Western Water Assessment 2012 Stakeholder Meeting

October 2, 2012

Welcome and Introductions

Brad Udall

Purpose of Meeting

Jeff Lukas

Purpose of Meeting

- Inform stakeholders about WWA projects
- Get direct feedback
- Identify possible new partners
- Learn more about stakeholder needs and identify new projects

Follow-Up from 2011 Meeting

Eric Gordon

WWA's Strategic Revisioning

Bill Travis

WWA's Strategic Re-Visioning

Key plank in 2010-2015 proposal to "evolve and learn in an adaptive framework"

Adapt, recognizing:

- Feedback from stakeholders and Advisory Board, plus insights form internal and external reviews of operations
- Changing stakeholder needs and increasing sophistication
- Changing landscape of regional climate institutions (e.g., LCC's)
- Changing societal engagement with climate (e.g., extremes, climate services, etc.)

WWA's Strategic Re-visioning

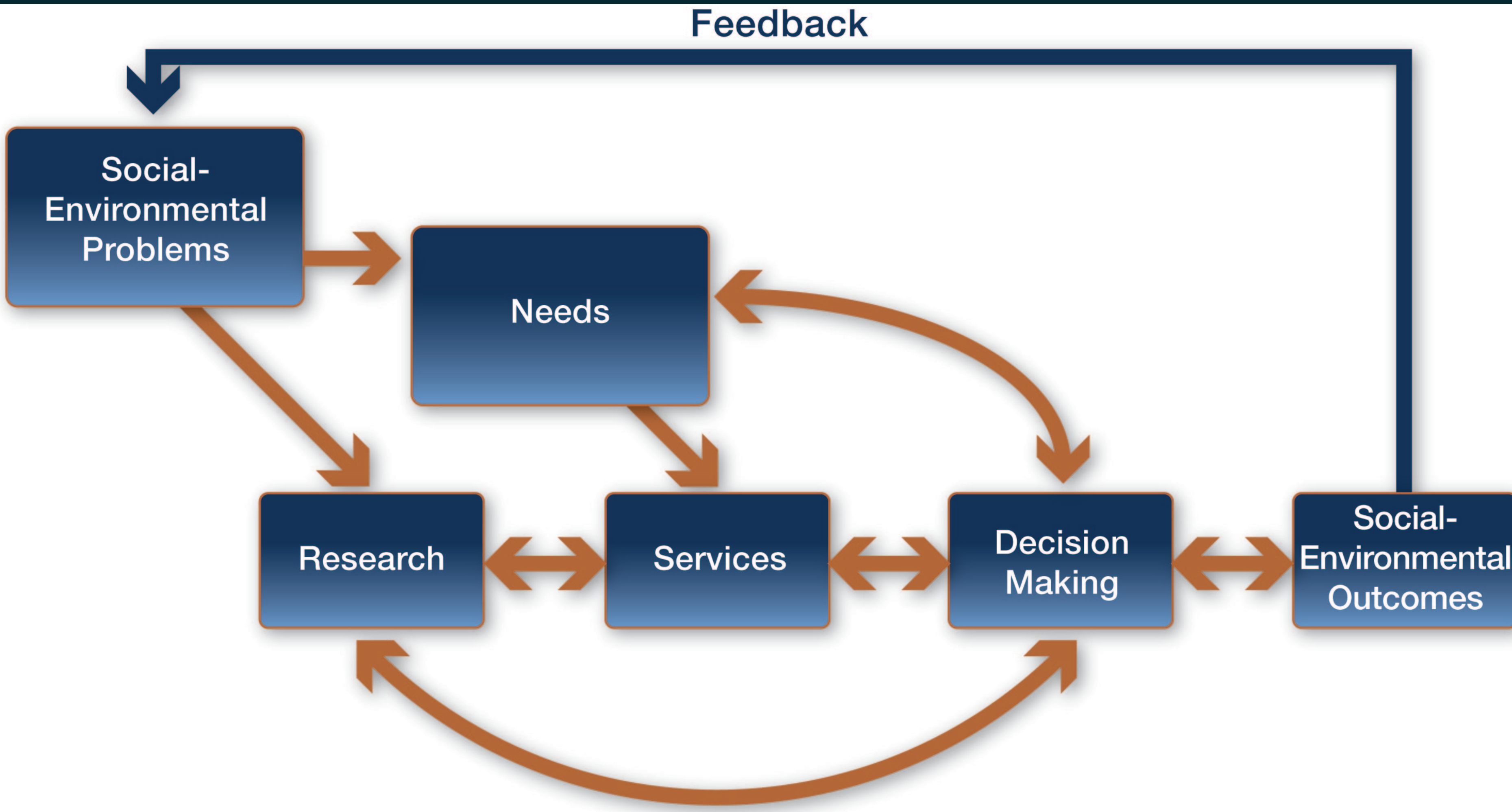
Key plank in 2010-2015 proposal to "evolve and learn in an adaptive framework"

- Renewed focus on the regional hydrological cycle and water reliability
- Revised process of developing and funding projects
- Development and application of an "end-to-end" project framework

WWA's New End-to-End Framework

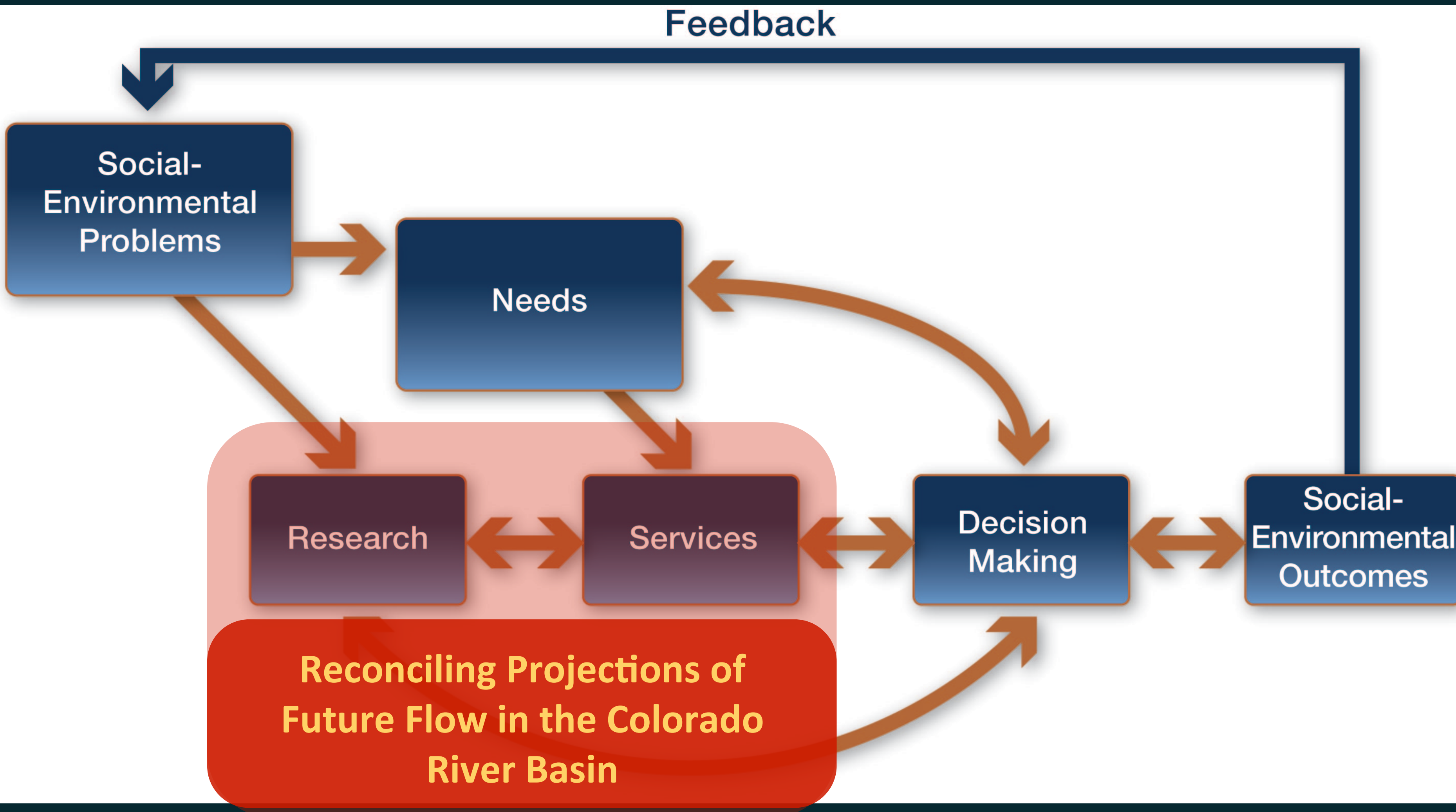
Lisa Dilling

End-to-End Framework



Recently Completed Projects

Part 1



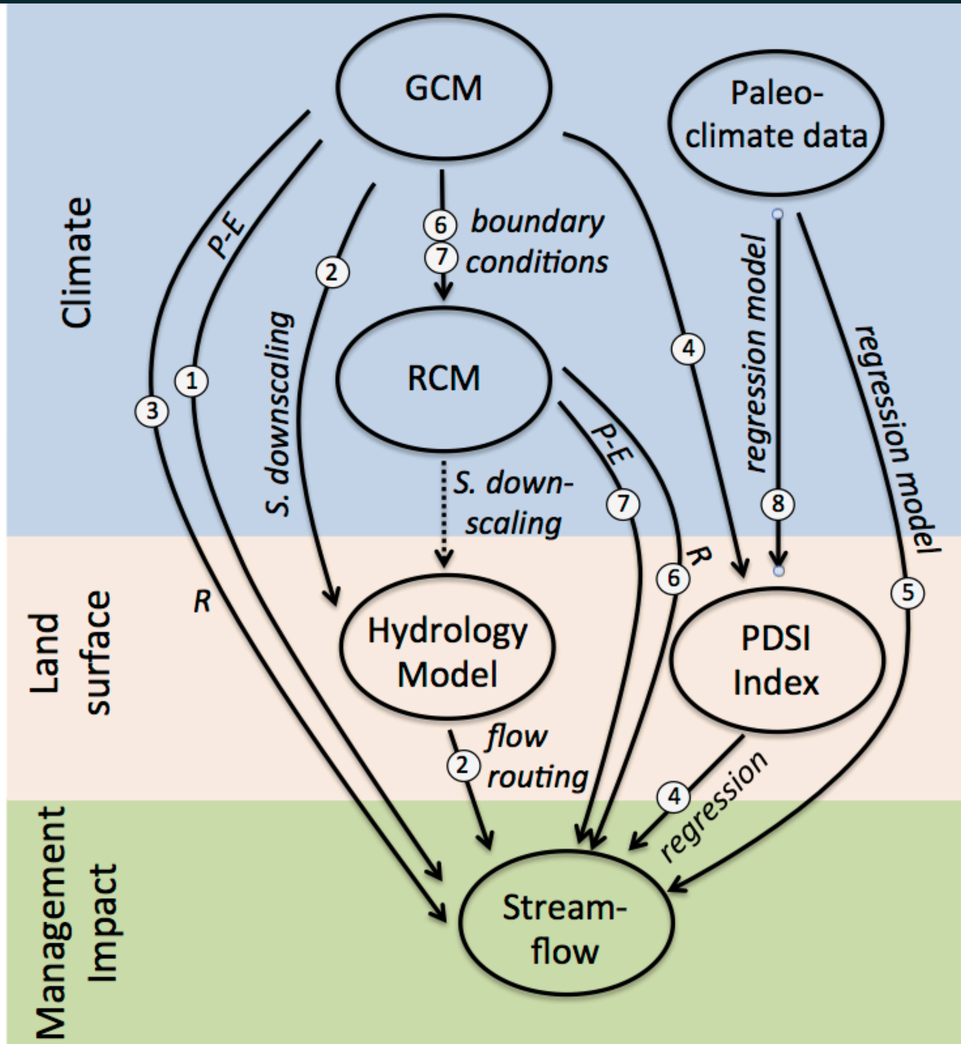
Feedback
Social-Environmental Problems
Needs
Research
Services
Decision Making
Social-Environmental Outcomes
Reconciling Projections of Future Flow in the Colorado River Basin

Reconciling Projections of Future Flow in the Colorado River

B. Udall and Colleagues

- Multi-institutional effort to understand diverse 21st Century projections for CRB flows
  - UW, Scripps, UA, CU, Reclamation, CBRFC, NOAA
- Journal Articles
  - Vano et al, 2013: Uncertainties in Future Colorado Streamflow, *BAMS*
  - Vano et al., 2011: Hydrologic Sensitivities, *JoHM*
  - Das et al, 2011: Importance of Warm Season Warming, *GRL*
  - Hoerling et al., 2009: Reconciling Projections, *SH*
- Note: Many recent CRB studies
  - Reclamation, NCAR, CWCB among others

Reconciling Colorado River Flows



Studies using various approaches:

1. Seager et al. 2007
2. Christensen et al. 2004; Christensen and Lettenmaier, 2007; USBR 2011
3. Milly et al. 2005
4. Hoerling and Eischeid, 2007
5. Woodhouse et al. 2006; McCabe and Wolock 2008; USBR 2011
6. Gao et al. 2011; Rasmussen et al. 2011
7. Gao et al. 2012
8. Cook et al. 2004

Abbreviations:

GCM – Global Climate Model
RCM – Regional Climate Model
PDSI – Palmer Drought Severity Index
P – Precipitation
T – Temperature
R – Runoff
E – Evaporation
S. Downscaling – statistical downscaling (studies above use BCSD)

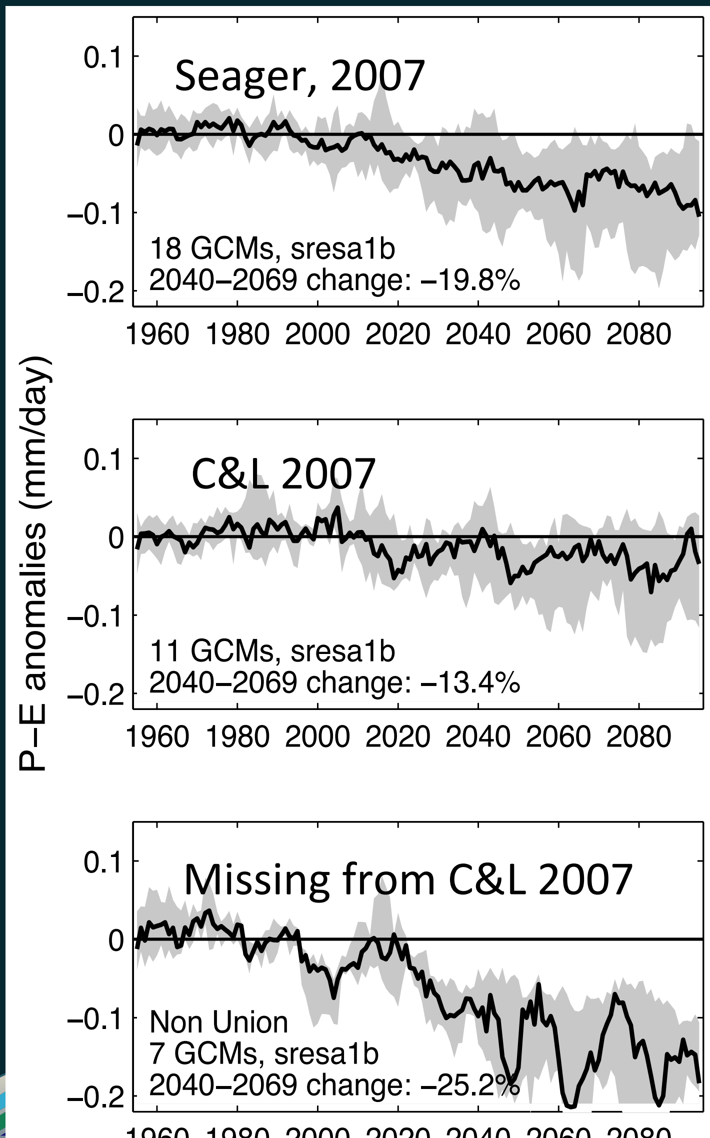
Figure 6. Approaches to generating climate projections. Dotted lines indicate future studies.

Reconciling Colorado River Flows

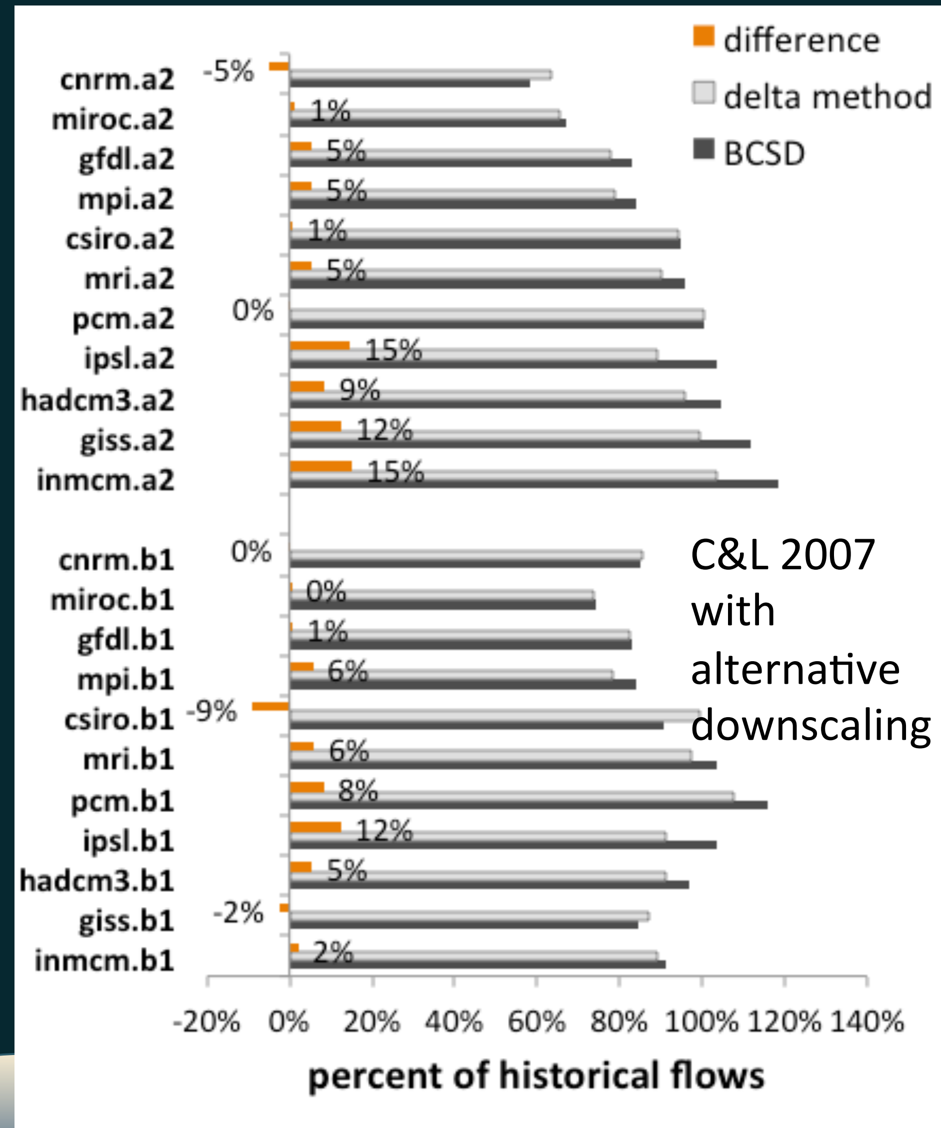
- Global Climate Models
  - Seager's 19 models (2007) drier than C&L 11 models (2007)
  - Model selection can significantly impact results
- Downscaling Methods
  - Preserve or not preserve GCM precipitation amounts?
- Land Surface Models
  - Land surface models (hydrology models) also contribute to uncertainty
  - Sensitivities and elasticities are another way to think about future changes outside of projections
- Model Scale
  - High elevation contribution to runoff critical
  - Hoerling and Eischeid (-45%) and GCM scale fundamentally wrong

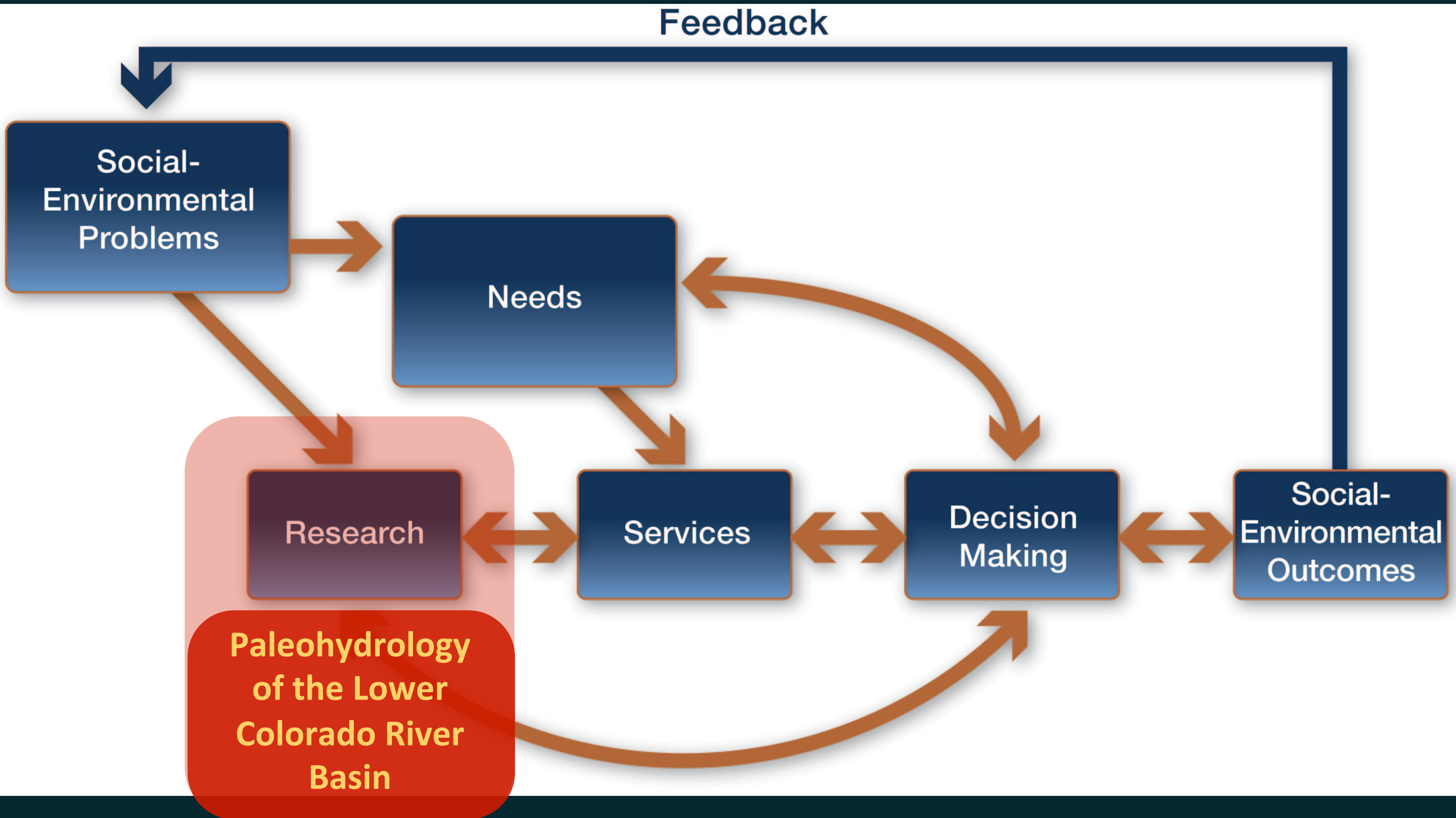
Reconciling Colorado River Flows

GCM Selection is Important



Downscaling Method is Important




Feedback
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Needs
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Services
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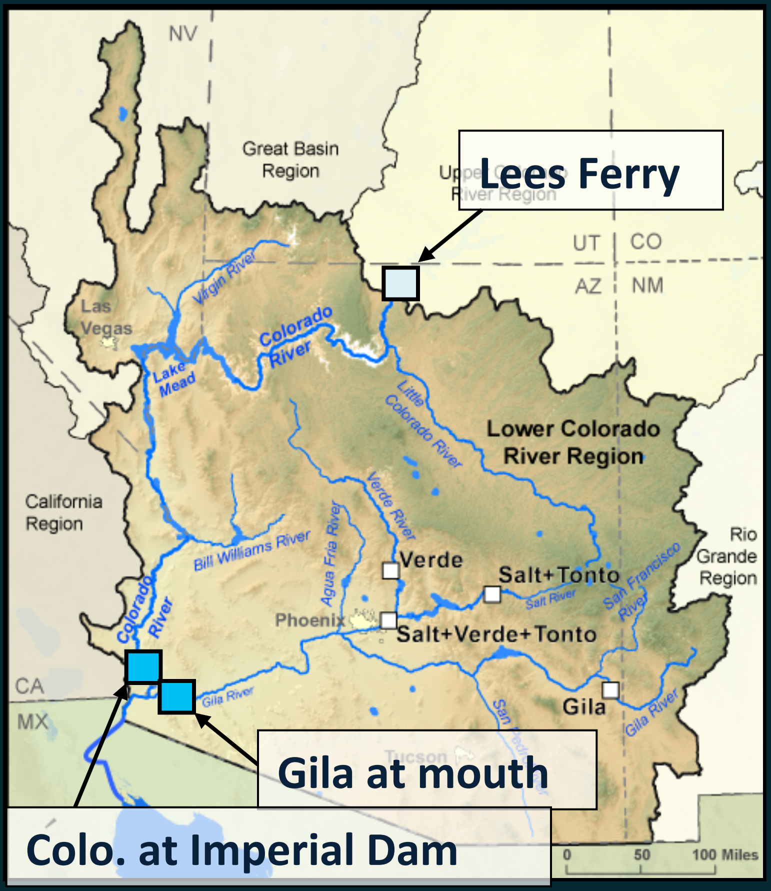
Paleohydrology of the Lower Colorado River Basin

Paleohydrology of the Lower Colorado River Basin

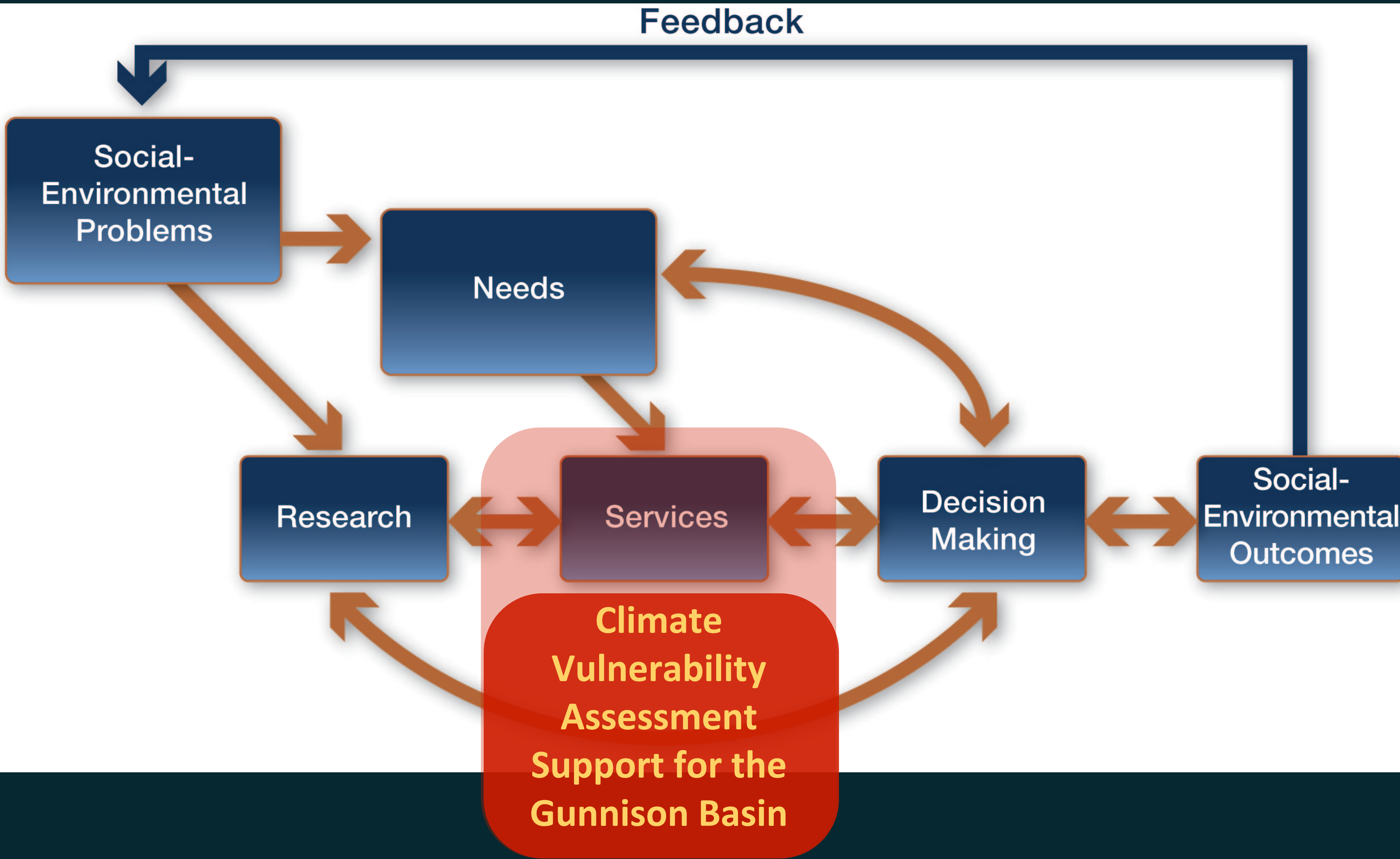
B. Rajagopalan, J. Lukas, L. Wade, D. Kanzer



- Rationale: Lower Basin contributes ~15% of total basin flow, influences Mead & Powell operation
- Generated tree-ring paleo-hydrologies 400+ years long for Gila and mainstem LCRB flows, using multiple methods
- Conducted modeling of entire Colorado Basin to assess risk of drying under different flow scenarios and shortage policies

Findings

- Annual-to-decadal variability in LCRB flows is enormous, both in observed and paleo periods
- Reconstructed LCRB flows show extended dry periods before 1900 worse than any since
- 1900s anomalous in having two multidecadal wet periods
- System response modeling indicates that periodic Gila inflows under current management could modestly decrease risk of drying upstream reservoir storage
- *Bottom line:* The Upper Basin drives the system, but the Lower Basin still matters
  - Could Gila inflows be managed specifically to reduce system risk?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Climate Vulnerability Assessment Support for the Gunnison Basin

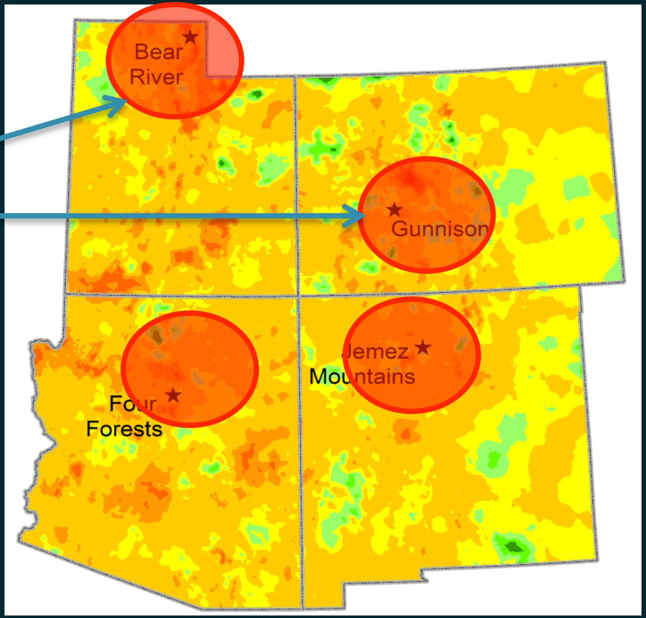
Climate Vulnerability Assessment Support for the Gunnison River Basin

J. Barsugli, B. Neely

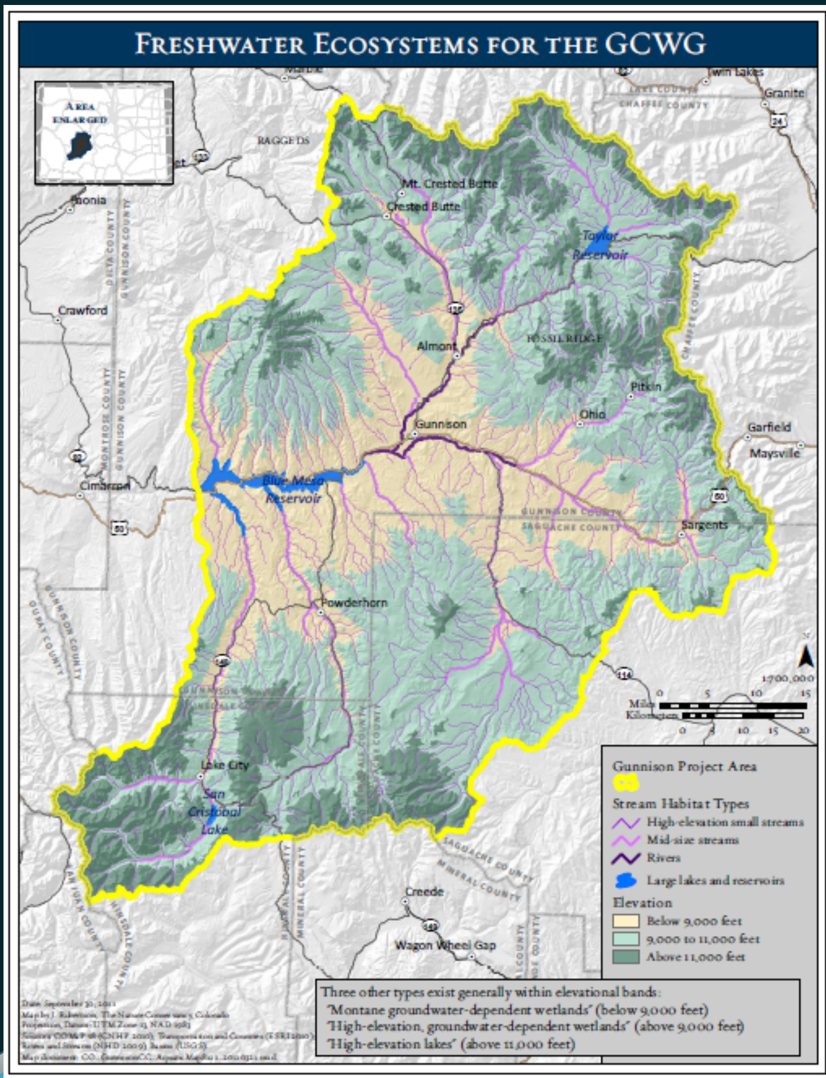
WWA participated in Bear River &Gunnison pilots of **TNC's Southwest Climate Change Initiative**.

WWA's roles in the Gunnison Basin:

- Develop climate and hydrologic change scenarios for an initial workshop, including a follow-up written report.
- Participate actively in translating climate scenarios for vulnerability and adaptation expert assessments.
- Participate with the **Gunnison Climate Working Group** in developing a strategy for ongoing work.
- Co-author (with TNC, Colorado Natural Heritage Program and GCWG members) a landscape-scale climate change vulnerability assessment for habitats and species of concern.



Gunnison Basin Vulnerability Assessment: Freshwater Ecosystems



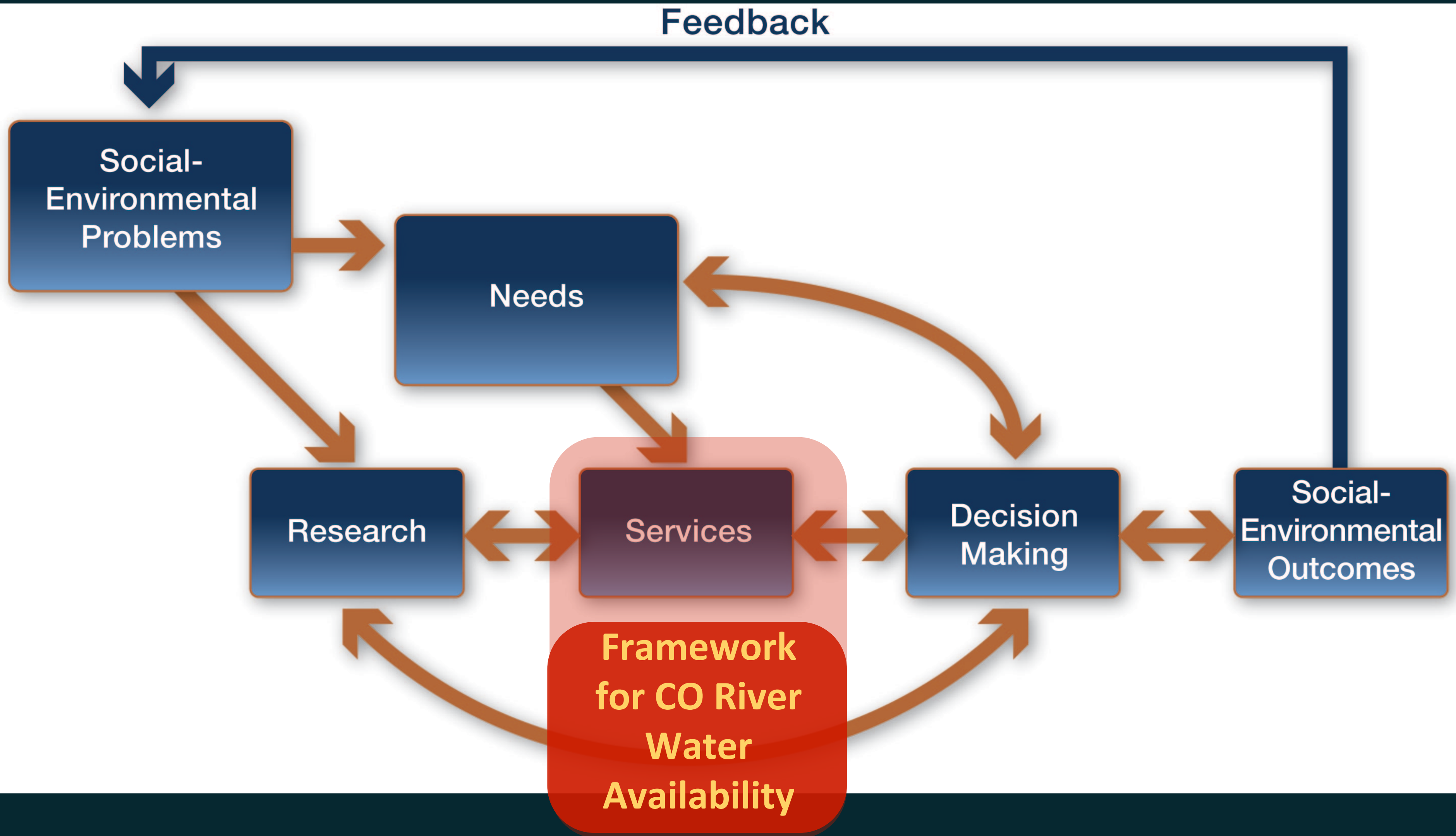
Ecosystem	Vulnerability Rating
Small high-elevation streams	Low to Moderately Vulnerable
Mid-size streams	Moderate to Highly Vulnerable
Rivers	Moderate to Highly Vulnerable
High-elevation, groundwater-dependent wetlands	Low to Moderately Vulnerable
Montane groundwater-dependent wetlands	Highly Vulnerable
High-elevation lakes	Low to Moderately Vulnerable
Reservoirs and associated wetlands	Moderately Vulnerable

Slide contents courtesy of Renee Rondeau CNHP

Gunnison Basin Vulnerability Assessment: Species Vulnerability Summary

- Highly vulnerable
- Sagebrush shrublands – appear to have a positive future, but . .
- Declines in available water (avg.) affecting brood-rearing habitat
- Increase in weeds, e.g., cheatgrass.
- Increase in fire
- Increase in drought and therefore summer food availability declines
- Relatively low genetic variability

Slide contents courtesy of Renee Rondeau CNHP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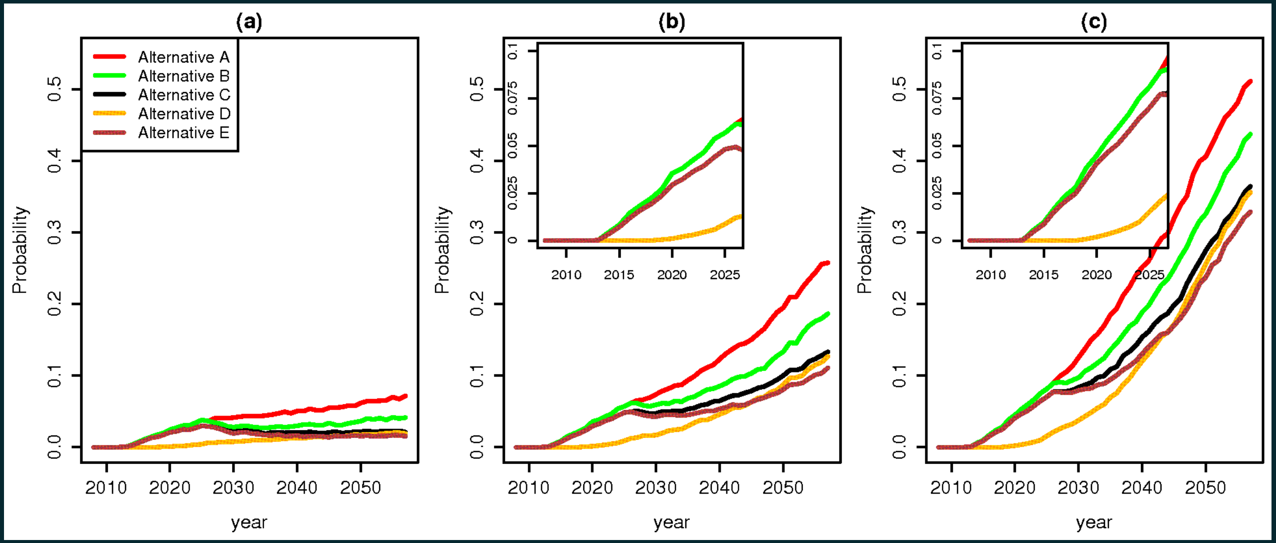
Framework for CO River Water Availability

Framework for Colorado River Water Availability

B. Rajagopalan, A. Verdin



Inspired by Rajagopalan et al., 2009 assessing risk of reservoir drying under:

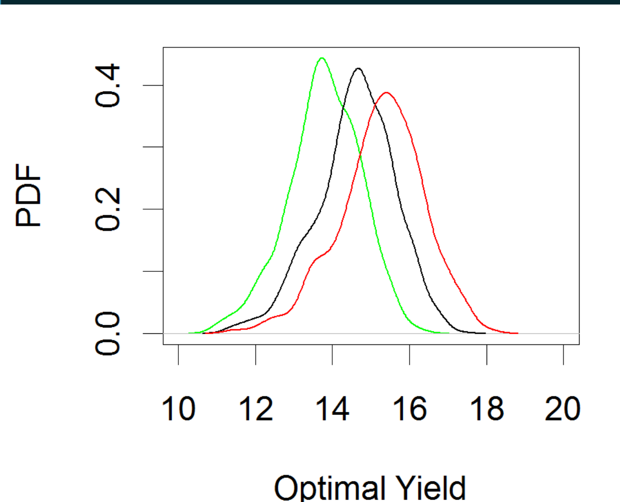
(a) Natural Variability
(b) Natural Variability + 10% flow reduction
(c) Natural Variability + 20% flow reduction

Used "Two Tubs" approach

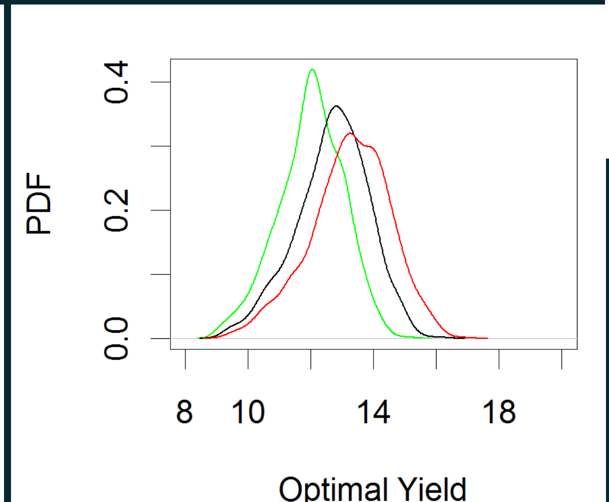
- Considered current operating rules (2007 Shortage Sharing EIS)
- Analyzed minimum storage requirement alternatives of 0%, 20%, 40%
- Developed alternative operating rules
  - Store more in Powell (no equalization) to reduce evaporation
- Easy tool to evaluate policy options
- Drive the model with flow scenarios from Rajagopalan et al. (2009)

What is the yield reliability from the system under climate change and operations scenarios?

Min. Storage 0MaF (let the system go dry)



Min. Storage 24MaF (40% storage)



No Equalization

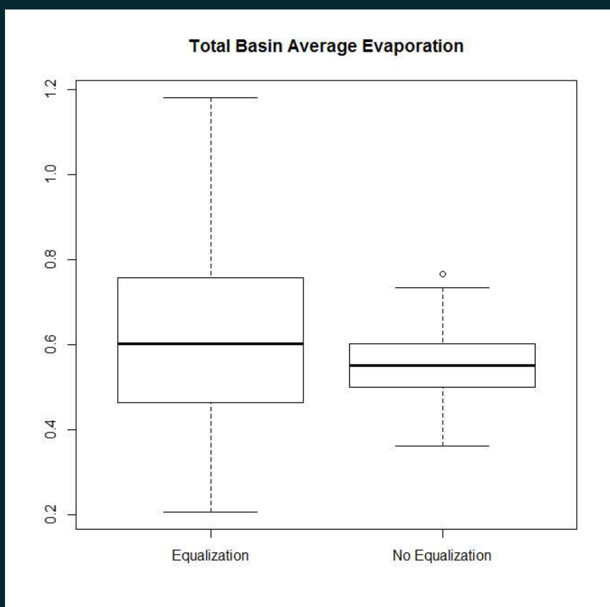
Natural Flows

10% Reduction

20% Reduction

Key Messages

- Reduce risk with CC induced flow reductions
- Reduced evaporation by forgoing equalization
- PDFs of optimal yields help planners to assess risk of desired yield for growth
- Reliability improves without equalization

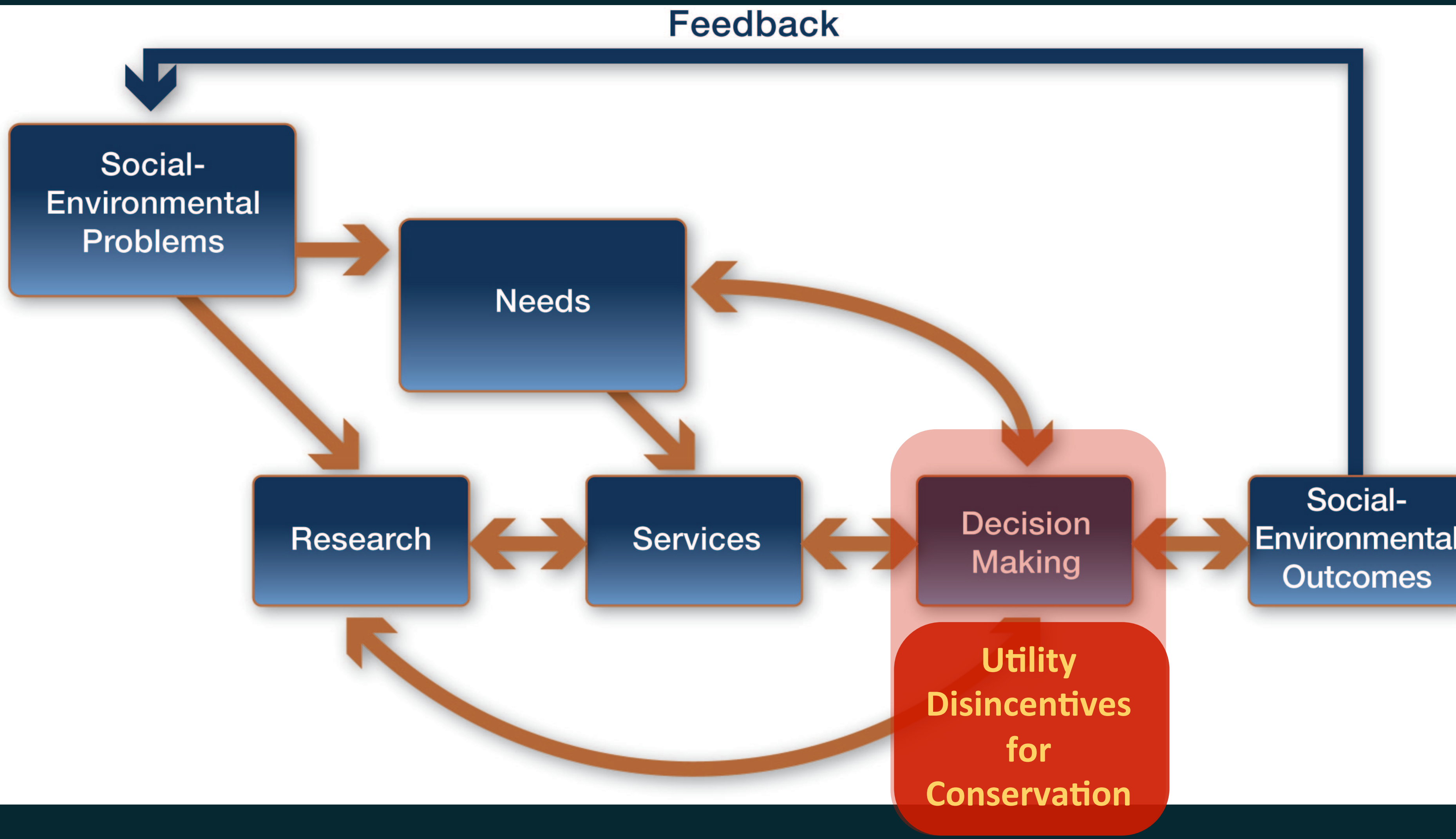


With Equalization

Condition	Yield (MAF/yr) 12.7	13.5	15
	Reliability (%)		
Minimum storage of zero			
Natural Variability	91	78	28
20% flow reduction	59	27	1
Minimum storage at 40% capacity			
Natural Variability	69	44	8
20% flow reduction	26	7	0

Without Equalization

Condition	Yield (MAF/yr) 12.7	13.5	15
	Reliability (%)		
Minimum storage of zero			
Natural Variability	98	93	62
20% flow reduction	87	64	10
Minimum storage at 40%			
Natural Variability	89	74	24
20% flow reduction	57	25	1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Utility Disincentives for Conservation

Utility Disincentives for Conservation

D. Kenney

<u>Conceptually</u>: Reduced demands = less vulnerability to shortages = effective adaptation

Is that true across different scales?

- Two types (of many) disincentives to water conservation facing M&I utilities:
  - *Fiscal Disincentives*
  - *Supply Reliability Concerns*

Utility Disincentives for Conservation

Fiscal Disincentives

- Incentives for consumption
- The "throughput incentive"
- The dark side of increasing block rate structures

Supply Reliability Concerns (Demand Hardening)

- Demand hardening exists, but is it a problem?
- Water managers' concerns about demand hardening may reflect their inability to influence land-use decisions