A Practitioners Dilemma: Useable vs Useful Data

August 3, 2015 - AGCI High Resolution Climate Modeling and Data
Laurna Kaatz - Climate Program Manager, Denver Water

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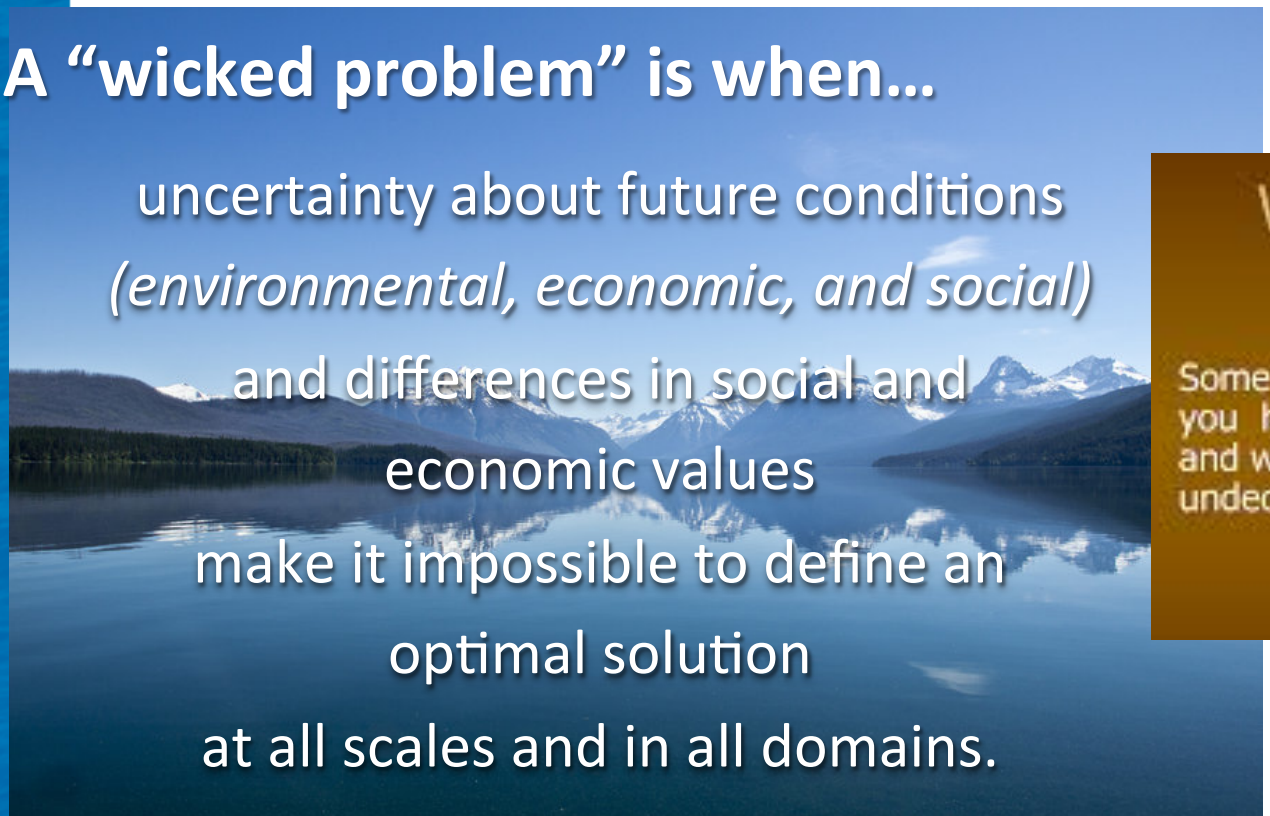
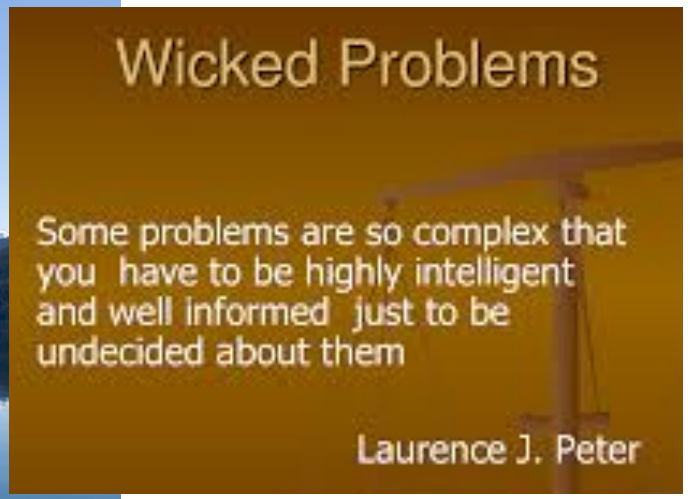
Climate Change is Difficult

We are dealing with a *wicked problem*:

- Complex scientific components
- No solution that is positive across values
- Challenges fundamentally planning assumptions





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Climate Application Challenges

The Drinking Water Utility Mission:
provide safe, high quality, reliable water at a low cost

- What information should be used? Why? How?
  - Conversion tools?
  - Simple vs sophisticated?
  - probabilities? scenarios?
  - Trade-offs?
- New science?
- Messaging?
- New planning methods?
- Deep uncertainty in decision-making.

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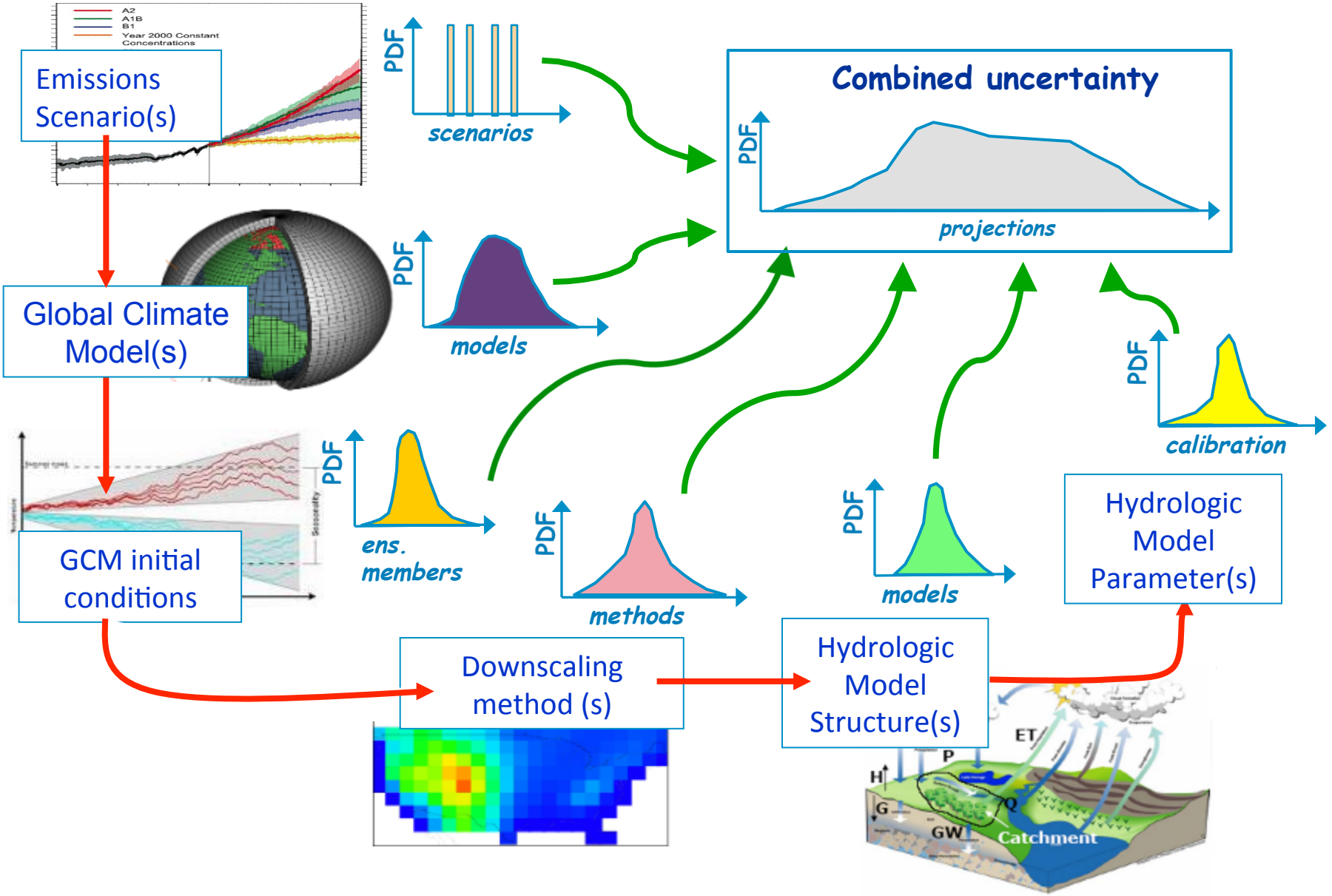
“Revealing” uncertainties (Martyn Clark, NCAR)



Useful and Useable Science

Information

- Accuracy
- Range
- Magnitude
- Timing
- Resolution
- User friendly information
- Articulate uncertainty

How

- Monitoring
- Science
- Modeling
- Translation
- Strong relationships
- Proven track record

Depends on the decision scale:
operational vs long-term needs are different

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Water Utility Climate Alliance

The Water Utility Climate Alliances provides leadership in assessing and adapting to the potential effects of climate change through collaborative action. We seek to enhance the ***usefulness of climate science*** *for the adaptation community and improve water management* ***decision-making in the face of climate uncertainty.***

Barriers to Climate Adaptation

- Politics and agendas
- Changing organizational priorities
- Stakeholders
- Immediate vs long-term
- It's not black and white
- Vertical axis of uncertainty
- Careful who and what we ask for
- Responsibility: Mission without stranded assets

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Key Conclusions

- Scale: decision and data
- Consistency
- Track record
- Relationships
- Responsibility
- Is it more predictive? Will it make my decisions better?
- High resolution research is critical

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Workshop Opportunities

- Build relationships and learn from each other
- Explore new thinking
- Push boundaries of practice and research

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Wicked Problem

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Four Adaptation Steps

WUCA
Water Utility Climate Alliance

- **Understand** climate science and model projections capabilities and limitations
- **Assess** water system vulnerabilities to potential change
- **Plan** to incorporate climate change uncertainty into water utility planning
- **Implement** adaptation strategies

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Application Barriers: Using High Res Data at Denver Water

August 4, 2015 - AGCI High Resolution Climate Modeling and Data

Laurna Kaatz - Climate Program Manager, Denver Water

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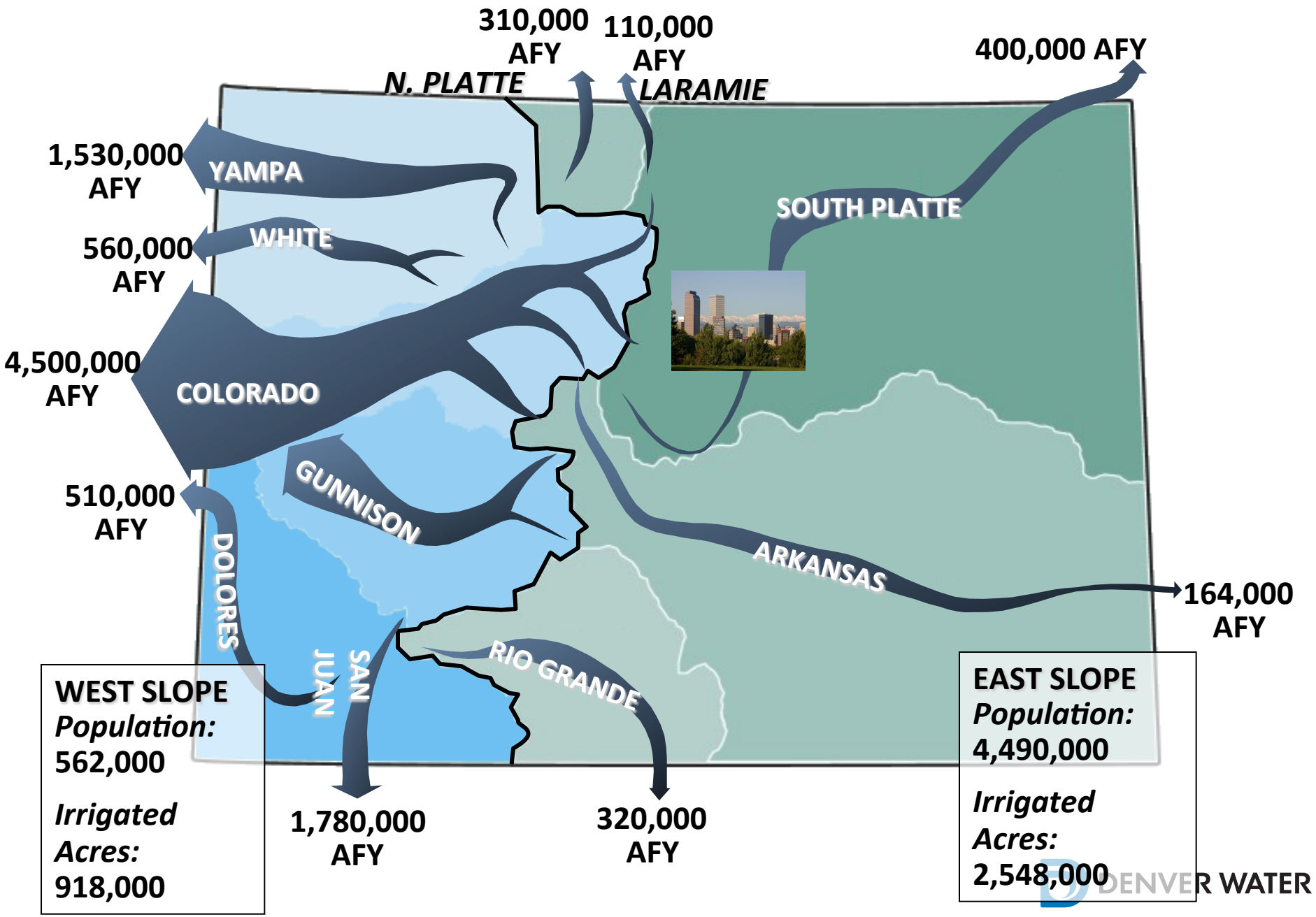
Colorado Water



WEST SLOPE
Population:
562,000

Irrigated Acres:
918,000

EAST SLOPE
Population:
4,490,000

Irrigated Acres:
2,548,000

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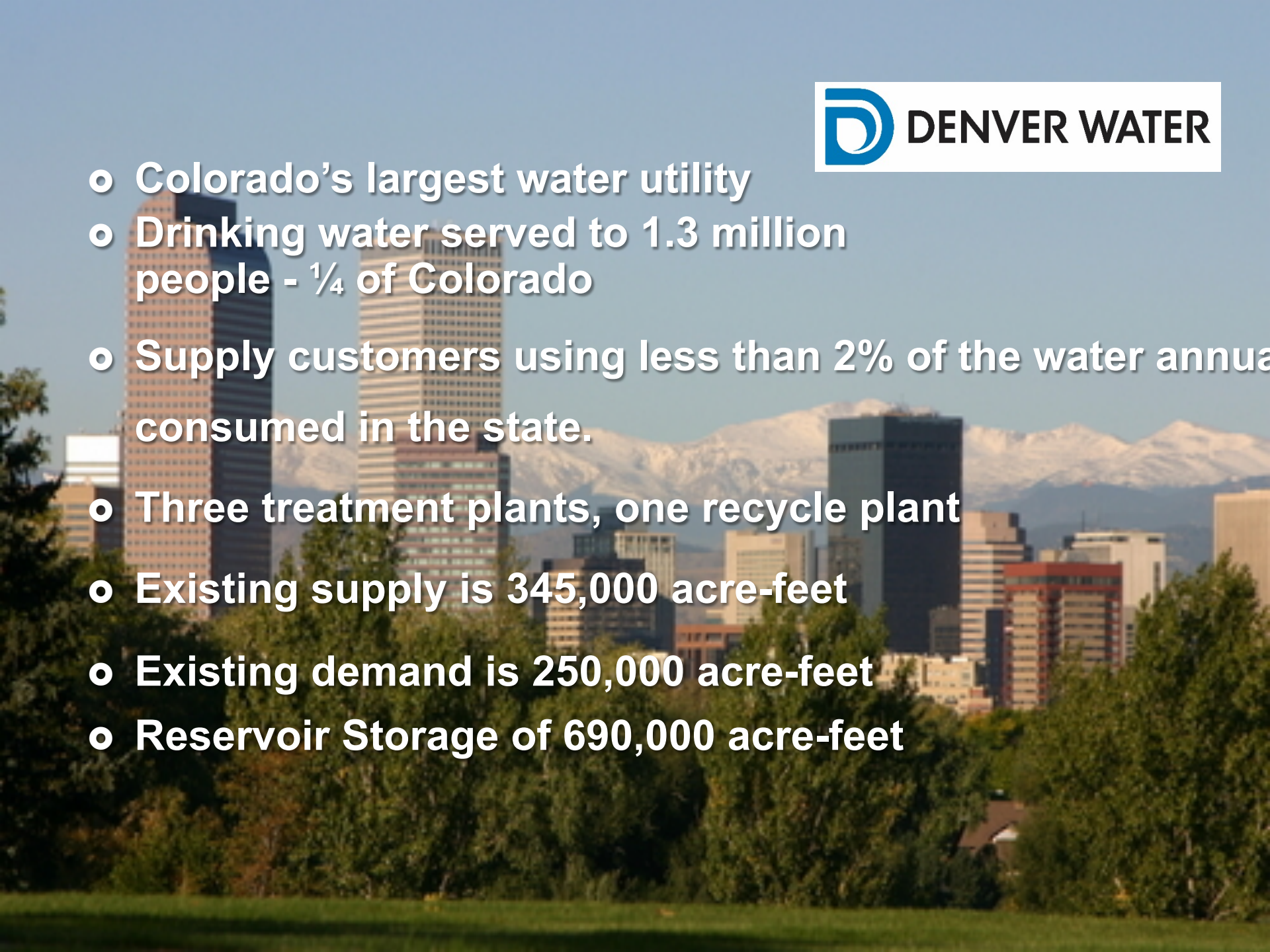
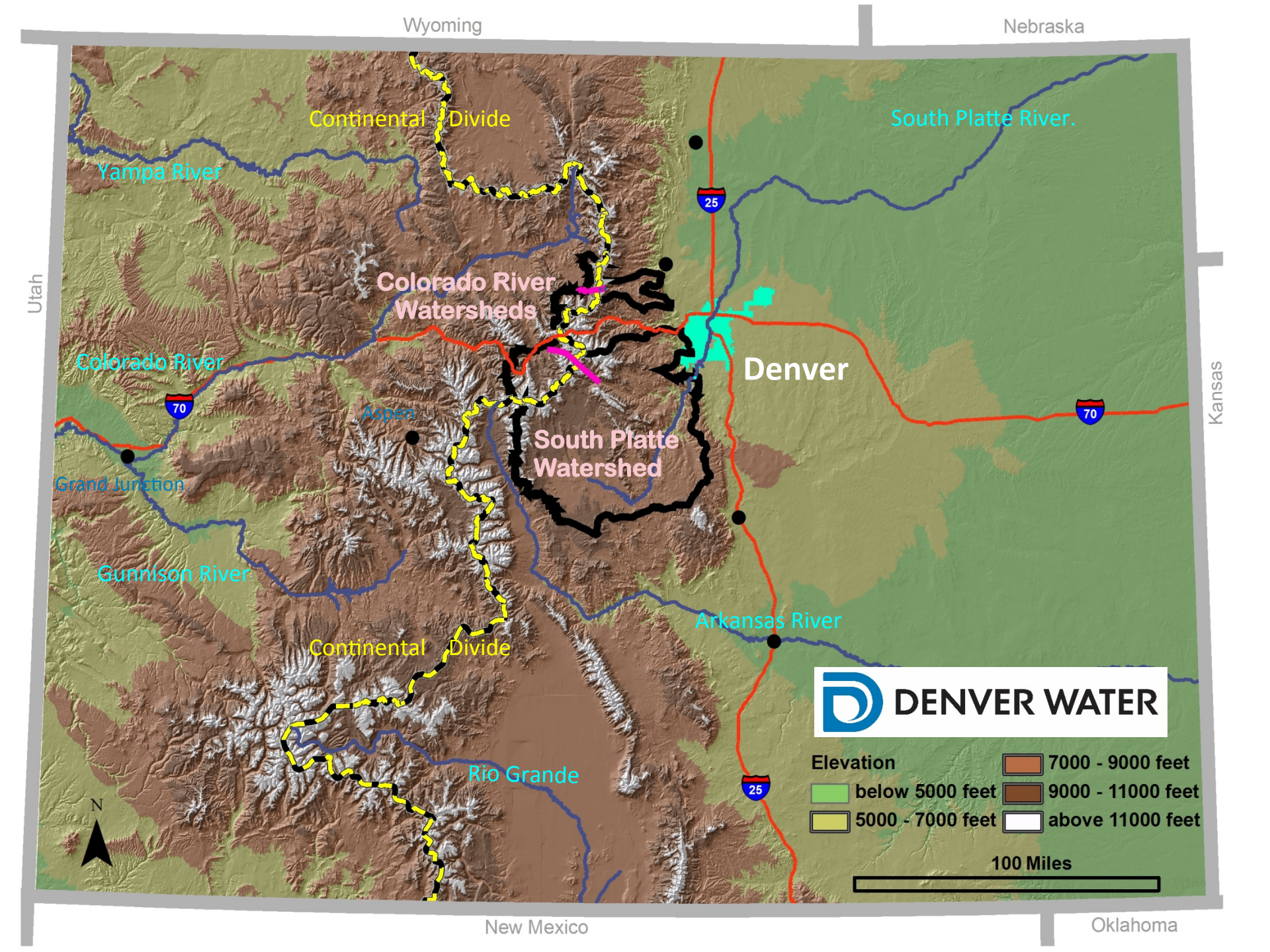

DENVER WATER
Colorado's largest water utility
Drinking water served to 1.3 million people - ¼ of Colorado
Supply customers using less than 2% of the water annua
consumed in the state.
Three treatment plants, one recycle plant
Existing supply is 345,000 acre-feet
Existing demand is 250,000 acre-feet
Reservoir Storage of 690,000 acre-feet


Wyoming
Nebraska
Utah
Kansas
New Mexico
Oklahoma
Continental Divide
South Platte River.
Yampa River
25
Colorado River Watersheds
Colorado River
Denver
70
Aspen
South Platte Watershed
Grand Junction
Gunnison River
Arkansas River
Continental Divide
Rio Grande
N
DENVER WATER
Elevation
below 5000 feet
5000 - 7000 feet
7000 - 9000 feet
9000 - 11000 feet
above 11000 feet
100 Miles

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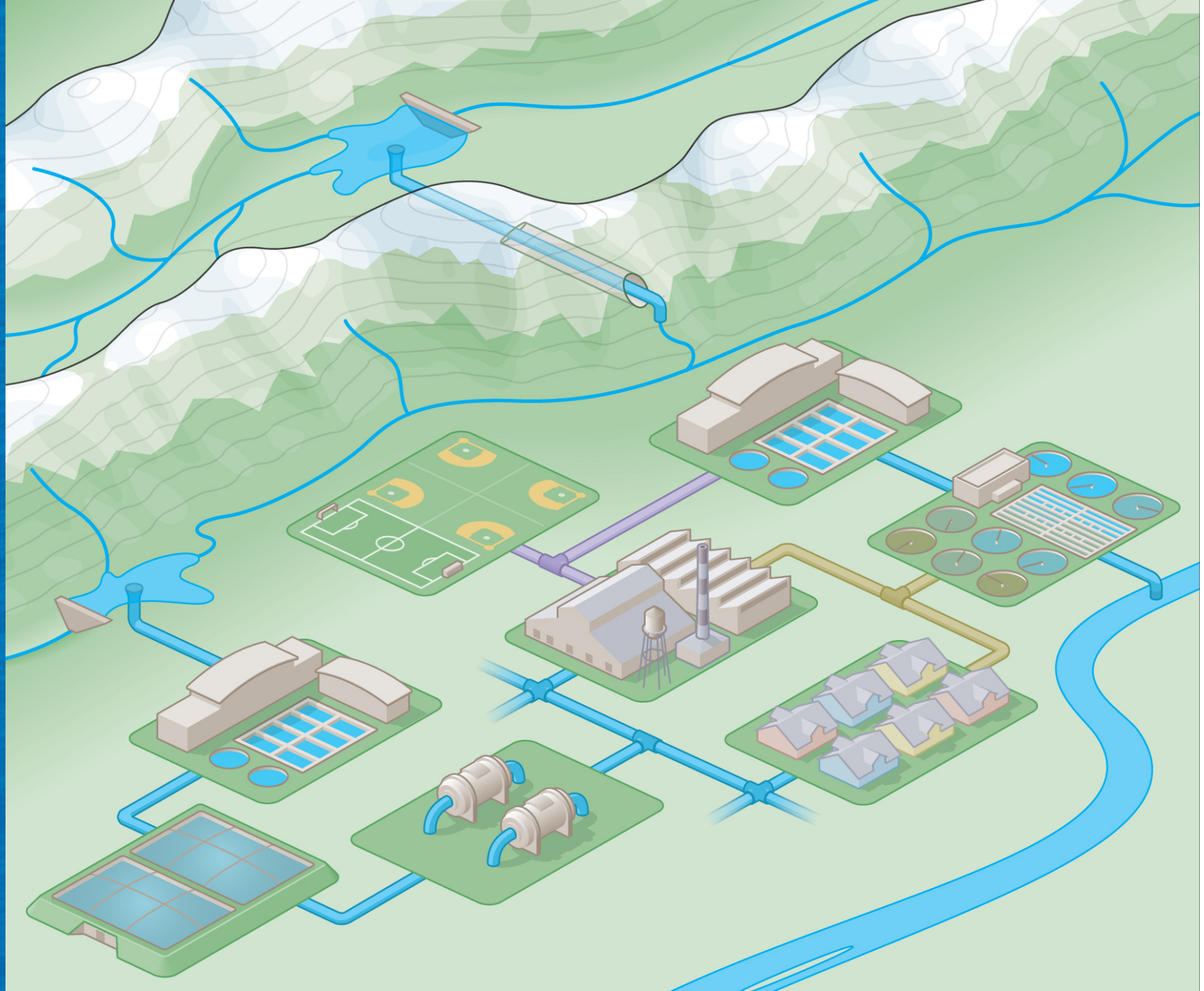
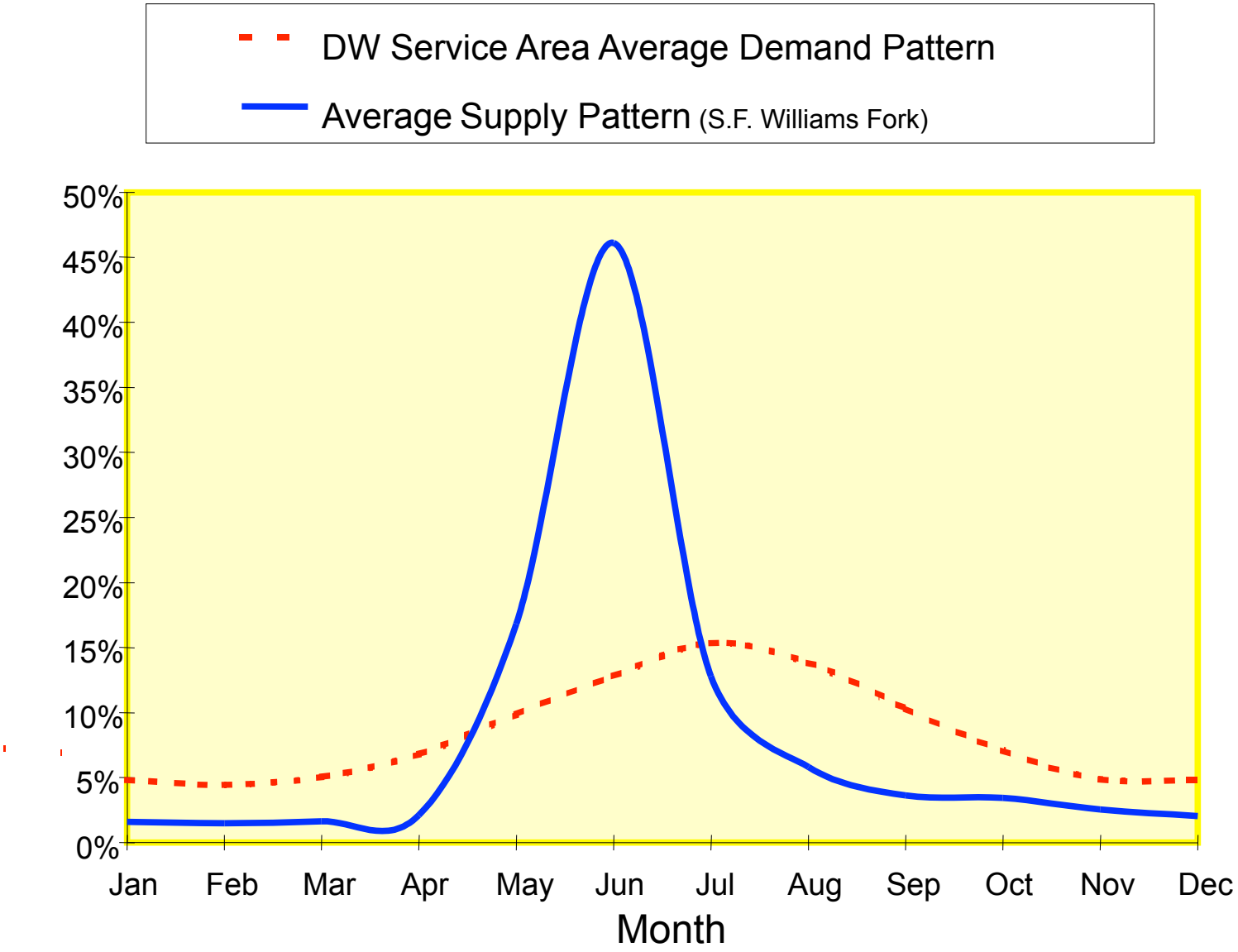
Major rivers of the U.S.



Comparison of Water Supply and Demand Patterns



Factors Affecting Water Supply

- Available Flow (natural flows)
  - Variations in annual, seasonal and daily weather patterns and runoff
  - System losses (evaporation, carriage losses)
- System Constraints
  - Tunnels, canals, reservoirs
  - Stream channels
  - Treatment plants and distribution
  - Water quality
- Water Rights and Agreements
  - Colorado water law
  - Contracts & agreements
  - Minimum, maximum flows
  - Environmental factors
- Demand
  - Existing vs. Future
  - Variations in annual, seasonal and daily demands
  - Indoor versus outdoor demand
  - Future conservation savings
  - Demands of other entities
  - Social values

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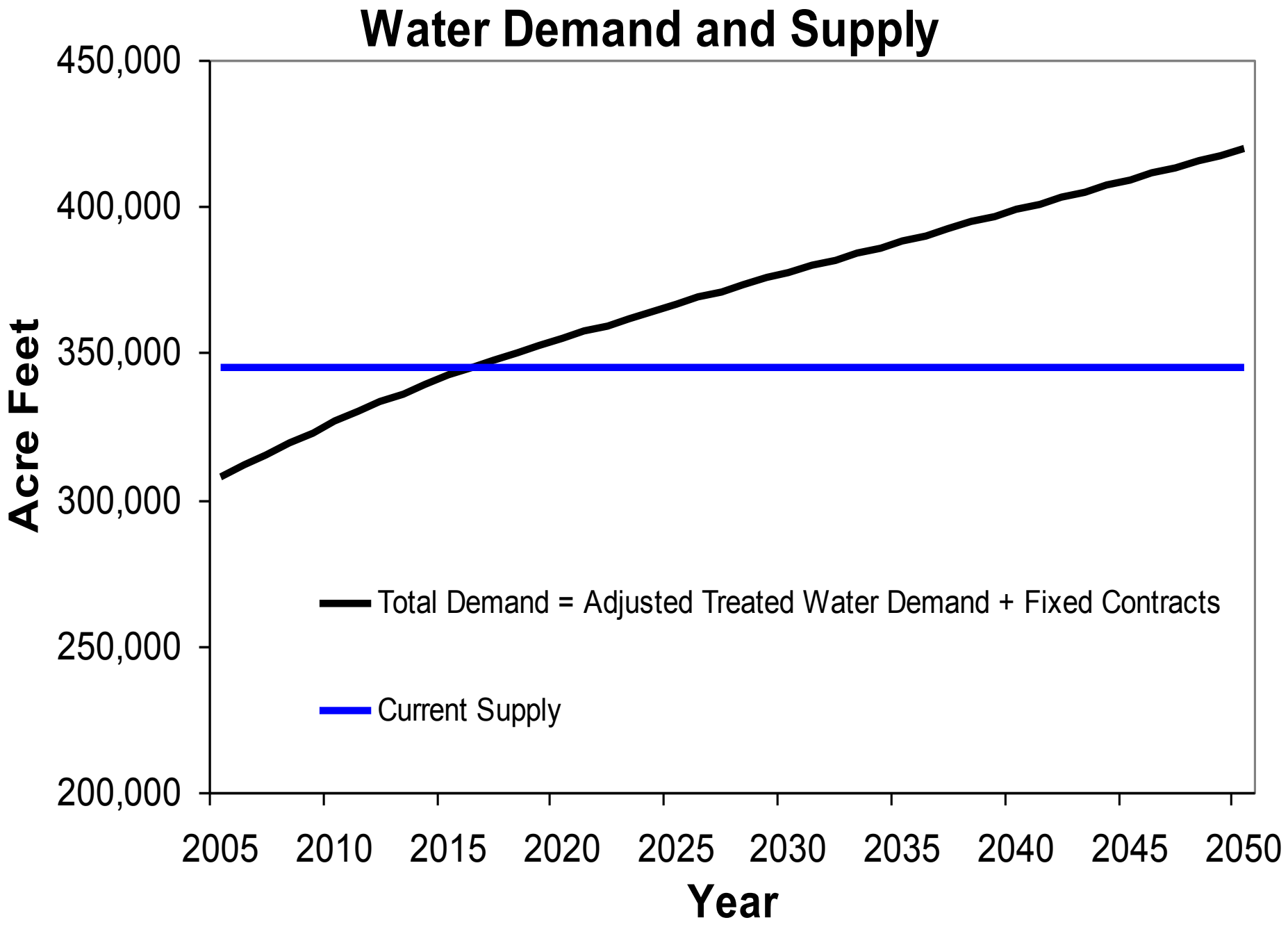
Short-Term Planning Goals

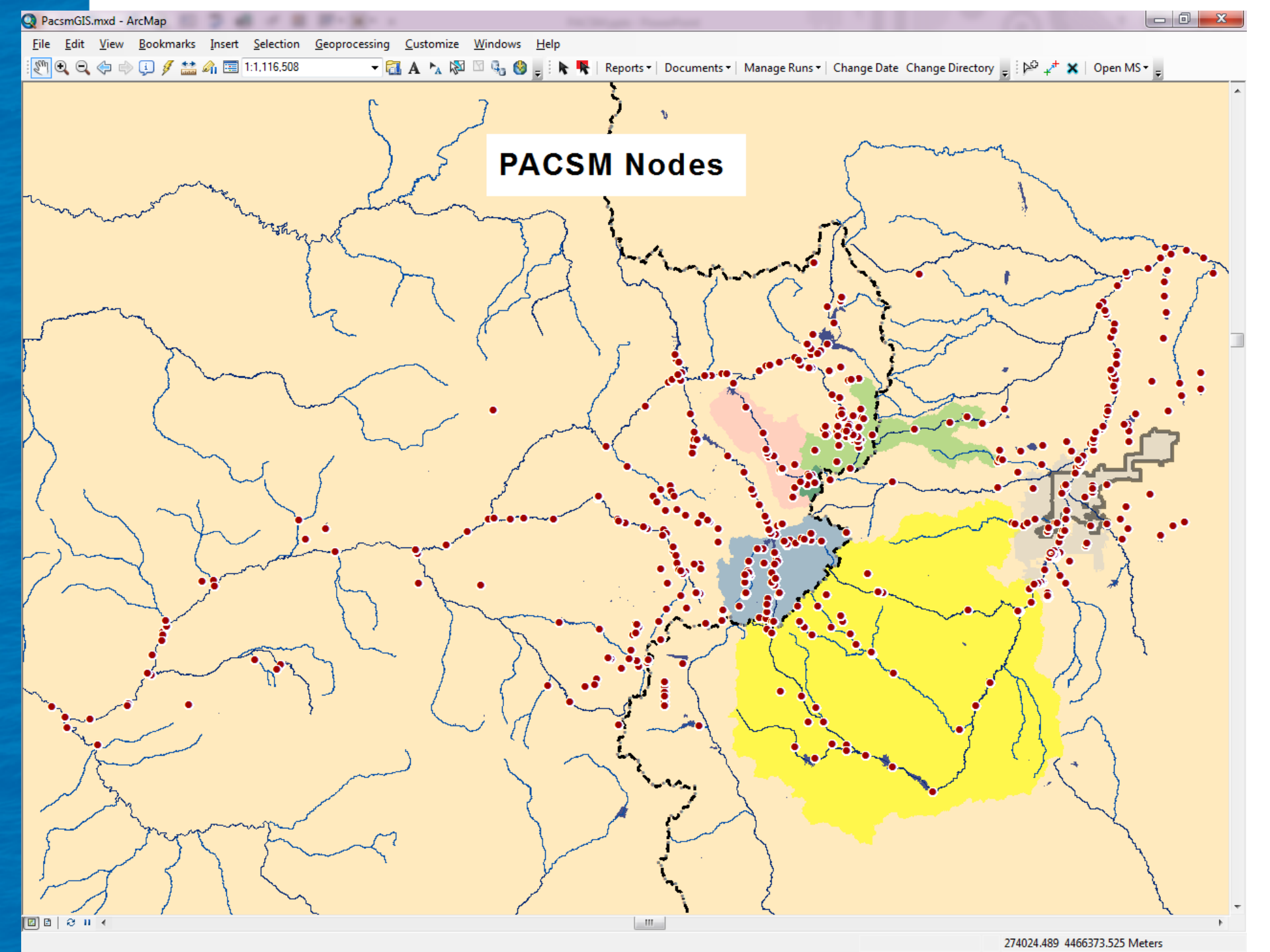
Annual Objectives

- Fill Reservoirs
- Maximize Runoff Capture
- Maintain System Balance

Common Questions Along the Way…

- How much water should be released this week?
- How should we balance our system?
- Should we make power, recreation, environment, flood, etc. releases?
- Do any parts of the system need to be serviced?
- Do we need to prepare for drought?
- Should we run Robert's tunnel over winter?


Water Demand and Supply
450,000
400,000
350,000
300,000
250,000
200,000
Acre Feet
Total Demand = Adjusted Treated Water Demand + Fixed Contracts
Current Supply
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
Year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What is the State of Science of Climate Adaptation???

DW Challenges

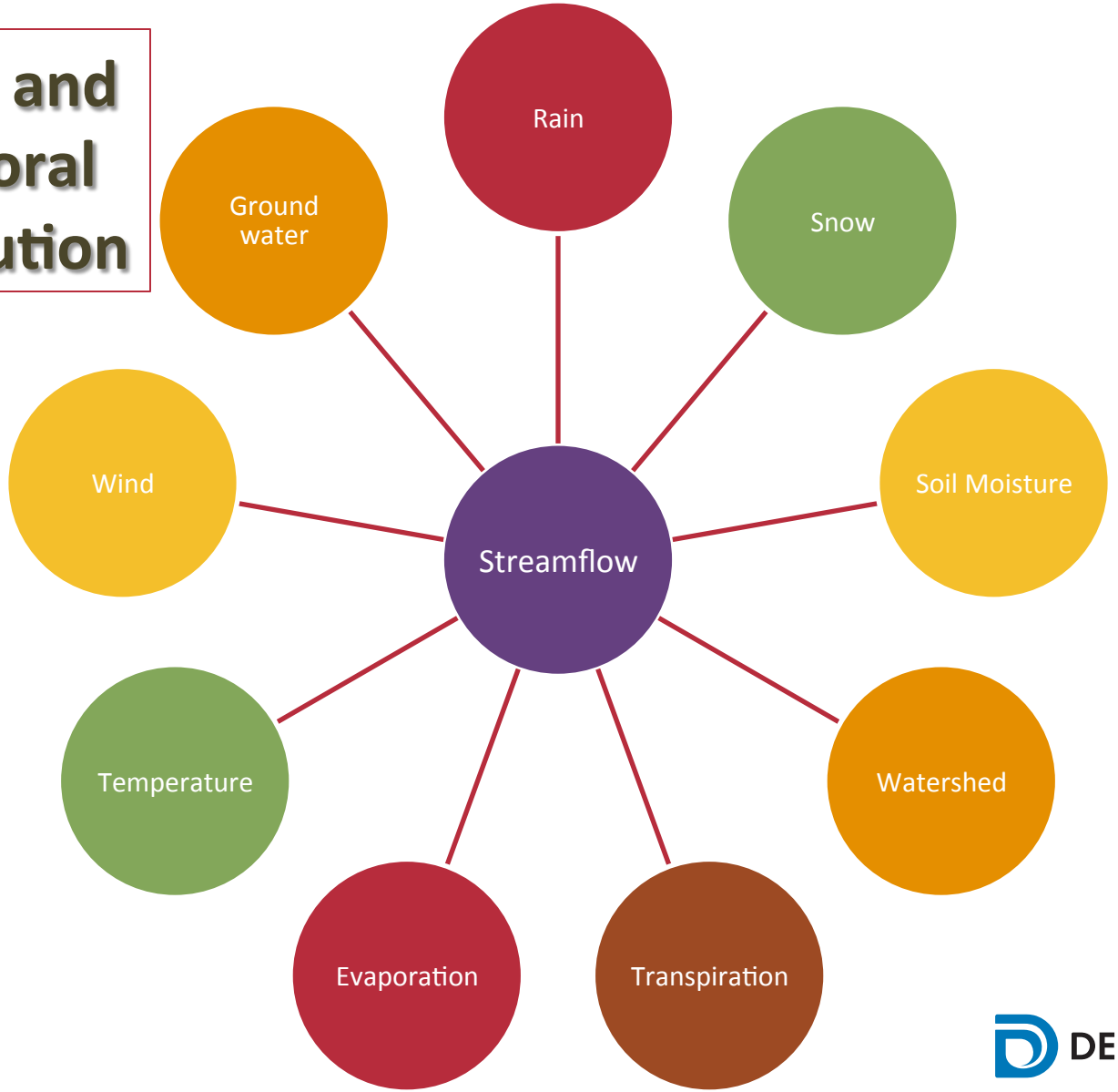
- Sophisticated water system model
- Responsibility to customers
- Organizational buy-in and risked loss of trust
- Preparation vs stranded assets

Science Questions

- How predictive is it?
- What do we actually know?
- What do we need to know to act?

High Resolution Climate Model Data

Spatial and Temporal Distribution



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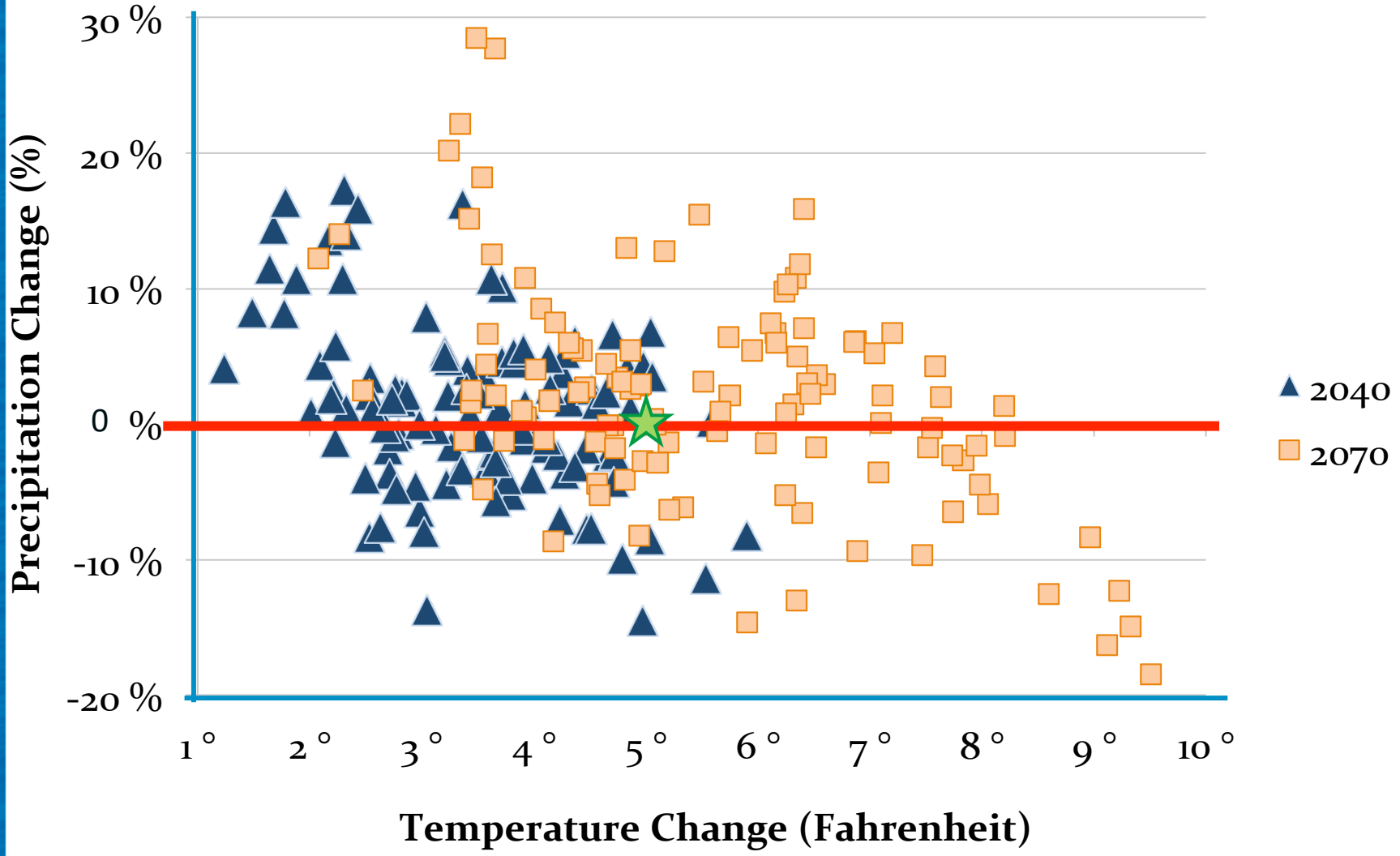
Projected Changes for North Central Colorado



Denver Water's Simple Assessments

	2° F		5° F	
	Colorado	South Platte	Colorado	South Platte
Additional precipitation to offset warming	5%	5%	8%	12%

	5° F
	% Change
Yield	-22%
Demand	7%

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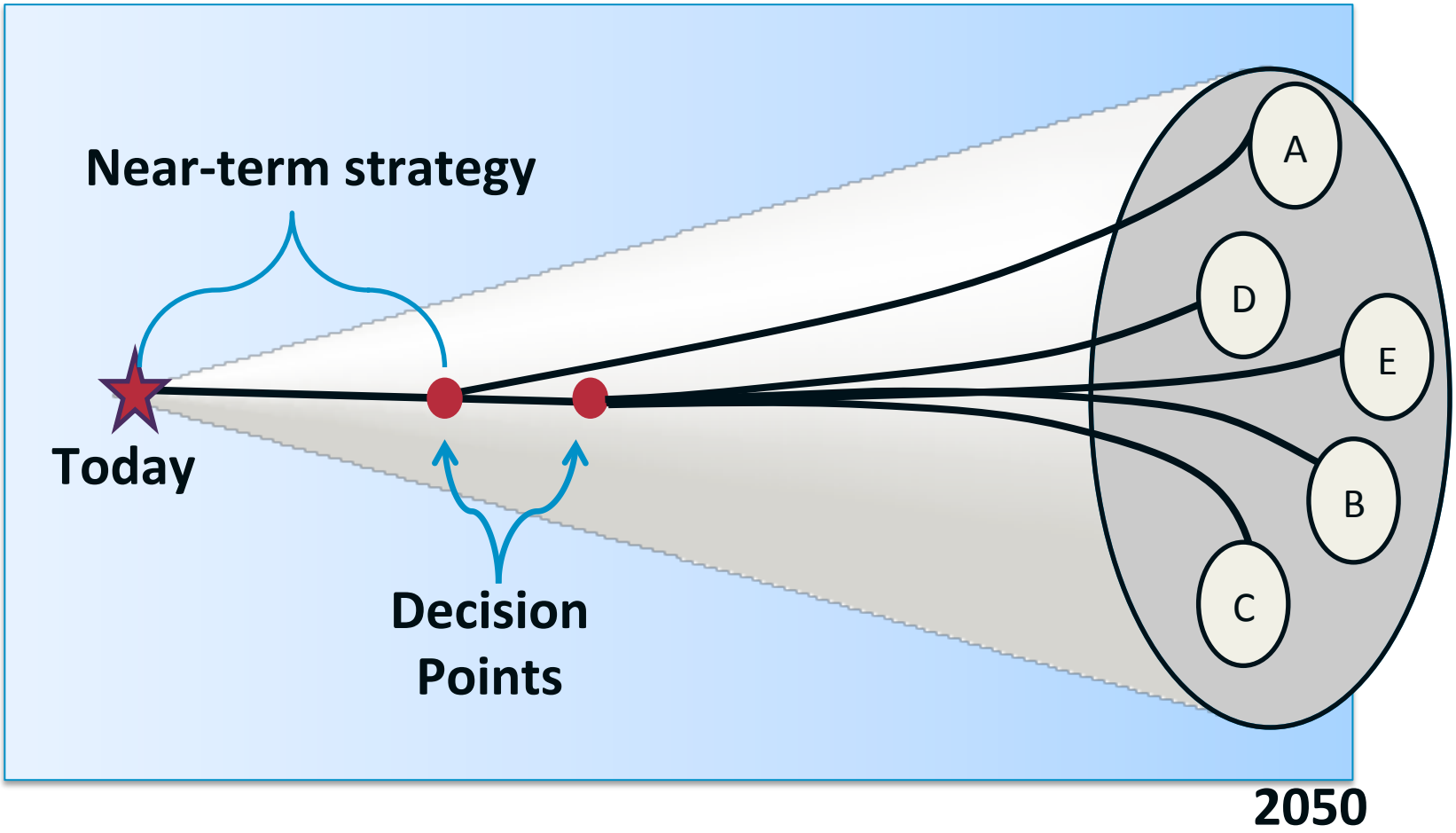
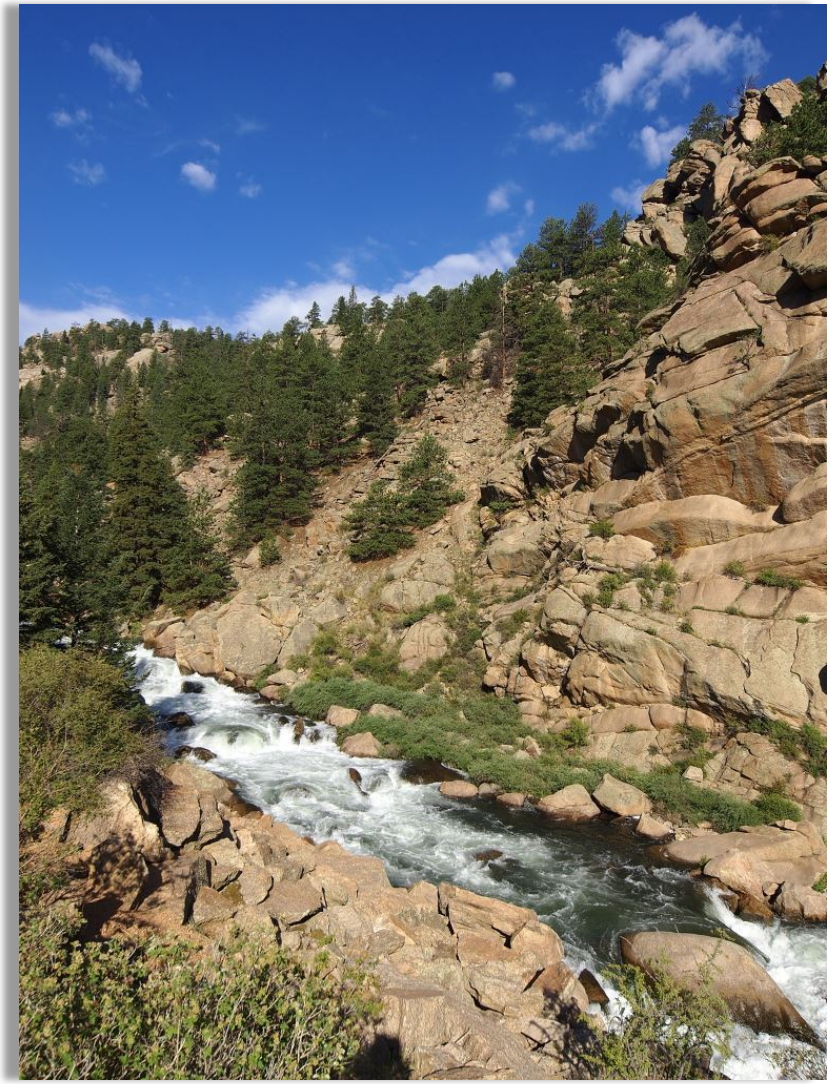
Scenario Planning

The Cone of Uncertainty



Conclusions

- Increase system diversity and flexibility
- Maintain reliability
- Plan for multiple futures
- Identify and preserve options



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EXTRA SLIDES

"All I'm saying is *now* is the time to develop a plan to deflect an asteroid."

Water Planning Challenges

Planning Futures

- **Traditional future** - The future is extrapolated from past trends.
- **Water quality rules** - Contaminant removal and other drinking water requirements are extremely stringent.
- **Hot water** - A warmer climate accompanied by more frequent and more severe droughts.
- **Economic woes** - An ongoing energy crisis and deep economic downturn.
- **Green revolution** - Environmental values and sustainable living become dominant social norms.

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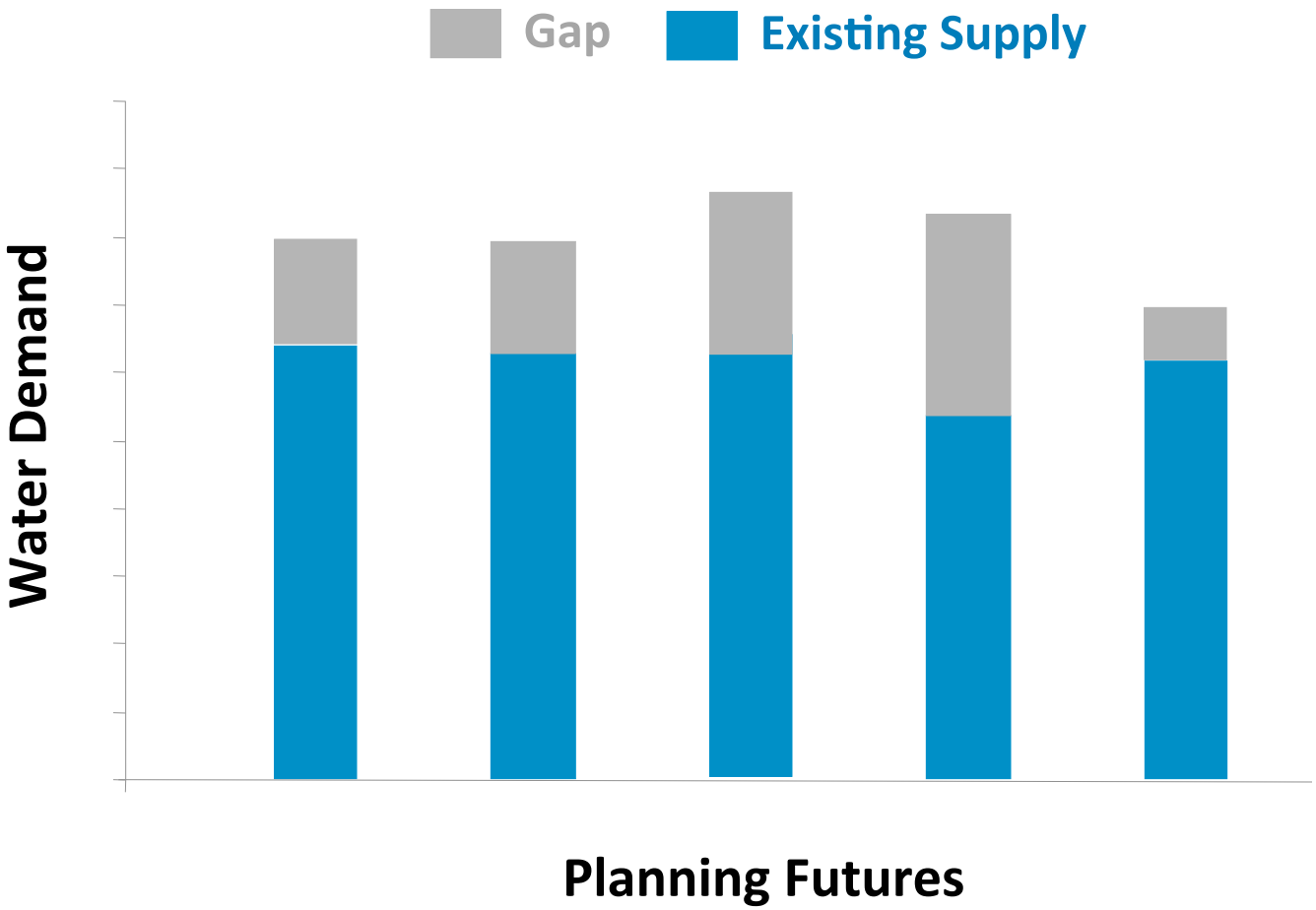
Supply Gap in 2050



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