Riparian Functions for River and Lake Water Quality

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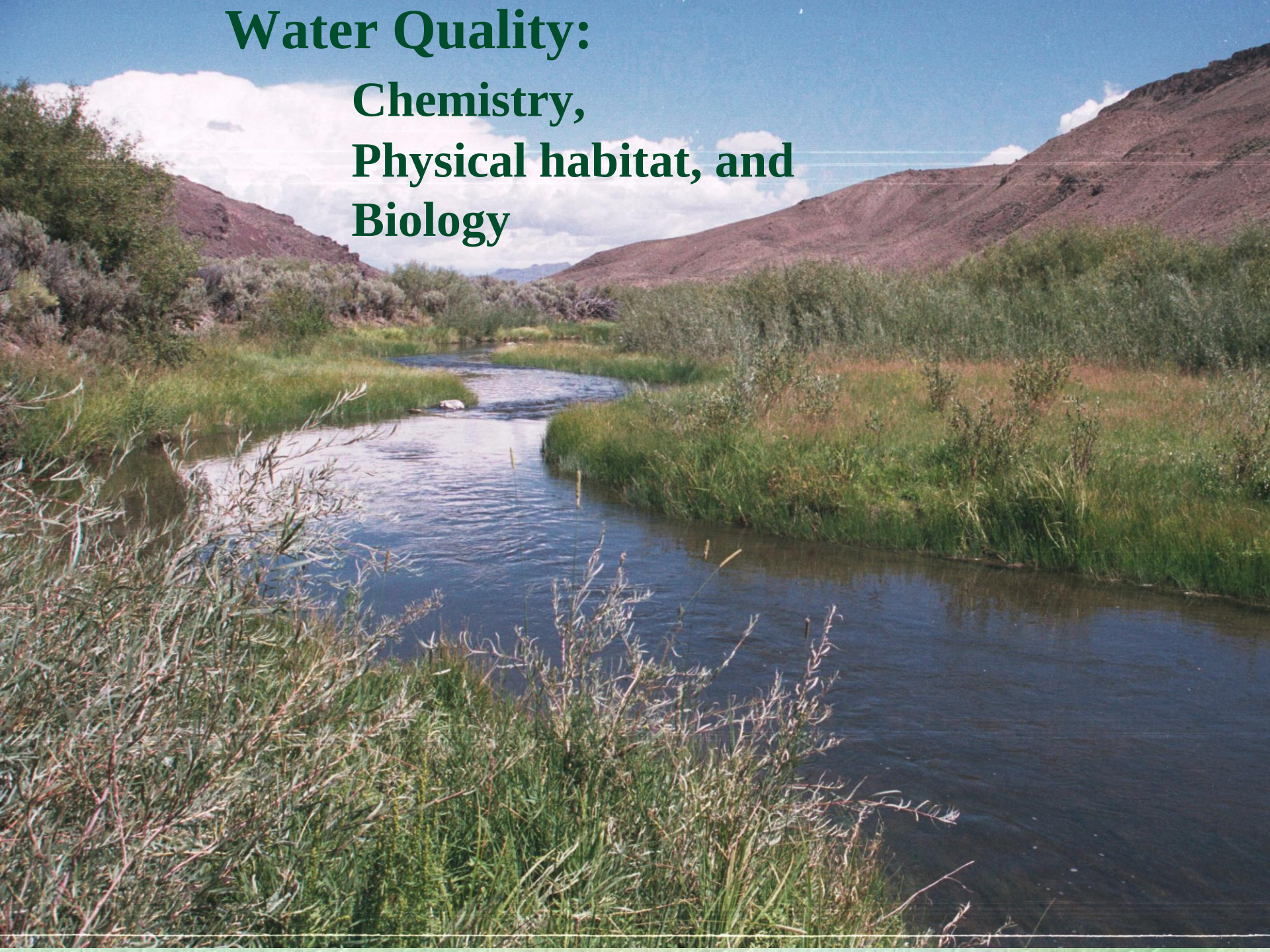
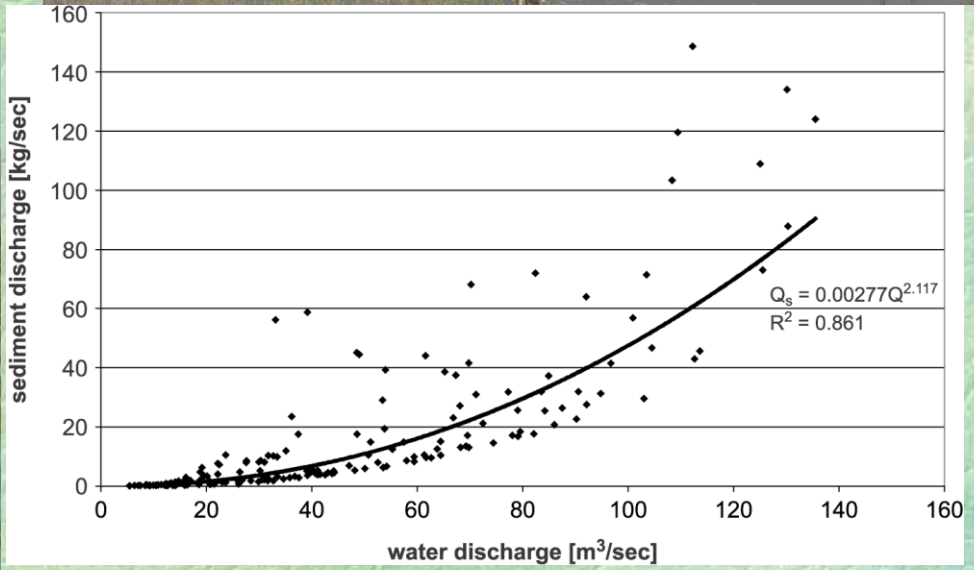


Water Quality:

Chemistry, Physical habitat, and Biology

Floods Happen:

- Exponentially increased sediment
  - Channel erosion
- Sediment deposits
  - Channel repair
- Nutrient release
  - Nutrient uptake
- Saturated soil
  - Denitrification



Floods Happen:

- Exponentially increased sediment
  - Channel erosion
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  - Channel repair
- Nutrient release
  - Nutrient uptake
- Saturated soil
  - Denitrification

What Happens in Floods:

Depends on riparian functions

What Happens between Floods:

Depends on riparian functions

Non-point Source Stressors

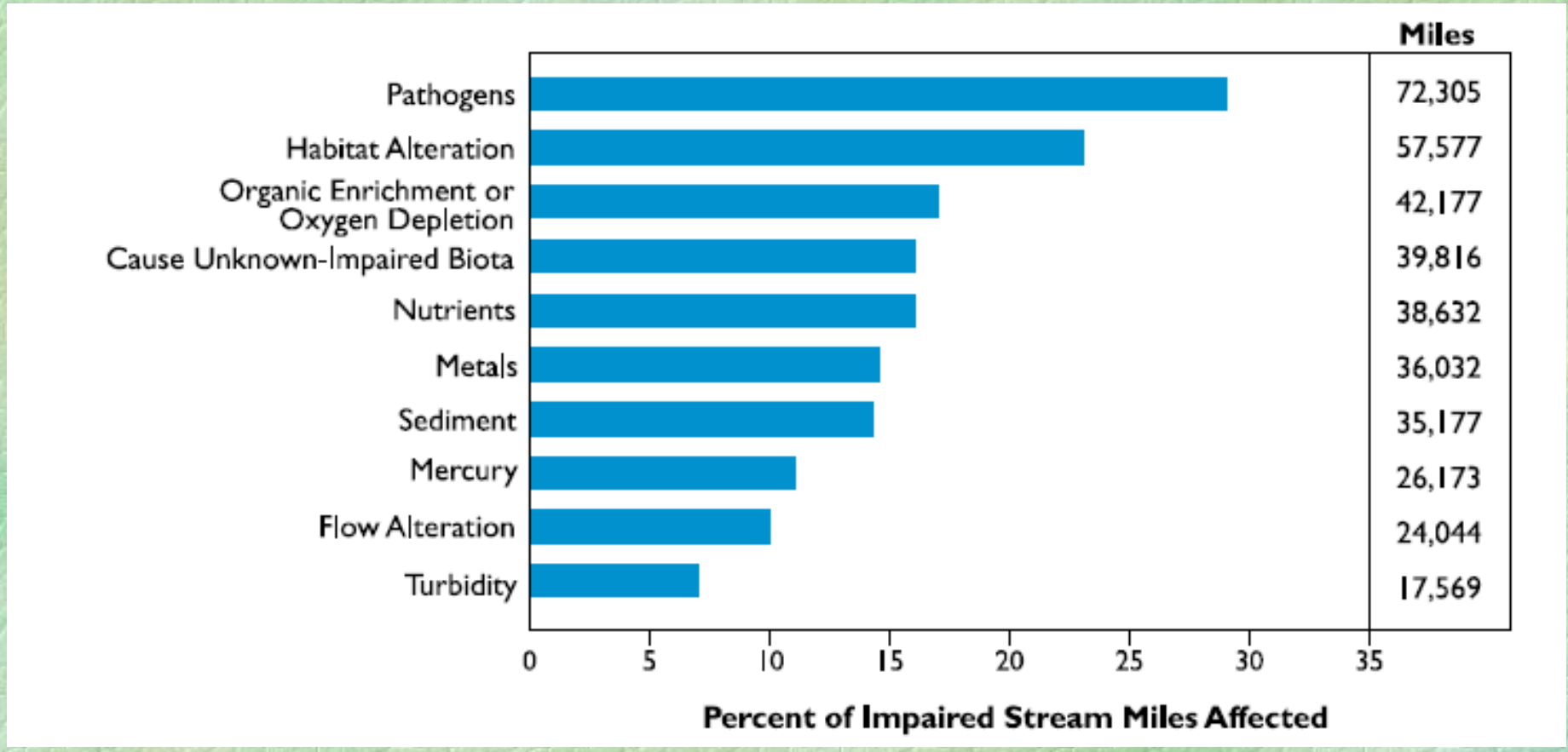


Figure from the National Water Quality Inventory: Report to Congress, August, 2009

Non-point Source Stressors

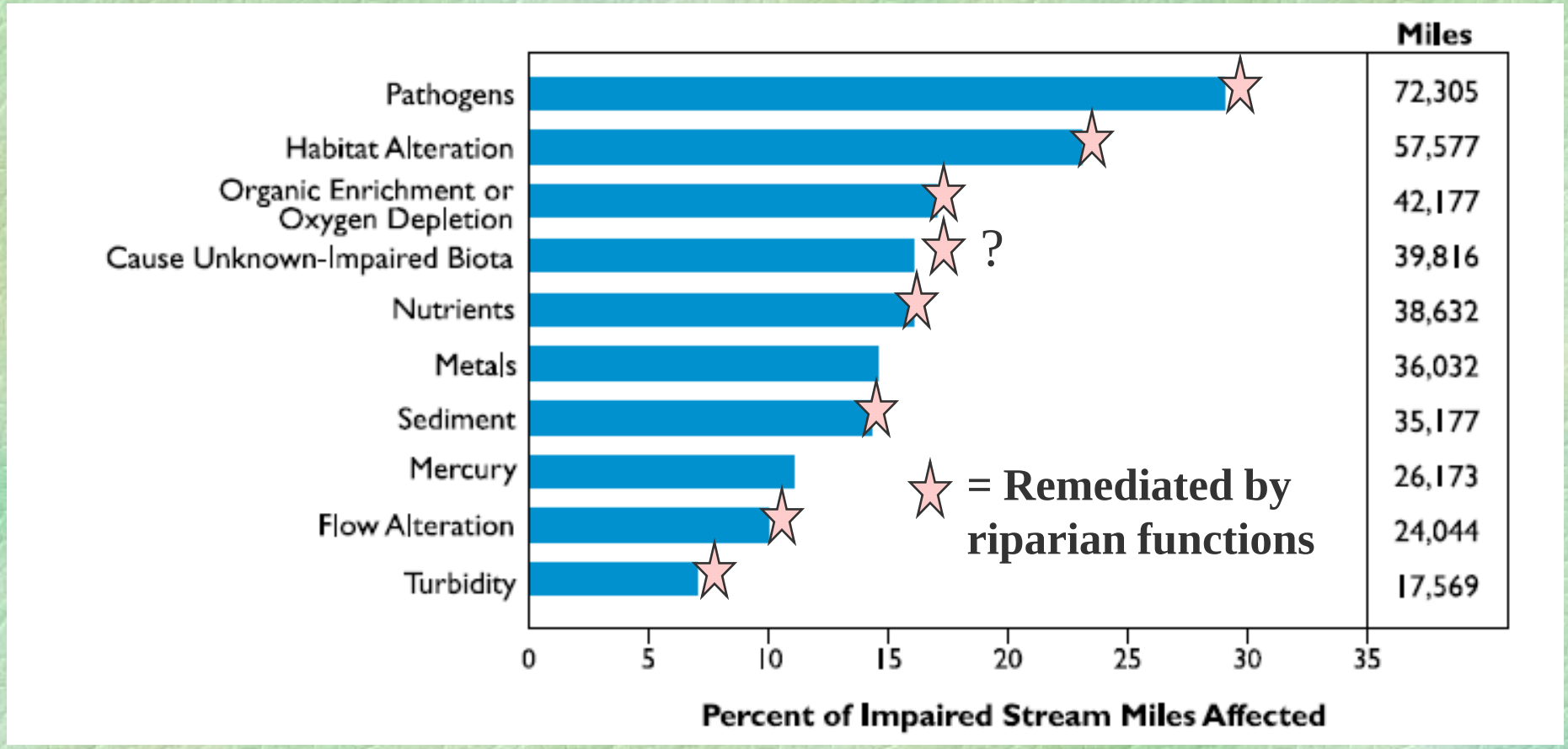


Figure from the National Water Quality Inventory: Report to Congress, August, 2009

PROPER FUNCTIONING CONDITION – DEFINITION

- RIPARIAN-WETLAND areas are functioning properly when adequate vegetation, landform, or large woody debris is present to:
  - Dissipate **STREAM ENERGY** associated with high flows
  - Filter **SEDIMENT** and **CAPTURE BED LOAD**
  - Aid **FLOODPLAIN DEVELOPMENT**
  - Improve **FLOOD WATER RETENTION** and **GROUNDWATER RECHARGE**
  - Stabilize **STREAMBANKS**

PROPER FUNCTIONING CONDITION

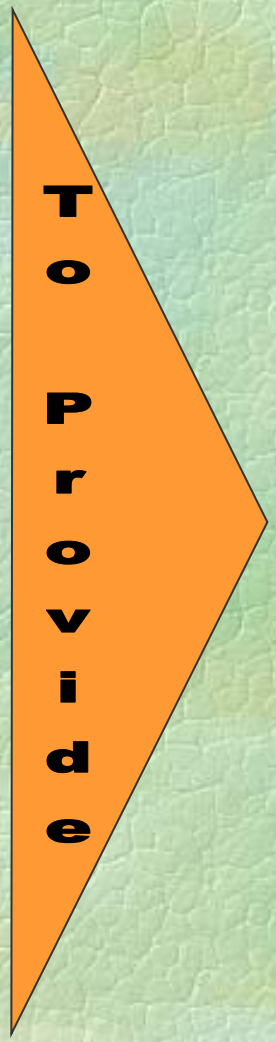
PROVIDES FOR:

- Habitat for **FISH** and **WILDLIFE**
- Improved **WATER QUALITY**
- Improved **FORAGE PRODUCTION**
- Decreased **SOIL EROSION**
- Greater **BIODIVERSITY**
- **ECOSYSTEM SERVICES**

On-The-Ground Condition

Adequate vegetation, land form or large woody material to:

- **Dissipate stream energy**
- **Reduce erosion**
- **Filter sediment**
- **Capture bedload**
- **Aid floodplain development**
- **Improve floodwater retention and groundwater recharge**
- **Develop root masses that stabilize stream banks**



- Increased water quality and quantity
- Diverse ponding and channel characteristics
- Habitat for fish and wildlife
- Greater biodiversity
- Forage for livestock

FUNCTIONAL AT RISK

- **RIPARIAN-WETLAND** areas in Functional Condition,

- But, a **Soil, Water, or Vegetation** attribute makes them

SUSCEPTIBLE TO DEGRADATION

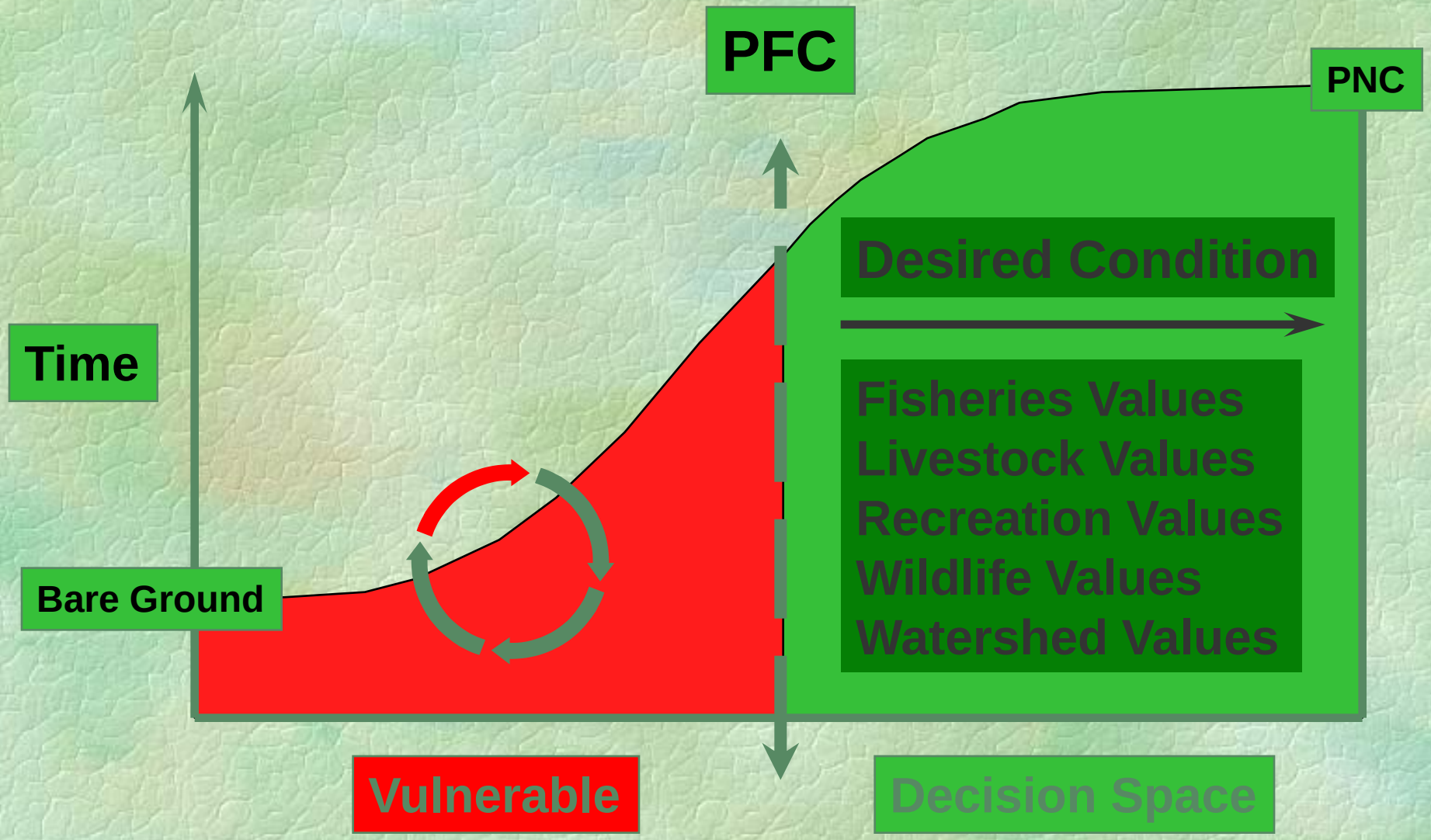
NONFUNCTIONAL

- RIPARIAN-WETLAND areas that are **CLEARLY NOT PROVIDING** adequate Vegetation, Landform or Large Woody Debris to:
- Dissipate Stream Energies associated with higher flows
- Filter Sediment and Capture Bedload
- Aid in Floodplain Development
- Improve Floodwater Retention and Groundwater Recharge
- Stabilize Streambanks

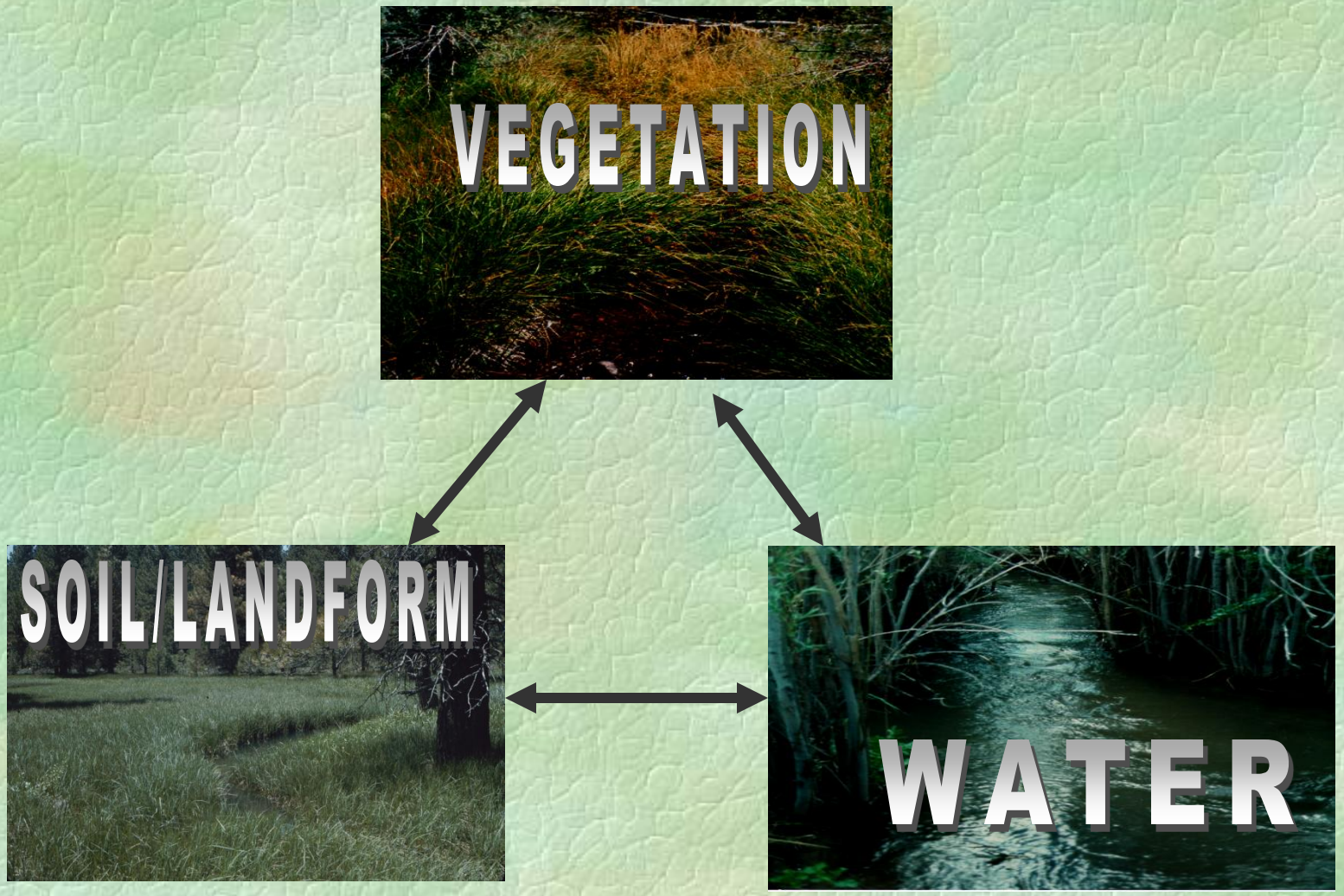
NONFUNCTIONAL

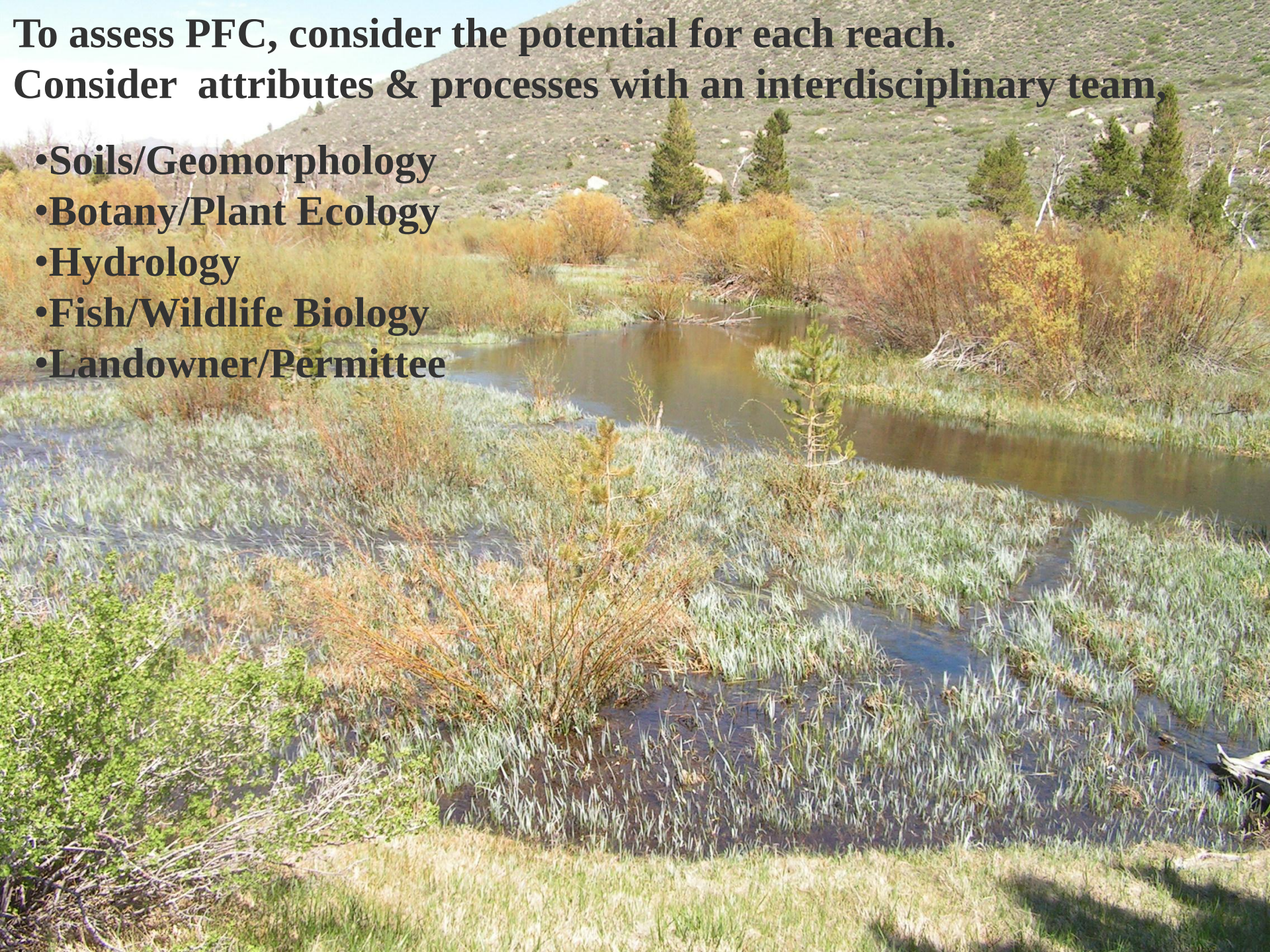
- Areas that are Nonfunctional
  - **DO NOT** provide quality **wildlife habitat**
  - **DO NOT** provide improved **Water Quality**
  - **DO NOT** improve **Forage** Production
  - EXHIBIT **INCREASED Soil Erosion**
  - EXHIBIT **DECREASED Biodiversity**

STREAM RECOVERY



Riparian functions depend on:





To assess PFC, consider the potential for each reach.
Consider attributes & processes with an interdisciplinary team,

- **Soils/Geomorphology**
- **Botany/Plant Ecology**
- **Hydrology**
- **Fish/Wildlife Biology**
- **Landowner/Permittee**

ATTRIBUTES/PROCESS LIST

- **HYDROGEOMORPHIC**
  - **GROUND-WATER DISCHARGE**
  - **ACTIVE FLOODPLAIN**
  - **GROUND-WATER RECHARGE**
  - **FLOODPLAIN STORAGE & RELEASE**
  - **FLOOD MODIFICATION**
  - **BANKFULL WIDTH**
  - **WIDTH/DEPTH RATIO**
  - **SINUOSITY – HYPORHEIC INTERCHANGE**
  - **GRADIENT**
  - **STREAM POWER**
  - **HYDRAULIC CONTROLS**
  - **BED ELEVATION**

ATTRIBUTES/PROCESS LIST

- **VEGETATION**
  - **COMMUNITY TYPES**
  - **COMMUNITY TYPE DISTRIBUTION**
  - **DENSITY**
  - **CANOPY**
  - **COMMUNITY DYNAMICS & SUCCESSION**
  - **RECRUITMENT/REPRODUCTION**
  - **SURVIVAL**

ATTRIBUTES/PROCESS LIST

- **EROSION/DEPOSITION**
  - **BANK STABILITY**
  - **BED STABILITY**
  - **DEPOSITIONAL FEATURES**

ATTRIBUTES/PROCESS LIST

- **SOILS**
  - **CAPILLARITY**
  - **ANNUAL PATTERN OF SOIL WATER STATES**
  - **ERODIBILITY**
  - **FERTILITY**

ATTRIBUTES/PROCESS LIST

- **WATER QUALITY**
  - **TEMPERATURE**
  - **SALINITY**
  - **NUTRIENTS – Nutrient Spiral**
  - **DISSOLVED OXYGEN**
  - **SEDIMENT**

- **STREAM CROSS SECTIONS**

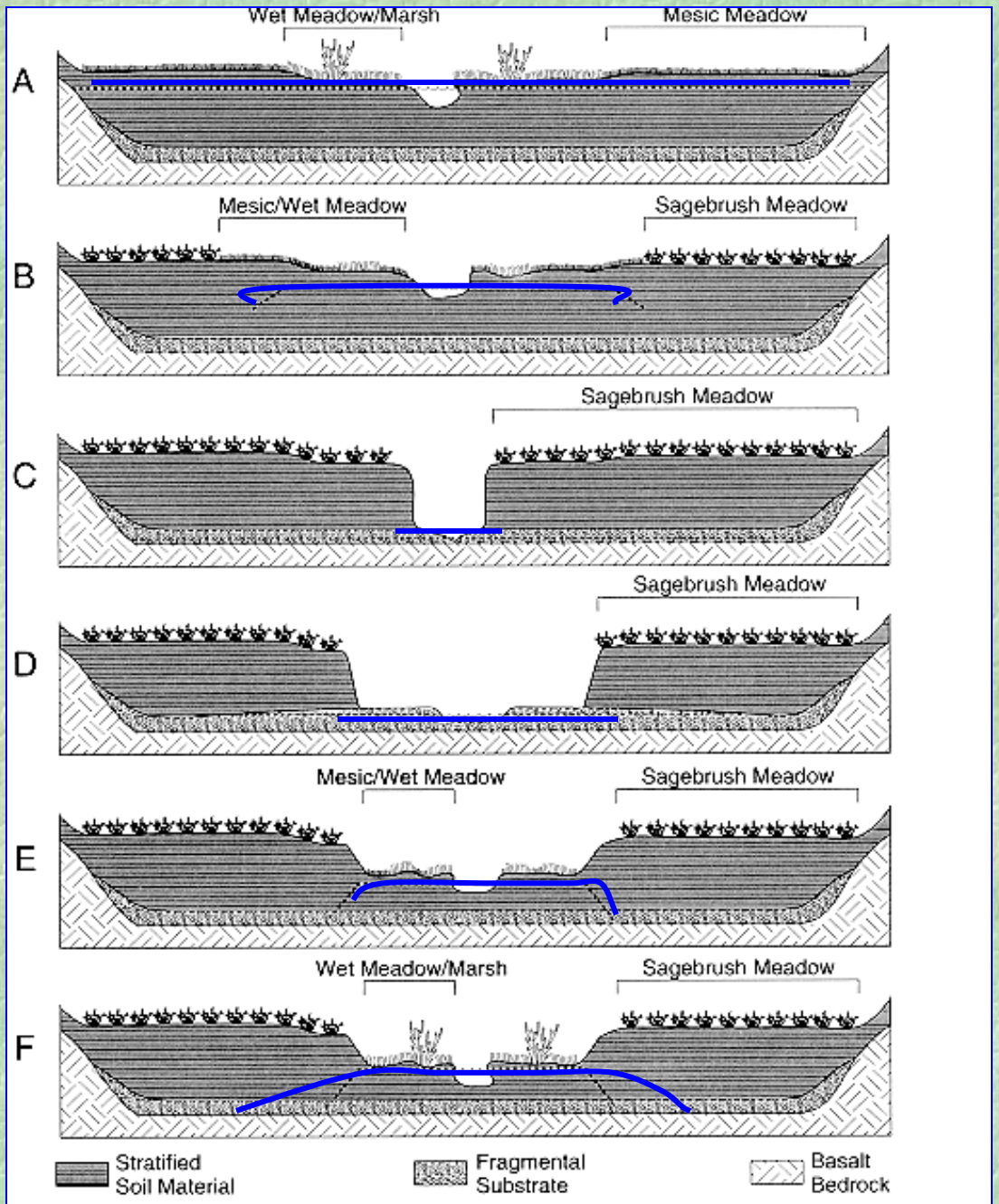


Figure 1. Succession of states for alluvial/nongraded valley-bottom type.

STANDARD CHECKLIST -- Hydrology

YES	NO	NA	
			1) Floodplain above bankfull is inundated in "relatively frequent" events
			2) Where beaver dams are present, they are active and stable
		XX	**3) Sinuosity, width/depth ratio, and gradient are in balance with the landscape setting (i.e., landform, geology, and bioclimatic region)**
			4) Riparian-wetland area is widening or has achieved potential extent
		XX	**5) Upland watershed is NOT contributing to riparian-wetland degradation**

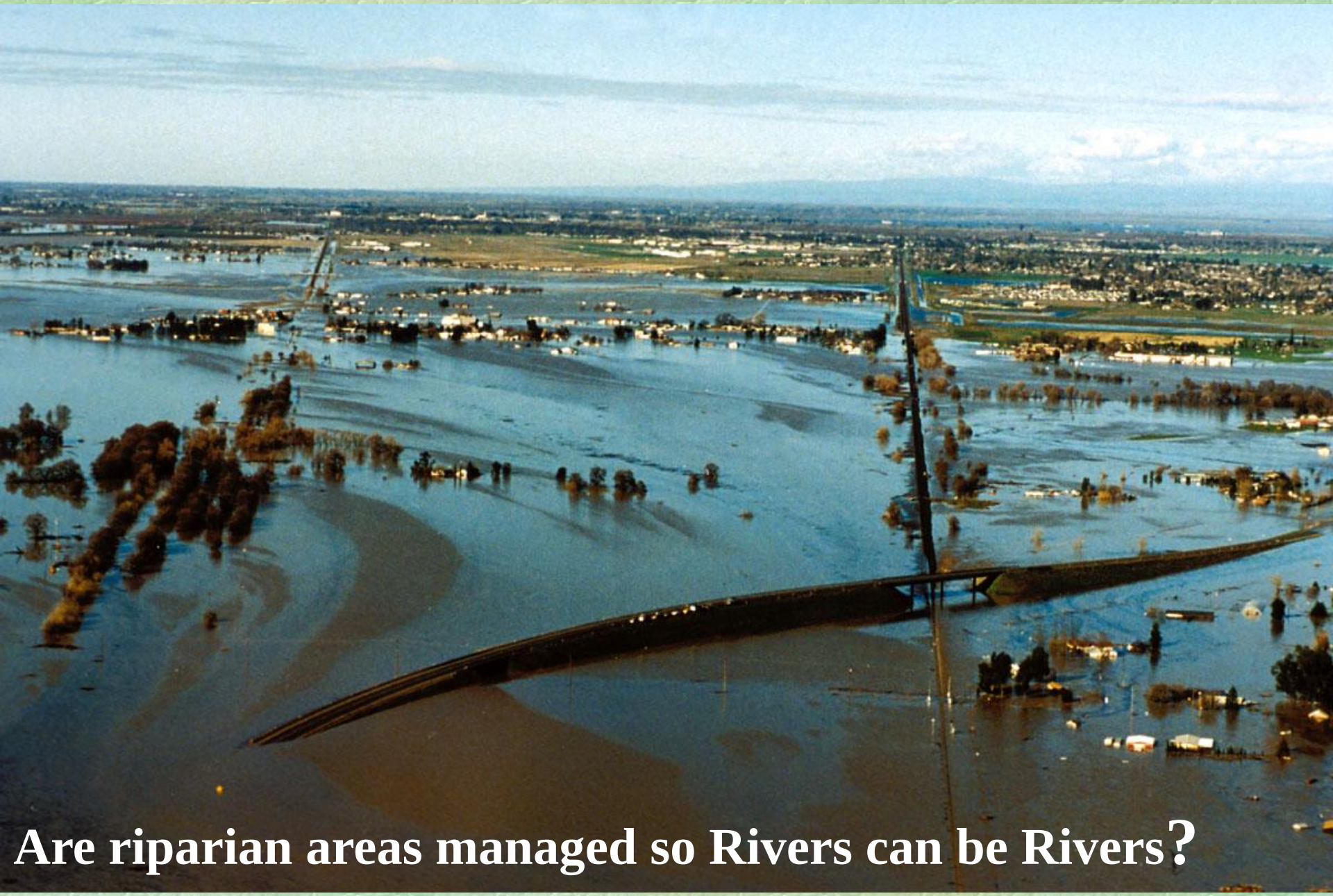
VEGETATION

YES	NO	NA	
			6) There is diverse age-class distribution of riparian-wetland vegetation (recruitment for maintenance/recovery)
			7) There is diverse composition of riparian-wetland vegetation (for maintenance/recovery
			8) Species present indicate maintenance of riparian-wetland soil moisture characteristics
			9) Streambank vegetation is comprised of those plants or plant communities that have root masses capable of withstanding high-streamflow events
			10) Riparian-wetland plants exhibit high vigor
			11) Adequate riparian-wetland vegetation cover is present to protect banks and dissipate energy during high flows
			12) Plant communities are an adequate source of coarse and/or large woody material (for maintenance/recovery)

EROSION/DEPOSITION

YES	NO	NA	
		xx	13) Floodplain and channel characteristics (i.e., rocks, overflow channels, coarse and/or large woody material) are adequate to dissipate energy
			14) Point bars are revegetating with riparian-wetland vegetation
		xx	15) Lateral stream movement is associated with natural sinuosity
		xx	16) System is vertically stable
		xx	17) Stream is in balance with the water and sediment being supplied by the watershed (i.e., no excessive erosion or deposition)

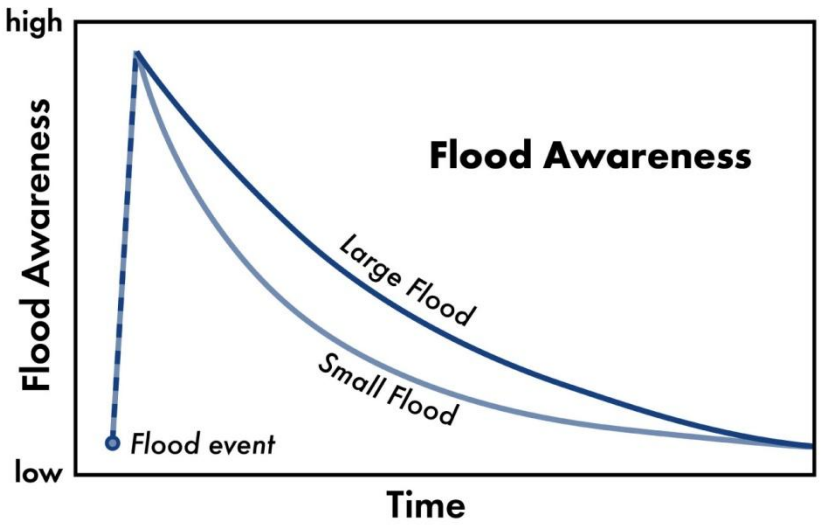

Is this riparian area functioning properly?
Do the land uses here allow it to function properly?


Are riparian areas managed so Rivers can be Rivers?

The Flood Memory Half-Life: The Power to Forget

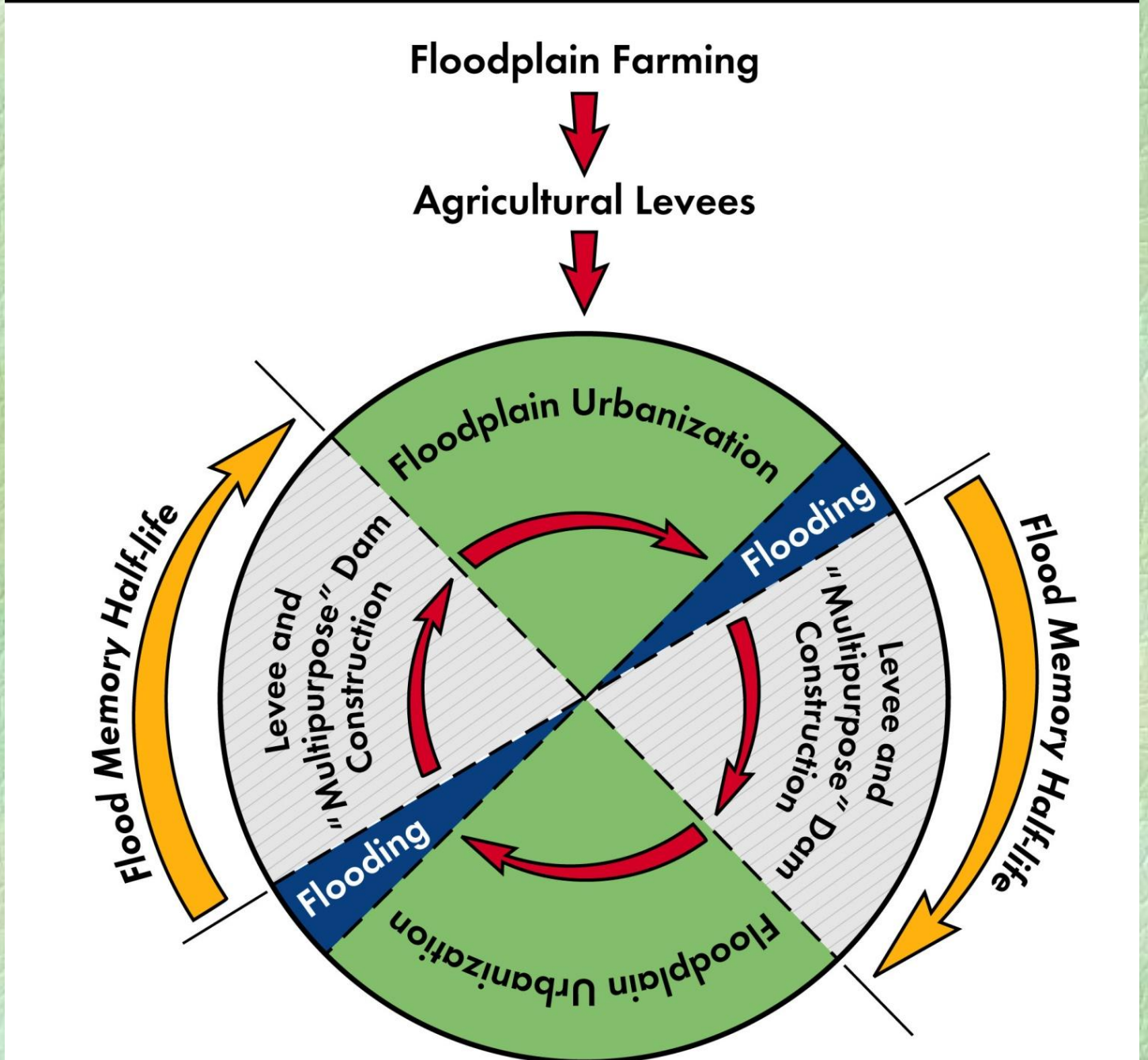
Longitudinal studies* show long-term declines in:

- Threat Preoccupation
- Risk Perception
- Psychological Distress

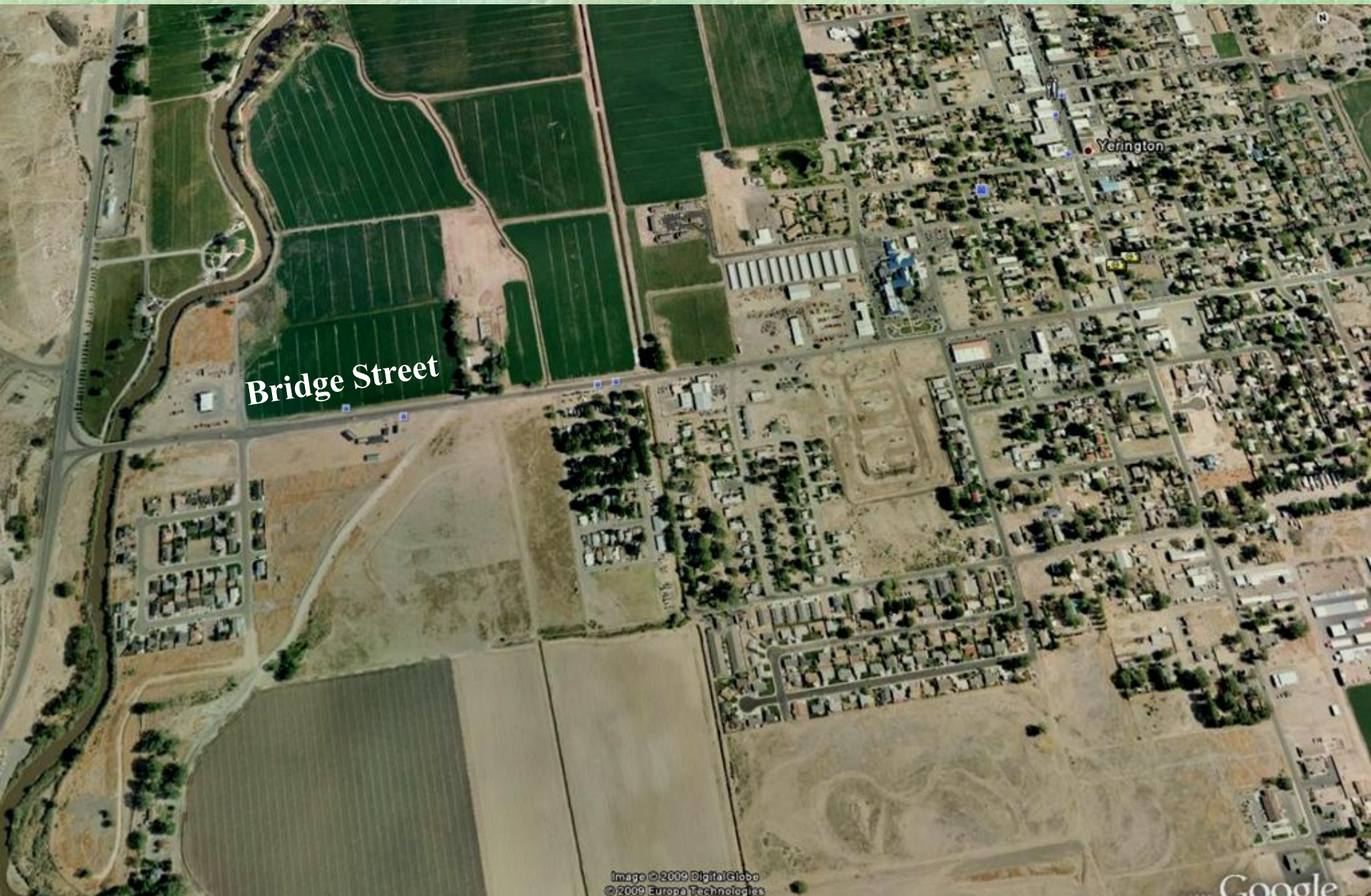


*Based upon studies of Mississippi River Floods of 1993, Hurricane Opal and Andrew, numerous tornado studies and Three Mile Island.

The Serial Engineering of Rivers & Floodplains

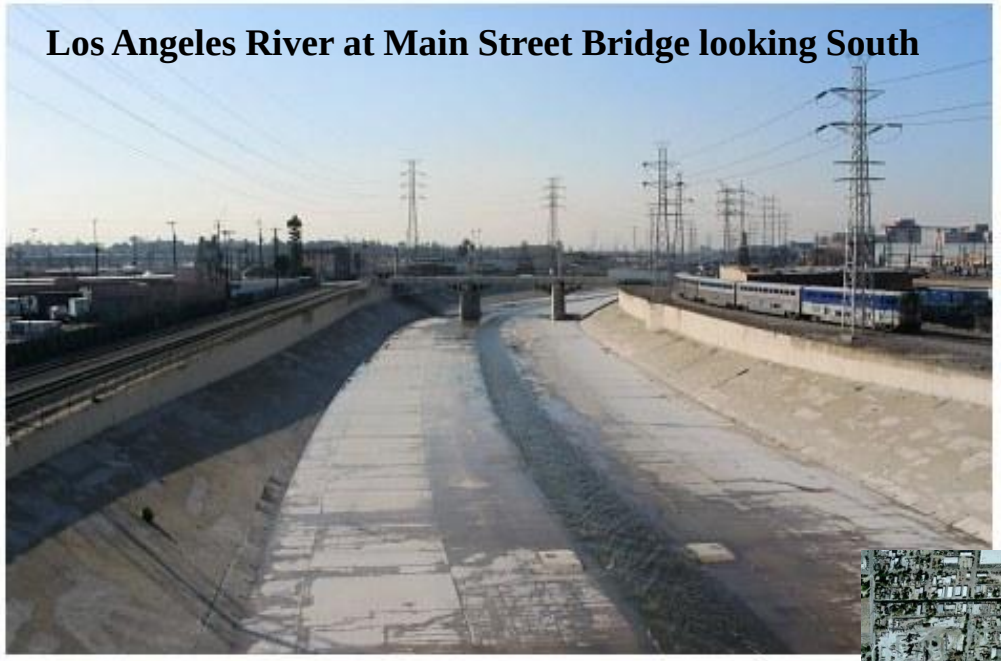


As Bridge Street, Yerington becomes a floodplain dam, what will we do to the Walker River after the next flood?




What evidence of serial engineering?
Where is it pretty to develop?
Which land uses are flood compatible?
Image © 2009 DigitalGlobe
© 2009 Europa Technologies
Image USDA Farm Service Agency
© 2009 Google
Google
38°52'44.61" N 119°09'51.71" W
elev 1358 m
May 25, 2006
Eye alt 4.73 km

What is the future of Our Rivers?



Los Angeles River at Main Street Bridge looking South

Truckee River in Reno & Sparks


When their waters flow,
what will they bring?
Image © 2009 DigitalGlobe
© 2009 Europa Technologies
© 2009 Google
©2008 Google
38°47'05.22" N 118°43'09.65" W
elev 1206 m
Feb 4, 2007
Eye alt 4.48 km

PLANNING PROCESS (Adaptive Management)

- **1. EXISTING CONDITION**
- **2. POTENTIAL CONDITION**
- **3. PFC (what is needed)**
- **4. RESOURCE VALUES (what is wanted)**
- **5. PRIORITIZE**
- **6. MANAGEMENT GOALS and OBJECTIVES**
  - **Achievable & sustainable**
  - **Measurable**
  - **Worthy**
- **7. PLANNED ACTIONS**
- **8. MONITORING**
- **9. FLEXIBILITY to modify management**

A Management Chain Reaction

- **Floodplain access & proper use management leads to**
- **At least a four inch stubble height leads to**
- **An increase in colonizers leads to**
- **Deposition there of fine sediments leads to**
- **An increase in stabilizers leads to**
- **Narrowing a stream leads to**
- **Increased floodplain access & aquifer recharge leads to**
- **Improved base flow leads to**
- **Improved water and habitat quality leads to**
- **Increased fish populations leads to**
- **Increased recreationist satisfaction**

So, where is the objective?

A Management Chain Reaction

Where is the objective?

- Floodplain access & proper management
- At least a four inch stubble height
- An increase in colonizers
- Deposition there of fine sediments
- An increase in stabilizers
- Leads to narrowing a stream
- Increased floodplain access & aquifer recharge
- Improved base flow etc.
- Improved water and habitat quality
- Increased fish populations
- Increased recreationist satisfaction

Efficiently Monitored Actions

Efficiently Monitored Objectives

PFC

Values

ADAPTIVE MANAGEMENT

T
I
M
E

ANNUAL INDICATORS OF RECOVERY

= **End-of-season condition**

e.g. ✓**residual vegetation**
✓**bank alteration**

3 - 5 - YEARS INDICATORS OF RECOVERY

= Vegetative

e.g. ✓ greenline

5 - 10 YEARS INDICATORS OF RECOVERY

= Vegetative/Physical

e.g. ✓ X-section composition
✓ Woody recruitment
✓ Greenline/Greenline Width
✓ Bank Stability

DECADES INDICATORS OF RECOVERY

= Water and Habitat Quality

e.g. ✓ Temp
✓ pools

ADAPTIVE MANAGEMENT

TIME

ANNUAL
INDICATORS OF
RECOVERY

= End-of-season condition

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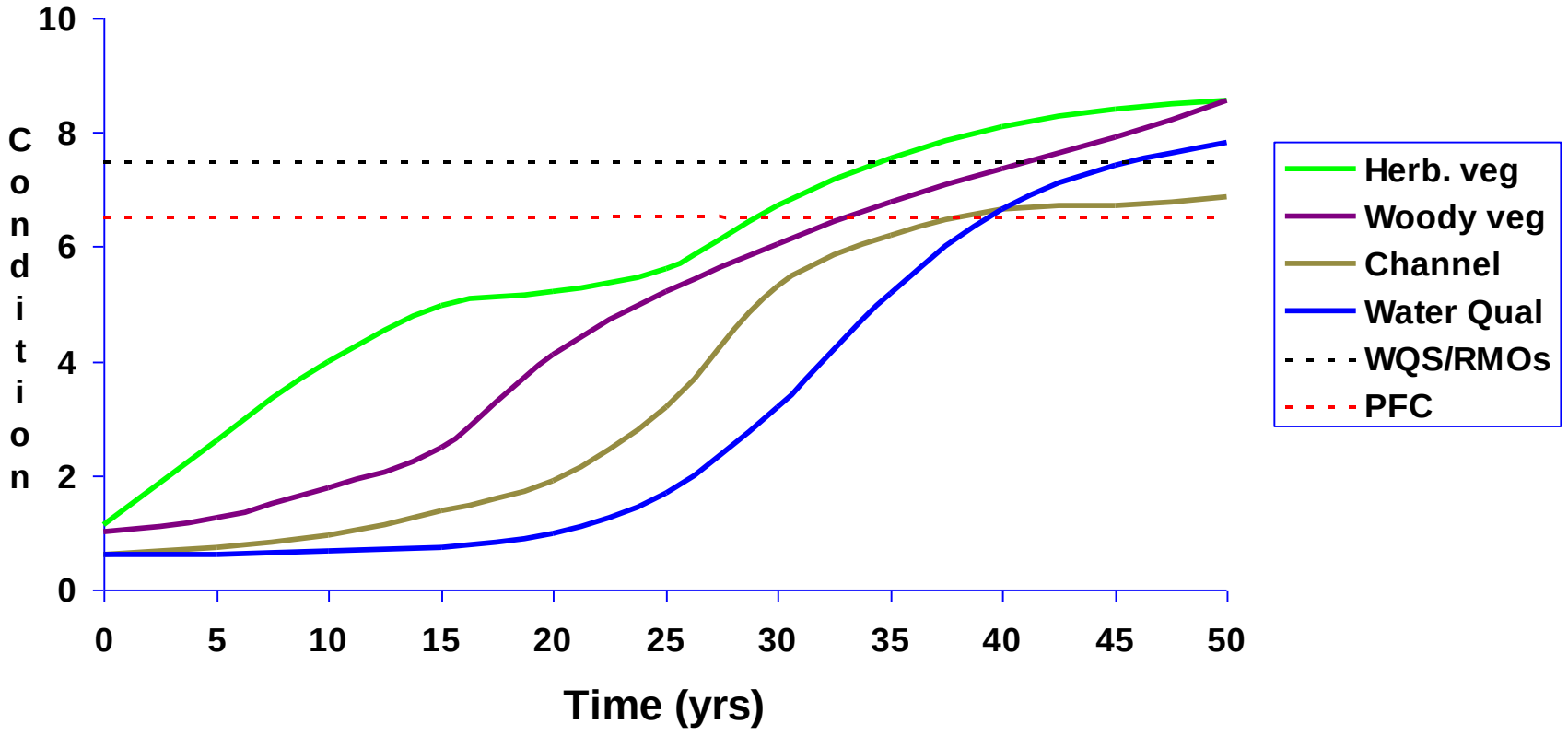
Recovery Rates

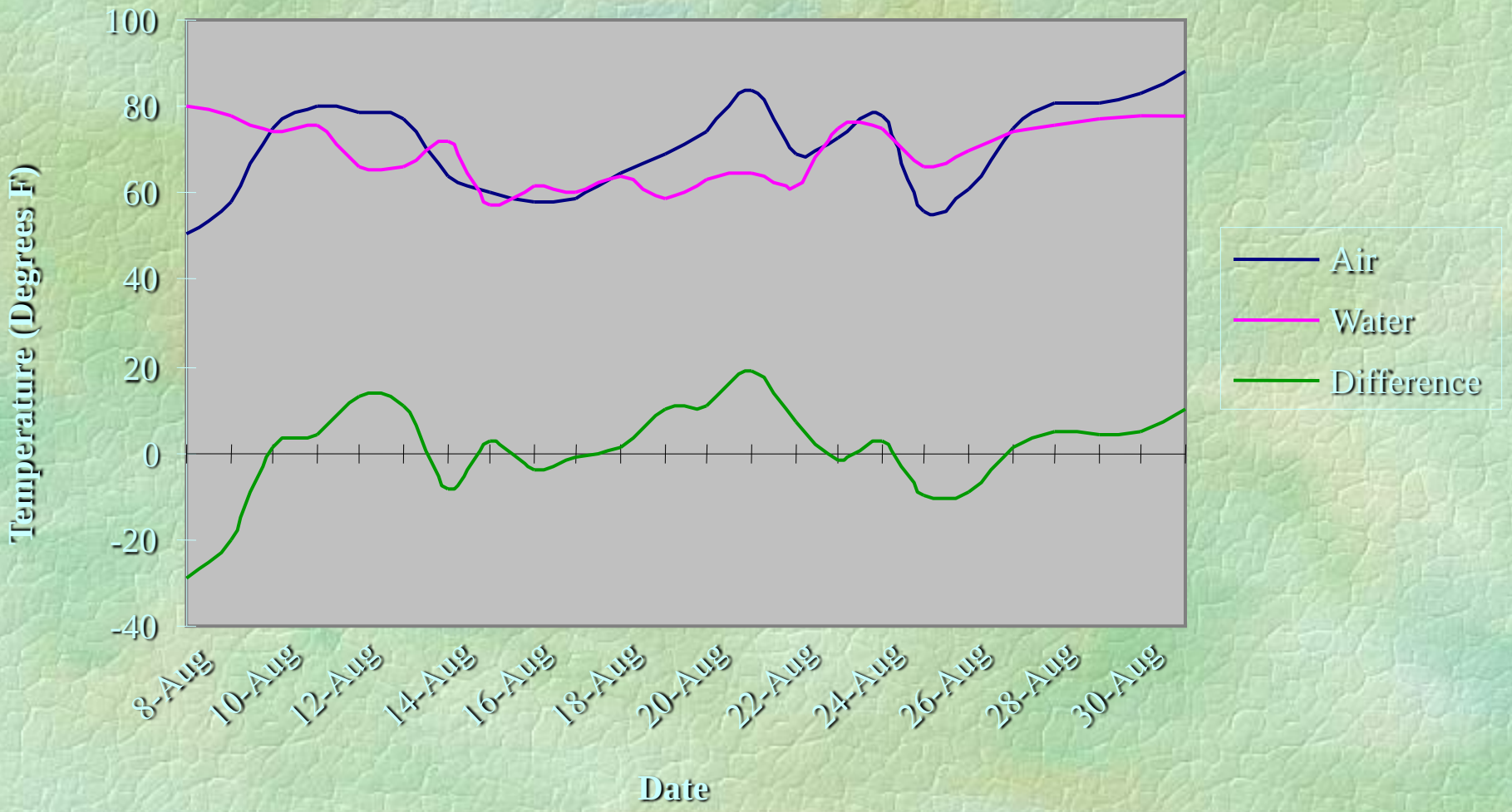
Non-Functional

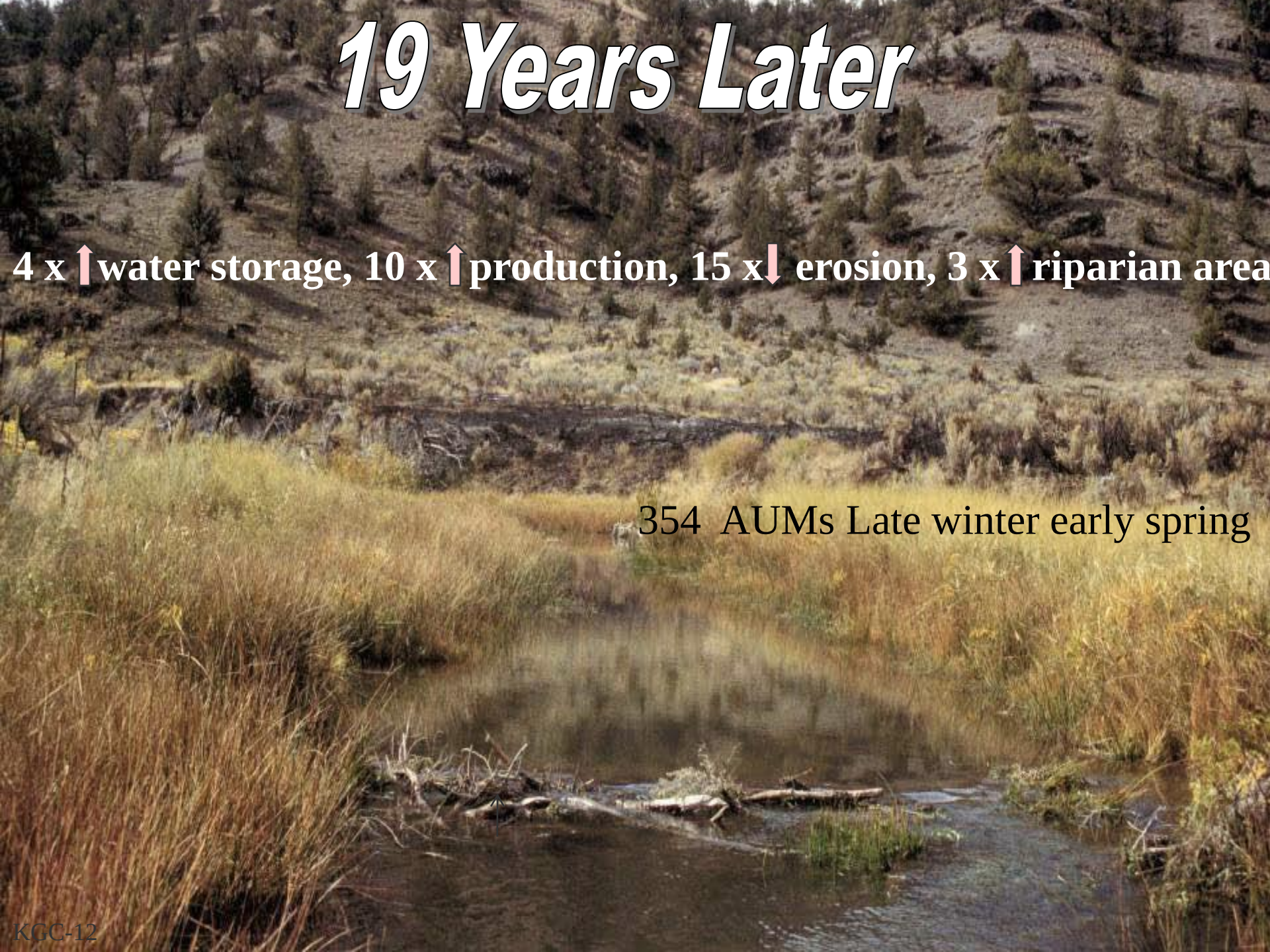


Bear Creek 1977

Difference in Air & Water Temperatures

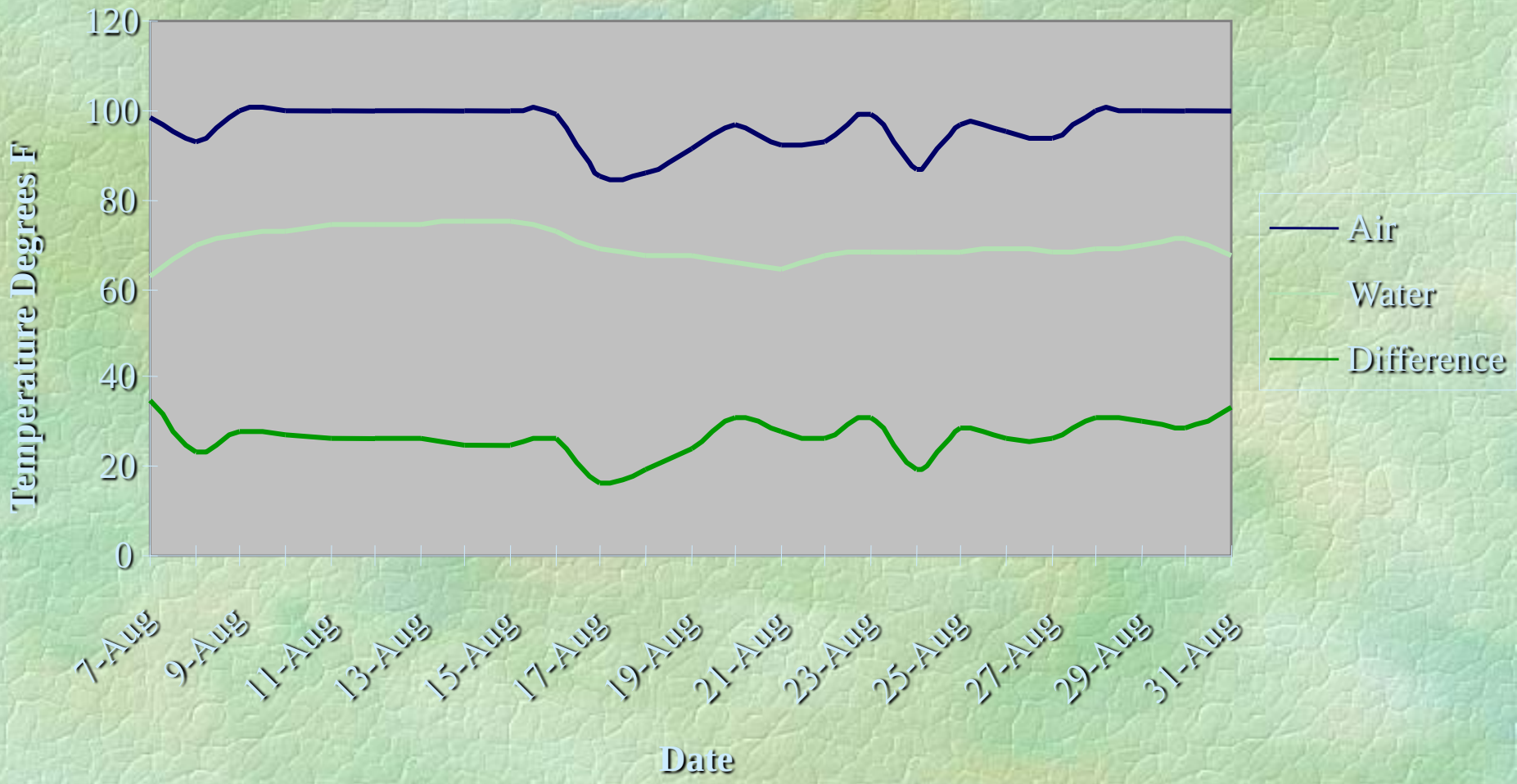
Bear Creek - Central Oregon
1976



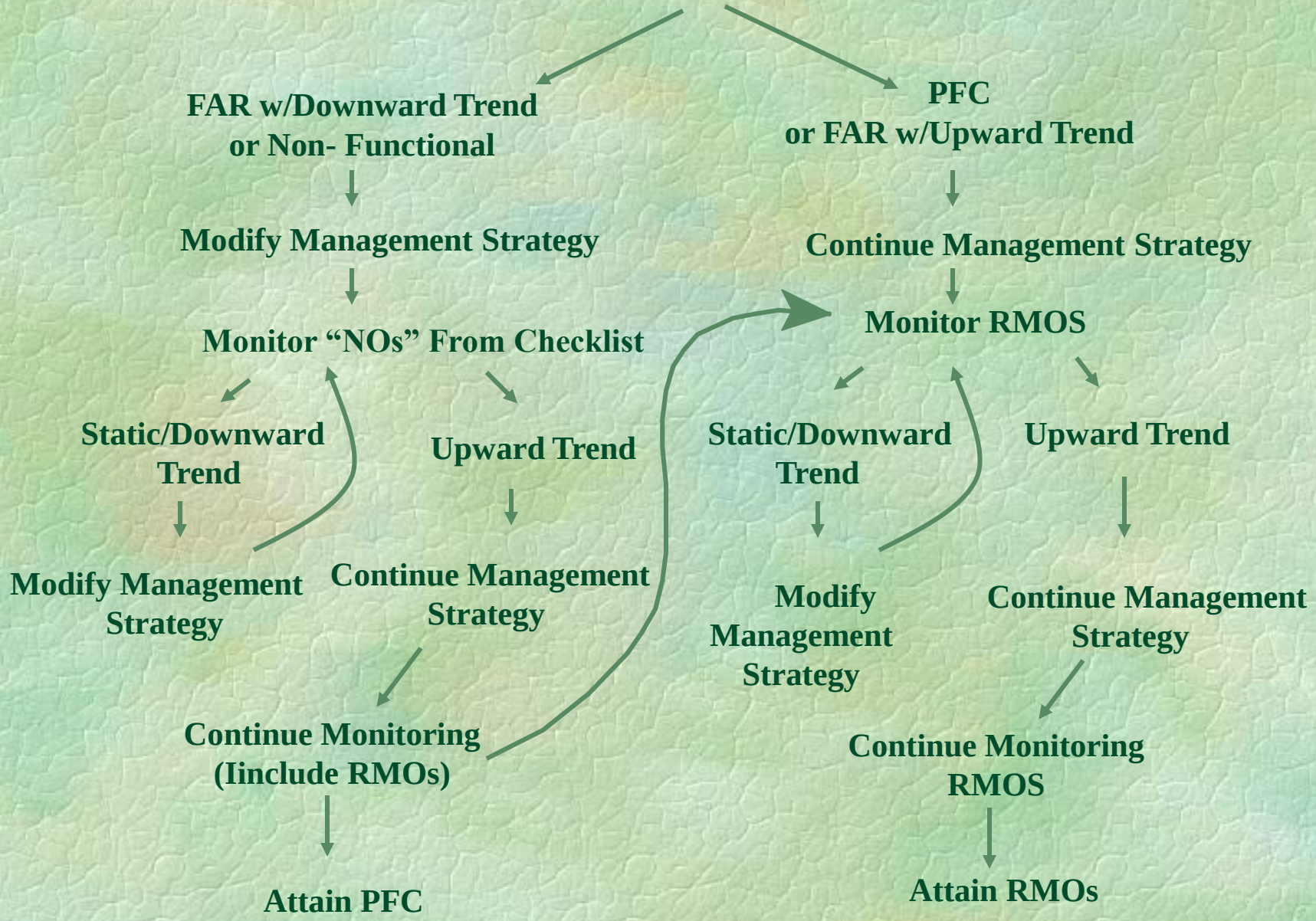

19 Years Later
4 x ↑ water storage, 10 x ↑ production, 15 x ↓ erosion, 3 x ↑ riparian area
354 AUMs Late winter early spring

Difference in Air & Water Temperatures

Bear Creek - Central Oregon
1998



INVENTORY ALL STREAMS UTILIZING PFC PROCESS



Supports

PFC ~~does not equal~~

- **Desired Future Condition (DFC)**

Supports

PFC ~~does not replace~~

- **Legal Requirements, e.g., ESA, CWA**

PFC Helps

Determine potential and capability

Link reach/watershed processes to habitat/water-quality conditions

Define issues to be addressed

Select appropriate management practices

Determine appropriate monitoring

For Further Information:

- Sherman Swanson (775-784-4057)
- sswanson@cabnr.unr.eu
- National Riparian Service Team – BLM, FS, NRCS, and a network of other agency and NGO people in all western states
  - http://www.blm.gov/or/programs/nrst/index.php

Addendum:

- PFC is a qualitative assessment to understand the location and nature of riparian issues & opportunities
- To monitor at-risk reaches or wetlands, use quantitative method(s)
- Riparian monitoring provides excellent experience for developing professionals
- They gain journey-level skills needed for an effective ID Team for qualitative assessment