Groundwater Response to Natural Infrastructure in Dryland Streams in Baja California Sur, Mexico

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Rural communities in arid Baja California Sur, Mexico, rely on groundwater for water supply that is recharged during infrequent storms. Detention structures designed to disperse and slow flashy streamflow, known as Natural Infrastructure in Dryland Streams (NIDS), are a nature-based solution for restoring ephemeral channels. However, effects of NIDS on groundwater recharge have not been fully quantified. This study evaluates whether NIDS enhances groundwater recharge. Depth to water and streamflow duration are indicators of groundwater storage capacity and can be used to identify locations of bedrock springs or areas of potential alluvial storage. Groundwater levels and streamflow are compared in watersheds with and without NIDS to determine 1) how NIDS affect overall groundwater hydrology, 2) what hydrogeologic factors related to NIDS sites have the largest effects on recharge, and 3) what magnitude of change in recharge occurs at NIDS sites after considering variations in NIDS placement, geology, evapotranspiration, and precipitation?

To address these questions, we established a network of fifteen wells in four watersheds to assess event-driven changes in water levels. Six surface water gages and three meteorological stations supplement this network. Three storm events, including hurricane Norma, were recorded in 2023. Groundwater levels rose rapidly in most wells indicating recharge in response to precipitation. Groundwater levels receded at different rates in the alluvium, whereas levels rose after several weeks near suspected bedrock fracture zones. Lag and attenuation of peaks in the groundwater hydrographs indicated that flow is occurring through hydrologic units characterized by lower conductivity, greater storage capacity, longer flow paths or a combination of factors. The impacts of NIDS on recharge volumes will be further explored using geophysical data and groundwater modeling. Understanding the underlying hydrogeology at restoration sites can help optimize NIDS site selection and quantify the impacts of restoration on groundwater availability.

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