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Safe Yield Methodology Update

Peer Review Meeting #1

October 26, 2021

Agenda

- Welcome and Introductions
- Background and Objectives
- Overview of Uncertainty in Surface Water and Groundwater Modeling
- Q&A
- Uncertainty in the CVM and its Use in the Safe Yield Reset
- Q&A
- Break
- Potential Methods for Characterizing and Addressing Uncertainty
- Discussion
- Next Steps and Schedule

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Background – April 28, 2017 Court Order

- April 28, 2017 Court Order
  - Approved current Safe Yield reset methodology
  - Included a provision to update the Safe Yield reset methodology
  - Required a peer review process

"4.4 Safe Yield Reset Methodology. […] In furtherance of the goal of maximizing the beneficial use of the waters of the Chino Basin, Watermaster, with the recommendation and advice of the Pools and Advisory Committee, may supplement the Reset Technical Memorandum's methodology to incorporate future advances in best management practices and hydrologic science as they evolve over the term of this order."

Background – 2020 Safe Yield Recalculation

- Applied Court-approved methodology to reset the Safe Yield for fiscal year 2021 through 2030
- Several peer review comments recommended that the SY reset methodology account for uncertainty

Background – Scope to Implement Court Order

- Watermaster proposed a scope of work to update the SY reset methodology to address uncertainty
- Appropriative Pool requested modified scope to solicit feedback early in the process
  - Identify important sources of uncertainty to address
  - Update scope and budget for the SY reset methodology update.

Scope to Implement Court Order

- Initial steps:
  1. Develop a TM outlining sources of uncertainty in the SY reset methodology and related questions. Submit the TM to the Parties for review and comment.
  2. Conduct peer review meeting and gather feedback
  3. Develop a supplemental scope and budget to address the sources of uncertainty in the SY reset methodology update

Meeting Goals

- Gather feedback on TM1
- Achieve general agreement from the peer review committee on the next steps of the process

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Overview of Uncertainty in Surface Water and Groundwater Modeling

- Sources of uncertainty in surface water and groundwater modeling
- SGMA Modeling BMP to address uncertainty (DWR, 2016)

Sources of Uncertainty in Surface Water and Groundwater Modeling

- Surface water and groundwater model parameters
- Historical data
- Supply and demand projections
- Projected climate impacts on land surface processes

Source of Uncertainty: Surface Water and Groundwater Model Parameters

- Hydrologic processes that are not measured directly – ET, DIPAW, stream percolation
- Hydraulic parameters – HK, VK, Ss, Sy, etc.
- Hydrogeologic features that are not well characterized – stratigraphy, fault barriers, aquifer geometry
- Non-unique solutions of the calibrated model parameters

Source of Uncertainty: Historical Data

- Types of historical data
  - **Directly observed**: geologic, precipitation, temperature, stream discharge, metered pumping, managed artificial recharge, wastewater discharge, and groundwater levels
  - **Not observed/not measured directly**: ET, unmanaged recharge, septic tank discharge, unmetered pumping, and unmeasured applied water.
- Model uncertainties related to historical data
  - Measurement error
  - Lack of records
  - Inconsistent spatial resolution
  - Inconsistent temporal resolution

Source of Uncertainty: Supply and Demand Projections

- Forecasting water supply and demand is uncertain and influenced by
  - Macro-socioeconomic factors
  - Climatic factors
  - Behavior of water purveyors
  - Behavior of water users
  - Regulatory environment
  - Wastewater re-use and disposal plans

Source of Uncertainty: Projected Climate Impacts on Land Surface Processes

- Climate change
  - The climate impacts the groundwater system through recharge and changes in demand.
  - Currently, most studies on climate impacts rely on the downscaled results of Global Circulation Models (GCMs) - CMIP5 and CMIP6.
  - GCM projections are inherently uncertain.

Source of Uncertainty: Projected Climate Impacts on Land Surface Processes

- Legislation to promote water conservation in response to drought
  - Model Water Efficient Landscape Ordinance (MWELO) enacted in 1993 and updated in 2015
  - New water efficiency standards for purveyors in response to the California drought – The Water Conservation legislation of 2018 (AB1668 and SB 606).

SGMA Modeling BMP to Address Uncertainty (DWR, 2016)

Develop and run predictive scenarios to

- Include (1) expected future conditions under varying climate conditions, and (2) various projects and management actions.
- Assess the anticipated conditions at five-year milestones.
- Demonstrate that the sustainability goal will be maintained over the 50-year horizon.

SGMA Modeling BMP to Address Uncertainty (DWR, 2016)

Conduct an uncertainty analysis of the scenarios to

- Identify the impact of parameter uncertainty on the model's ability to support decision making.
- Identify high-value data gaps.
- Assist in a formal optimization simulation of management options.

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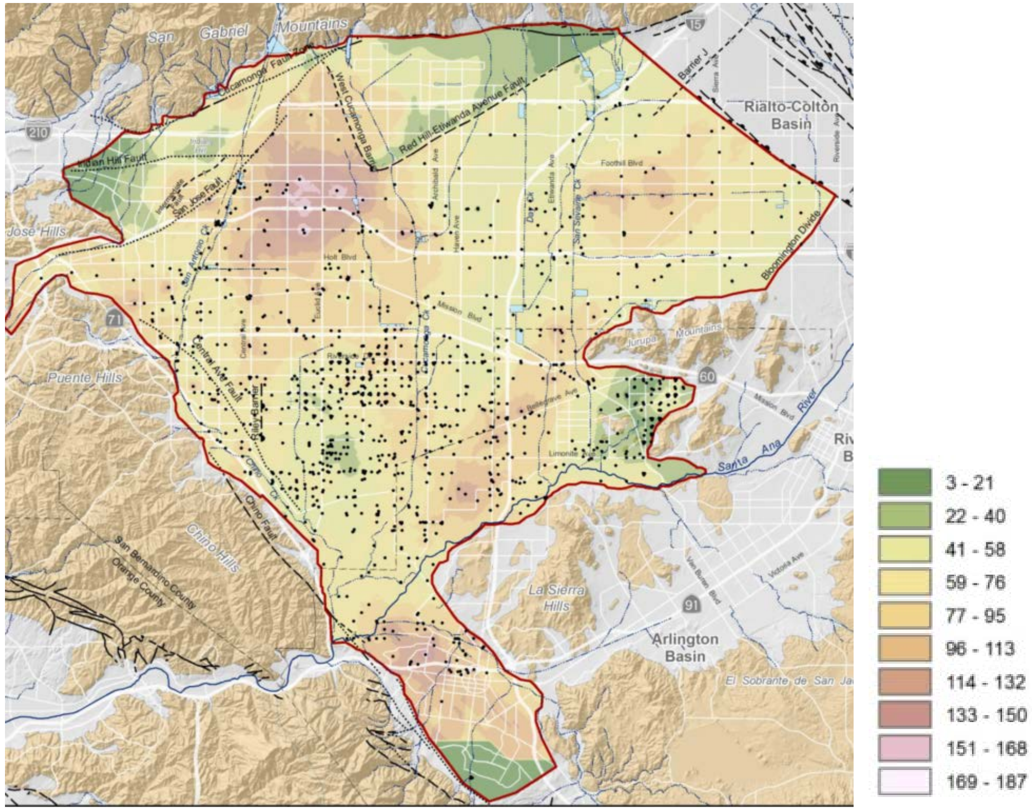
Uncertainty in the CVM and its Use in the Safe Yield Reset

- Surface water and groundwater model parameters
- Historical data
- Supply and demand projections
- Projected climate impacts on land surface processes

Source of Uncertainty: Surface Water and Groundwater Model Parameters

- Surface hydrologic parameters
- Hydraulic conductivity, specific storage and specific yield
- Hydraulic characteristics of faults
- Stream properties
- Groundwater evapotranspiration
- Vadose zone travel (lag) time



Layer 1 Initial and Pre-calibrated Horizontal Hydraulic Conductivity (ft/day) Based on Borehole Lithology

Source of Uncertainty: Historical Data

- Pumping
- Groundwater levels
- Stream discharge
- Managed artificial recharge
- Wastewater discharge
- Precipitation
- Potential ET
- Evaporation
- Applied water
- Land use
- Septic tank discharge
- Subsurface inflow from adjacent groundwater basins
- Mountain-front inflow

Source of Uncertainty: Supply and Demand Projections

- Groundwater pumping
- Managed artificial recharge
- Wastewater discharge
- Land use
- Future extent of septic tanks
- Subsurface inflow from adjacent groundwater basins
- Replenishment obligations
- Management programs (e.g., OBMP PEs)

Source of Uncertainty: Projected Climate Impacts on Land Surface Processes

- The DWR (2018) climate change datasets in the form of change factors of precipitation, ET_0, and surface runoff for 2030 and 2070 were used to model climate change in the 2020 Safe Yield Recalculation.
- The impact of new conservation legislation was not included in the 2020 Safe Yield Recalculation.

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Q&A

- Do you need clarification and/or more details on a given source of uncertainty?
- Are there any additional sources that were not presented on today?

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Potential Process to Address Uncertainty in Calculating Net Recharge

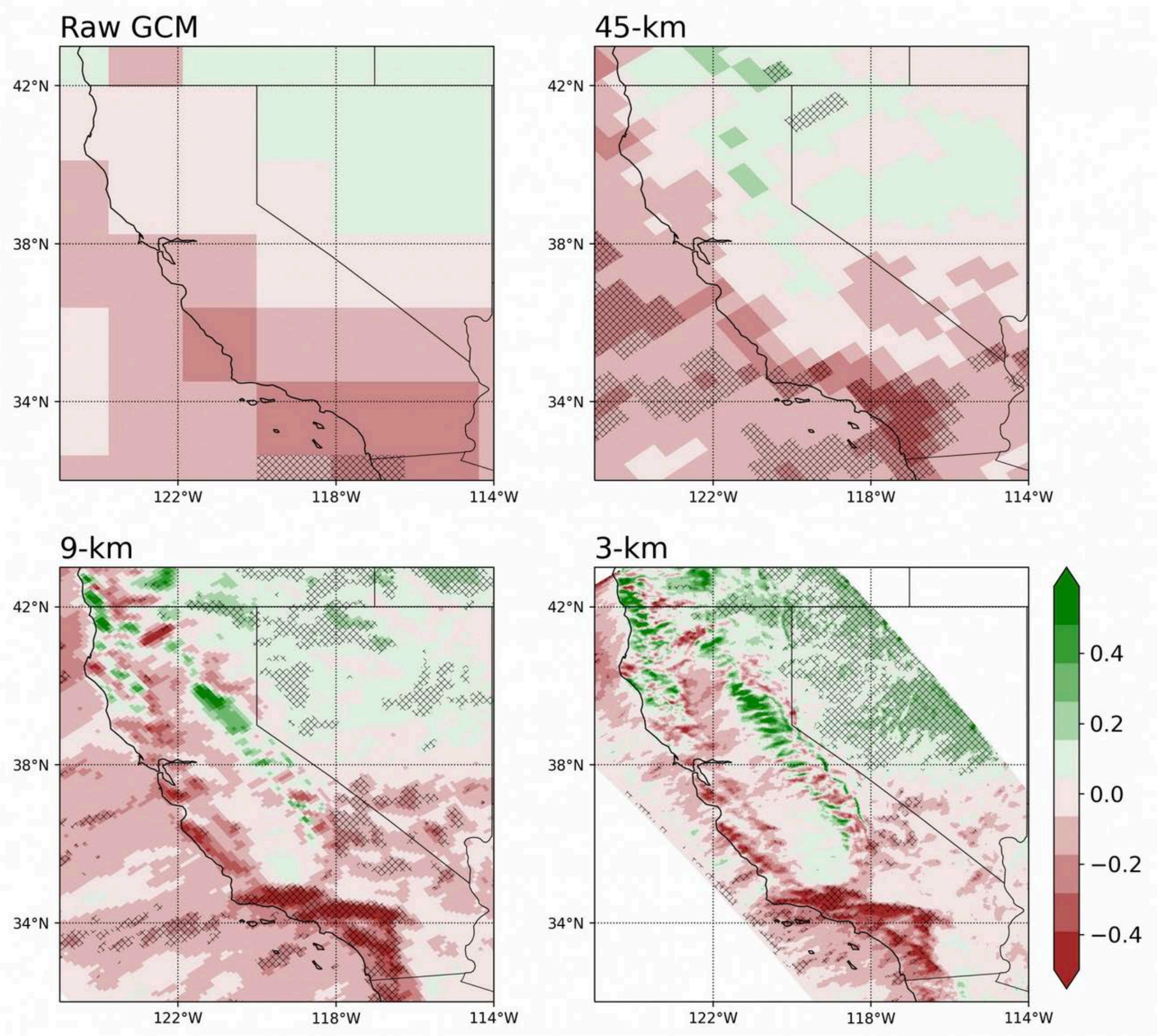
1. Generate multiple realizations of calibrated model
2. Generate ensemble of projection scenarios based on each realization

Potential Methods: Parameters/Historical Data

- Honor historical data
- Addressing uncertainties related to model parameters:
  1. Select parameters with highest sensitivities
  2. Define upper and lower bounds of parameters
  3. Conduct Monte Carlo simulation to generate calibrated realizations

Potential Methods: Future Projections

- Supply/demand projections
  - Discussions with the Parties
  - Review of historical data
- Climate projections
  - DWR change factors
  - Gridded climate datasets



Future (2080-2100 average) minus historical (1980-2015 average) simulated precipitation anomalies [mm/d] from a raw GCM and from WRF downscaling grids. Hatching denotes statistical significance greater than 0.9, and cross hatching denotes significance greater than 0.99.

https://dept.atmos.ucla.edu/alexhall/downscaling-cmip6

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Discussion

- What are your thoughts on addressing uncertainty in historical data?
- What else do you recommend we consider in the uncertainty analysis of the model parameters and development of the calibrated realizations?
- What else do you recommend we consider in developing supply and demand projections?
- What else do you recommend we consider in developing climate projections?

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Next Steps and Schedule

- Summarize peer-review feedback from today's meeting
- Refine supplemental scope and budget to address the sources of uncertainty in the SY reset methodology update
- **Friday 10/29** – Watermaster submits draft supplemental scope and budget to peer reviewers
- **Wednesday 11/3** – deadline for comments from peer reviewers
- **Friday 11/5** – Supplemental scope and budget included in agenda for Pool committee meetings on 11/11

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THANK YOU

Table 1. Typical Historical Data used in Groundwater Models				
Data Type	Purpose of Data	Use of Data in Model		
		Direct Input	Indirect Input	Model Calibration
Groundwater levels	Groundwater simulation		X	X
Groundwater pumping	Groundwater simulation	X		
Lithology and geologic data	Groundwater simulation	X	X	
Climatic data (precipitation, ET_0, temperature, evaporation, etc.)	Recharge estimation	X		
Ground elevation data	Recharge estimation		X	
Land use	Recharge estimation	X		
Stream discharge	Recharge estimation	X		X
Wastewater treatment plant influent	Recharge estimation			X
Water and wastewater infrastructure (sewersheds, water supply maps)	Recharge estimation		X	
Managed aquifer recharge	Recharge estimation/ groundwater simulation	X		X
Stream geometry	Recharge estimation/ groundwater simulation	X		
Wastewater treatment plant effluent	Recharge estimation/ groundwater simulation	X		

Parking Lot