SANTA ROSA PLAIN
GROUNDWATER CONDITIONS

The Santa Rosa Plain is a distinctive, ecologically and economically important hydrologic area of Northern California. Many of its finest attributes and assets are directly related to its water resources, which includes strong reliance on groundwater to meet demands. Trends in water use, land use, population growth, and climate change indicate that the region's water resources will come under increasing stress in the future, requiring careful and thoughtful monitoring and management. The Basin has been the subject of technical studies and voluntary groundwater management programs that provide a strong technical and institutional foundation to build upon under SGMA. The USGS completed studies and modeling of the basin in 2014, and basin stakeholders completed a voluntary Groundwater Management Plan (GMP) that same year.

SANTA ROSA PLAIN HYDROGEOLOGIC CONCEPTUAL MODEL AND GROUNDWATER CONDITIONS

This summary of the conceptual model of groundwater conditions in the Santa Rosa Plain Watershed is intended to provide an overview of the hydrogeologic setting and historical and recent groundwater conditions.

WATERSHED AND CLIMATE

The Santa Rosa Plain is located within the North Coast Ranges of northern California, which has a Mediterranean climate, with moderate temperatures and distinct wet and dry seasons. About 90 percent of the annual precipitation typically occurs during the months of November through April, and nearly half of the precipitation is due to atmospheric rivers, which concentrate rainfall and runoff along narrow bands.

Mean annual precipitation at Santa Rosa has been variable and averaged 30.7 inches in the Basin during the 113-year period from 1903 through 2016, with 7 of the last 10 years seeing below average rainfall, including 8 years of a state-defined drought. Stream discharge patterns typically mirror rainfall, with peak flows occurring in response to precipitation. Significant for Santa Rosa Plain is that late spring rains provide soil moisture to crops, thereby reducing spring and early summer groundwater demands. Hydrologic models of potential climate change scenarios predict that precipitation could be subject to increased variability resulting in reduced water supply reliability and increased water demands due to increased evapotranspiration rates during warmer and extended summers.

HYDROGEOLOGY

The Santa Rosa Plain is located within the geologically complex North Coast Ranges of California, dominated by northwest trending valleys with faults that may act as barriers to groundwater flow, or conduits to deeper saline water intrusion. The four main geologic units (groups of rocks with similar characteristics) which form the primary aquifers in the Santa Rosa Plain are sedimentary deposits of the Alluvium/Glen Ellen Formation, the Wilson Grove Formation, the Petaluma Formation, and the Sonoma Volcanics. The Basin's best water-producing units are stream channels filled with alluvial (water and air deposited sand, silt, clay and gravel) sands and gravels; basin-fill alluvium and alluvial fan deposits that connect the Santa Rosa Plain with its bordering hills; and massive sandstone units of the Wilson Grove Formation extending beneath the Basin from the low western hills. The Sonoma Volcanics, a thick sequence of lava flows present along the eastern boundary of the Basin, and the Petaluma Formation, a shale and sandstone unit that extends beneath much of the deeper portions of the Basin, produce variable amounts of water.

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GROUNDWATER LEVELS AND MOVEMENT

Monitoring of groundwater levels over time indicates a general pattern of groundwater movement from the highlands towards the axis of the Basin to the location of the Laguna de Santa Rosa, which historically was the main location of natural groundwater discharge. In addition, groundwater moves toward and discharges into stream channels, sustaining stream baseflow in many parts of the Basin. Historically, as more wells were added to the Basin and agricultural, domestic and urban pumpage increased over time, groundwater levels dropped, less groundwater discharge occurred in the Laguna De Santa Rosa and more discharge resulted from well pumpage. As pumping increased, two pumping depressions formed, one in the west part of the Basin and the other in the Rohnert Park-Cotati area of the Basin in the early 1990's, with increased urban pumping considered largely responsible. Since the early 2000s, increases in imported surface water from the Russian River and water conservation have greatly reduced groundwater demand. More recent monitoring and groundwater level contour maps show significant groundwater recovery in the Rohnert Park-Cotati area of the Basin, with the depressions largely recovered, and shallow wells are generally stable while deeper zone wells vary with some increasing, some stable and some declining groundwater levels.

WATER QUALITY

Groundwater quality within the Santa Rosa Plain is highly variable throughout the study area and generally acceptable. Manganese, iron, boron, and arsenic are potential constituents of concern that occur naturally in groundwater and exceeded secondary or health-based standards for drinking water. While concentrations of chloride and specific conductance are predominantly well below secondary drinking water standards, increases have occurred in two-thirds and three-quarters of the wells evaluated for the study, respectively.

WATER BUDGET

The US Geological Survey developed a groundwater flow model for the entire watershed encompassing the Basin (that was used to simulate an average groundwater budget from 1976 to 2010:

- Rainfall percolation and streambed infiltration together recharged an estimated 73,000 acre-feet per year of groundwater, accounting for over 90 percent of total groundwater inflow on average.
- Overall, streams are a net source of groundwater recharge. That is, over the entire watershed, more surface water was lost to groundwater (known as a losing stream reach) than was gained by groundwater flowing into streams (known as a gaining stream).
- Groundwater pumping increased from a long-term average of 36,000 acre- feet per year (1976-2010) to an estimated 42,000 acre-feet per year between 2004 and 2010. The increase is mainly attributed to increased rural pumping.
- From 1976 to 2010, 120,000 acre-feet were lost from overall groundwater storage, or an average of roughly 3, 300 acre-feet per year.

Increased pumping has reduced the total amount of groundwater in storage across the Basin, and groundwater levels have declined slightly - although the estimated storage loss is only a small percentage of both total groundwater storage and the long-term average recharge rate. However, because groundwater helps support stream flows, even slight declines in groundwater levels may result

in decreased streamflows overall, with associated ecosystems and habitat decline.

The model also examined the potential impacts of four climate change scenarios on the Santa Rosa Plain, including the effects of two different global climate change models, combined with both higher and lower greenhouse gas emission scenarios. General results of all four climate change simulations include an overall lowering of groundwater levels, reduced baseflow in streams, reduced evapotranspiration and reduced groundwater discharge to wetlands and springs. Declining groundwater levels also result in additional losing stream reaches, further reducing streamflow as larger quantities of surface water sinks into the ground.