RECLAMATION

Managing Water in the West

Taking RiverWare to the Extreme: the Colorado River Basin Study

2012 RiverWare User Group Meeting
February 2, 2012

U.S. Department of the Interior
Bureau of Reclamation

Colorado River Basin Water Supply and Demand Study

- Basin Study Overview
- Demand Input Tool
- RiverWare Modeling
- Questions

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Colorado River Basin Water Supply and Demand Study

- Study Objective
  - Assess future water supply and demand imbalances over the next 50 years
  - Develop and evaluate opportunities for resolving imbalances
- Study being conducted by Reclamation and the Basin States, in collaboration with stakeholders throughout the Basin
- Study began in January 2010 and will be completed by July 2012
- A planning study – will *not* result in any decisions, but will provide the technical foundation for future activities

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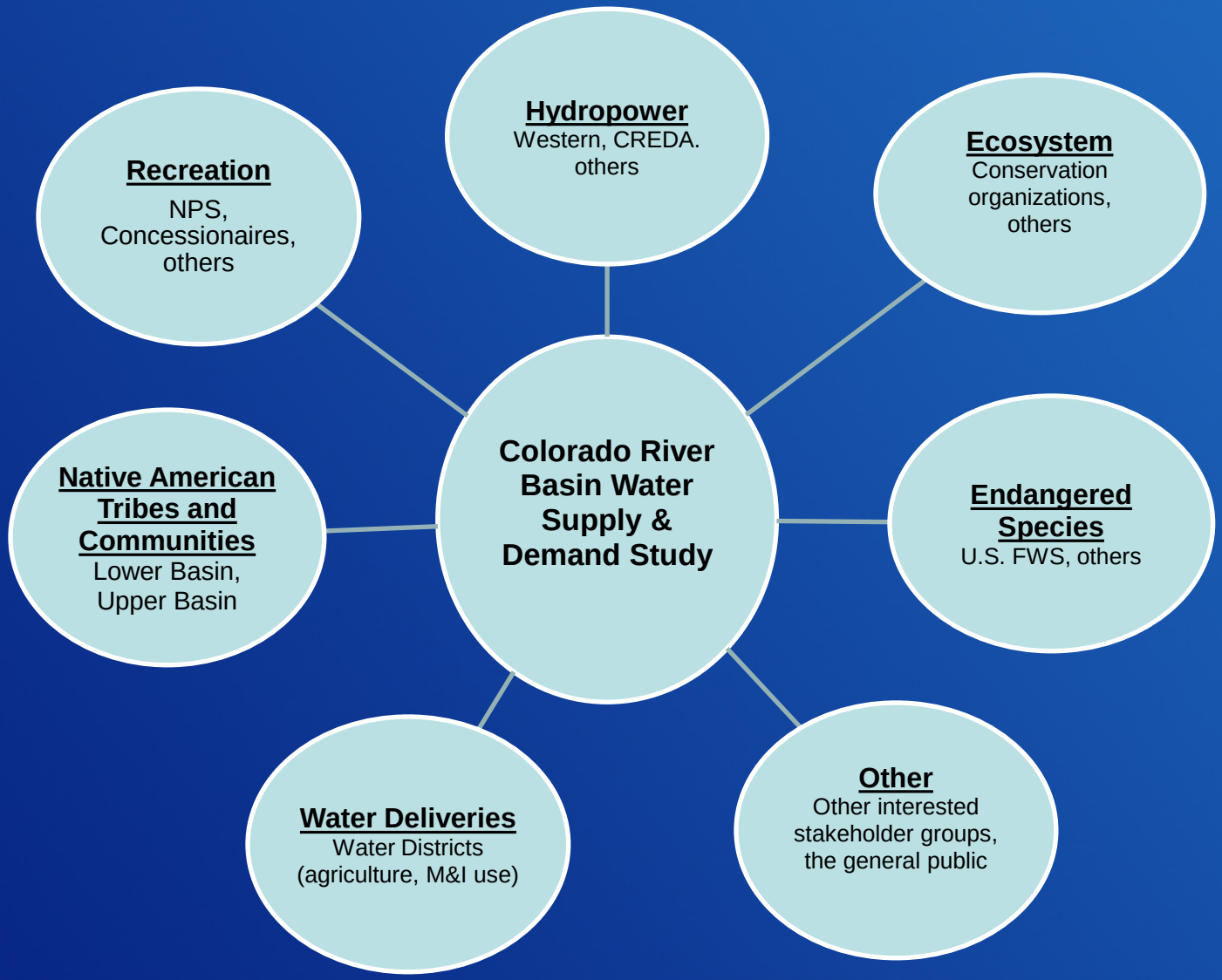
Study Outreach



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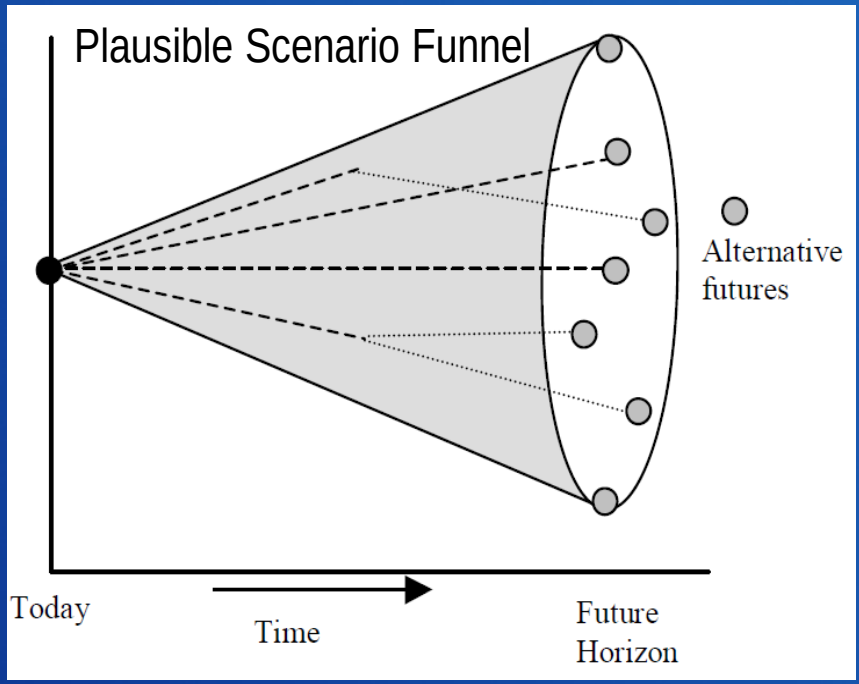
Approach for Incorporating Uncertainty

- Effective treatment of uncertainty is key to project success
  - Trajectory of major influences on the Colorado River system is uncertain and cannot be represented by a single view
- Uncertainty is being addressed through a Scenario Approach
  - Provides structured process and common language for discussing uncertainty
  - Explores alternative views of plausible futures
  - A manageable and informative number of scenarios developed to explore the broad range of futures



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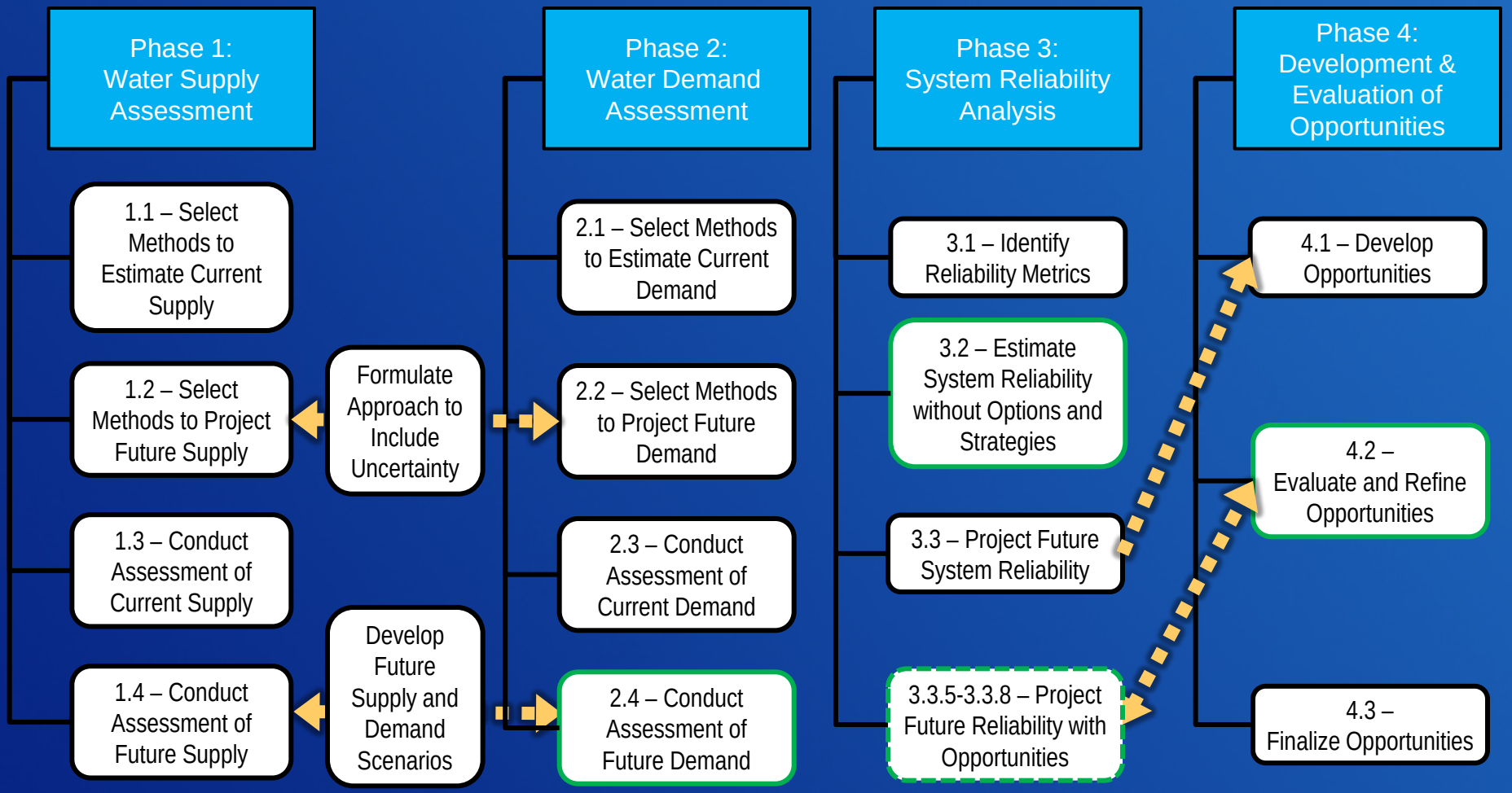
Study Phases and Tasks



Use of RiverWare or DIT is critical

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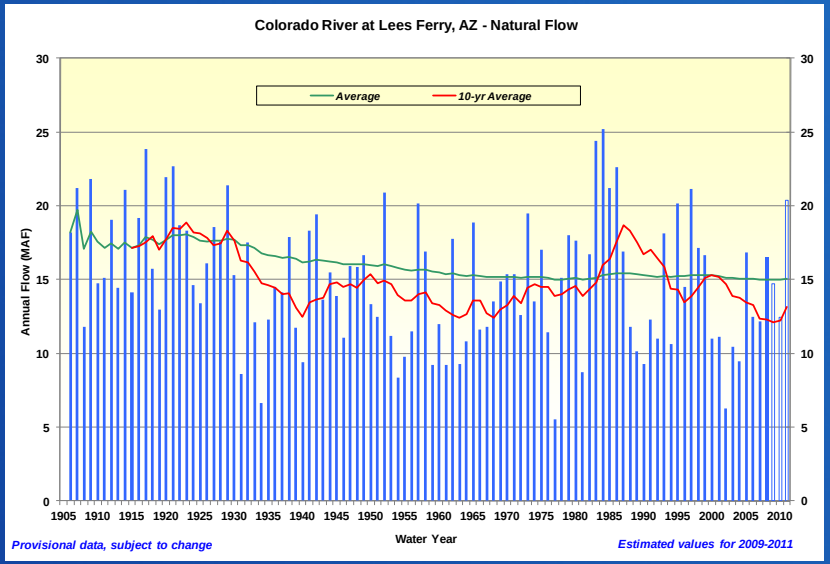
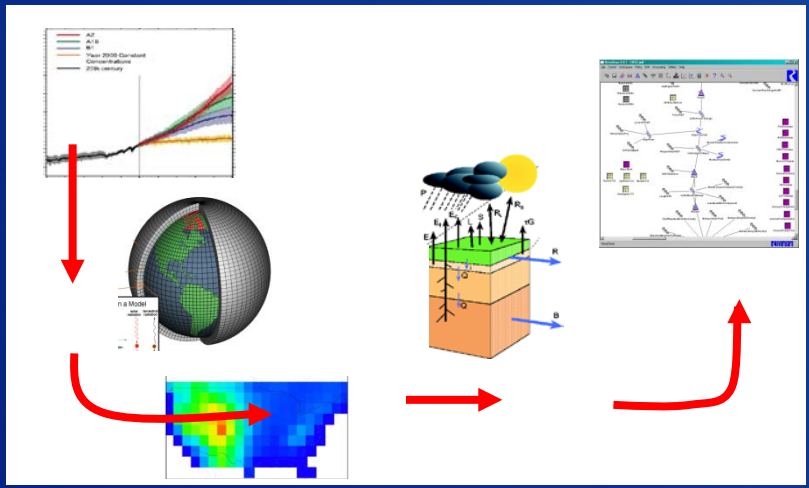
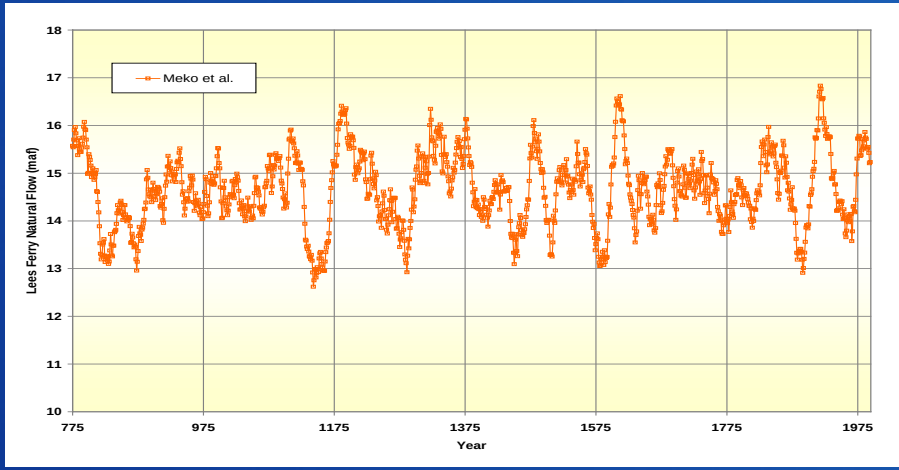
Phase 1: Water Supply Assessment

Scenarios*:

- Observed Resampled
- Paleo Resampled
- Paleo Conditioned
- Downscaled GCM Projected







* Multiple realizations for each scenario

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Phase 2: Water Demand Assessment

Scenarios*:

- **Current Projected**: growth, development patterns, and institutions continue along recent trends
- **Slow Growth:** low growth with emphasis on economic efficiency
- **Rapid Growth:** economic resurgence (population and energy) and current preferences toward human and environmental values **
- **Enhanced Environment:** expanded environmental awareness and stewardship with growing economy **

* Preliminary – Scenario names subject to change

** Additional "branches" possible depending upon assumed trajectory of specific socio-economic factors

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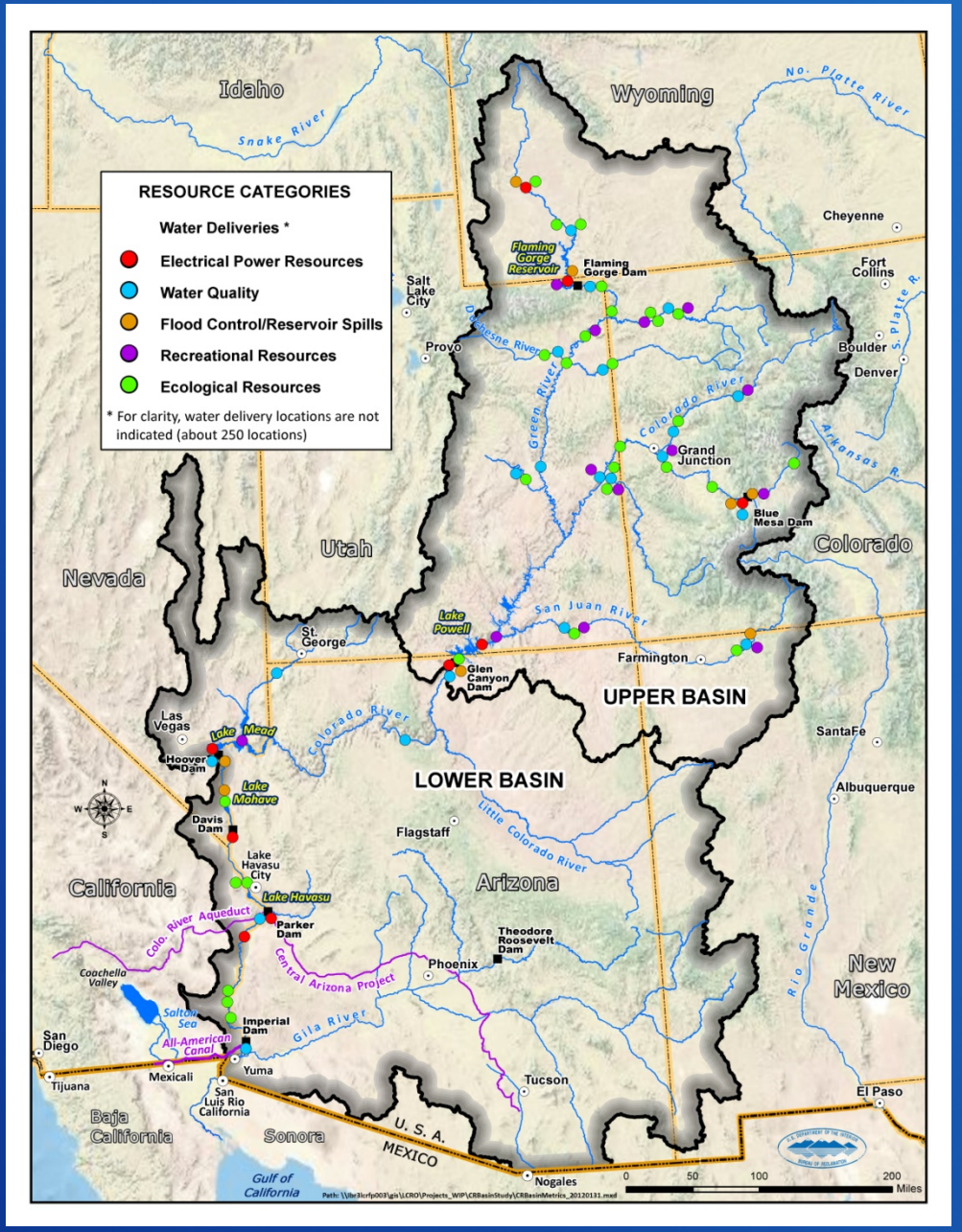
Phase 3: System Reliability Analysis

- Simulate the state of the system on a monthly time step over the next 50 years for each scenario, with and without options and strategies
- Metrics will be used to quantify impacts to system resources
- **Resource Categories**
  - Water Deliveries
  - Electrical Power Resources
  - Water Quality
  - Flood Control
  - Recreational Resources
  - Ecological Resources



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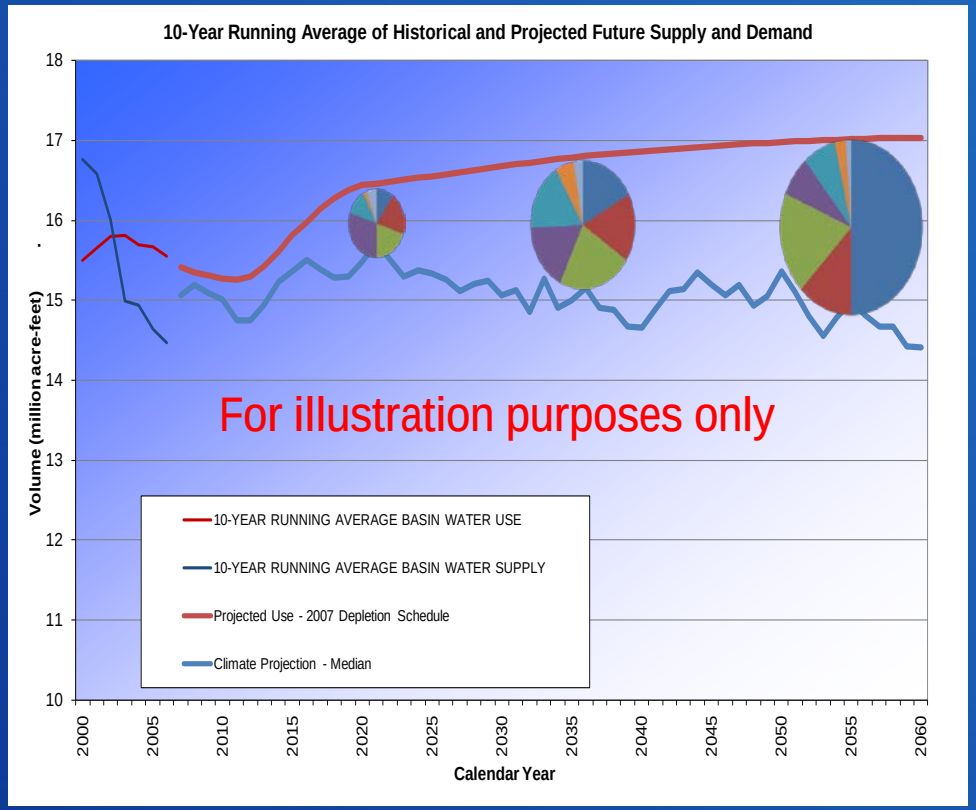
Phase 4: Development and Evaluation of Opportunities to Balance Supply and Demand

- Consider a wide range of options and strategies
  - Representative options
- Consider "Portfolios" of unique combinations of options
- Will not result in selection or funding of a proposed project



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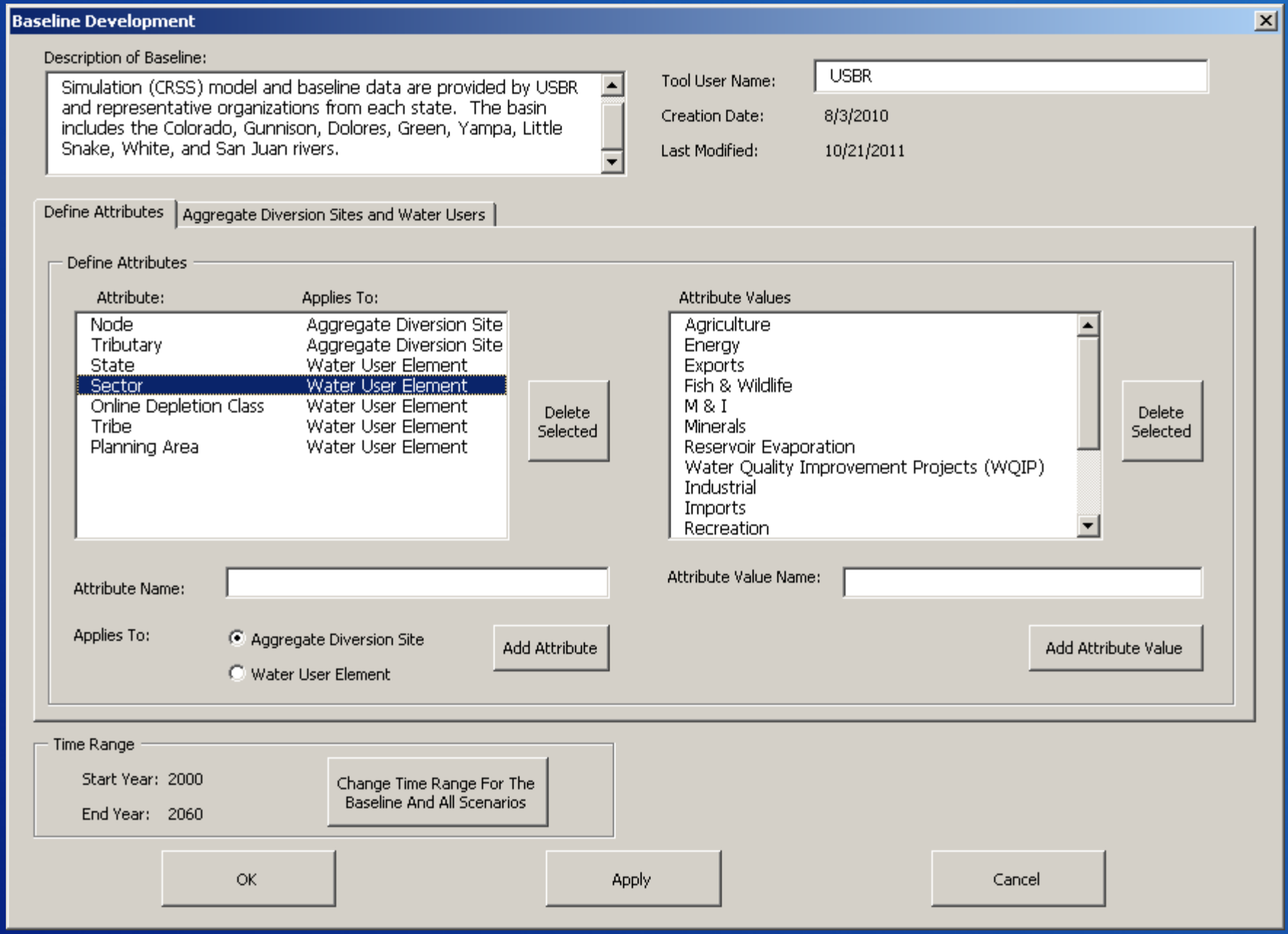
Demand Input Tool

- Excel based tool for specifying/modifying demands
- User specifies demands identical to the model structure
  - Aggregate diversion objects
  - Water users
- Create attributes to ‘tag’ each water user



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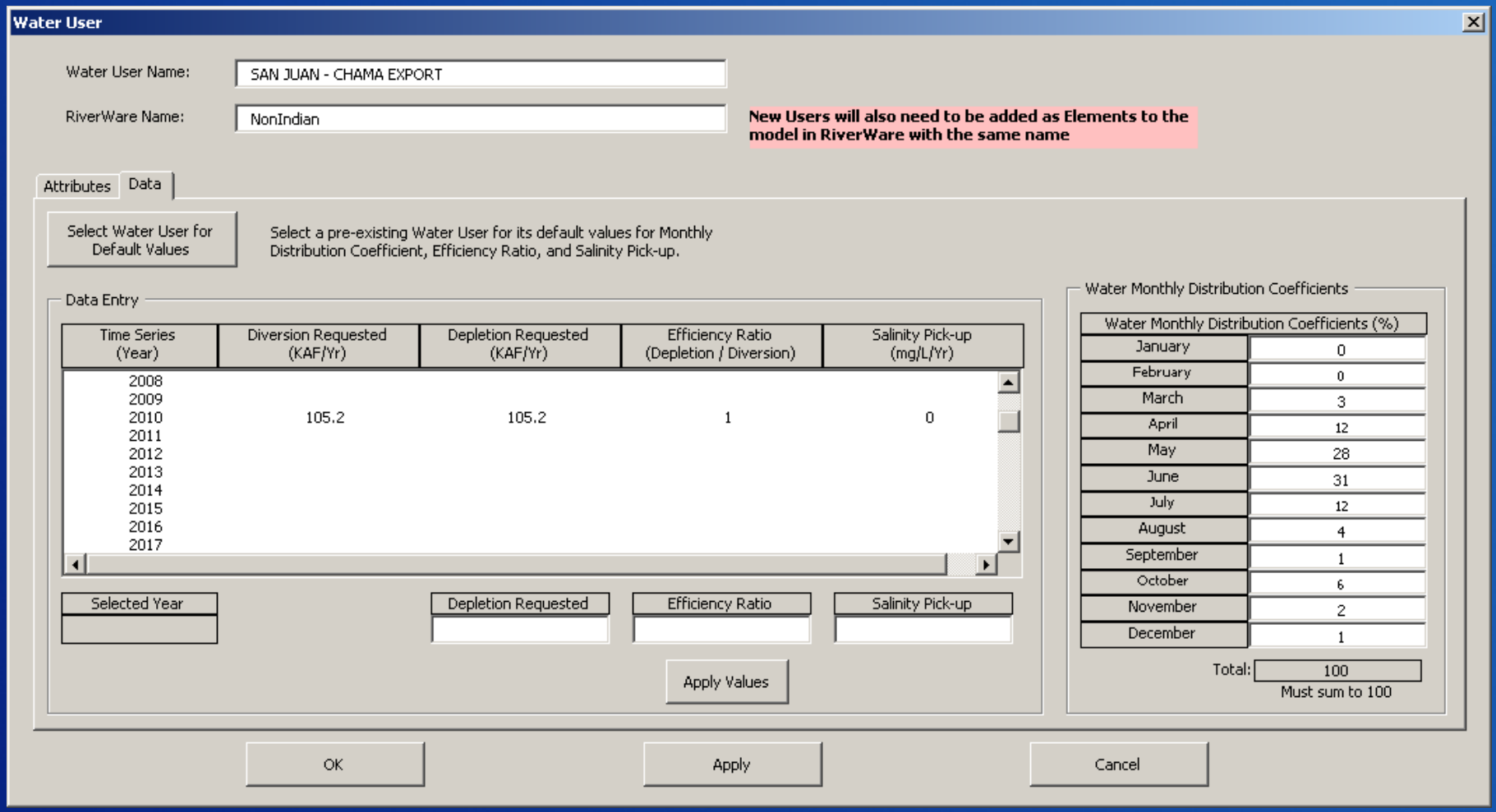
Demand Input Tool

- Quickly input demands
- Allows user to specify ‘baseline’ scenario
  - Specify depletion requested and efficiency ratio
    - DIT computes diversion requested
- Create scenarios based on changes to baseline
  - Relative or percent change from the baseline, or new amount
- Plotting feature

Demand Input Tool



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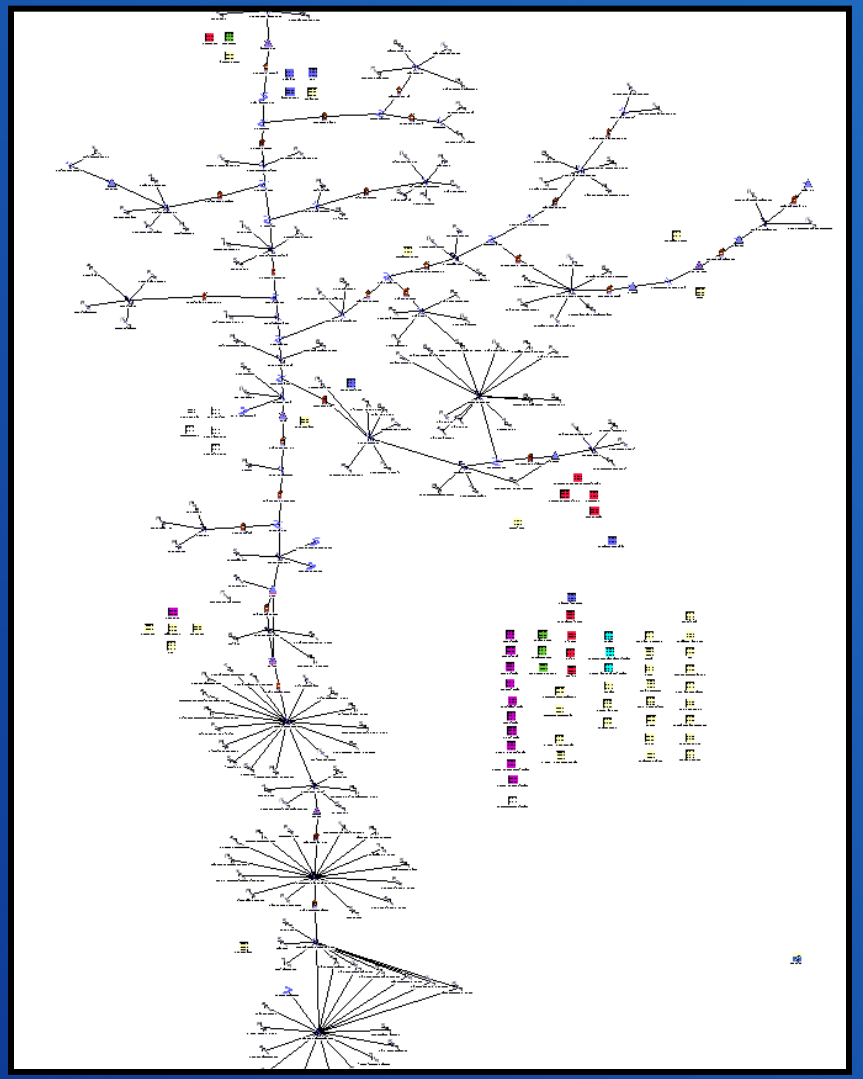
Use of Demand Input Tool

- Worked closely with cost-share partners to develop the demand scenarios
- Input the Current Projected demand scenario as the ‘baseline’ scenario
  - Does not imply greater significance of this demand scenario
- Specified all other demand scenarios as changes to the ‘baseline’ scenario
- Can easily import to CRSS through the Excel DMI feature

Colorado River Simulation System (CRSS)

- Monthly time step, basin-wide planning model
- Simulates operations at 12 reservoirs and deliveries to over 500 individual ‘water users’
- Upper Basin reservoir rules updated to reflect recent RODs
  - Flaming Gorge
  - Navajo



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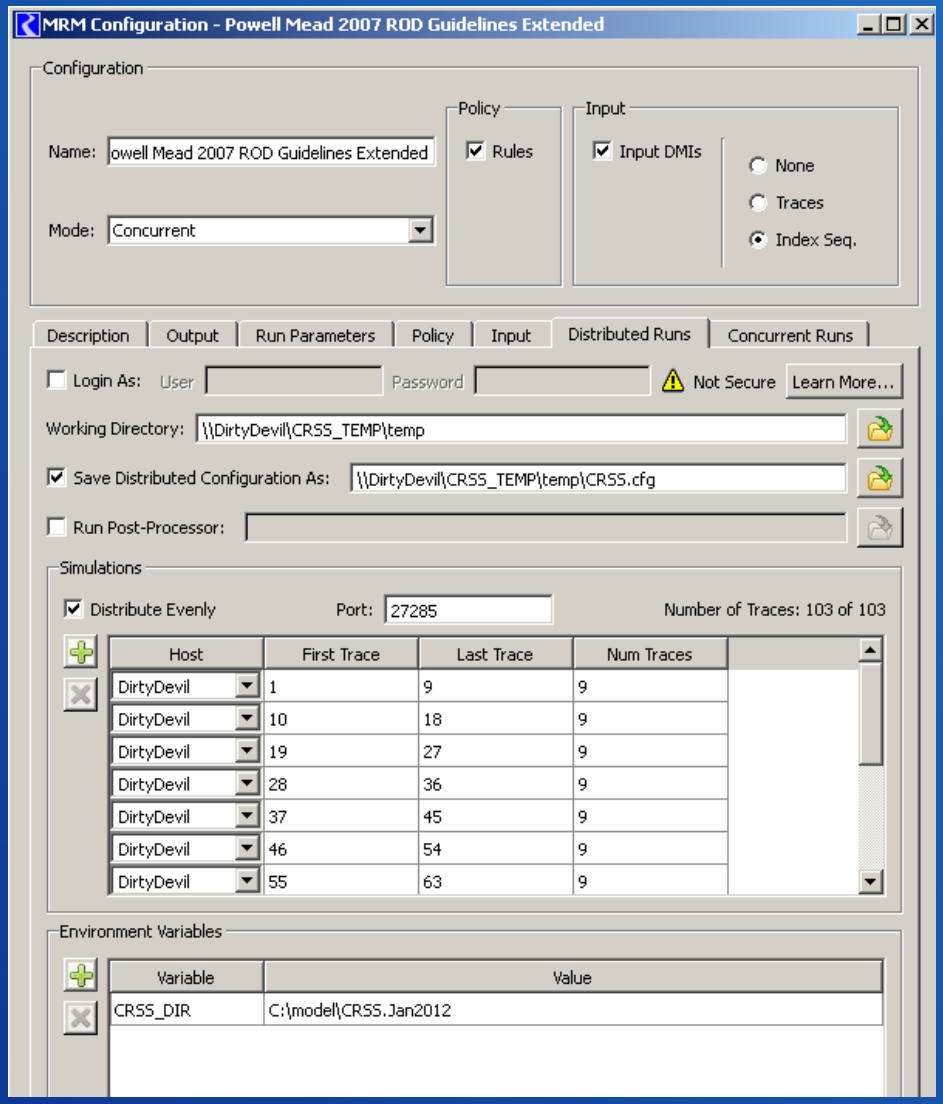
System Reliability Modeling

- System reliability analysis without options and strategies
- 48 different scenarios
  - 6 demand scenarios
  - 4 supply scenarios
    - Total of 1959 traces
  - 2 policy alternatives
- 23,508 traces
- 1,151,892 simulated years

Distributed MRM

- Allows multiple RiverWare instances to run at the same time
  - 1 instance for each core
- Reduces estimated computing time from 200 hours to 15 hours
  - Even more savings from increased computing power



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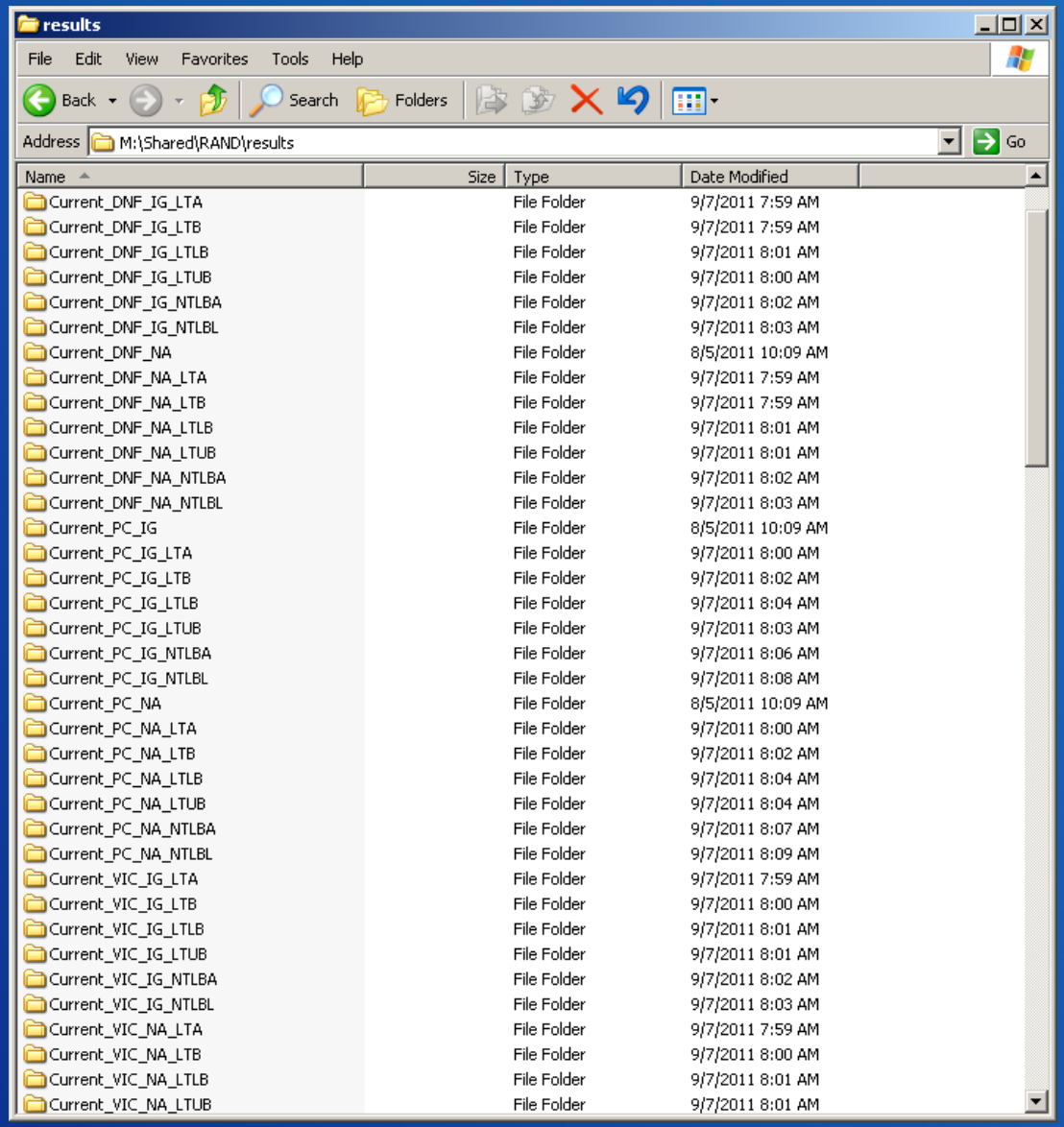
Additional Modeling

- System reliability with representative options and strategies
  - About 25 representative options
  - Reducing number of scenarios in half based on system reliability analysis without options and strategies
  - Results in about 140,000 additional traces
- System reliability with portfolios
  - Each portfolio implements multiple representative options
    - Portfolios will have various objectives, e.g., hydropower focused
  - Anticipating between 5-8 portfolios
  - About 34,000 additional traces

Data Management

- Overall that is over 9.6 million simulated years of data!
- Need an automated way to manage input/output data as well as configure and start simulations



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Study Manager

- Study manager helps:
  - Organize input and output data
  - Configure scenarios
  - Automatically start MRM
    - No downtime between scenarios
    - Creates/invokes batch-mode scripts
  - Perform automatic post processing of results
    - RDF to Excel
    - RDF annualizer
    - Run other scripts
- More about the Study Manager from CADSWES


QUESTIONS?