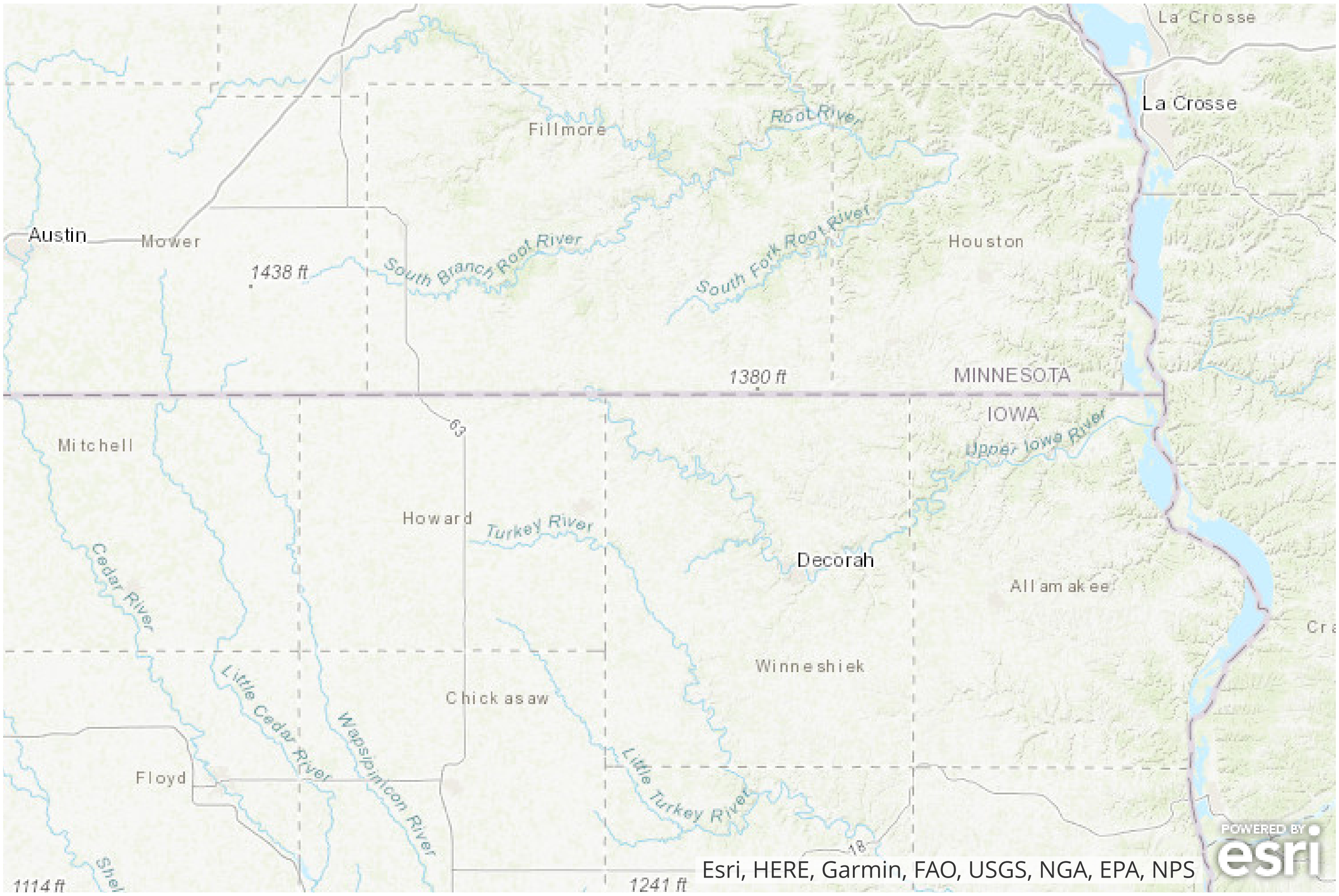
# Karst Features — Where and What are They?

*This story was made with [Esri's Story Map Journal](Esri's Story Map Journal).*
*Read the interactive version on the web at https://arcg.is/jCmza.*

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. In the report, they note that “One of the primary goals of the study was to gain more thorough understanding of relationships between bedrock geology and karst features within the watershed.”

Black River Falls photo courtesy of Larry Reis.

# Sinkholes




According to the GIS data from the Iowa DNR, the UIR Watershed has 6,649 known sinkholes in the Iowa portion of the watershed. Although this number is very precise, sinkhole development is actually an active process in the UIR Watershed so the actual number of sinkholes changes over time as some are filled in through natural or human processes and others are formed. One of the most numerous karst features found in the UIR Watershed, sinkholes are formed when specific types of underlying bedrock are gradually dissolved, creating voids in the subsurface. When soils and other materials above these voids can no longer bridge the gap created in the bedrock, a collapse occurs.

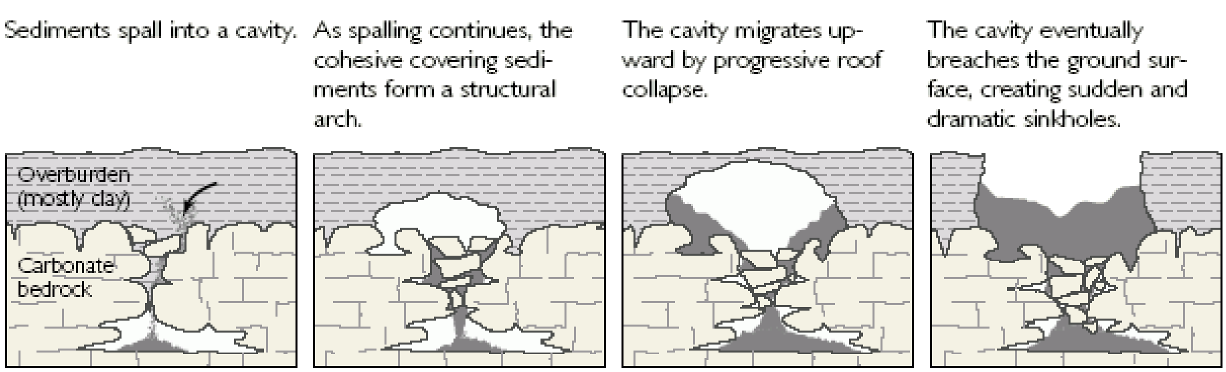



Photo Courtesy of USGS

Sinkholes vary in size and shape and can and do occur in any type of land use in the UIR Watershed, from row crop to forest, and even in roads. According to the Iowa Geologic Survey, sinkholes are often connected to underground bedrock fractures and conduits, from minor fissures to enlarged caverns, which allow for rapid movement of water from sinkholes vertically and laterally through the subsurface. Therefore, sinkholes provide a direct conduit for surface water to enter underground aquifers without the benefit of the filtration that would normally occur through soil layers. As a result, following rainfall or snowmelt, sediment, nutrients like phosphorus and nitrate, herbicides, and bacteria can be quickly carried into groundwater aquifers. When considering sinkholes, landowners and conservation professionals must also remember that sinkholes are important to groundwater recharge. In some cases, they also connect to springs via what the Iowa Geologic Survey calls transmissive conduit zones that function as drains that feed springs. The Iowa Geologic Survey notes that,

*"Almost 78% of sinkholes occur in the Wise Lake/Dubuque and Dunleith formations, which comprise the Galena Group and that these two formations also have the highest occurrence of sinkholes/square mile with 19.6 and 13 respectively. Another 16% of the sinkholes occur in the Cedar Valley Group, with an occurrence of 8/square mile."*

Photo Courtesy of Steve Carlson of the Seed Savers Exchange

The frequency of sinkholes has significant implications for landowners, conservation professionals and public road infrastructure managers, influencing where specific strategies and practices should be placed on the land and or how those strategies and practices function. Additional information about the susceptibility of various geologic layers to form sinkholes can be found in "**Geologic Mapping for Water Quality Projects in the Upper Iowa River Watershed**", a 2011 publication by the Iowa Geological and Water Survey.

# Springs and Water Falls


The largest spring by volume in Minnesota discharges into the Upper Iowa River and the second largest spring in Iowa discharges into a tributary of the Upper Iowa River. Hundreds of other well-known and lesser springs have also been documented in the watershed. While sinkholes are infiltration points for rainfall and surface water to recharge groundwater, springs and seeps are the locations on the landscape where the water table intersects with the land surface and groundwater flows or seeps out, usually in stream valleys but also on hillsides. Although not all are recorded, their presence can be predicted through a careful examination of the geology and topography of the watershed. There are many well-known waterfalls that are associated with the larger springs in the UIR Watershed, including **Siewers Spring (link available only in online story)**, Dunning Spring, and **Malanaphy Spring (link available only in online story)**. **Twin Springs (link available only in online story)** was, and Siewers Spring continues to be used by the Iowa DNR to provide a source of coldwater for trout rearing.


*This video can be viewed in the online version of this story map*

Minnesota DNR has conducted an inventory of springs in the Minnesota section of the watershed. The springs found in this study are shown in a map. The Minnesota DNR has also worked with partners to conduct dye-tracing and other research to identify “springsheds,” areas within groundwater and surface water basins that contribute discharge to springs. They have helped natural resource professionals realize that springsheds do not necessarily align with topographic watershed boundaries. Water flowing into a sinkhole in the York Blind Valley of the Root River Watershed of Minnesota, which is north of the UIR Watershed, was traced to a spring that flows into the Upper Iowa River. The full **2017 York Blind Valley Dye Trace study is available in PDF format**.

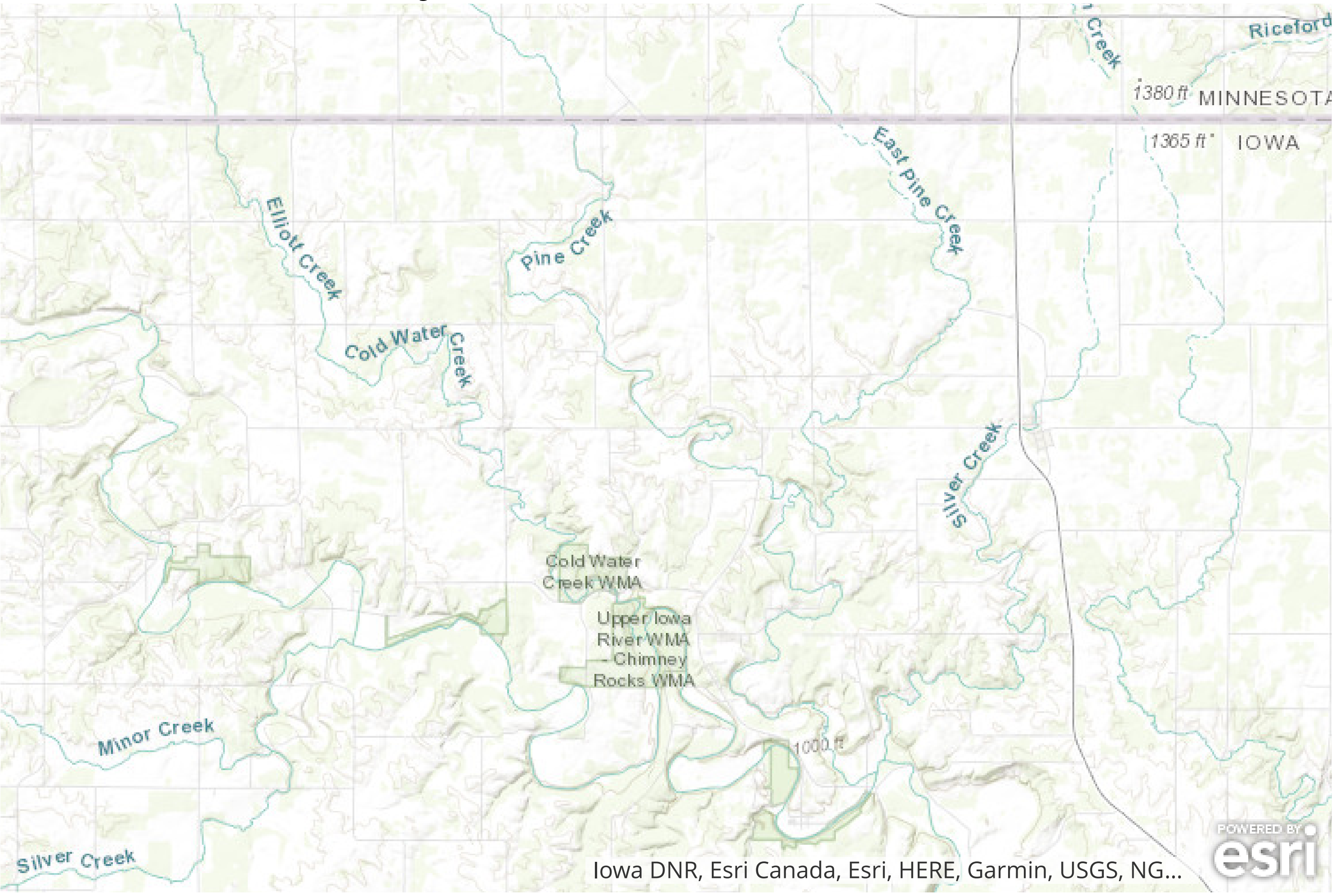
# Losing Streams

Losing streams may be one of the least obvious karst features in the UIR Watershed. They are common in karst areas and occur where the water table has dropped below the level of a stream bed. Some, or all, of the stream flows downward into fractured bedrock rather than continuing down the surficial stream. Water in some losing streams visibly flows directly into a sinkhole in the streambed. In other cases, the loss of water from the stream is more gradual, the location of the loss is not readily visible and the loss may only be detectable through flow measurements. Losing stream segments are more easily identifiable during periods of low water flow or drought when the stream flow may all be “lost”, drop underground.

The Iowa DNR reports recording 61 losing stream segments in the UIR Watershed, with the majority, 70%, flowing over the Dunleith and Wise Lake/Dubuque formations, which also have the highest density of sinkholes. Two of most locally well-known losing streams in the UIR Watershsed are below Black Falls (Right) and Hidden Falls. Black Falls is located in the Silver Creek West subwatershed and Hidden Falls tumbles over bedrock to disappear into the subsurface in the subwatershed named Community of Freeport-Upper Iowa River. Both Black Falls and Hidden Falls are located on private property. Neither are open to the public.

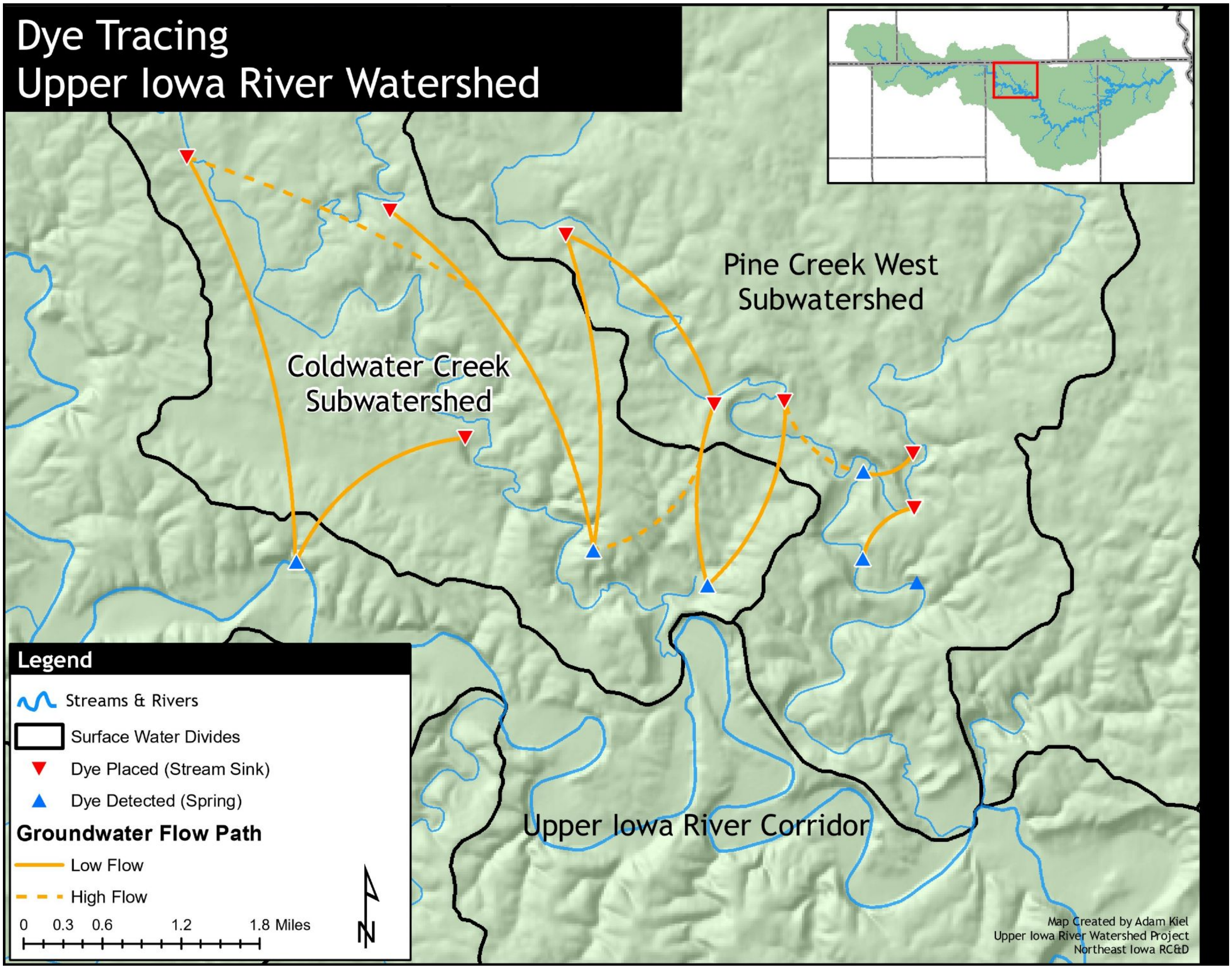
Black Falls photo (right) courtesy of Larry Reis.

# Coldwater Cave Project




Losing streams, sinkholes and other karst features can redirect surface water from one surface watershed or subwatershed to another. This scenario was demonstrated in the Upper Iowa River Watershed by P. Kambesis through the **Coldwater Cave Groundwater Basin Study**.

In her report, Kambesis describes the difference between surface drainage basins and groundwater basins, *"The drainage basins of surface creeks and streams can be identified by looking at topographic maps. Groundwater basins are not so obvious. Many times they do correspond with topographic basins. However, in karst groundwater basins, approximately 20-30% of the time, they do not correspond to topographic basins."* (The Coldwater Cave Project was completed in cooperation with the UIR Alliance Project and with the Hoffman Environmental Research Institute at Western Kentucky University in water quality and contaminant source studies.) The map on the right and the photo below demonstrate how the underlying groundwater recharge area is different than the topographic basin above. The underground basin intersects the Pine Creek and Coldwater Creek subwatersheds above causing an underground exchange of water between these two subwatersheds.




Map courtesy of P. Kambesis

Unfortunately, other than the Coldwater Cave Study project and a small dye tracing project in a losing stream that reemerges in Siewers Spring at the Decorah Fish Hatchery (subwatershed named Community of Nordness), no other known dye tracing studies have been conducted in the UIR Watershed. Additional dye tracing studies could help watershed residents and conservation professionals better understand how losing streams and other karst features transfer water between surficial basins. Understanding groundwater basins could also help watershed residents and conservation professionals better understand how to improve water quality and reduce flooding in specific streams and rivers.

# Caves

There are caves and networks of caves throughout much of the UIR Watershed, including small caves and large world class caves, some that are more accessible than others. Active cave formation is ongoing as underground rivers and streams carve new openings and bedrock collapses redirect underground water flow and subsequent erosion. Some caves in the watershed were originally located and explored because they were associated with other karst features such as springs, losing streams, and/or sinkholes. Spelunkers would enter the caves through the spring or sinkhole opening and in some cases identify alternative entrances and or created new man-made entrances.

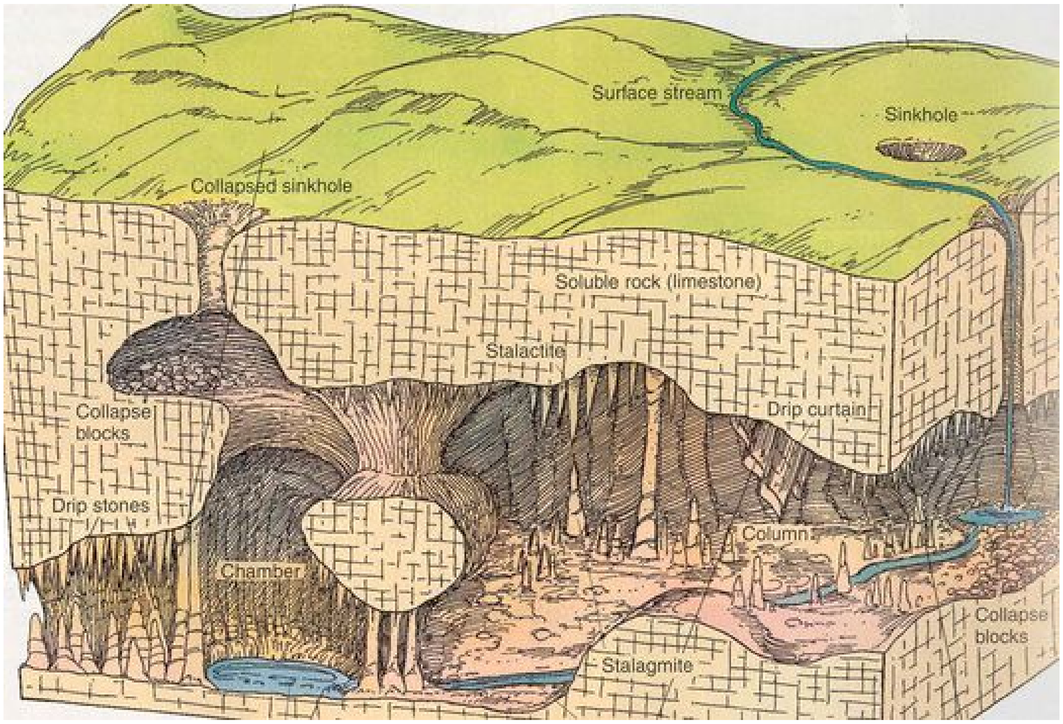
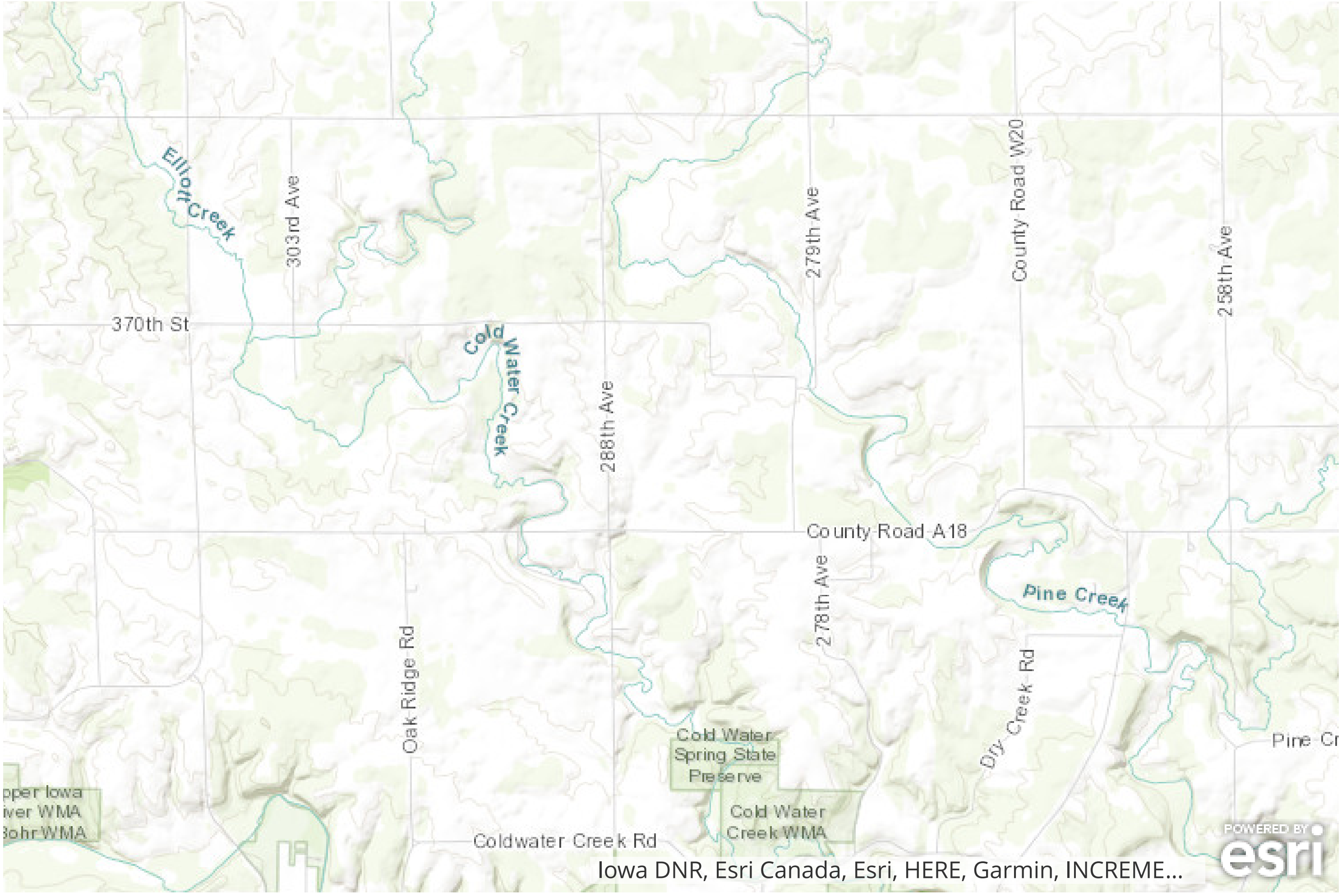



Photo courtesy of Christopherson, 2003

One of the largest and most publicly accessible caves in the UIR Watershed is Niagara Cave, which is located in the Minnesota portion of the UIR Watershed. Independent sources rank it as one of the top ten caves in the United States. The public is invited to enjoy **Niagra Cave** through tours that are run by a private business.

# Coldwater Cave

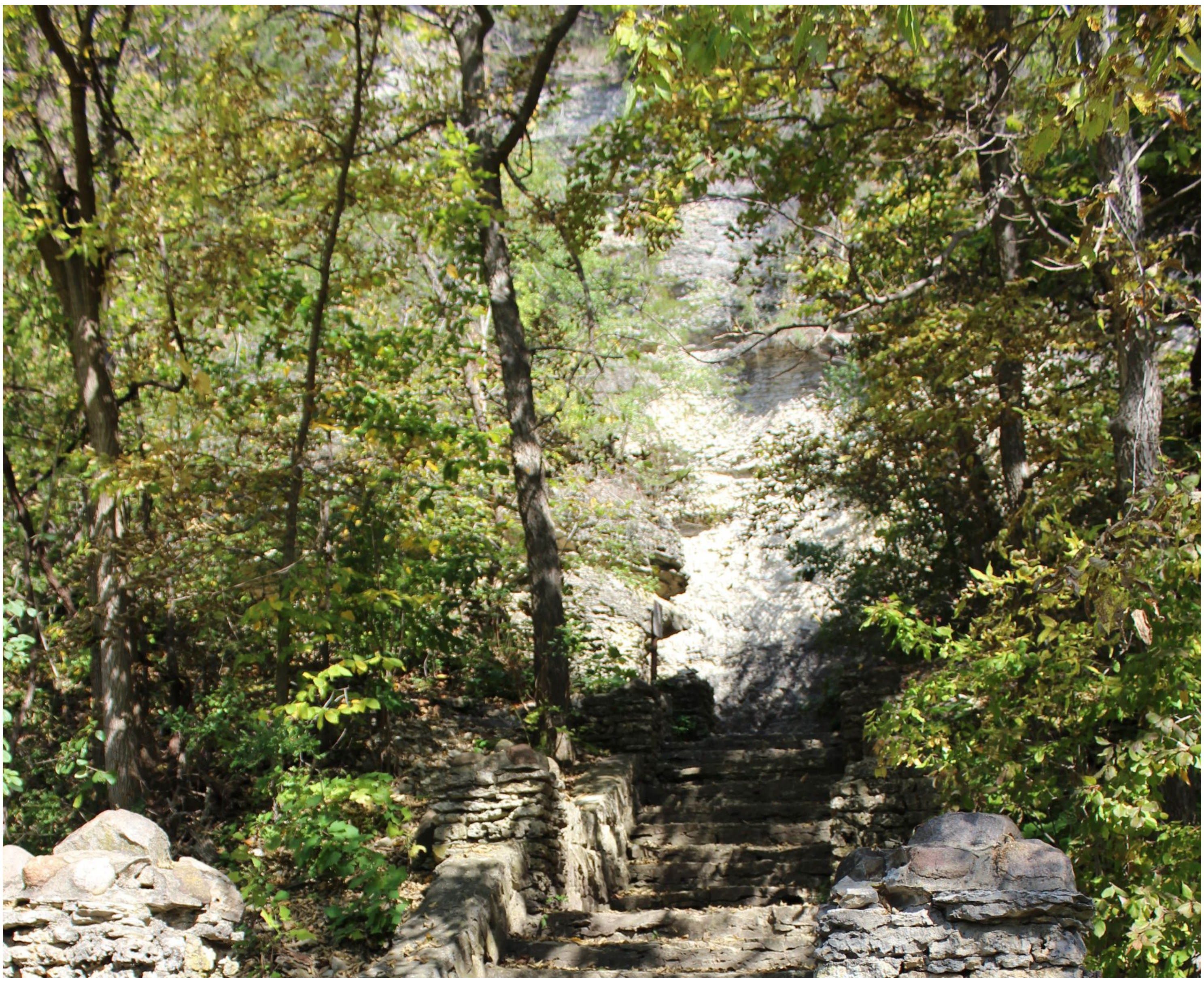



Iowa's longest known cave, **Coldwater Cave**, is considered by many to be the most significant documented cave of the Upper Midwest karst region. It is located in the UIR Watershed and has been the subject of extensive study. Researchers have documented over 16 miles of underground passages in Coldwater Cave. The network of tunnels, domes and rock formations associated with this cave extend from northeast Winneshiek County in Iowa to southeast Fillmore County in Minnesota. Coldwater Cave has been studied since 1973 when the Iowa Geologic Survey explored the cave to determine its potential for development of a state-run recreational facility. Although the potential cost of the venture ultimately stopped the development, Coldwater Cave was designated as a National Natural Landmark by the U.S. Department of the Interior in 1987. There is only one natural access to the cave. It is an underwater entrance located at the base of a 100 foot cliff and requires scuba gear. It is currently gated. Primary access to this cave through the 94-foot deep, 30-inch diameter research shaft, which was developed by the state during early explorations, is restricted. The cave is not commercialized, has no lighting, and exploration requires permission, a guide and wetsuits, in part because the underground river in this cave is active, unpredictable, and cold, with temperatures between 37 degrees and 57 degrees.


Coldwater Cave photos provided by Scott Dankof

# Ice Cave and Wonder Cave

Ice Cave, which is a system of crevices about 200 feet long and 15 feet deep, is located at the base of a limestone cliff about one hundred yards from the Upper Iowa River within the **Decorah Park and Recreation system**. It was listed on the **National Register of Historic Places** (NRHP) in the 1970s. The cave is within a 2.9 acre Iowa State Preserve that also encompasses other caves and crevices. The NRHP nomination notes that it is the *"largest known glacier in North America east of the Black Hills."* It is the largest caverns containing ice in the Midwest and was once used to store ice harvested from the Upper Iowa River. Ironically it is full of ice in the warm months rather than in the winter. Ice starts to form and accumulate between January and March and reaches its maximum of 8 to 10 inches by May or June and, because there is limited air circulation, persists until August or September. The cave is dry during fall and early winter. Its size and ice are not the only fascinating characteristics. Rare insects, relics of the Ice Age, have been found in Ice Cave.




Entrance to Ice Cave

Wonder Cave, north of Decorah, was at one time used for school field trips to help students understand caves, karst systems and geology. Public entrance is now prohibited but historic postcards of the cave and its features abound.

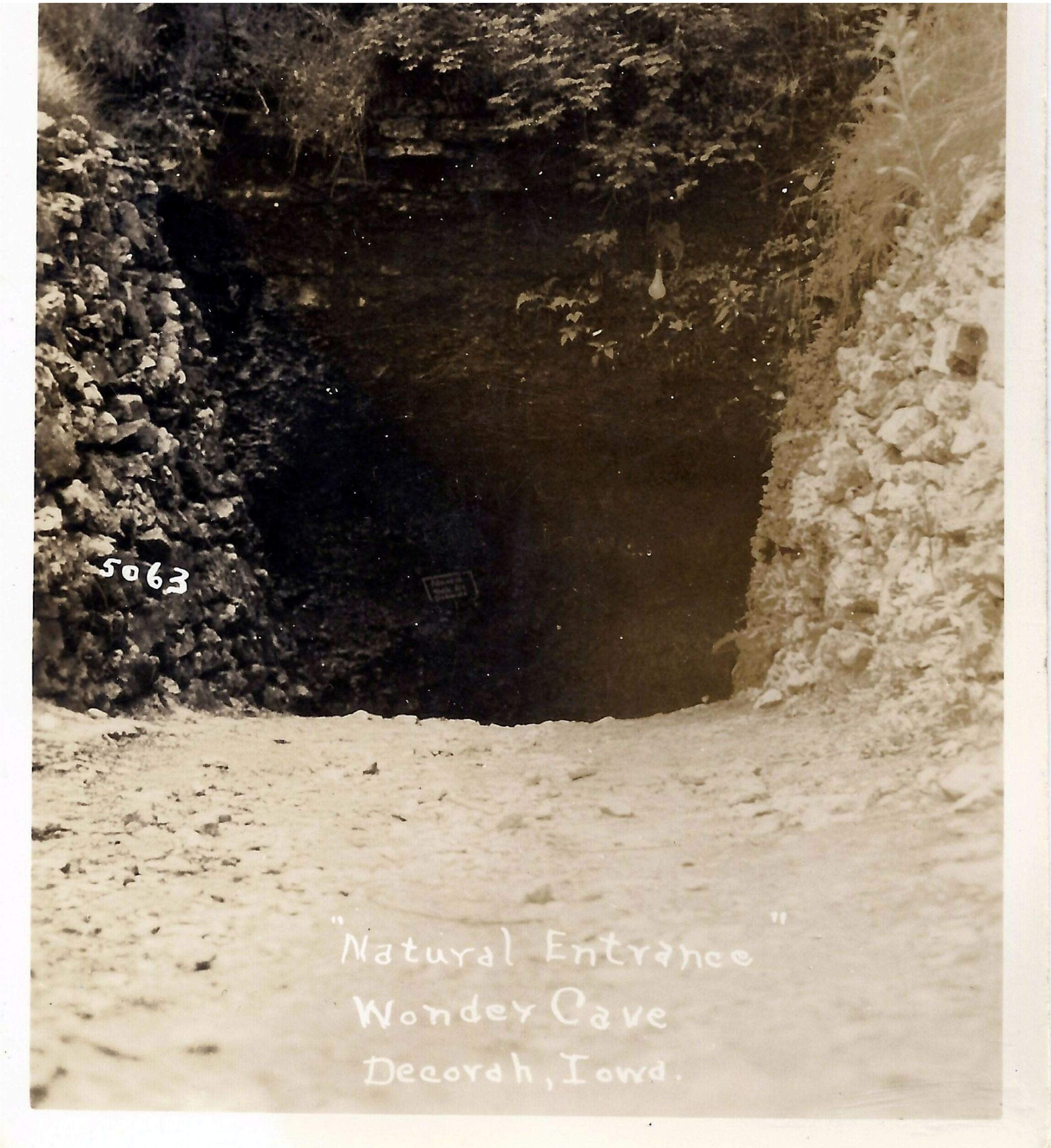
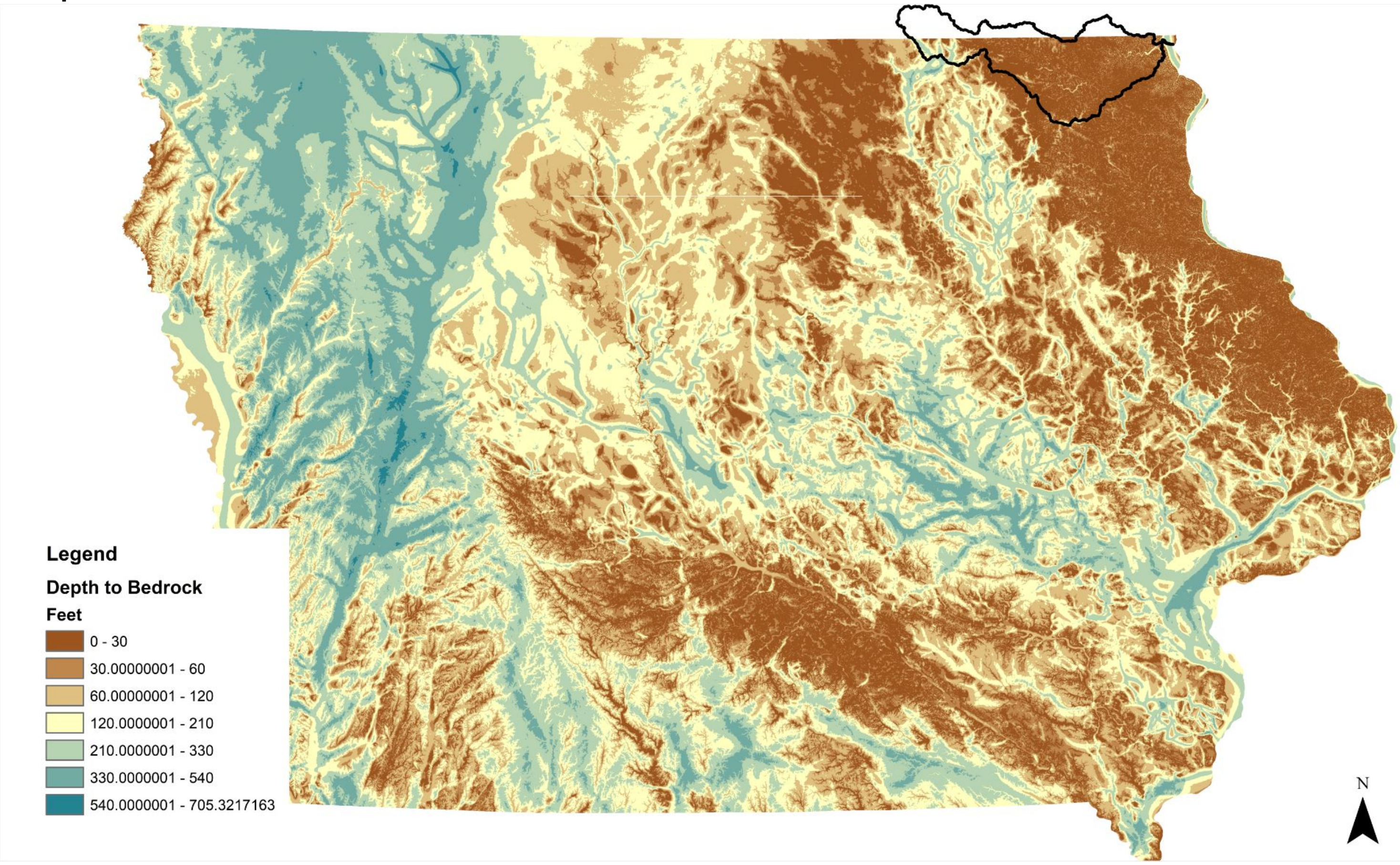
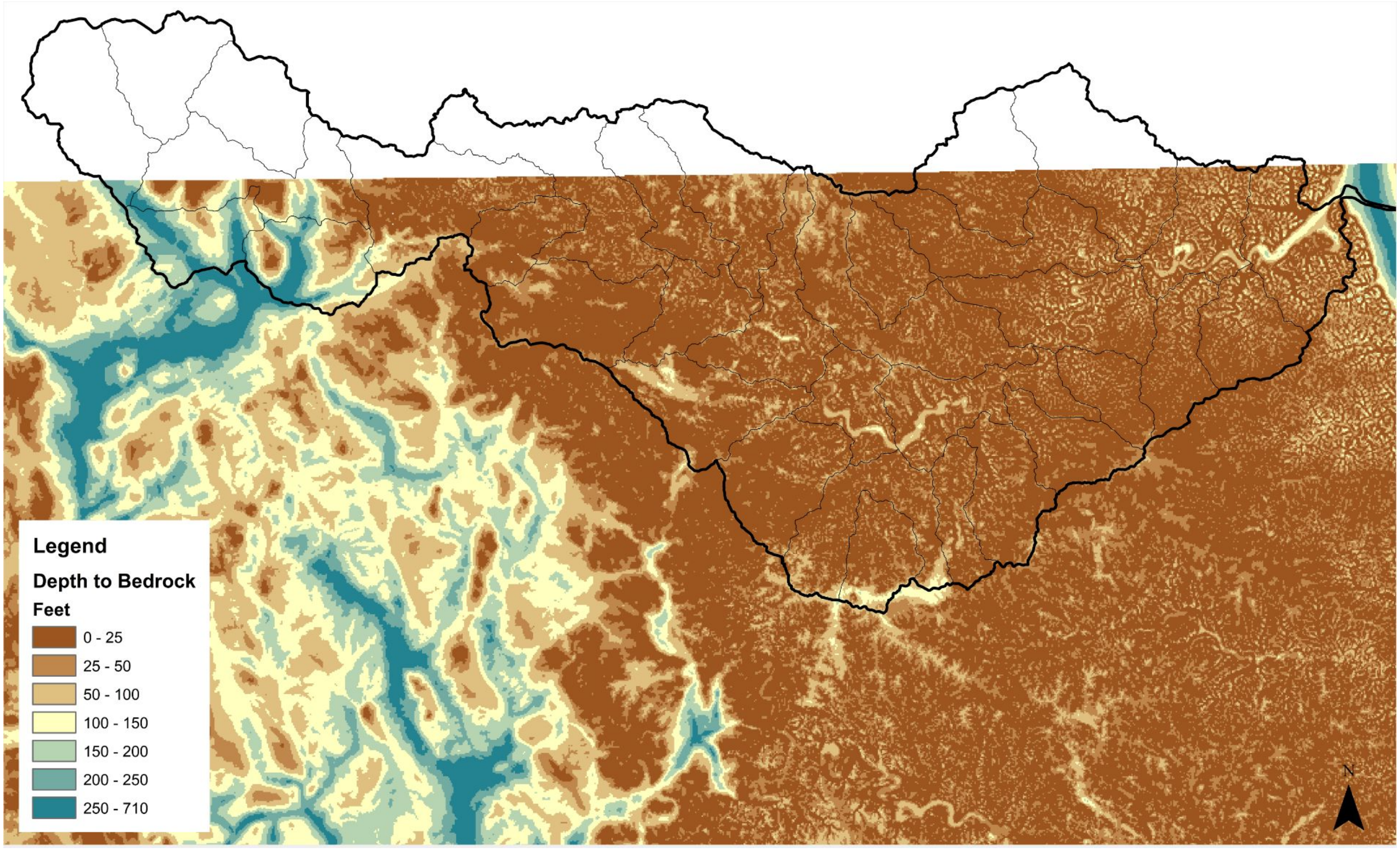



Photo courtesy of Photolibrarian

# Depth to Bedrock

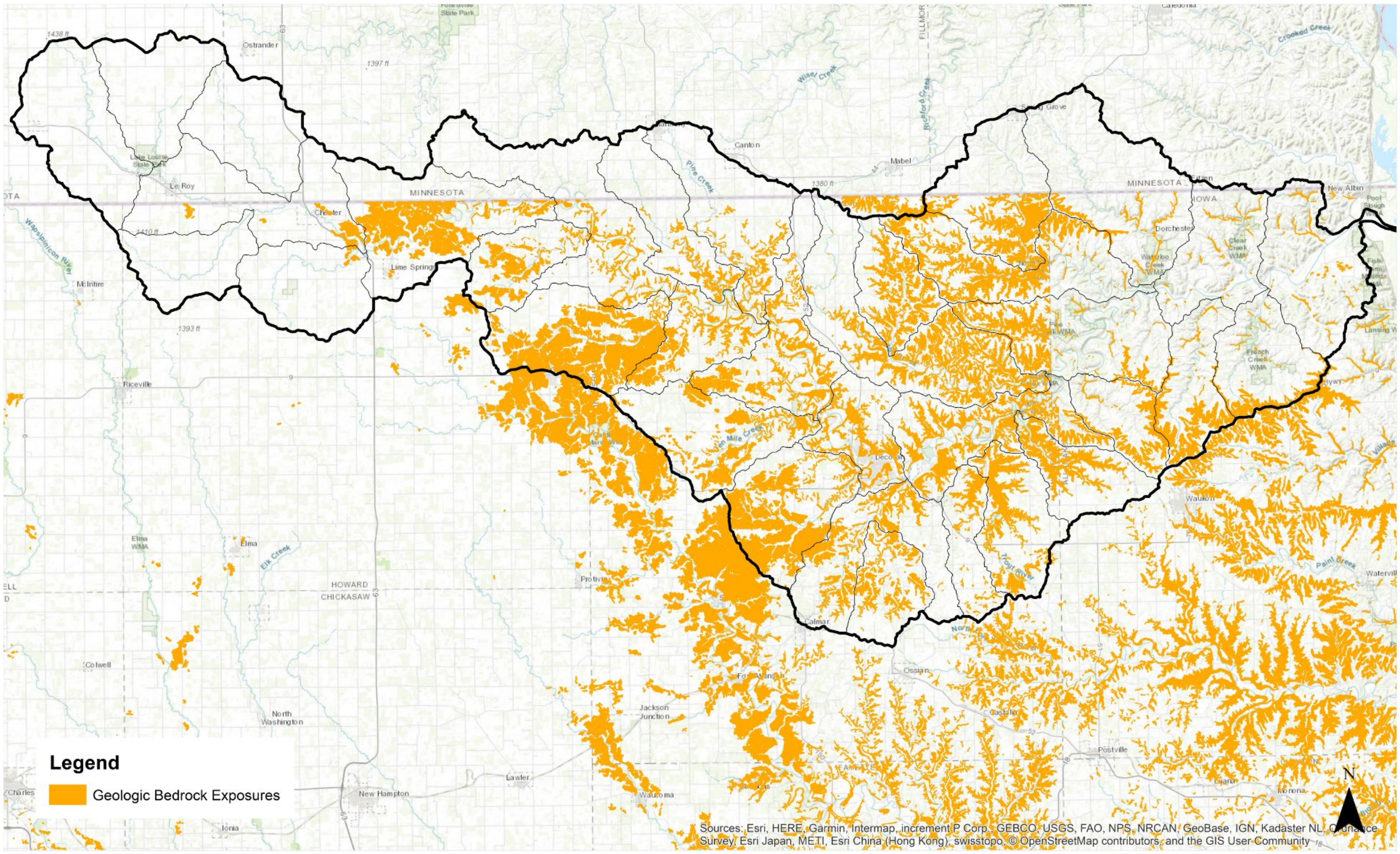



The depth of the soil in the UIR Watershed is much shallower than the rest of Iowa. Majority of the Upper Iowa River Watershed has a soil depth of less than 30 feet, while other areas of Iowa have depth to bedrock between 100 and 700 feet. Some sections on the Upper Iowa River Watershed contain Loess soils that are less than 40 inches thick located in the Pleasant, Highland, Canoe and Hesper townships in Winneshiek county. In other parts of the watershed majority of the loess soils range between 180 and 240 inches deep (Iowa DNR Data).




Upper Iowa River Watershed Depth to Bedrock

Throughout the UIR Watershed the depth to bedrock is less than 30 feet. An estimated 14.6% of the UIR Watershed has very thin soil where bedrock is within 2.5 feet of the surface. The Iowa Geologic Survey considers bedrock “exposed” if the depth to bedrock is within 2.5 feet of the surface. Visually exposed bedrock can most easily be seen by the public at natural bluff outcroppings and at man-made road cuts and quarries. The Iowa Geologic Survey has inventoried 1,028 outcrops and quarries on readily accessible land and rights-of-way. Bedrock exposures, whether natural or man-made, provide opportunities for the public to see and better understand, the ‘depth to bedrock’ in this watershed.




Bedrock Exposures in the Upper Iowa River Watershed

The depth to bedrock is extremely relevant to producers, communities and conservation professionals working to improve or protect ground and surface water and/or reduce flooding. The Iowa Geologic Survey recognizes the impact relatively thin cover of soil has on ground and surface water in the Upper Iowa River Watershed, *"infiltration recharge to the aquifer, passing through the relatively thin cover of soil and superficial materials, delivers relatively high concentrations of soluble, non-adsorbing contaminants, in particular nitrate."* Additional information about the depth to bedrock can be found in "**Geologic Mapping for Water Quality Projects in the Upper Iowa River Watershed**", a 2011 publication by the Iowa Geological and Water Survey.