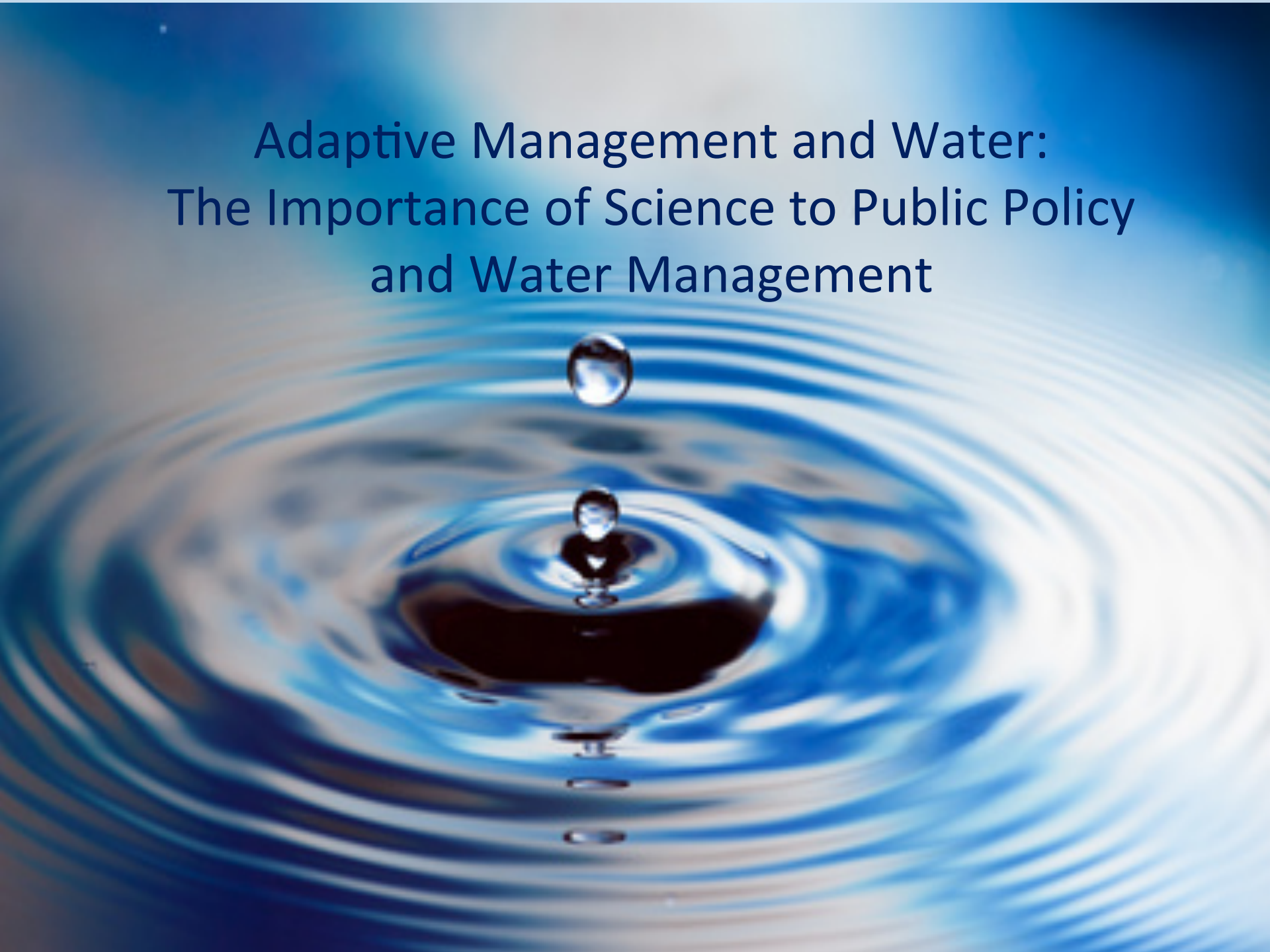
Adaptive Management and Water: The Importance of Science to Public Policy and Water Management



Organization

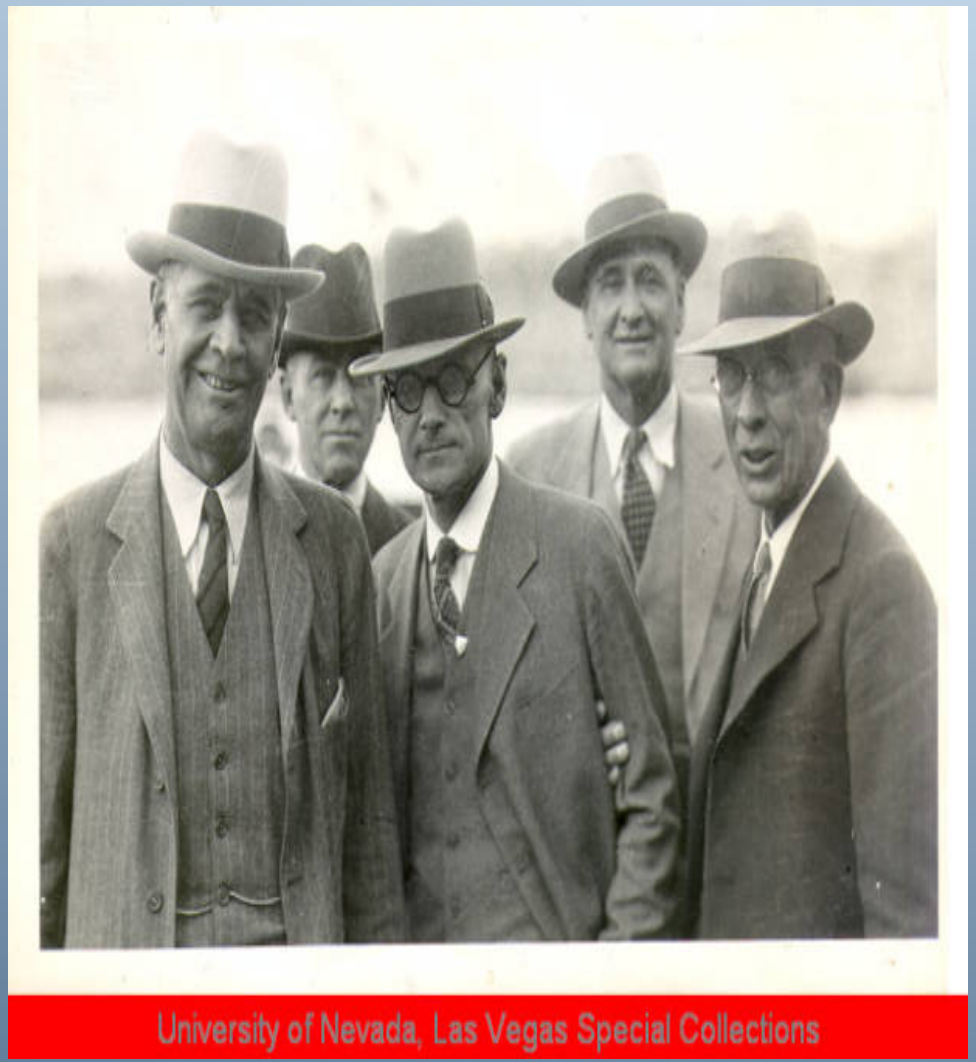
- Part I. The use of science in the Federal government
- Part II. Adaptive Management - concept to use
- Part III. Examples/projects that use of Adaptive Management for water management challenges
- Part IV. Summary and thoughts regarding use of science and adaptive management

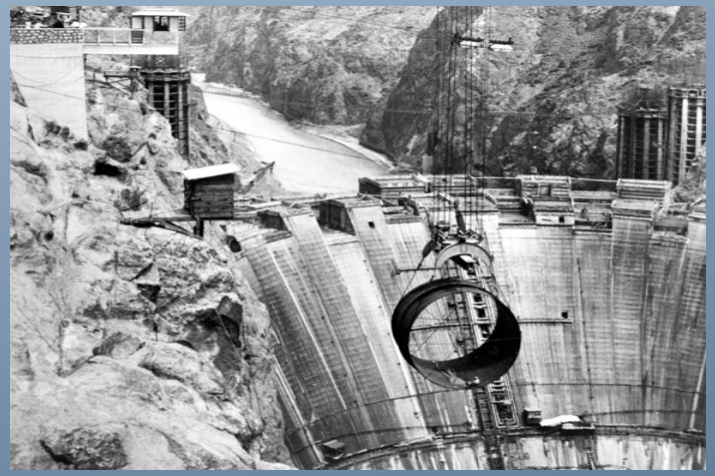
Water Policy and Actions

Good water policy is dependent upon :

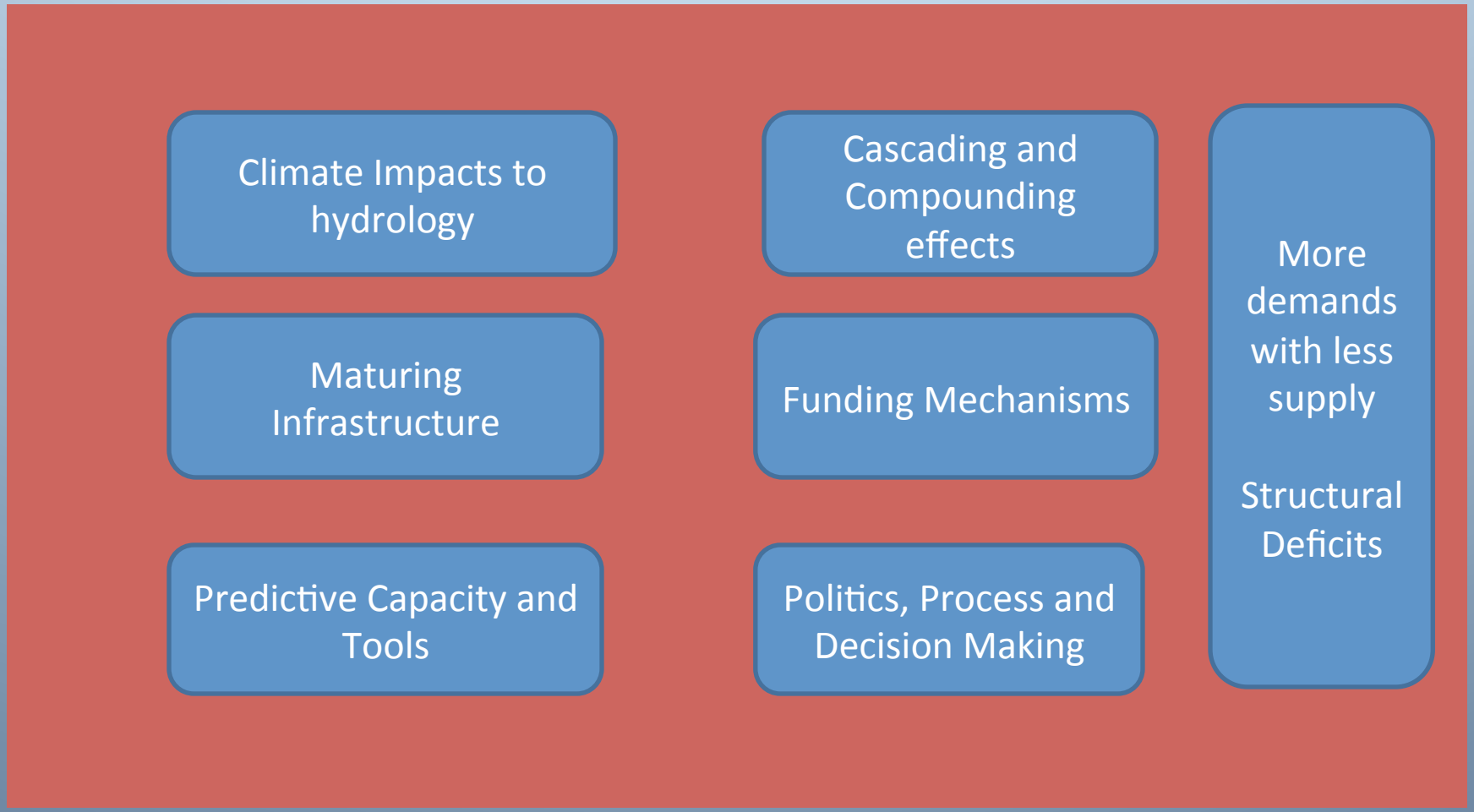
- Science
- Open process
- Debate and discussion
- Follow-through
- Implementation
- Monitoring and feedback
- Adaptive management

Historically water policy dominated by linear and monolithic thinking





Challenges to Monolithic and Linear Thinking



Silo-ed Water Policy in the Federal Government

26 Federal Agencies have “water” in their missions

Has led to “protected turf” and “structured thinking”

Science and the Federal Government

- Scientists embedded in each agency - initially
- 1941 – FDR initiated the Office of Scientific Research and Development/Science Advisory Committee
- Continued role in various forms 1941-2017
  - 1955 Science Advisor to the White House
  - Office of Science and Technology Policy (1976-2017)
- National Academy of Sciences – 1863 established by Congress and approved by President Lincoln
- Executive, Legislative and Judicial branches of government – authorization/appropriation

A Digression on Science and Politics

- 1970's implementation of new environmental laws
- 1980's – Era of environmental/holistic management began to emerge – nasty problems being addressed

- **1992** Clinton elected President – appointed Bruce Babbitt as Secretary of the Interior
- **1993** - SOI Babbitt desired to form a "National Biological Survey" to reshape how the science of the DOI was being used in agency decision making
- Congress could not move fast enough so SOI Babbitt used Secretarial Orders to implement NBS – Wise use & public takings folks went berserk
- **1994** – Republicans take over Congress and immediately begin to undermine NBS. New Speaker of the House Gingrich's "Contract with America"
- **1995** – SOI Babbitt renames NBS but runs out of options – no funding
- **1996** NBS ceases to exist – scientists rolled into USGS – DOI science impacted

Adaptive Management and Science

Background

- **Adaptive Management – is composed of:**
  1. **A structured, iterative process of robust decision making in an uncertain environment**
  2. **Goal is to reduce uncertainty over time by using system monitoring and assessment**
  3. **Gather scientific and ecosystem response information necessary to improve future management of resources**

Origins of Adaptive Management

- As *common sense* - has been practiced for generations to help support multiple use of resources
- As a *scientific concept* – origins in early 1900's as part of natural resource management – Gifford Pinchot and President Teddy Roosevelt
- *Passive* and *Active* adaptive management evolved in late 1970's and early 1980's through studies and efforts by Kai Lee, C.S. Holling and C.J. Walters

Reasons why Federal Government includes Adaptive Management

- Politically expedience
- Enshrine “status quo”
- Legacy resilience and sustainability in water management

Adaptive Management Examples

- Increasing Use of Adaptive Management language in government programs
- Initiated a review with *Congressional Research Service*
- Case studies that show the range of use of Adaptive Management in respect to rivers:
  - Florida Everglades
  - Missouri River Dam and Reservoir System
  - Upper Mississippi River
  - Rio Grande River
  - Glen Canyon Dam and Colorado River

Caveats: Rivers are Complex Ecosystems

River ecosystems function as complex, dynamic systems with nonlinear responses to:

- Internal forces
- External forces
- Feedback loops
- Thresholds
- Inherent unpredictability

Because Rivers are Complex:

Effective management tends to be difficult, complex, and dependent on the interdependency of multiple components and stakeholder commitment to solutions

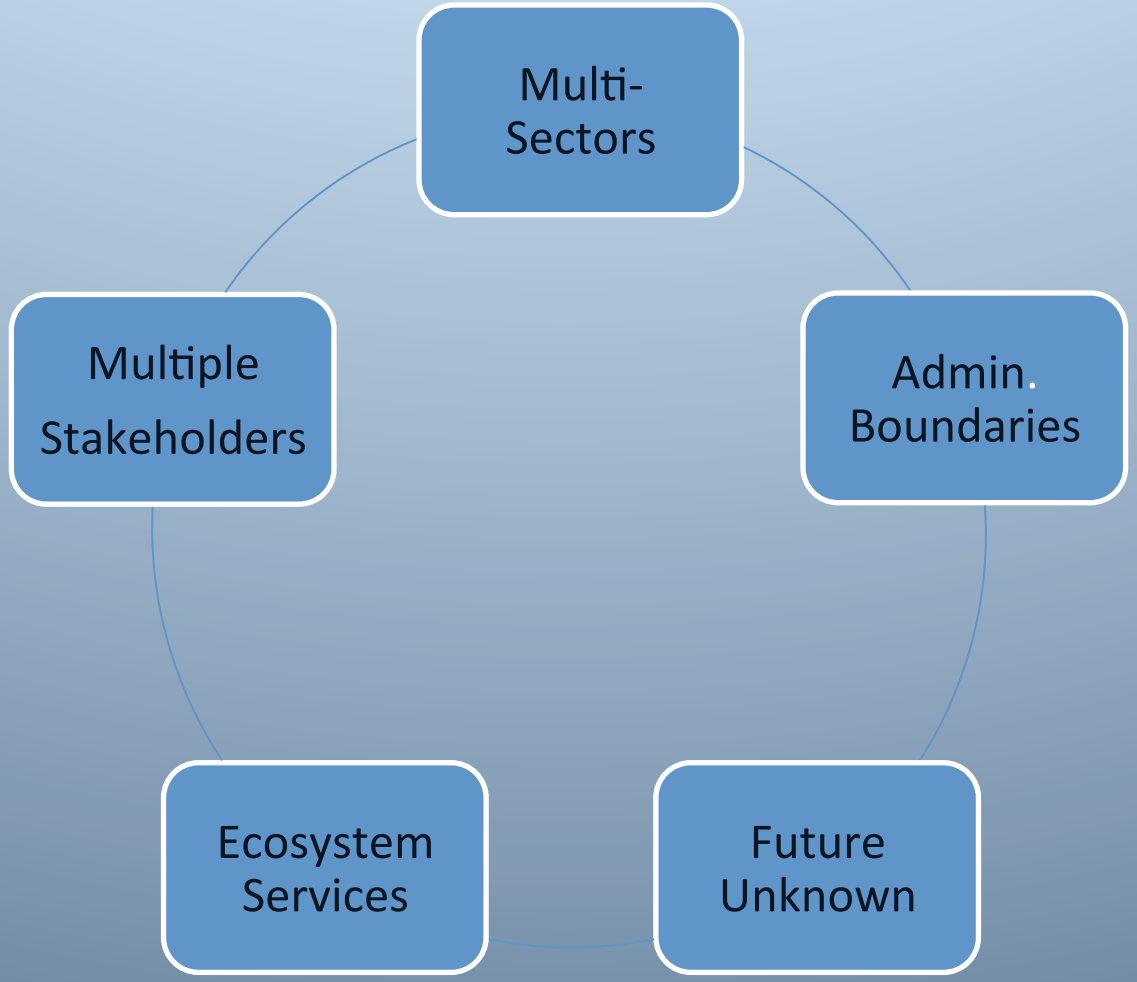
Complexity of the Issues may Determine the Appropriate Response

Type I Problems. Technical problems that have *clearly defined questions and mechanical,* straightforward solutions

Type II Problems. Definable problems but have no clear-cut solution
Proposals must be tested and refined
Adaptive Management Lite

Type III Problems. No clear-cut definition of the problems and no clear-cut technical solutions. Require continual learning to formulate the problem and adaptively work towards solutions.
Adaptive Management Full

Systemic Elements of Complex Ecosystem Management Issues



Issue: Loss of wetlands in the Everglades

Reasons:

- Urban development
- Agriculture
- Draining of wetlands
- Water development

Adaptive Management recognized as a water management approach
Corps of Engineers authorized to share in the costs of all operations and maintenance costs of restoration

Missouri River Dam and Reservoir System

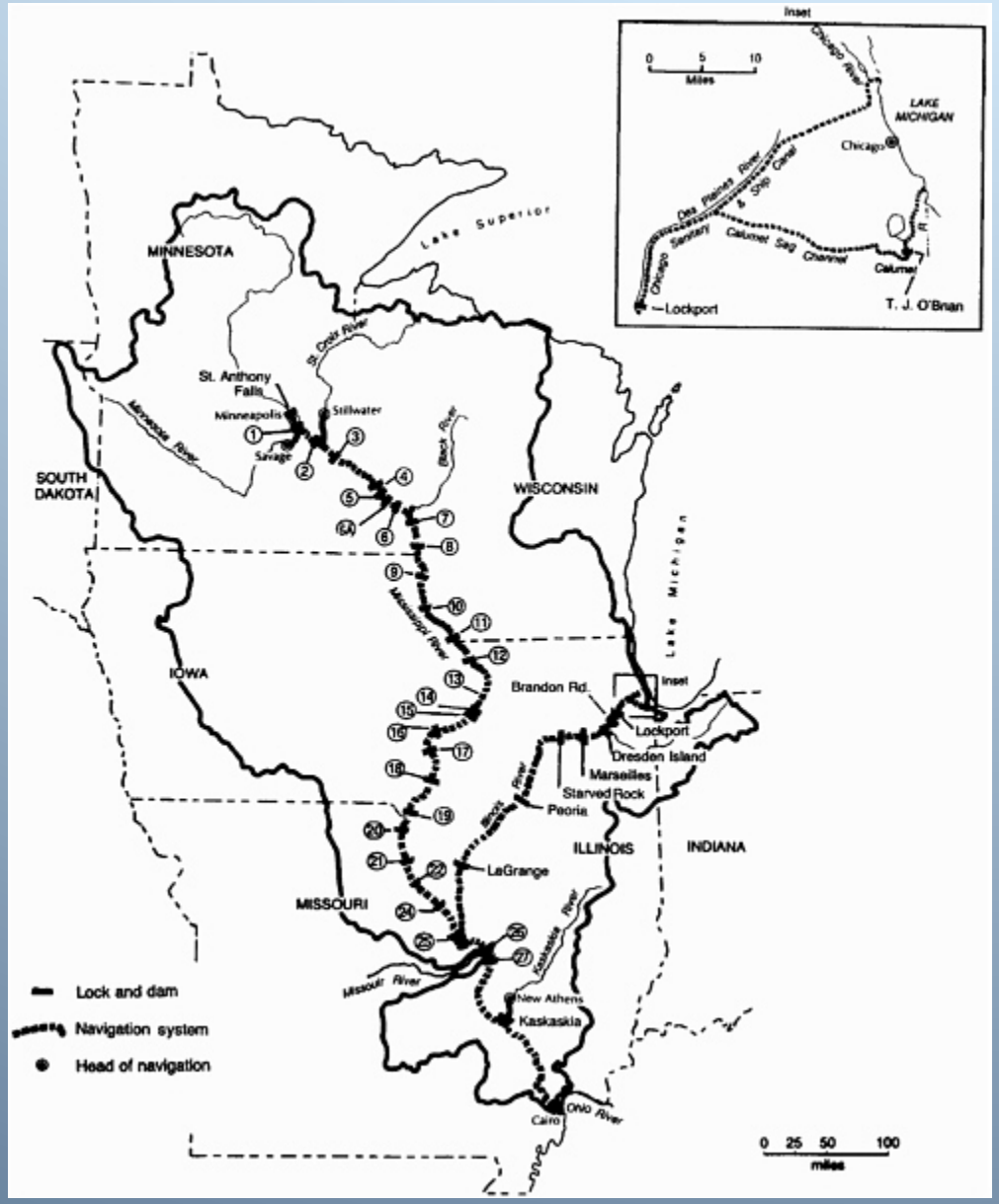
Missouri River Dam and Reservoir System

Context: Water Development project by the U.S. Army Corps of Engineers and the Bureau of Reclamation for:

* Navigation
* Flood Control
* Hydropower
* Irrigation
* Recreation

Impacts: Loss of ecosystem integrity

Challenge: Operations and maintenance of the river system



Upper Mississippi River

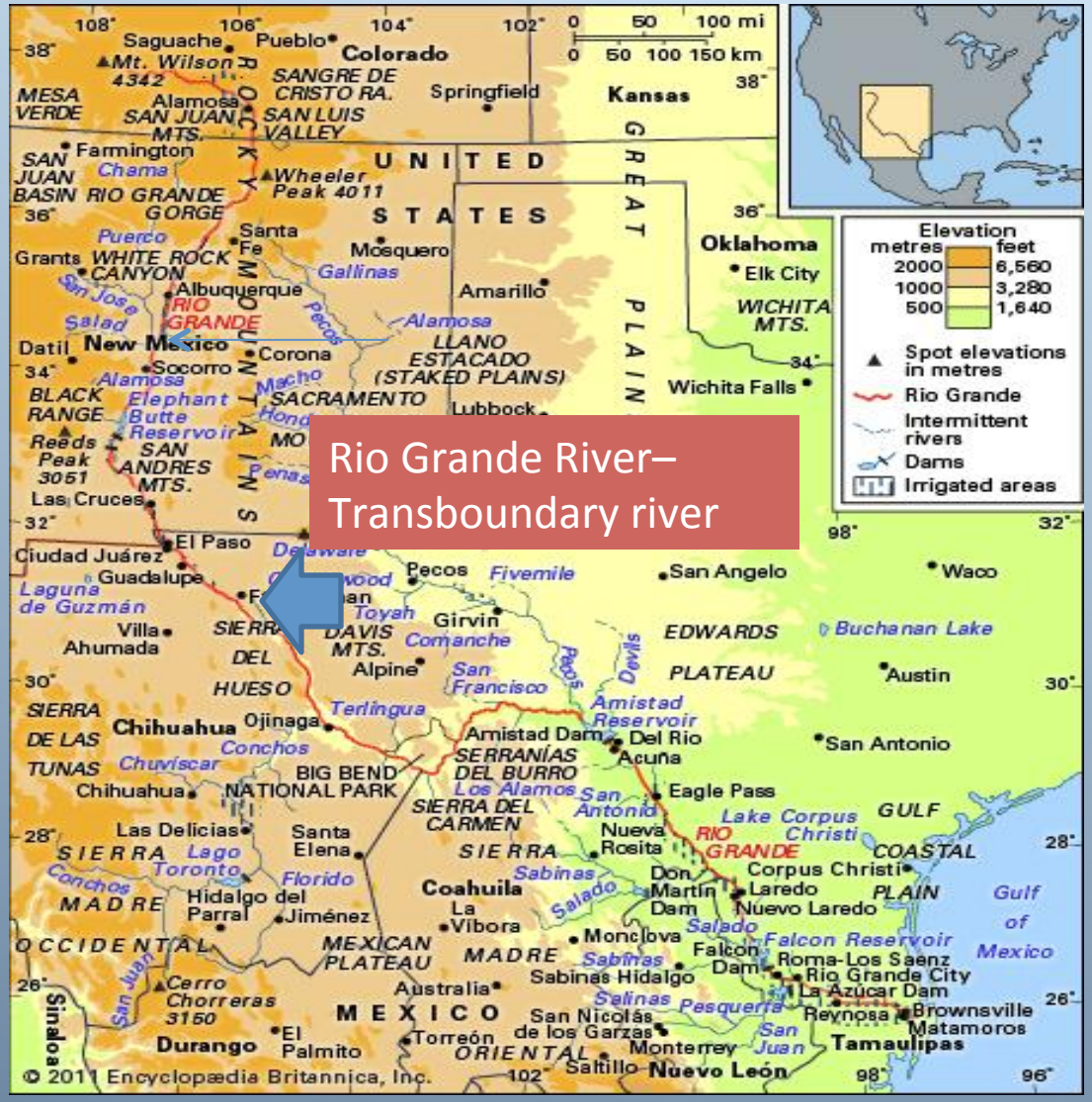
Breadbasket of America

Upper Mississippi River

- Issues
  - Management of water quality, flooding, navigation, nutrient flows from farms
  - Loss of ecosystem integrity

- Impacts
  - Seasonal navigation – commodities
  - River control has reduced natural floodplain
  - Sediment movement reduced to delta

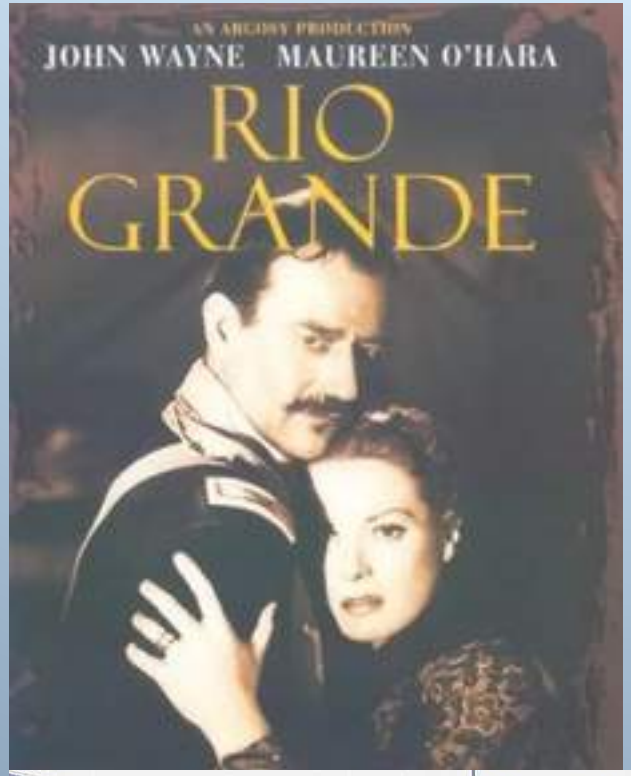
- Challenges
  - Multiple stakeholders
  - Economic impacts
  - Environmental issues



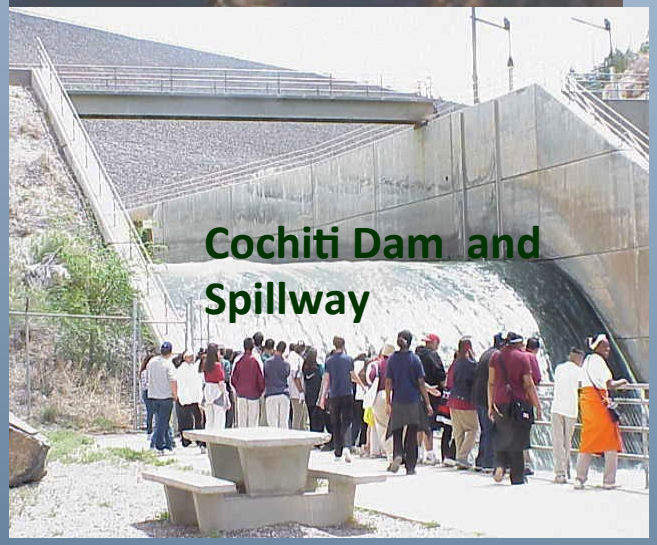
Middle Rio Grande River

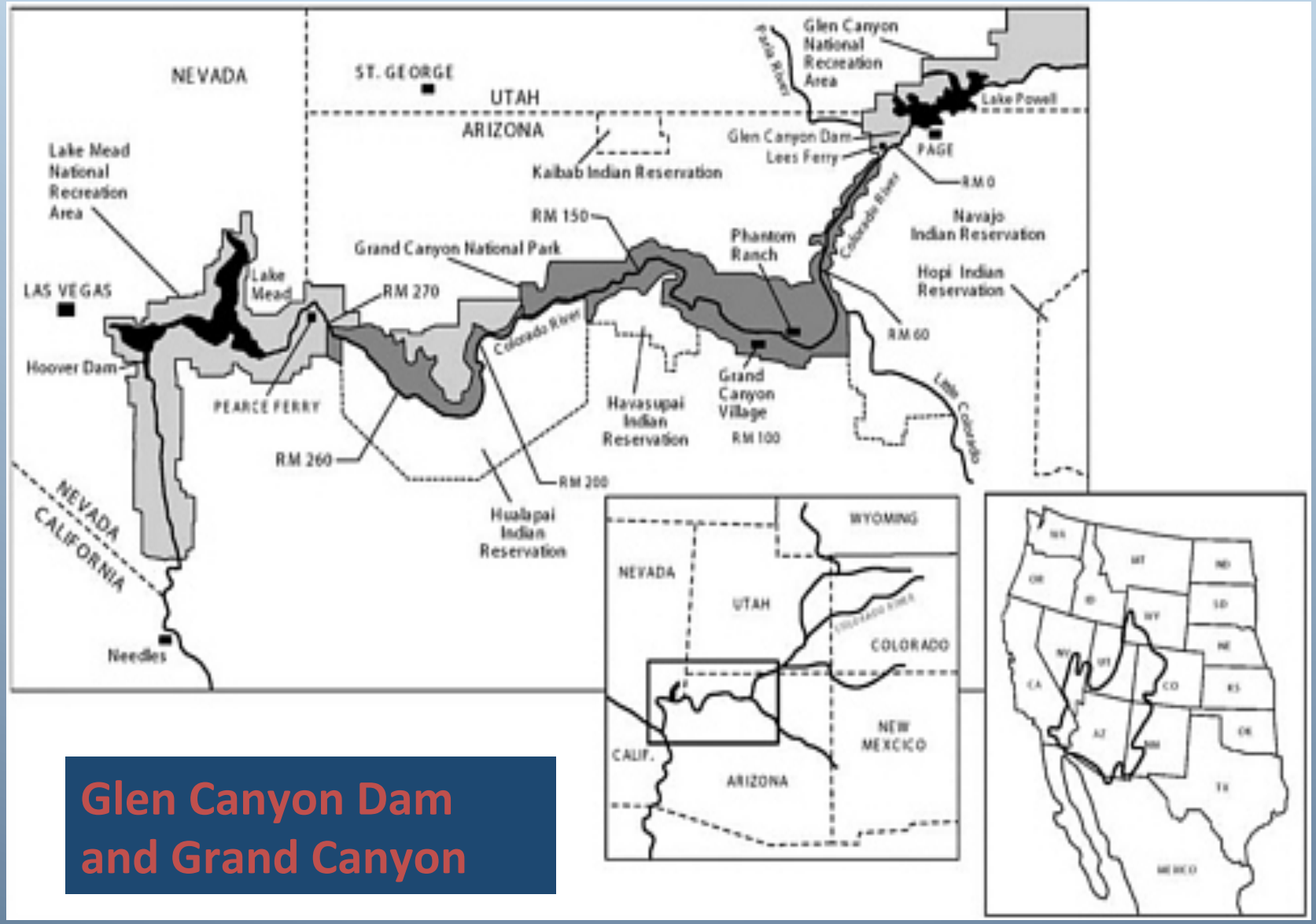
Collaborative Program

20 plus years of contentious debate



Rio Grande, north of Albuquerque, New Mexico.





Glen Canyon Dam and Grand Canyon

Evolution of Adaptive Management at Glen Canyon Dam

Why the Need? *Monolithic thinking meets knowledge*

- Water development began in the Colorado River in the mid 1800's. Based on limited data and limited assumptions
- Why:
  - Irrigation
  - Hydropower
  - Flood control
  - Development
- Impacts
  - Changing water quality
  - Changing natural water cycles
    - Seasonal shifts in water scheduling
    - Daily shifts in water releases
  - River integrity compromised

Glen Canyon Dam – Colorado River

Construction: 1956 – 1963

Modified sediment and water dynamics

Colorado River in the Grand Canyon

ECOLOGICAL INTEGRITY COMPROMISED BY

GLEN CANYON DAM

7 states
2 Countries
26 Tribes

Variable water supply

1400 miles long

Large elevation change

Adaptive Management at Glen Canyon Dam: Water Management is Challenging

- **1922** – Colorado River Compact between the Upper and Lower Colorado River Basin States
- **1928** – Boulder Canyon Project Act – Hoover Dam and development
- **1944** – **Mexico/United States Treaty over the Colorado, Rio Grande, Tijuana rivers – Minute 323 completed on September27, 2017**
- **1948** – Upper Colorado River Compact – allocation of water to Colorado, Wyoming, Utah and New Mexico (and a small part to Arizona)
- **1956** – Federal authorization to construct Glen Canyon Dam
- **1956** – construction begins
- **1963** – dam essentially completed – water storage begins
- **1968** – Colorado River Basin Act – directs water management in Lake Powell and Lake Mead
- **1969** – National Environmental Policy Act passed into Law

Adaptive Management and Glen Canyon Dam

- **1963-1980** – Lake Powell reservoir fills with water
- **1980** – Federal government proposed expanding hydropower at Glen Canyon Dam
  - Public outcry over dam operations and impact of dam on river
- **December 6, 1982** – Environmental Assessment on Glen Canyon Dam hydropower generators
- Glen Canyon Environmental Studies initiated – first systematic science
- **1983/1984** - high reservoir and river levels
- **1983-1988 – GCES Phase I. First discussion of Adaptive Management**
- **1989** – GCES Phase II begins with EIS focus on dam operations
- **1992** - *Grand Canyon Protection Act* passes into law – Adaptive Management direction
- **1996** – Glen Canyon Dam EIS completed – Adaptive Management included. GCES program is terminated
- **1997** – USGS Grand Canyon Monitoring Research Center takes over
- **1996, 2004, 2008, 2012,2013, 2016** - High Flow Experiments
- **2016 – Long Term Experimental and Management Plan- EIS**

Has Adaptive Management worked?
What is the role of science?
Does it make a difference?

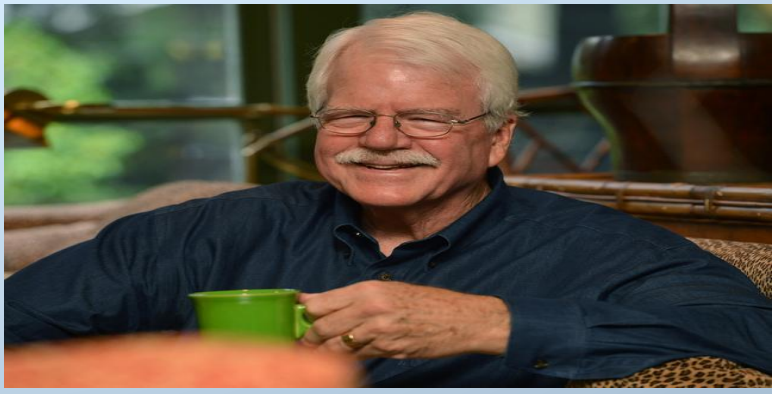
Benefits *of a Credible Adaptive Management Program*

- Can initiate restoration efforts when scientific uncertainty exists.
- Potential to deal with changing circumstances over large time periods
- Creation of formal monitoring networks and processes
- Can increase stakeholder buy-in
- Ability to serve as an oversight tool for ecosystem restoration initiatives
- Ability to generate fundamental information

*Potential **Problems** of Achieving a Credible Adaptive Management Program*

- Connecting Experimentation to operational changes
- Failure to resolve fundamental value conflicts
- Lack of flexibility to implement changes to a program
- Undefined objectives and performance metrics
- Use of uncertainty to delay action
- Defining roles

Engaged stakeholders



Vision and political leadership

CONCLUSION:

Adaptive Management

An option but not a panacea
success depends upon many factors

Educated decision-makers

Dedicated scientists

And a lot of patience!

Multiple Roles, Responsibilities & Risks

Water Resource Research Centers

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Thank you

Questions?