

# RECLAMATION

*Managing Water in the West*

## **Klamath River Basin Study Update**

**Klamath Basin Monitoring Program  
General Membership Meeting,  
November 6, 2014  
Yreka, CA**



U.S. Department of the Interior  
Bureau of Reclamation

# Basin Studies

- **Purpose**

- Work with state and local partners in 17 Western States to evaluate future water supply and demand imbalances in a changing climate

- **Elements**

- Projections of future supply and demand, including the impacts of climate change
- Analysis of how the basin's existing water operations and infrastructure will perform in response to the projections of future water supplies and demands
- Development of adaptation strategies to reduce any identified imbalances in water supply and demand
- Trade-off analysis of the options identified, findings, and recommendations as appropriate

# Basin Studies Cont.

- Appraisal level studies that are intended to build upon existing information
- Basin Study reports are not considered decision documents
- May lead to potential subsequent investigations



RECLAMATION

# Klamath River Basin Study Area



RECLAMATION

# Klamath River Basin Study – Cost Share

- Equal 50 percent cost share by Reclamation and non-federal cost-share partners
  - Oregon Water Resources Department
  - California Department of Water Resources

# Phases of the Klamath River Basin Study

## *Basin Study Elements*

**Phase 1:**  
Water Supply and  
Demand Assessment

Assess current and projected water supply and demand, including the impacts of climate change

**Phase 2:**  
System Reliability  
Analysis

Analyze how the basin will respond to water supply and demand projections according to identified metrics

**Phase 3:**  
Development of  
Adaptation Strategies

Develop adaptation strategies to reduce any identified imbalances

**Phase 4:**  
Evaluation of Adaptation  
Strategies

Evaluate adaptation strategies, findings, and recommendations as appropriate

RECLAMATION

# Study Components

## Water Supply Assessment

### Groundwater Models

MODFLOW (upper)  
Statistical  
(Scott/Shasta)

### Surface Hydrology Model

VIC (entire basin)

### Paleo Climate Analysis

Climate Inputs (CMIP3&5)  
Precip and Temp

## System Risk and Reliability Analysis

### Management Models

RiverWare  
RBM10

Trade Off Analysis of  
Adaptation  
Strategies

## Water Demand Assessment

### Human Influenced Consumptive Uses

ET Demands  
M&I, RD Demands

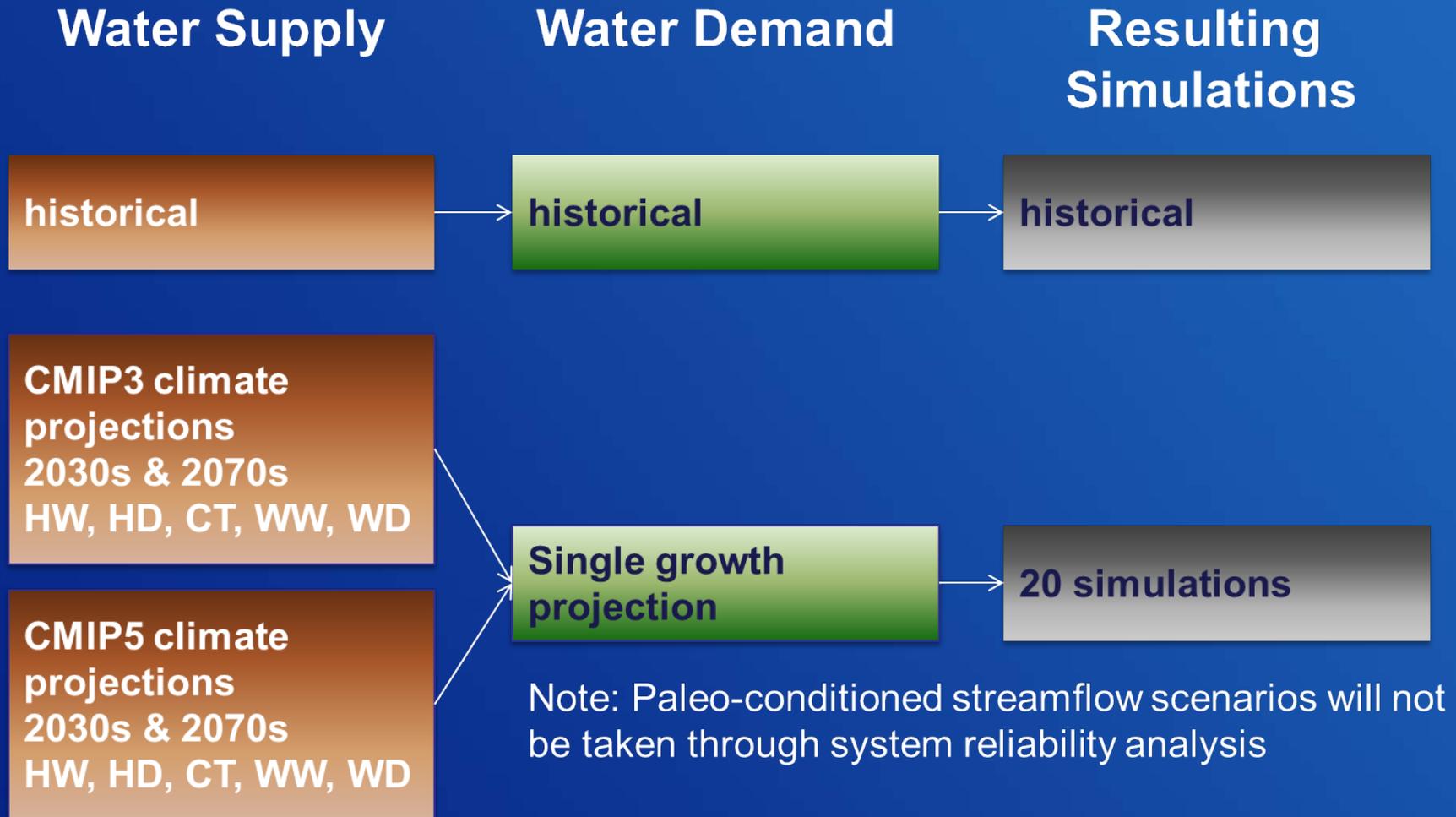
### Other Consumptive Uses and Losses

Lake Evaporation  
Wetlands ET

### Non Consumptive Uses

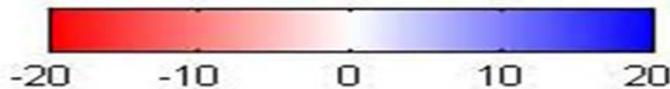
Climate Inputs (CMIP3&5)  
Precip and Temp

# System Simulations Accounting

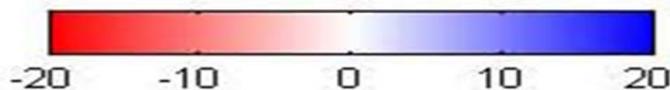


# Study Climate Change Scenarios – Projections

Mean-Annual Precipitation Change, percent  
CMIP3, 1970-1999 to 2040-2069, 50%tile



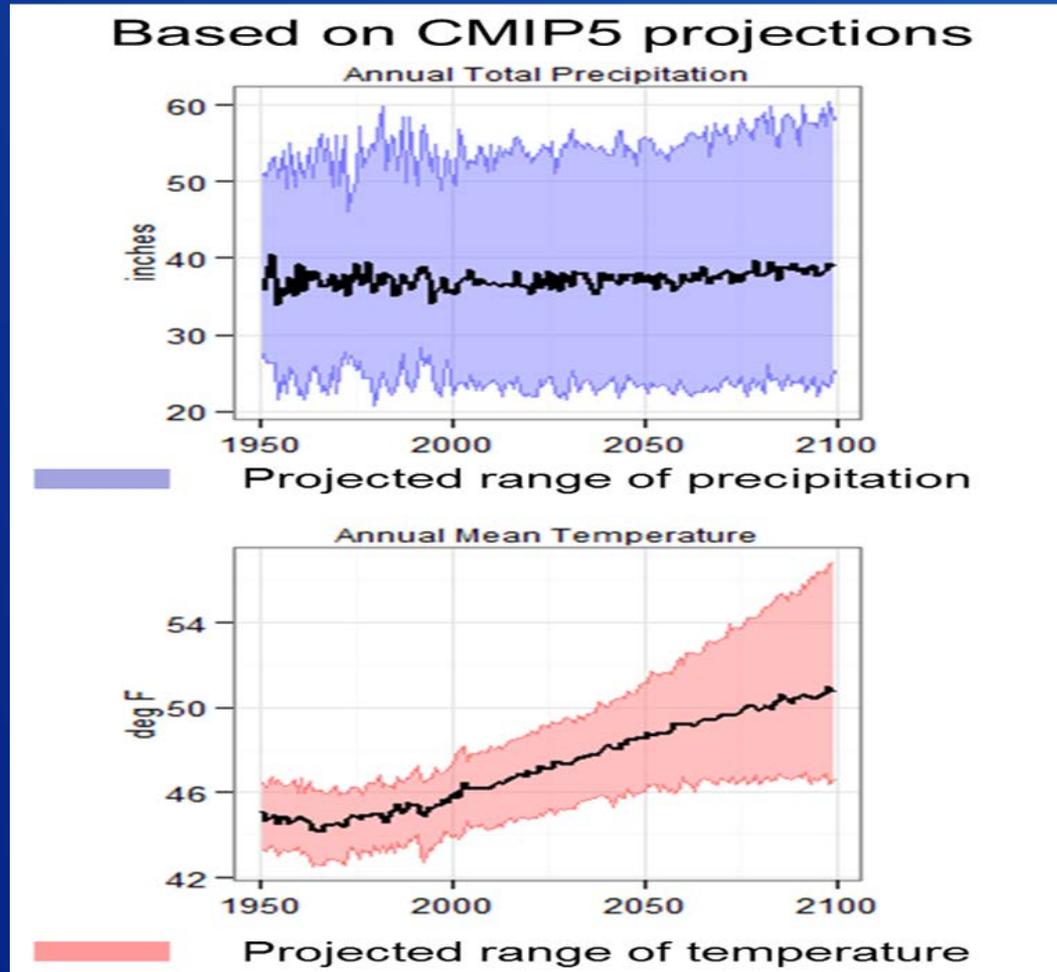
Mean-Annual Precipitation Change, percent  
CMIP5, 1970-1999 to 2040-2069, 50%tile



# Water Supply Assessment

- **Projected increases in central tendency for Prcp and Tavg for both CMIP3 and CMIP5 for the 2030s and 2070s**
- **Projections indicate:**
  - **Wetter winters & slightly drier summers**
  - **Increased temperatures in all seasons**
- **By the 2050s, annual temperature will be largely outside range of historical variations; annual precipitation will be largely within the historical record**

# Water Supply Assessment Projections



RECLAMATION

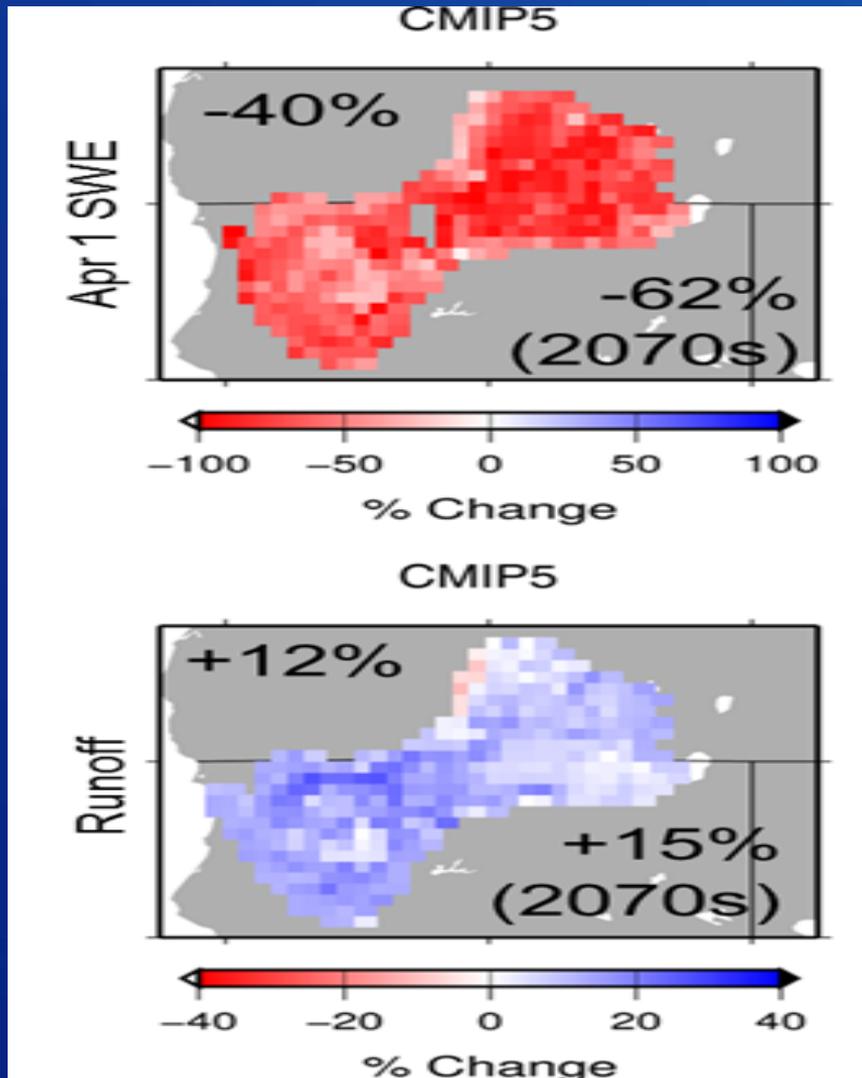
# Water Supply Assessment Summary

- **April 1 SWE is projected to decline (exception: Mt Shasta)**
- **Mean annual runoff is projected to increase in the Lower Klamath Basin, while changes in the Upper Klamath Basin vary between CMIP3 and CMIP5 both in magnitude and direction**
- **Droughts were less severe over the last 600 years than what is shown in the recent instrumental record (paleo)**

# Water Supply Assessment Summary Cont.

- Max lengths of drought & max deficit volumes are expected to decline, while max surplus volumes are estimated to be nearly equal to the historical maximum surplus
- Results show projected increases in head (<9%) in mountainous recharge areas (note: NE corner) and little head change in the populated and farmed interior parts of the basin

# Central Tendency Hde Projections for 2030s



RECLAMATION

# Water Demand Assessment Demand Categories

## Demand Categories

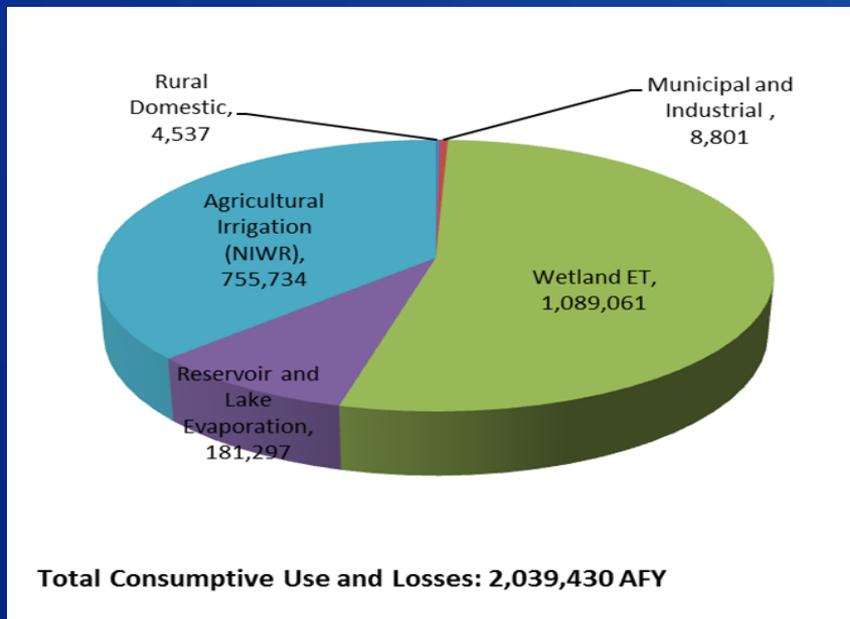
Human Influenced Consumptive Uses

Other Consumptive Uses and Losses

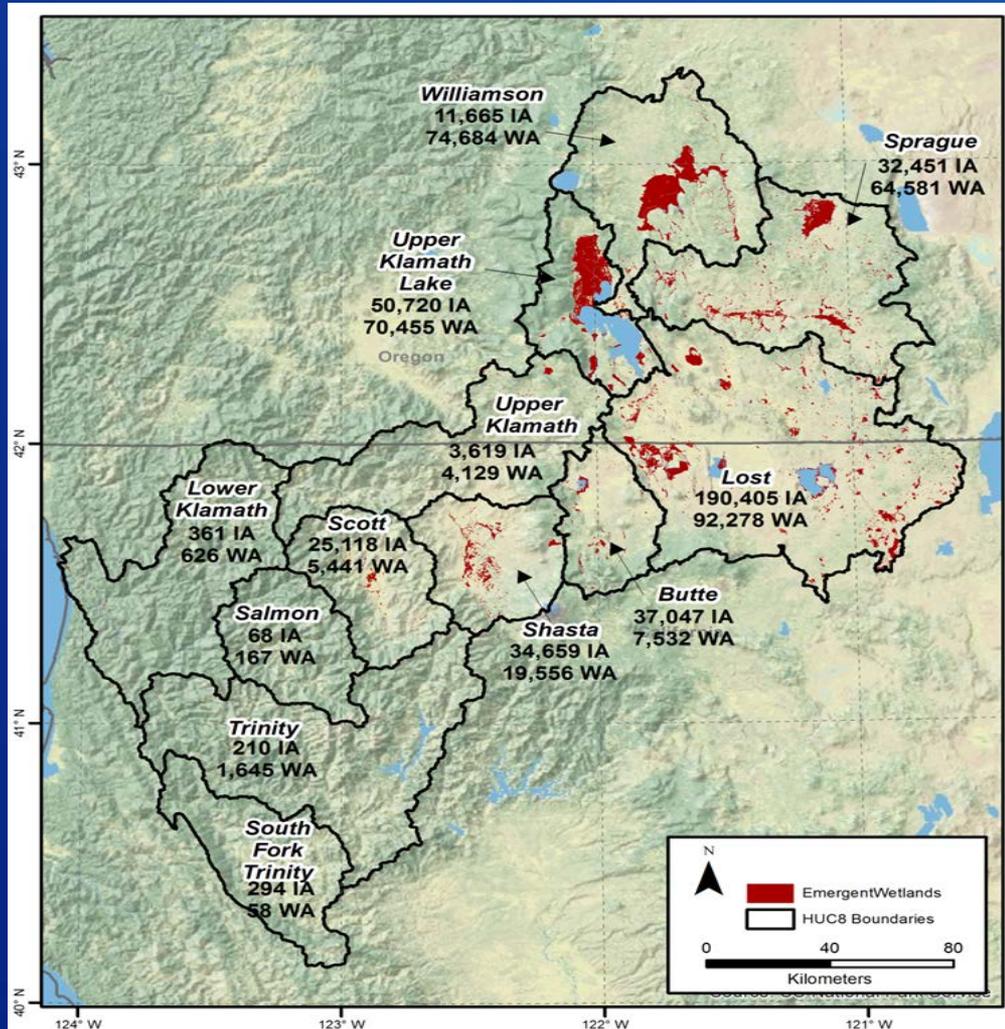
- **Assess current and future consumptive uses and losses**
  - **Focus on:**
    - **Human Influenced Consumptive Uses**
    - **Other Consumptive Uses and Losses**
- **Non-consumptive uses are briefly discussed, but further addressed in System Risk and Reliability Analysis**

# Water Demand Assessment Scenarios

- Single demand growth scenario
  - Tied to projected population
  - Static crop mix
  - Static wetland acreage
  - Static % of domestic use as landscape irrigation

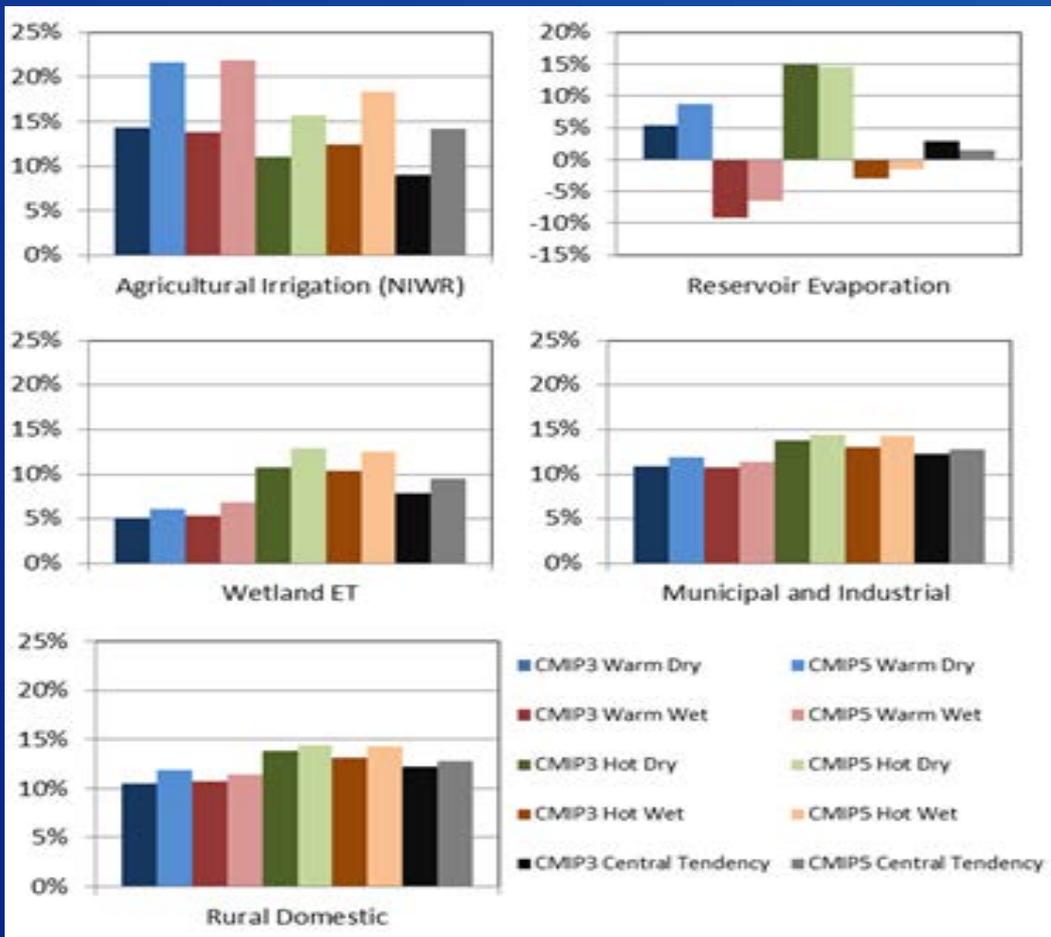


# Water Demand Assessment



RECLAMATION

# Water Demand Assessment Summary



# System Risk and Reliability Analysis

- Identify historical reliability of water supply and risk of water supply shortages
- Identify how risk/reliability may be increased or decreased as a result of climate change
- Identify metrics (evaluation criteria) that are used to determine historical and future system vulnerabilities

# System Risk and Reliability Analysis Models



- **Watershed planning model**  
→ to simulate managed flows at various locations
- **Stream temperature model**  
→ to simulate water temperature in Klamath River reaches

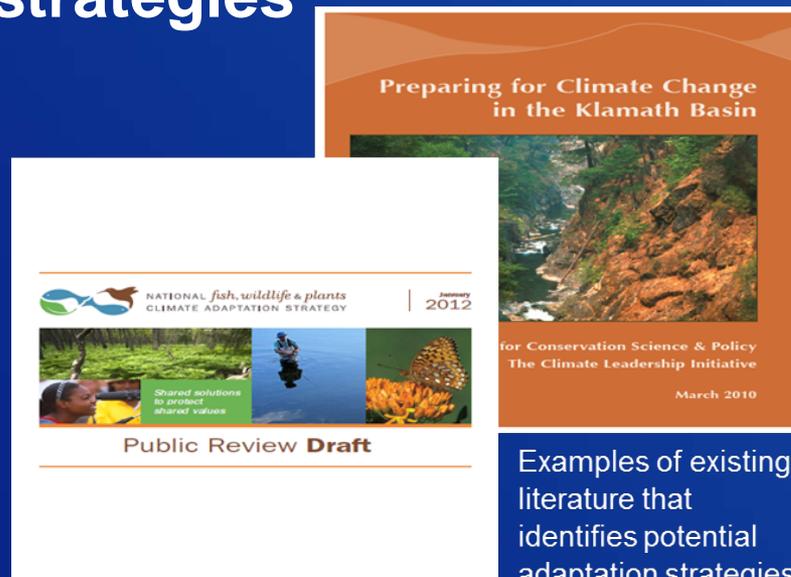
# System Risk and Reliability Metric Categories

- **Ecological Resources**
  - Fish and wildlife habitat, applicable species listed as an endangered, threatened, or candidate species under the Endangered Species Act of 1973, species and habitat of cultural importance, and flow and water dependent ecological resiliency
- **Electrical Power Resources**
- **Flood Control**
- **Recreational Resources**
  - Recreation at Reclamation facilities and those facilities impacted by Reclamation operations
- **Water Deliveries**
- **Water Quality Resources**

RECLAMATION

# Identification of Adaptation Strategies Trade Off Analysis

- Compile identified strategies from existing studies and solicit additional potential strategies
  - Screen strategies for those that can be evaluated in model framework
- Assess the multi-resource reliability of adaptation strategies



Examples of existing literature that identifies potential adaptation strategies

RECLAMATION

# Study Information

- Reclamation's Basin Study Website
  - [Reclamation's Basin Study Website](#)
- Klamath River Basin Study Website
  - [Klamath River Basin Study Website](#)
- Questions or comments
  - Shelley McGinnis, Project Manager
    - Phone: (916) 978-4349
    - Email: [bor-mpr-klamathbasinstudy@usbr.gov](mailto:bor-mpr-klamathbasinstudy@usbr.gov)