

Use of Intra-Seasonal and Seasonal Forecasts to Reduce Risk in Regional Public Water Supply Management

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Overview

- Project Partners
- Project Background & Goals
- Methods
- Results
- Lessons Learned
- Relevance



Funded by NOAA's Climate Program Office
SARP-Water program



Background

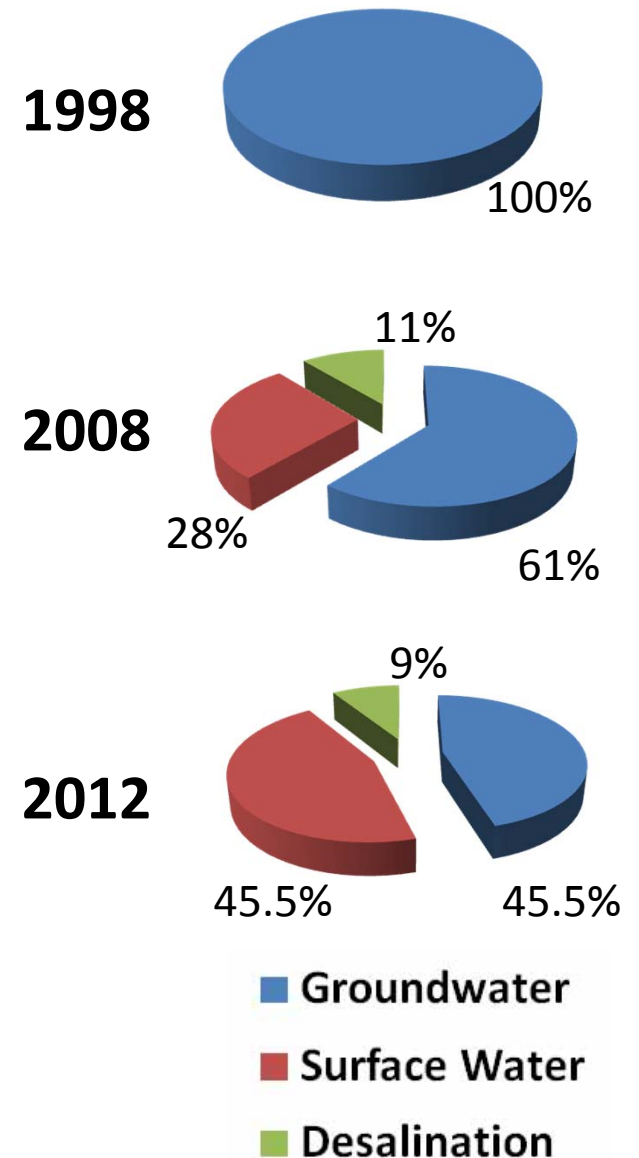
- Current sources:
 - Groundwater (13 wellfields)
 - Tampa Bypass Canal/Hillsborough River
 - Alafia River
 - C.W. Bill Young off-stream reservoir
 - Desalination Plant



(12-month moving average)

<u>Groundwater Permit</u>	
Pre-1998	192 MGD
1998	158 MGD
2002	121 MGD
2008	90 MGD

Percentage of Water by Source



Source Allocation Decisions

- Multiple decision scales:
 - Water year plan (6-months prior)
 - Month to month adjustments
 - Operational decisions (weekly)
- Multiple constraints:
 - Permitted groundwater (12-month moving average)
 - Minimum streamflows
 - Streamflow extraction ratio (maintain Fluoride limit)
 - Costs of different sources

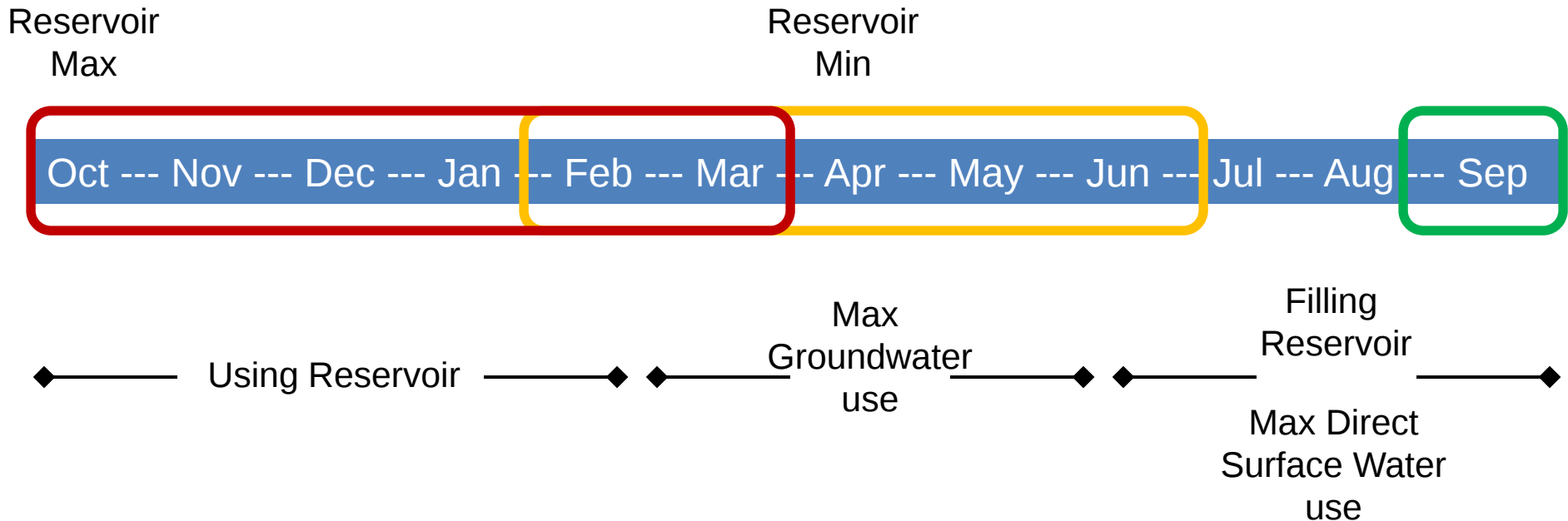
Project Goals

- Integrate forecast information into decision making
 - Multiple temporal scales
 - Relevant spatial scales
 - Integrate forecasts into suite of models used by Tampa Bay Water
- System-wide Decision Support
 - What is the system-wide benefit/risk of adopting forecast information?
 - What is the reliability of the current system?
 - Value judgments under different scenarios?

Links Between Climate/Hydrologic Information and Decisions by Tampa Bay Water

Decision	Time-Scale	Required Information Climate/Hydrology
Set Prices and monthly Source Allocation for water-year	18 months in advance	•Estimate of initial reservoir volume •Scenarios of historical conditions •Demand forecasts
Update water-year Allocations	Monthly, out to 12 months	•Precipitation and Streamflow forecasts
Operational Allocations	Weekly, out to 4 weeks	•Precipitation, Streamflow and Demand forecasts

“Typical” Water Year

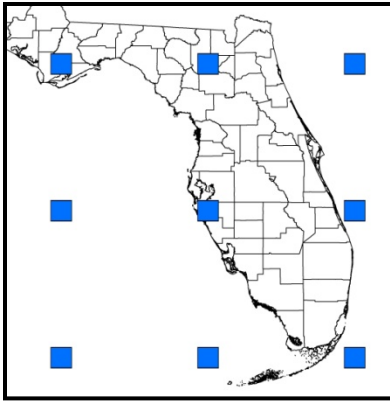


- Estimate of end of year reservoir level needed for plan for next water year
- Greater than expected groundwater pumping impacts next water year plan
- Seasonal forecasts can be used to determine expected higher/lower groundwater pumping in winter months

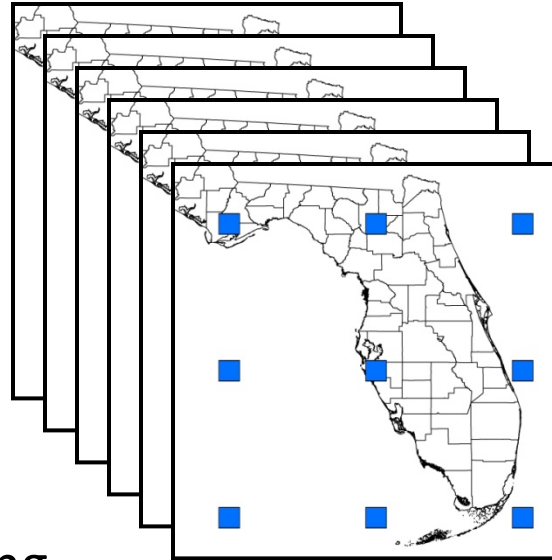
Different Products for Different Time-Scales

- Operational – Ensemble Precipitation, Streamflow and Demand forecasts derived from medium-range forecast products
- Monthly/Seasonal – Probabilistic Precipitation and Streamflow/Withdrawal Climate-based Forecasts
- Water-Year – Decision Support, taking into account previous and next 12 months

Current Forecast



Historical Forecast Analog



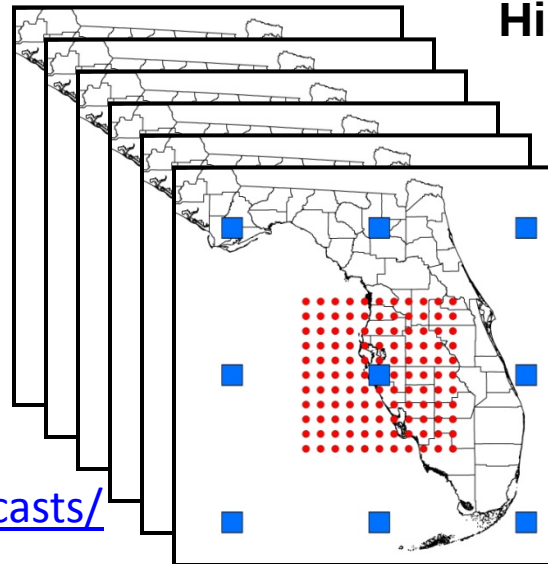
Operational Time-scale

- +/- 30 day search window
- 100 analog forecasts

- Forecast analogs using the ESRL/PSD GFS Retrospective forecast archive
 - 1-15 day
 - 2.5° x 2.5°
 - 1979-present
- Analog selection can be tailored to need



Historical Observations (Stations or NARR)

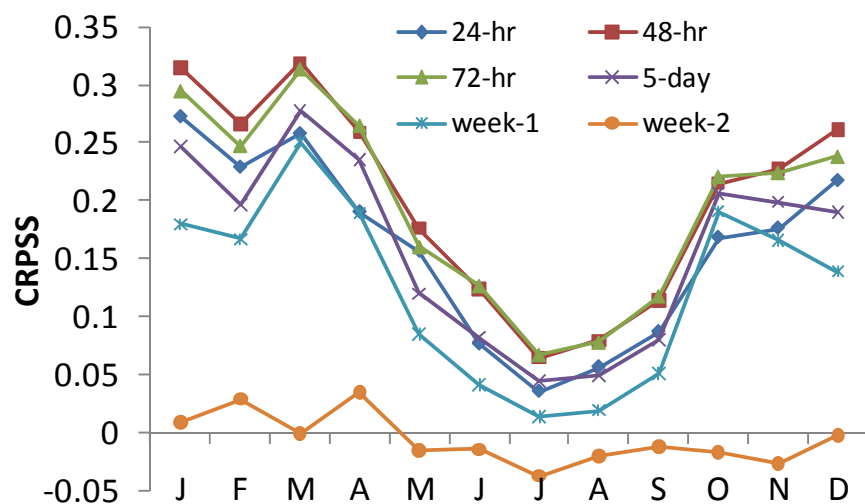
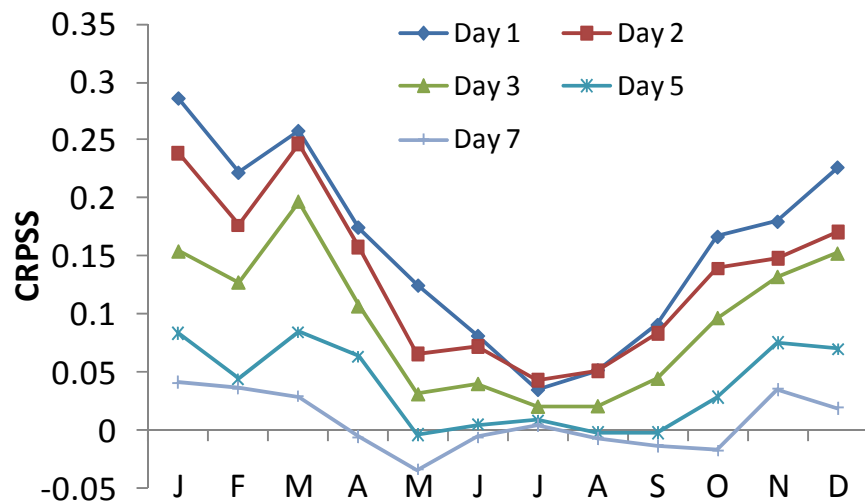


Ensemble of Hydrologic Forecasts

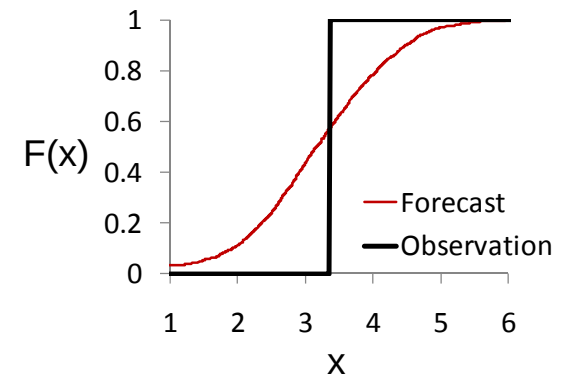


<http://www.esrl.noaa.gov/psd/forecasts/reforecast/>

Precipitation Forecast Skill



CRPSS: Continuous Ranked Probability Skill Score



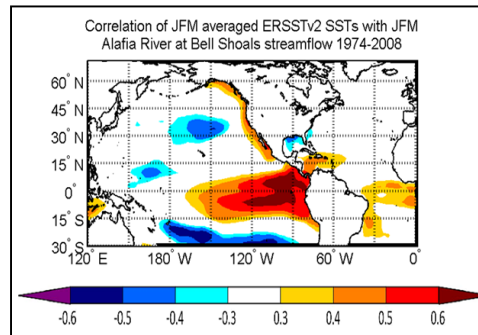
$$\text{CRPS} = \int_{-\infty}^{\infty} [F(x) - F_o(x)]^2 dx$$

$$\text{CRPSS} = 1 - \frac{\text{CRPS}_{\text{Forecast}}}{\text{CRPS}_{\text{Ref}}}$$

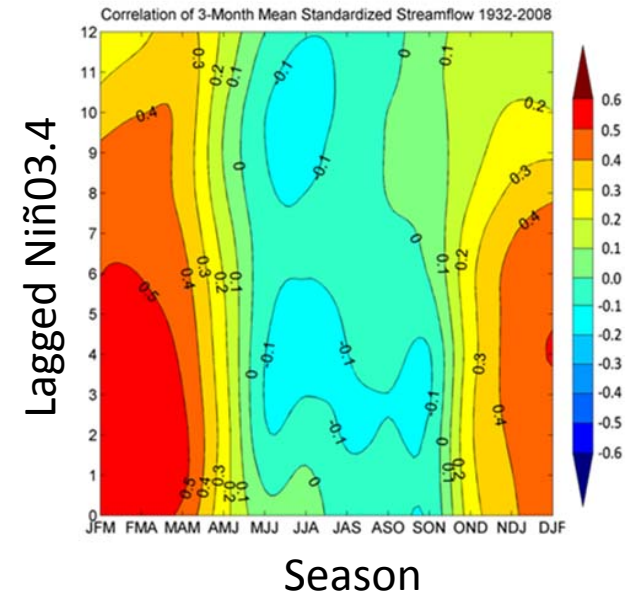
Monthly/Seasonal Time-scale

- Forecast analogs using CFS retrospective forecast archive <http://cfs.ncep.noaa.gov/>
 - Week 2
 - Monthly
 - Seasonal
- Climate-based probability of exceedance streamflow forecasts

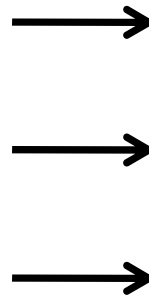
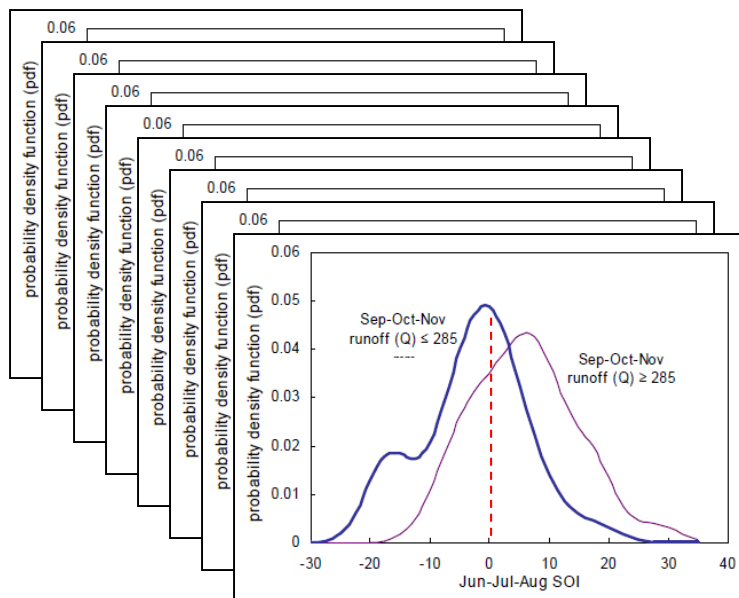
Probability of Exceedance Streamflow Forecasts



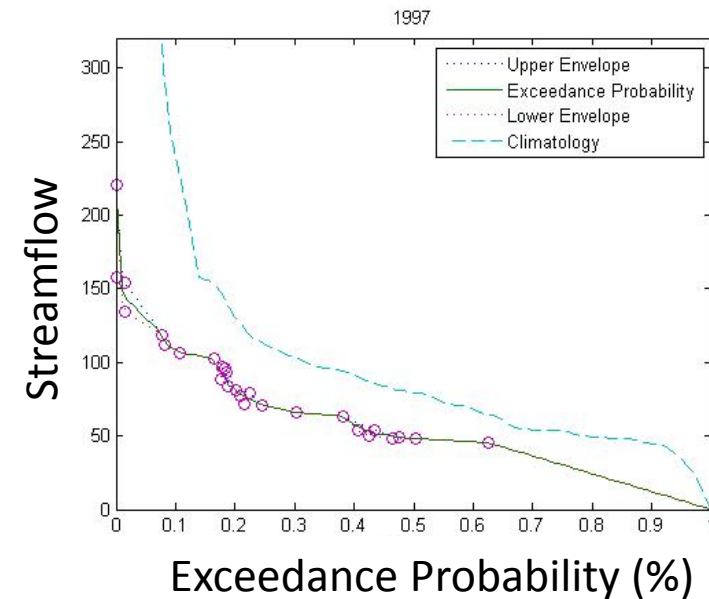
Correlation of Streamflow w/ ENSO



Posterior probability of streamflow conditioned on predictor

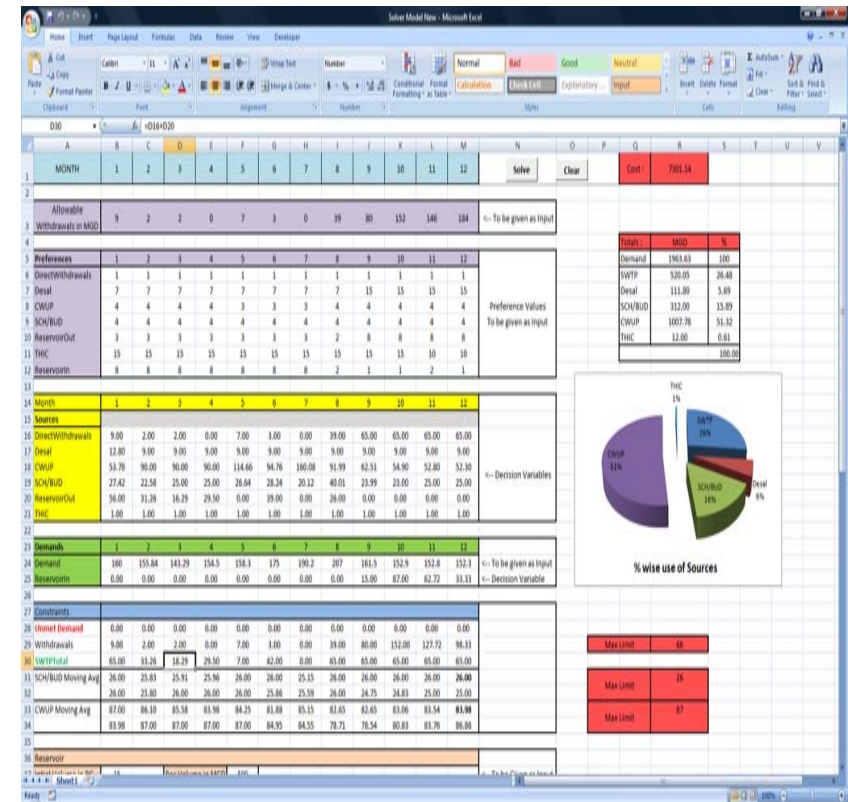
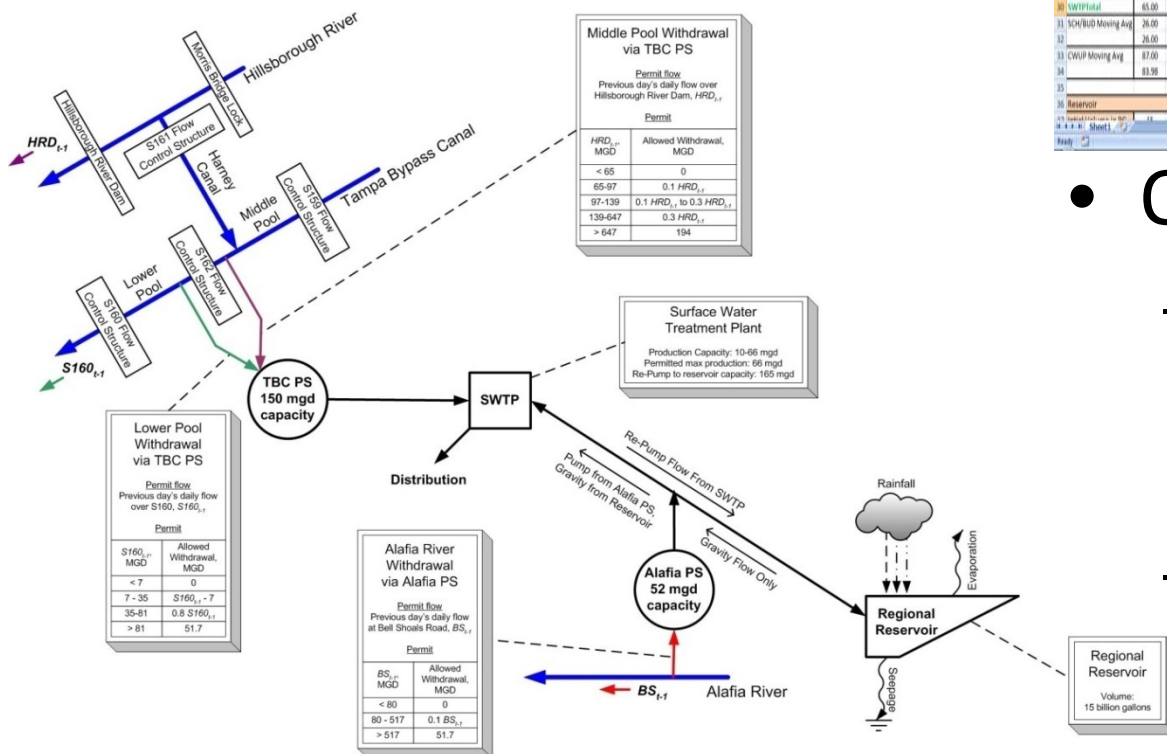


Streamflow Forecast



Decision Support + Scenarios

- Inputs:
 - Forecasted Demand
 - Forecasted Withdrawal



- Outputs:
 - Optimized source-water allocations based on preferences/constraints
 - End of year reservoir volume

Lessons Learned

- There is a learning curve associated with using weather/climate datasets!!!
(for hydrologists/engineers, at least...)
- Limited number of forecasted variables archived in retrospective archives may limit usefulness

Relevance

- Tools/approaches that can easily be replicated in other regions
 - Analog forecasts
 - Exceedance streamflow forecasts