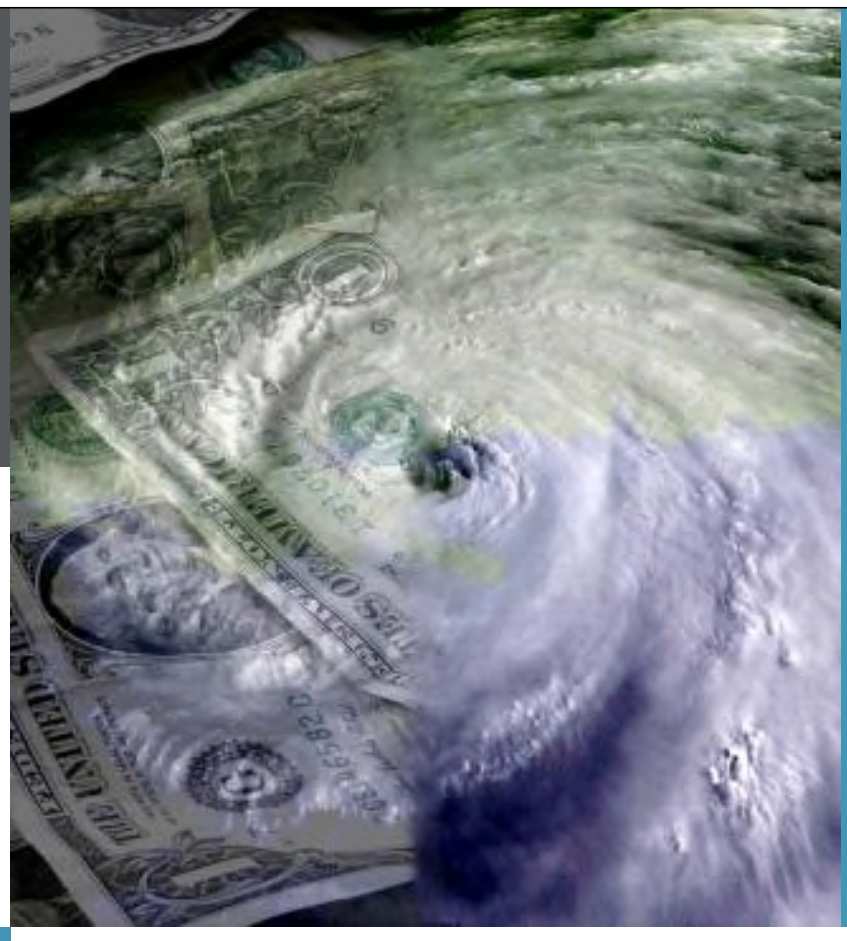
THE ECONOMICS OF RISK AND RESILIENCE

"Adding Value in Decision Making"

Chris Behr – Silver Springs, MD



Resilience Investments

- **Great!...**

  but, at what cost?

  - High capital costs for long-term protection
  - Uncertainty if protection is sufficient and for how long
  - Continued deferral of maintenance and capital improvements
  - Loss in productive land

- Trade-offs in options are not trivial
- Quantitative analysis with best available data is necessary

Source: National Geographic

The Problem with Resilience Investments:

- Warning ***signs won't cut it***
- We have to build resilience protection first as ***pre-emptive actions***
- Protection from flooding or another disaster gains value ***if a disaster occurs***
- Disasters with especially devastating consequences are ***highly unlikely***
- Predictions of weather events are ***not reliable*** given climate change conditions
- Wide ***range of uncertainties*** influence value proposition (e.g. construction and O&M costs, land use changes,

Source: https://www.flickr.com/photos/jms2/6085825106/

Enter the Economist

Bad Cop or **Good** Cop?

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"Bearer of Bad News" if benefits < costs

But, we are often just the piano player (*so don't shoot*):

- Project options limited
- Fed Funding $ => Fed Econ Methods
- Local value (e.g. jobs, etc.) excluded

Enter the Economist

Bad Cop or **Good** Cop?

"Problem-solver" if benefits < costs

We can identify and estimate value:

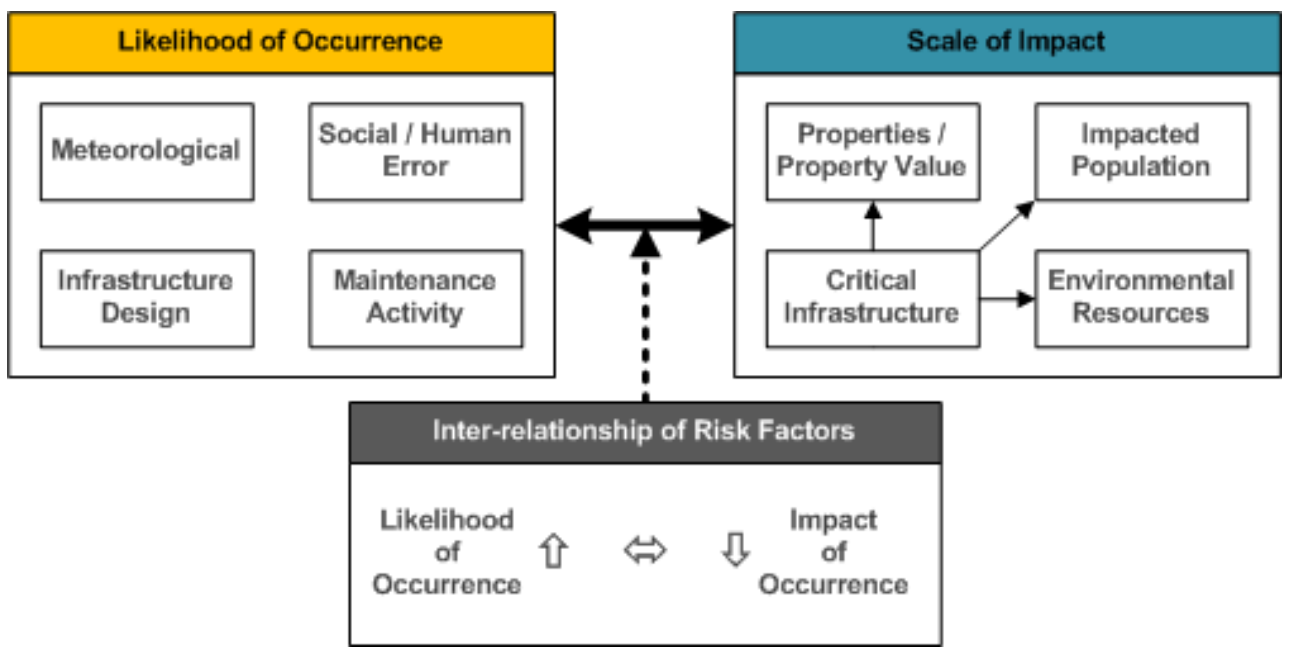
- Identify key indicators of value
- Make the case for local support
- Business cases for alternative funding
- Communicate project value

Analysis begins with Asking Questions

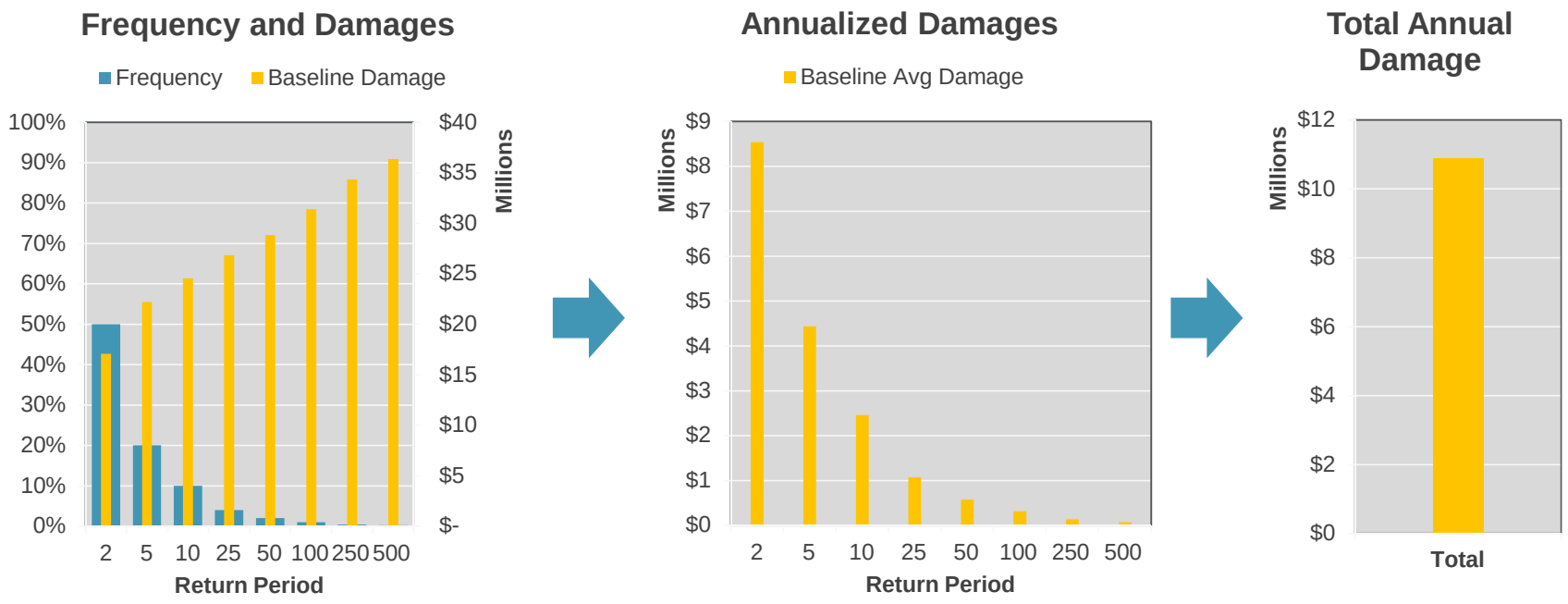
- Which risks have significant consequences?
- What are the likelihoods and consequences of occurrence?
- What actions or investments could mitigate the likelihood or consequences?
- Who benefits and who pays (directly or indirectly)?
- Which is the best mechanism of risk mitigation (infrastructure, insurance, buyouts, etc.)?

The Basics: Quantitative Analysis of Risk and Value

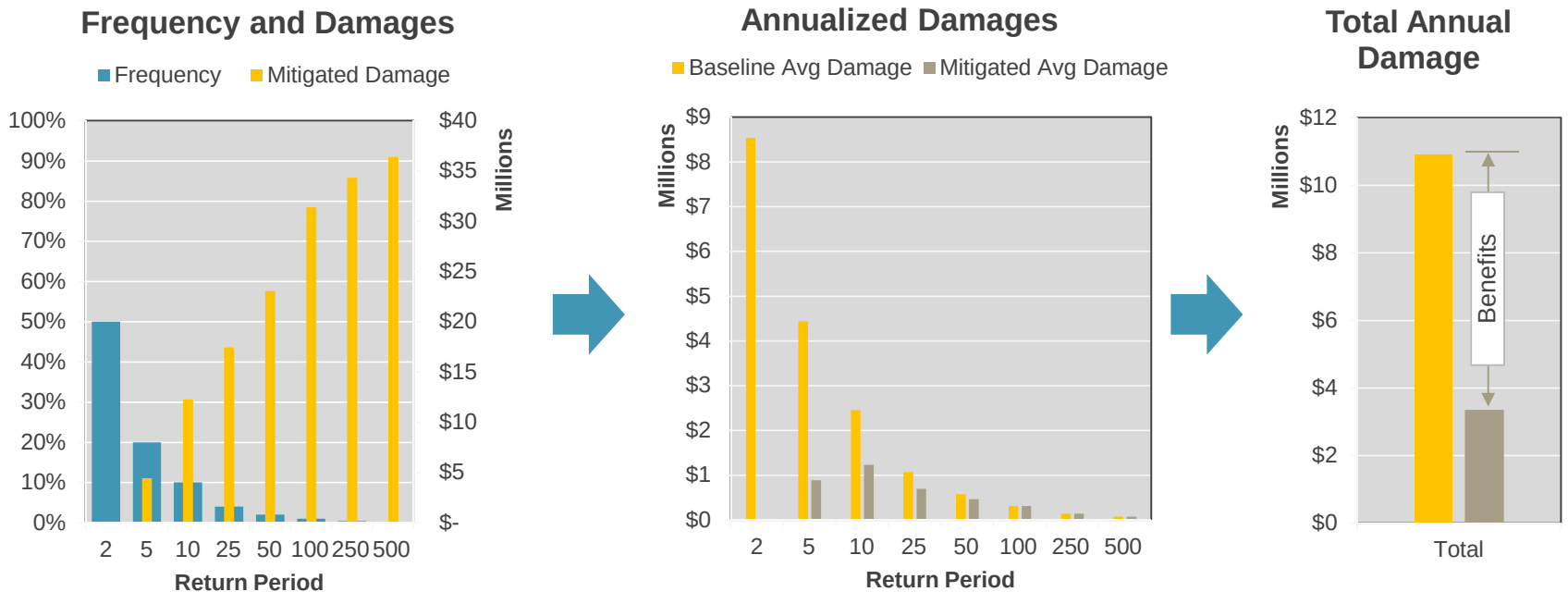
- Risk = Likelihood that an Event Occurs * Scale of Impact (if event occurs)
- Consequences = Value of impacts



Tools of the Trade:
Valuing Annualized Impact
(Without Resiliency investment)



Tools of the Trade:
Valuing Annualized Impact
(Without and With Resiliency investment)



Tools of the Trade:
Valuing Annualized Impact with Risk and Uncertainty
(Without and With Resiliency investment)

Uncertainty is inherent in:

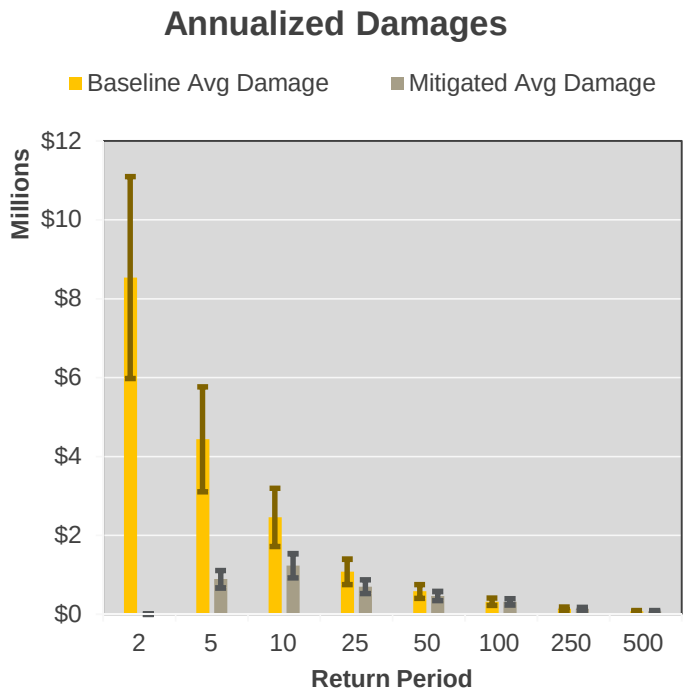
- Forecasts of likelihood
- Consequences of failure

Account for it by:

- Scenarios (separate failure modes)
- Simulation (Monte Carlo methods)

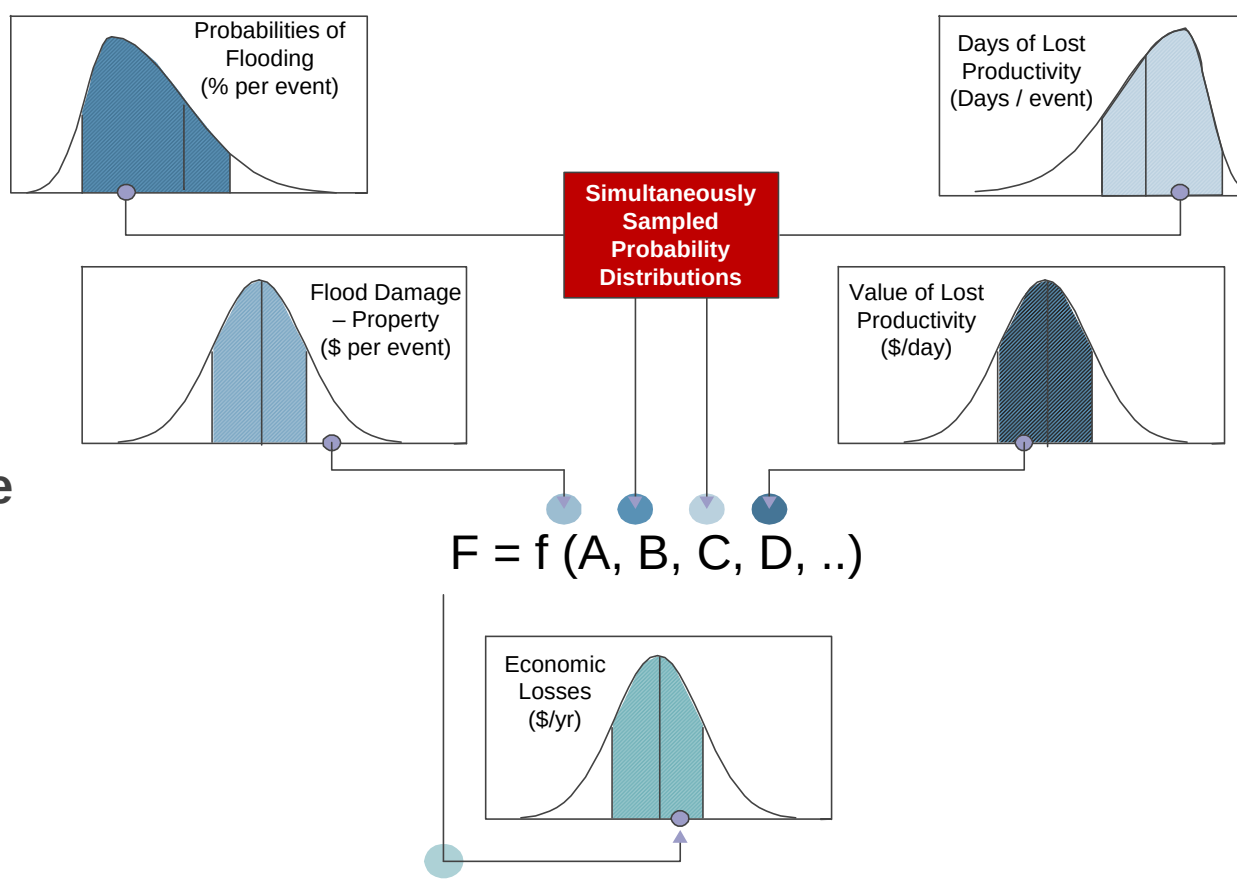
Results improve decision making with info on:

- Scale of upside and downside risk in decision
- Key drivers of uncertainties



Monte Carlo Simulation:

Produces a range of potential economic losses



Coastal Flooding Impact Assessment
Sullivan's Island Waste Water Treatment Plan – FEMA HMGP

Scope of Work

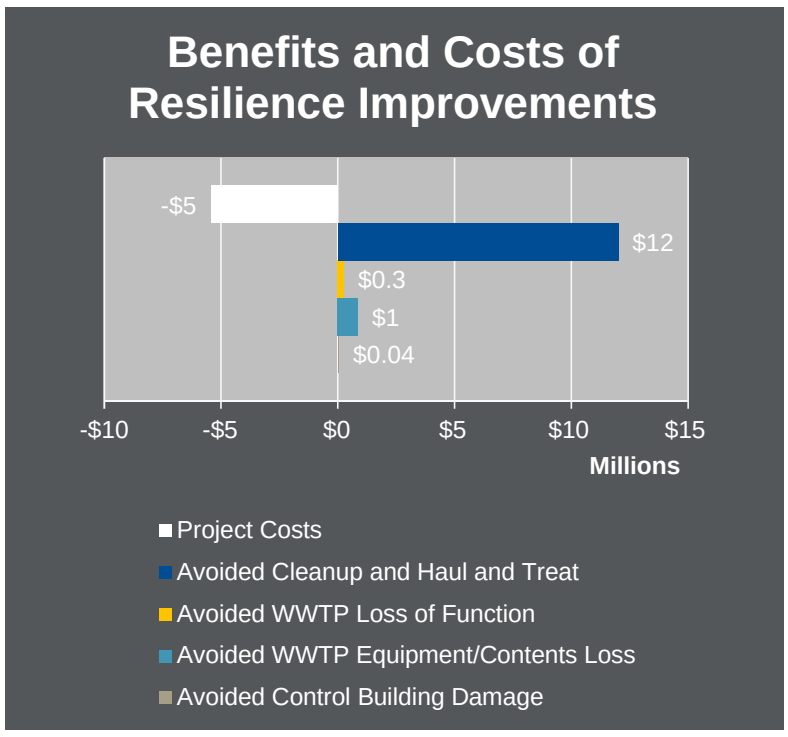
» Determine improvements needed to reduce risk of flooding

» Identify economically feasible protection level (100 vs. 500 year)

» Perform FEMA Benefit Cost Analysis of resiliency improvements

- Raising elevations of structures and protective walls
- Integration of current seismic codes in designs

PROJECT OUTCOMES



100 year or 500 year Protection?

- As in most cases the 500 year was a tough ask
- Significant cost increases for raising walls and structures to necessary flood elevations
- 100 year protection was economically feasible
- Informed client of costs of additional resiliency at the plant

What are the Benefits from Resiliency?

- Rate payer savings from reduced risk of flooding and earthquakes
- Reduced costs of alternative actions with loss of functionality
- Reduced risk of damage to the environment from effluent releases with a flood
- Improvement in operations recovery times following extreme events

Flood Control Options Analysis
Chehalis Basin, WA - WA State – Dept. of Fish and Wildlife

Scope of Work

- Estimate costs of flood impacts
- Estimate economic impacts of salmonid population changes due to flood control and restoration activities
- Analyze impacts from Federal, State, and Local perspectives

Outcomes

- Comprehensive understanding of tradeoffs in between flood control and environmental impacts
- Support for collaborative decisions

ECONOMIC EVALUATION

ENVIRONMENTAL

Quantitative

- Environmental Use
  - Fisheries Production
  - Sport Fishing
  - Tribal Fishing
- Environmental Non-Use

Qualitative

- Aquatic Species
- Semi-aquatic Species

NON-ENVIRONMENTAL

Quantitative

- Flood Reduction
  - Structure, Content, Inv.
  - Business Interruption
  - Transportation
  - Clean-Up Costs
  - Agricultural Impact
  - Public Assist., Emerg. Aid
- Economic Impacts
- Hydropower

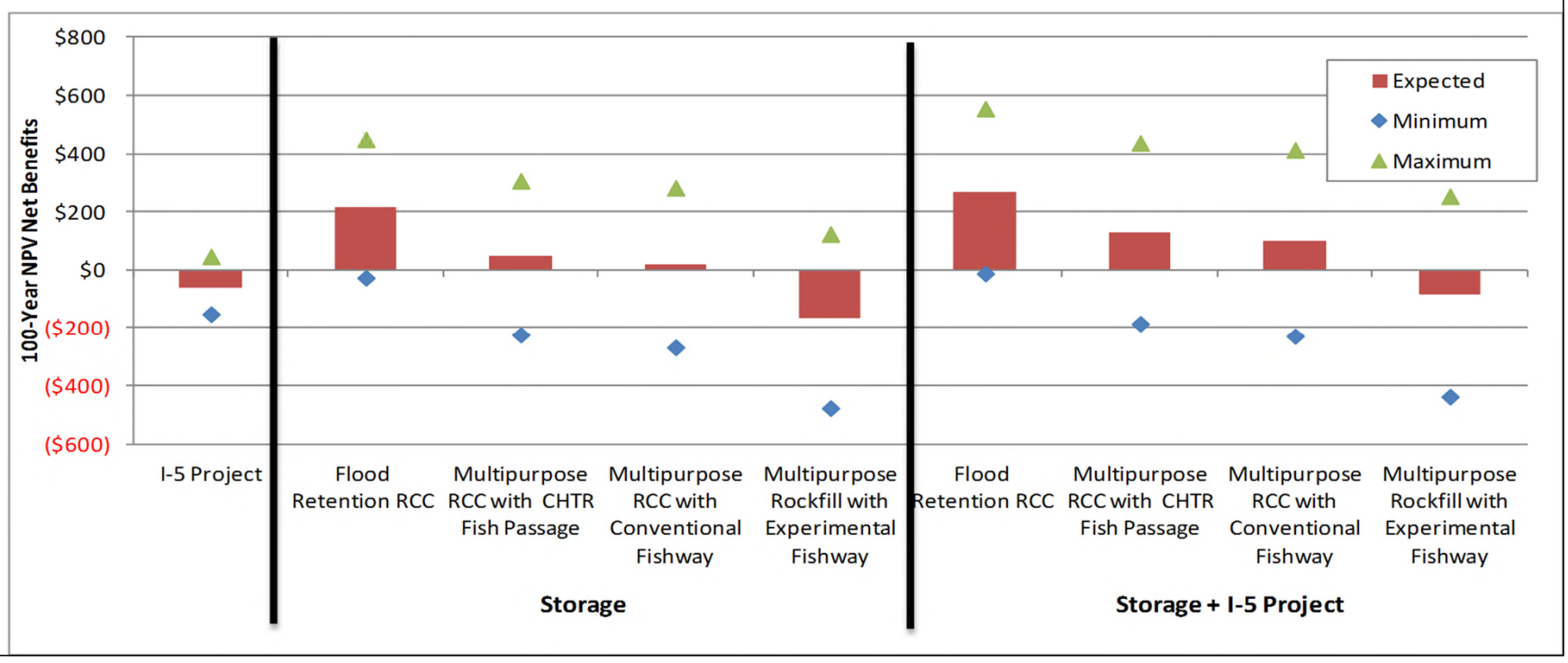
Qualitative

- Social
- Cultural
- Health and Safety
- Distribution Wealth and Welfare
- “Cloud” Values

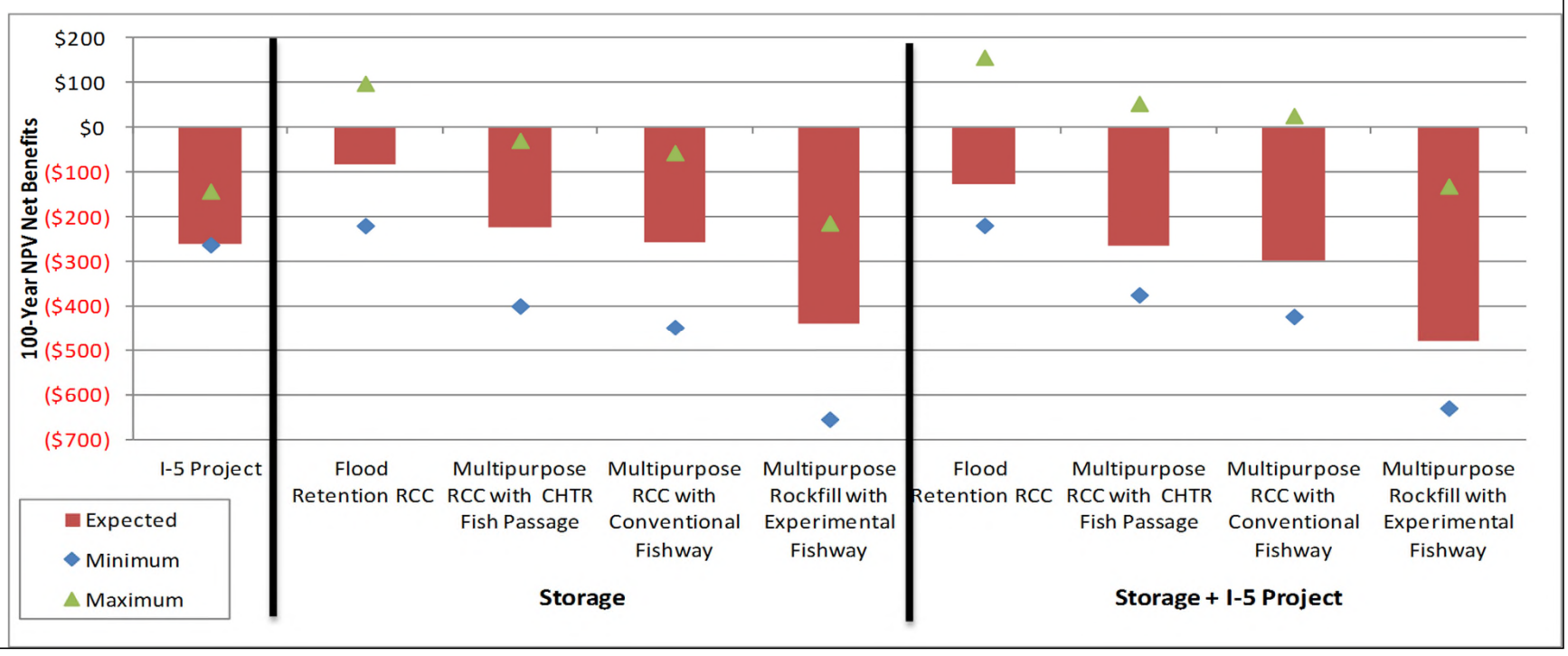
MULTIPLE PERSPECTIVES

Factor	State	Basin-Wide	Federal
Geographic Area for Evaluating Impacts	State of WA	Lewis, Thurston, & Grays Harbor Counties	U.S.
Discount Rate	1.63%, range 0%-7%	1.63%, range 0%-7%	3.5%
Agriculture Crops	Value at State Prices	Value at State Prices	Value at National Prices
I-5 Delays	All Traffic	Local + internal/external traffic	All traffic
Structure & Content Value	Depreciated or Replacement	Depreciated or Replacement	Depreciated
Business Interruption	None	Included	None
Input-Output Models	State Model	County Model	None
Fish benefits	Total value + Impacts	Rec. Benefits + Impacts	Rec. Benefits

PROJECT NET BENEFIT RANGES STATE PERSPECTIVE



PROJECT NET BENEFIT RANGES
FEDERAL PERSPECTIVE



Summary

Don’t do this:

Summary

Do this:

Summary

- Conduct vulnerability assessment to identify risks
- Focus on adaptive management
  - Identify cost-effective management measures
  - Develop long-range risk planning scenarios
- Bring in the economists to:
  - Quantify and model likelihood and consequences
  - **Bad Cop:**
    - Break the bad news, if necessary
  - **Good Cop:**
    - Develop decision support guidelines
    - Evaluate risk and options for risk mitigation
    - Explore traditional and non-traditional financing strategies
    - Assess long-range plans

Thank You!

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