Four County Groundwater Initiative
(Colfax, Harding, Mora, Union)

Severe drought conditions for the past 10 or more years have had major impacts on the economy of Northeastern New Mexico. The four county area is largely groundwater dependent. There is very little surface water for agricultural or municipal use. Future economic development depends upon a sustainable source of water. It is important to have baseline data not only for the quality of the water, but the water levels prior to any development. The Village of Maxwell gets 100% of their water from a shallow well field that has been severely depleted by the drought.

Colfax County is cooperating with Harding, Mora and Union Counties, the municipalities within the four-county region, and the Soil and Water Conservation Districts that represent this region to fund an aquifer mapping endeavor to better understand the groundwater resources. The goals of this project are to define groundwater bearing rock units in the subsurface, begin tracking changes in water levels in existing wells, and determine the age of water residing in the aquifers that are in use or may be used in the future. This information will allow the communities and producers to make informed decisions regarding groundwater use.

Eighteen entities within Northeastern New Mexico have signed on to a Memorandum of Understanding with the program intent being to support a groundwater monitoring study to determine the groundwater resources and quality within the area. The intent is to identify resources for future development and identify areas that should not see further development for agricultural and municipal use or for future economic development. Further intent is to educate the public about groundwater resources and management of such.

The primary objective of the four-county hydrogeology project is to characterize the groundwater systems utilized by the communities and producers to the fullest extent in terms of 1) static water level measurements in existing wells, 2) geologic information about the surrounding area, including subsurface data, 3) water chemistry data, and 4) water age data.

Static water level measurements provide information about drawdown and recovery of an aquifer unit. By choosing a set of wells that are distributed across the region, we can develop a sense of where the water table is falling or rising.

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. Geologic data includes surface geologic maps and rock unit descriptions, as well as petroleum and water well logs. Just as the geology provides the overall context for movement of water under the landscape, so does it provide valuable clues to where the water is present in the subsurface?

The chemistry of groundwater is related to the rock units that it has spent time in contact with. 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 mappings, well logs, and chemistry give us a much more complete picture of the subsurface.

Water age data helps us to understand whether or not a particular aquifer may be recharging. Using two different isotopic dating systems: carbon 14 and tritium, makes it possible for an approximate age of the water to be determined. Tritium is useful for determining if "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.

This proposed geohydrology study is based upon preliminary work started by Northeastern and Mora-Wagon Mound Soil and Water Conservation Districts. Expanding this effort to a four county region will provide those data sets for a large area that are critical for our understanding of groundwater resources and can be used to craft informed decisions regarding groundwater resource use. The Union County data demonstrates that aquifers to the east are not being recharged except in the Dry Cimarron. The lack of any pattern to the carbon-14 dates tells us there is no connection between the Rocky Mountain Front Range

and the High Plains. We need to try and find out where this connection is broken so the producers and communities know if they are in a recharging area or not.

The total cost over a three year period for the four county region is $1.723 million. Broken down by Soil & Water Conservation districts as follows:

Colfax:	Year 1-	$125,120.00	**Mesa:**	Year 1-	$90,920.00
	Year 2-	$125,945.00		Year 2-	$93,745.00
	Year 3-	$125,945.00		Year 3-	$85,483.00
		$377,010.00			$270,148.00
15% contingency		$56,551.50			$40,522.20
Total		$433,561.50			$310,670.20

Ute Creek:	Year 1-	$90,920.00	**Mora-Wagon Mound**	Year 1-	$90,920,00
	Year 2-	$93,745.00		Year 2-	$93,745.00
	Year 3-	$85,483.00		Year 3-	$85,483.00
		$270,148.00			$270,148.00
15% contingency		$40,522.20			$40,522.20
Total		$310,670.20			$310,670.20

Northeastern:	Year 1-	$118,561.00
	Year 2-	$106,435.00
	Year 3-	$85,908.00
		$310,904.00
15% contingency		$46,635.60
		$357,539.60

Total Cost:	Year 1-	$516,441.00
	Year 2-	$513,615.00
	Year 3-	$468,302.00
15% contingency		- $224,753.70
Total		$1,723,111.70

Findings from initial groundwater surveys conducted in eastern Union County provide the foundation for expanding this effort into the surrounding counties. The data from the Union County project demonstrates the following points:

1. The subsurface geology is more complicated than has been shown by previous research. This complexity means that determining where aquifer units are in the subsurface and which aquifer units are being utilized is not straight forward. The geology of much of this area has not been mapped in detail in decades, if ever. The geology is critical to understand where aquifer units are, how thick they are and how continuous they are in the subsurface.

2. Tritium and carbon-14 data indicate that much of Union County does not receive any modern recharge, or very minimal volumes. This shows that the supposed recharge pathway from the front range of the Sangre de Cristos Mountains to the High Plains is interrupted somewhere between the mountains and the Colfax/Union County border. This disconnect needs to be understood and we need to determine where along that pathway the water begins to fail to enter the aquifer units utilized by producers and communities. A lack of recharge has significant implications for how producers and communities choose to use groundwater resources.

3. Groundwater (and surface water) does not stop at political boundaries. It is important to study groundwater in a detailed manner at a regional scale in order to be able to provide communities and producers within the region with solid information on which they can base their groundwater use decisions.

Other than the study for Northeastern Soil & Water Conservation District, the geology of the region has not been studied in detail. The New Mexico Bureau of Geology efforts in northeastern New Mexico focused solely on a narrow strip east of Clayton. The United States Geological Service (USGS) maintains a website indicating wells that are currently or have been monitored in the past for static water level measurements. A review of this website for all counties indicate that Union and Harding County have long histories of measurements and are still

sporadically monitored by the USGS. Review of the website for Mora and Colfax Counties show approximately two dozen wells with sporadic data, some with only one or two measurements. The latest measurements are generally around 2012, with only a few wells having more recent data. Given the lack of data on the USGS website and their distribution of wells across the proposed study area, we feel we are not duplicating efforts, but adding to the existing data set.

The New Mexico Office of the State Engineer (OSE) does also monitor wells within the proposed study area. Working with the OSE to add additional data to their data set by filling in gaps in their distribution of wells, will enhance our knowledge of groundwater resources within the region.

A survey of existing literature for this region shows that major groundwater studies were mostly done in the 1960s and there have been few efforts to update other than small studies focused on very particular areas. (1972 study of the Mora drainage basin, 1987 study on the Roy- Solano area) The most complete study for Colfax County was the Geology and Ground-Water Resources of the Eastern Part of Colfax County prepared by Roy L. Griggs in 1948.

Our proposal is to enhance and build upon all these data sets. This would be the first time that measurements of static water levels in existing wells, geologic information, water chemistry and water age data would be incorporated into one study. This information will allow producers and communities to identify resources for future development and identify those areas that should not see further development. It will also provide accurate data to educate the public about groundwater resources and conservation that will sustain municipalities over time.