



Updating Groundwater Parameter Maps in Eau Claire County

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Introduction

Groundwater demand in portions of western Wisconsin has grown substantially in the last few years due to the increase in sand mining and the number of high capacity wells used for irrigation. This increased demand requires a better understanding of available groundwater supplies and potential contamination sources. In Eau Claire County, the publically available information related to groundwater flow and susceptibility to contamination is somewhat limited. Existing maps were produced over 25 years ago and were compiled from generalized maps ranging from a scale of 1:250,000 to 1:500,000 (Markham, et al., 2008); these maps are available only as static documents. In this project, we seek to update and improve the publically available groundwater information in Eau Claire County using higher resolution data and updated methodologies. This first phase of this project was to create a digital groundwater elevation map based on approximately 3,000 monitoring well construction reports and LIDAR elevation data. The second phase was to produce an improved digital groundwater susceptibility map by evaluating factors such as depth to water, soil thickness, topography, and permeability of soil and bedrock. The maps generated from this project are interactive and will be available to municipal officials, homeowners, and other interested parties and can be used to guide public policy for protection of local groundwater resources.

Groundwater Elevation Map

A map of groundwater elevation was created by finding the land surface elevation throughout the county, then subtracting the depth to the water table from the ground surface. A map of land surface elevation is available from the county. The first portion of this research focused on finding the depth to the water table from the ground surface. Water-supply well-construction data include the depth to the water table; well construction reports were obtained from the Wisconsin Department of Natural Resources for 2,943 wells installed between June 1940 and October 2014. 1,318 wells for which the listed owner's addresses could be matched with the Eau Claire County address data were repositioned to the corresponding address. The remaining wells were mapped to the center of the quarter-quarter section (40 acre section) of the public land survey system. The depth to groundwater information in the wells data were subtracted from ground surface elevation data to calculate groundwater elevation for each well. The groundwater elevation data was then interpolated into a continuous groundwater surface elevation data which was contoured in ArcMap. The continuous groundwater elevation data was then subtracted from the ground surface elevation data to calculate continuous depth to groundwater data.

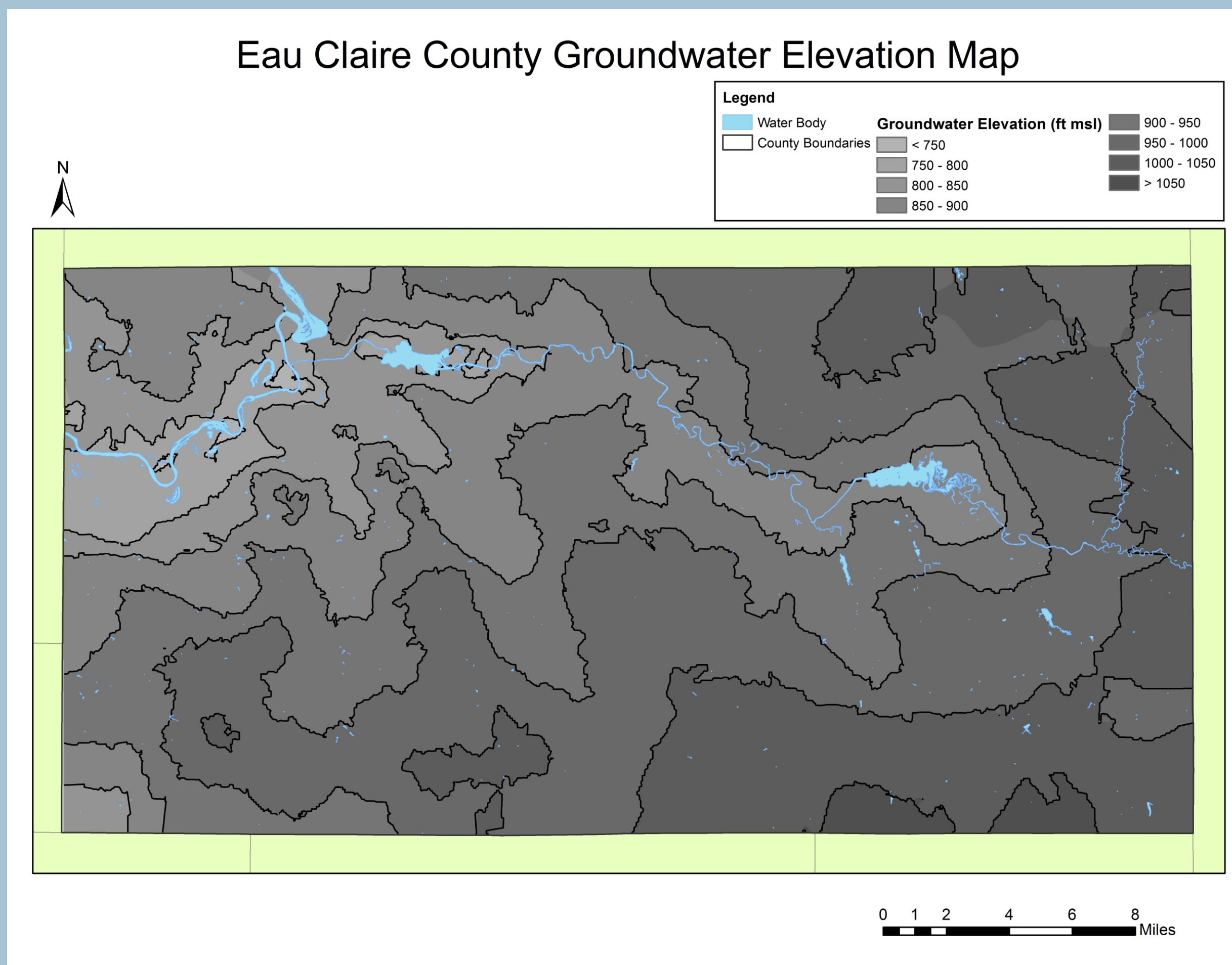


Figure 1: Groundwater elevation map created for Eau Claire County using the most current water-supply well-construction data.

The groundwater elevation map indicates that the groundwater flow in Eau Claire County is predominantly to the west-northwest, with more flow occurring to the north in the westward portion of the county. In the northwest corner of the county, the flow is primarily to the southeast. Both of these flow patterns converge near the Chippewa River, indicating that the groundwater flow empties into the Chippewa River. The map also indicates the presence of a groundwater divide in the southwest portion of the county, which means that groundwater flow south of this divide is likely flowing south-southwest.

In addition to showing the dominant groundwater flow directions, the groundwater elevation map can be used to understand local groundwater flow directions. For any location, the groundwater flow direction can be found by understanding that groundwater will flow from a high elevation to a low elevation. Thus, landowners can use this map to determine groundwater flow directions near their property and to evaluate the risk of contamination from properties in the upgradient direction.

Groundwater Susceptibility Map

The next step to create a current groundwater susceptibility map for Eau Claire County is to use information from the new depth to the water table map (Methods), local recharge rate, aquifer and soil parameters, topography, and vadose zone parameters (thickness, porosity, and permeability) with weighted values developed in the Environmental Protection Agency's DRASTIC Method (Aller, Lina, et. al., 1985). The impact of each of these parameters on groundwater susceptibility is discussed below.

The depth to the water table is the depth from the ground surface to the water table determined by using current well information on water depth from around the county. This parameter is critical to groundwater susceptibility as this determines the thickness of the zone that contaminants must pass through before reaching the saturated zone.

Net recharge (Figure 2) is a value obtained after taking yearly precipitation values and deducting the amount of water which either evaporates or runs off the surface. This value expresses the amount of water per unit area of land which penetrates the ground and arrives at the water table. The water infiltrating into the aquifer is likely to carry contaminants to the water, so higher infiltration rates often correspond to high susceptibility to contamination.

The aquifer material and soil type (Figure 3) will also be factored into the groundwater susceptibility map, as they control the route and total distance over which contaminant will travel. If the media is more permeable due to either large grain size or a large number of fractures, water will flow through the material more rapidly and contaminants will have less time to sorb, react, or disperse. This reduction in travel time will lead to a more susceptible region.

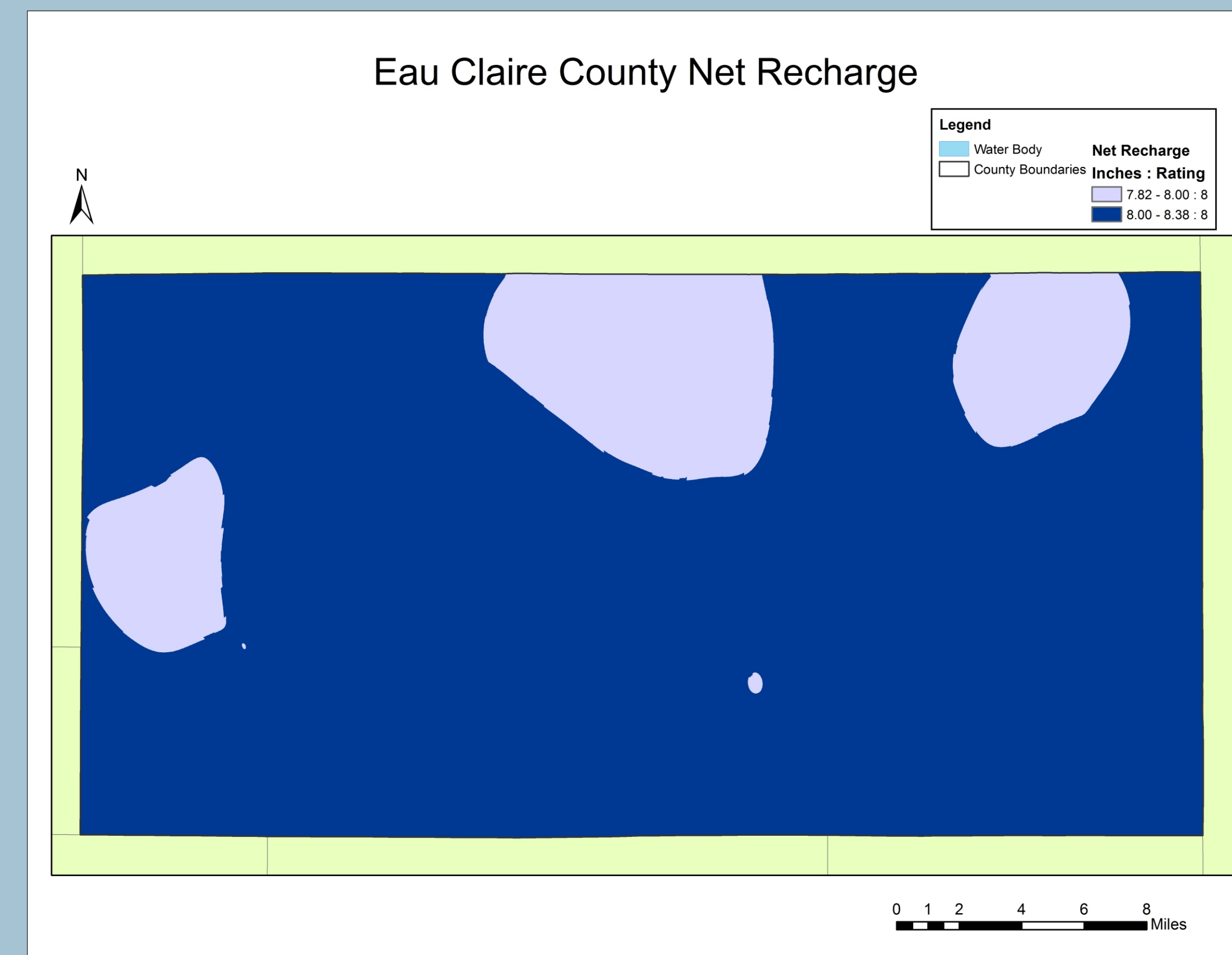


Figure 2: Annual Net Recharge in inches. Based on calculated recharge the entire county has a rating of 8 in the DRASTIC methodology.

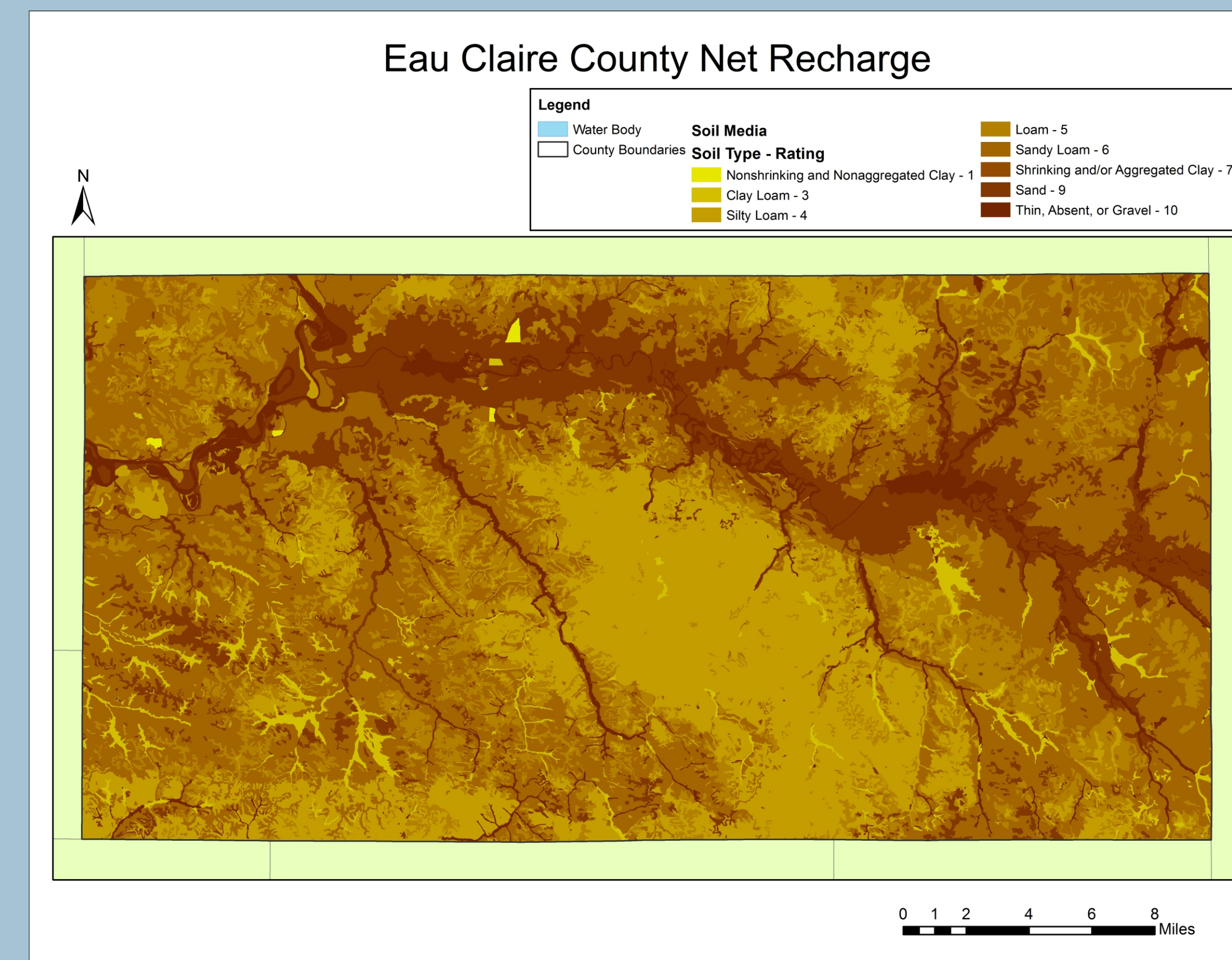


Figure 3: Map of the slope in Eau Claire County with ranges fitted to the DRASTIC Method.

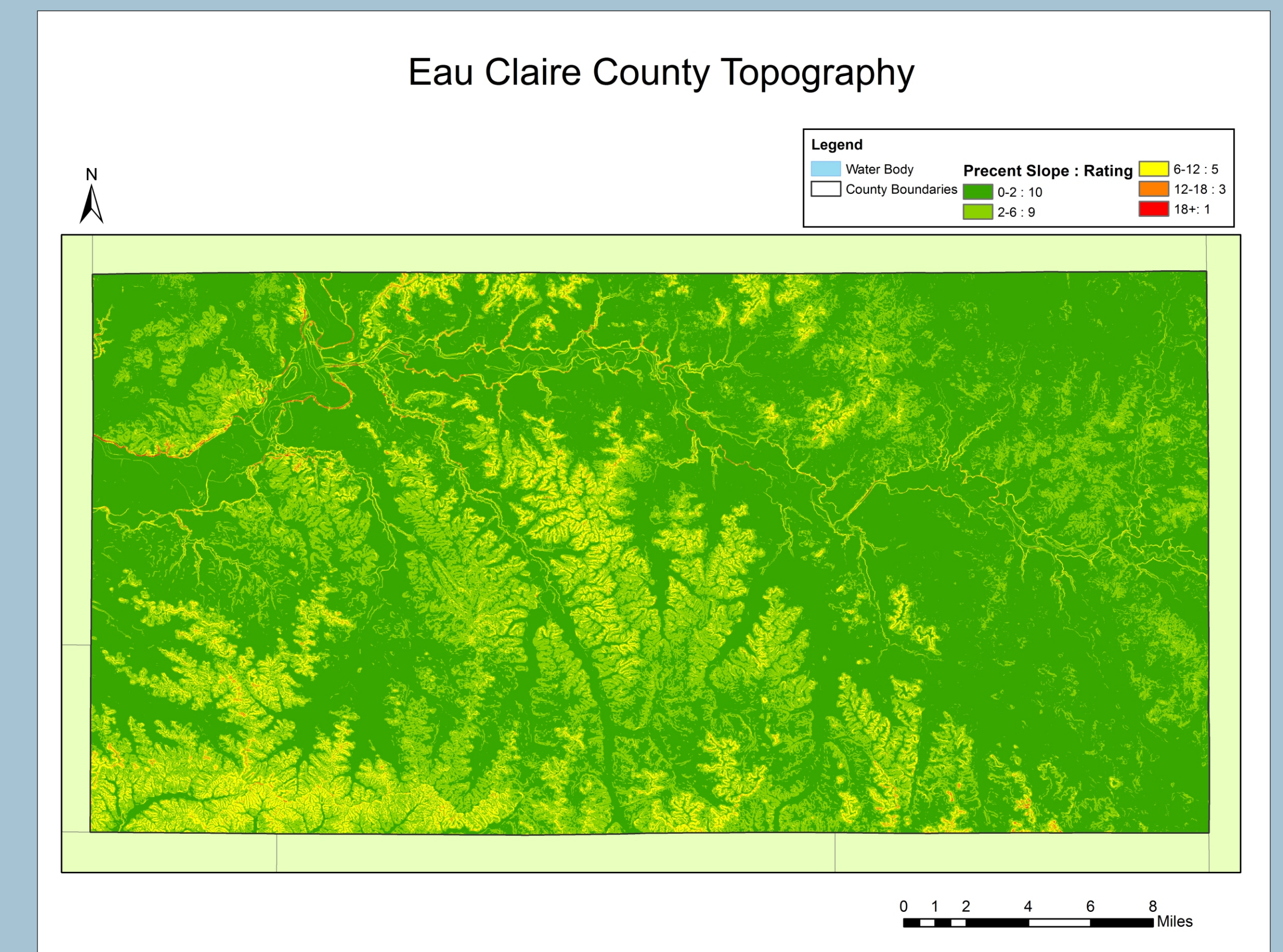


Figure 4: Map of soil types in Eau Claire County fitted to the DRASTIC Method scale.

Conclusions

The creation of an updated groundwater elevation map will be very important for the future development of wells in Eau Claire County for home and municipal uses and also provide information to other interested parties. Unlike the current map, which is only available as static document, the new water elevation and depth to water table maps are interactive, allowing the user to consider most closely the areas of interest, and they use more current information obtained from monitoring well construction reports. Comparison of the new maps with the older version will show changes which have happened in the 25 years since the last map was created. This information will become increasingly more important in the future as the demand for water continues to rise. The groundwater susceptibility map for Eau Claire County which is currently in progress will also be very useful for guiding development and for allowing property owners to evaluate risks to their drinking water supplies.

References

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