

Projecting Forward

A Framework for Groundwater Model Development Under the Sustainable Groundwater Management Act

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Implementation of SGMA will require agencies throughout the state to undertake management actions that have been necessary for many years, but have not been politically feasible without a state mandate. Water agencies will need to work collaboratively with each other, land-use planning agencies and interested parties within the basin to develop plans managing groundwater sustainably. Basins with multiple groundwater management agencies will require basin management, data collection and monitoring efforts to be closely coordinated. Additionally, agencies must ensure their efforts to manage sustainably do not adversely impact neighboring basins. Groundwater models will play a critical role in achieving these goals.

While models are a simplification of reality, they can serve as powerful tools to develop a better understanding of groundwater systems, develop more reliable estimates of water budgets, ascertain future data collection needs, forecast the outcome of future management actions on a groundwater basin and explore alternative management strategies (Barnett et al. 2012). Models will play a critical role in simulating environmental changes during the 50-year planning and implementation horizon required under SGMA, providing the link between established management criteria and the management approaches necessary to achieve them. In many cases, models will form the basis of groundwater management decisions.

This report provides a framework for model development under SGMA. It offers guidance on how and when stakeholders should be engaged in model development, milestones for third-party model review, model documentation and archiving and communicating model outputs to nontechnical audiences. While many of these practices are already occurring, there are additional opportunities during development to encourage model coordination and the active engagement of local entities who will be impacted by management decisions as well as the state agencies responsible for evaluating Groundwater Sustainability Plans (GSPs) under SGMA. Coordinating model development at the basin-scale and beyond can maximize efficiency, avoid conflicts over boundary issues, provide opportunities for cost sharing and result in more consistent models that can be used for local and regional management.

This report makes the following recommendations to promote consistency, transparency, and coordination during groundwater model development.

Groundwater models should be:

1. **Developed through a collaborative, inclusive, and transparent process.** Local water agencies, county and municipal agencies, managers, advisory committees and other interested parties should be actively involved in groundwater model development. In particular, they should have a role in defining



groundwater model objectives, assumptions and the level of risk or uncertainty they are willing to tolerate for groundwater management planning purposes. Decision-makers and stakeholders should fully understand the purpose of using a model for water budget development and water management planning as well associated uncertainties.

2. **Developed in a manner consistent with model objectives and the amount and type of data available.** Where the amount or quality of data is inadequate to meet model objectives goals, model limitations and uncertainty must be clearly articulated to decision-makers, stakeholders and other interested parties. Additional data and technical studies should be conducted to remedy data deficiencies.
3. **Communicated clearly to technical and nontechnical audiences.** Model results and uncertainty must be clearly articulated to decision-makers, stakeholders and other technical and nontechnical users. Presenting model results as a range of possible outcomes rather than as a single value can help to convey the uncertainty inherent in model results.
4. **Developed using consistent datasets and projections.** The state should provide and require the use of consistent datasets for model development and projections under SGMA. These data and projections should include climate, surface water, land-use, regional water budgets and population.
5. **Developed using public domain, open-source model codes.** This provides improved opportunity for model review and evaluation. It also improves model access and may encourage coordination between adjacent basins. DWR's IWFM and the USGS' MODFLOW are two examples of public domain, open-source model codes.
6. **Developed at the system scale whenever possible.** Developing models of the hydrogeologic system as a whole, rather than modeling individual hydrologically

connected basins, can maximize efficiency, avoid conflicts over boundary issues and provide the opportunity to share financial and personnel costs of model development.

7. **Subject to thorough peer review.** Groundwater models should be reviewed by the state, independent hydrogeologists with modeling experience, neighboring jurisdictions and other interested parties. Peer review of groundwater models helps ensure that a model is consistent with model objectives and with assumptions in adjacent basins. Model review should be a formal process undertaken after each model reporting milestone.
8. **Subject to thorough model reporting, documentation and archiving.** Groundwater model reporting should be accessible to technical and nontechnical audiences and should include an executive summary with easy-to-read visuals. Model data and source files should be publicly available in electronic format with all necessary metadata and be in a format that can be easily viewed and shared among multiple model platforms. All relevant data files should be uploaded to the basin's shared data platform.
9. **Developed with state assistance.** The state should provide technical and financial assistance to develop groundwater models that use a consistent, transparent and collaborative model development framework that has been subject to third-party review by a hydrogeologist with modeling experience.

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