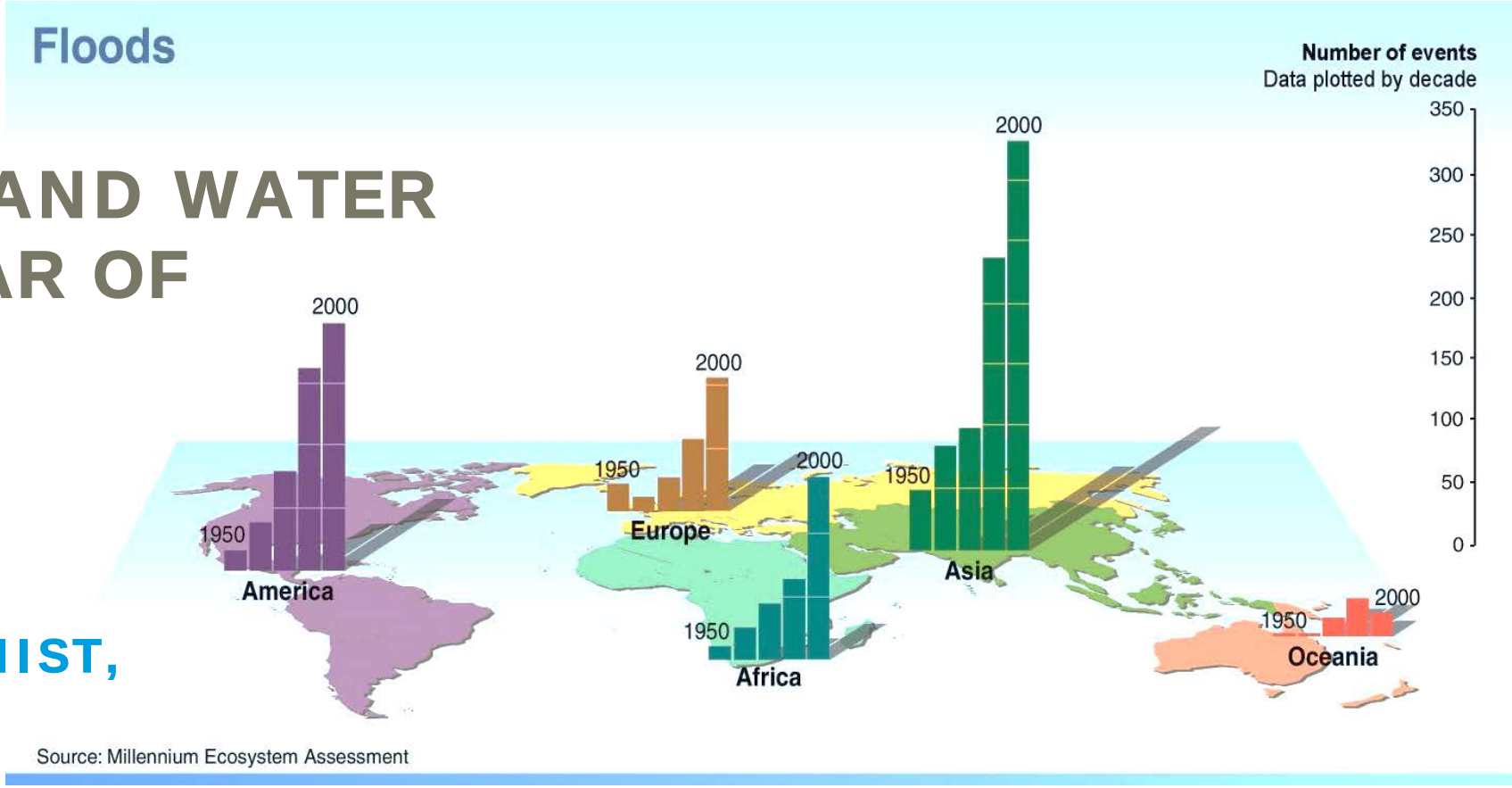
CLIMATE CHANGE AND WATER MANAGEMENT: FEAR OF UNCERTAINTY



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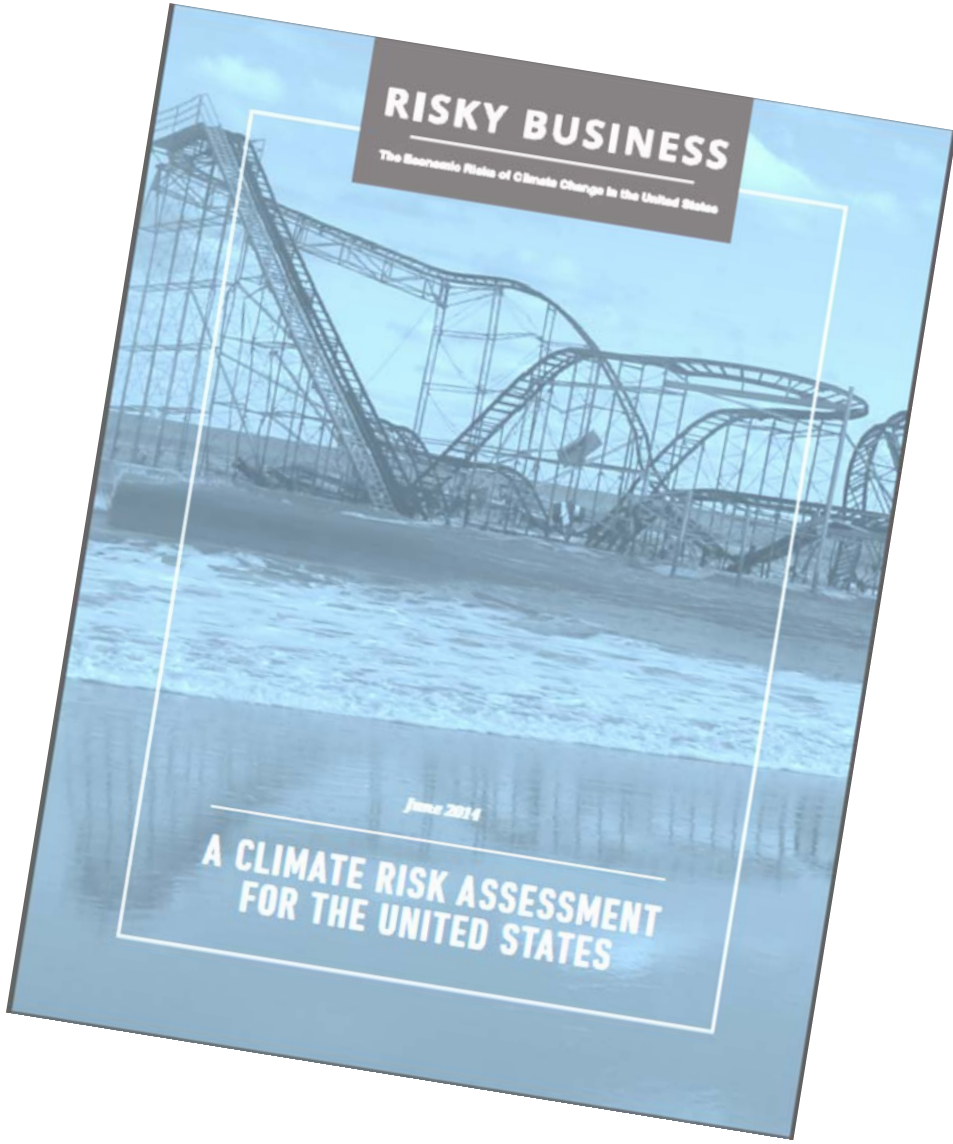
2015 AWRA WASHINGTON STATE CONFERENCE –
WATER MANAGEMENT STRATEGIES IN THE FACE OF CLIMATE CHANGE

SESSION 3: ECONOMIC CONSIDERATIONS, 11:00

RAMBOLL ENVIRON

PRESENTATION TOPICS

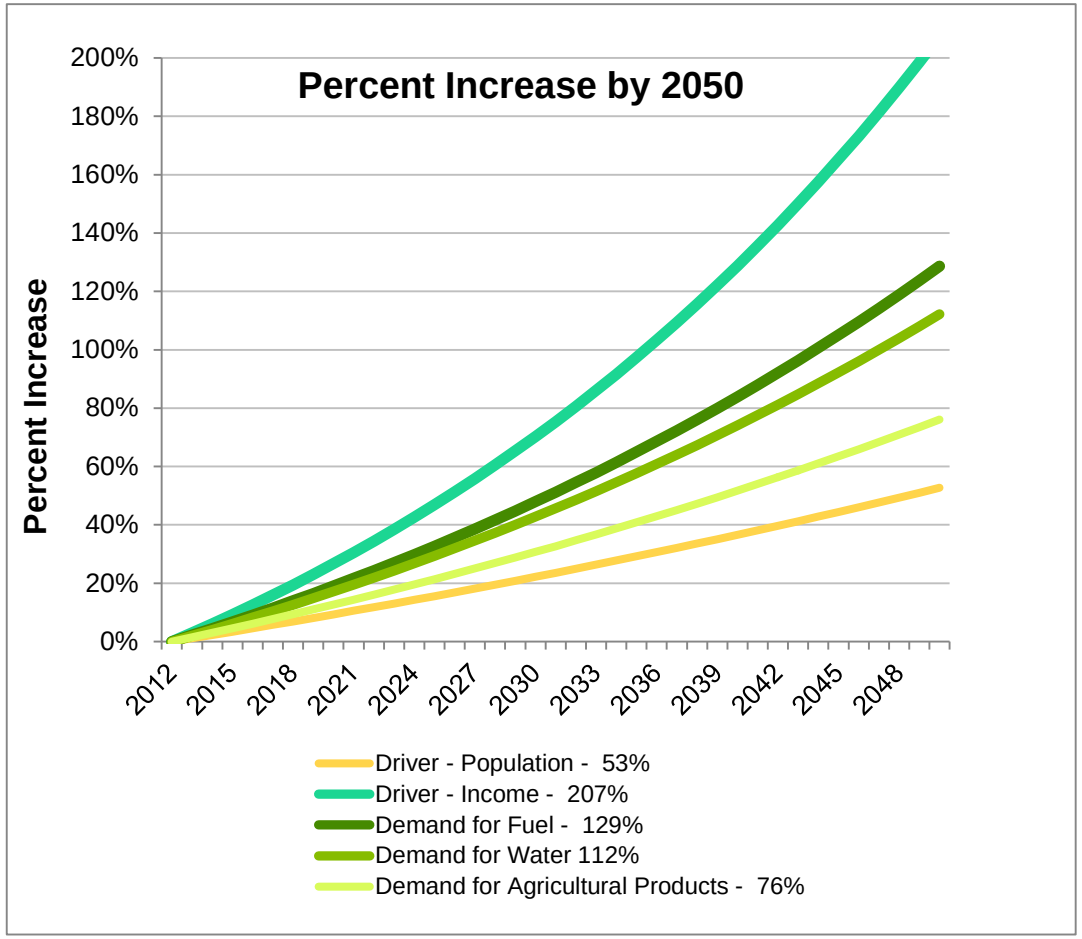
- Acknowledgement - Uncertainty is Fundamental to Climate Change and Water Management
- Realization – Non-Stationary Probability Presents New Challenges
- Realization – Water Management with Climate Change can Benefit from Economics
- Weighing Benefits and Costs; Tools
- Summary



UNCERTAINTY IS FUNDAMENTAL TO CLIMATE CHANGE AND WATER MANAGEMENT

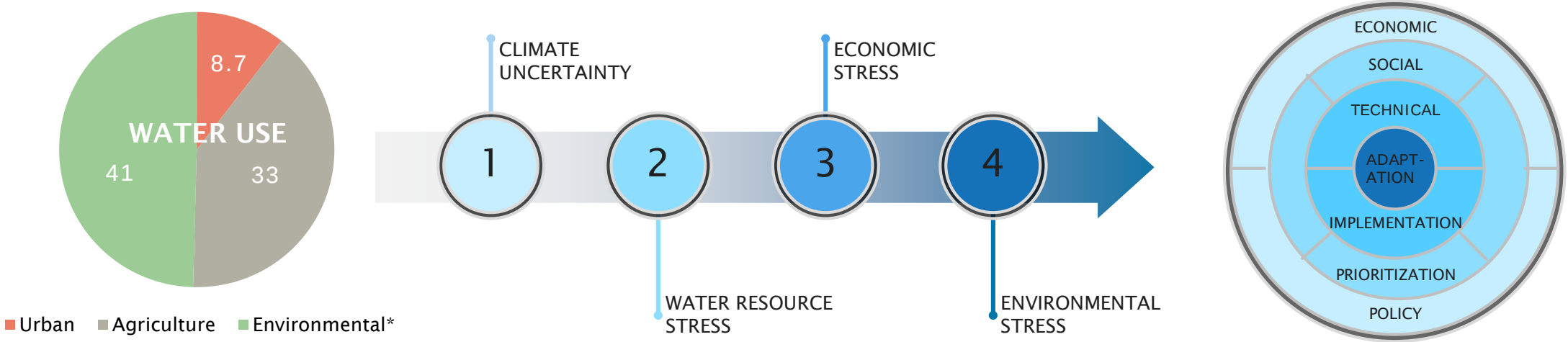
ECOSYSTEM SERVICES: A FRAMEWORK FOR MEASURING ENVIRONMENTAL QUALITY

- Pressures on Resource Base
  - **Population** 1% per year
  - **Economic growth** forecast at 3% per year
  - **Fuel** demand forecast to grow at 2.2% per year
  - **Water** demand expected to grow at 2% per year
  - Demand for **agricultural products** – 1.5% per year



CHALLENGE TO WATER MANAGEMENT

Climate/Water Uncertainty and Stress Principal



California Gross Average Annual Water Use 1998-2005 (million acre-feet)
*Environmental water use estimates include flows in designated Wild and Scenic Rivers, required Delta outflows, and managed wetlands.

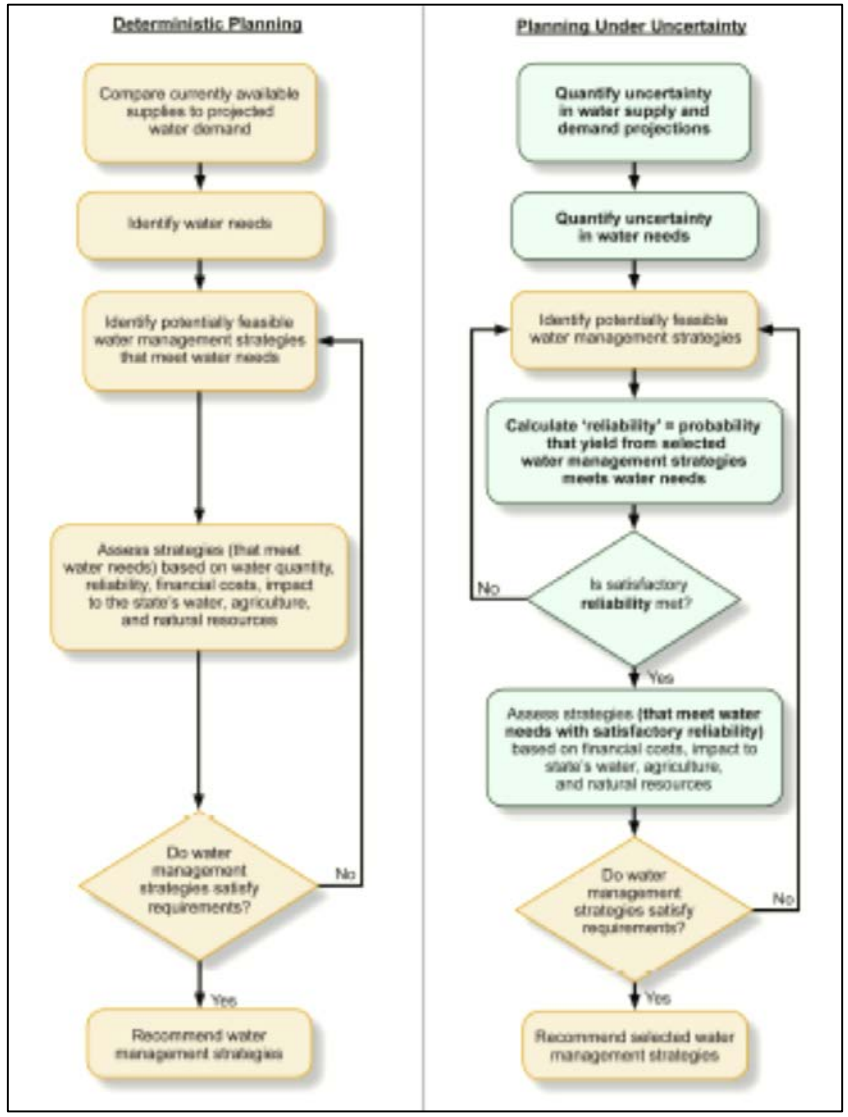
Source: Public Policy Institute of California, 2011. Managing California's Water: From Conflict to Reconciliation.

The theorem: reliability reduces stress

The solution: well-managed, adaptive approaches increase reliability

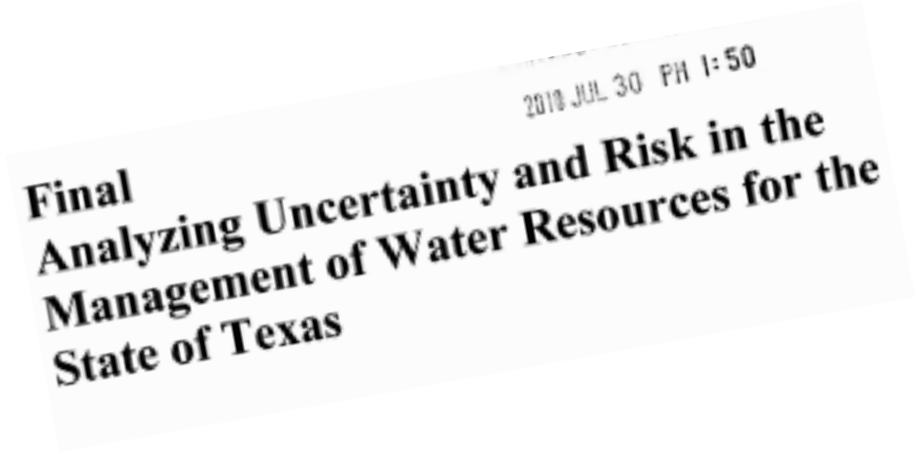
HANDLING UNCERTAINTY

1. Uncertainty in Demand – Population, Rates of Water Use, Increasing Income
2. Uncertainty in Supply – Ecology, Climate, Drought, Increasing Use
3. Strategies to Increase Reliability – Technical Feasibility, Cost, Social Acceptance

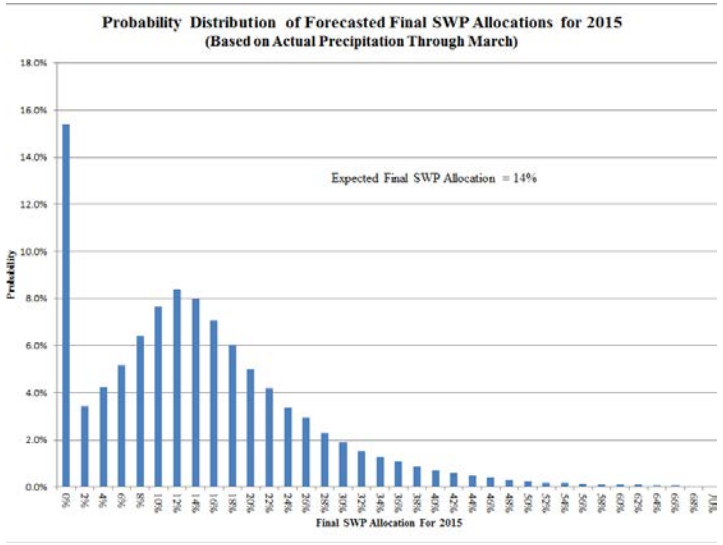


HANDLING UNCERTAINTY

1. Develop Multiple Scenarios with Different Assumptions for Underlying Factors
2. Compare Past Projections to Actual Data and Bound Uncertainty Based on Match
3. Assess Historic Variability for Particular Factor and Use This to Quantify Uncertainty



NON-STATIONARITY PRESENTS NEW CHALLENGES



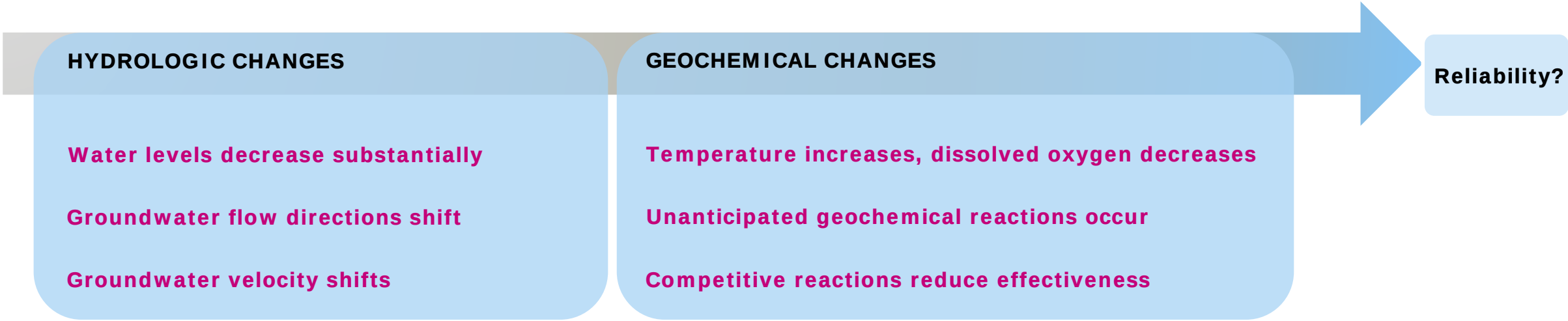
NON-STATIONARITY COMPLICATES USE OF OLD UNCERTAINTY TOOLS

"Stationarity – The idea that natural systems fluctuate within an unchanging envelope of variability – is a foundational concept that permeates training and practice in water resource engineering"

POTENTIAL IMPACTS FROM CHANGING CLIMATIC CONDITIONS - REMEDIATION

- Precipitation decreases substantially
- Recharge decreases substantially
- Water levels decrease substantially

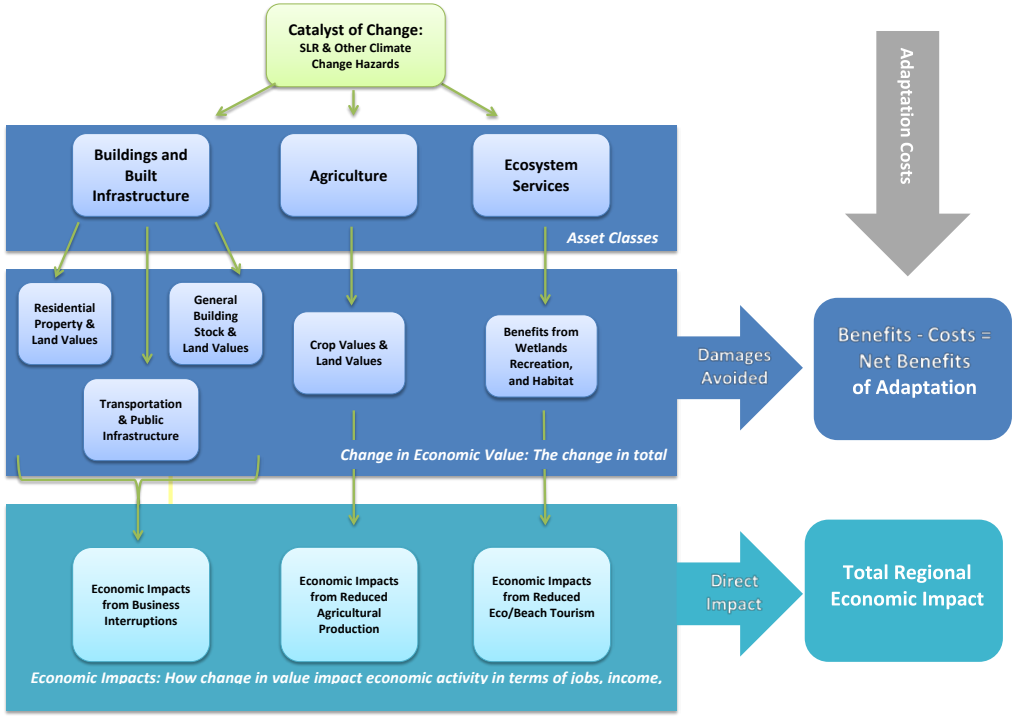
} Or, perhaps, the opposite!



WHAT DOES ECONOMICS HAVE TO OFFER?

CLIMATE CHANGE ADAPTATION MANAGEMENT - INCORPORATING ECONOMICS

- Economic decision making focuses on weighing all benefits and costs
- Benefits and costs need to include environmental assets as well as financial and physical
- For water resource protection strategies, we either include the value of preserving the water source, or solve for the least cost method of protection
- In the face of uncertainty, we do not need to know what will happen – we need to know the tipping points where our decision would change



FRAMEWORK FOR RISK

Probability of an event or chance that it will occur in the future

X

Impacts of events in terms of structural damage, environmental harm, business interruptions

Likelihood of Events

Consequences of Events

KEY CONCEPTS – DECISION MAKING

The Ability and willingness of a community to invest in protective measures depends on local geographic conditions, incomes, discount rates, social norms, perceptions of local climate risk, and the costs of risk mitigation measures. Complete insulation from climate risk is infeasible, even for the wealthiest communities, and affordable adaptive measures may leave poor communities exposed to recurrent losses in hazard-prone areas.

Wheeler, David, "Quantifying Vulnerability to Climate Change: Implications for Adaptation Assistance"

The relative increase in peak discharge is greater for frequent, small floods than infrequent, large floods.

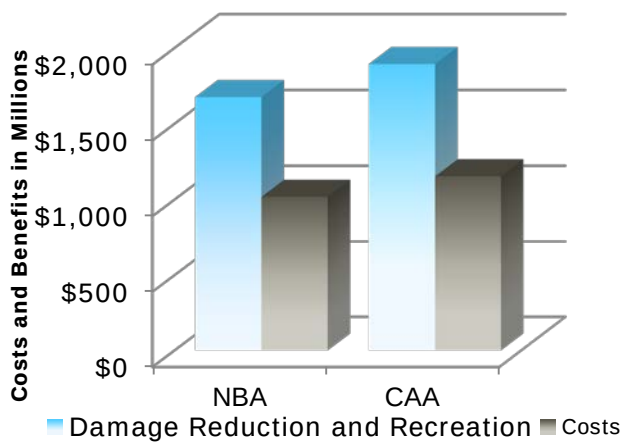
Flood frequency	Chance that flood's peak discharge will be exceeded in any year	Increase in flood peak discharge because of urban development
2-year	50 percent	100 to 600 percent
10-year	10 percent	20 to 300 percent
100-year	1 percent	10 to 250 percent

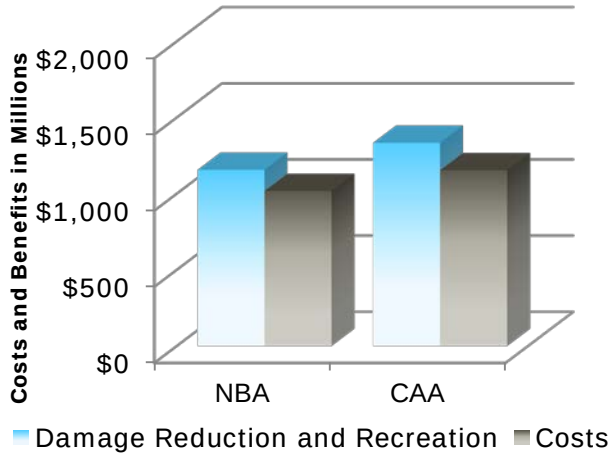
Konrad, (2003)

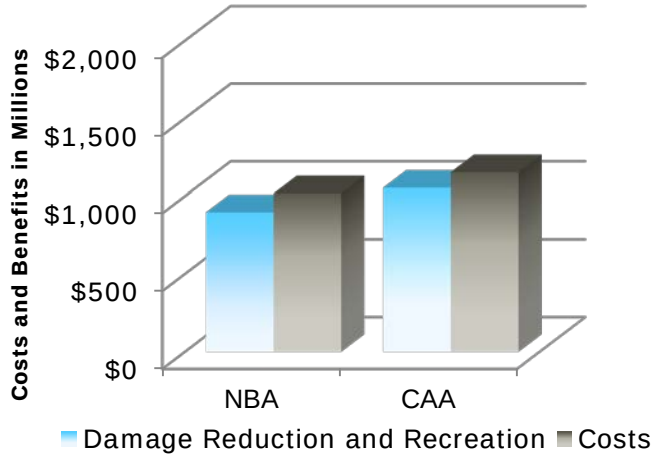
WHAT TOOLS CAN WE USE TO MAKE DECISIONS?

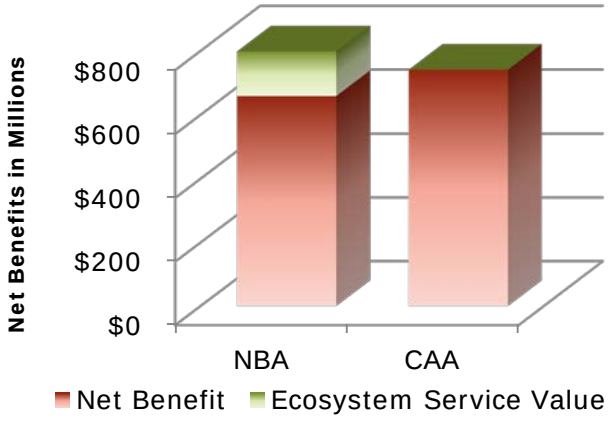
- From evolving website, “Valuation and Risk Management” affinity group of the National Climate Assessment Network

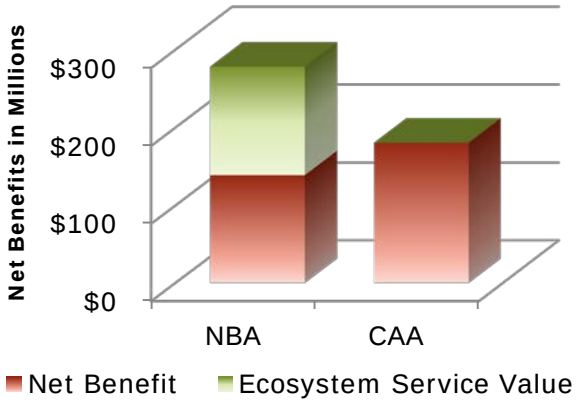
PLAYING AROUND – HOW RESILIENT IS THE DECISION?

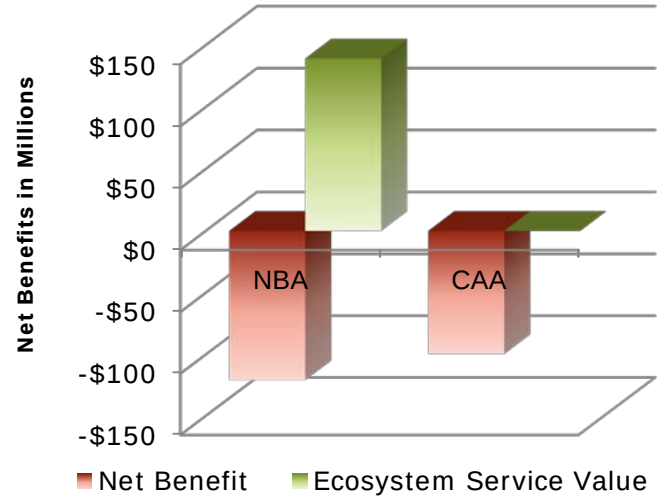












50 Year Event

100 Year Event

200 Year Event

SUMMARY

1. Uncertainty in water management can be quantified
2. Uncertainty is changing, so older methods are not as effective
3. Economics offers benefits and costs approach
4. Focus on decision making and tipping points with an interdisciplinary team

THANK YOU

CONTACT

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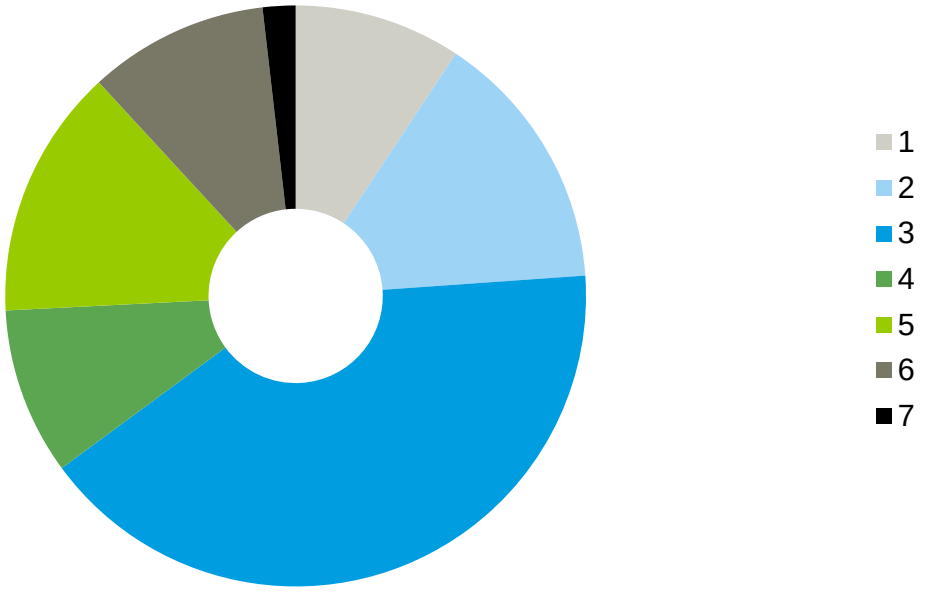
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