ICONS

Interconnected Surface Water in the Central Valley
The Nature Conservancy, California
June 2023

Sustainable groundwater management in California requires an understanding of how groundwater pumping affects surface water features. Groundwater seeps into many river and lake beds in California, providing a steady source of cool clean water. This source of water is crucial for people and nature because it remains steady throughout the year even after the winter rains stop. Under the Sustainable Groundwater Management Act (SGMA), interconnected surface water (ISW) is defined as "surface water that is hydraulically connected at any point by a continuous saturated zone to the underlying aquifer and the overlying surface water is not completely depleted" (Groundwater Sustainability Plan Emergency Regulations). SGMA requires special treatment of ISW, but in many parts of the state, ISW is poorly understood. This dataset categories rivers and stream segments on the likelihood that they are ISW, using groundwater depth as a proxy to determine ISW. This data is available to view in an interactive online map at: http://icons.codefornature.org/.

Methods and Data Sources:
The groundwater elevation data, available for Spring 2011-2012, and Spring and Fall 2013-2018, comes from the California Department of Water Resources (https://sgma.water.ca.gov/webgis/?appid=SGMADataViewer). These data are represented as continuous raster layers that approximate "feet above or below mean sea level" based on groundwater well measurements. According to the documentation online, groundwater level measurements were selected based on measurement date and well construction information (where available) and are intended to approximate the groundwater levels in the unconfined to uppermost semi-confined aquifers. Each of the raster layers has a different extent, but all of them are limited to the Central Valley. To determine ISW, we used ArcGIS software to calculate the average, minimum, and maximum groundwater elevation for the years with available data. Next, we subtracted the elevation grids from the statewide 30-meter resolution digital elevation model (DEM). The resulting layers represent the mean, minimum, and maximum *depth* to groundwater, expressed in feet below the ground surface. Finally, we used flowline data from the National Hydrography Dataset Plus (https://nhdplus.com/NHDPlus/NHDPlusV2_home.php) to assign groundwater depth values to river and stream segments up to 45 meters in length. We developed a new shapefile of stream segments with three attributes representing mean ("Depth_Mean"), minimum ("Depth_Min"), and maximum ("Depth_Max") groundwater depth (each in feet below the ground surface). The attribute "ISW" categorizes the likelihood of the ISW connection based on the minimum depth to groundwater. Using minimum groundwater depth for the categorization provides a conservative estimate of ISW, identifying streams as ISW if they have been connected to groundwater at any point over the last ten years.

ISW likelihood is split into the following four categories, based on depth to groundwater:

- Likely Connected – Gaining: Groundwater elevation is equal to or greater than the surface water elevation and thus groundwater is likely flowing into the surface water body.
- Likely Connected – Losing: Groundwater elevation is between 0 and 20 feet below the surface water elevation and thus groundwater is likely receiving water from the surface water body through a continuous saturated zone.

- Uncertain: Conditions where the groundwater elevation is between 20 and 50 feet below the surface water elevation are labeled as uncertain because the groundwater may or may not be connected to surface water.
- Likely Disconnected: Groundwater elevation is greater than 50 feet below the surface water elevation and thus is likely disconnected from the surface water body.

Since there is no comprehensive data on stream depth, we analyzed all the gage height measurements from USGS gages in the Central Valley. For some (17%) of the stream gages, the average gage height measurement was greater than 20 feet. This is only a proxy for the depth of the stream at the gage location because gage height is measured from a reference elevation which may or may not be the bottom of the stream bed. However, since this is the best information available, we chose a breakpoint of 20 feet between losing and uncertain streams.

Suggested Citation:
The Nature Conservancy, California. ICONS: Interconnected Surface Water in California's Central Valley, Version 1.0.2. https://icons.codefornature.org/. June 2023.