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Appendix 7-A
Model Maintenance and Improvements for the Sonoma Valley Groundwater Sustainability Plan

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Appendix 7-A:
Model Maintenance and Improvements

Groundwater Sustainability Plan

Sonoma Valley Groundwater Subbasin

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1 Introduction

The Groundwater Sustainability Plain (GSP) for the Sonoma Valley Subbasin (Subbasin) relied on groundwater modeling to support development of historical, current, and projected water budgets, and to evaluate projected benefits from implementing Projects and Management Actions (PMA) scenarios.

The Sonoma Valley Integrated Groundwater Flow Model, Version 1 (SVIGFM V1) is based on MODFLOW-OWHM and was developed by SCWA (SCWA, 2020). Recommended model improvements that are relevant to GSP implementation will be addressed during the first five years of GSP implementation. In addition to recommended model improvements, routine model maintenance activities will also be conducted during GSP implementation. Routine model update tasks include updating the model with recent land use, pumping, and climate data, and recalibrating the model, if necessary. Finally, model predictive simulations will be updated to reflect more new information on alternative future climate scenarios and PMA planning and implementation.

All model improvements incorporated during GSP implementation will build on additional data collection and interpretation activities described in GSP Section 7. These additional data will be used to verify model inputs (Section 2.2), compare against model outputs (Section 2.3), and guide improvements to model structure (Section 3).

This appendix summarizes model improvements that are planned during the first five years of GSP implementation, including updating input data, improving the model structure, and refining the representation of projected PMAs for the 5-year GSP assessment.

2 Update Data Inputs to Model

2.1 Update Simulation Period

The SVIGFM V2 simulation period covers the period from December 1969 through September 2018. During GSP implementation, the simulation period will be extended through Water Year (WY) 2025 for the 5-year GSP update due in 2027. As part of extending the simulation period, the following data inputs will be updated and incorporated in the model:

- Land use in the Subbasin and surrounding watershed, which will guide changes in agricultural irrigation pumping
- Rural domestic pumping rates and septic return flows
- Municipal and industrial pumping rates
- Streamflow diversion locations and rates

- Runoff and mountain-front recharge from tributary subcatchments
- Recycled water deliveries to agricultural and non-agricultural customers
- Precipitation and reference evapotranspiration

2.2 Verify Model Inputs Against Available Data

During assessment of SVIGFM V1, several model inputs were identified as sources of uncertainty due to uncertain or limited data. During GSP implementation, these model inputs will be validated against the following additional datasets collected as part of GSP implementation. Table 1 lists datasets that will be used for model input validation.

Table 1. Model inputs to be validated against data gathered during GSP implementation

Dataset	Description	Corresponding Model Inputs to be Validated
Commercial/industrial groundwater pumping, including Golf Club	Monthly volumes of groundwater pumping	Specified pumping rates for Golf Club wells in WEL package
Recycled water deliveries	Spatial and seasonal distribution of recycled water deliveries to farms	Non-routed deliveries specified in FMP package
Gage datum for Sonoma Valley above Kenwood	Resolve apparent discrepancies for the model streambed elevation for Sonoma Creek relative to the vertical gage datum for the USGS stream gaging station above Kenwood, and available digital elevation data.	Streambed elevation for Sonoma Creek at specified in SFR package
Aquifer hydraulic properties	Hydraulic properties inferred from both existing completed aquifer testing, if any, and additional testing conducted during implementation	Discrete zonal and continuously varying property fields in UPW package
Fault evaluation	Airborne electromagnetic survey and aquifer testing results and interpretation	HFB package
Riparian consumptive use	Spatial extent and rates of riparian consumptive use	Extent and crop coefficients used to represent riparian land uses in FMP package

Some datasets relevant to certain model inputs may not become available or be completed during the first 5 years of GSP implementation. These data include:

- Screened intervals for agricultural irrigation and rural residential wells
- Metered irrigation pumping
- Locations and rates of surface water diversions

Any datasets relating to the three items listed above will be evaluated opportunistically, as they become available, with the understanding that the schedule of model improvements and maintenance will not be dependent on those datasets. It should be noted that amounts, locations, and depths of groundwater pumping for all water use sectors has been identified as a key data gap in Section 7 of the GSP and will be addressed through additional data collection during GSP implementation; however, it is not anticipated that comprehensive data for all wells in the Subbasin will become available during the first 5 years of implementation.

2.3 Verify Model Outputs Against Available Data

Existing groundwater level, interconnected surface water, and seawater intrusion monitoring networks will be expanded during GSP implementation (GSP Section 7.2.4). Data collected from these monitoring networks will be used to check model simulation results and provide guidance to model re-calibration planned toward the end of the first 5 years of GSP implementation.

In addition to the data collected during monitoring network expansion, extent of mapped seeps and springs will be compared against the extent of simulated groundwater exfiltration, or surface leakage. Any discrepancies will be identified and used to guide both improvements to model structure and model recalibration.

3 Improvements to Model Structure

The following model structural improvements will be addressed during GSP implementation:

- Update model code to MODFLOW-OWHM2 (OWHM2; Boyce and others, 2020)
    - OWHM2 is the current supported version of MODFLOW-OWHM, and includes improvements to facilitate future model maintenance and reporting and simulate landscape processes
    - OWHM2 provides an option for internal calculation of surface water runoff both within and outside of active groundwater domain (within surrounding watershed). The SVIGFM V2 specifies surface water inflows to streams in the active groundwater domain based on the Basin Characterization Model (BCM) Including surface water runoff calculations internally in the SVIGFM would simplify the process of updating the model.

- Consider integrating tributary subcatchments into MODFLOW domain (i.e. simulate both the basin and the mountain-block)
- Assess model boundary conditions, and modify as needed:
    - Mountain-front recharge: upgrade to newer version of the Basin Characterization Model (BCM), BCMv8, as it becomes available and if necessary
    - Review recent data and evaluate any changes to position of the groundwater divide within the Kenwood Basin, which is specified as a no-flow boundary in the SVIGFM V2
    - Review General Head Boundary (GHB) representing San Pablo Bay
        - Review consistency of GHB reference elevations between Sonoma Valley and Petaluma Valley groundwater models
        - Review sensitivity of simulated water levels in the Baylands to GHB conductance

4 Five-Year Model Update and Maintenance

The SVIGFM, incorporating model updates and improvements described in Section 2 and Section 3, will be used to support the five-year update to the GSP. The updated model will be re-calibrated to both existing and new data collected during GSP implementation, and will be used to update historical and current water budgets (Section 4.1), and to provide future projected water budgets and water levels for comparison against Sustainable Management Criteria (SMC; Section 4.2) and to support planning and implementation of PMAs.

As part of the five-year update to the GSP, the latest available projected climate science and data will be reviewed and considered for incorporation into the scenarios for the 2026 through 2072 projected period.

4.1 Update Historical and Current Water Budgets for Reporting

As part of the five-year update to the GSP, the model will be assessed to determine if recalibration is necessary. If necessary, recalibration will occur after completing the model update and improvement tasks described in Section 2 and Section 3. Model recalibration would entail adjusting model hydraulic properties to improve the goodness-of-fit between hydrologic and hydrogeologic datasets, and their model-simulated equivalents. At a minimum, datasets to be used during model calibration would include:

- Groundwater level hydrographs at Representative Monitoring Point (RMP) wells, including all new wells in the monitoring network
- Streamflow hydrographs from existing and any new stream gages
- Individual low-flow discharge measurements collected during seepage runs

- Groundwater-surface water exchange rates calculated based on seepage runs

After completing model recalibration, revised simulated historical and current water budgets will be prepared through the extended simulation period (Section 2.1).

4.2 Update Future Projected Conditions

A number of PMAs were evaluated using the SVIGFM V2 (Appendix 6A). These included construction and operation of ASR wells, expansion of recycled water deliveries, and construction and operation of stormwater recharge facilities. Specific project details, such as ASR, recycled water deliveries, and stormwater recharge volumes and schedules, and infrastructure locations, were defined based on the best available information at the time.

As stated in Section 7.2.6 of the GSP, the GSA plans to immediately begin implementation of selected PMAs. This will include permitting and conceptual design. As specific project details are refined, the representation of PMAs in the model will be updated so that groundwater model projections are based on updated designs of PMAs.

The recalibrated model will be used to provide future projected water budgets and groundwater levels to be compared to SMC at RMPs. Updated future projected conditions will likely vary from projections in the GSP due to the following:

- Starting head distributions will reflect groundwater responses to climate and pumping stresses through WY2025
- The model structure and calibration will be revised relative to the SVIGFM V2
- Details of PMAs will have been further developed since GSP preparation

Predictive simulation results based on the updated and recalibrated model, with refined representation of PMAs, will then be processed to provide:

- Projected water budgets
- Projected groundwater levels relative to Sustainable Management Criteria for RMP wells
- Projected changes in exchange with interconnected surface water

5 References

Boyce, S.E., Hanson, R.T., Ferguson, I., Schmid, W., Henson, W., Reimann, T., Mehl, S.M., and Earll, M.M., 2020, One-Water Hydrologic Flow Model: A MODFLOW based conjunctive-use simulation software: U.S. Geological Survey Techniques and Methods 6-A60, 435 p., https://doi.org/10.3133/tm6a60Sonoma County Water Agency, 2020. Sonoma Valley Integrated Groundwater Flow Model, http://sonomavalleygroundwater.org/