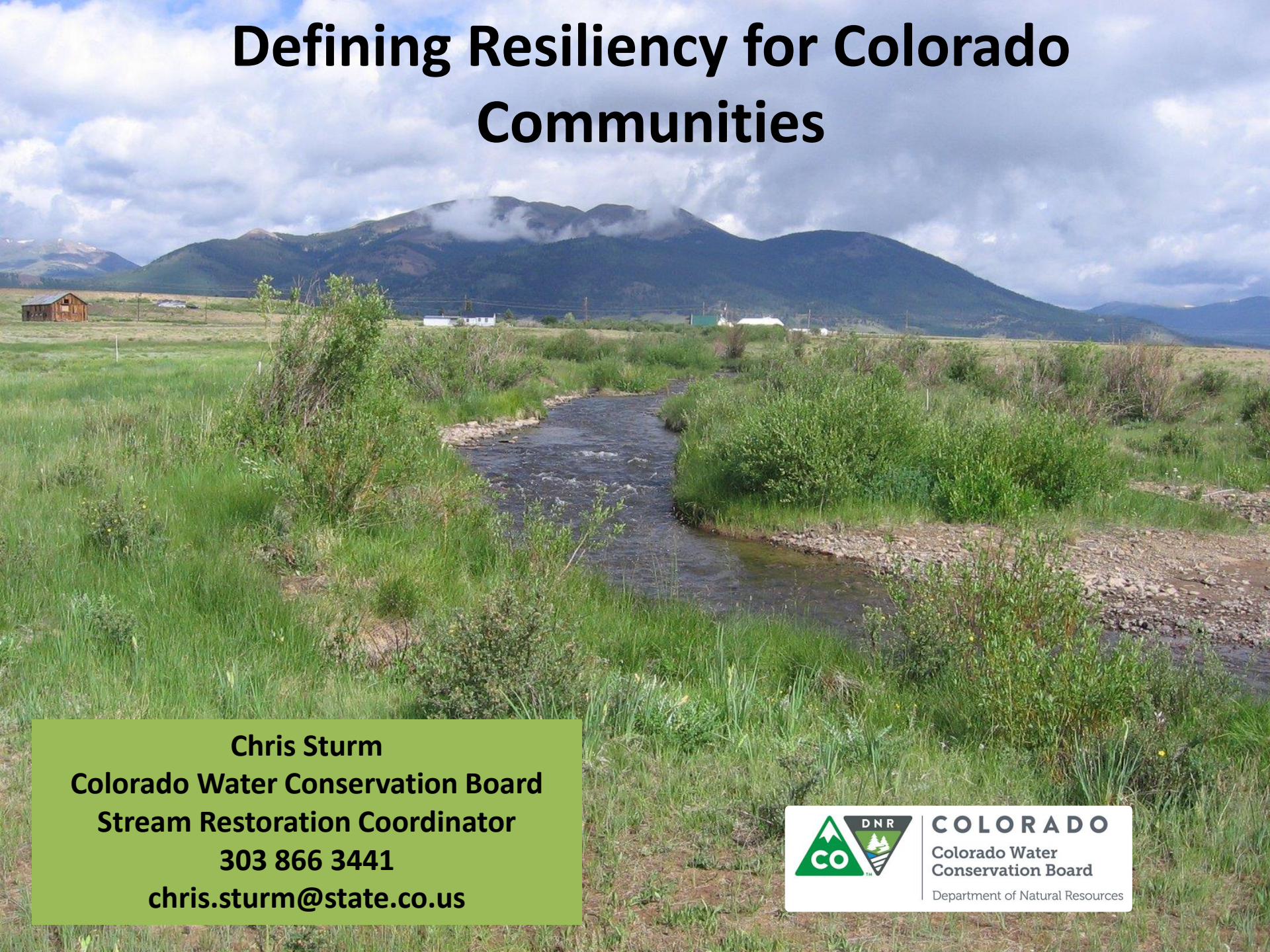


Defining Resiliency for Colorado Communities



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COLORADO

**Colorado Water
Conservation Board**

Department of Natural Resources

The background of the slide features a light blue grid pattern overlaid with numerous circles of varying sizes. The circles are rendered in a darker blue color, creating a textured, bubble-like effect across the entire surface.

Resilient Restoration of Rivers

Different Views of the River

ENGINEER

Hmmm?



GEOLOGIST

Hmmm?



BIOLOGIST



GEOMORPHOLOGIST

Hey man, like why worry? Let mother nature do her thing.



COLORADO WATER PLAN

Why Do We Need a Water Plan?

1. Gap between supply and demand: Declining or flat-lining water supplies and population growth
2. Unacceptable pace of agricultural dry up
3. Environmental stress and recreational opportunities
4. Inefficient and ineffective regulatory processes
5. Fiscal challenges of our water infrastructure systems

Colorado Water Plan, 2nd Draft

The Nature
Conservancy



*“A key component of Colorado’s brand is its environment. We must address water quality, watershed health, and ecosystem **resilience** in light of water demands and a changing climate.”*

“The policy of the state of Colorado is:

- Promote restoration, recovery, sustainability, and **resiliency** of endangered, threatened, and imperiled aquatic and riparian dependent species and plant communities*
- . . . promote self- sustaining fisheries and functional riparian and wetland habitat to promote long-term sustainability and **resiliency**”*

What is resiliency? (part 1)

The IBCC TMD conceptual agreement builds on one of the oldest definitions of ecosystem resilience:

“Resilience of a stream or watershed can be measured as an ecosystem’s ability to recover function after a disturbance, whether acute or chronic. The resilience of an ecosystem is a measure of its ability to absorb changes and still exist.”

See <http://torrensresilience.org/ecological-resilience>, citing Holling, C.S. 1973. "Resilience and stability of ecological systems" in: *Annual Review of Ecology and Systematics*. Vol 4 :1-23.



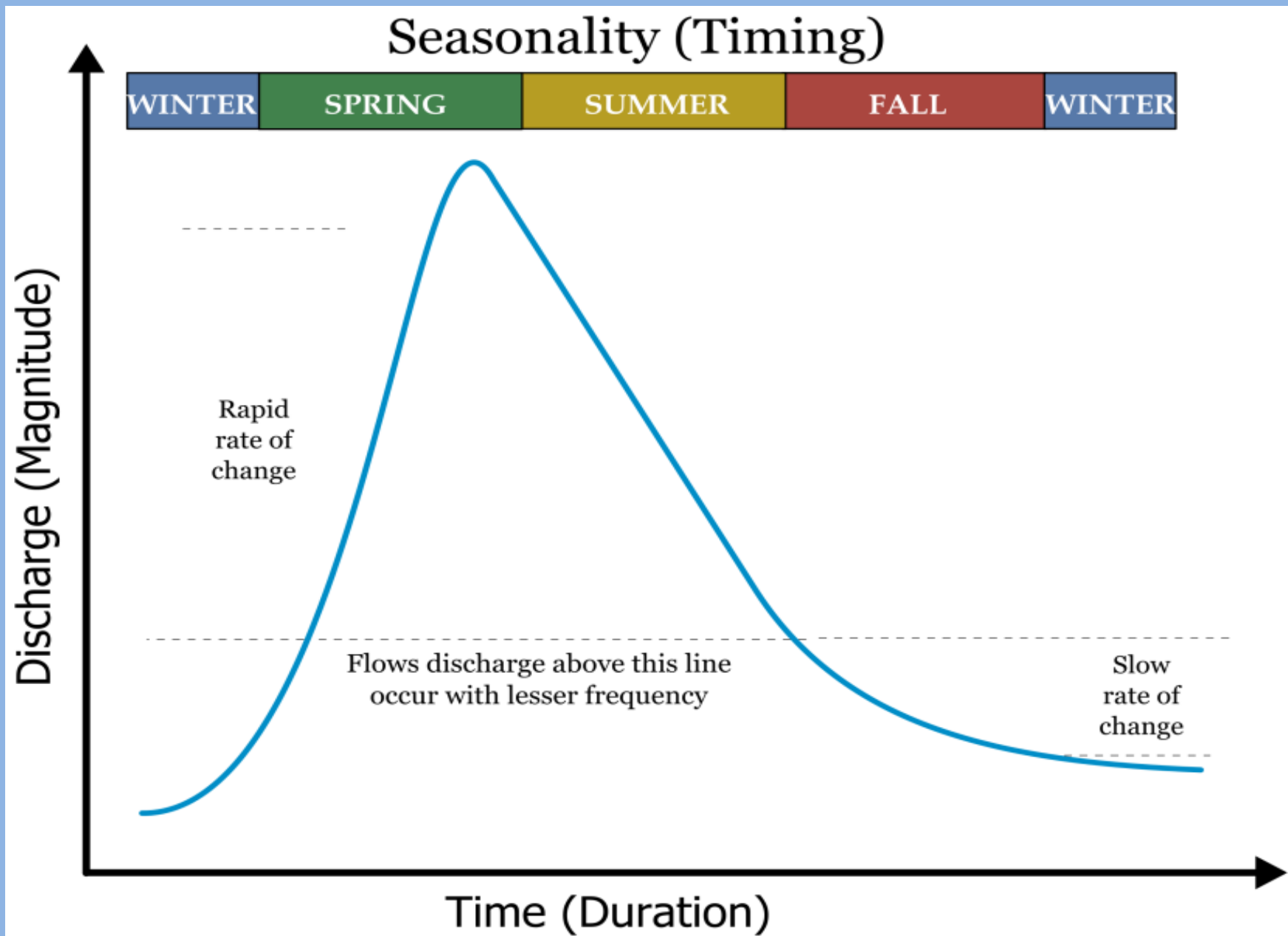
What is resiliency? (part 2)

The Colorado Water Plan

“Resilient river systems require seasonal flow fluctuations and provide complex and connected aquatic and riparian habitats in order to sustain stable, diverse, abundant, and reproducing populations of aquatic and riparian species.”



Figure 7.1-1: Stream Hydrograph



This is not just academic . . .

Most likely, there will continue to be funding directed at environmental and multi-purpose projects, and, as the Colorado Resiliency Framework states:

“Assessing the health and resiliency of watersheds across the state will help prioritize areas for resource spending . . . “



Common Metrics

Both the Colorado Water Plan and the Colorado Resiliency Framework indicate the need to develop metrics for environmental resiliency.

CWP (2nd draft, p.265): “. . . the CWCB will develop common metrics for assessing the health and resiliency of watersheds, rivers, and streams.”

Resiliency Framework (Table 4-6, Metrics): “Develop metrics to evaluate progress and success, and to continue to improve resiliency planning, policies, and actions . . . measure the positive and negative environmental impacts of State-funded watershed projects.”

A starting point for environmental resilience metrics: three broad categories of metrics

- 1) Ecosystem Condition = A broad set of characteristics (water quality, watershed structure, etc.) that are the baseline requirements for sustaining ecosystems.
- 2) Resilience Characteristics = A narrower set of characteristics that are key to an ecosystem's ability to absorb and recover from disturbance.
- 3) Social Dimensions = Policies, agreements, etc. that allow for shared goals, collaboration, flexible water management, etc.

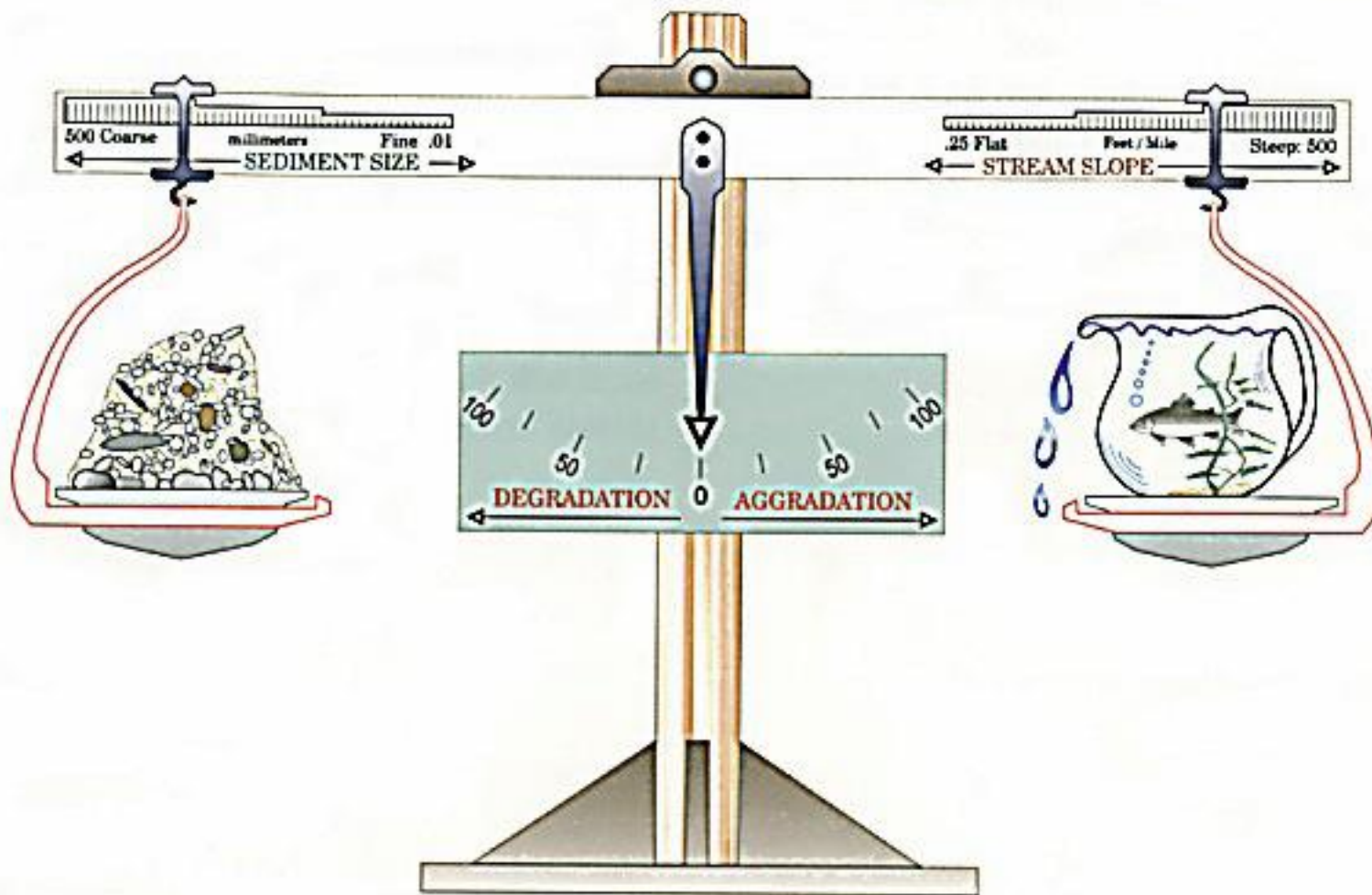
These categories are expanded upon in:

“Ecosystem resilience: How do we know if a river is more or less resilient?”

Comments from The Nature Conservancy in response to the IBCC Conceptual Agreement and the Colorado Water Plan. August 25, 2015



Lane's Balance



$$(\text{Sediment LOAD}) \times (\text{Sediment SIZE}) \quad \infty \quad (\text{Stream SLOPE}) \times (\text{Stream DISCHARGE})$$

“Thresholds”

Does Vincent absorb and recover from the disturbance (abuse)?



THE WOLF

“I solve problems.”

“I've got a threshold, Jules. I've got a threshold for the abuse that I will take. Now, right now, I'm a [expletive] race car, all right? And you got me in the red. And I'm just saying, I'm just saying that it's [expletive] dangerous to have a race car in the [expletive] red, that's all. I could blow.”

What is resiliency? (part 3)

Colorado Resiliency Framework

“Watershed resiliency can be measured by evaluating the health of the active river area, which includes monitoring the:

- landscape condition,
- flow regimes,
- geomorphology,
- habitat,
- biota, and
- water chemistry.

Watershed Health

Broadly defined, watershed health is a measure of ecosystem structure and function.

Structure refers to species richness (characterized by abundance and diversity), inorganic and organic resources, and physical attributes (including habitat complexity).

Function refers to ecosystem processes such as the hydrologic cycle, nutrient cycling, energy flow, and succession. A critical component of the hydrologic cycle is flow regime.

CWCB Flood Recovery Team

➤ Technical Support - Stream Restoration Design/Implementation



CWCB Flood Recovery Team

➤ Technical Support - Stream Restoration Design/Implementation



CWCB Flood Recovery Team



Compound Channel



Typical Cross Section



CWCB Flood Recovery Team



