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Outline – 3 S's

- **Science**
- **Simplicity stump holes**
- **Sweet spot**

SCIENCE

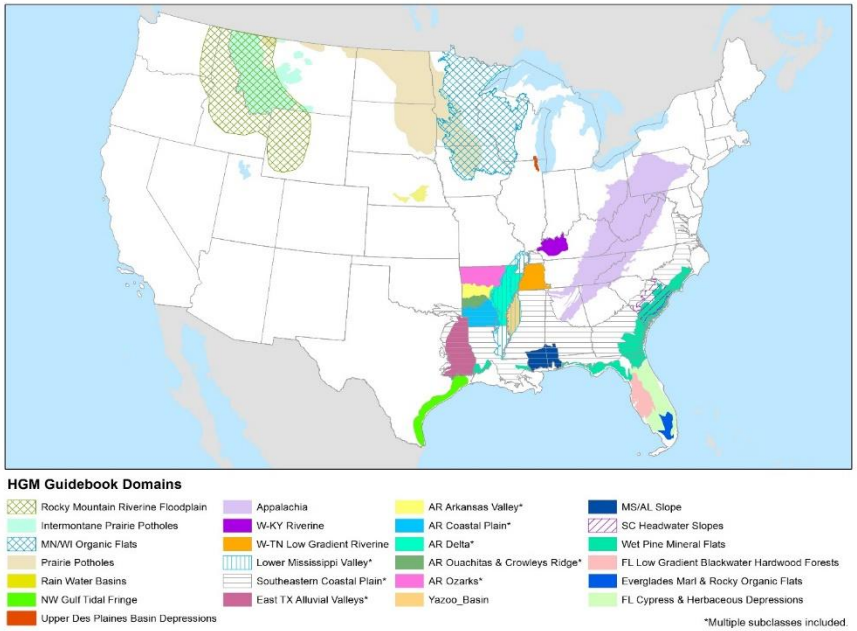
US Army Corps
of Engineers
Waterways Experiment
Station

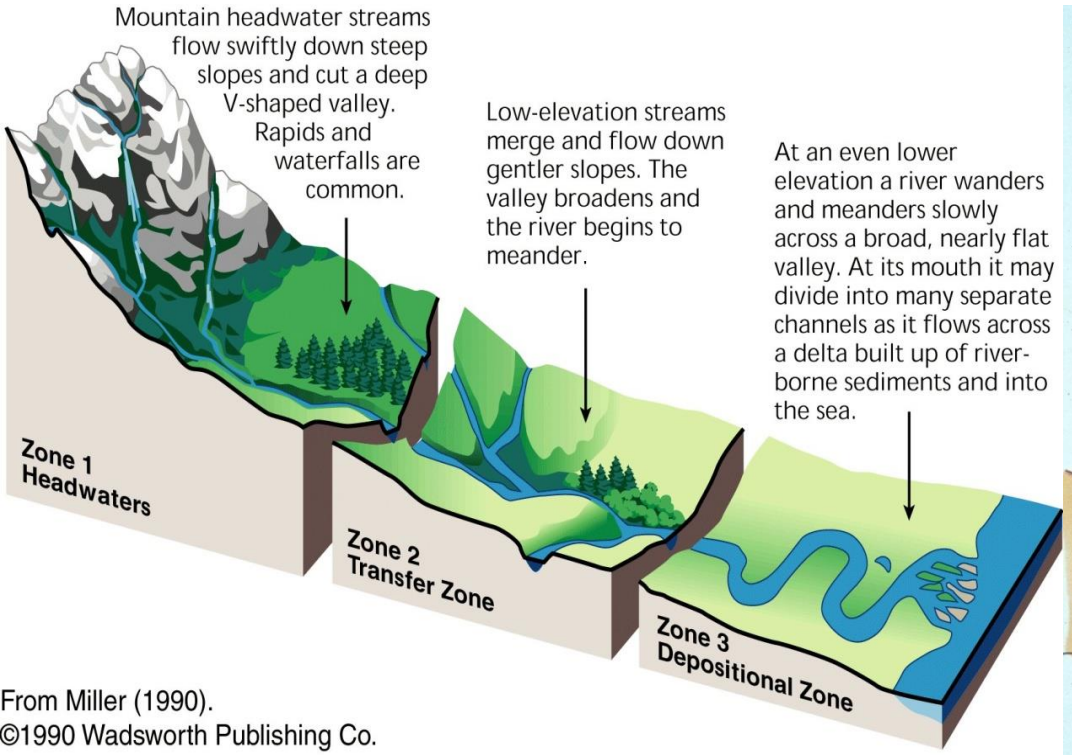
Wetlands Research Program Technical Report WRP-DE-11

A Guidebook for Application of Hydrogeomorphic Assessments to Riverine Wetlands

by Mark M. Brinson, Richard D. Rheinhardt, F. Richard Hauer,
Lyndon C. Lee, Wade L. Nutter, R. Daniel Smith, Dennis Whigham

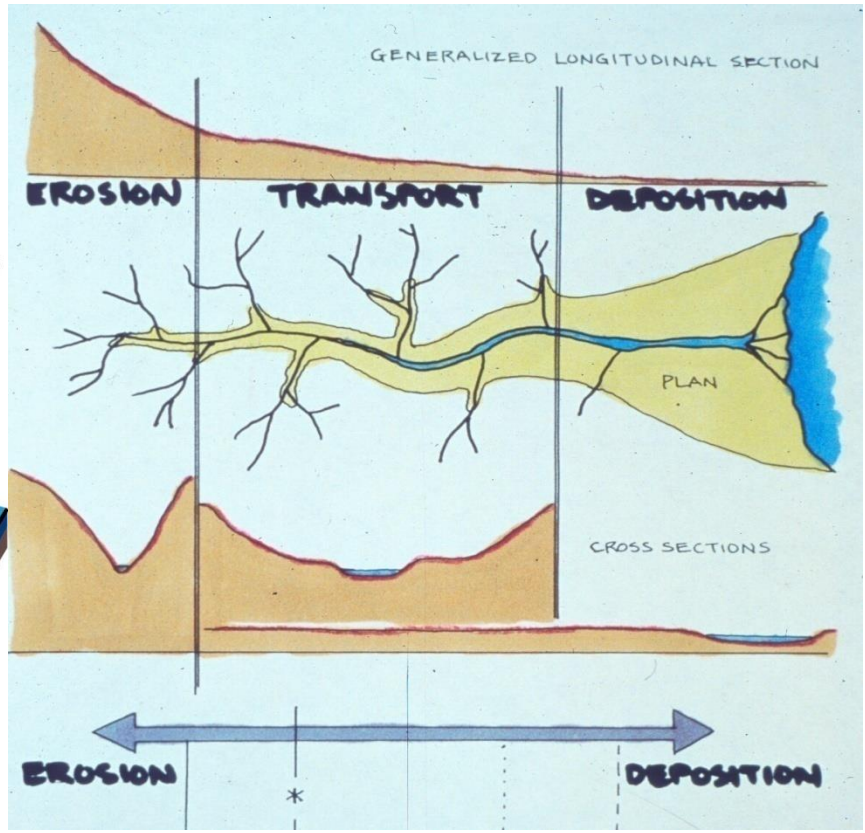
December 1995 – Operational Draft
Approved For Public Release; Distribution Is Unlimited



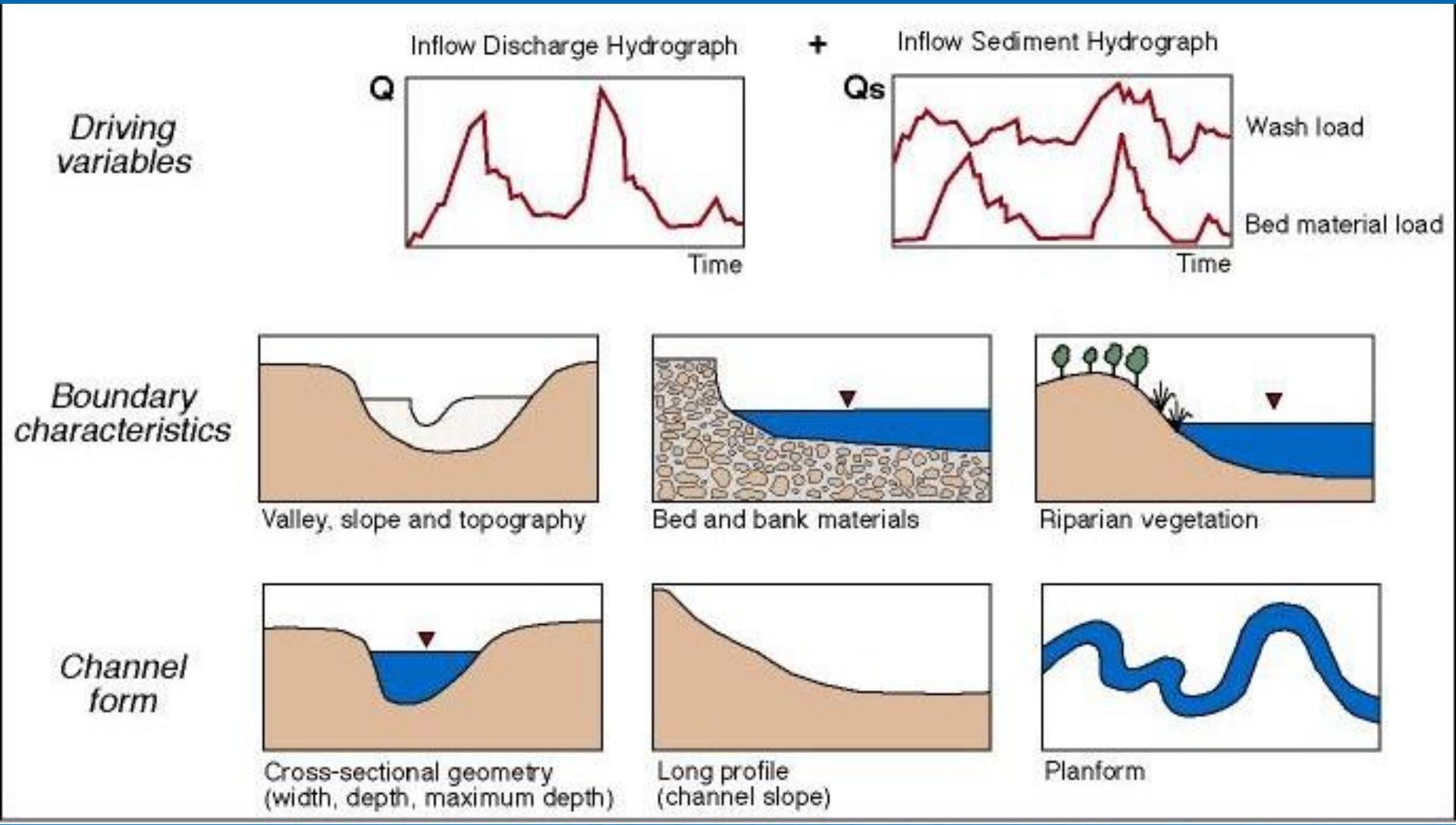


From Miller (1990).

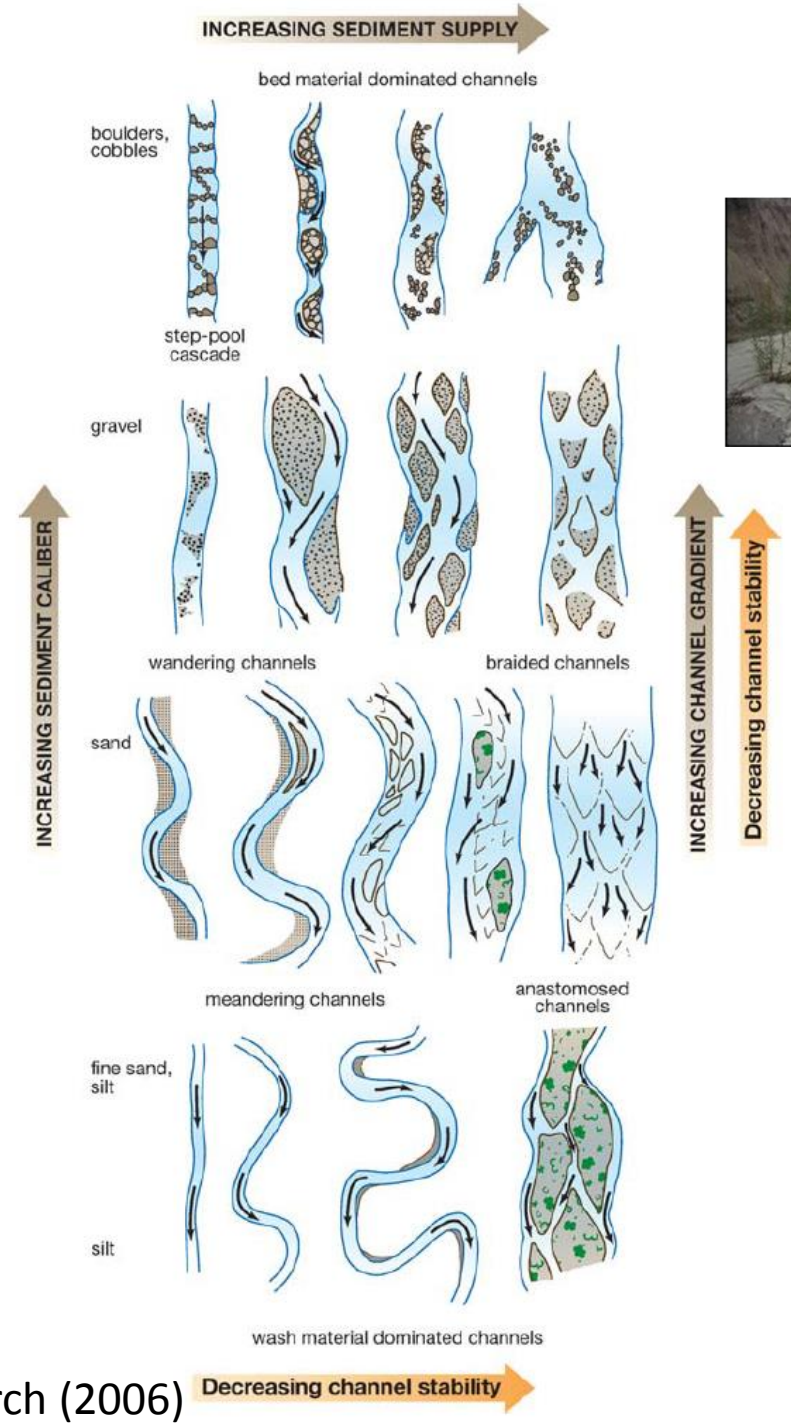
Fig. 1.27 – Three longitudinal profile zones.
In Stream Corridor Restoration: Principles, Processes, and Practices, 10/98.
Interagency Stream Restoration Working Group (15 Federal Agencies of the US).



Independent and Dependent Controls



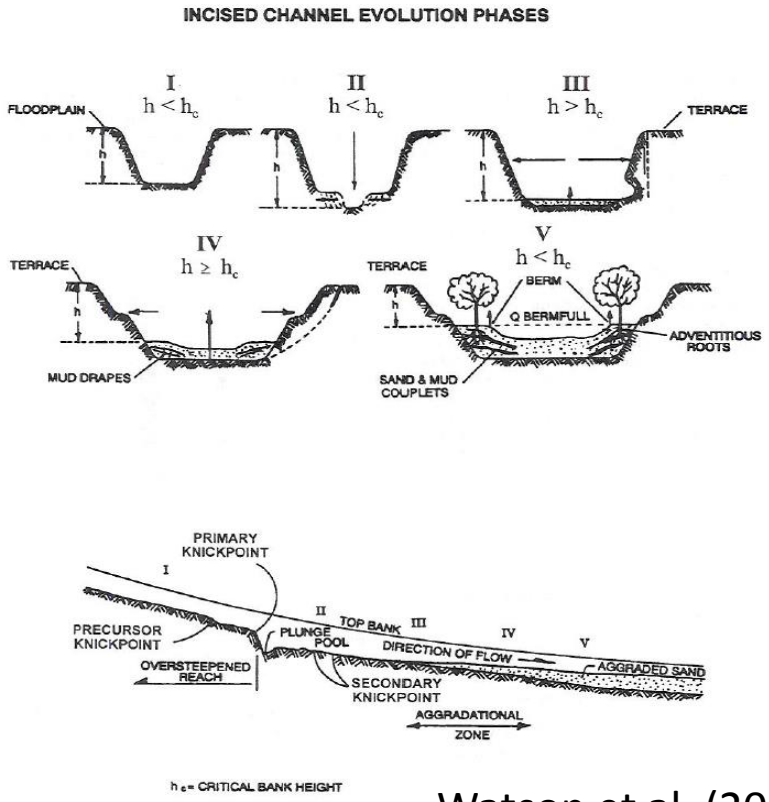
Thorne (1997)



Church (2006)

$$\text{Transience} = \frac{\text{recovery time}}{\text{time between disturbance events}}$$

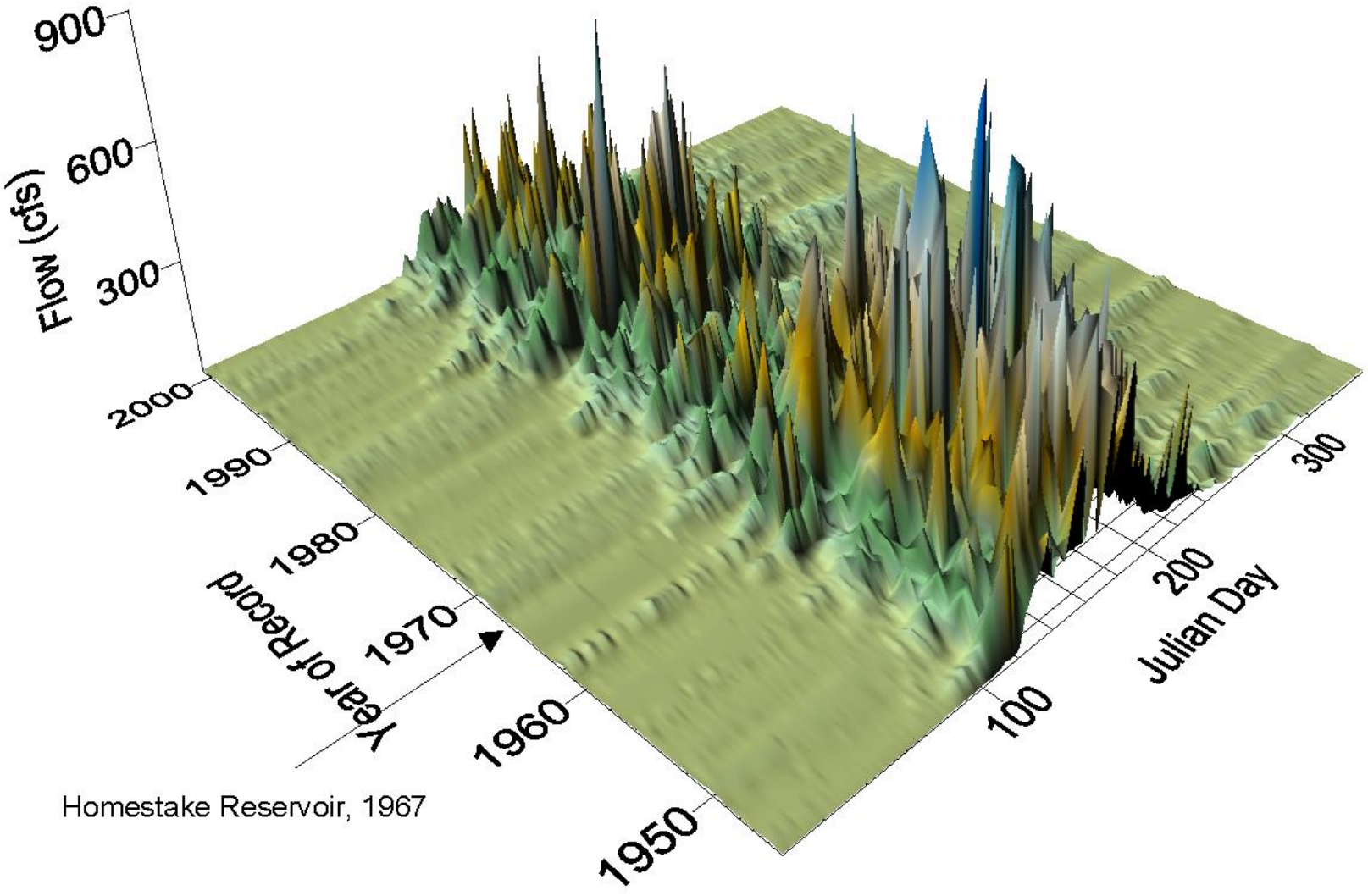
Highly sensitive | Sensitive | More resistant



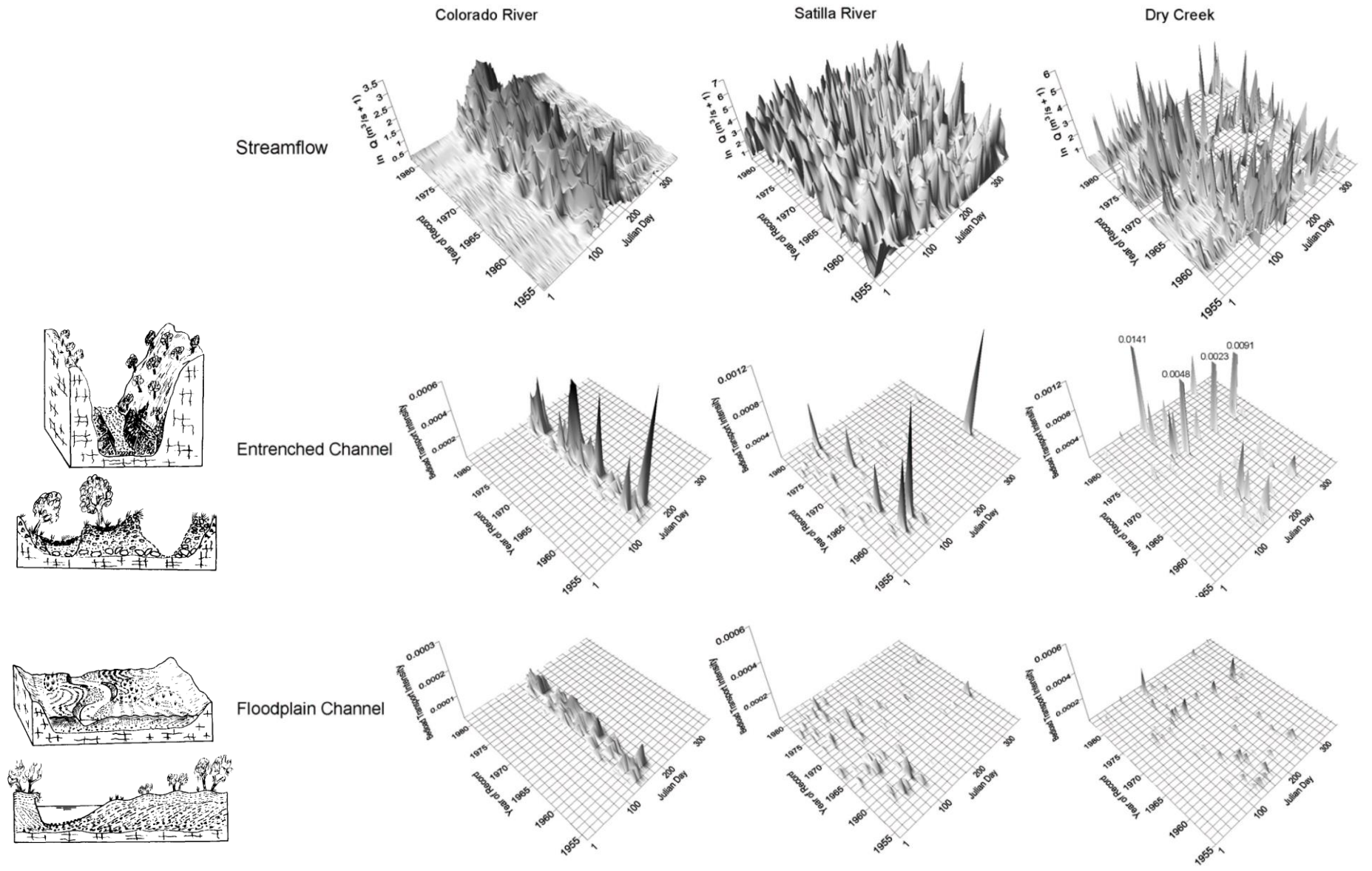
Watson et al. (2002)

Parameter	Sand bed	Gravel bed
Bed material transport	Continuous	Episodic
Variation in sediment transport	(Velocity) ^{5}	(Velocity) ^{3}
Armoring	Ineffective	Significant
Bed forms and changes in bed roughness / configuration	Rapidly adjusting across flow events	Not rapidly adjustable / formed by relatively infrequent events
Scour depth	Deep	Shallow
Variation in scour depth	Rapid	Slow
Slope and Stream Power	Low	High
Channel response to changed hydrology	Rapid	Slower
Sensitivity to changed sediment loads	High	Lower
Variation in bed material size	Small	Large

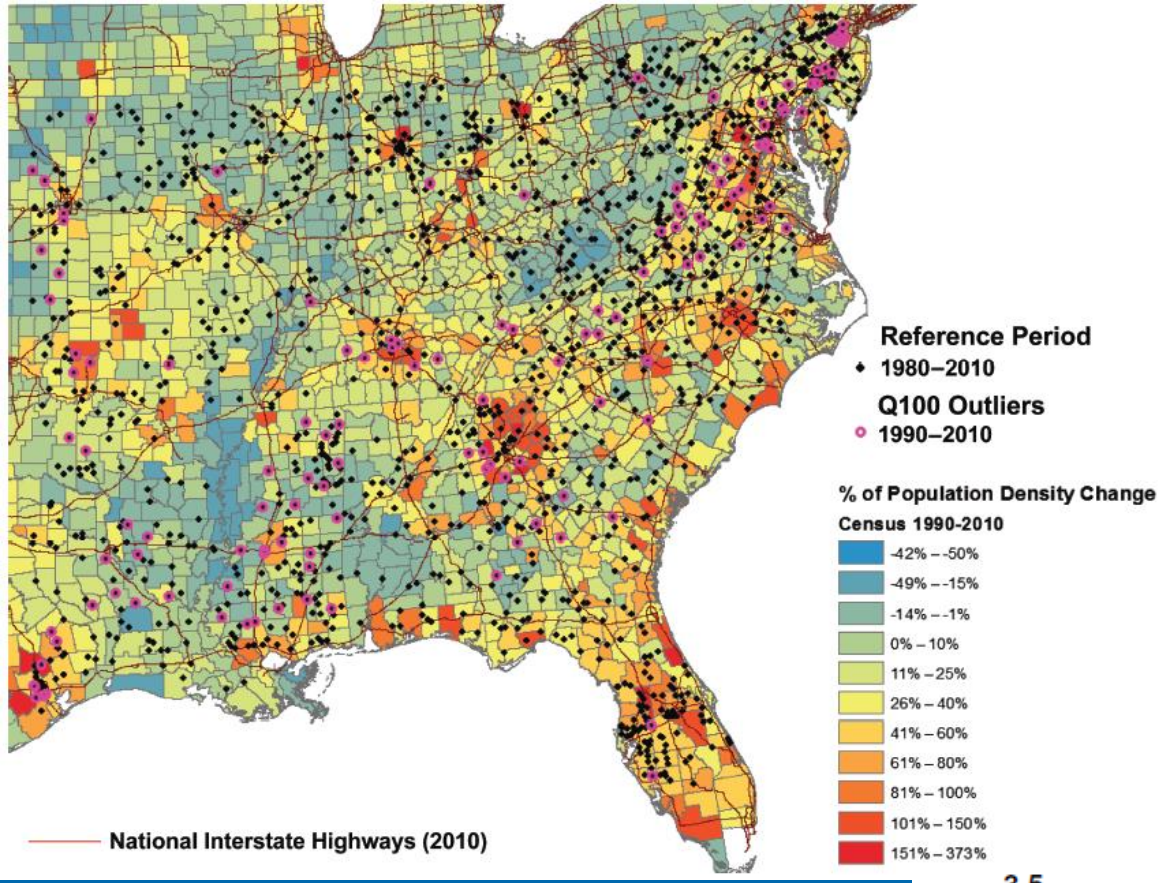
Flow Regime



Homestake Reservoir, 1967



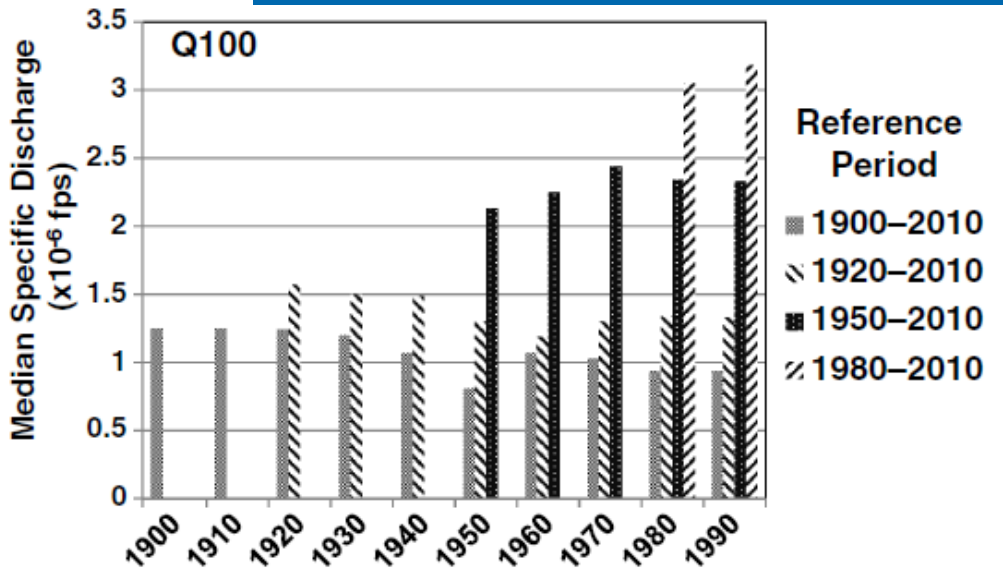
Physical habitat created, destroyed, recreated – a shape-shifting mosaic of patches



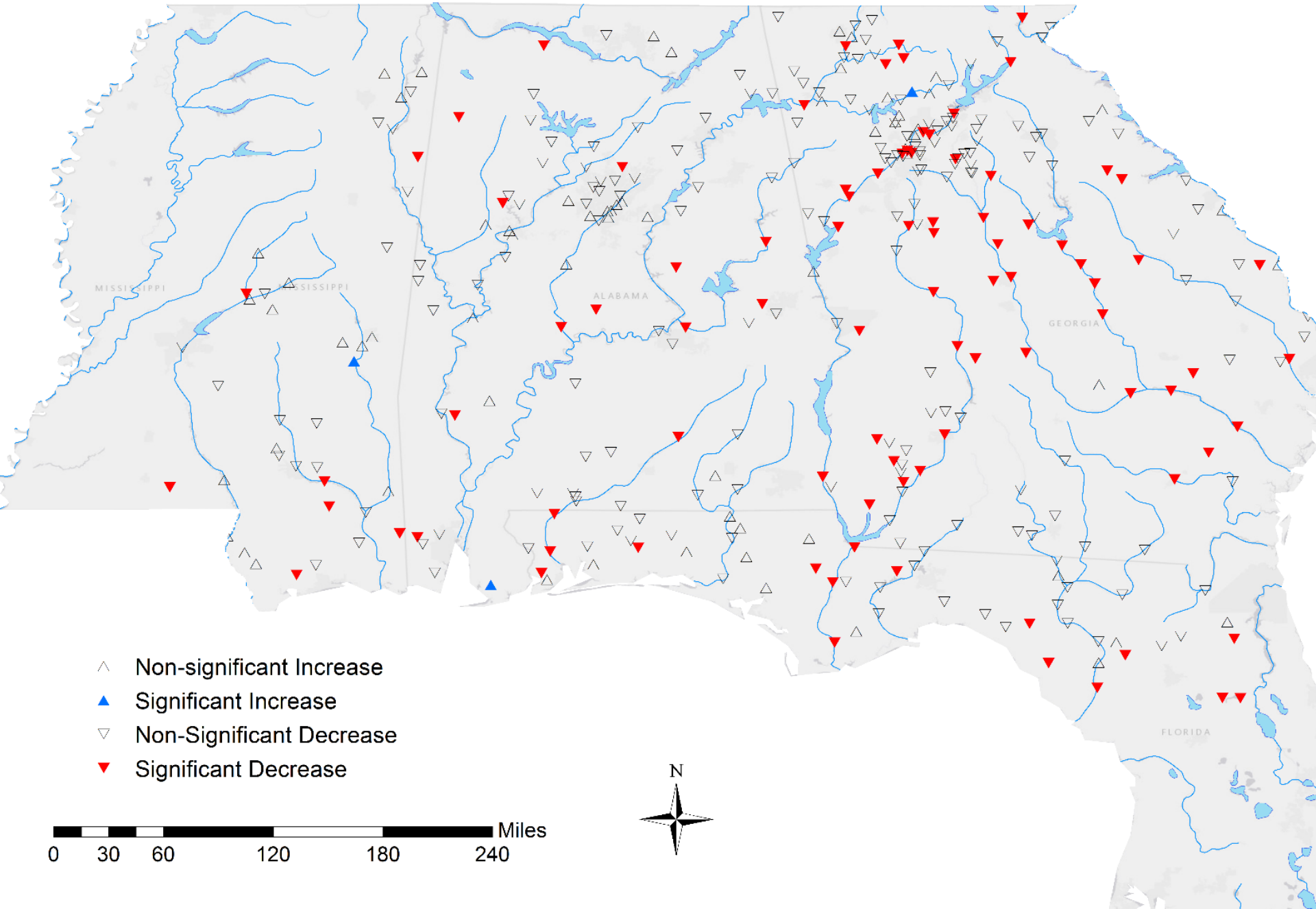
Change in flood risk is not new.

But how will land use change interact with climate?

Barros et al. (2014)



Trends in the Annual Minimum 7-day Mean Streamflow



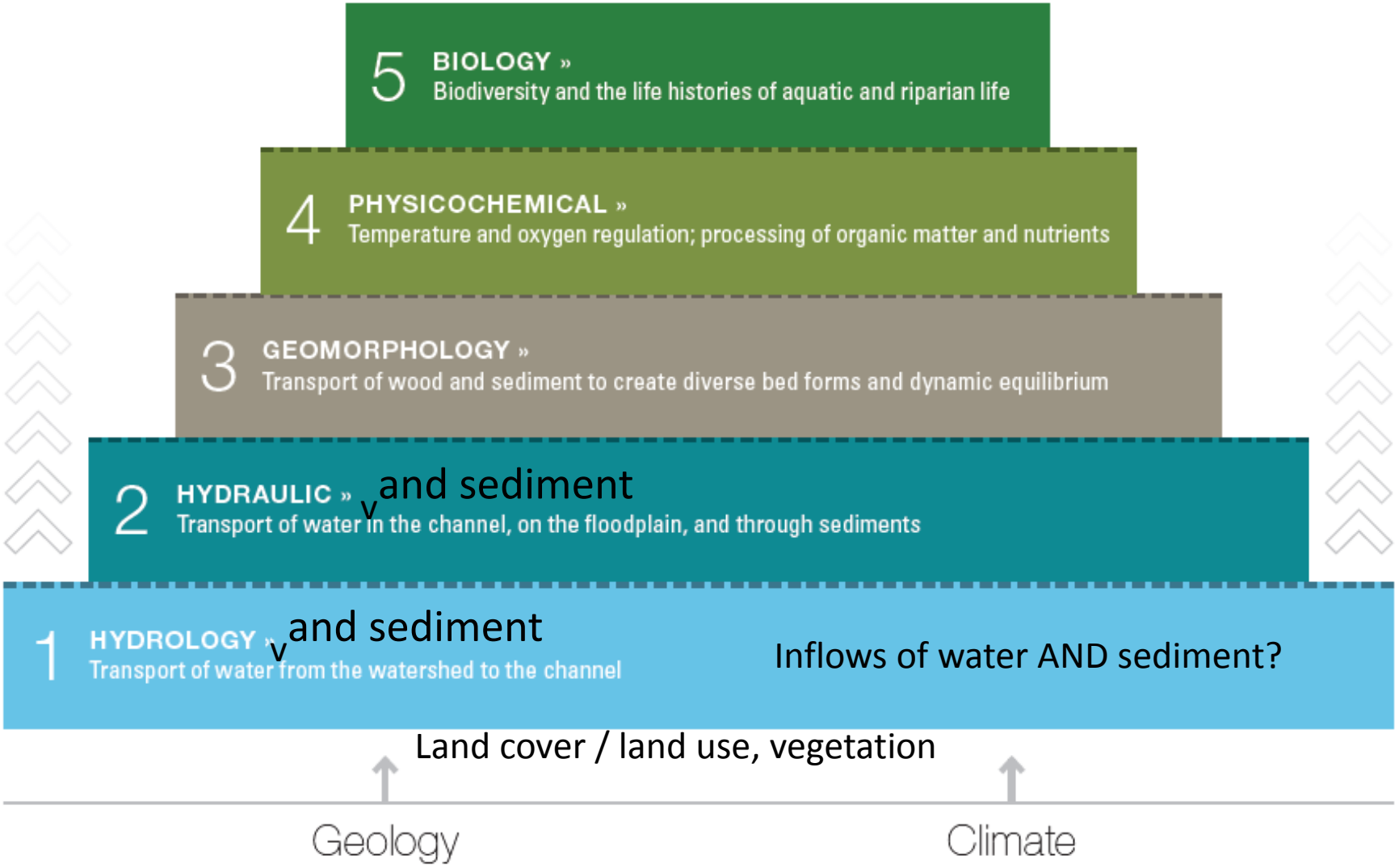
SIMPLICITY STUMP HOLES

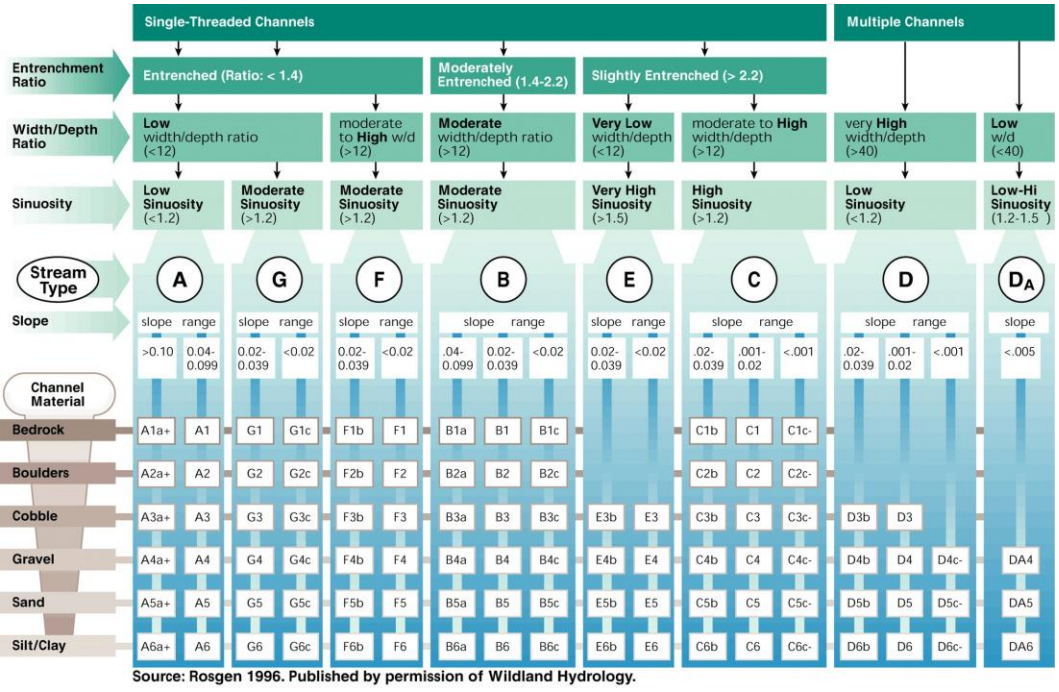
Table 8. Hierarchy of Functions.

Rank	Function	Functions Directly Affected[1]	Functions Indirectly Affected[1]
1	Hydrodynamic Character	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 14, 15	13
2	Stream Evolution Processes	1, 3, 4, 5, 6, 7, 8, 10, 11, 12, 14, 15	9, 13
3	Surface Water Storage Processes	1, 4, 6, 10, 11, 12, 14, 15	2, 5, 7, 8, 9, 13
4	Sediment Continuity	3, 5, 6, 7, 8, 9, 11, 15	1, 13, 14
5	Riparian Succession	1, 2, 3, 4, 6, 12, 14, 15	9, 13
6	Energy Management	1, 2, 3, 4, 5, 7, 8, 15	-
7	Substrate and Structural Processes	1, 2, 4, 6, 7, 10, 15	5, 9, 11, 13
8	Quality and Quantity of Sediments	2, 4, 5, 6, 7, 10, 15	1, 9, 11, 14
9	Biological Communities and Processes	5, 11, 13, 14, 15	1, 2, 3, 7, 8, 10, 12
10	Surface / Subsurface Water Exchange	1, 5, 11, 15	3, 9, 12, 13
11	Water and Soil Quality	8, 9, 13, 14	5
12	Landscape Pathways	9, 13, 14, 15	6
13	Trophic Structures and Processes	9, 11, 14	8
14	Chemical Processes and Nutrient Cycles	8, 9, 13	6
15	Necessary Habitats for all Life Cycles	9, 12, 13	-

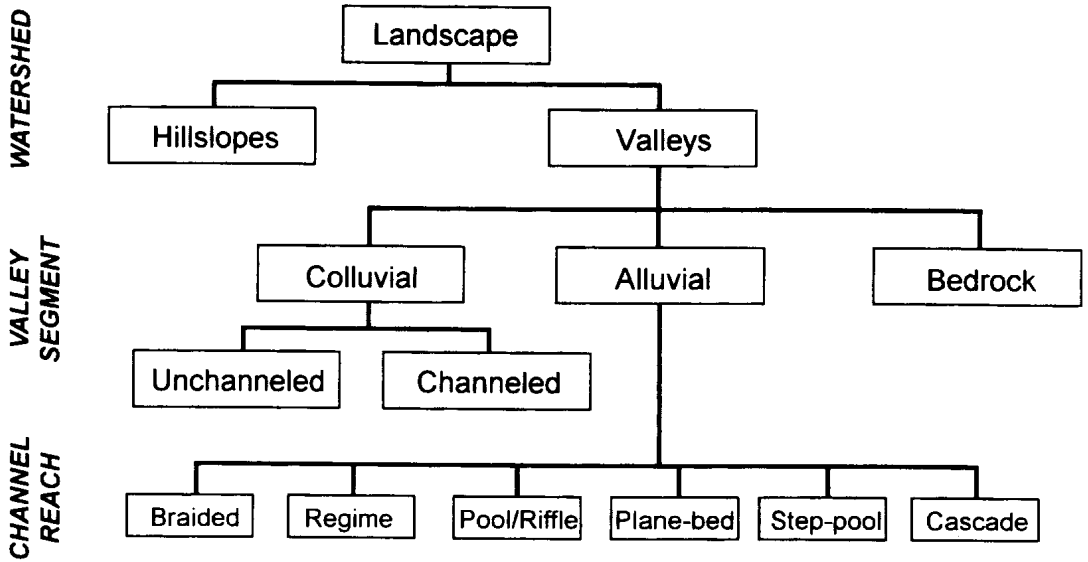
[1] Listed by number, according to ranking (e.g. Function #6 is Energy Management)
Note: The interactions among functions are such that the relations presented in Table 8 can change with the type of ecosystem, and the nature and magnitude of the impact, and the specific temporal and spatial scales utilized in the relevant analysis. This is particularly true for the indirect impacts.

Fischenich (2006)

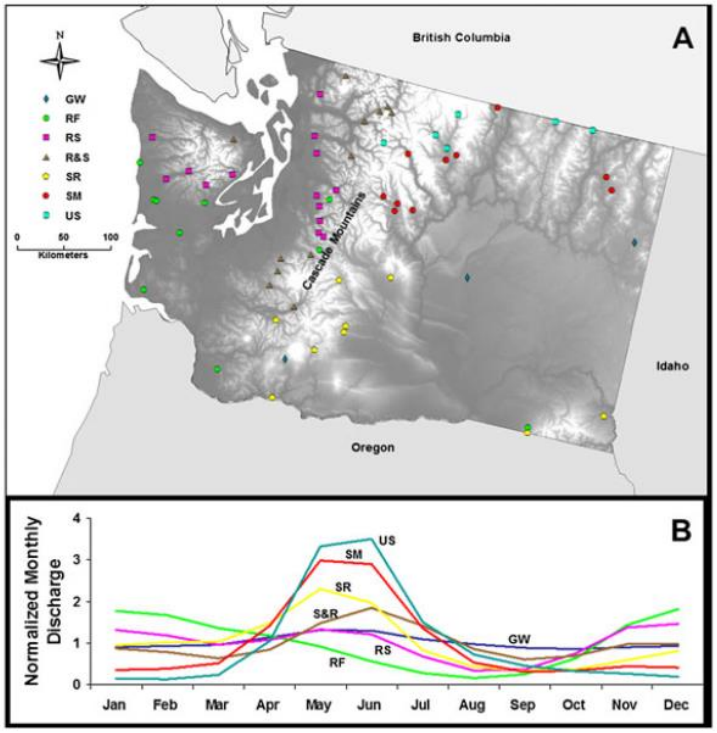

5 BIOLOGY »
Biodiversity and the life histories of aquatic and riparian life
4 PHYSICOCHEMICAL »
Temperature and oxygen regulation; processing of organic matter and nutrients
3 GEOMORPHOLOGY »
Transport of wood and sediment to create diverse bed forms and dynamic equilibrium
2 HYDRAULIC »
Transport of water in the channel, on the floodplain, and through sediments
v and sediment
1 HYDROLOGY »
Transport of water from the watershed to the channel
v and sediment
Inflows of water AND sediment?
Land cover / land use, vegetation
Geology
Climate



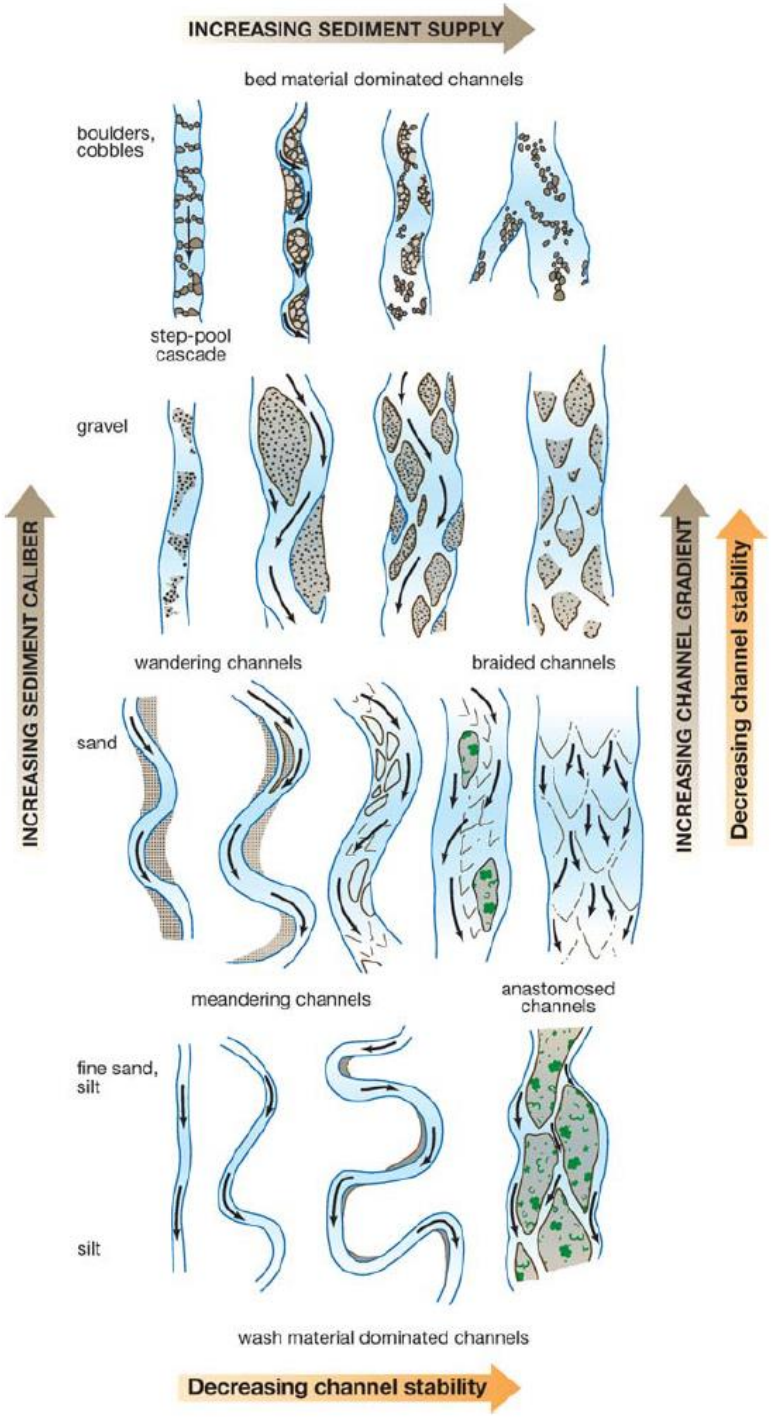
Source: Rosgen 1996. Published by permission of Wildland Hydrology.



Geomorphic classification vs. Hydro-geomorphic classification



Reidy Liermann et al. (2011)

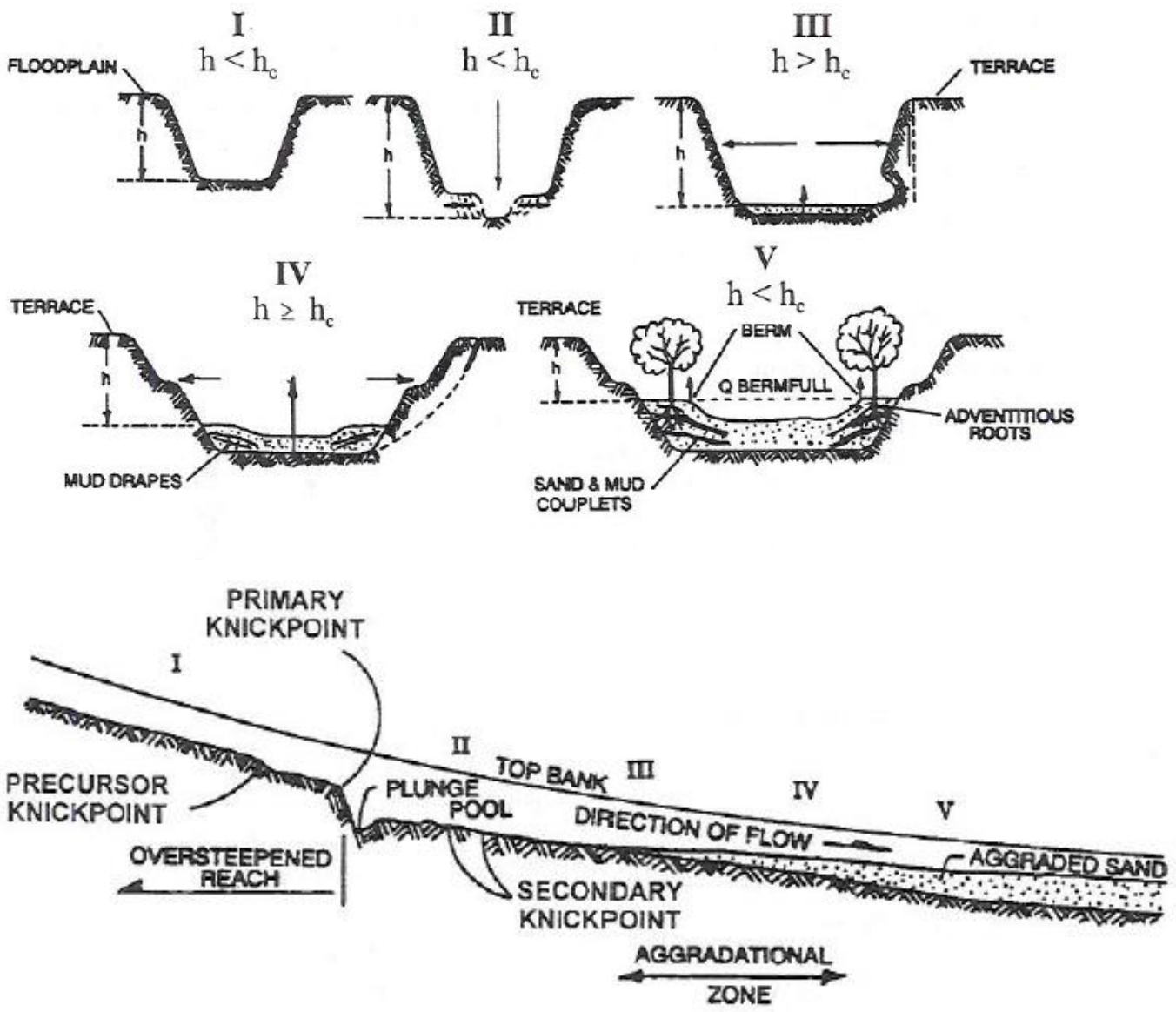


Channel types fall into fairly distinct categories of τ^* and ω^*

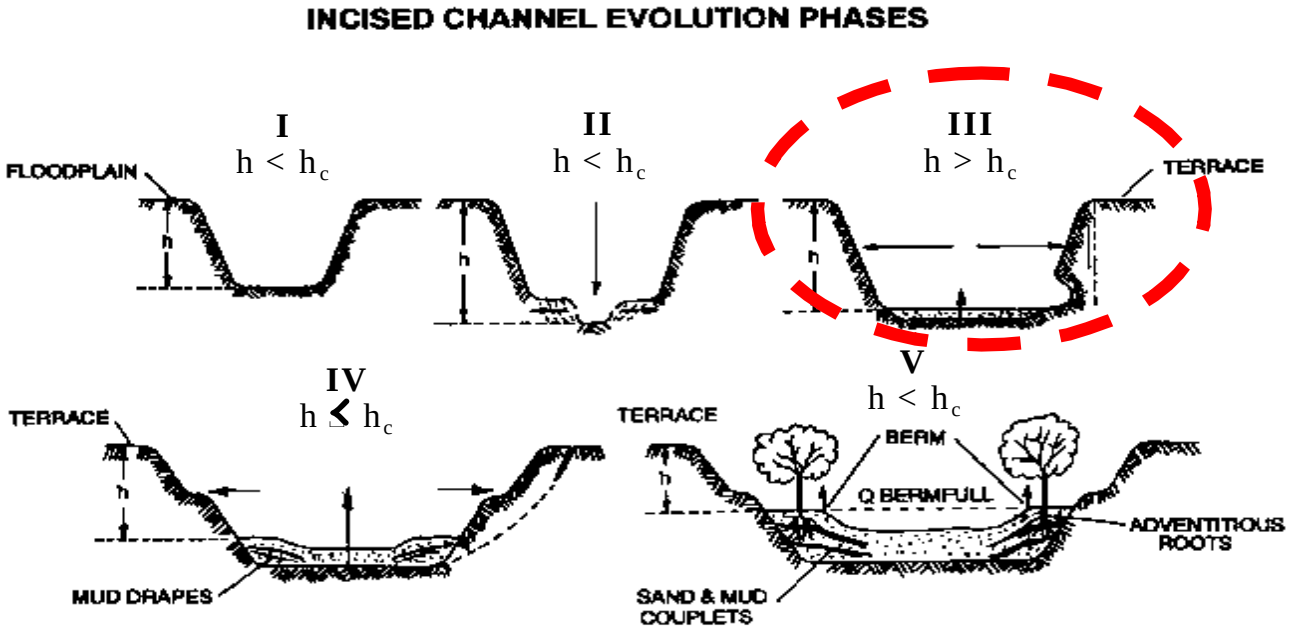
These ratios describe:

- flow power relative to boundary
- erosive forces vs. resisting forces
- hydrology and hydraulics in the numerator (e.g., Q2) vs. bed material (e.g., D50) in the denominator

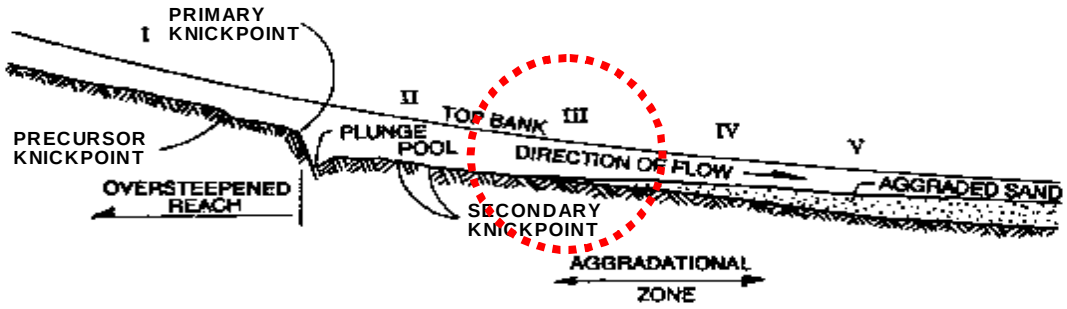
Directly assesses interactions between hydrologic and geomorphologic processes

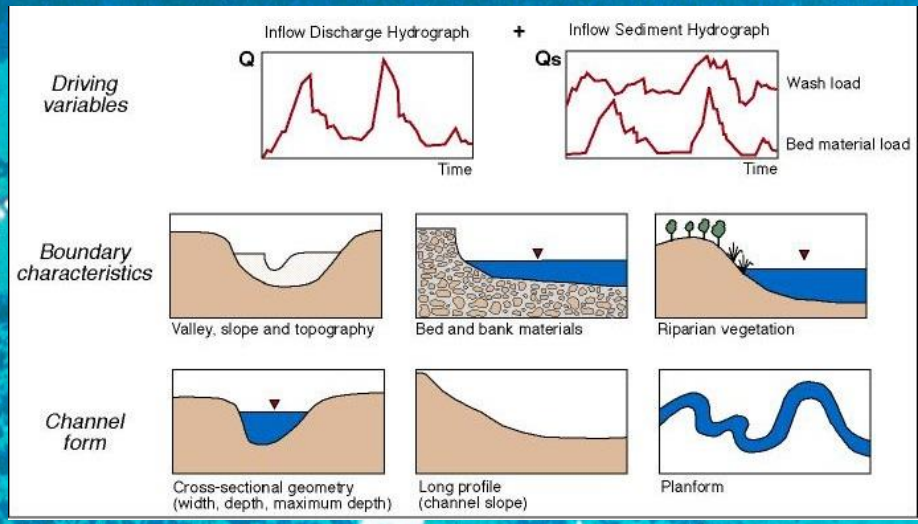


Watson et al. (2002)



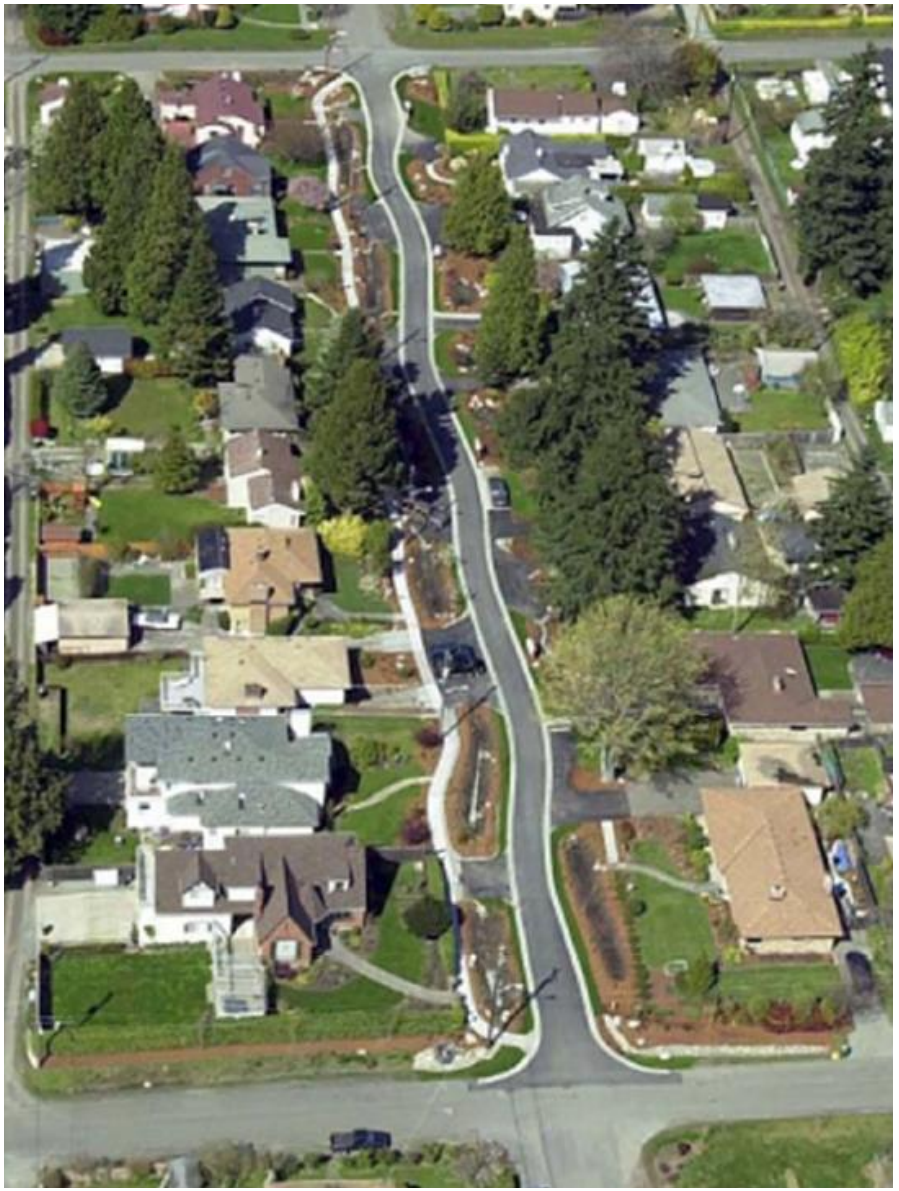
In the Type III reach, mass wasting of the banks with rapid channel widening is the dominant process





Sinuosity = $S_{valley}/S_{channel}$

No optimal value



Not all imperviousness and urban land cover created equal

Urban River Parkways

An Essential Tool for Public Health

Richard J. Jackson, MD, MPH - UCLA Fielding School of Public Health

Tyler D. Watson, MPH - UCLA Fielding School of Public Health

Andrew Tsiu, MPH - UCLA Fielding School of Public Health

Bianca Shulaker, MURP - USC Department of Urban Planning

Stephanie Hopp, MPH - Johns Hopkins School of Public Health

Mladen Popovic - UC Santa Barbara

July 2014

Center for Occupational & Enviromental Health UCLA

Every 1 dollar spent on trails results in $3 to >$10 of direct medical benefit

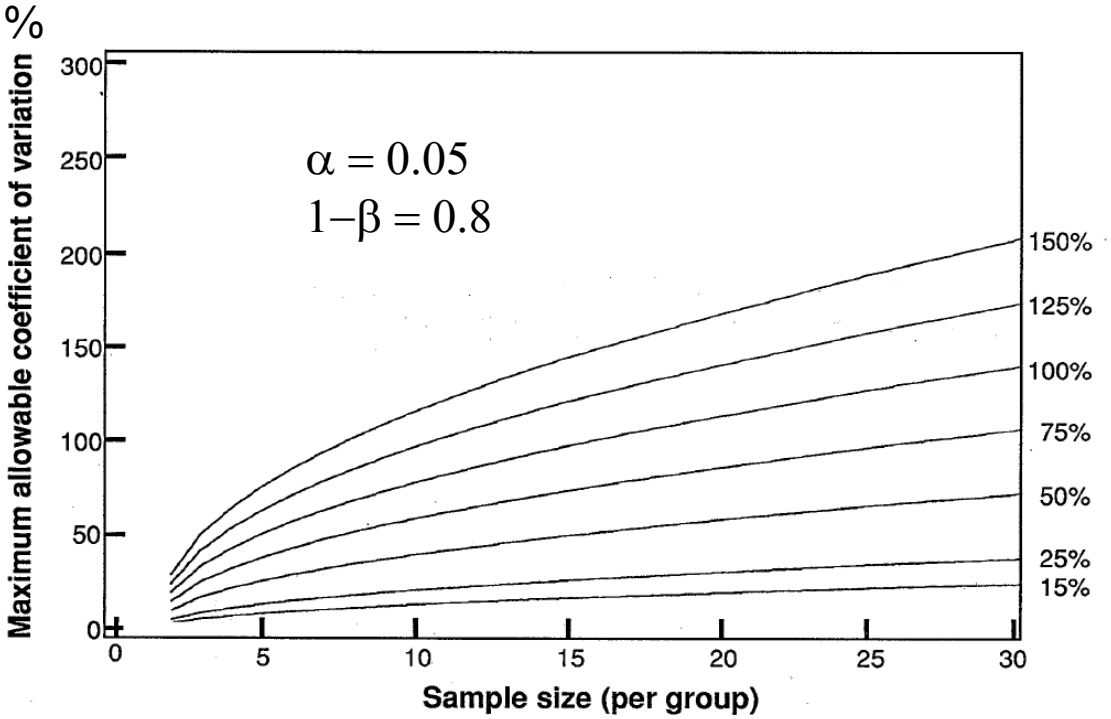


Figure 6. Maximum allowable coefficient of variation to detect changes ranging from 15 to 150%. Figure assumes a two-sample t-test is being used to detect change at a 5% level of significance and a power of 80%. The labeled curves show the minimum percent change that can be detected given a particular coefficient of variation for the parameter being measured and population sample size (figure courtesy of L. Conquest, Center for Quantitative Studies, University of Washington).

Minimum % change that can be detected

Simplicity is the ultimate sophistication.

-Leonardo da Vinci

SWEET SPOT

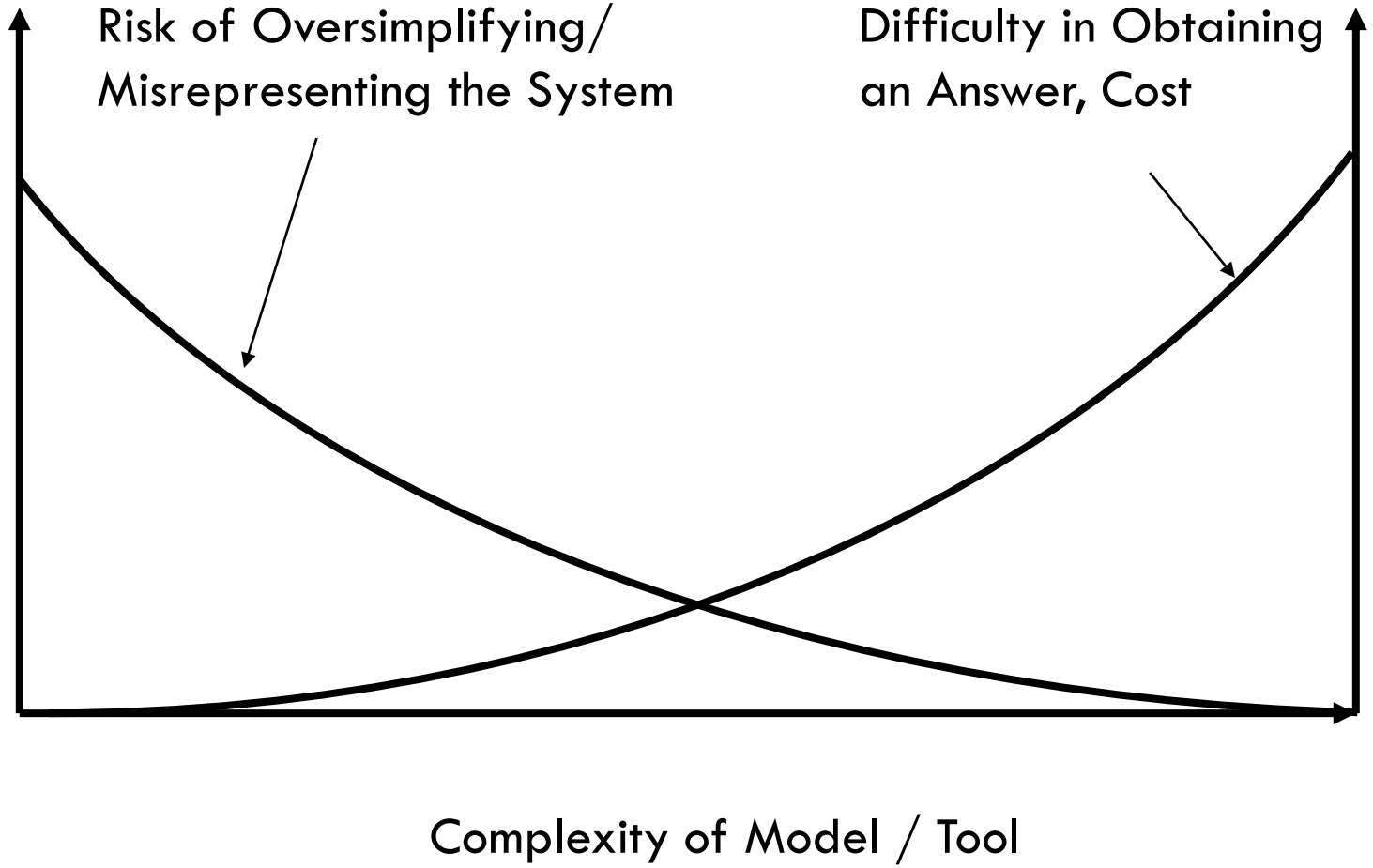
Stream Functional Assessment Methods

Must be:

- Rapid
- Consistent
- Defensible

How much fidelity to real stream processes and complexity is necessary for methods to be “defensible?”

Tradeoff Diagram



Tradeoff Diagram