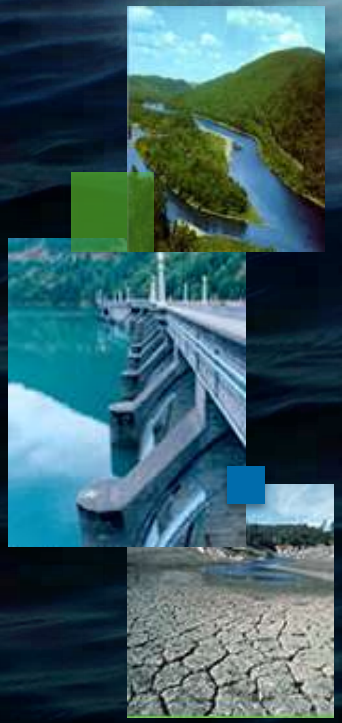

Transition to Dynamic Reservoir Operations for Municipal Water Supply

IWRA World Water Congress

May 29, 2017

Steven Nebiker, HydroLogics

Alberto Quiroz, Suez

Advancing the Management of Water Resources

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Overview

- The New Normal
- System Description
- Operating Rule Assessment
- Implementation
- Conclusions

The New Normal

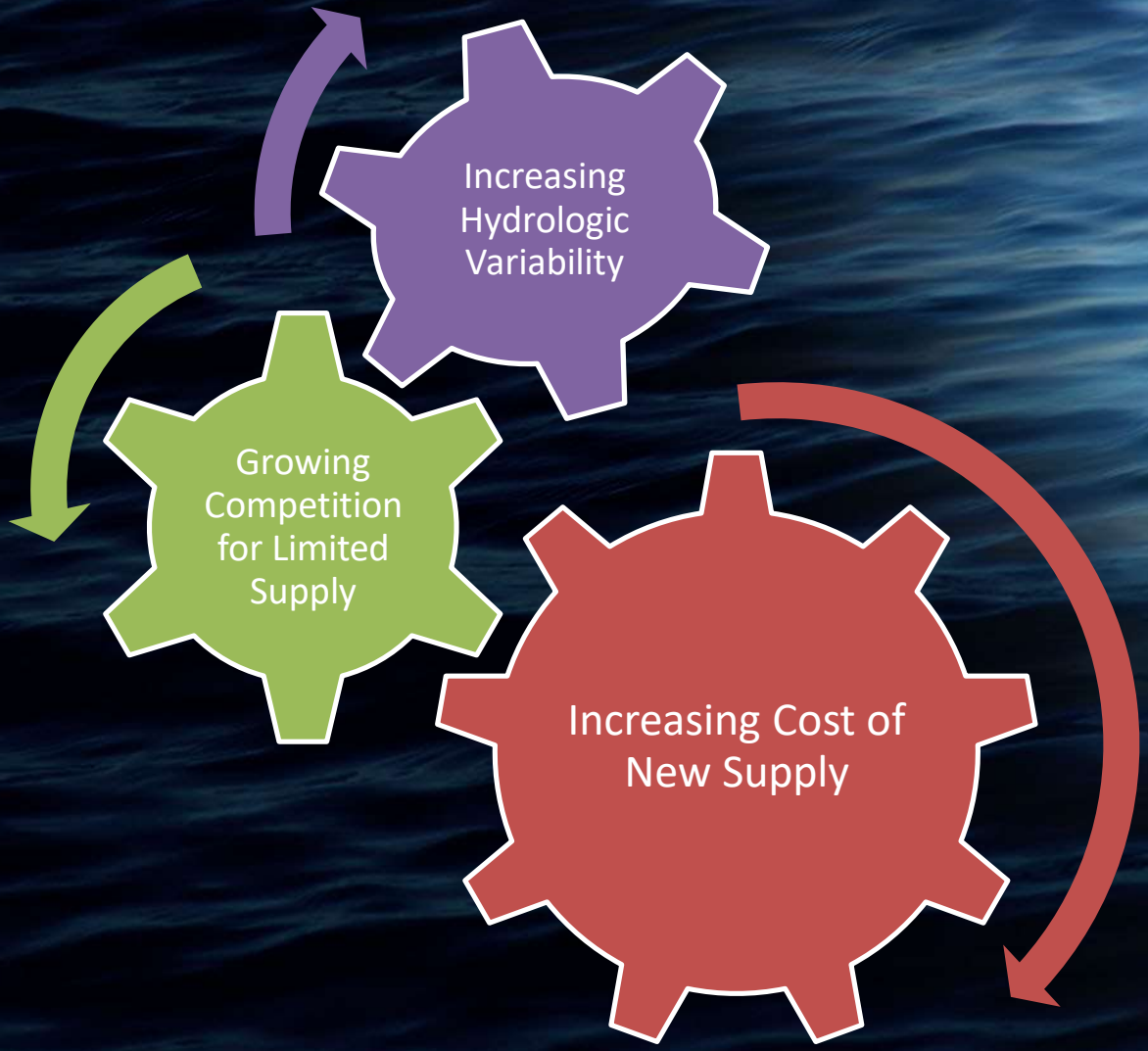
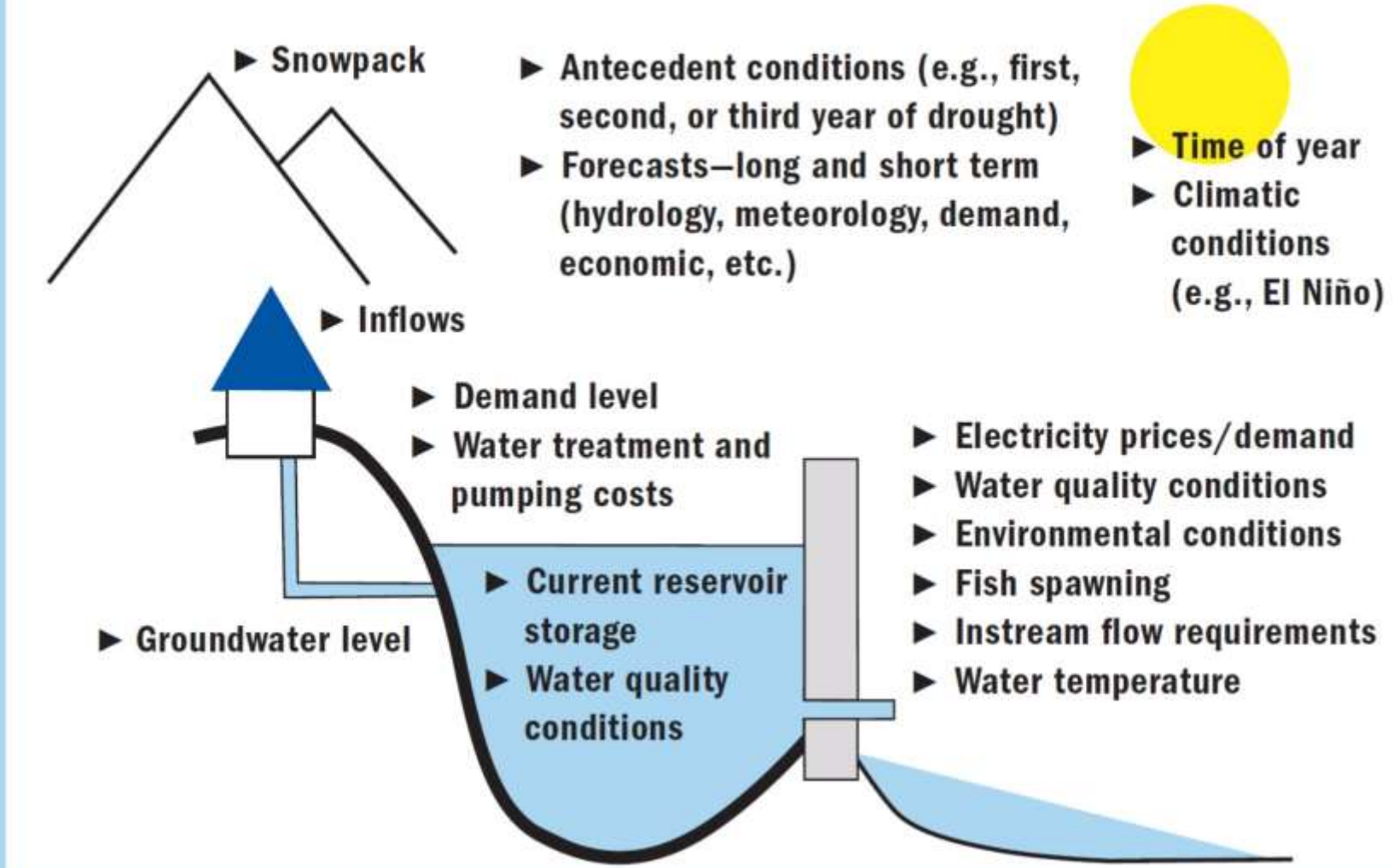


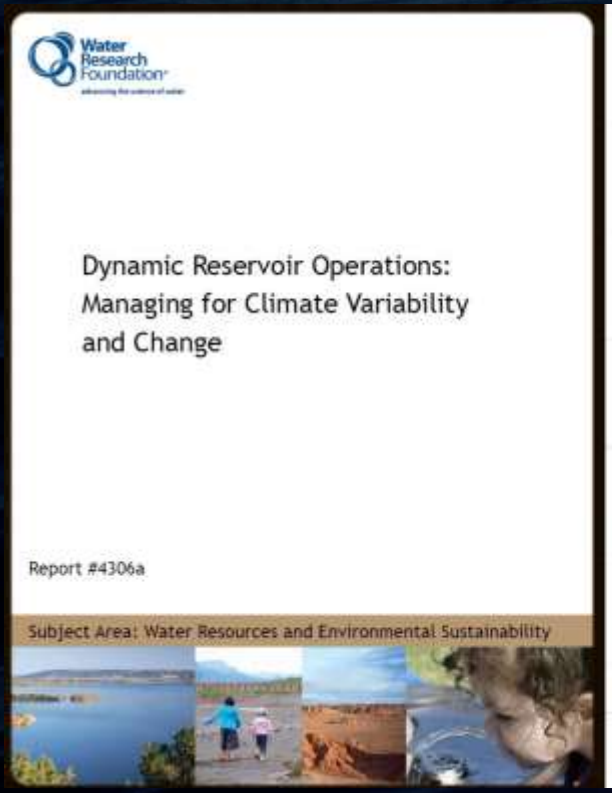
Figure 1. DRO Information

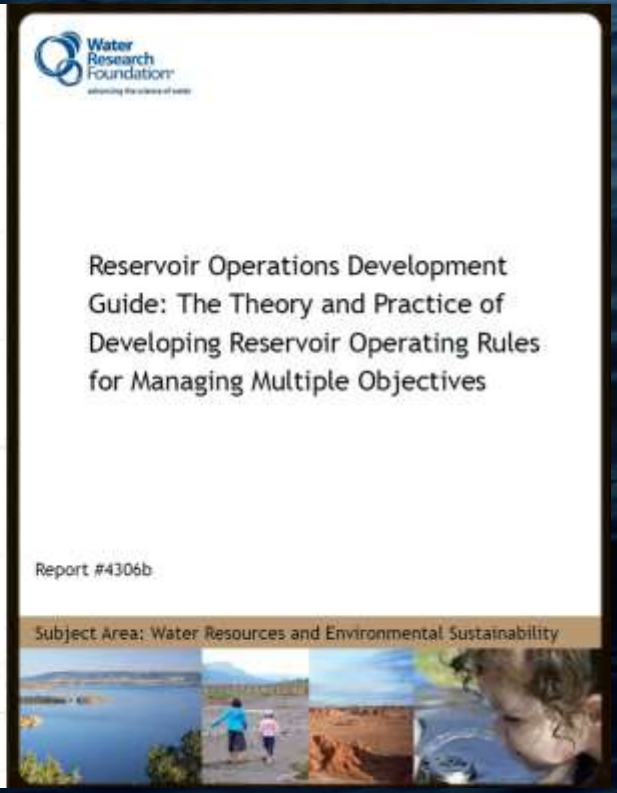
A variety of information is used to meet a utility's DRO objectives.



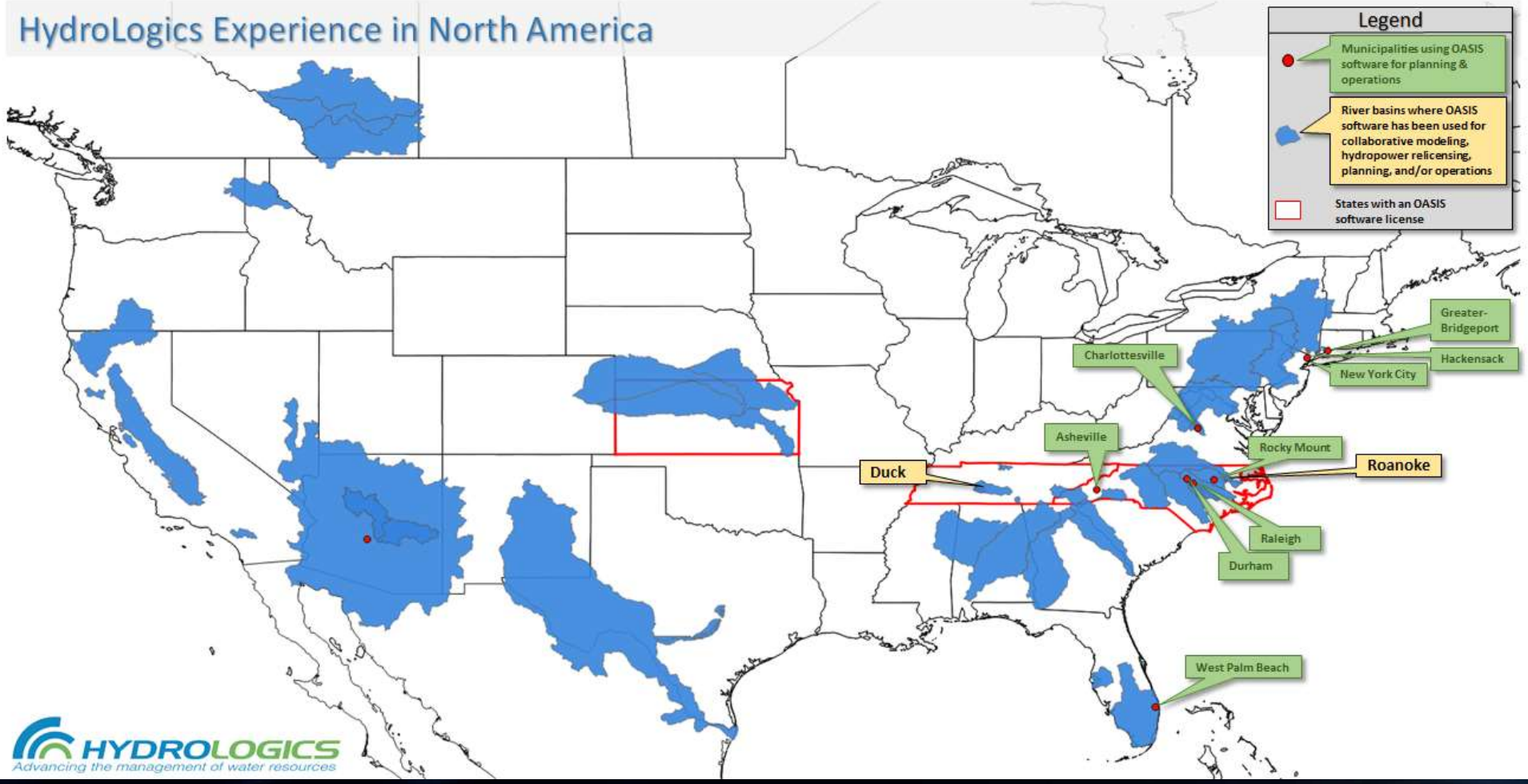
From AWWA *Opflow* magazine, March 2016

DRO: Dynamic Reservoir Operations





HydroLogics Experience in North America



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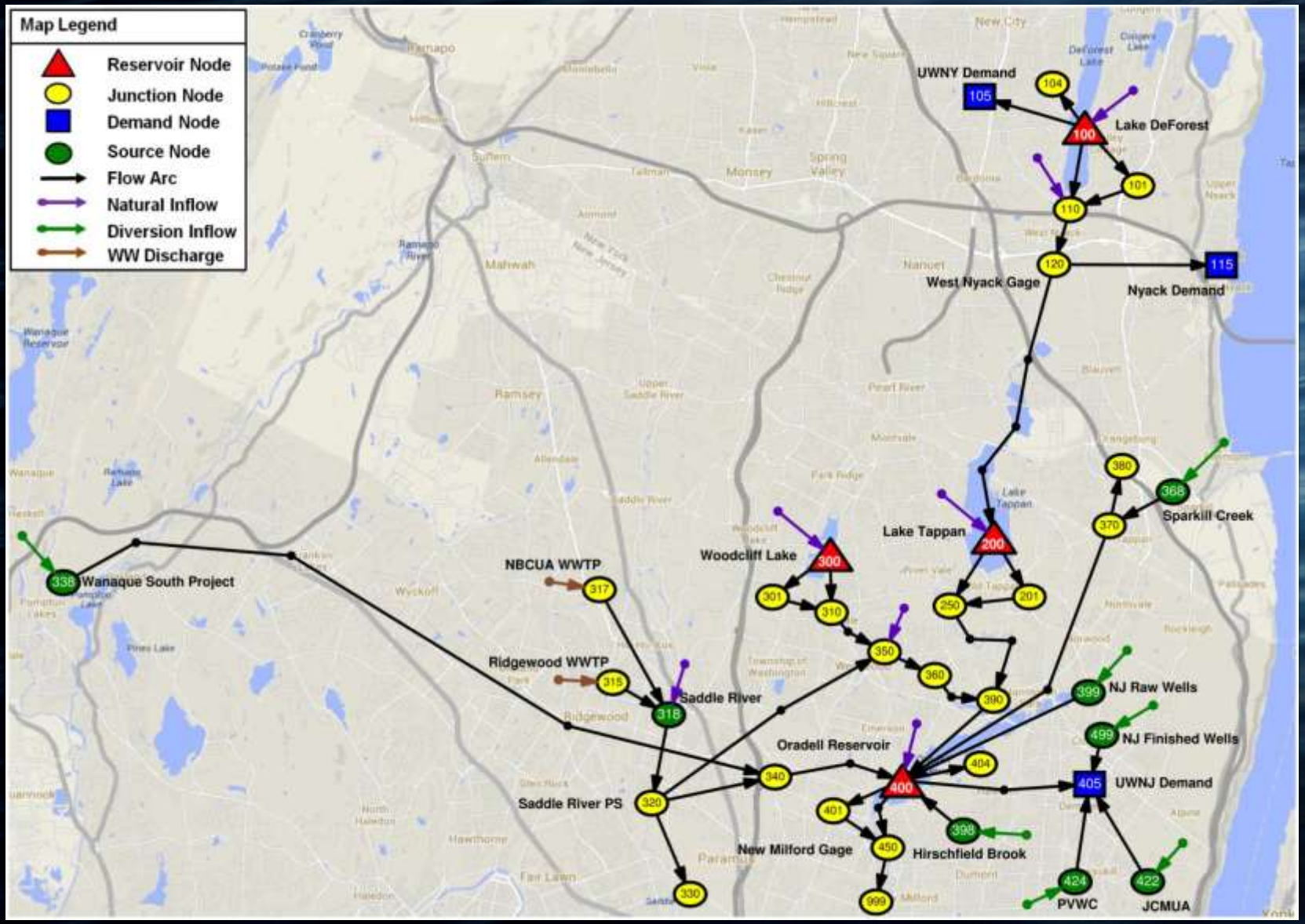
Suez Water New Jersey

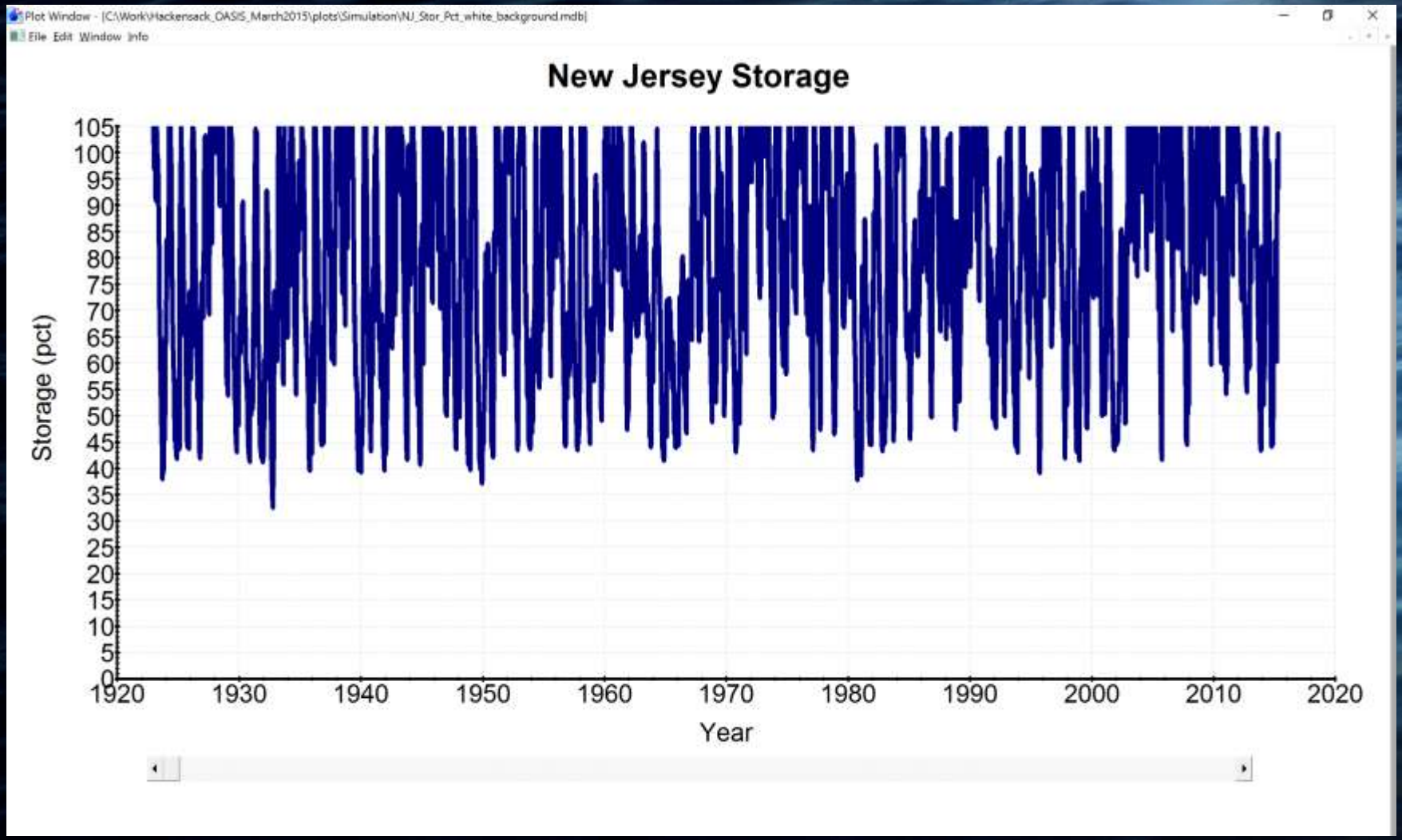
- Serving nearly one million residents from the Hackensack River Basin

- New model needed to deal with operational changes
  - Growing pressure from NY regulators to make greater use of NJ supply
  - Safe yield changes in the main backup supply

Schematic of Hackensack OASIS Model

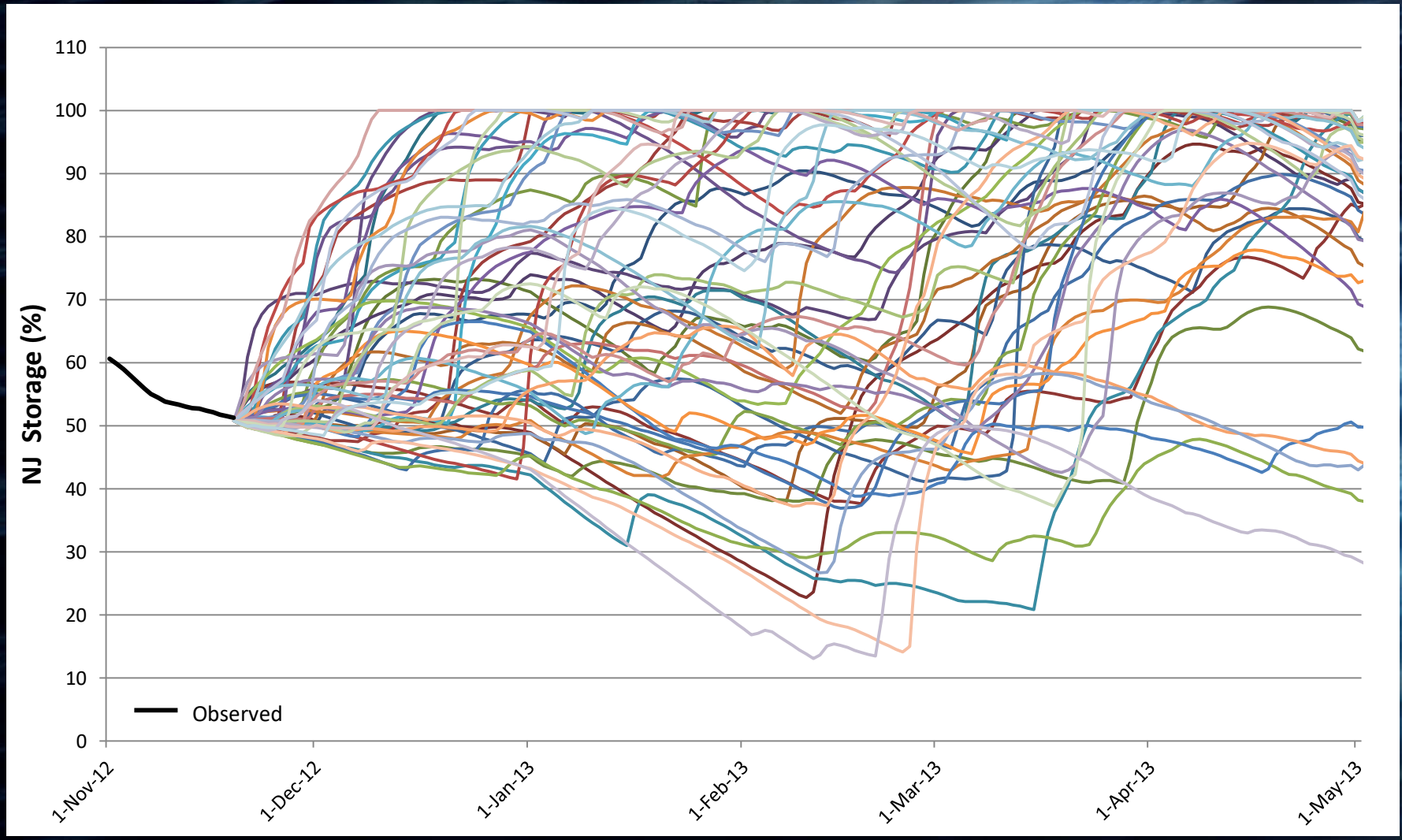


Reliability Assessment



Limitations of “Static” Rules

Sample Forecasts



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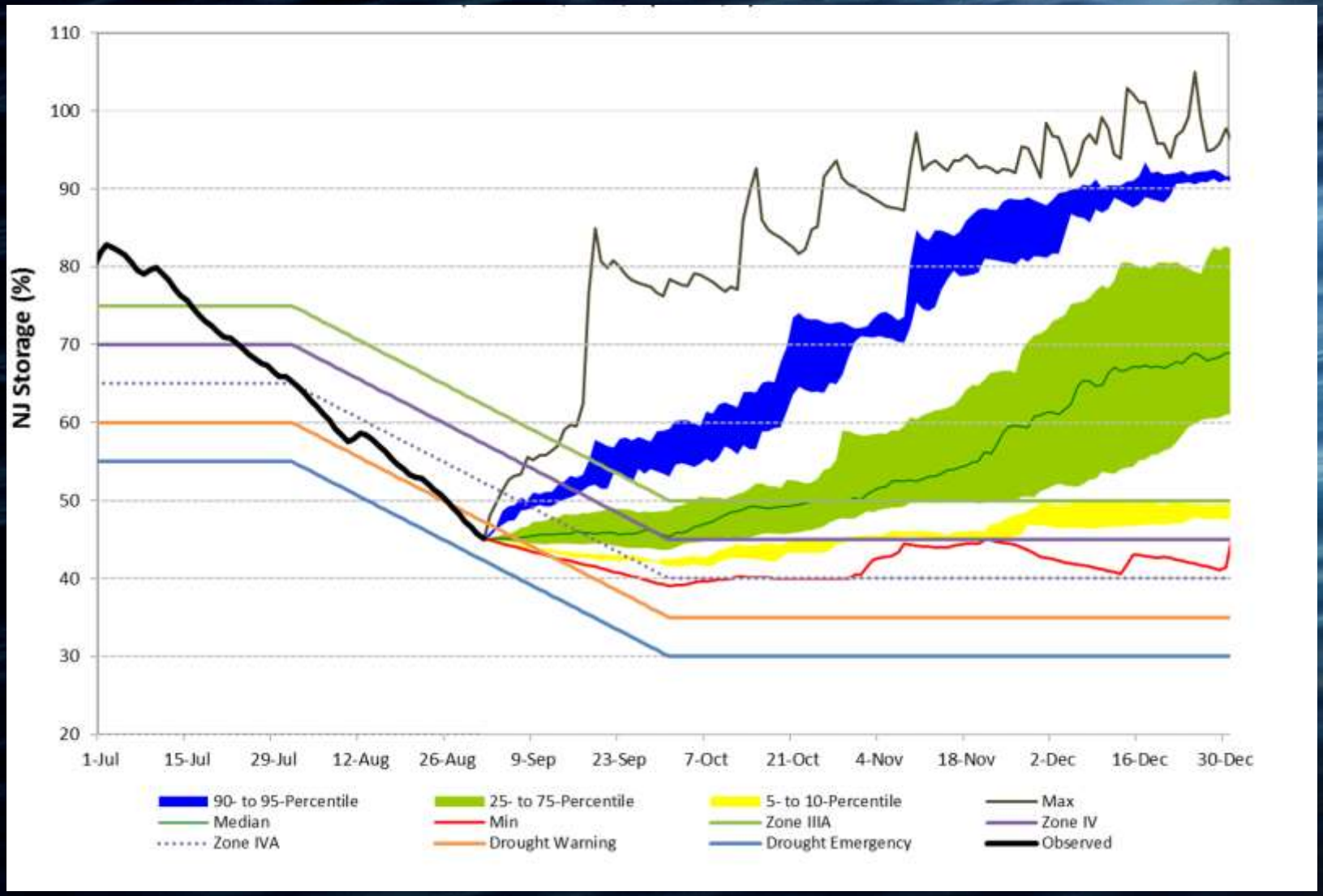
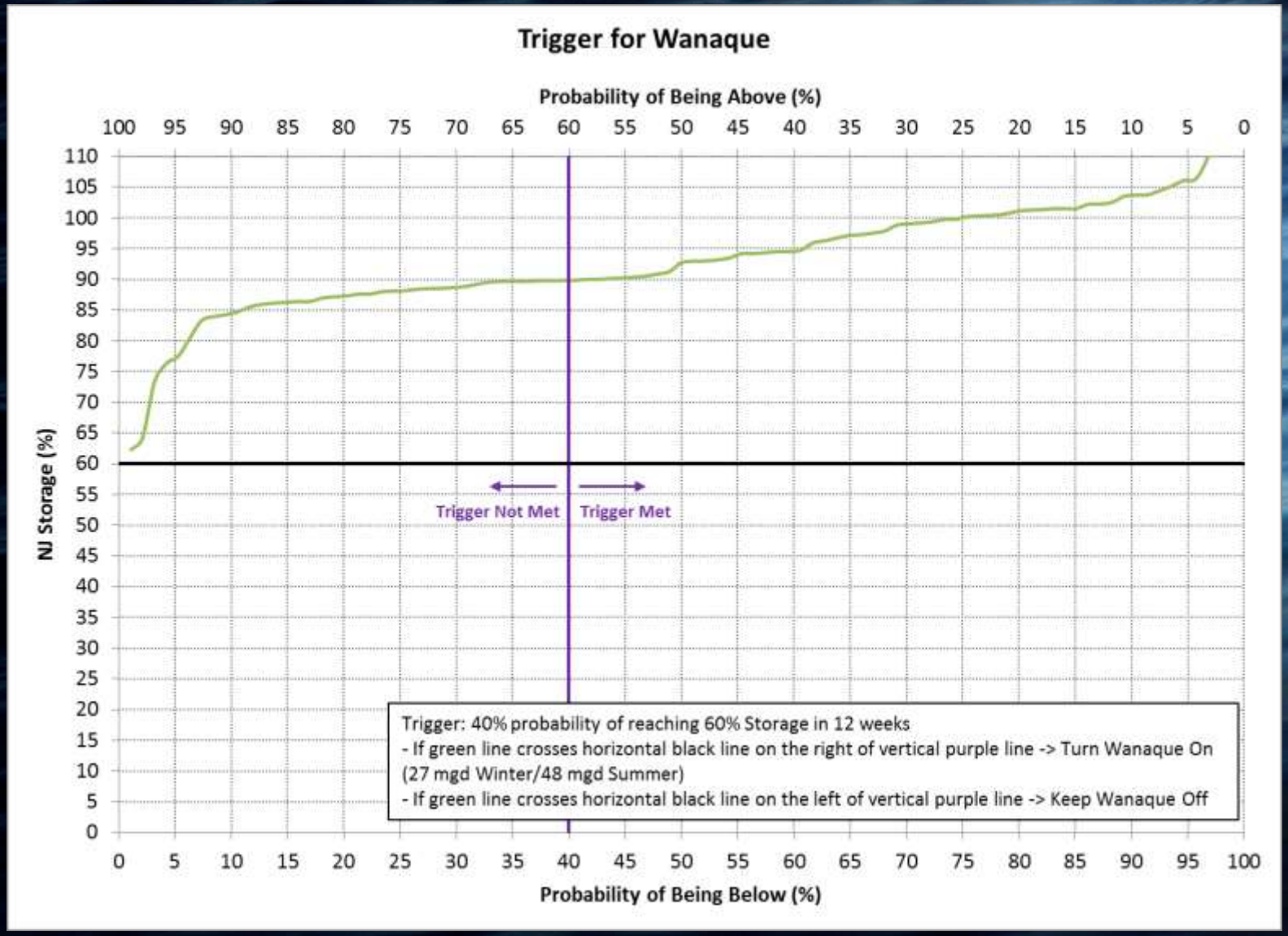
Sample Forecasts



Dynamic Rules Based on the Forecasts

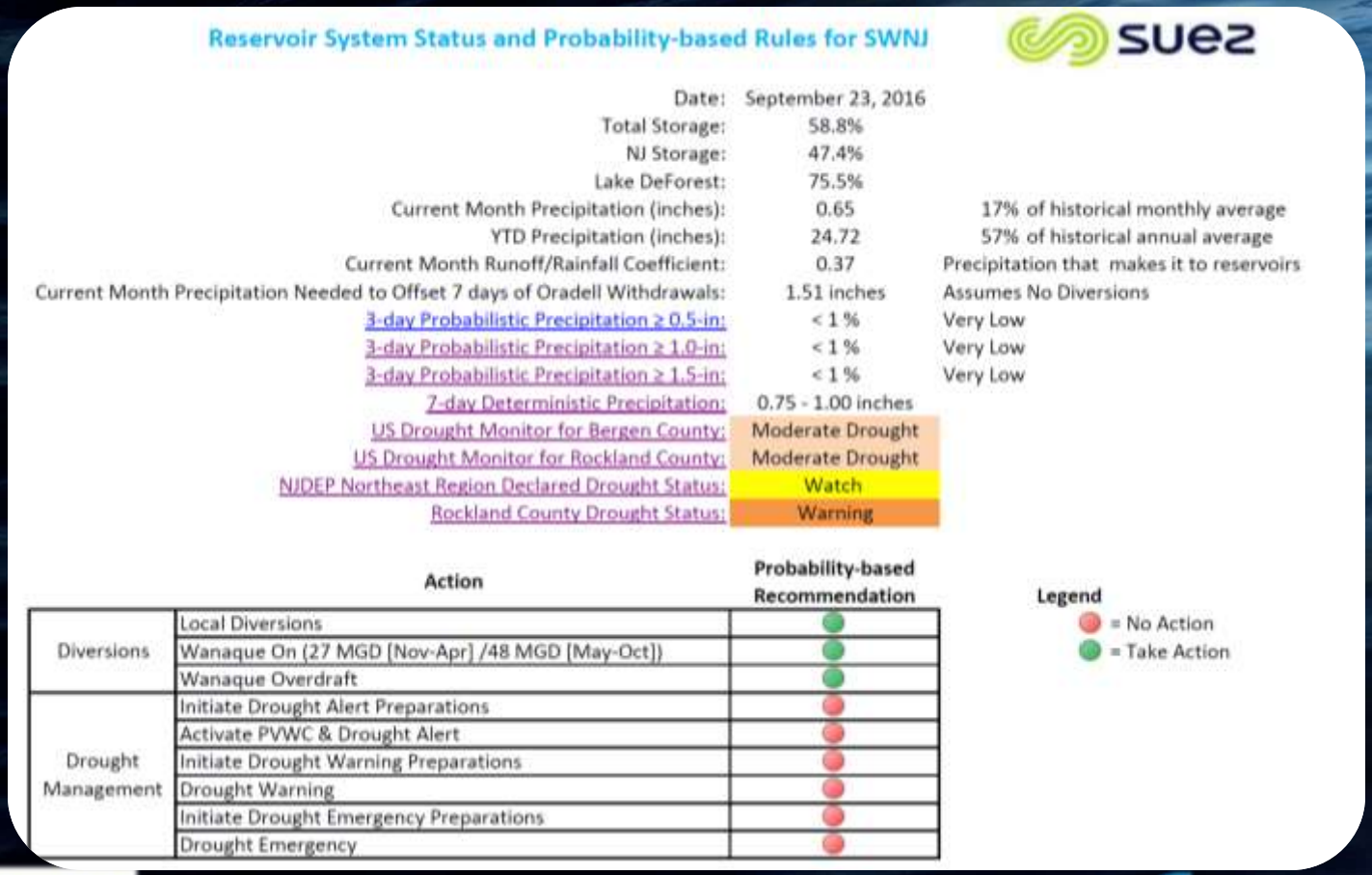


Outcomes

- 20-year old rule curves replaced with forecast-based triggers
- Results
  - Summer: More aggressive action to preserve reliability
  - Winter: Less aggressive action to reduce cost
- NJ regulator embracing forecasts as way of improving regional operations
- 2015 Innovation Award from Suez North America

Implementation

- Suez runs OASIS in operations mode
  - Inputs starting conditions, like inflows and storage
  - Runs forecast and produces recommendation



Reservoir System Status and Probability-based Rules for SWNJ

Date:	September 23, 2016	
Total Storage:	58.8%	
NJ Storage:	47.4%	
Lake DeForest:	75.5%	
Current Month Precipitation (inches):	0.65	17% of historical monthly average
YTD Precipitation (inches):	24.72	57% of historical annual average
Current Month Runoff/Rainfall Coefficient:	0.37	Precipitation that makes it to reservoirs
Current Month Precipitation Needed to Offset 7 days of Oradell Withdrawals:	1.51 inches	Assumes No Diversions
3-day Probabilistic Precipitation ≥ 0.5-in:	< 1 %	Very Low
3-day Probabilistic Precipitation ≥ 1.0-in:	< 1 %	Very Low
3-day Probabilistic Precipitation ≥ 1.5-in:	< 1 %	Very Low
7-day Deterministic Precipitation:	0.75 - 1.00 inches	
US Drought Monitor for Bergen County:	Moderate Drought	
US Drought Monitor for Rockland County:	Moderate Drought	
NJDEP Northeast Region Declared Drought Status:	Watch	
Rockland County Drought Status:	Warning	

	Action	Probability-based Recommendation
Diversions	Local Diversions	Take Action
	Wanaque On (27 MGD [Nov-Apr] /48 MGD [May-Oct])	Take Action
	Wanaque Overdraft	Take Action
Drought Management	Initiate Drought Alert Preparations	No Action
	Activate PVWC & Drought Alert	No Action
	Initiate Drought Warning Preparations	No Action
	Drought Warning	No Action
	Initiate Drought Emergency Preparations	No Action
	Drought Emergency	No Action

Legend
- No Action
- Take Action

Conclusions

- Planning and operations are improved through dynamic rules
- Systems models are needed to develop and implement the rules
- Forecast-based rules reduce the uncertainty of drought