CHARACTERIZATION OF THE GEOLOGY AND HYDROGEOLOGY OF THE ROUNTREE FORMATION IN SOUTHWESTERN WISCONSIN

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Objectives:

The goal of this project was to better understand the spatial distribution of residual clays of the Rountree Formation in the subsurface in Iowa, Grant, and (to a lesser extent) Lafayette Counties; and to evaluate what, if any, buffering capacity this clay unit provides to the bedrock groundwater system from non-point source surface contamination.

Background/Need:

Recent studies in southwest Wisconsin (Grant, Iowa, and Lafayette Counties) have documented widespread pathogen contamination in private water wells. This previous work has sought to better characterize and understand the bedrock geology and bedrock aquifer systems, and to understand the potential causes of contamination.

One specific component of understanding the local geology that may control groundwater quality is improving our understanding of the Rountree Formation. This geologic unit is a red, residual, often-cherty clay that is formed by the chemical weathering of carbonate bedrock. Where it occurs—which is directly related to occurrence of Ordovician carbonates as the capping bedrock unit—it is found on top of the bedrock surface and at times within weathering voids and vugs within the top few meters of the top of the carbonate bedrock. It is not exposed at the surface because the landscape is pervasively blanketed by windblown silt (loess) sourced from the Mississippi River corridor during the last glaciation. Because it only occurs in the subsurface, its distribution and physical characteristics are poorly understood. Anecdotally, it has widely been presumed to be fairly widespread in the subsurface across the landscape and to provide significant buffering capacity to the bedrock. This project provided quantitative data on the distribution of the Rountree Formation across Grant and Iowa Counties, and multi-scale assessment of the buffering capacity of the unit based on its distribution and comparison to water well contamination data.

Methods:

We completed 1:100,000-scale surficial geologic mapping in Iowa County (mapping had previously been initiated using federal grant funds) and conducted and completed an entirely new 1:100,000 scale map of Grant County. Mapping was done entirely in a GIS environment, and accessed high-resolution LiDAR digital elevation models and shaded-relief topographic maps, previously conducted soil maps, and aerial photography. Initial map interpretations were made in ArcMap and subsequently verified by field examination.

To evaluate the subsurface material covered by windblown silt on upland surfaces, we accessed core descriptions and photographs from 94 Geoprobe cores previously collected by the WGNHS in the study area, and collected 123 additional Geoprobe cores in southern Iowa, Grant, and west Lafayette Counties. These cores were split, described, and photographed at the

WGNHS's Mt. Horeb Core Repository and Education Center. Core descriptions and photographs were used to delineate between several subsurface materials: residual clays of the Rountree Formation, residual clays derived from the Readstown Member of the St. Peter Formation, Pre-Illinoian till, and undifferentiated bedrock (no unconsolidated material underlying the windblown silt). These data were incorporated into the new surficial geologic mapping to quantify the area of the study counties that might contain residual clays of the Rountree Formation on top of the bedrock surface.

At Pioneer Farm near Platteville, WI, we refurbished several previously installed monitoring wells; conducted several geophysical transects to evaluate 2-D distribution of Rountree Formation on the farm property; and collected 12 (of the previously mentioned 123) Geoprobe cores along the transect lines to ground-truth interpretations of the geophysical data.

Finally, we conducted univariate statistical analysis evaluating the relationship between mapped areas of Rountree Formation present in the subsurface and presence of pathogens in water wells across Grant and Iowa Counties. This analysis compared areas of the two counties mapped as having Rountree Formation present/absent in the subsurface versus presence/absence of contamination in wells.

Results & Conclusions:

Surficial geologic mapping of Grant and Iowa Counties indicates that less than one quarter (23.7%) of the total area of the two counties potentially contains Rountree Formation in the subsurface on top of bedrock. This amount likely represents a maximum, or even over-estimation, of the total area given the fact that the 1:100,000 scale mapping does not account for the patchy, discontinuous nature of the Rountree Formation that occurs at a finer spatial scale. The geophysical surveys from Pioneer Farm reveal the patchy nature of the Rountree Formation at this finer scale, and the water quality data from monitoring the wells at Pioneer Farm indicate ready transport of pathogens into the bedrock aquifer system even in an area such as this where the Rountree Formation has been documented to occur. Finally, the univariate statistical analysis showed no statistical relationship between presence of Rountree Formation and occurrence of contamination in wells.

In sum, these results all indicate that the Rountree Formation provides fundamentally no buffering capacity to the bedrock groundwater system from non-point source surface contamination. A minority of the counties (significantly less than was anecdotally understood) contains the Rountree Formation; its distribution seems to be patchy when present; and no relationship exists between mapped presence of the material and water well condition.

Recommendations/Implications:

This study indicates that residual clays of the Rountree Formation underlie a surprisingly small proportion of Iowa and Grant Counties, and that those clays provide fundamentally no buffering capacity to the bedrock aquifer. Management practices should not include or expect any such buffering capacity from non-point source surface contamination.

Availability of report

WDNR, WGNHS

Key Words:

Rountree Formation; carbonate aquifer, Non-point source contamination