Geology and Why it Matters

This story was made with Esri's Story Map Journal.
Read the interactive version on the web at http://arcg.is/qrG8W.

The geology, landforms and land features are extremely important components of watersheds. They influence water quality, hydrology and watershed resiliency. Every watershed has critical areas where water interacts with and mobilizes contaminants, including non-point and point source contributions to surface water bodies. Where and how nutrients, bacteria and/or pesticides are mobilized to reach surface water can be better understood through a careful study of subsurface hydrology, or hydrogeology, which, according to the Iowa Geological and Water Survey Bureau, *"allows better identification for sources, pathways and delivery points for groundwater and contaminants transported through the watershed's subsurface geological plumbing system."*

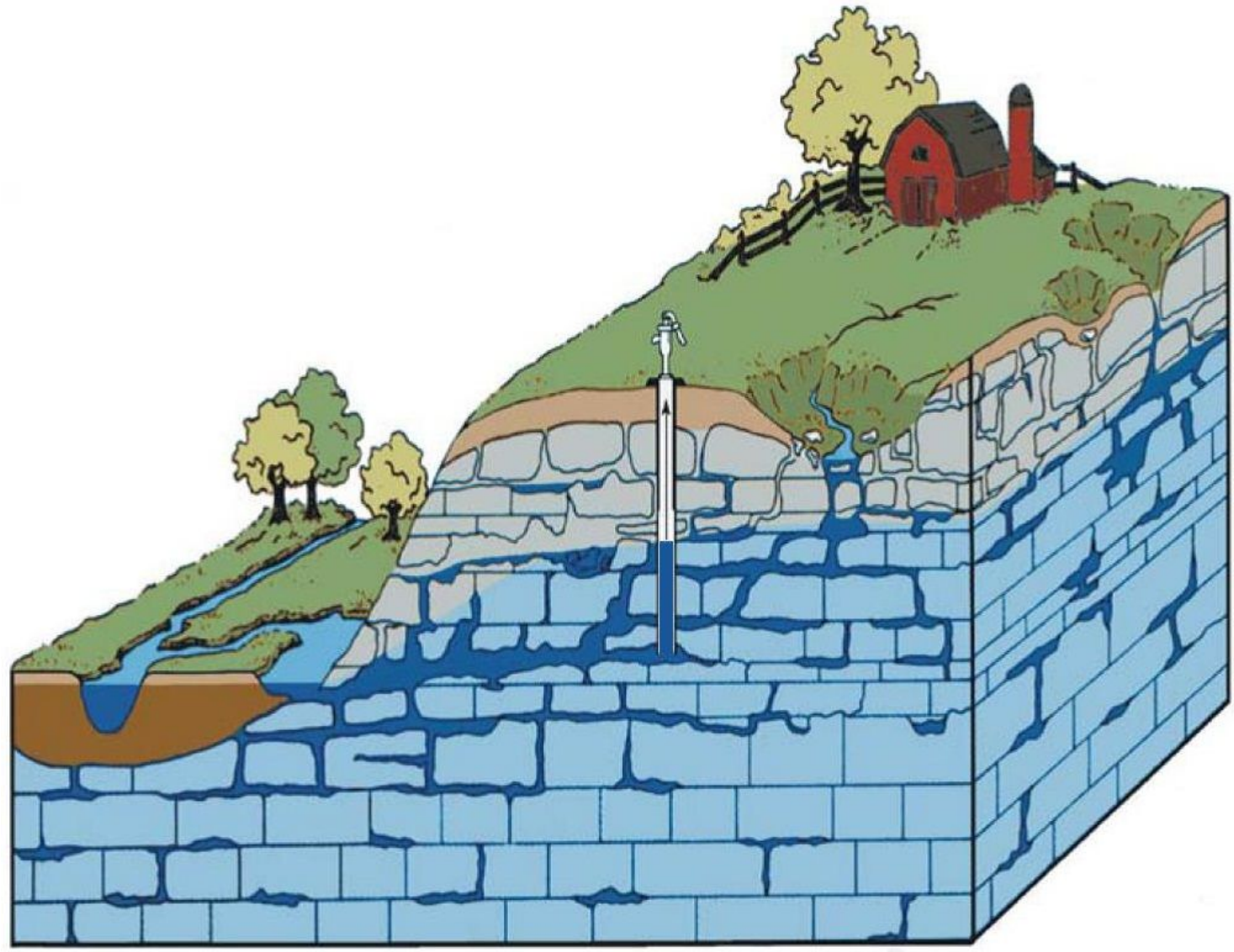
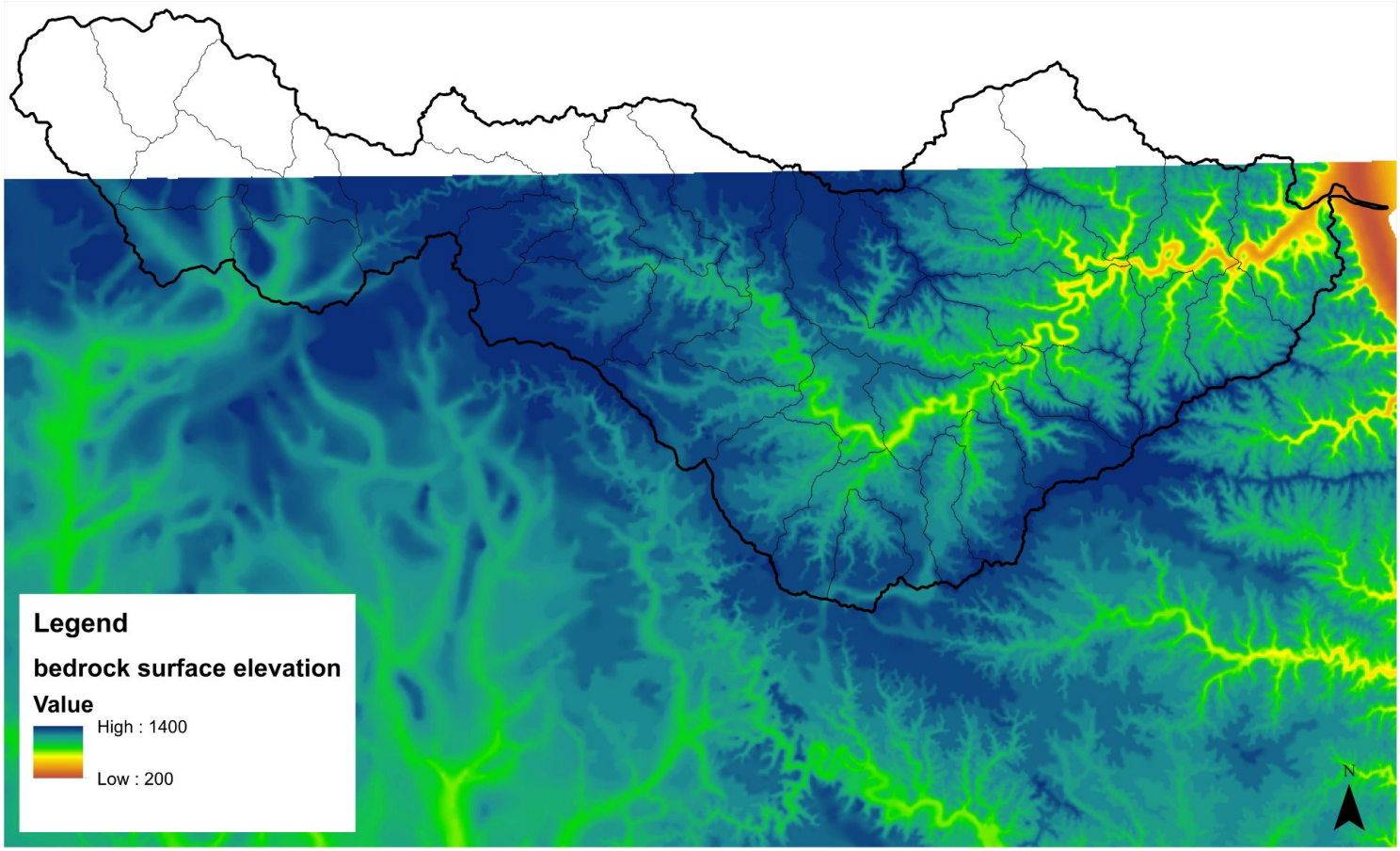


Diagram courtesy of Iowa DNR

Iowa Geological Survey



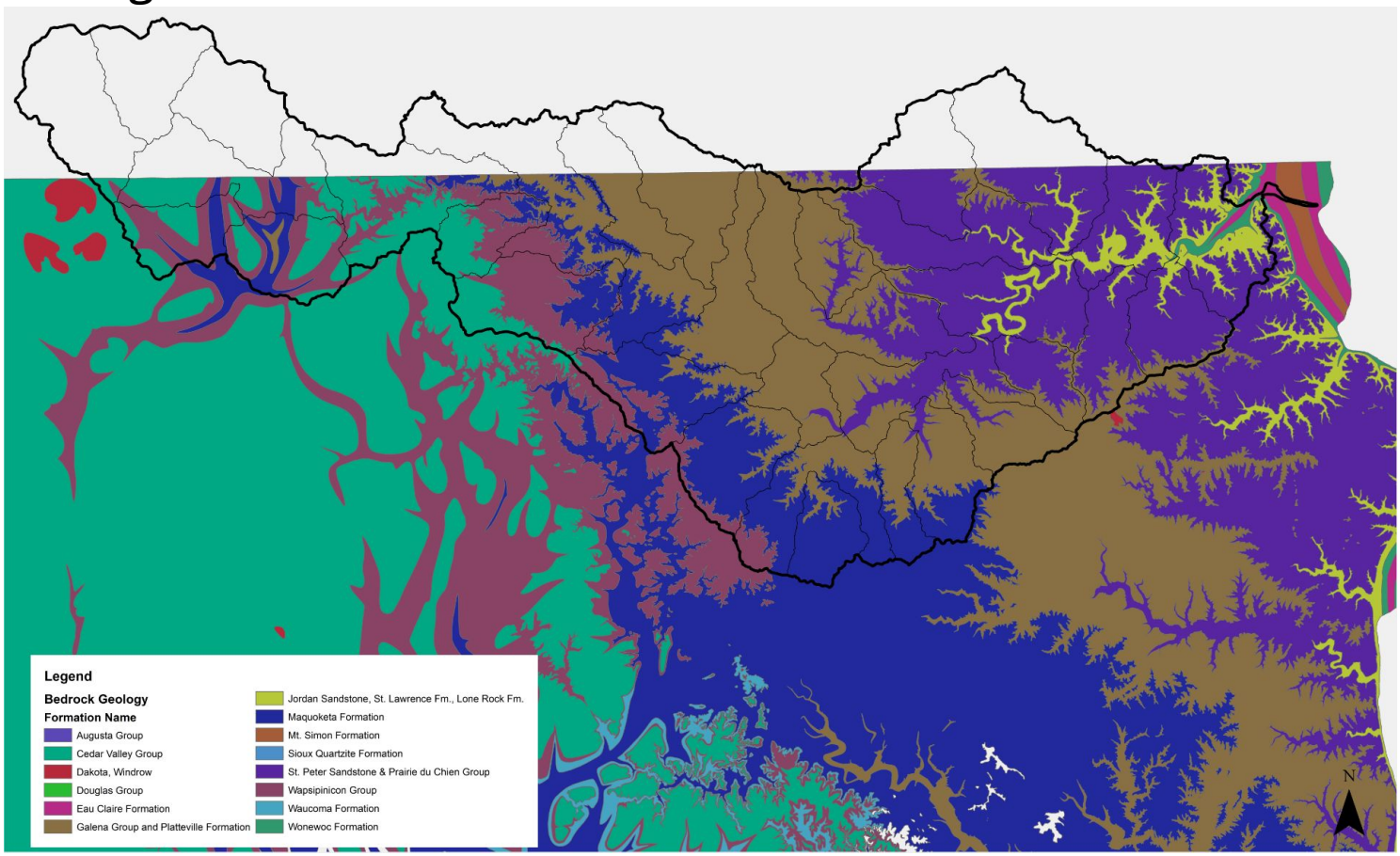
The highly developed karst topography and highly permeable bedrock layers of the Upper Iowa River increase the depth from which actively circulating groundwater contributes to stream flows, making an understanding of the hydrogeology even more important. Fortunately, the Iowa Geological and Water Survey Bureau completed a detailed mapping project of bedrock geologic units, key subsurface horizons, and surficial karst features in the Iowa portion of the Upper Iowa River watershed in 2011. The project *"provides information on the subsurface part of the watersheds, which is necessary for evaluating the vulnerability of groundwater to nonpoint-source contamination, the groundwater contributions to surface water contamination, and for targeting best management practices for water quality improvements."*

The map on the right shows the surface elevation of bedrock in the state of Iowa and the Upper Iowa River Watershed. Areas in blue have bedrock at higher elevations meaning they also have shallow soil depth, while areas in yellow and orange have lower bedrock elevations and larger topsoil depth.

As noted in the report, the assessment included the following.

"three-dimensional mapping of the bedrock and unconsolidated materials that underlie the watershed, including their thickness, distribution, and top and bottom elevations. It provides a classification of the relevant geologic units into their hydrologic roles as aquifers which readily transmit groundwater, or aquitards which restrict and divert groundwater flow. In addition it provides mapping of concentrated groundwater recharge and discharge points from karst features such as losing streams, sinkholes, and springs. All relevant mapping products are in the form of geographic information system (GIS) coverage, or electronic map layers. This allows the mapping to be readily used in watershed assessments and targeting of best management practices, and to be updated as needed. These coverage are available online via the Iowa Department of Natural Resources (IDNR)" – ***Natural Resources GIS Library***

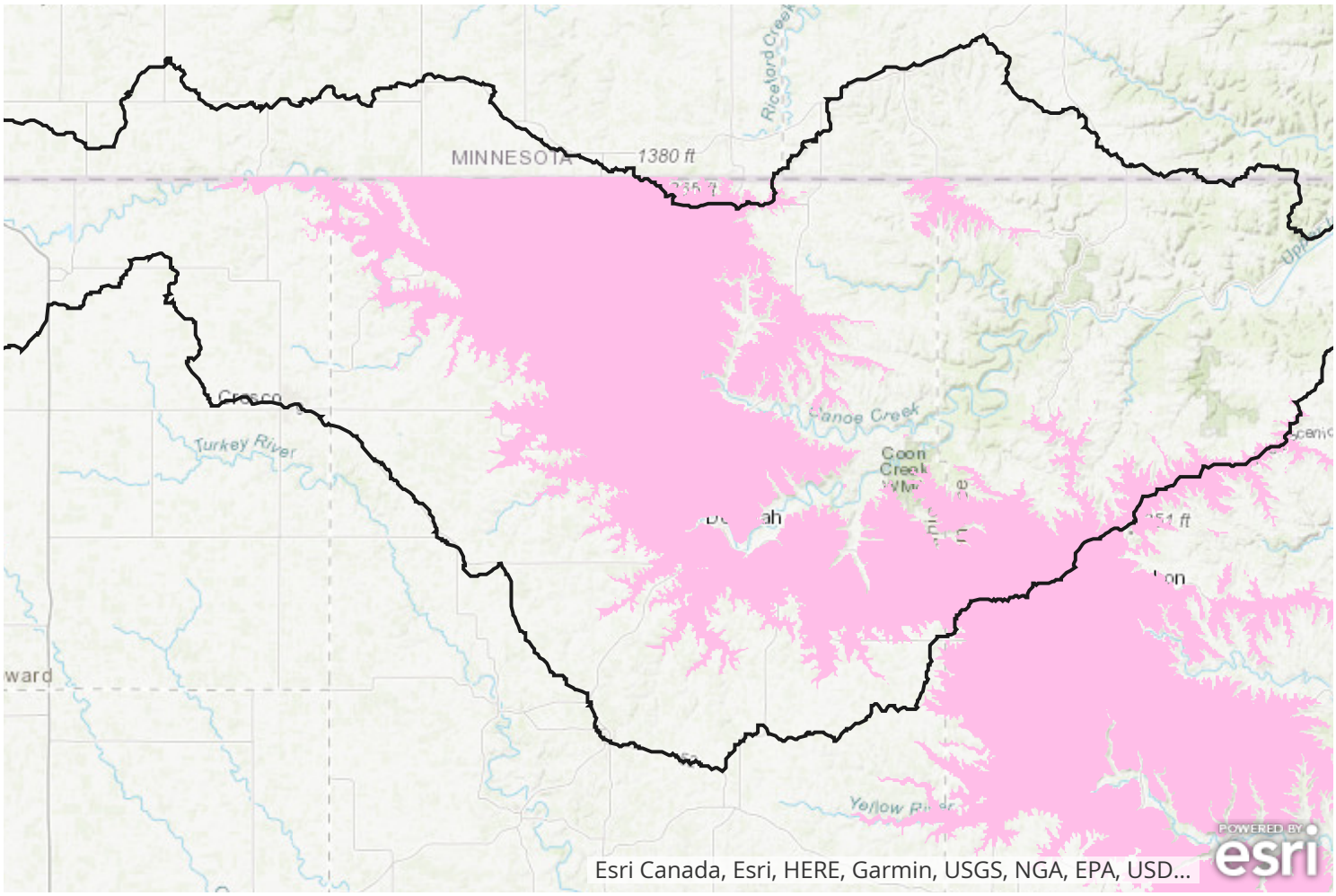
Geologic Formations



When combined with other GIS layers developed by partners, the GIS layers from this project are very useful for the Upper Iowa River WMA Board and their partners, particularly for targeted use of specific strategies and actions. The research identifies the most transmissive bedrock units, which are in the eastern and central parts of the watershed. These units are the most prone to the development of karst and as a result the land surface activities above these bedrock units can readily result in groundwater contamination of specified aquifers. The report also details where groundwater discharge to the surface as springs and seeps is most likely to occur. Landscape information about karst development and groundwater discharge to the surface is particularly useful for private and public partners working to install conservation structures. Watershed resiliency strategies and practices utilized in sensitive areas may require different specifications, considerations and precautions to prevent failure and/or groundwater contamination. Partners working in the eastern portion of the watershed will also find the information related to the susceptibility of important aquifers very useful.

Note: This **hydrogeological assessment** is very different than the "Hydrologic Assessment" conducted of the Upper Iowa River Watershed by the Iowa Flood Center in 2018.

Decorah Shale



UpperIowaWatershed

Decorah Shale Formation

Cedar Valley Group

Dakota, Windrow

Wapsipinicon Group

Maquoketa Formation

St. Peter Sandstone & Prairie du Chien Group

Galena Group and Platteville Formation

Waucoma Formation

Wonewoc Formation

Mt. Simon Formation

Eau Claire Formation

Jordan Sandstone, St. Lawrence Fm., Lone Rock Fm.

Other

The Decorah Shale complicates the geology of the UIR Watershed. This geologic feature was named for the City of Decorah and the shale outcropping that surrounds Decorah. The Decorah Shale is actually one of three formations that are grouped into one mapping unit by the Iowa Geologic Survey, the Decorah- Platteville - Glenwood formations. It is the lowest formation of the three, which collectively act as a major aquitard throughout the watershed, forming an impermeable barrier that restricts downward vertical migration of water from overlying aquifers. **(Geologic Mapping for Water Quality Projects in the Upper Iowa River Watershed, Iowa Geological and Water Survey Bureau Technical Information Series 54.)** Water flows vertically through limestone bedrock until it reaches the Decorah shale layer. It then moves laterally until the shale is exposed, typically on a side hill slope. At the point where the shale layer out-crops, the water flows above ground, either through surface vegetation until it bypasses the shale and re-enters the bedrock through cracks or fissures, or as a larger springs that feeds a stream.

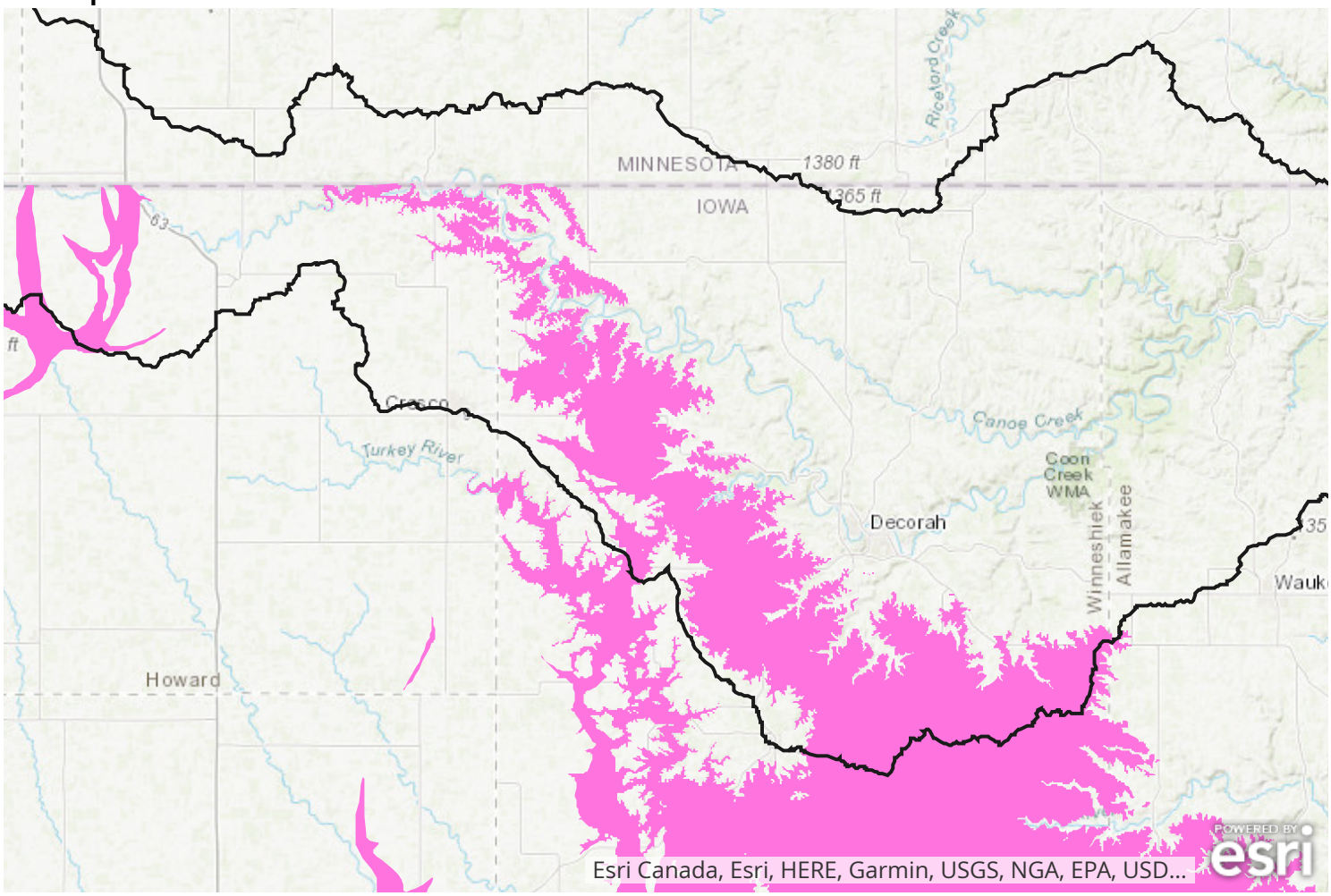
Vegetation on the Decorah Shale acts to filter contaminants in the water, much like wetlands act to remove contaminants. This phenomenon was found to be significant by the US Geologic Survey Bureau (USGS) in the nearby City of Rochester, Minnesota, which is also located in a valley surrounded by outcroppings of the Decorah Shale. Building and infrastructure development of the Decorah Shale portions of hillsides pushed the City of Rochester to contract with the USGS to conduct extensive analysis of the hydrologic characteristics and filtering abilities of vegetation along the Decorah Shale. The analysis found it would cost the city millions of dollars in water filtration each year to replace the action of the vegetation along the shale.

The horizontal movement of water associated with the Decorah Shale is most dramatic around Decorah where springs seem to surround the city, including some of the largest springs in Iowa, **Twin Springs, Dunning Spring**,

Siewers Springs, Malanaphy Springs, Falcon Springs, but also numerous other smaller springs.

Although the springs around Decorah are the most visible and public, springs associated with the Decorah Shale should be considered by watershed residents and conservation professionals working with public and private partners to implement specific practices and strategies. The Iowa Geologic Survey and Iowa DNR have mapped the **"Elevation of the Decorah Shale in the Upper Iowa River watershed" (link available only in online story)** (Photo courtesy of the Iowa Geologic Survey). They have also provided, through a bedrock geology map, a GIS layer that identifies the location of the Decorah- Platteville - Glenwood formations (Shown on the right). When overlaid with the UIR Watershed subwatersheds GIS layer, the bedrock formation layer identifies the subwatersheds where landowners and conservation professionals should seriously consider this geologic formation before implementation of specific strategies and actions.

Maquoketa Formation



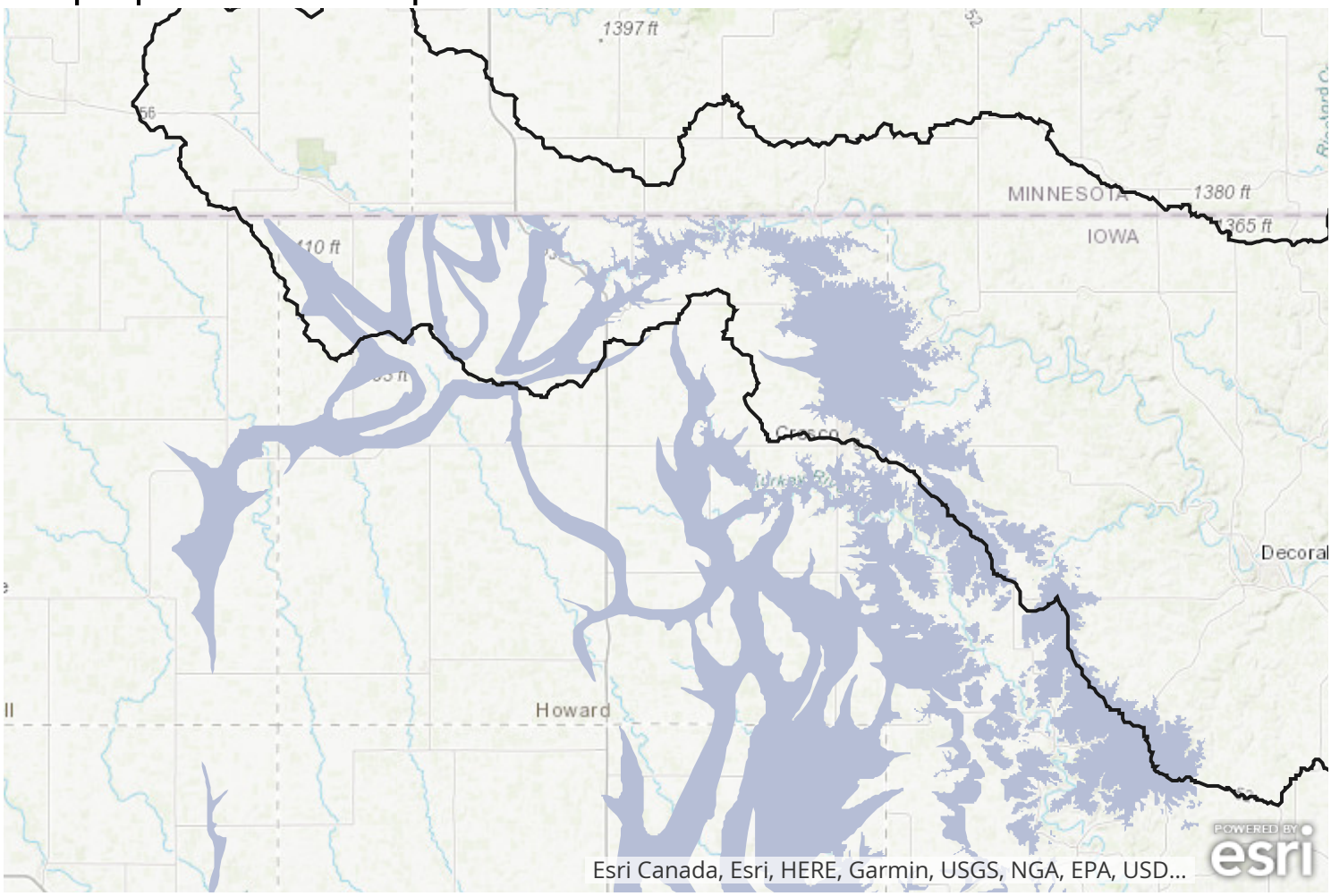
UpperIowaWatershed

Maquoketa Formation

- Cedar Valley Group
- Dakota, Windrow
- Wapsipinicon Group
- Maquoketa Formation
- St. Peter Sandstone & Prairie du Chien Group
- Galena Group and Platteville Formation
- Waucoma Formation
- Wonewoc Formation
- Mt. Simon Formation
- Eau Claire Formation
- Jordan Sandstone, St. Lawrence Fm., Lone Rock Fm.
- Other

The Maquoketa Formation is a 190 foot formation that the Iowa Geologic Survey notes has sinkholes and is susceptible to karst formation in the lower limestone portions of the formation. The Iowa Geologic Survey has mapped both the elevation of the top of the Maquoketa Formation and the depth to the top of the Maquoketa Formation in the UIR Watershed **(Geologic Mapping for Water Quality Projects in the Upper Iowa River Watershed, Iowa Geological and Water Survey Bureau Technical Information Series 54)**. The Iowa Geologic Survey and the Iowa DNR has also provided a GIS layer that identifies different groupings of bedrock formations, each identified by different rock groupings. Both these GIS maps and the GIS layer are useful for, and should be carefully considered by conservation professionals and watershed residents striving to implement specific practices and strategies that could accelerate karst formation in Upper Iowa River Subwatersheds. Click **here (link available only in online story)** to view which subwatersheds are located in the Maquoketa Formation.

Wapsipinicon Group



UpperIowaWatershed

Wapsipinicon Formation

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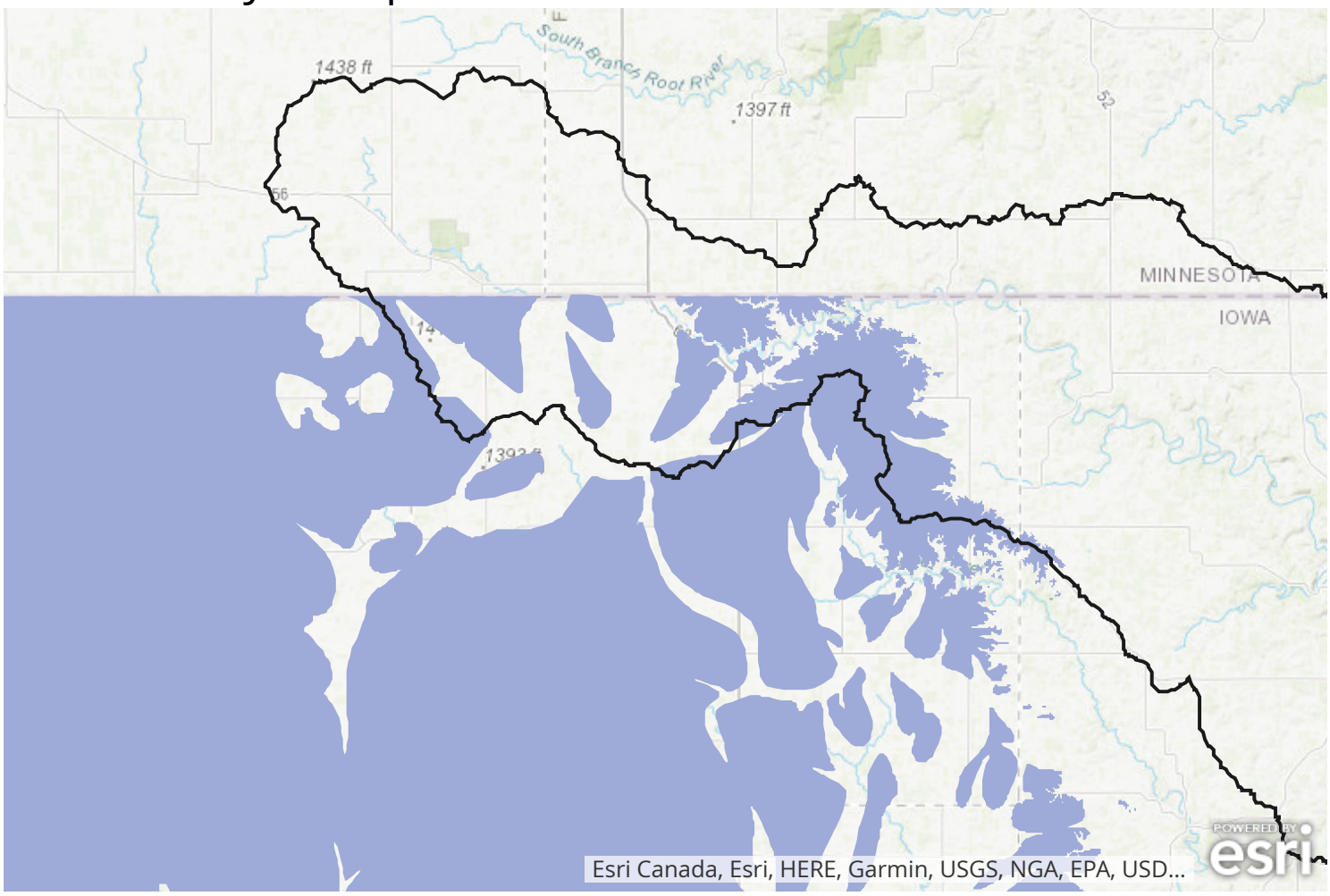
- Mt. Simon Formation
- Eau Claire Formation
- Jordan Sandstone, St. Lawrence Fm., Lone Rock Fm.
- Other

The Wapsipinicon Group is a 90-100 foot formation found in the UIR Watershed. The Iowa Geologic Survey notes that springs and seeps occur both near the base pf the Wapsipinicon Group and top of near Spillville. The Wapsipinicon Group is considered to be karst-susceptible, and where this group is near the land surface, rainfall infiltrates rapidly. The Wapsipinicon Group formation is also shown in the Iowa Geologic Survey and Iowa DNR bedrock formations layer shown in the map. The presence of springs and seeps as well as the infiltration rates are both important considerations for conservation professionals and watershed residents striving to implement specific practices and strategies in Upper Iowa River Subwatersheds. Click **here (link available only in online story)** to view which subwatersheds are located in the Wapsipinicon Group.

Cedar Valley Group



UpperIowaWatershed

Cedar Valley Group

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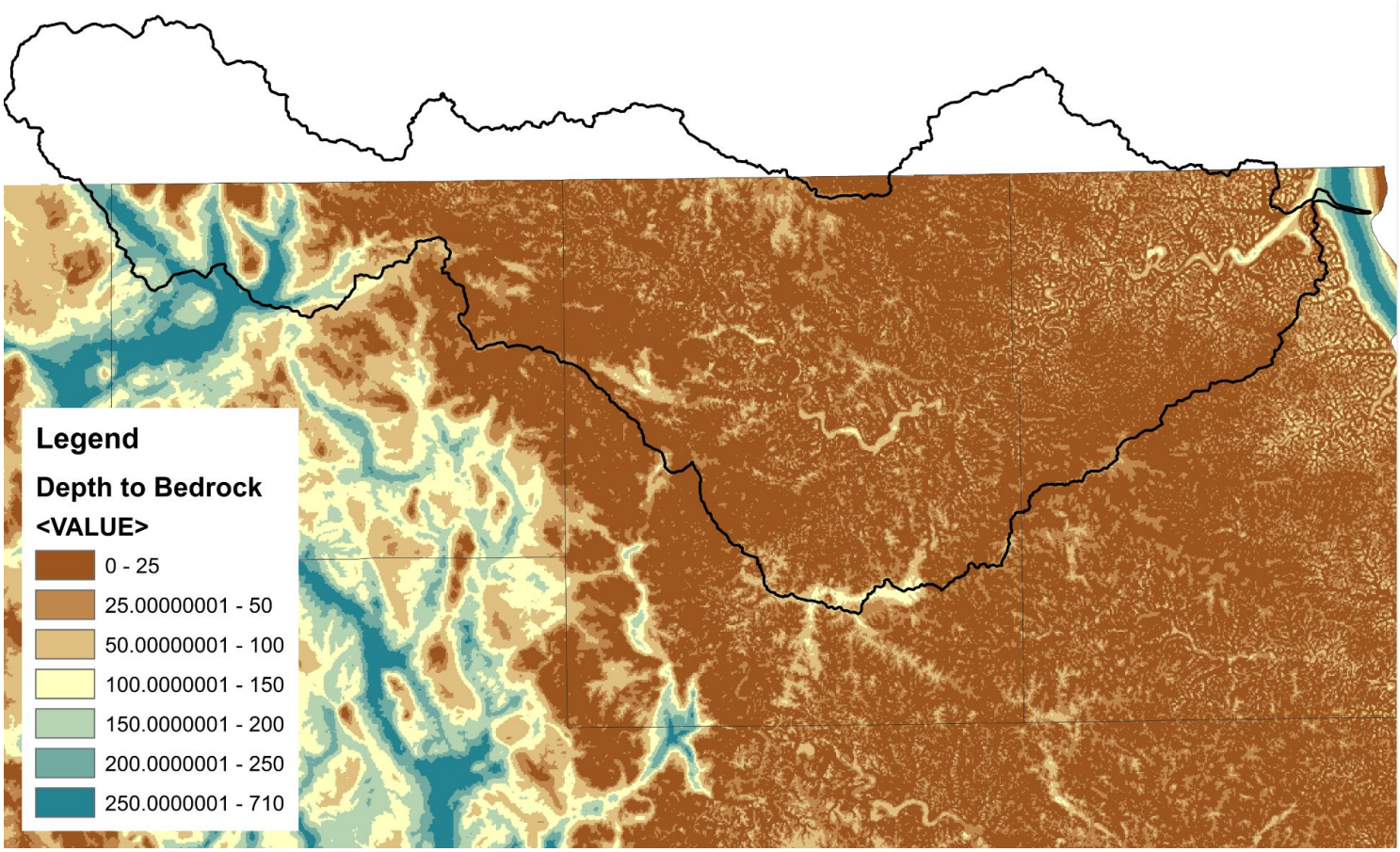
Jordan Sandstone, St. Lawrence Fm., Lone Rock Fm.

Other

According to the Iowa Geologic Survey, the Cedar Valley Group, which is throughout the southwest and west portions of the UIR Watershed, hosts an abundance of karst and sinkholes, and is considered to be highly karst-susceptible. This high susceptibility to karst formation should be carefully considered by conservation professionals and watershed residents striving to implement specific practices and strategies that could accelerate karst formation Upper Iowa River Subwatersheds. Click **here (link available only in online story)** to find out which subwatersheds are affected by the Cedar Valley Group.

Sediment as an Infiltration System



Overlaying the bedrock formations of the Upper Iowa River Watershed is a variable thickness of loose sediments containing different mixtures of clay, sand and silt. This layer is typically thicker in the western portions of the watershed. The layer of loose sediments works as an infiltration system for surface water pulling out contaminants and nutrients as water works its way into the bedrock aquifers bellow. This layer is very important and influential to the water quality in an area.