

HPGA Hydrogeology Project

BACKGROUND AND RATIONALE

Since 2013, the High Plains Grasslands Alliance has participated in, and financially helped support, a regional scale hydrogeology project geared toward identifying and mapping groundwater resources to help landowners better manage and plan for future water use and development. The project is led and coordinated by Zeigler Geologic Consulting, based out of Albuquerque, NM and has to date engaged landowners in both Union and Mora Counties. The Mora County work has been focused within the Mora-Wagon Mound Soil and Water Conservation District, which encompasses the HPGA land base.

Currently, 27 wells are being monitored within the Mora/Wagon Mound Conservation District for static water levels. Eleven of these are located on HPGA ranches. A subset of these wells has been sampled to determine basic water chemistry and water age. Water sampling analyses have included carbon-dating water to assess aquifer recharge rates and assessment of appropriate ions to set a baseline in the event that fracking becomes an issue in the region. Digitized geologic mapping will further provide a better understanding of potential aquifer units and their associated porosity and permeability. Collectively, this information will be used to support land-management decision-making at both the landowner and county levels.

The HPGA decided to participate in and support this project because the economic and ecological viability of ranch businesses is inherently tied to long-term water availability. Thus, an understanding of groundwater resources will help inform land management decisions at both local and regional scales. From the perspective of the individual ranch, there is substantial economic value in knowing whether the ranch's wells are losing water, whether the aquifers on which those wells rely are recharging, and at what rate those losses or gains in water are occurring. Understanding these dynamics at the scale of the individual ranch empowers managers to make informed decisions for the betterment of the ranch and its associated businesses.

For instance, a recent parallel study in Union County showed that much of the county is not part of the Ogallala Aquifer as previously thought. Rather, many landowners are dependent on small, isolated aquifers that are not recharging. As a result, some landowners switched from crop farming to ranching, some farmers altered their crop management practices and a few shifted away from agriculture (whether farming or ranching) altogether. The rate of depletion taking place on specific properties determined the rate of decision-making and nature of the decisions that had to be considered.

At a regional scale, counties and soil and water conservation districts are using this information to better plan for future agricultural and municipal water use, and to inform economic development. Mora County is following in the footsteps of Union County and as their data set develops, this information will be shared with resident landowners so that they can begin the decision-making process as well. In addition, the neighboring counties of Colfax and Harding are joining with Union and Mora Counties to develop a region-wide groundwater project. Members

of communities in all four counties will have access to data on both regional and local scales. An important part of these two studies is the education that has been a significant component of the process. Producers have been taught how these data are collected and why they are important. In turn, the geologists involved have been learning aspects of the agricultural cycle that allow them to focus their efforts on areas with the greatest potential for resource management issues.

UNDERSTANDING THE HYDROGEOLOGY PROJECT

Any hydrogeology project requires a fundamental data set that includes a minimum of:

- Static water level measurements in a well-distributed set of water wells (5-10 years)
- Geologic information about the surrounding area, including subsurface data (4-6 years)
- Water chemistry data (2-3 years)
- Water age data (2-3 years)

Static water level measurements provide information about drawdown and recovery of an aquifer unit. By choosing a set of wells that are distributed across a county (or district), we can develop a sense of where the water table is falling or rising. Static water levels are usually measured in January to record water levels in minimum use season and in August to measure the maximum use. The recovery of an aquifer unit between August and January is useful information that stems from these biannual measurements. To get a true sense of groundwater fluctuations, it's best to collect biannual measurements for at least five years, with ten years being the ideal.

Groundwater is stored in and transmitted through porous and permeable rock types such as sandstone, fractured limestone, conglomerate and unconsolidated sands and gravels. It is important to know the geologic units present both at the surface and in the subsurface in order to know which rock units will be acting as aquifers and which may present barriers to groundwater flow. In addition, faulting, folding and paleotopography in the subsurface may cause aquifer units to occur at unexpected depths or be cut off from potential recharge. Geologic data includes surface geologic maps and rock unit descriptions, as well as petroleum and water well log data. Petroleum and water well logs provide snapshots of the geology in the subsurface and this information can be correlated among wells to help understand the position and thickness of rock units below the ground.

Just as the geology provides the overall context for the movement of water under the landscape, so does it provide valuable clues to where water is present in the subsurface. The chemistry of groundwater is related to the rock unit(s) with which it has been in contact. For example, the Morrison Formation sandstones contain the mineral feldspar, which includes sodium and potassium in its crystal structure. Water that is sampled for water chemistry and returns relatively high proportions of sodium and potassium is probably from a Morrison Formation sandstone. The combination of geologic mapping, well logs and chemistry give us a much more complete picture of the subsurface.

Water age data helps illustrate whether or not a particular aquifer unit may be recharging. ZGC uses two different isotopic dating systems: carbon-14 and tritium. Usually, samples for carbon-14 dating are collected first and if the age of the water for a particular well is less than 1000 years old, then the same water will also be analyzed for tritium. Tritium is useful for determining whether “modern” water has entered a groundwater system because this isotope has a very short half-life. A well with water that has no tritium in it has little or no recharge entering the aquifer unit.

Building these data sets for a large area is critical to gain a better understanding of groundwater resources and can be used to assist communities and producers with crafting informed decisions regarding groundwater use. Studies conducted by Oklahoma State University over the past five years have demonstrated substantial reductions in the proportion of land under center pivot irrigation in Union County, NM where landowners are learning about their groundwater resources. In contrast, in Cimarron County, OK where farmers and ranchers do not have access to this type of groundwater information, the number of acres under center pivot irrigation has increased. Thus, having fundamental information on local and regional groundwater dynamics is altering land management techniques by farmers and ranchers.