WHERE’S THE WATER IN COLORADO?

OVERVIEW

Water resources for human populations are drawn from surface water and groundwater near population centers. The High Plains Aquifer is a major bedrock aquifer located under Colorado’s eastern border, and several smaller bedrock aquifers serve the rest of the state.

On average, Colorado receives between zero and 58 inches of precipitation per year in different parts of the state. Most of the state receives less than 30 inches of precipitation annually. For context, areas that receive less than 10 inches of precipitation each year are deserts. Massachusetts receives about 45 inches per year, whereas Nevada averages about 9.5 inches per year. While Colorado is not considered a desert, it is still important to understand how the water supply is managed, particularly if Colorado’s major cities are not close to the largest stores of surface water and groundwater.

The spatial distribution of water determines how much water is transported from rural areas to populated areas. In general, areas with higher population density require more water, and this project indexes water availability relative to demand based on population density.

METHODS

The main data layers are Annual Average Precipitation, Elevation, River Density, Bedrock Aquifers, and Population Density.

Precipitation data came from NOAA’s Climate Data Online. Annual precipitation data from 2014 to 2018 with corresponding geographic coordinates were loaded into ArcMap as XY data. The five data layers—one for each year—were joined into a single table, and the average annual precipitation was calculated for the period 2014 to 2018. The data were interpolated using the IDW method.

River density data came from a national surface water dataset from ESRI Data & Maps 10. The data were clipped to the Colorado state border and then converted to a line density raster with five equal-interval categories.

Population density is organized as population per square mile and broken into five classes using Jenks Natural Breaks.

Aquifer storage is assumed to be uniform throughout the aquifer volume.

RESULTS

Water availability in Colorado is impacted by precipitation, surface water, groundwater, and population density. The areas with the lowest water availability are near Denver, Fort Collins, Colorado Springs, and Pueblo, which are areas of high population density relative to the rest of the state. These cities are situated above the edges of the major bedrock aquifers. The areas with the highest water availability are located in the Rocky Mountains at high elevations; these areas are also the locations with high annual precipitation and river density.

The data layers were factored into a weighted sum to classify spatial water availability in Colorado. Precipitation (P) was ranked from 1 to 5, with 1 representing areas with the lowest precipitation and 5 representing areas with the highest precipitation. River density (R) and population density (H) were similarly ranked with 1 as very low density and 5 as very high density. Aquifer data (A) was classified as 1 in areas overlying a bedrock aquifer and 0 in areas not overlying a bedrock aquifer. These variables were added to create an index of water availability (W).

\[ W = P + R + A - H \]

SOURCES

ESRI Data & Maps 10, Colorado DOT, State of Colorado, NOAA, USGS

PROJECTION

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