Robust Decision Making in Metropolitan's IRP

Brandon Goshi
Metropolitan Water District

December 5, 2018

Overview

- Metropolitan and its planning scope
- Review of uncertainty planning for MWD
- Metropolitan's Robust Decision Making Framework
- Key findings from 2012 RDM analysis
- Re-tooling RDM with the 2015 IRP Update

Metropolitan Water District

Water Wholesaler

26 Members Agencies

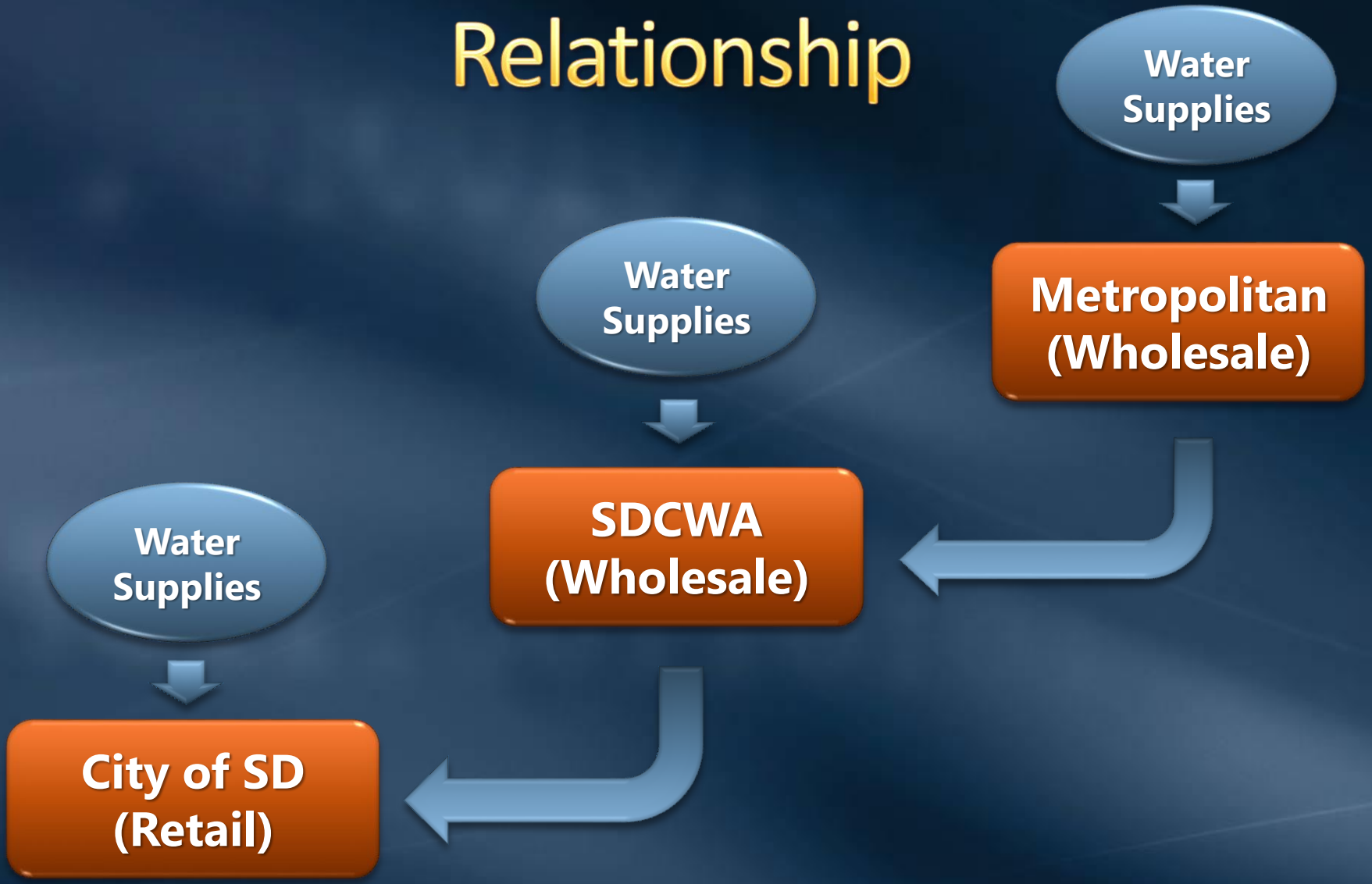
19 Million People

5,200 Square Miles

~4 MAF Annual Demand

- ½ Imported Supplies
- ½ Local Supplies

The Retail/Wholesale Water Supply Relationship



Sources of Water for Southern California

Metropolitan's Integrated Water Resources Strategy (IRP)

- Invest in a diversified supply mix
  - Stabilize imported supplies
  - Meet new demands with local resources and conservation

Review of Uncertainty

Recognizing Types of Uncertainty

There are known knowns; there are things we know we know. We also know there are known unknowns; that is to say we know there are some things we do not know. But there are also unknown unknowns – the ones we don't know we don't know.

~Donald Rumsfeld

Known Knowns

- Official Demographic projections
- Project parameters (online dates, capacity, yield)
- Historical weather outcomes
- Other

Known Unknowns

- Existing project loss/ yield reductions
- Changes in project parameters
- Regulatory changes
- Shifts in demographics and growth
- Economic boom and bust
- Climate change

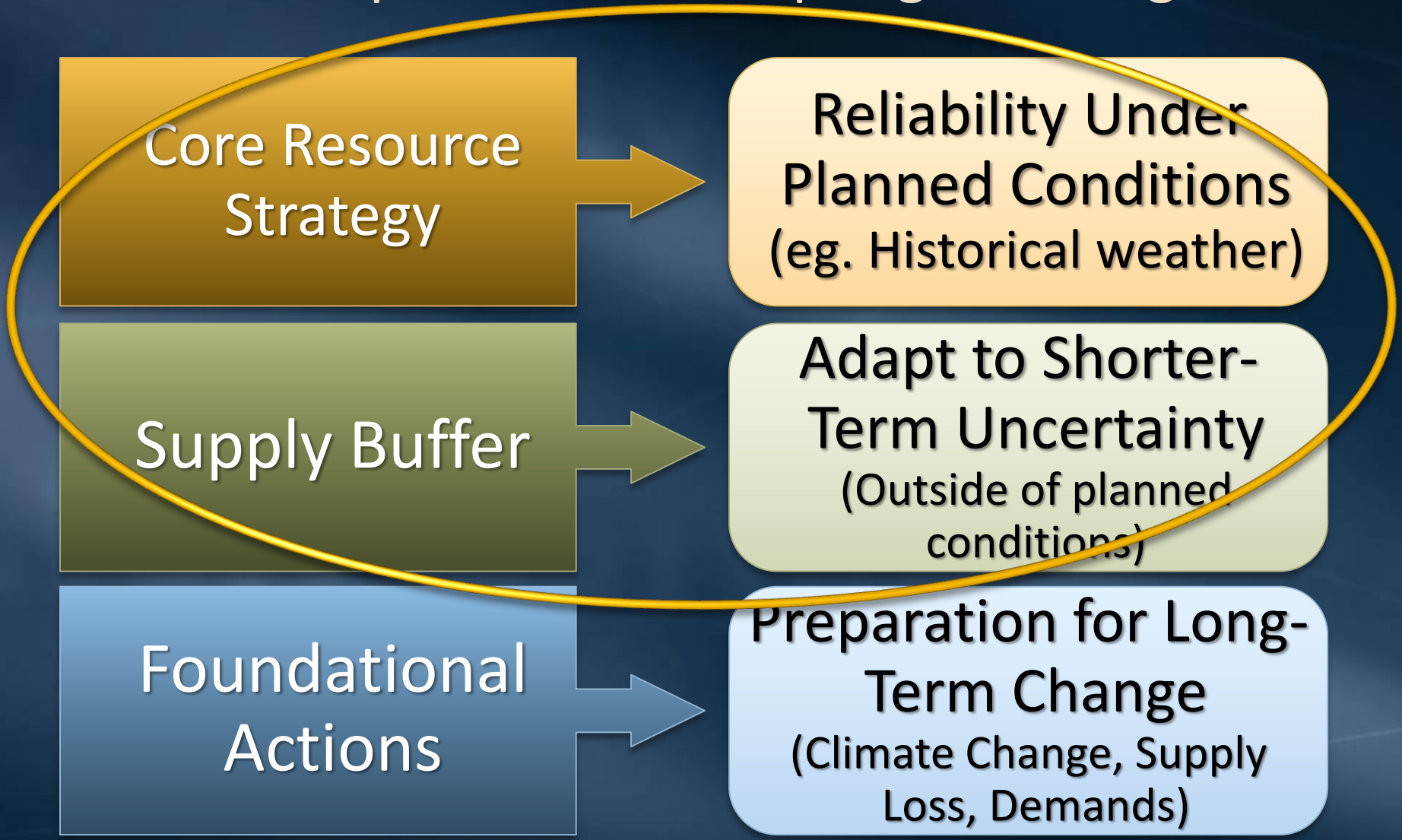
Unknown Unknowns

- I don’t know what these are and neither do you, because that’s the whole point of unknown unknowns!

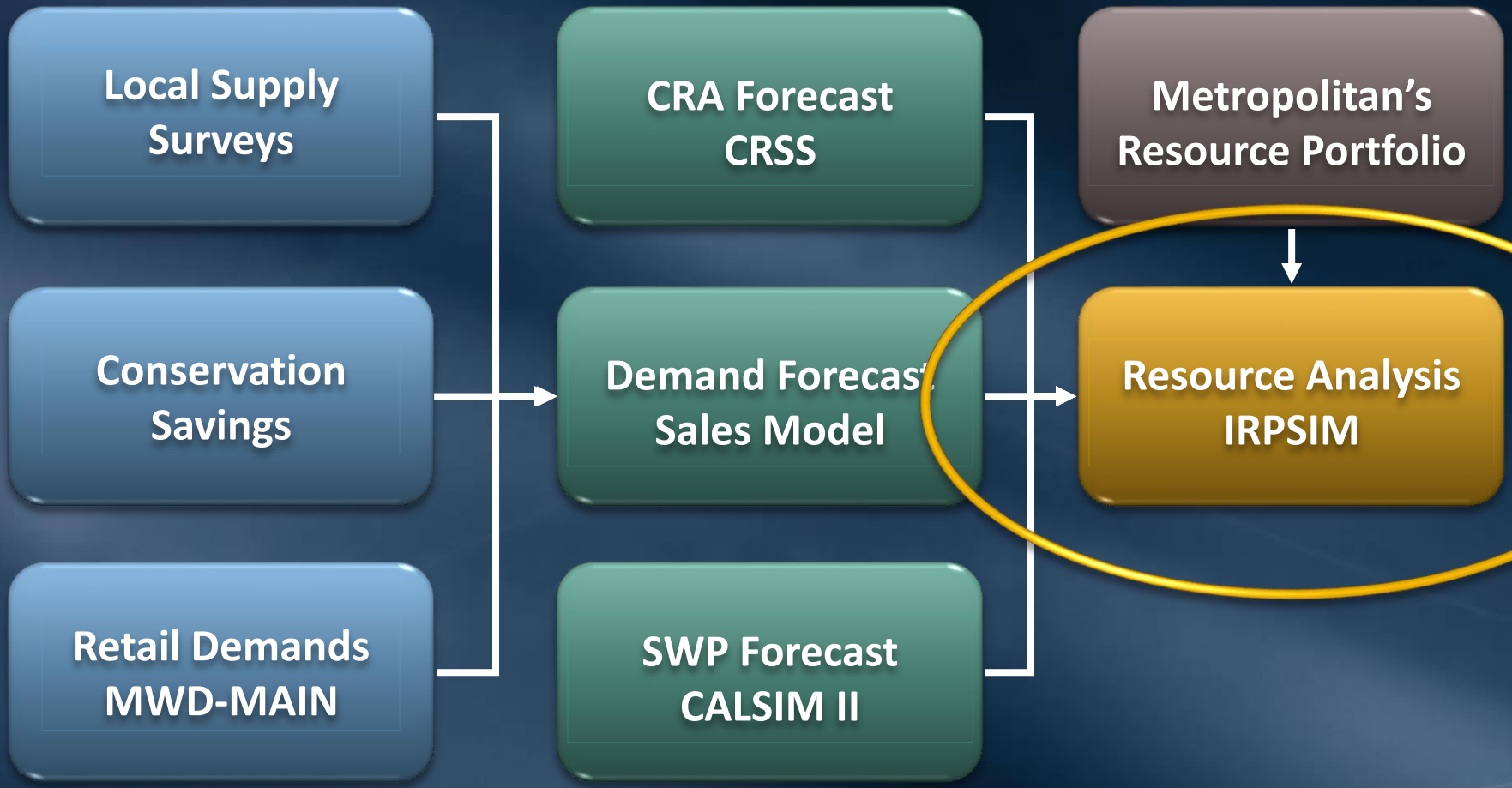
Overview of the IRP Robust Decision Making Process

IRP Adaptive Management Strategy

3 Components for Adapting to Change



Metropolitan's Planning Models



IRPSIM Summary

- Inputs
  - 30 Supply Sources and Programs
  - 10 Demand Categories
  - 20 Storage and Transfer Programs
  - 1000+ Supporting Variables
  - 24 Operational Stages
- Outputs
  - 50 Year Simulation
  - 83 Hydrologic Traces

50 Years x 83 Traces x 1000 Variables x 24 Stages
≈ 100 Million Calculations

Simulation Run Time… 8 seconds !

Incorporating Uncertainty

Using an Existing Model Framework

Defining Future Uncertainties
The Experimental Design

Factor	Range of Uncertainty
Demographic Changes	4 Scenarios: Balanced Growth, Baseline Growth, Periurban Growth, High Growth
Climate Conditions	12 Climate Scenarios: 6 GCMs x 2 Emissions Scenarios used by IPCC
Bay-Delta Conditions	3 Scenarios: No Delta Fix, Partial Delta Fix, Full Delta Fix
Local Resource Yields	±20% Variation in Groundwater, Recycling, Groundwater Recovery, Conservation
Project Implementation Timing	Delays: 0-10 years Desalination & Recycling, 0-20 years Conservation, 0-30 years Delta Fix

RDM Analytical Approach

- Analyzed +6,900 combinations of uncertainty
- Used “scenario discovery” to identify where IRP Resource Mix failed:
  - Net Balance
  - Total Storage
- Used statistical methods to determined common areas of vulnerability

Analytical Steps

1. Configure IRPSIM with “Core Resources Strategy and Buffer” of the IRP
2. Evaluate “Core Resources Strategy and Buffer” with Experimental Design
3. Identify when the IRP fails based on specified markers/thresholds
4. Identify factors that led to failure
5. Develop “signposts” for monitoring data associated with uncertainty factors

Key Findings from RDM

Summary of RDM Conclusions

- The IRP approach is vulnerable when two or more uncertainties turn out unfavorably
  - Example: High inland growth combined with an increasingly hot/dry climate
- Key uncertainties to “signpost” and monitor
  - Future Delta conditions
  - Demographic trends
  - Groundwater yields
  - Climate Conditions

Signposts for Monitoring

Demographics

- Growth Rates
- Areas of Growth
- Housing Type Trends
- Density Trends
- Employment

Bay-Delta

- Environmental Impacts
- Ecosystem Restoration
- New and Improved Facilities
- Operations

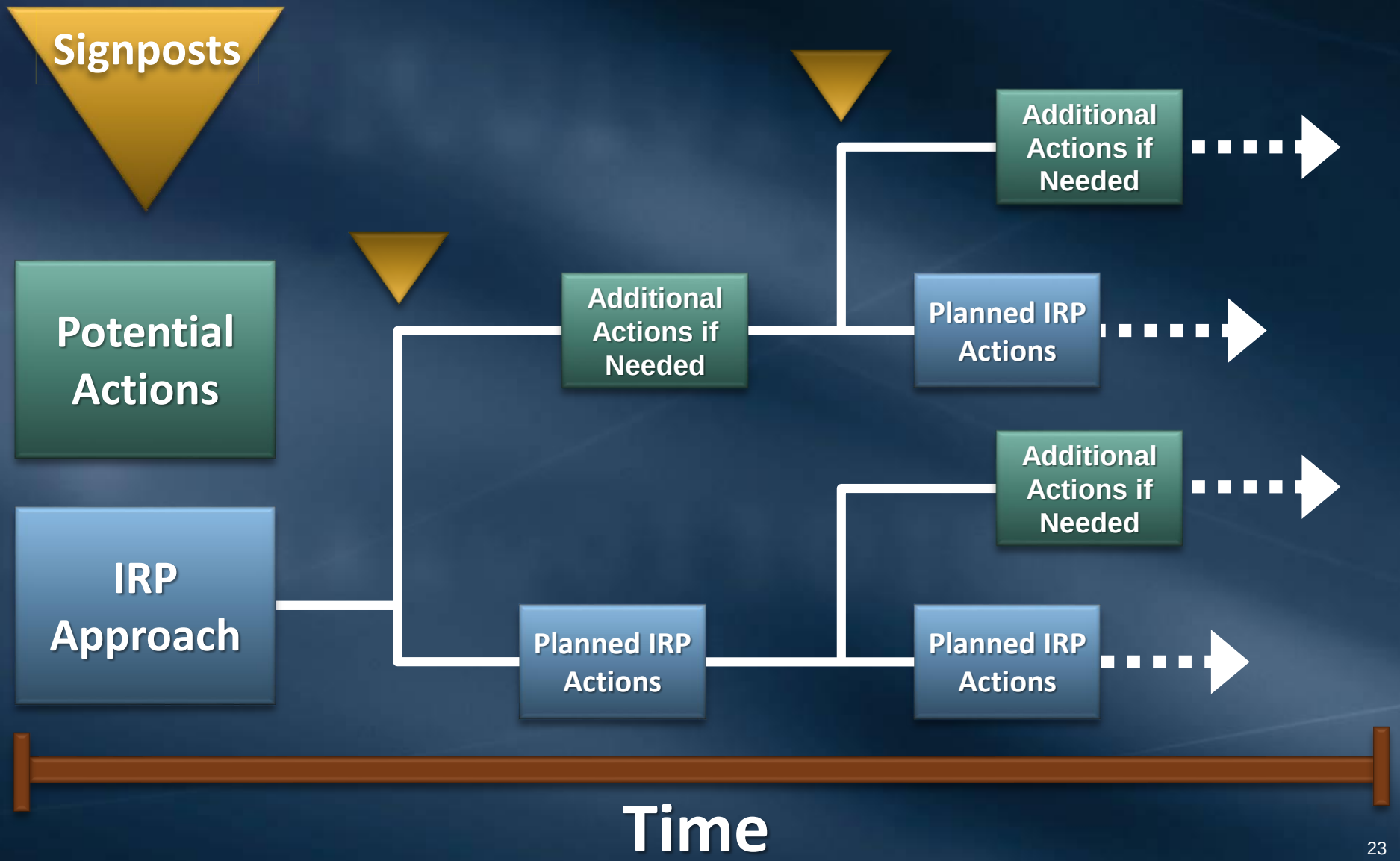
Local Supplies

- GW Adjudications
- Water Quality Impacts
- Regulations
- New Projects/Timing
- Reduced Yields

Climate Change

- Precipitation Trends
- Temperature Trends
- Global Modeling results
- Downscaling improvement

IRP Adaptive Plan Approach



Re-Defining Future Uncertainties

Factors and Ranges

Factor	Range of Uncertainty
Demographic Changes	4 New Scenarios: Baseline, Balanced Growth, Peri-Urban Growth, High Growth
Climate Conditions	12 Climate Scenarios: Used to inform a range of *Delta Method* climate scenarios and map results
Bay-Delta Conditions	2 Scenarios: No California WaterFix, Full California WaterFix
Local Resource Yields	±20% Variation in Groundwater, Recycling, Groundwater Recovery, Conservation
Project Implementation Timing	Delays: 0-10 years Desalination & Recycling, 0-20 years Conservation, 0-30 years Delta Fix

Summary of RDM for Metropolitan

- Approach developed with RAND
- Supports adaptive decision-making approach
- Incorporates data, modeling, and analytics
- Evaluates system against a wide range of uncertain future conditions
- Identifies factors leading to when and why scenarios fail
- Informs signposts and monitoring criteria for adaptive management and practicable implementation


THE METROPOLITAN WATER DISTRICT OF
SOUTHERN CALIFORNIA
1928