Climate Adaptation at Denver Water

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Grand Junction
Aspen
Arkansas River
South Platte River.
Yampa River
Gunnison River
Colorado River
Continental Divide
South Platte Watershed
Colorado River Watersheds
Continental Divide
Denver
Transbasin Diversions

- 25% of state population
- 1.4 million people
- 1.0 million jobs
- 30% of state GDP
- 2% of Colorado’s water
- Service area <1% of land area
This story begins in 2002

Deterministic thinking

- Observed hydrology and extrapolation of past trends

Unprecedented Simultaneous Natural Disasters

- Integrated Resources Plan (IRP):

Cylinder of Certainty

Present  Future
Colorado River at Kremmling
1634-2005
Median Flow over 4 Years
Paleohydrology
Simulated Reservoir Contents
1634-2005

% Full

Year

Science will *solve* this problem

Science can only take us so far.

**Climate Model Projections for Northcentral Colorado**

- **Precipitation Change (%)**
- **Temperature Change (Fahrenheit)**

- **2040**
- **2070**
Denver Water’s simple assessments

<table>
<thead>
<tr>
<th></th>
<th>5° F Warming Means</th>
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<tbody>
<tr>
<td>Reduced Supply</td>
<td>20%</td>
</tr>
<tr>
<td>Increased Demand</td>
<td>7%</td>
</tr>
<tr>
<td><strong>Additional precipitation</strong></td>
<td><strong>10%</strong></td>
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<tr>
<td>needed to offset warming</td>
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Lessons learned

- Warming alone is pretty devastating
- Simple assessments provide extremely valuable information
- Science cannot “solve” this problems
"Let’s see... jellyfish and seaweed in vicinity... threats analyzed, proceeding left."
Deterministic Planning
Cone of Uncertainty

Future

Trigger Points

Near-term Plan
- Robust and Low Regrets Actions
- Preserving Options

Present

Future
Scenario Planning – IRP 2011
The Cone of Uncertainty

- Traditional Future
- Water Quality Rules
- Hot Water
- Economic Woes
- Green Revolution
SCENARIO PLANNING
IRP 2065

Robust Solutions
- Diversified portfolio
- Scalable options
- Preserving options
- Continuous & iterative planning

Weak Economy
- Suburban preference

Warmer Climate

Strong Economy
- New urban preference

Hot Climate
Lessons Learned

• Deep seated deterministic thinking takes a long time to change
• Simple scenario approach provides a lot of insight
• Few low regrets approaches for the long term
• Focus on increasing options and flexibility
• Worked well with complex water system model
Following IRP 2065

- **RDM lite**: Break and hedge strategy against different futures and challenges
  - Small set of futures - combinations of warming, streamflow variability, and density
  - Colorado River Compact call and acute challenges like water system failures and outages
- Planning model
- Sustained planning
“Uncertainty is an uncomfortable position. But certainty is an absurd one.”

-VOLTAIRE
Climate Adaptation at Denver Water

Thank you!

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