

FYI in 45 Better Water Planning for a Prosperous Future

Panelists:

Dan Rodrigo

Andria Loutsch

Moderated by:

Andrew Beaton

May 9, 2018



**CDM
Smith**

Today's Discussion

- ▶ Why does traditional water planning fail when “disruption points” occur in the future?
- ▶ How can we account for the full range of uncertainties in water planning, and overcome them successfully?
- ▶ Why is scenario planning a better technique for water planning, and how does it work?
- ▶ What tools are available for faster, more comprehensive forecast simulations to address future unknowns?

Our Panel



Dan Rodrigo

Senior Vice President, Technical Specialist



Andria Loutsch

Principal Water Resources Planner

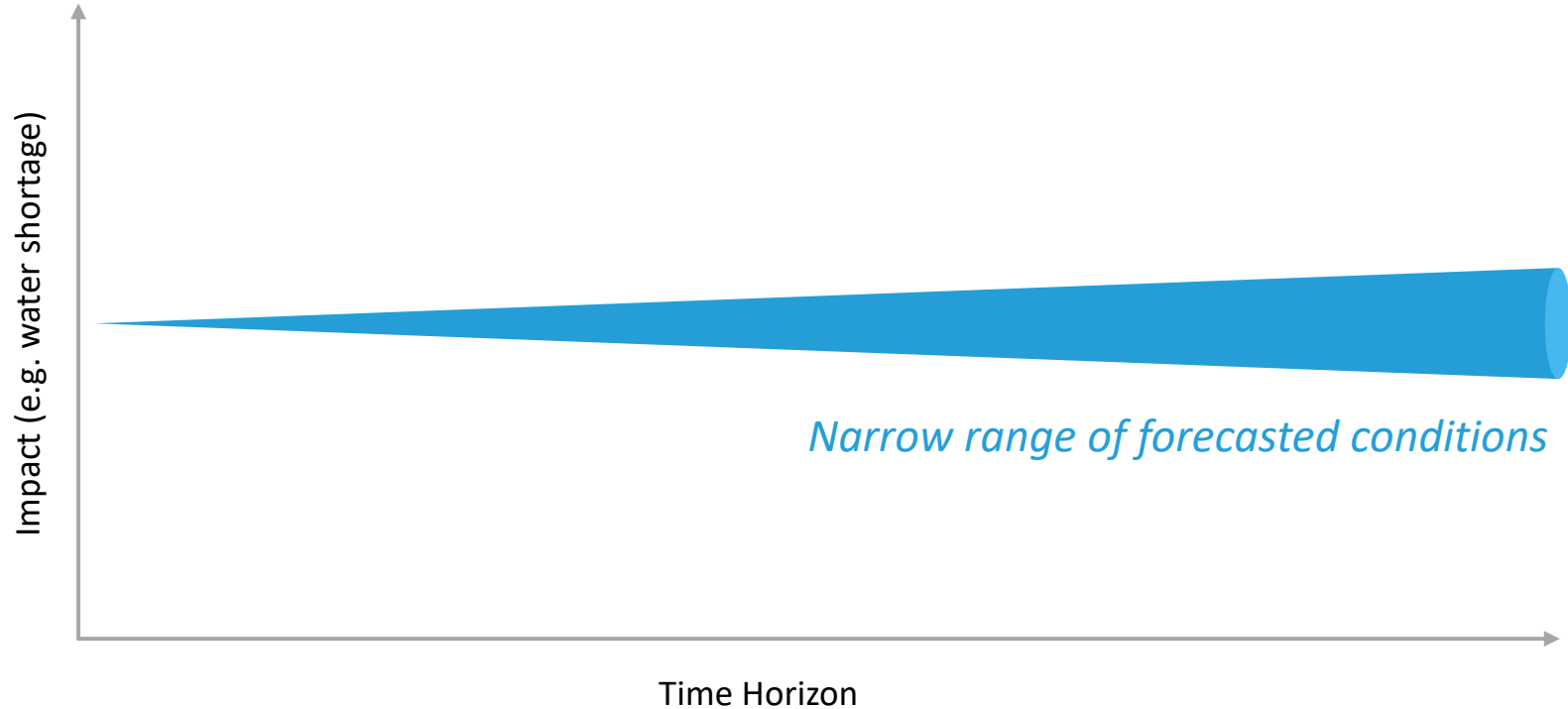
A photograph of a wooden boat, possibly a rowing boat, resting on a dry, cracked, and parched lake bed. The boat is positioned in the lower right foreground. The ground is dark brown and covered in a network of deep cracks. In the background, a range of blue mountains stretches across the horizon under a clear sky. The overall scene conveys a sense of drought and environmental hardship.

What's Missing from Traditional Water Planning?

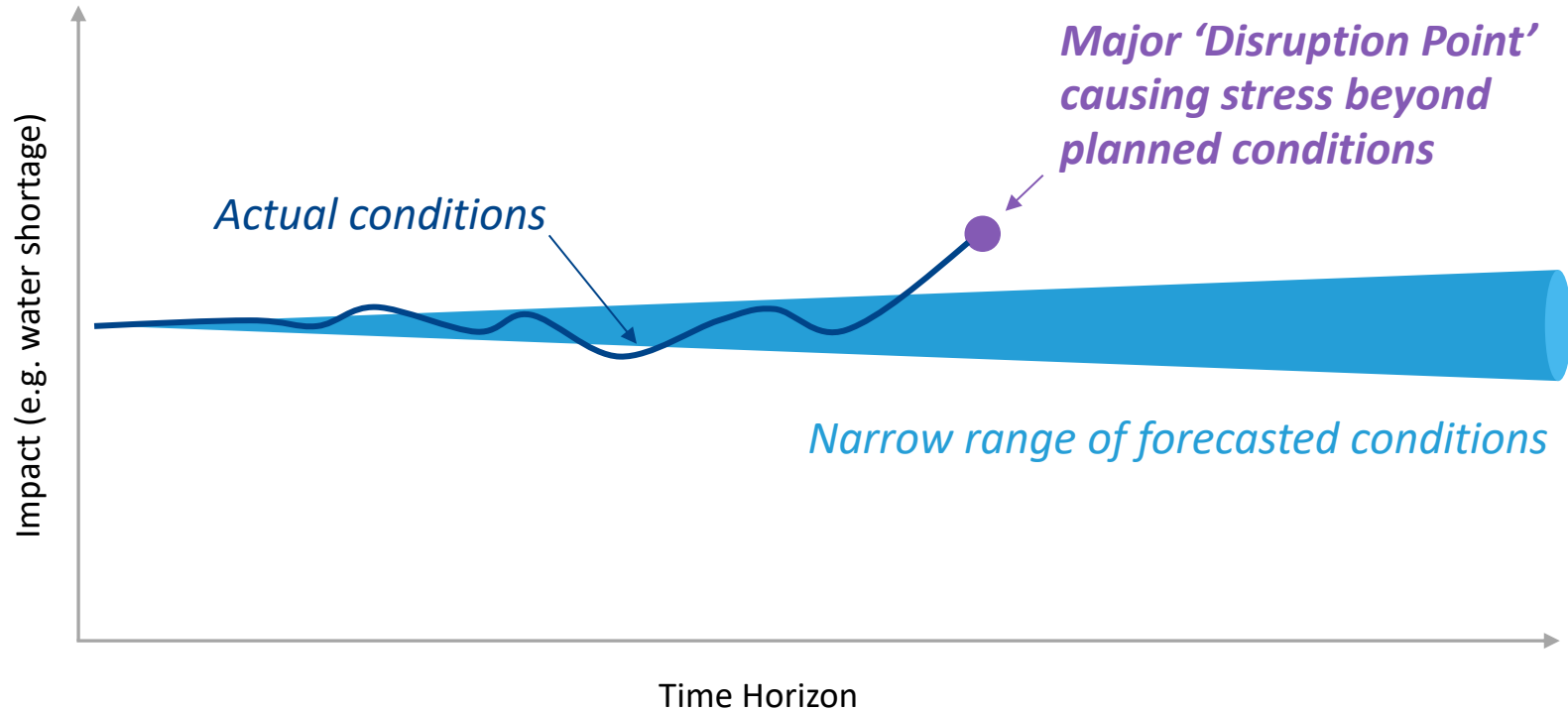
Why Do We Need Better Planning?

- ▶ As utility managers, you have to plan for the future
- ▶ But we all know the future is uncertain
- ▶ Given the time and expense to plan for critical infrastructure, it is essential to account for uncertainty

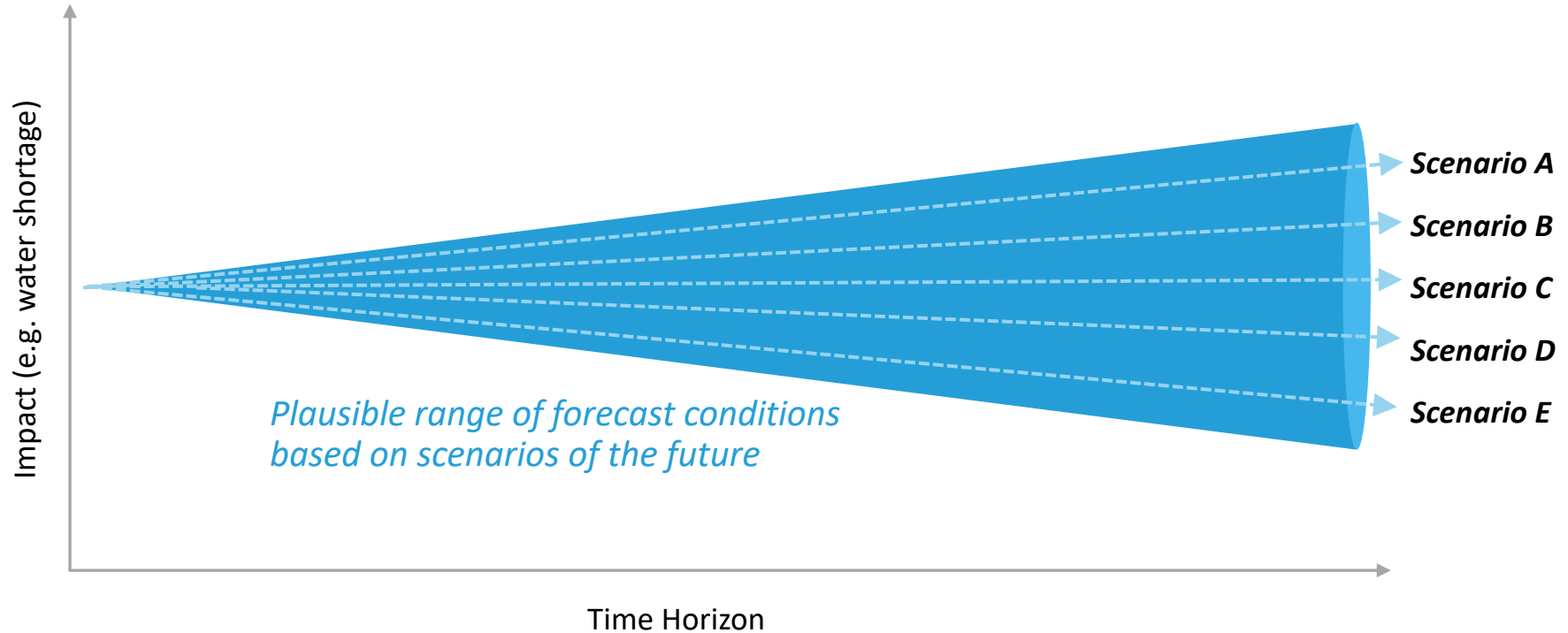
Current Water Planning Paradigm



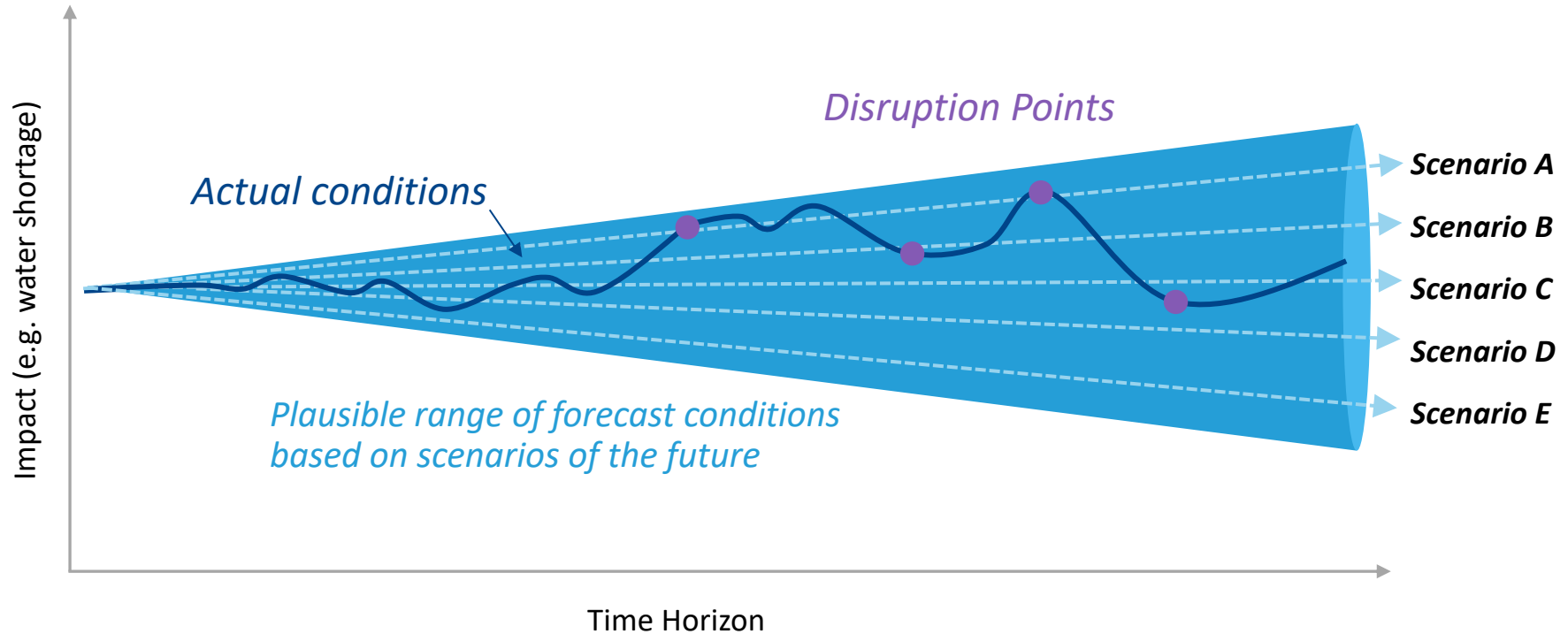
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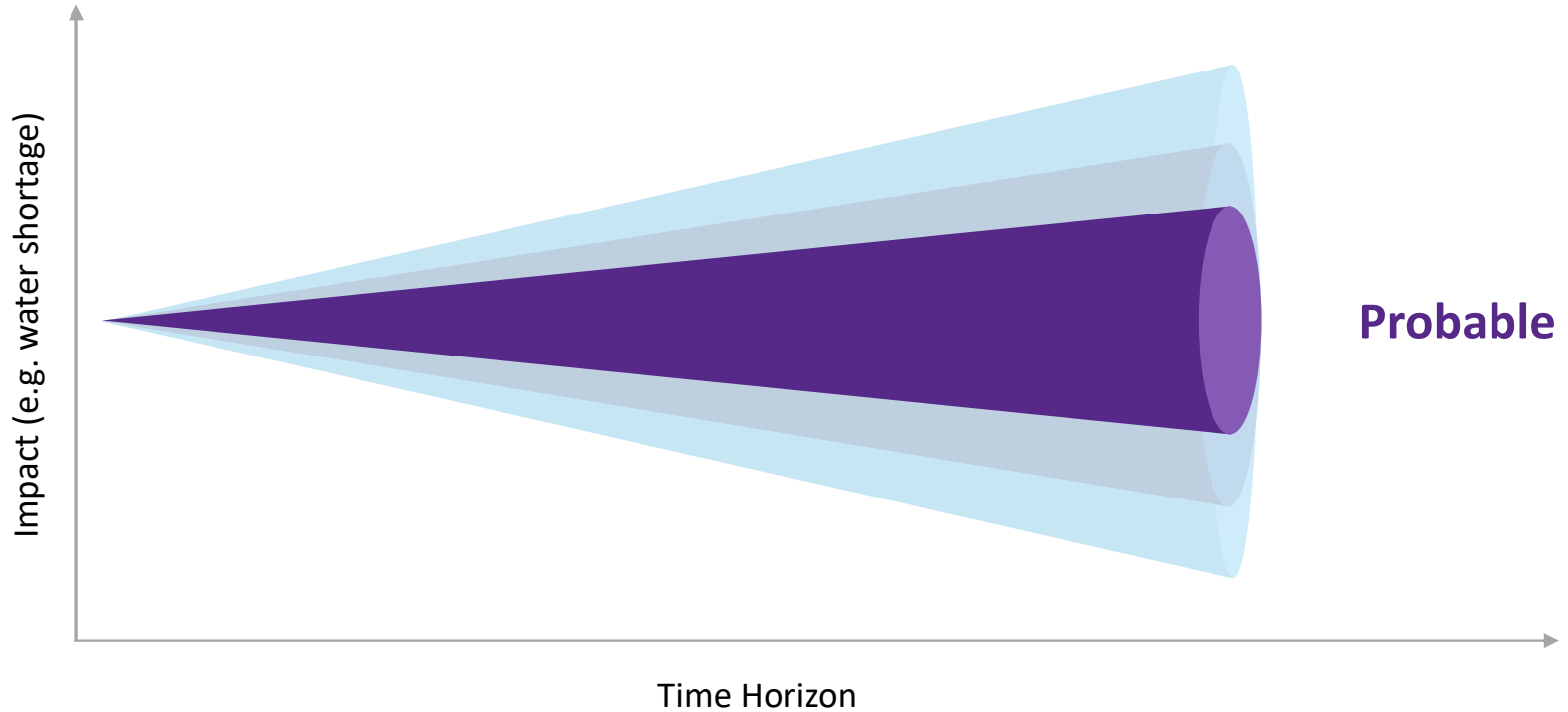
Scenario Planning



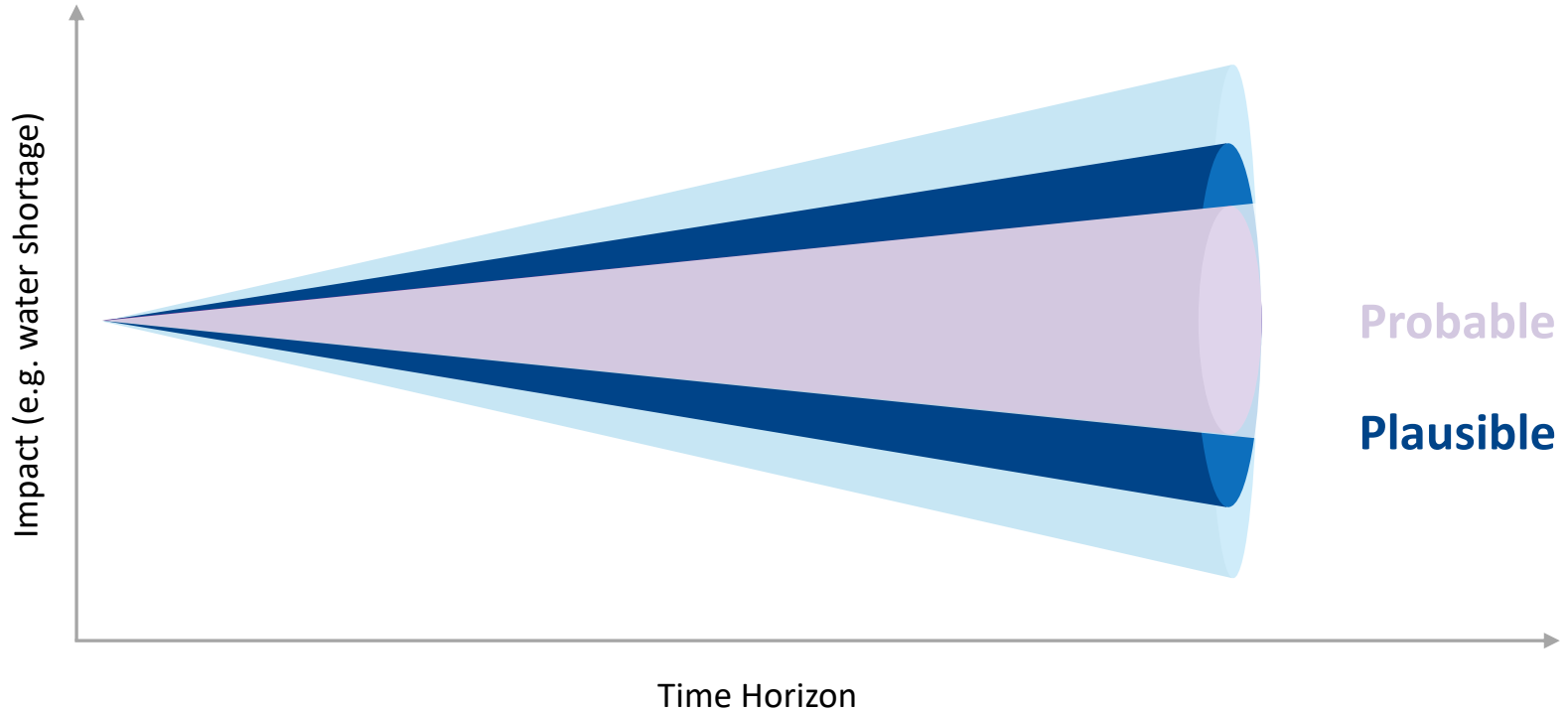
Scenario Planning



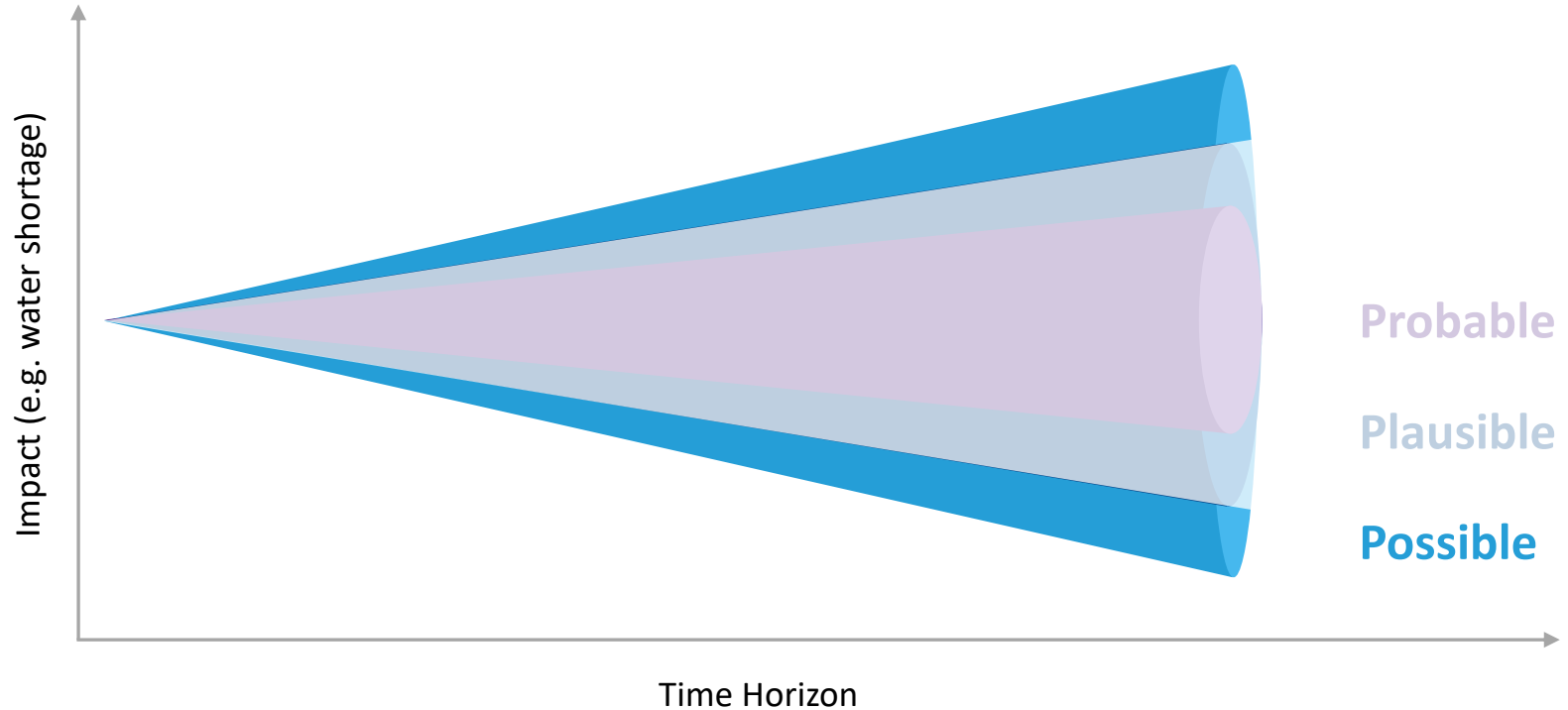
Scenario Planning in Practice



Scenario Planning in Practice



Scenario Planning in Practice



A photograph of a wooden boat, possibly a rowing boat, resting on a dry, cracked lake bed. The boat is positioned diagonally in the lower right foreground. The ground is dark and heavily cracked, indicating extreme dryness. In the background, a range of mountains is visible under a clear blue sky. The overall scene conveys a sense of desolation and the impact of climate change.

The Five Steps of Scenario Planning

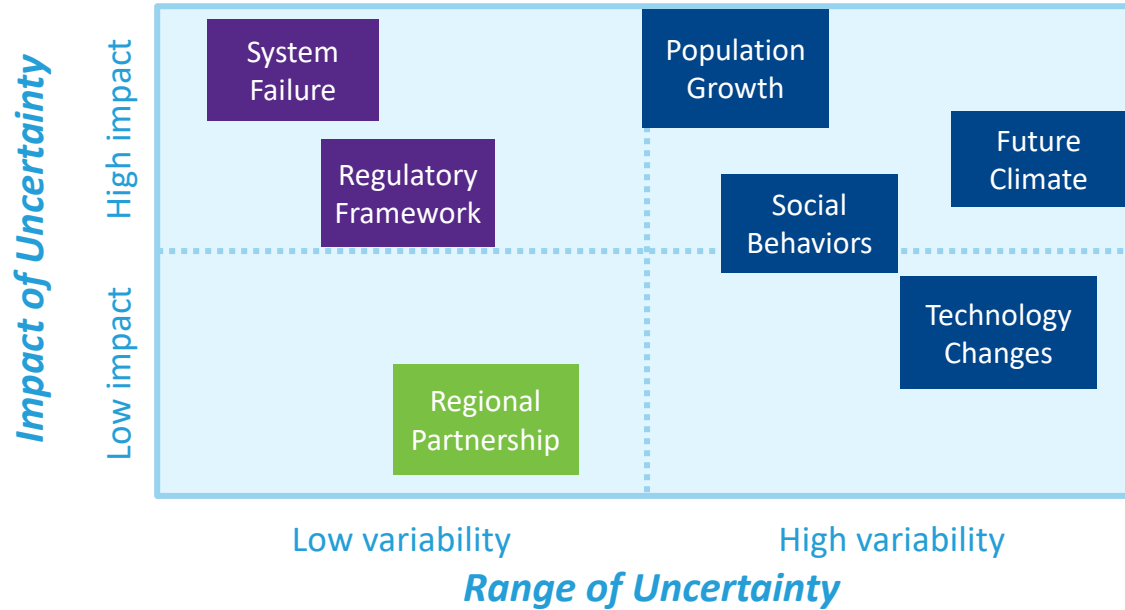
STEP 1

Assess Major Uncertainties



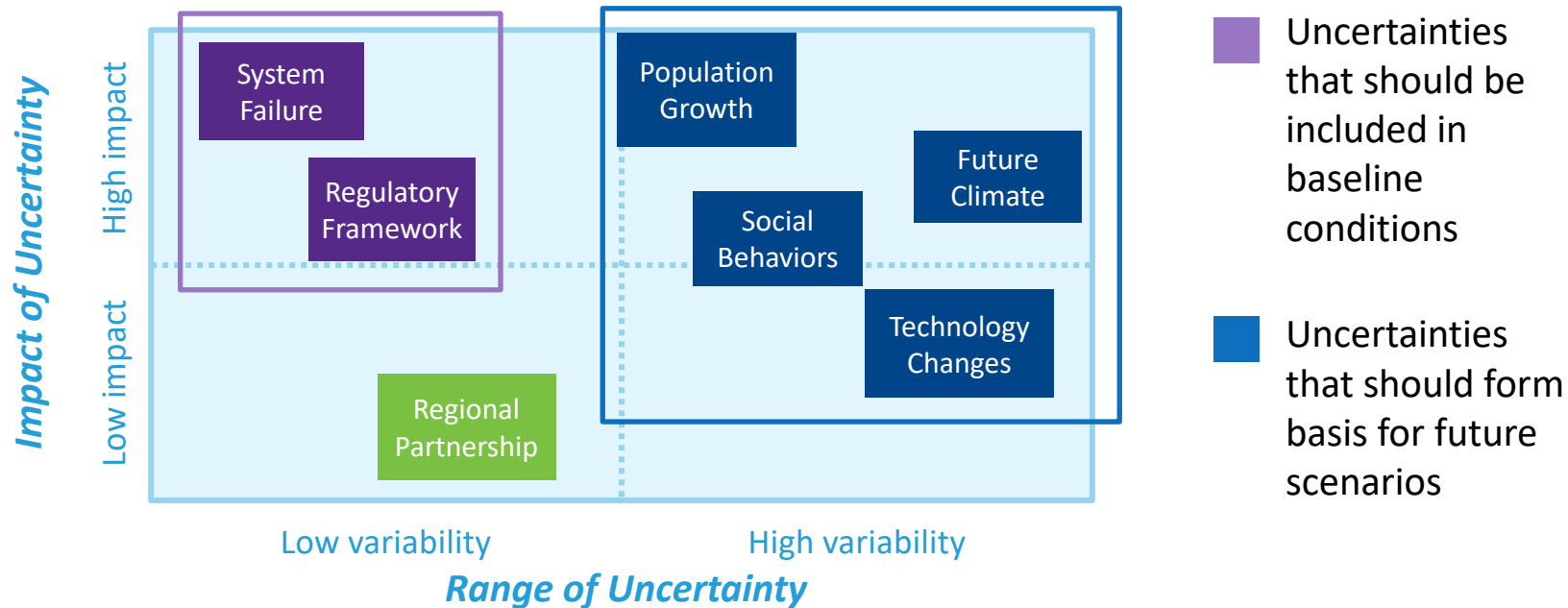
STEP 2

Select Most Important Uncertainties



STEP 2

Select Most Important Uncertainties



STEP 3

Develop Scenario Narratives

Scenario Name	Population Growth	Development Density	Future Climate	Social Behaviors	Regulatory Framework
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STEP 3

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Weak Economy	Low	Low	Warmer/wetter	Sustainability attitudes erode	Less stringent

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Hot Growth	High	Medium	Hot/dry	Current sustainability attitudes	More stringent

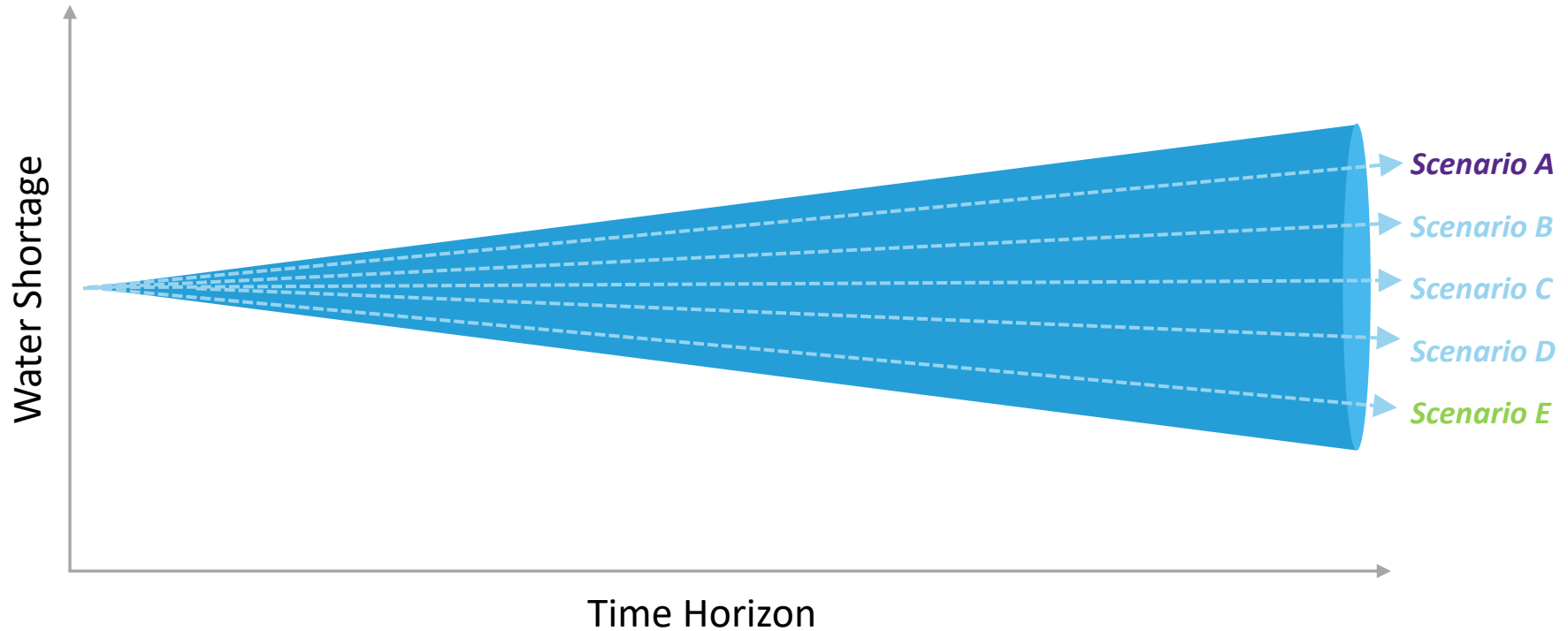
STEP 3

Develop Scenario Narratives

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Hot Growth	High	Medium	Hot/dry	Current sustainability attitudes	More stringent
Adaptive Innovation	High	High	Hot/dry	More favorable sustainability attitudes	Adaptive

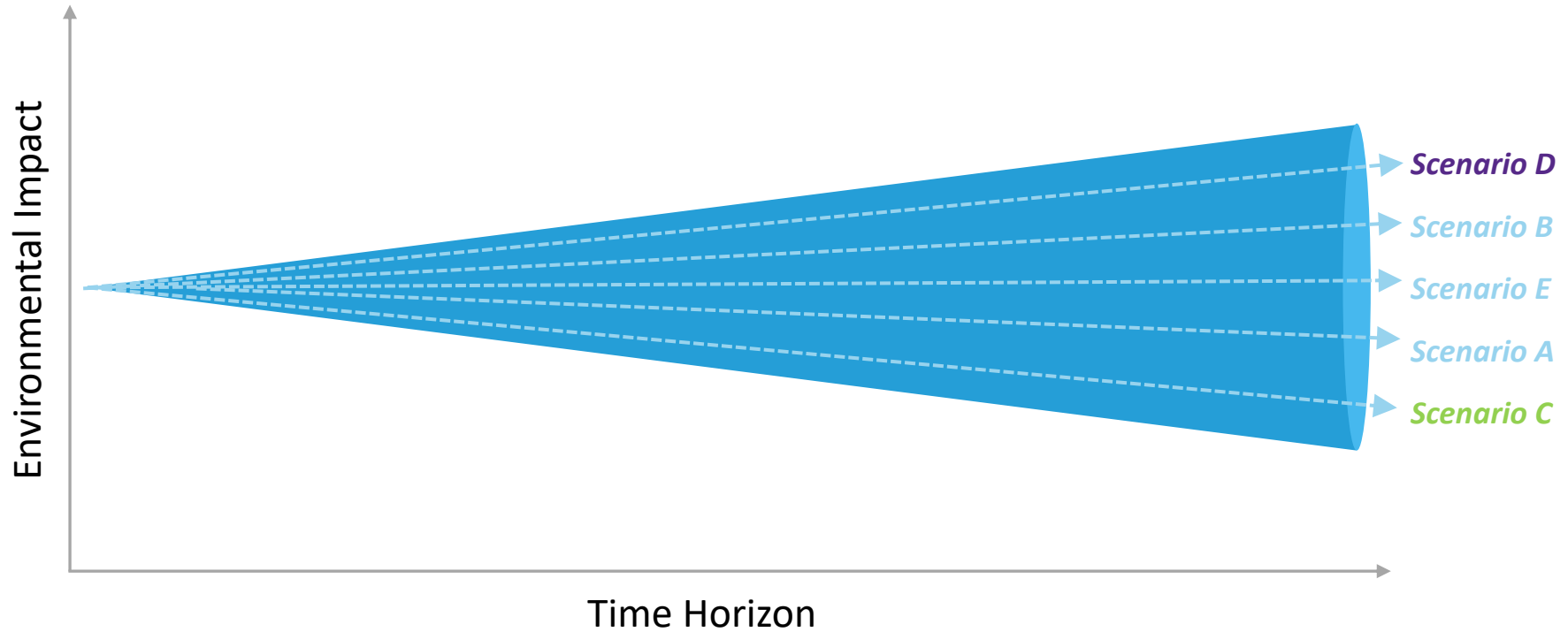
STEP 4

Analyze Impact of Scenarios




STEP 4

Analyze Impact of Scenarios



STEP 5

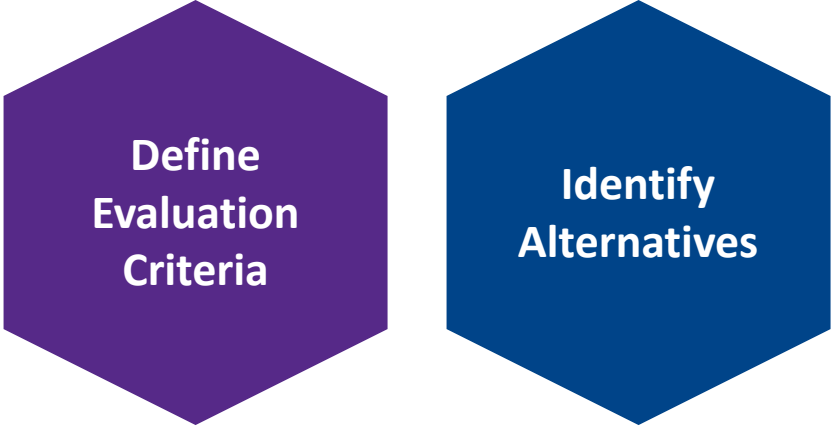
Test Alternatives



**Define
Evaluation
Criteria**

STEP 5

Test Alternatives




**Define
Evaluation
Criteria**

**Identify
Alternatives**

STEP 5

Test Alternatives



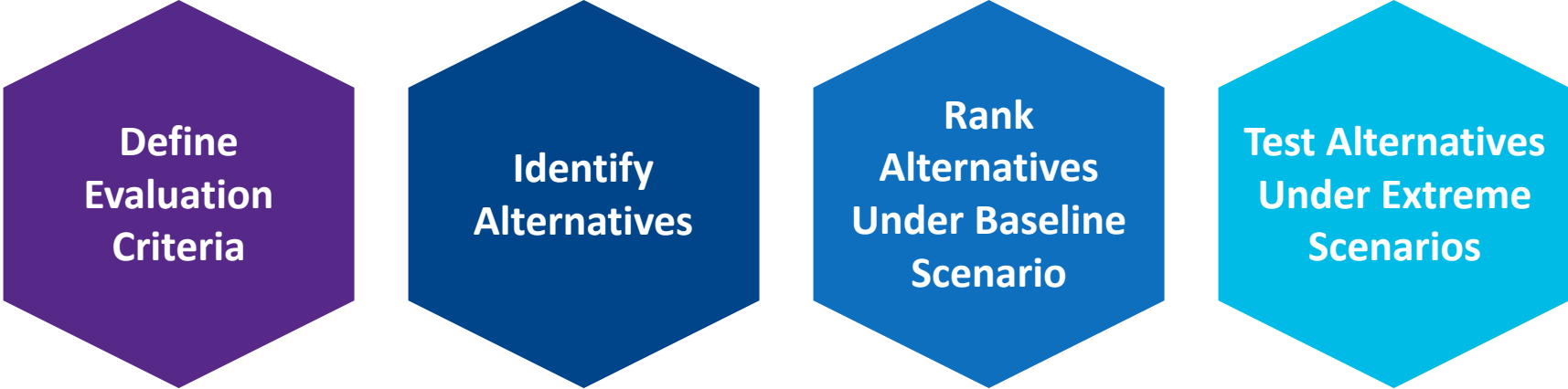
**Define
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**Identify
Alternatives**

**Rank
Alternatives
Under Baseline
Scenario**

STEP 5

Test Alternatives



**Define
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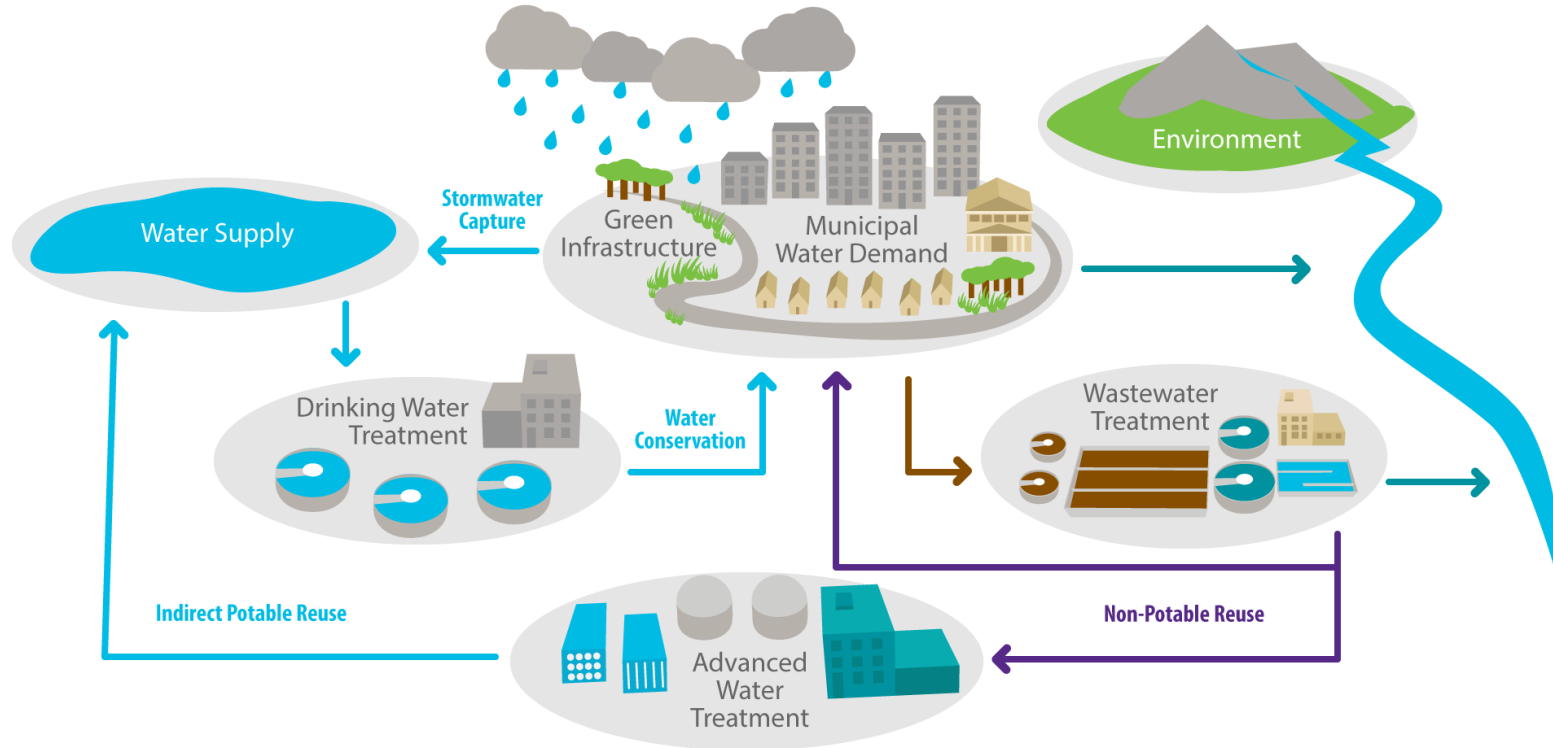
**Rank
Alternatives
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**Test Alternatives
Under Extreme
Scenarios**

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Tools Used in Scenario Planning

Integrated Perspective



Traditional Models vs Systems Models

Traditional Water Planning Models

- ▶ Single-focused in capability (e.g., water distribution, or groundwater)
- ▶ Output limited to flows, or sometimes flow and cost
- ▶ Typically not user friendly
- ▶ Runtimes are longer, interim results not possible, and not well-suited for rapid testing of scenarios

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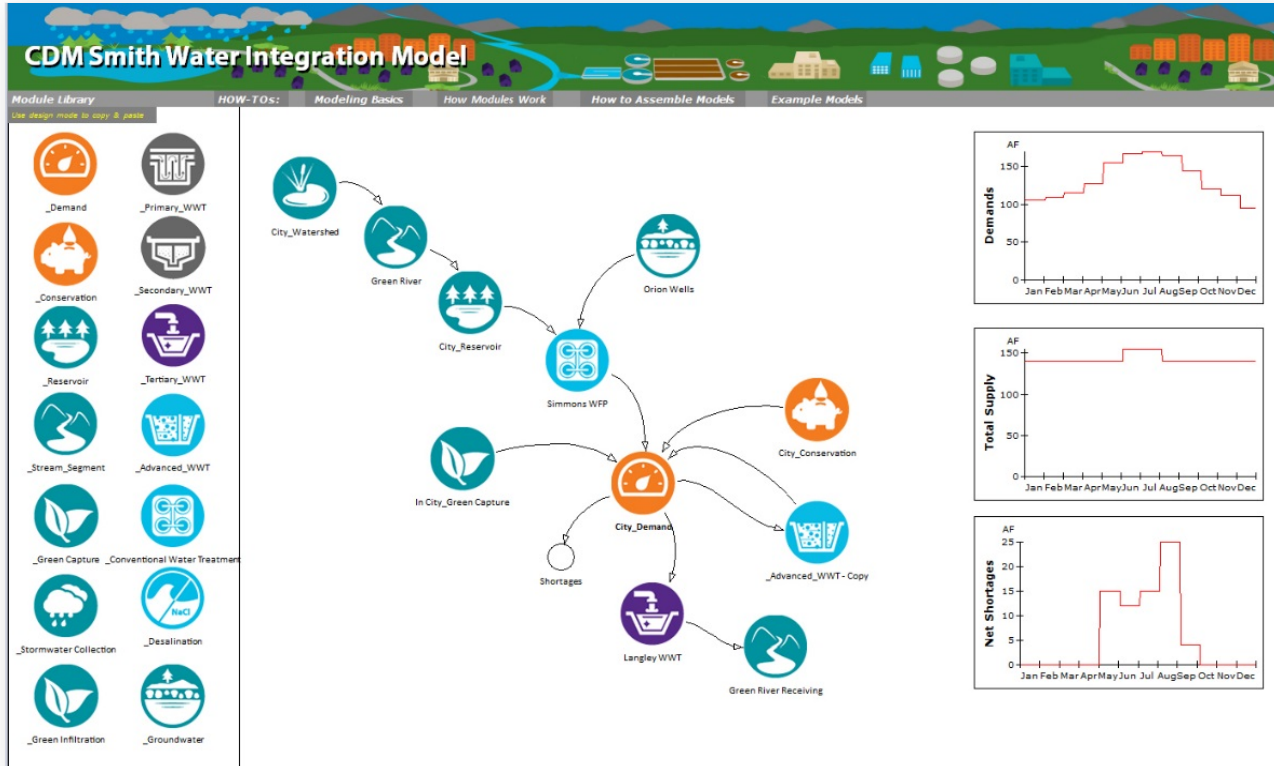
Systems Planning Models

- ▶ Simulates multiple systems (water, wastewater, stormwater) at same time
- ▶ Can output metrics on flows, water quality, cost, and energy
- ▶ User friendly, menu-driven
- ▶ Runtimes are seconds and minutes for monthly simulations, allowing for rapid testing of scenarios

Variety of Systems Models Readily Available



Systems Models: More Intuitive Programming









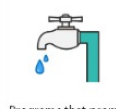





Systems Model: User Friendly Interface

Project Explorer

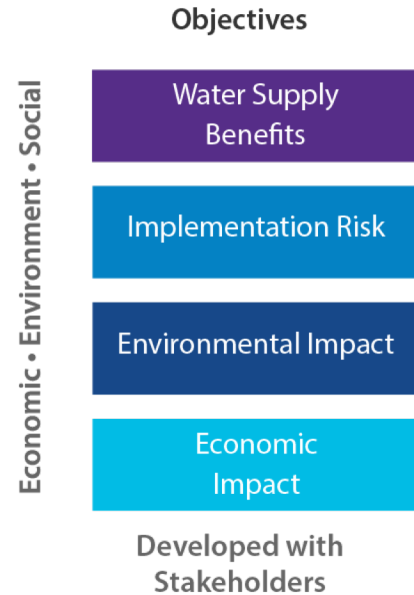
- Project 'Simulat...
- Component 1
 - Simulati...
 - Equati...
 - Conne...
 - Analysi...
 - Events
 - Private ...
 - Share...
 - Local Ran...
 - Local Units
 - Runs
 - Global Ranges
 - Global Units

CDM Smith Water Integration Model

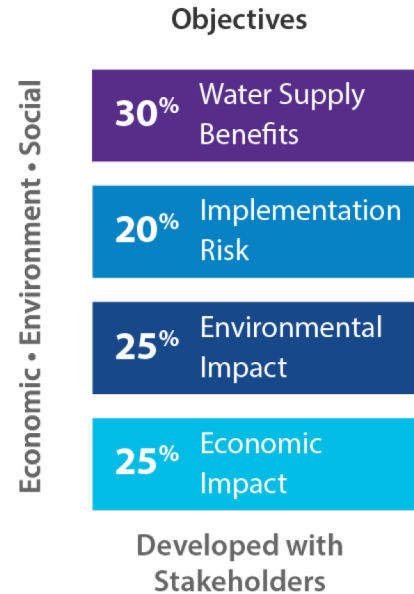
SCENARIO MANAGER

<p>Population Growth</p>  <p> <input type="radio"/> Low Growth <input type="radio"/> Medium Growth <input checked="" type="radio"/> High Growth </p> <p>Level of growth among water customers.</p>	<p>Weather</p>  <p> <input type="radio"/> Mild-Normal <input type="radio"/> Warm <input type="radio"/> Hot <input checked="" type="radio"/> Very Hot </p> <p>Temperature affects both demands and supply.</p>	<p>Hydrology/Climate Change</p>  <p> <input type="radio"/> Wet <input type="radio"/> Normal <input type="radio"/> Dry <input checked="" type="radio"/> Very Dry </p> <p>Level of drought now and in future.</p>	<p>Land Use/Density</p>  <p> <input type="radio"/> Low <input checked="" type="radio"/> Moderate <input type="radio"/> High </p> <p>Increases in land use density increases demands.</p>
<p>Agricultural Demand</p>  <p> <input type="radio"/> Slight Demand Decrease <input type="radio"/> Slight Demand Increase <input checked="" type="radio"/> Large Demand Increase </p> <p>Accounts for decrease in irrigated acres due to urbanization, ag exports and demands, and ags ability to compete with urban areas for water</p>	<p>Energy</p>  <p> <input type="radio"/> Low <input checked="" type="radio"/> Moderate <input type="radio"/> High </p> <p>Energy used in water production, treatment, and delivery</p>	<p>Water Efficiency</p>  <p> <input type="radio"/> 3.0 <input checked="" type="radio"/> 4.0 <input type="radio"/> 5.0 </p> <p>Programs that promote water efficiency, e.g. active conservation. Input represents a percent decrease in future demand.</p>	<p>Supply Availability/Water Rights</p>  <p> <input type="radio"/> Low <input checked="" type="radio"/> Moderate <input type="radio"/> High </p> <p>Supply availability often depends on user's water rights.</p>
<p>Societal/Environmental</p>  <p> <input checked="" type="checkbox"/> Watershed Protection <input checked="" type="checkbox"/> Supply Equity </p> <p>Programs that support societal and environmental awareness: full use of resources, equity, stream protection</p>	<p>Regulatory Constraints</p>  <p> <input type="radio"/> Low <input checked="" type="radio"/> Moderate <input type="radio"/> High </p> <p>Regulatory constraints can affect the availability of water supply options and the timing of supply needs.</p>	<p>Water Quality</p>  <p> <input type="radio"/> Low <input checked="" type="radio"/> Moderate <input type="radio"/> High </p> <p>This option sets water general quality goals through system. The more stringent, the more limiting in terms of sources used and expensive in terms of treatment.</p>	<p>Technology Advancements</p>  <p> <input type="radio"/> Low <input checked="" type="radio"/> Moderate <input type="radio"/> High </p> <p>Technological advancements can help an agency save money and reduce water loss.</p>

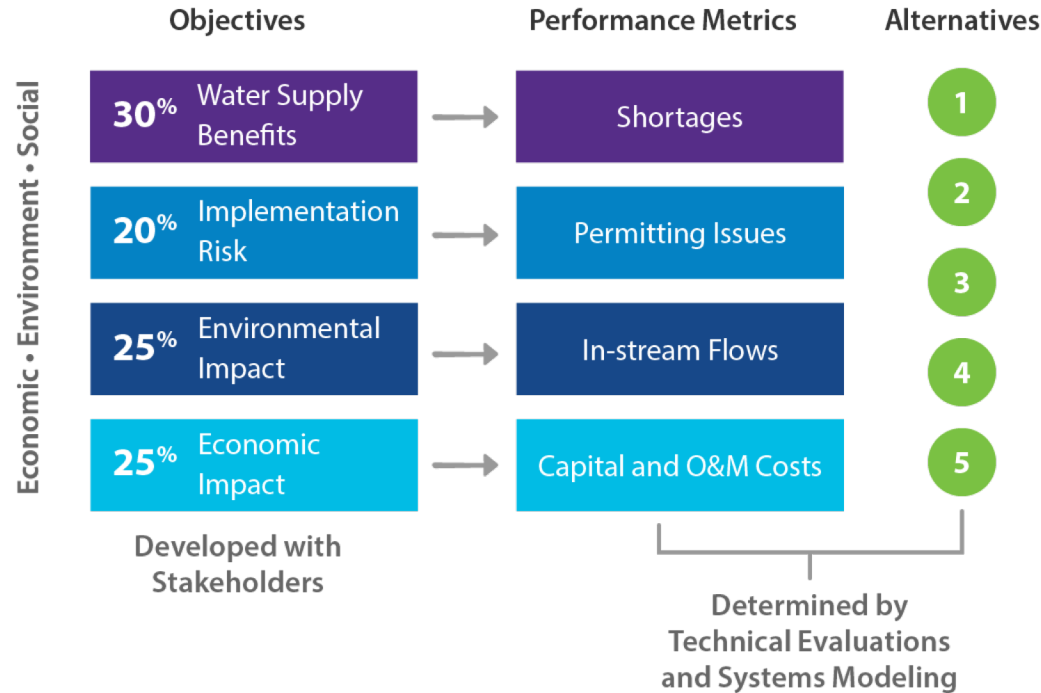
Multi-Criteria Decision Analysis (MCDA)



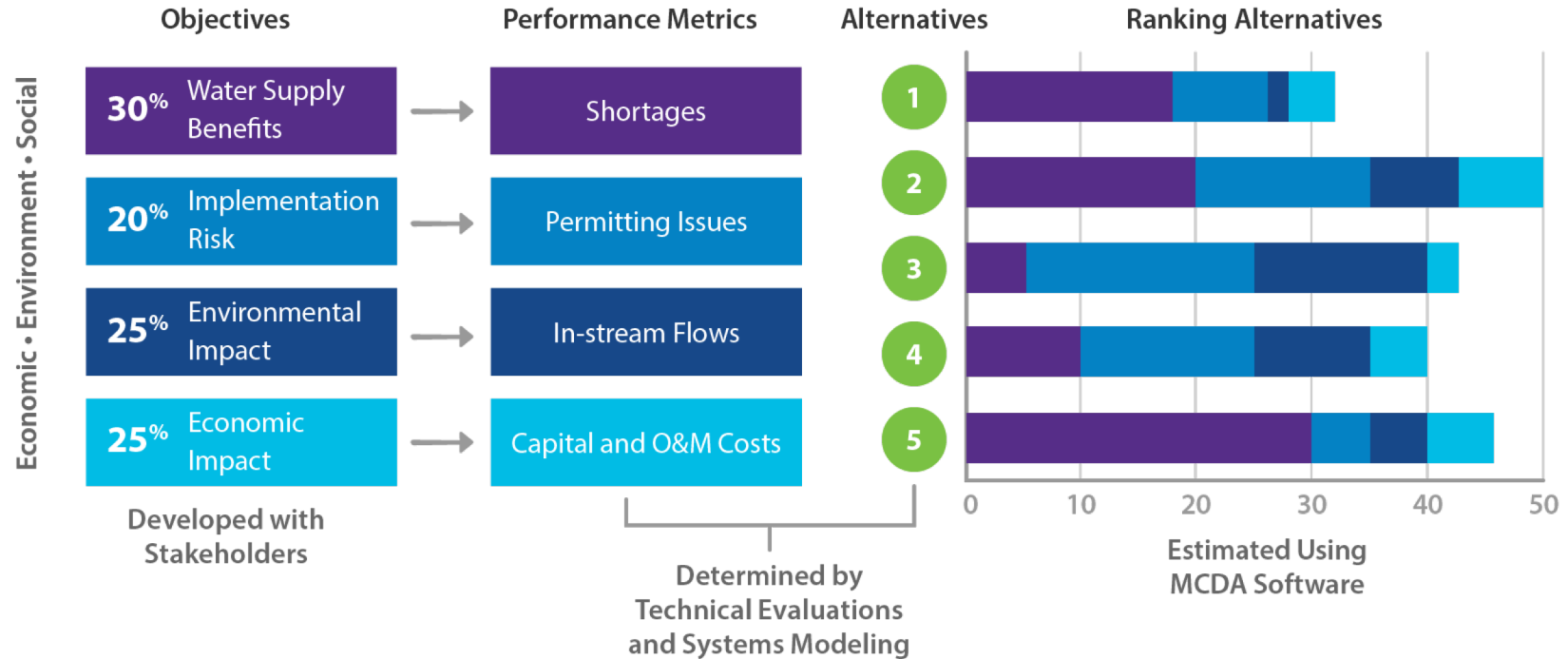
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Multi-Criteria Decision Analysis (MCDA)





CASE STUDY

Metro Vancouver

Comprehensive Water System Plan

Comprehensive Regional Water System Plan

MV Overview

- ▶ Federation comprised of 23 local government jurisdictions
- ▶ Provides regional planning and serves as regional provider of water and wastewater services
- ▶ Current population 2.5 million
- ▶ All water supplied from 3 main surface reservoirs

Challenges

- ▶ Fast-growing service area
- ▶ Climate change is reducing snowpack and changing monthly patterns of inflows to surface reservoirs
- ▶ Area is at risk to large seismic events
- ▶ Uncertainties in growth, future climate and technologies

Comprehensive Regional Water System Plan

Purpose of Plan

- ▶ Forecast water demands
- ▶ Conceptualize water supply alternatives
- ▶ Define planning scenarios to account for uncertainties, such as climate, growth, regulations
- ▶ Conduct resiliency assessment for droughts, flooding and seismic risks
- ▶ Evaluate and rank alternatives against multiple criteria and planning scenarios
- ▶ Develop an adaptive strategy for investments for the next 100 years

Planning Scenarios



**Limited
Stressed
Conditions**

**Moderately
Stressed
Conditions**

**Significantly
Stressed
Conditions**

Planning Scenarios



Limited Stressed Conditions

Regional Growth

10% lower-than-baseline
projection

Future Climate

Warmer annual temperatures,
less summer precipitation

Technology/Regulations

Moderate implementation of
residential water metering


Water Use Efficiency

Current Levels

Drought Actions

Target Level 3
restrictions in water use no
more than 1 in 20 years

Planning Scenarios



Moderately Stressed Conditions

Regional Growth	Baseline Projection
Future Climate	Hotter annual temperatures, dry summer precipitation
Technology/Regulations	Moderate implementation of residential water metering
Water Use Efficiency	Moderate Levels
Drought Actions	Target Level 3 restrictions in water use no more than 1 in 20 years

Planning Scenarios



Significantly Stressed Conditions

Regional Growth

15% greater-than-baseline,
Plus expansion of service area

Future Climate

Hotter annual temperatures,
dry summer precipitation

Technology/Regulations

Accelerated implementation of
residential water metering

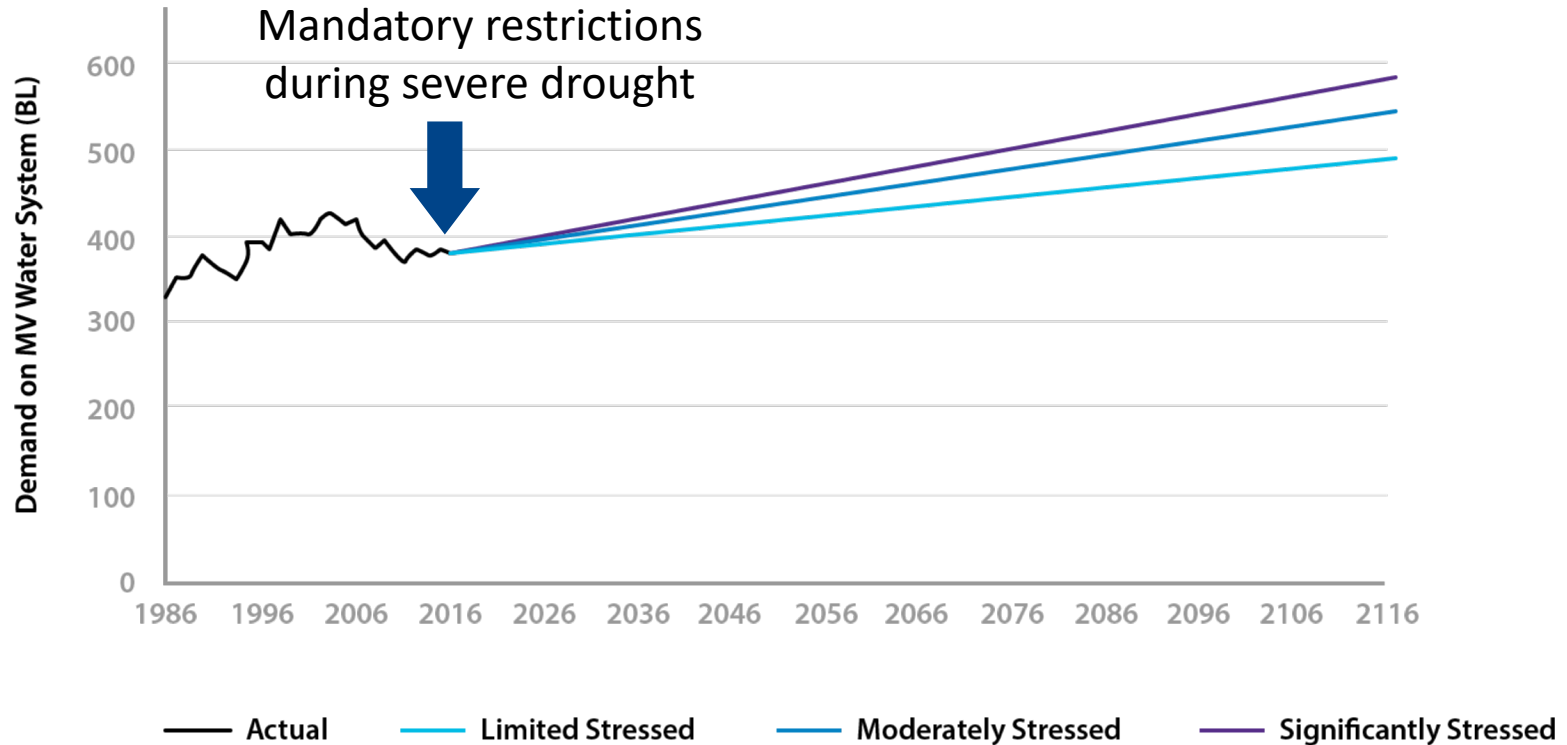
Water Use Efficiency

Highest Levels

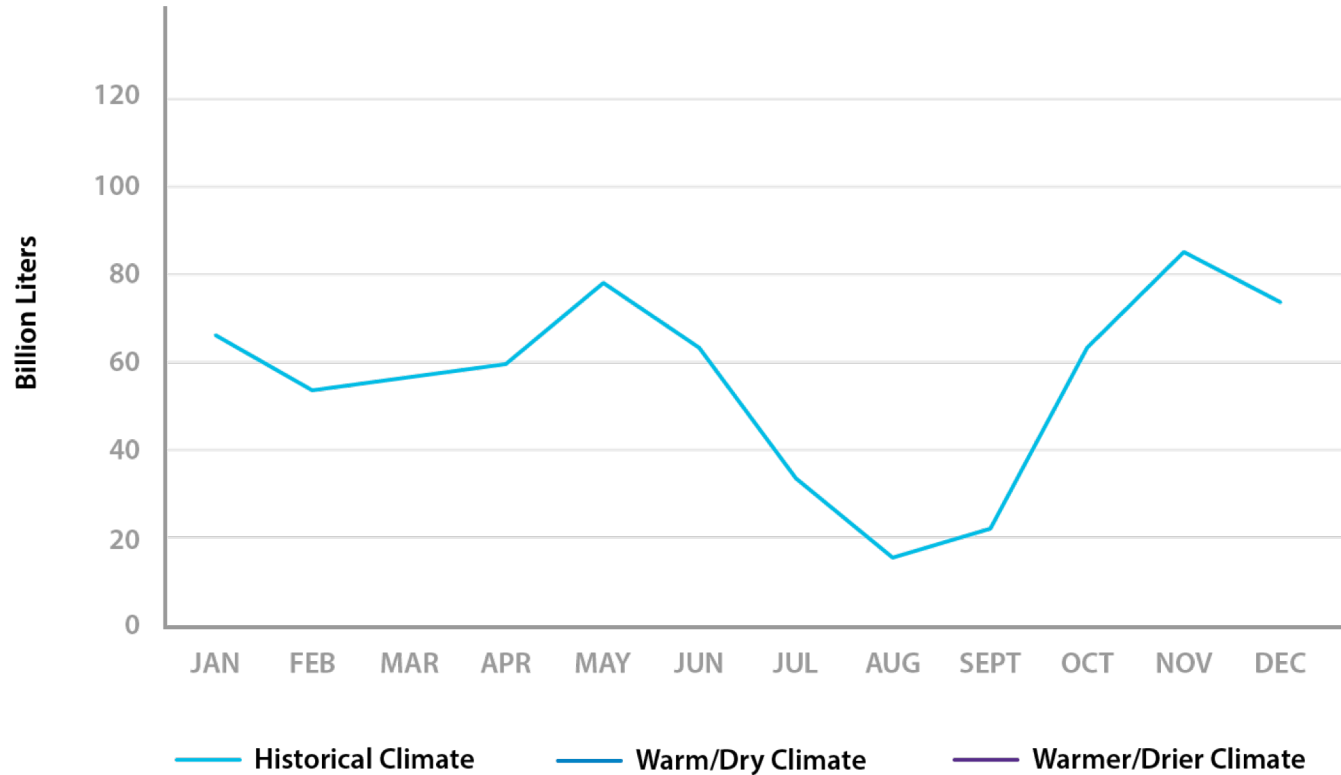
Drought Actions

Target Level 3
restrictions in water use no
more than 1 in 15 years

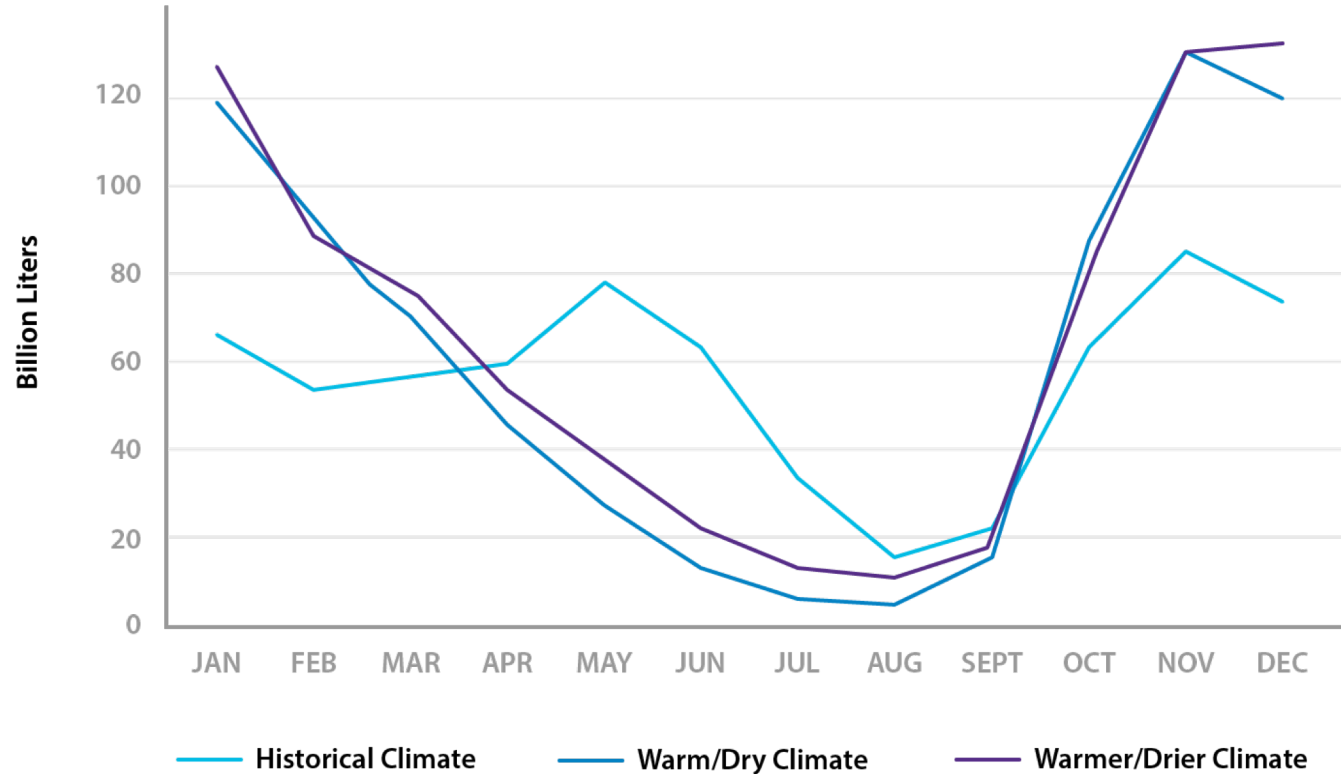
Water Demand Forecast Under Demographic Scenarios



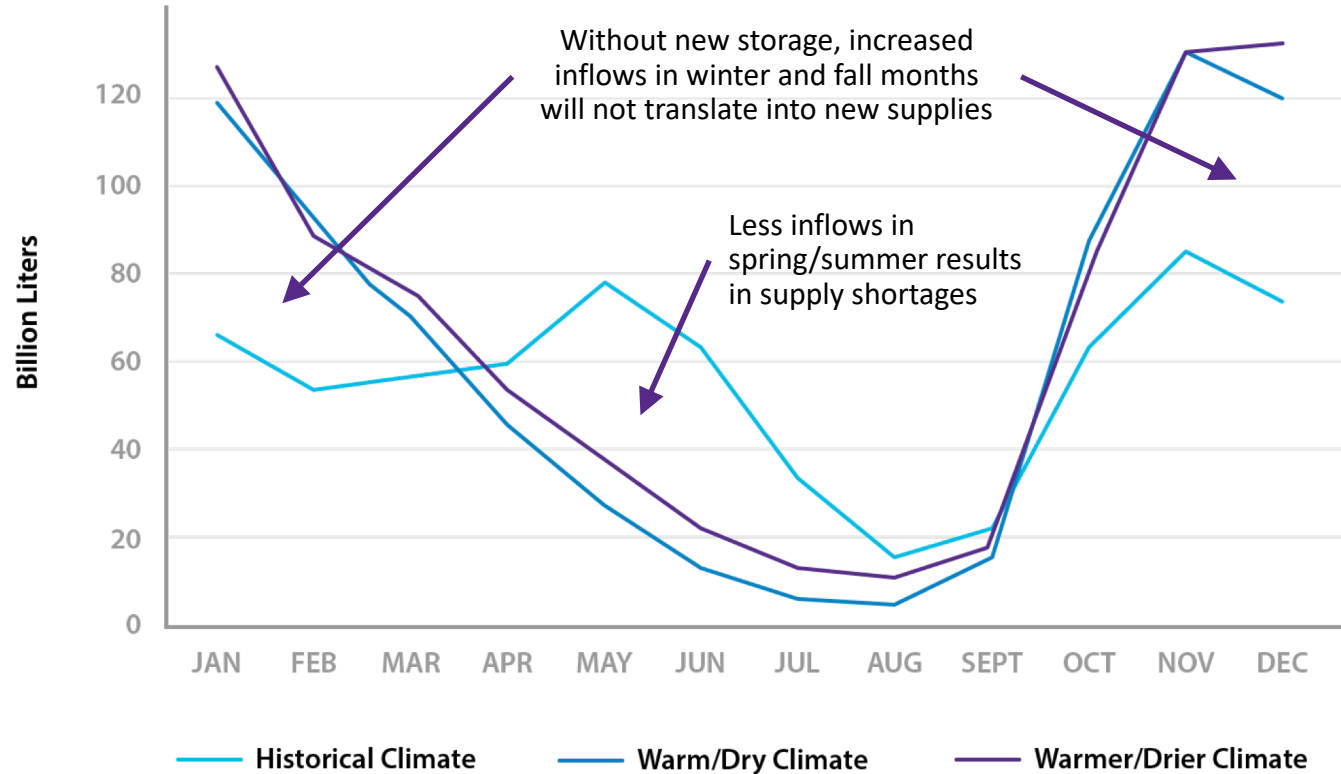
Supply Reservoir Inflows Under Climate Scenarios



Supply Reservoir Inflows Under Climate Scenarios

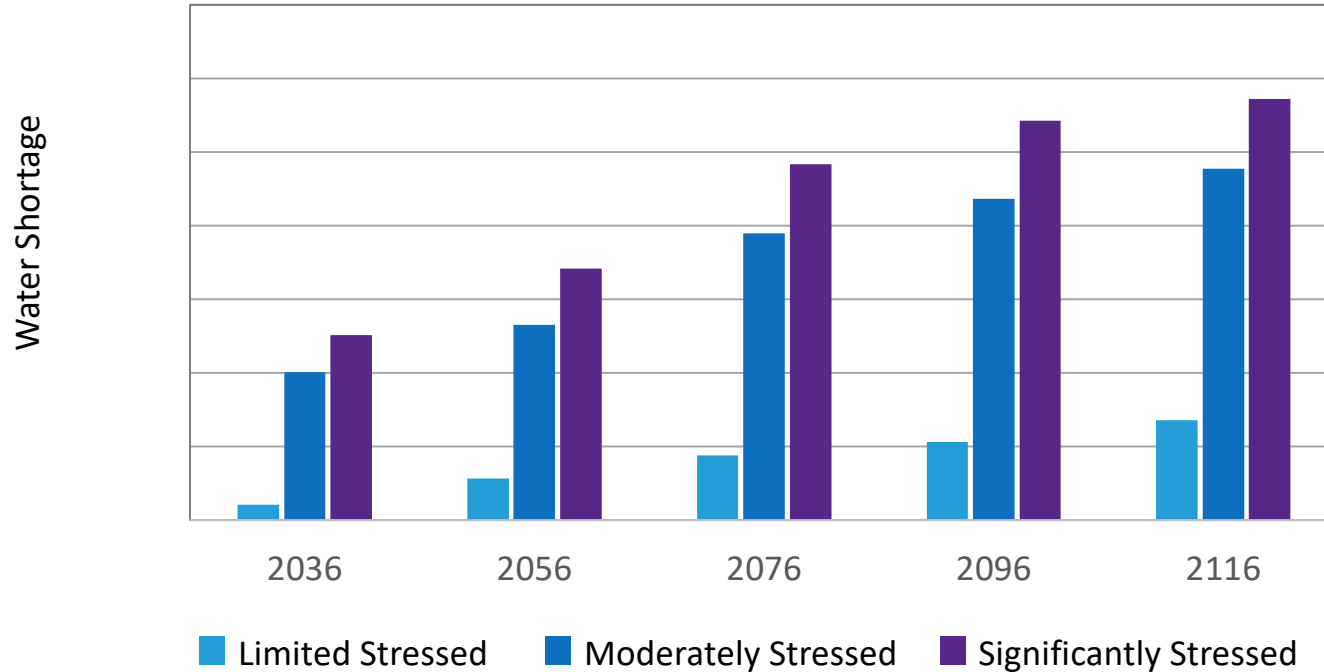


Supply Reservoir Inflows Under Climate Scenarios



Water Supply Gap Under Planning Scenarios

Maximum Shortage - No New Projects



Summary of Feasible Water Supply Options

Supply Option	Maximum Annual Supply	Resiliency Score*	Unit Cost (\$M/BL)	Implementation Score**
New Upper Watershed Dam 1	Large	3	\$2.5	4
New Upper Watershed Dam 2	Small	3	\$2.3	4
New Lower Watershed Dam	Medium	4	\$2.7	2
Raise Existing Dam	Large	4	\$2.2	5
Lake Intake – Large Project	Large	5	\$3.9	3
Lake Intake – Small Project	Medium	4	\$6.1	4
River Intake	Large	4	\$4.4	2
Out of Region Lake Intake	Large	2	\$7.2	1

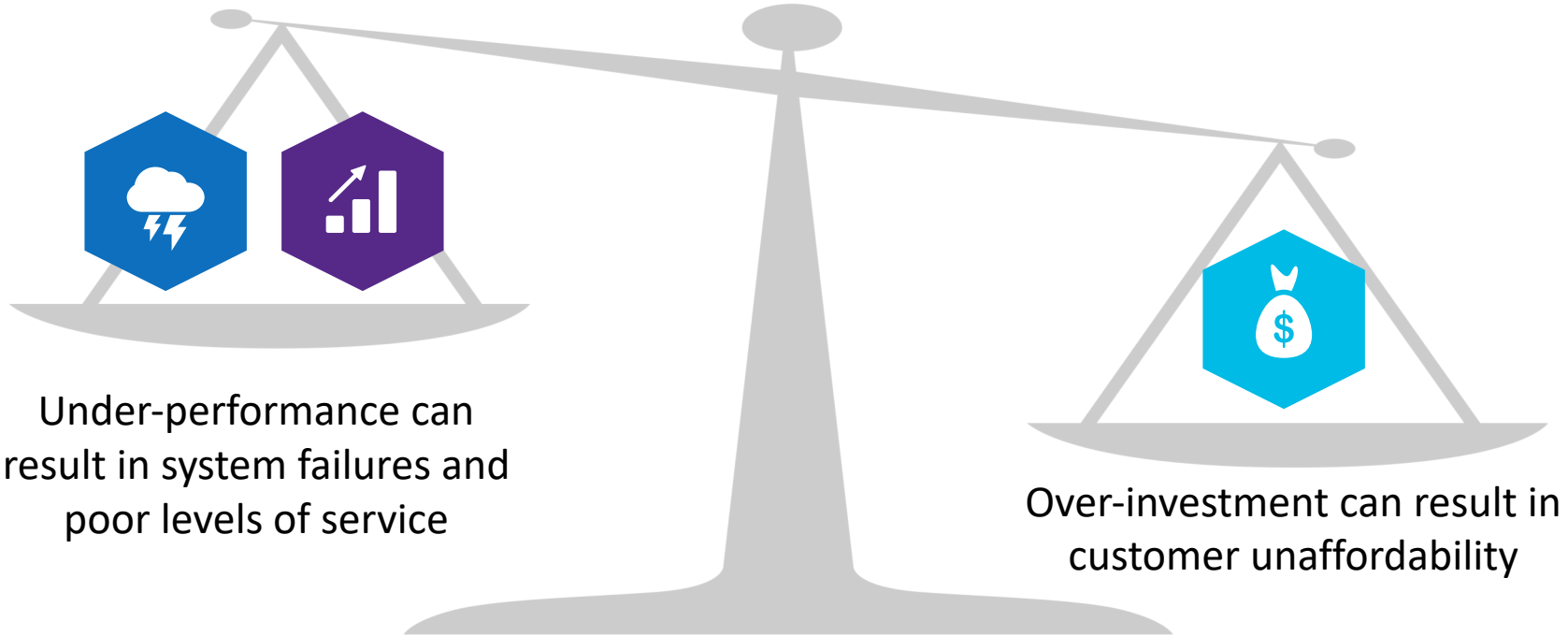
* Qualitative score from 1 to 5 (with 5 being best score) that measures resiliency against extreme climate, forest fires, seismic events and water quality degradation.

** Score from 1 to 5 (with 5 being best score) that measures implementation challenges such as permitting, land acquisition, public support, impacts to recreation

A photograph of a wooden boat, possibly a rowing boat, resting on a dry, cracked, and textured surface that appears to be a dried-up lake bed. The boat is dark brown and has several oars or poles inside it. In the background, there is a range of mountains under a clear blue sky. The overall scene conveys a sense of desolation and the end of a journey.

Where We Go From Here

Balancing Under-Performance & Over-Investment



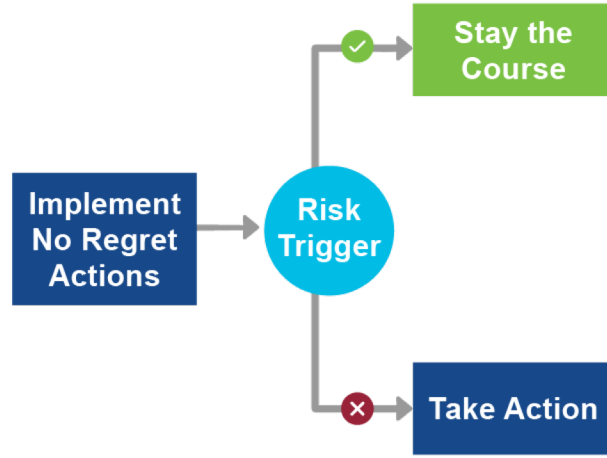
Adaptive Management

Implement
No Regret
Actions

TIME



Adaptive Management



Adaptive Management



TIME

Adaptive Management



Final Thoughts



Lessons Learned and Observations

- ▶ The future is uncertain and always will be

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- ▶ Scenario planning can be valuable in
 - ▶ Understanding the plausible range of future outcomes that can impact water systems
 - ▶ Developing a long-term strategy to mitigate such impacts

Lessons Learned and Observations

- ▶ The future is uncertain and always will be
- ▶ Uncertainty should not be an excuse not to plan
- ▶ Scenario planning can be valuable in
 - ▶ Understanding the plausible range of future outcomes that can impact water systems
 - ▶ Developing a long-term strategy to mitigate such impacts
- ▶ Adaptive management allows for incrementally phasing investments

Questions & Answers



Contact Information

Panelists



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Moderator



Andrew Beaton

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Thank You