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Supporting Information S2

How can we support the development of robust Groundwater Sustainability Plans? An illustrative example from Yolo County

Cache Creek model

We used the Cache Creek model that was built in Water Evaluation and Planning System (WEAP) software (Yates, Sieber, et al. 2005). WEAP is a modeling platform that enables integrated assessment of a watershed's climate, hydrology, landuse, infrastructure and water management priorities (Yates, Sieber, et al. 2005; Yates, Purkey, et al. 2005). Its rainfall-runoff routine consists of a lumped, one-dimensional, two storage soil water accounting that uses empirical functions to estimate evapotranspiration, surface runoff, interflow, and deep percolation (Yates 1996). These routines are applied to landscape areas that are the hydrological response units (HRU), which are called WEAP catchments. The Cache Creek model, run at a monthly time step, covers 5072 sq km from the Cache Creek watershed up to Capay, and all of Yolo County (see Figure 3 of main text). The model area is discretized into 13 catchments described in (Table S2.1), each with its own climate and land-use time series.

Table S2.1

ID	Area (km^2)	Catchment	Description	Dominant land use
CC-01	150	Upper Indian Valley	Twin Valley and Bartlett Creeks	Forest
CC-02	162	Middle Indian Valley	Spanish Creek and Indian Valley Reservoir	Forest
CC-03	268	Lower Indian Valley	Wolf, Long Valley, Hog Hollow and Grizzly Creeks to confluence with Cache Creek	Forest
CC-04	115	Kelsey Creek	Kelsey Creek	Forest
CC-05	1149	Clear Lake	Clear Lake except Kelsey Creek, Copsey Creek and Siegler Canyon	Forest, grassland, some urban
CC-06	45	Copsey Creek	Copsey Creek	Forest, grassland
CC-07	93	Seigler Canyon	Seigler Canyon which ends below gauge at confluence with North Fork	Forest
CC-08	183	Upper Cache Creek	From North Fork confluence to Bear Creek confluence, including Rocky and Davis Creek	Forest
CC-09	266	Bear Creek	Bear Creek to confluence with Cache Creek	Forest, grassland
CC-10	349	Capay Valley	Capay Valley to Capay Diversion Dam	Forest, grassland, agriculture
YC-01	186	Willough slough	Willow Slough headwaters outside District service area	Grassland, forests, agriculture
YC-02	753	YCFCWCD Lower	District service area below Capay Dam	Agriculture
YC-03	1308	Yolo East	Yolo County portion outside District service area	Agriculture

WEAP includes routines for reservoir operations and a linear programming routine for allocating water based on prioritization of water demands. The Cache Creek model includes the operating rules and characteristics for the Clear Lake and Indian Valley reservoirs, the District's two main sources of water supply. In particular, the water releases for the District's water supply from Clear Lake are limited by the 1978 Solano Decree (Superior Court of the State of California 1978; Superior Court of the State of California 1995)- these rules have been integrated into the Cache Creek model (Mehta et al. 2013). The District supplies water through a large network of largely unlined canals; these are aggregated in the model as a single transmission link, including the substantial losses to groundwater that occur from this canal system. Crop water demand at each time step is determined in the model using a reference crop estimation, crop coefficients and cropping schedules. Irrigation water requirements for 17 crops are simulated in the model by setting crop-specific irrigation thresholds (Mehta et al. 2013) that correspond to volumetric soil moisture below which irrigation water is demanded by the crop.

Since the model building and calibration are described in detail in (Mehta et al. 2013), only essential features are summarized here, with more details provided regarding the calibration of additional enhancements, namely, the groundwater-surface water interactions. Table S2.2 summarizes the calibration of the model across hydrology, water demand, and water supply dimensions.

Deep percolation recharges groundwater, and was represented using a calibrated groundwater-surface water interaction routine based on the “wedge” model routine found in the WEAP software (1). This routine was used to simulate lowland-aggregate groundwater depth that could be used to implement a simplified groundwater conservation rule under SGMA. This groundwater parametrization was informed by the literature on groundwater supply in the Yolo groundwater sub-basin (Scott & Scalmanini 1975; DWR 2004), as well as on other groundwater and surface water information contained in various studies undertaken by the District, including its integrated water resources management plan and groundwater specific studies (Borcalli and Associates 2000; WRA 2005; WRA 2007; WRIME 2006; RMC Water and Environment 2011;

YCFCWCD 2012). The groundwater balance was estimated for the area of the District over the Yolo groundwater sub-basin, with the reach of Cache Creek below Capay dam to the town of Yolo providing the groundwater-surface water interaction. Estimated aquifer storage between 20 and 300 feet bgl was set at 6 MAF, hydraulic conductivity at 2000ft/day and specific yield at 0.058. Overall performance of the routine is shown in Figure 4 of the main text.

Table S2.2 Calibration summary

Type	**Type**	**Period**	**Calibration performance**	**Comments**
Kelsey creek	Unregulated streamflow	WY1975-WY2000; n=300 months	Bias=2%; NSE=0.65; r2=0.78	
Hough Springs	Unregulated streamflow	WY1970-WY1994; n=228 months	Bias=2.2%; NSE=0.55; r2=0.67	
Clear Lake	Reservoir levels	WY1970-WY2005;n=840 months	Bias=-1.9% r^2=0.87	
Indian Valley	Reservoir levels	WY1976-WY2005; n=720 months	Bias=4.3% r2=0.70	
Irrigation	Applied Water	1998-2001;n=48 months	Mean deviation=0.2% Mean absolute deviation 2.7%	Across all 17 crops
Groundwater depth	Groundwater calibration	1975-2009; n=34 months	Bias=2.9ft; r2=0.92;rmse=4.75ft	Based on average of October readings from 99 wells

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