Wisconsin Geological
and Natural History Survey
DIVISION OF EXTENSION
UNIVERSITY OF WISCONSIN–MADISON

Mineral assessments for conservation easements in Wisconsin

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The information in this report is for informational purposes only and is not intended to provide, or to be relied upon as, tax or legal advice. Readers should consult with their own attorney and tax advisor prior to making any decisions regarding the disposition of property.

Introduction

This report explains how the Wisconsin Geological and Natural History Survey (WGNHS) assesses mineral potential on land parcels. Typically, this service is performed to aid landowners and conservation organizations in their assessment of whether the value of a conservation easement qualifies as a charitable tax deduction on a land parcel where the mineral estate has been severed from the surface estate. A conservation easement is a legal agreement between a landowner and a government agency or nonprofit land trust that limits how the land may be used in order to protect its conservation values (https://dnr.wisconsin.gov/aid/Easements.html).

The purpose of this report is to describe the scope of mineral assessments completed by WGNHS geologists and to explain how we prepare these assessments as well as their limitations. The report also provides general information about severed mineral rights, mineral deposits, and conservation easements.

Landowners who donate a conservation easement to a land conservation organization may be able to claim the value of the easement as a charitable tax deduction. However, if a land parcel's surface estate is severed from its mineral estate, that is, if the minerals present in the subsurface are controlled by a different set of owners, then the donation of a conservation easement may not qualify as a charitable tax deduction.

A conservation easement that reserves the right to extract minerals ("a qualified mineral interest") by any surface mining method is not deductible under the law. Similarly, the owner of a property with severed mineral rights cannot claim a tax deduction for a conservation easement if the owner of the mineral estate has retained the right to extract minerals using surface mining methods. However, there is an exception: The Internal Revenue Code (IRC) may allow a charitable deduction for donation of a conservation easement if the probability of surface mining on that parcel is "so remote as to be negligible" (IRC § 170(h)(5)).* Typically, properties are evaluated on a case-by-case basis by a geologist (for example, see Jay, 2010). The Internal Revenue Code specifies that the geologist consider geological, geophysical, or economic data to evaluate the presence of mineral deposits on the property. The commercial feasibility of mining may also be considered (Treasury Regulations Section 1.170A-14(b)(1)(i)).

**This exception from the prohibition against surface mining where the mineral rights and the surface rights have been separated requires that the separation occurred prior to June 13, 1976, and that the owners of the separate rights may not be related to one another or in business with one another (Treasury Regulations Section § 1.170A-14(g)(4)(ii)).*

What is a mineral estate?

A property includes a surface estate (in other words, the right to own and use the property's land surface) and a mineral estate (the right to own and use the minerals buried in the subsurface of the property). A mineral estate, also referred to as owning mineral rights, includes the right to explore for, extract, and sell minerals from a property. The owner of a mineral estate has the right to modify the land surface for the purpose of developing the mineral resources.

What are considered minerals?

The IRS Code (U.S. Code § 170(h)(6)) defines a "qualified mineral interest" as "subsurface oil, gas, or other minerals." Metallic mineral resources including gold, silver, copper, lead, zinc, vanadium, and iron are present in Wisconsin and would be considered part of the mineral estate. Nonmetallic minerals, including oil, gas, coal, and aggregate, would also be considered part of the mineral estate. Nonmetallic mineral resources that are commonly extracted from surface pits and quarries in Wisconsin include sand and gravel, limestone, quartz sandstone (frac sand), quartzite, granite, and gneiss.

What is a mineral deposit?

Mineral deposits are naturally occurring, local concentrations of minerals. Mineral deposits are considered to be economic when they can be extracted for profit. The evaluation of the feasibility of economic surface extraction of minerals requires professional judgment. The reader is referred to *The Society for Mining, Metallurgy, and Exploration (SME) Guide* for a more in-depth definition of mineral deposit and a description of the minimum standards for estimating and reporting mineral resources (https://www.smenet.org/Professional-Development/SME-Guide-for-Reporting). In addition to these industry guidelines, several reports on mineral resources relevant to Wisconsin are available, for example: Southwick and others (2000), Brown (1999), Barrows and others (1976), and WGNHS and USGS (1976).

Nonmetallic mineral deposits

Wisconsin's nonmetallic mineral deposits are present at or near the land surface and are sourced from unconsolidated material (loose sediment) or bedrock (solid rock). Unconsolidated material, such as clay, silt, sand, and gravel, is present across much of Wisconsin; bedrock may be found at the land surface or buried beneath a few to several hundreds of feet of unconsolidated material. The composition of bedrock is highly variable. Certain parts of the state are underlain by bedrock units that are more likely to contain metallic or nonmetallic mineral deposits.

In Wisconsin, economic deposits of nonmetallic minerals typically are present at or near the land surface, making them relatively easy to directly observe. As a result, the distribution, thickness, and composition of potential sources for nonmetallic mineral deposits are relatively well understood.

Metallic mineral deposits

Wisconsin's metallic mineral deposits may exist in bedrock units that are exposed at land surface. More commonly, however, the "host" bedrock is buried under thick accumulations of unconsolidated sediment and/or younger bedrock. These deeply buried deposits are often much harder to identify and characterize than those found at the land surface. Because metallic mineral deposits tend to be found in areas with more complex geology than do nonmetallic deposits, detailed, site-specific evaluations of the sort performed by mineral exploration companies are usually required to demonstrate the presence of an economic mineral deposit on a particular property.

What geologic characteristics affect the economic value of a mineral deposit?

Certain physical characteristics influence how difficult—and therefore how expensive—it is to remove and process a mineral deposit, which affects whether that deposit could be extracted for profit. Geologic factors that affect whether a deposit can be extracted for profit, and that may be evaluated from publicly available information, are described in more detail below. Of course, economic and regulatory considerations as well as advances in mining technology are also important, but these considerations are beyond the expertise and scope of the WGNHS evaluations of mineral potential.

Depth of the deposit

A deposit at or near land surface can be extracted without first having to remove a significant amount of undesirable material. In Wisconsin, most economic nonmetallic mineral deposits are present within about 20 feet of land surface, whereas metallic mineral deposits buried deep beneath land surface can potentially be extracted for profit.

Homogeneity and distribution of the deposit

Mineral deposits that are homogeneous or have predictable composition decrease the chances of unexpected interruptions in production. Similarly, predictable spatial distribution simplifies planning for extraction of the material.

Thickness of the deposit

Thicker deposits can be extracted from the same location for a longer period of time. The ability to extract material from the same location for a long time decreases costs related to permitting and construction of site-specific infrastructure.

Depth to the water table

A shallow water table increases the likelihood of flooding and may necessitate pumping water from a mine, pit, or quarry. A shallow water table may also require procedures to prevent groundwater and surface-water contamination. In Wisconsin, extraction of metallic mineral deposits is typically larger-scale and more complex than nonmetallic deposits, and these operations require planning to protect groundwater and manage flooding. In contrast, steps to manage flooding and prevent water contamination may be less involved for smaller-scale excavation of nonmetallic minerals, especially in locations where the water table is deeper than the depth of excavation.

How does the Wisconsin Geological and Natural History Survey complete a mineral assessment?

What is the scope of a mineral assessment?

Mineral assessments completed at WGNHS focus on regional geology to address the question, "Is the probability of surface mining on this property so remote as to be negligible?" The geologist evaluates whether regional geologic conditions could host a mineral deposit and whether, in their professional opinion, it is feasible that the possibility of surficial exploitation of that deposit is negligible. The regulation stipulates consideration of "geological, geophysical or economic data showing the absence of mineral reserves on the property, or the lack of commercial feasibility" (Code of Federal Regulations § 1.170A-14(g)(4)(ii).

Both metallic and nonmetallic minerals should be considered part of the mineral estate. We evaluate the probability for economic surface extraction of (1) surficial sediments, usually sand and gravel and (2) metallic and nonmetallic minerals derived from bedrock.

Unconsolidated surficial sediments

We evaluate the potential for surface extraction of unconsolidated material by considering the form or shape (geomorphology) of the land surface on the property; the extent and composition of unconsolidated material shown on relevant surficial geologic maps; the thickness and composition of material reported in well construction reports, geologic logs, and other available well data; and water-table elevation. We also consider the proximity of pits to the land parcel, and whether nearby pits are sited on unconsolidated material similar to that which is present on the land parcel.

Bedrock

We evaluate the potential for surface extraction of bedrock-derived minerals by considering the bedrock lithology (rock type), thickness of the bedrock units (if known), thickness of the overlying unconsolidated material, water-table elevation, and the presence of nearby mines or quarries. To evaluate the presence of metallic mineral deposits we also consider the thickness of overlying, nonmetallic bedrock units, the proximity to known mineral deposits, the proximity to mineral exploration drill holes, and geophysical data, especially aeromagnetic anomaly data.

What are the limitations of mineral assessments completed by WGNHS geologists?

Evaluations completed by the WGNHS are based on publicly available geologic and geophysical datasets that provide a regional understanding of geologic conditions. WGNHS evaluations use existing information only—we do not collect new, site-specific information.

Many areas of Wisconsin lack good subsurface data (drill core data and water well logs) that would permit detailed characterization of potential deposits. Even though the regional geology in parts of Wisconsin may be favorable for mineral deposits, the likelihood that a deposit exists on a particular property is often low, even remote.

If regional geologic conditions could host a mineral deposit, the WGNHS mineral assessment evaluates the likelihood that surface mining might occur on the particular property based exclusively on available data. The uncertainty of the evaluation is greater in areas with little subsurface data. Evaluation of the potential for economic deposits of metallic minerals usually has a high level of uncertainty because these deposits tend to be found in more complicated geologic systems, their geometry and other physical characteristics are more difficult to constrain, and they are often present at deeper depths beneath land surface.

Consideration of mining technology and economics is beyond the scope of these reports. Property owners or conservation organizations may wish to verify local geologic conditions through additional detailed, site-specific investigation. They may also wish to consult an expert trained in the commercial feasibility of mining.

Data used to complete a mineral assessment

We consider publicly available geologic and geophysical information. The following is a brief description of the data and how they are used to complete an assessment.

Geologic maps

Geologic maps show a geologist's interpretation of the distribution of different surficial and bedrock materials. The WGNHS uses geologic maps to understand whether any surficial or bedrock units on a property may be potential areas of interest for metallic and nonmetallic mineral resources. Surficial geologic maps show the distribution of unconsolidated material at land surface. Bedrock geologic maps show the distribution of the uppermost bedrock unit that is present at land surface or buried beneath unconsolidated sediments. Precambrian geologic maps are an interpretation of the Precambrian geology that may be present at land surface or buried beneath many hundreds of feet of younger bedrock units. Most of Wisconsin's metallic mineral resources are hosted in Precambrian rocks.

In Wisconsin, most available geologic maps show the distribution and lithology (physical characteristics) of unconsolidated material or bedrock at scales of 1:1,000,000 (entire state), 1:250,000 (region), or 1:100,000 (county). Such coarse map scales broadly generalize the geology well beyond the typical scale at which land parcels in Wisconsin are described (township, range, and quarter-quarter section of the State Plane Coordinate System).

Wisconsin composite aeromagnetic anomaly map

Aeromagnetic anomaly data provide information on the distribution of magnetic minerals and thus characterize the distribution of rocks with different magnetic properties. The data can be used to locate buried geologic features, like faults or igneous rocks, which may have a role in potential mineralization. In Wisconsin, aeromagnetic data typically provide information about Precambrian bedrock, which hosts most of the state's metallic mineral deposits. We compare aeromagnetic anomaly data (Daniels and Snyder, 2002) to Precambrian geologic maps to evaluate any potential correlations between mapped Precambrian lithology and structures to aeromagnetic anomalies. If any nearby geologic features are known to host mineral deposits or were targets for mineral exploration, we compare mapped geology, information from drill holes, and aeromagnetic anomalies to evaluate whether similar geologic features might be present within the property.

Lidar and topographic maps

We use two types of maps, lidar and topographic, to review surface topography and elevation. Lidar maps are created from laser scans showing detailed ground elevation; topographic maps are available at a scale of 1:24,000. These data are used to characterize the geomorphology, or shape, of different landforms on the parcel, and are most useful for evaluating the unconsolidated sediments or bedrock at land surface, both of which typically are potential hosts for Wisconsin's nonmetallic mineral deposits.

By comparing the geomorphology of a parcel to the geomorphology of features shown on surficial geologic maps, we can evaluate whether the surficial material on the parcel might host nonmetallic mineral deposits like sand and gravel or clay. The geomorphology of larger landforms, like plateaus and escarpments, is often partially controlled by the kind of bedrock that underlies the landform. Some types of bedrock, like sandstone and shale, are relatively soft and tend to form slopes while others, like limestone, are harder and tend to cap hills or plateaus. Evaluation of potential bedrock control on landforms informs whether bedrock units underlying the land parcel could be potential sources for nonmetallic minerals such as sand or limestone.

Known mineral deposits and mineral exploration records

The location of known economic mineral deposits is highlighted by the presence of mines, pits, and quarries. The U.S. Geological Survey USMIN mineral deposit database (https://mrdata.usgs.gov/usmin/) has digitized mining-related features from historical USGS topographic maps. WGNHS maintains historic mineral exploration records for Wisconsin.

Well construction reports, and geologic logs, and geophysical logs

To get a sense of the type and thickness of the sediments and bedrock units and the elevation of the water table, we examine well construction reports, geologic logs, and geophysical logs from the parcel and surrounding area. Well construction reports are a well driller's record of the water-table elevation and general changes in rock or sediment type with depth. Geologic logs, prepared by geologists, are descriptions made in 5-foot intervals of the rock and sediment type that come from the rock cuttings that are generated as a well is being drilled. Geophysical logs, collected using tools that are lowered into a well, record information about changes in sediments, rocks, and water within a borehole.

Sample mineral assessments

Example from Sawyer County

In this example, the geologist evaluates publicly available data and concludes there is some possibility for surface mining of surficial deposits. However, this surficial material would likely be considered part of the surface estate unless rights to these materials had been previously severed. She concludes negligible likelihood of commercial extraction of nonmetallic or metallic minerals from bedrock.

Example letter:

Dear Conservation Land Trust,

On January 1, 2019, you contacted me requesting a mineral assessment on a property.

I currently serve as Geologist for the Wisconsin Geological and Natural History Survey, part of the University of Wisconsin-Madison Division of Extension. It is in this professional capacity that I offer the following.

Examination of the relevant 1:24,000-scale topographic maps, well construction reports, and the 1:250,000 Pleistocene Geology of the Superior Region, WI (Clayton, 1985) indicates the surficial sediment on the property is proglacial stream sediment, deposited between about 16,000 and 11,500 years before present. The specific unit the property overlies is "hummocky stream sediment overlain by silty material" (see fig. 1). This unit comprises sand and gravel typically 5 to 20 meters thick, overlain by a thin (meter scale) layer of glacial till (unsorted, gravelly, clayey, silty sand) or silt. The surface topography of this unit is hummocky, characterized by small hills and depressions. Locally, depressions form small lakes or wetlands. Well construction reports indicate the water table is on average about 90 to 100 feet below the ground surface, and ranging between 0, at wetlands and lakes, to 190 feet below the ground surface. Two sand and gravel pits are located on the "hummocky stream sediment overlain by silty material" map unit within several miles of the property. Given the depth to the water table relative to the thickness of the surficial sand and gravel and the presence of nearby sand and gravel pits, there is some possibility of surface mining of surficial sediment deposits.

The bedrock geology of the area has been mapped at 1:500,000-scale (Nicholson and others, 2004) and 1:250,000-scale (Mudrey and others, 1987) as Cambrian sandstone undivided (see fig. 2). Cambrian sandstone is mined elsewhere in Wisconsin for frac sand (Wisconsin Geological and Natural History Survey, 2014). However, the thickness of the unconsolidated material greater than 200 feet overlying the sandstone and depth to water table less than 200 feet would require significant excavation and dewatering in order to access the Cambrian sandstone. Therefore, the likelihood of finding commercial deposits of frac sand on the property is so remote as to be negligible.

Metallic mineral deposits are hosted in Precambrian bedrock in northern Wisconsin. The nature of the Precambrian bedrock that underlies the property is unclear. Available geologic maps (Mudrey and others, 1987, Sims, 1992, Nicholson and others, 2004) show the property lies north of the Niagara Fault, a major structure that separates the Wisconsin Magmatic Terrane to the south from the Continental Margin Assemblage to the north. In the vicinity of the property, Archean and Paleoproterozoic metasedimentary and intrusive rocks of the Continental Margin Assemblage are locally overlain by younger Paleoproterozoic quartzite and locally intruded by Mesoproterozoic gabbro (see fig. 2). The closest known occurrence of a metallic mineral deposit is vanadium titaniferous magnetite associated with the Mesoproterozic Round Lake intrusion, within several miles of the property (fig. 2). However, available data (core, aeromagnetic anomaly, geologic maps) give no indication that a similar deposit underlies the property. Several tens of miles east of the property, mineral exploration drill holes targeted a Paleoproterozoic metasedimentary unit that may extend to the west underneath the Cambrian sandstone in the area of the property. These exploration cores did not result in the discovery of a mineral deposit. Based on the lack of indication of Precambrian units known to host mineral deposits underlying the property, the thickness of the Cambrian sandstone, and the shallow water table, the likelihood of extracting commercial deposits of metallic minerals on the property through surface mining is so remote as to be negligible.

Sincerely,

WGNHS Geologist

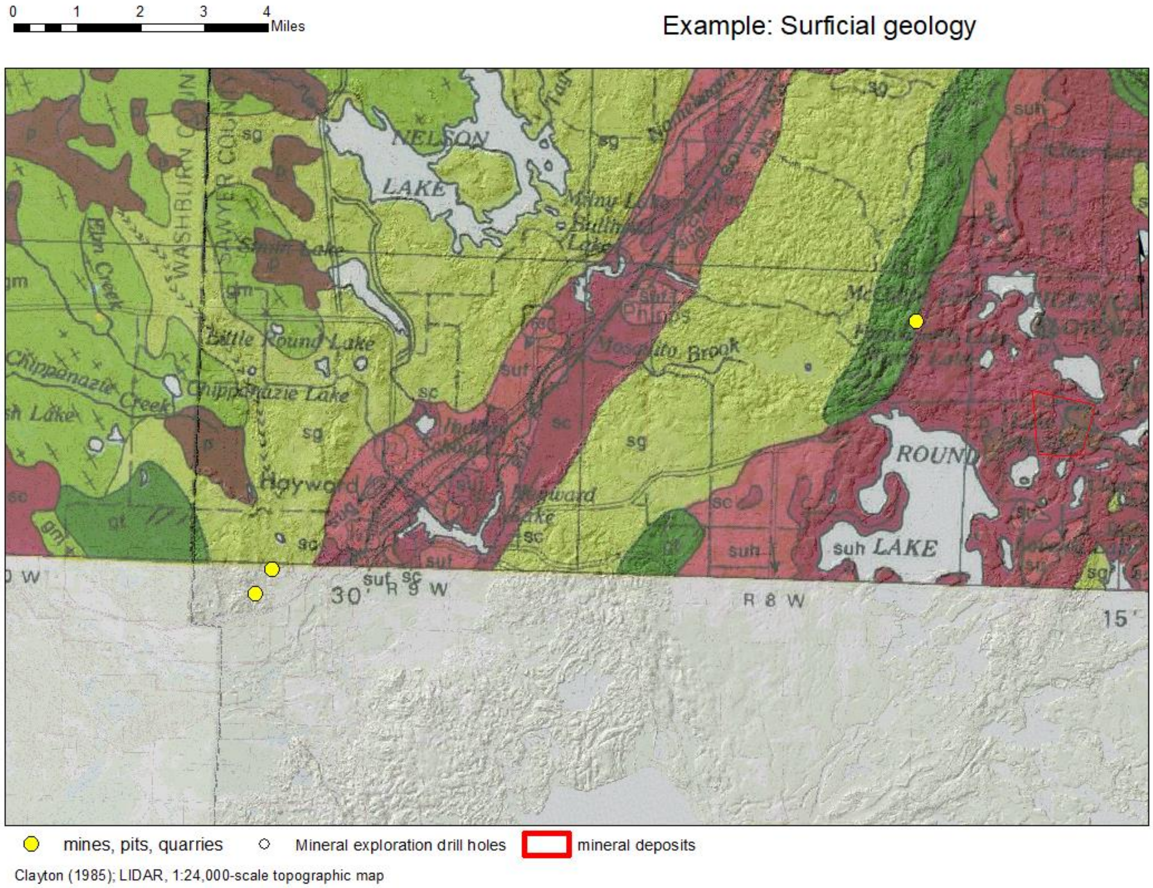

Figure 1. *Map showing the location of mines, pits, quarries, known mineral deposits, and mineral exploration drill holes overlain on a base that shows a surficial geologic map, lidar, and 24,000-scale topographic map (Clayton, 1985).*

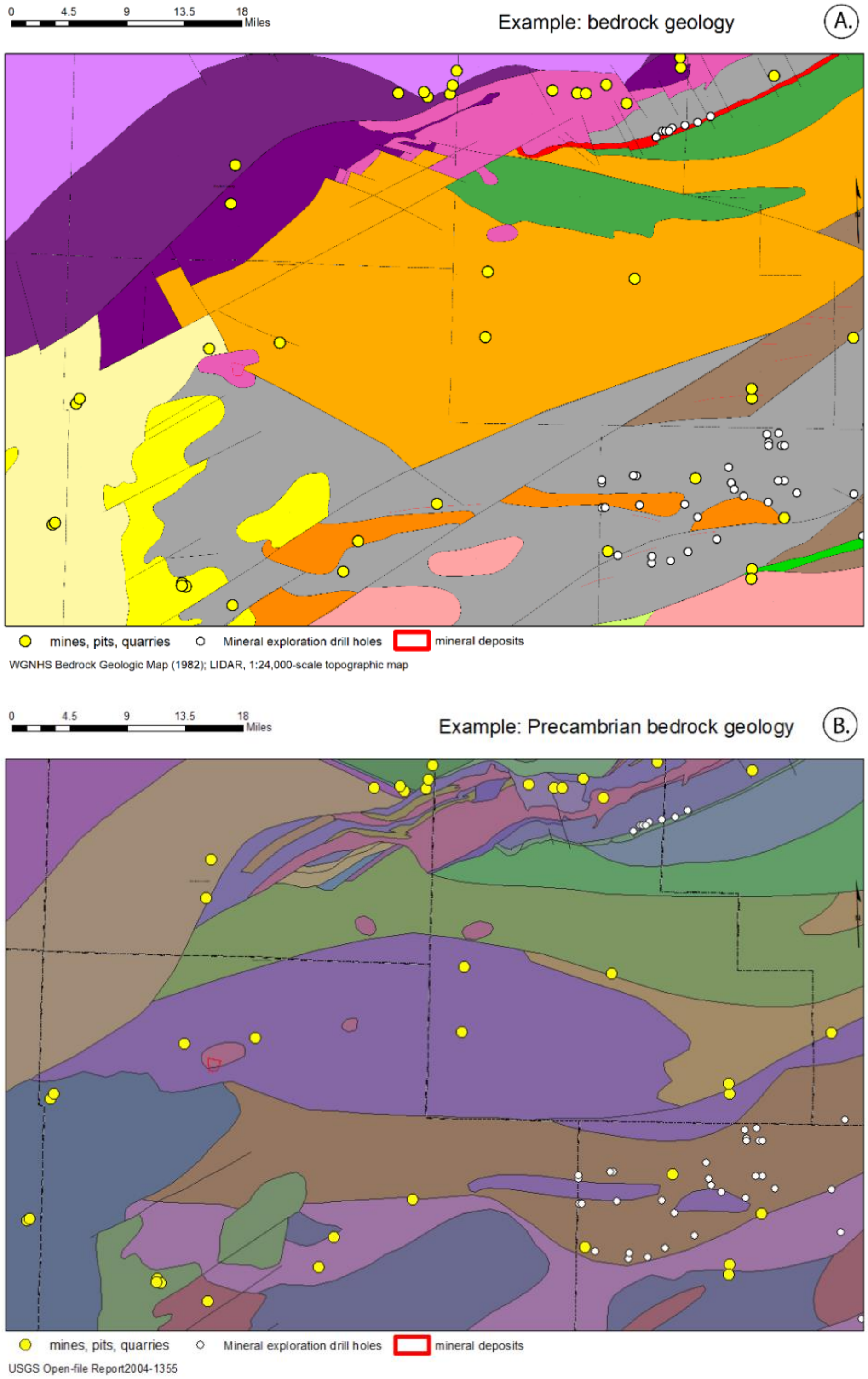

Figure 2. *Locations of mines, pits, quarries, known mineral deposits, and mineral exploration drill holes relative to the geology. The data is overlain on maps showing (**A**) bedrock geology, including Paleozoic sandstone (Mudrey and others, 1982), and (**B**) Precambrian geology (Nicholson and others, 2004).*

Example from Marinette County

In this example, the geologist evaluates publicly available data and concludes negligible likelihood for commercial extraction of surficial deposits. She concludes there is some likelihood of commercial extraction of metallic minerals from bedrock.

Example letter:

Dear Land Conservation Trust,

On January 1, 2019, you contacted me requesting a mineral assessment on a property.

I currently serve as Geologist for the Wisconsin Geological and Natural History Survey, part of the University of Wisconsin-Madison Division of Extension. It is in this professional capacity that I offer the following.

Examination of the relevant 1:24,000-scale topographic map, lidar (5-foot resolution), well construction reports, and the closest available published surficial geologic maps indicate the surficial sediment on the property include pitted outwash and other ice contact deposits, meltwater stream sediment, and ground moraine. No published surficial geologic maps at a scale less than 1:500,000 exist for the area immediately surrounding the property, so the physical properties of the surficial units that underlie the property are poorly constrained. Based on examination of the Quaternary geology of the area, surficial material underlying the property may include meltwater stream sediment comprised of gravelly sand and locally sand and till or till-like debris-flow sediment; glacial sediment comprised of sandy, dolomitic till and debris-flow sediment; and postglacial stream sediment comprised of silt, sand and gravel and commonly overlain by peat or muck.

The surface topography of this unit is hummocky, characterized by small hills and depressions. Locally, depressions form small lakes or wetlands, and an unnamed stream runs through part of the property. Well construction reports indicate the water table is on average about 20 to 40 feet below the ground surface, and ranging between 0, at wetlands and streams, to 45 feet below the ground surface. Well construction reports record 6 to 57 feet of sand, clay, gravel, or boulders overlying Precambrian bedrock. The closest sand and gravel pit is located several miles from the property and extracts material from Pleistocene features, including abundant eskers that likely are absent or minimal on the property. Given the shallow depth to the water table, presence of wetlands and streams, and shallow depth to bedrock it is unlikely that economic deposits of unconsolidated material are present on the property.

The bedrock geology of the area has been mapped at 1:100,000-scale (Sims and Schulz, 1993) as rhyolite, felsic tuff and volcanogenic greywacke of the Pembine-Wausau Terrane (fig. 2). Metallic mineral deposits are hosted in the Pembine-Wausau Terrane. The Back Forty deposit is located several miles from the property in Michigan and is presently undergoing permitting for development as an open pit mine. The deposit is hosted within altered rhyolite breccia and pyroclastic rocks cut by dikes, sills, and dacite and rhyodacite intrusions (Aquila Resources, https://aquilaresources.com/projects/back-forty-project/). Given the shallow depth to bedrock and the similarity between the bedrock that hosts the Back Forty deposit and that which underlies the property, there is potential for economic mineral deposits to underlie the property.

Sincerely,

WGNHS Geologist

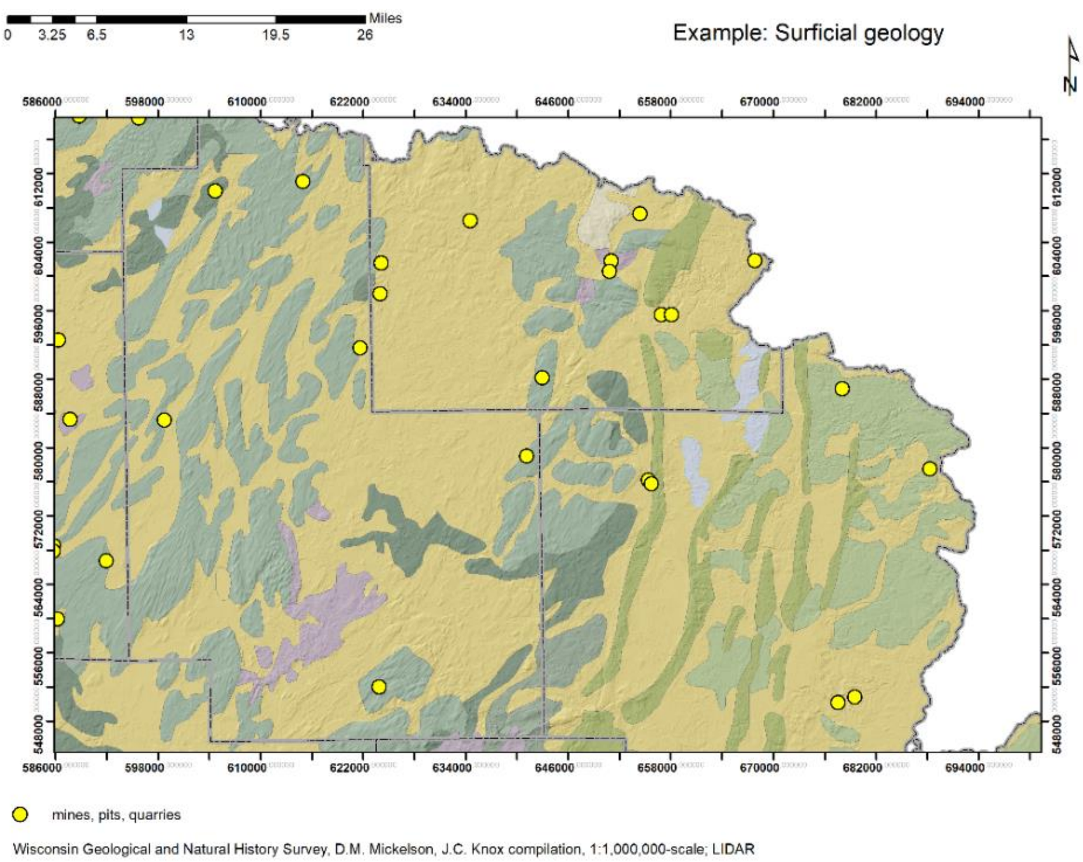

Figure 1. *Map showing the location of mines, pits, and quarries overlain on a base that shows a surficial geologic map (Farrand and others, 1984) and lidar.*

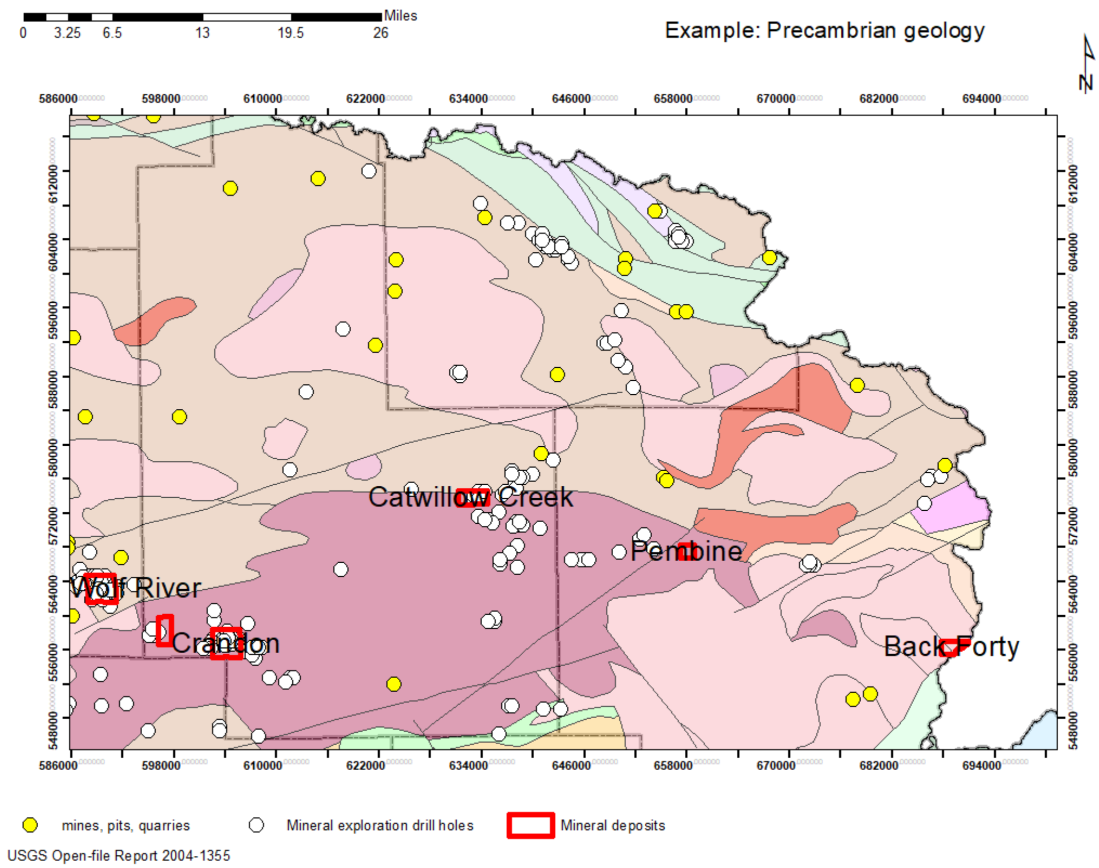

Figure 2. *Map showing the location of mines, pits, quarries, mineral exploration drill holes, and known mineral deposits overlain on a base that shows Precambrian bedrock geology (Nicholson and others, 2004).*

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