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Executive Summary

Understanding Multiple Benefits of Floodplain Restoration from Flood-Managed Aquifer Recharge in Madera County, California

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Groundwater supplies ~40% of California's water, but intensive groundwater use is lowering water tables, reducing aquifer storage, degrading water quality, inducing land subsidence, and depleting streamflow. In response to these issues, the state passed the Sustainable Groundwater Management Act (SGMA) in 2014 requiring Groundwater Sustainability Agencies to develop plans to balance groundwater withdrawals and groundwater recharge. An important strategy emphasized in many Groundwater Sustainability Plans is the augmentation of groundwater supply through the expansion of recharge projects.

One such strategy is Flood-Managed Aquifer Recharge (Flood-MAR) – an integrated water resource management strategy “that uses flood water resulting from, or in anticipation of, rainfall or snow melt for managed aquifer recharge on agricultural lands and working landscapes, including but not limited to refuges, floodplains, and flood bypasses” (quoting California Department of Water Resources, 2018). Highlighted action items from the California Department of Water Resources include the mapping of floodplain habitats and their potential for groundwater recharge, but more research is needed to understand the capacity of Flood-MAR to achieve multiple benefits.

The “Flood Forward” Project quantifies the multiple benefits of implementing Flood-MAR in the historical floodplains of river systems in the Madera and Chowchilla groundwater subbasins, located in the San Joaquin Valley of Central California. Our project analyzes three priority benefits, as determined by Flood Forward and its clients, the Environmental Defense Fund and California Department of Water Resources: 1) flood risk reduction, 2) floodplain ecosystem enhancement, and 3) groundwater recharge. Using geospatial analyses, this project provides a framework for determining priority areas in Madera and Chowchilla subbasins for locating groundwater recharge projects for the achievement of the co-benefits of flood risk reduction and ecosystem enhancement. The main finding of our geospatial

analysis is that there are numerous areas that may be well suited for Flood-MAR, most of which are located along the riparian corridors of smaller streams and tributaries within the study area.

Our results illuminate the important role that local, watershed-scale floodplain restoration actions can have in achieving the multiple benefits of Flood-MAR, and inform basin managers in Madera and Chowchilla subbasins on priority locations for implementing such projects. The sensitivity analysis results can be used to improve recharge project site prioritization by demonstrating which locations consistently receive high priority scores when the relative weight assigned to each input parameter is experimentally adjusted. The tradeoff analysis develops an understanding of how priority site locations may change depending on different potential management preferences. Ultimately, being better informed when prioritizing locations for multiple-benefit Flood-MAR in floodplain habitats will allow managers and stakeholders to successfully implement such projects in their efforts to comply with SGMA.

The Flood Forward Project provides an analytical framework that can be applied in different geographies throughout California by Groundwater Sustainability Agencies, Environmental non-profits, and local government agencies. Stakeholders can utilize this framework to implement floodplain restoration projects in smaller streams and tributaries that serve as a supplemental management opportunity to larger-scale flood risk reduction, restoration, and groundwater recharge projects. Our analysis provides key information required to help managers move from planning to implementation of multiple-benefit groundwater recharge projects as outlined in Groundwater Sustainability Plans. The spatial prioritization of project locations provided by our framework will be valuable in the ongoing effort to achieve groundwater sustainability across California's Central Valley.



Key Words: Sustainable Groundwater Management Act, groundwater recharge, multiple benefits, flood managed aquifer recharge, water resources, flood risk reduction, ecosystem enhancement, Central Valley, California