

Wisconsin Mineral Development Atlas: The Digitized Atlas

Kyle Pepp

kyle.j.pepp@gmail.com

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University of Wisconsin – Madison, Department of Soil Science

Scope

The goal of this report is to provide planning maps and general background of historic mining in southwest Wisconsin to augment current and future investigation. It also reviews the origination of the Wisconsin Mineral Development Atlas and the methodology used to create the maps. A contamination heat map is provided for each county and their most contaminated civil divisions. Feature maps are also included for each civil division.

History

Mining began in the Upper Mississippi Valley Zinc and Lead District (see figure one) as early as the 1690s by Native Americans and was followed by French colonizers who predominantly mined surface lead deposits (Heyl, 1959). Little documentation is available before 1820, but from 1830 to 1871, the mining district was by far the most important lead producing area in the United States (Heyl, 1959). After the 1870s, lead production declined and transitioned to zinc with peak production in World War I. Production ceased in 1979, leaving behind more than 2000 small mining sites. See figures two and three for graphs of metal extraction over time.

Lead ore was primarily mined at or near the surface while zinc ore was mined underground. Ore was crushed into 1-2 cm particles and sorted using gravity and alternating water currents to filter particles over a screen mesh. This produced waste rock (tailings), concentrated ore, and very concentrated ore. The very concentrated ore could go directly to roasters, but the less concentrated ore required further refinement through magnetic separation or froth flotation. Roasting and further refinement took place off site, or on rail cars. Tailings from initial sorting exist at virtually every mine site. Piles were stacked at the head of the slope near

the shafts, where gravity concentration was performed. Much of the material was used for road building, though a considerable amount of material was transported downslope by gravity (Cashell, 1980).

Because mining was the primary economic activity of the region, cities typically developed adjacent to mine sites, leaving most people near contamination. Zinc occurs naturally in soil and is a trace element essential for human health, however, high concentrations can negatively impact plants, soil, and water. Zinc can increase water acidity, bioaccumulate in food chains, contaminate groundwater, kill plants, and interrupt soil activity by hindering organisms that breakdown organic matter (Wuana & Okieimen, 2011). Unlike zinc, lead is not essential for human health and has a large suite of negative health implications for the brain, nervous system, red blood cells, and kidneys. Exposure to soil lead can happen through direct ingestion of soil, soil deposits on plants, water contamination, and ingestion of plants that have assimilated lead; though plants do not generally uptake lead unless soil is highly contaminated (Wuana & Okieimen, 2011).

Wisconsin Mineral Development Atlas

The Wisconsin Mineral Development Atlas (MDA) of the Upper Mississippi Valley District was conceived and structured in 1945 through combined efforts of the U.S. Bureau of Mines, the U.S. Geological Survey, and the State Geological Surveys of Illinois, Iowa, and Wisconsin. The atlas was created by collecting data from mining operations, including exploration, development, planned mines, and detailed logs sufficient to evaluate mineral potential at any site where work had been done. Visual data was assimilated into “MDA sheets,” one square mile PLSS sections, and organized by County. In Wisconsin, with the exception of five MDA sections in Dane County, virtually all of the atlas is within Grant, Lafayette, Iowa, and Green Counties. MDA sheets were georeferenced for use in GIS. In most cases, boreholes and mine sites have associated drilling information contained in the official copy of the Wisconsin Mineral Development Atlas housed at the Wisconsin Geologic and Natural History Survey in Madison, Wisconsin. The atlas is supplemented by the U.S. Geological Survey’s Professional Paper 309: The Geology of the Upper Mississippi Valley Zinc-Lead District written by Heyl et al. in 1959. The paper can be accessed here: <https://pubs.er.usgs.gov/publication/pp309>

The Digitized Atlas

In an effort by the Department of Soil Science at the University of Wisconsin-Madison and Grant, Lafayette, Iowa, and Green Counties, the georeferenced MDA sheets were digitized into shapefiles to improve analysis and visualization. Digitized data are broken into the following layer types: surveyed workings, unsurveyed workings, shafts, open activity, no mda sheet, lead digs, hazards, boreholes, and abandoned rails. In addition to MDA sheets, 2011 5ft resolution LIDAR hillshade imagery provided by WGNHS, 2015 NAIP orthophotos, and USGS’s Prospect- and Mine-Related Features (24k points) were used to identify features. The Atlas did

not provide coherent and detailed definitions for each feature so some interpretation is necessary. Shapefiles are available for Grant, Lafayette, Iowa, and Green counties and combined for the entire region.

Mine Feature Definitions

“_aban_rail” are abandoned railroad lines identified from MDA sheets and substantial visual inspection of 2011 hillshade imagery (including areas with no MDA sheets). 2015 NAIP orthophotos were used for additional confirmation.

“_boreholes” are all drill holes excluding water wells and mine shafts. Some of the densely mined areas have multiple overlapping layers with minor georeferencing discrepancies; in these cases, the most detailed sheet was used. Original MDA sheets include ‘degree of mineralization;’ this information was not retained. Moreover, most drill holes have an associated core sample with stratigraphy and mineralization details that can be accessed through the Wisconsin Geologic and Natural History Survey.

“_lead_digs” are sites identified primarily by MDA sheets with additional visual inspection of 2011 hillshade imagery where lead (and other minerals) were obtained on or near the ground surface. 2015 NAIP orthophotos were used for additional confirmation.

“_open_activity” includes open pit mines, historic quarries, prospecting sites, and some modern quarries. MDA sheets, 2011 hillshade imagery, 2015 NAIP orthophotos, and USGS’s Prospect- and Mine-Related Features (24k points) were all used to identify these features.

“_shafts” were identified exclusively by MDA sheets and include all deep mine shafts for underground mines and mine openings associated with surficial lead mining.

“_surveyed_workings” should be interpreted primarily as detailed, underground zinc mines. The definitions provided by the Atlas for these features are “mine workings” and “surveyed mine workings – outline of excavation”

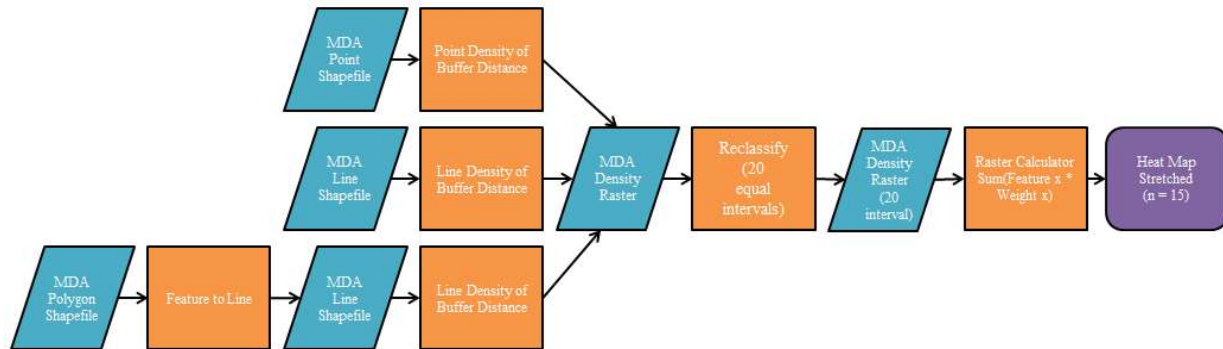
“_unsurveyed_workings” should be interpreted as underground zinc mines that lack some or considerable detail, or any other bona fide mine site that lacks detailed information. If a mine site was named but not outlined, this was also captured in the layer. The Atlas’s definition for this feature is “unsurveyed workings or workings that are subject to question” and “unsurveyed mine workings – outline of excavation.”

“_no_mda_sheet” are areas that do not have MDA sheets. It should not be assumed that these areas are free from mine activity.

“_hazards” are unique sites with individual labeling in their attribute table.

Heat Map Methodology

To make visualizing contamination simpler, a heat map was created using a GIS weighted overlay analysis. The analysis incorporated proximity and likely contamination to produce a generalized map of where contaminants may originate from. The analysis should be considered very coarse as it does not account for any soil movement resulting from natural processes like water or wind. The analysis was performed in ArcMap, using a 50ft raster cell, following the procedure in the diagram below, with the given buffer distances and weights.



Layer	Buffer Density Distance (ft)	Weight
Borehole	100	1
Mine Shaft	1000	4
Abandoned Railroad	150	1
Mine Hazard	1250	4
Lead Digging Site	1000	3
Open Mine Activity	1000	2
Surveyed Workings	1000	3
Unsurveyed Workings	1000	2

Bibliography

- Cashell, M. M. (1980). Chemical and Morphogenetic Characteristics of Zn-Pb Mine Tailing Soils in Southwest Wisconsin. *Masters Thesis*. Madison, Wisconsin: University of Wisconsin-Madison.
- Heyl, A. V. (1959). *The Geology of the Upper Mississippi Valley Zinc-Lead District*. Washington D.C.: United States Geological Survey.
- Wuana, R. A., & Okieimen, F. E. (2011). Heavy Metals in Contaminated Soils: A Review of Sources, Chemistry, Risks and Best Available Strategies for Remediation. *International Scholarly Research Notices Ecology*.

Figure One: Upper Mississippi Valley Zinc and Lead District, from Heyl, 1959

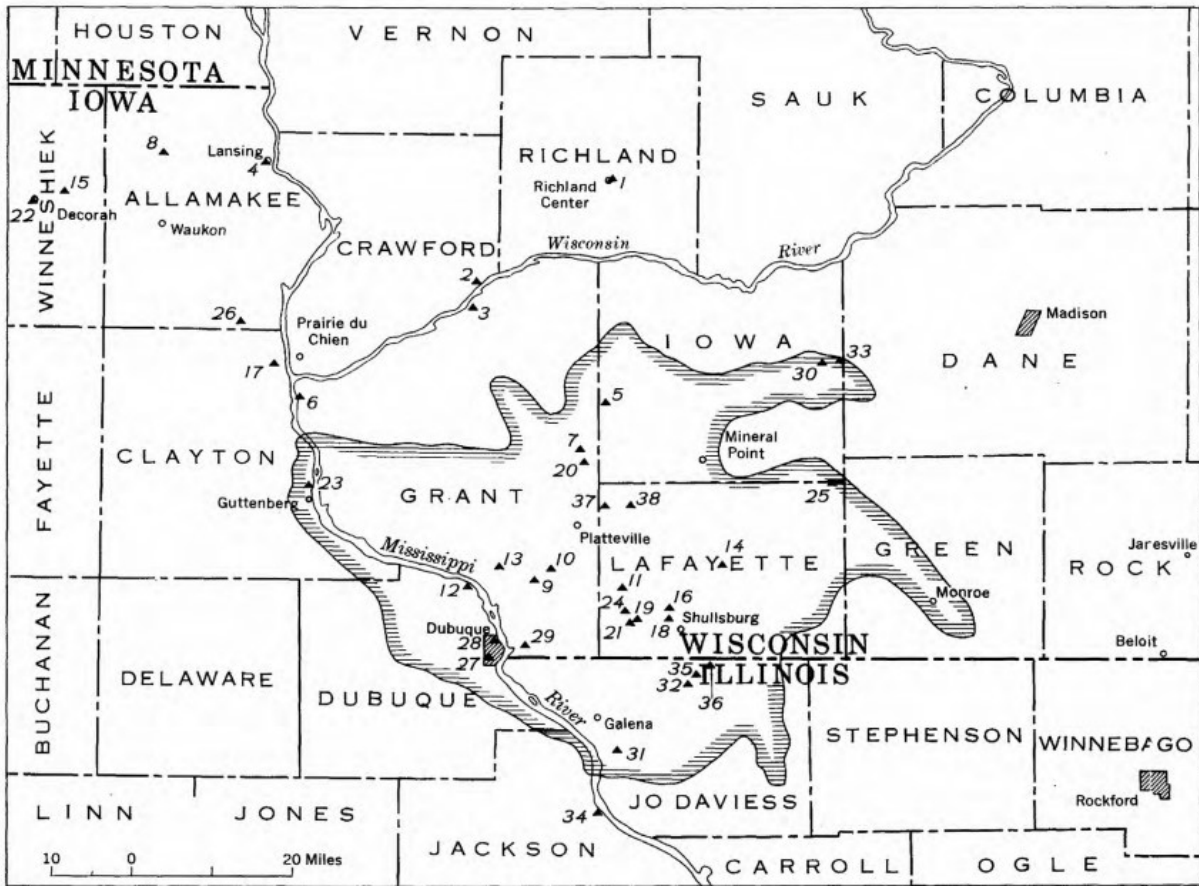


Figure Two: Lead extraction in short tons from 1800 to 1952, from Heyl, 1959

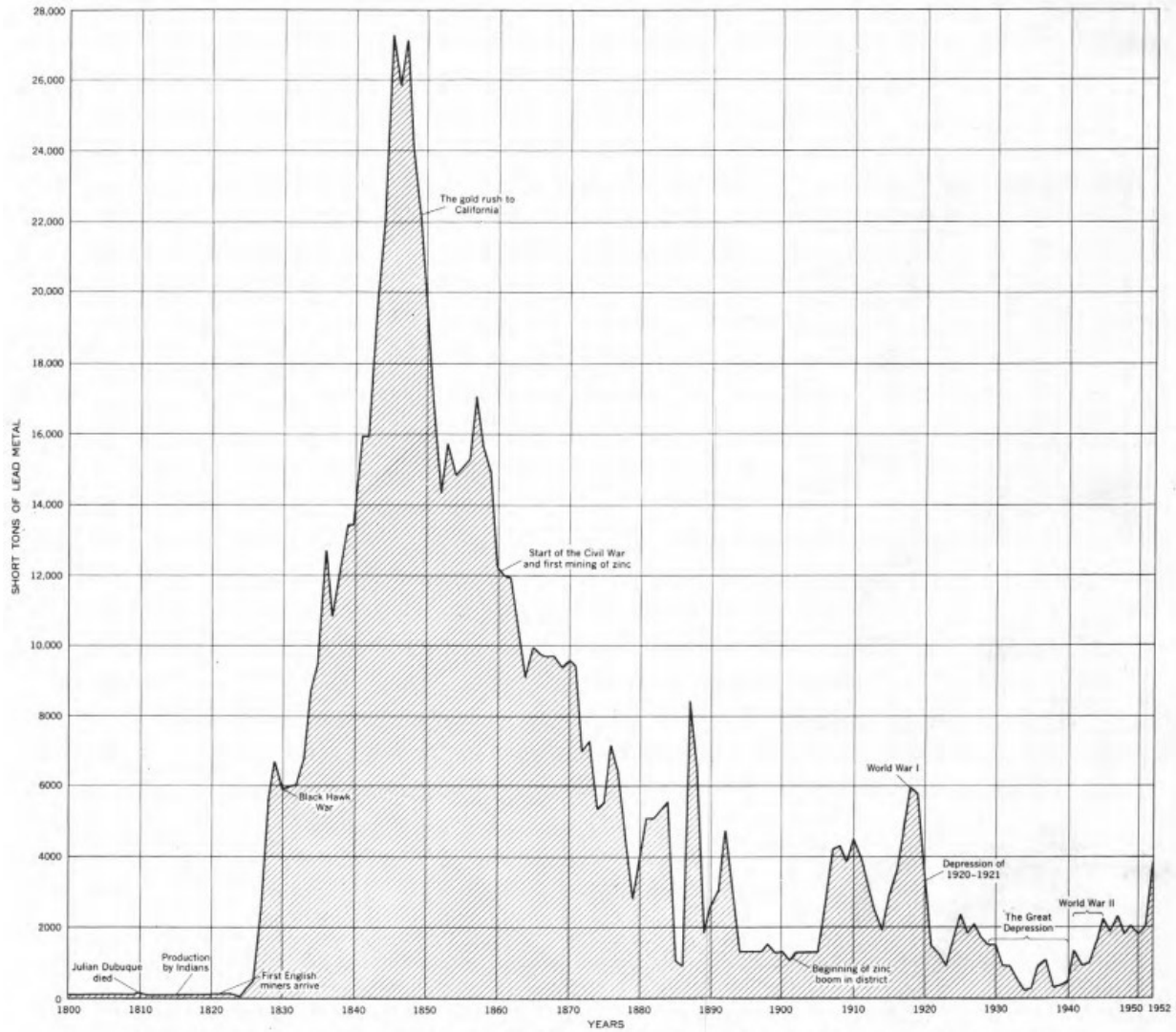
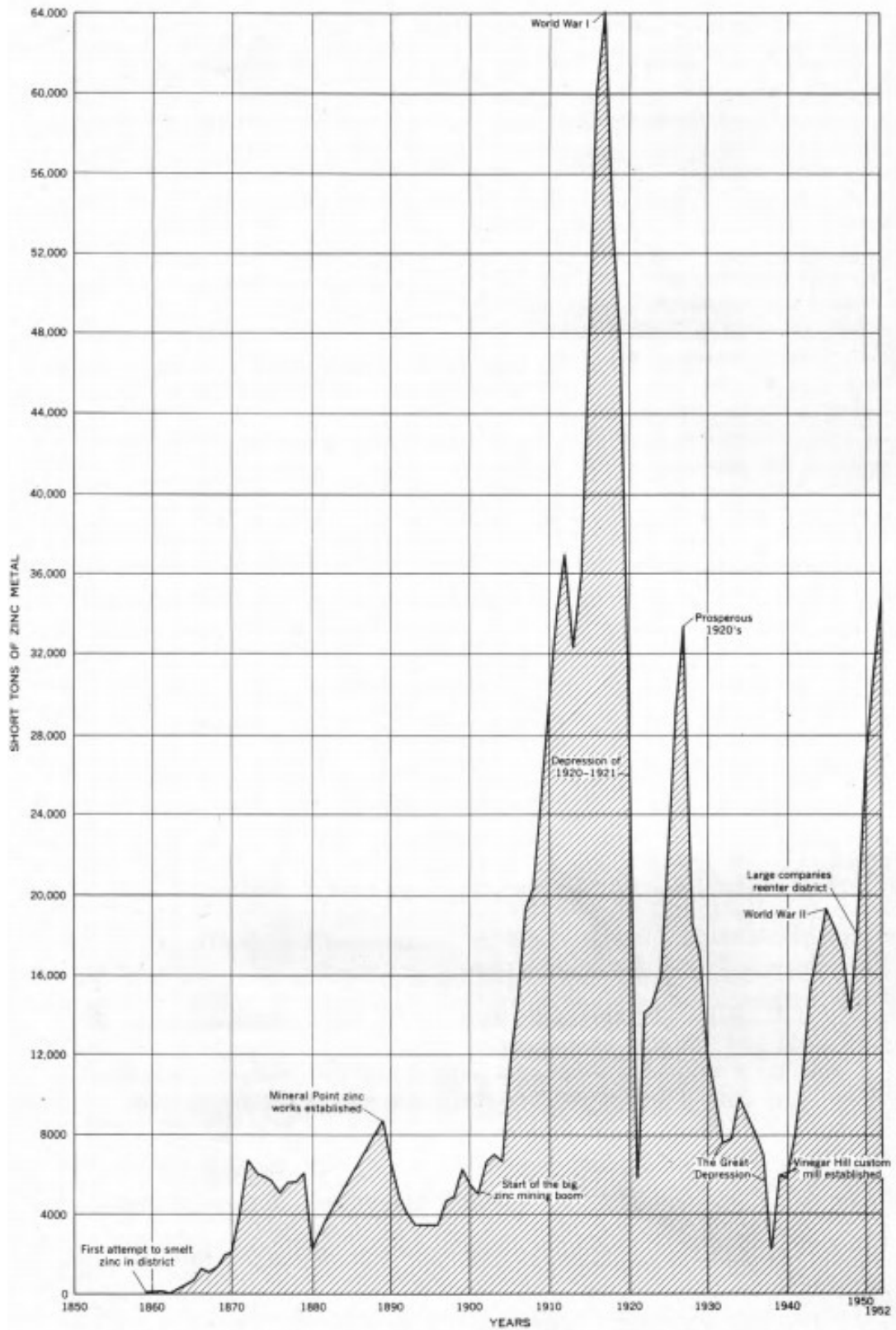
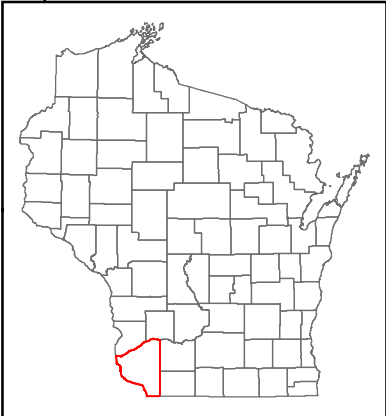
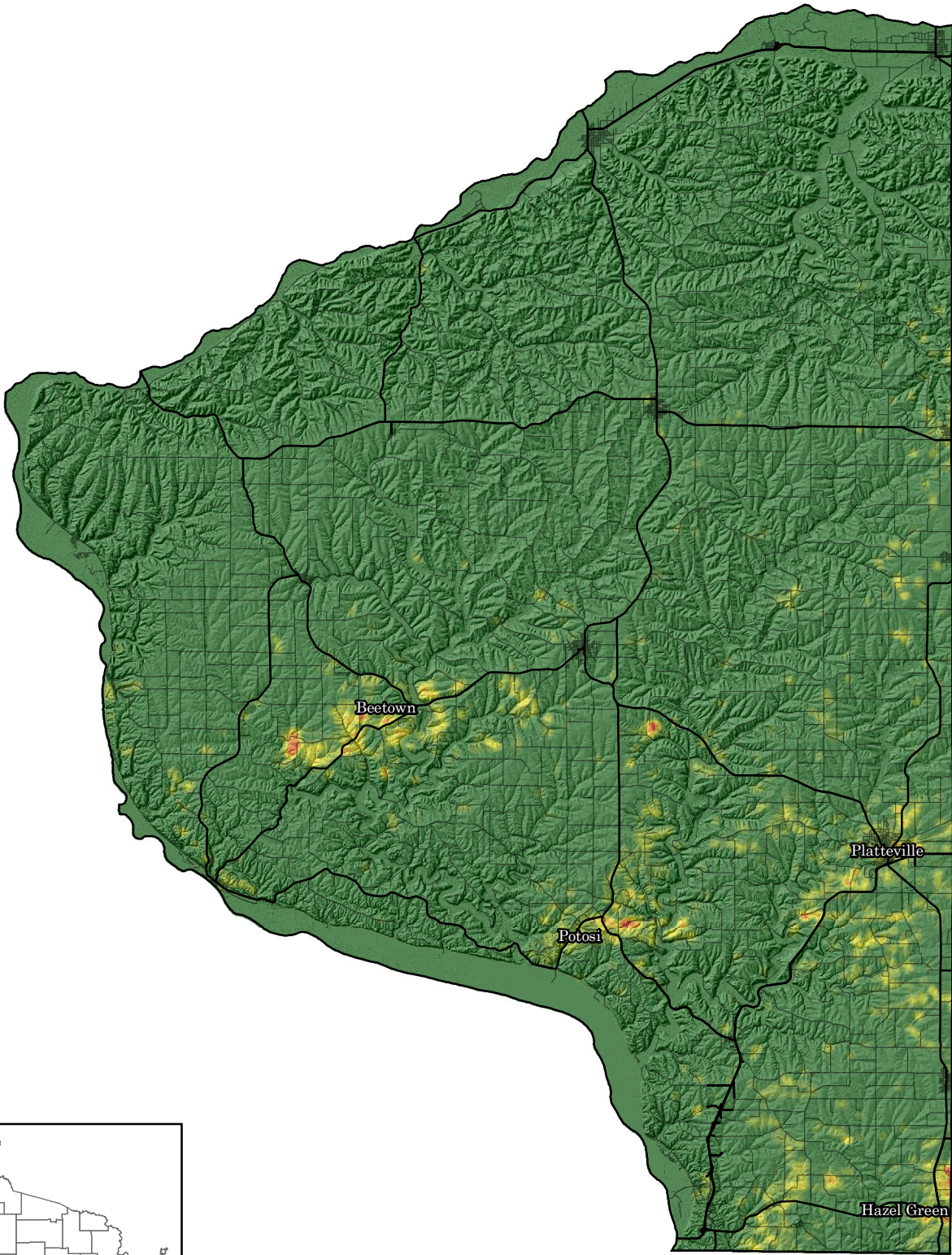


Figure Three: Zinc extraction in short tons from 1850 to 1952, from Heyl, 1959



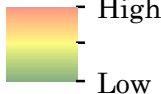
Grant County



0 2.5 5 10 Miles

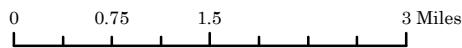
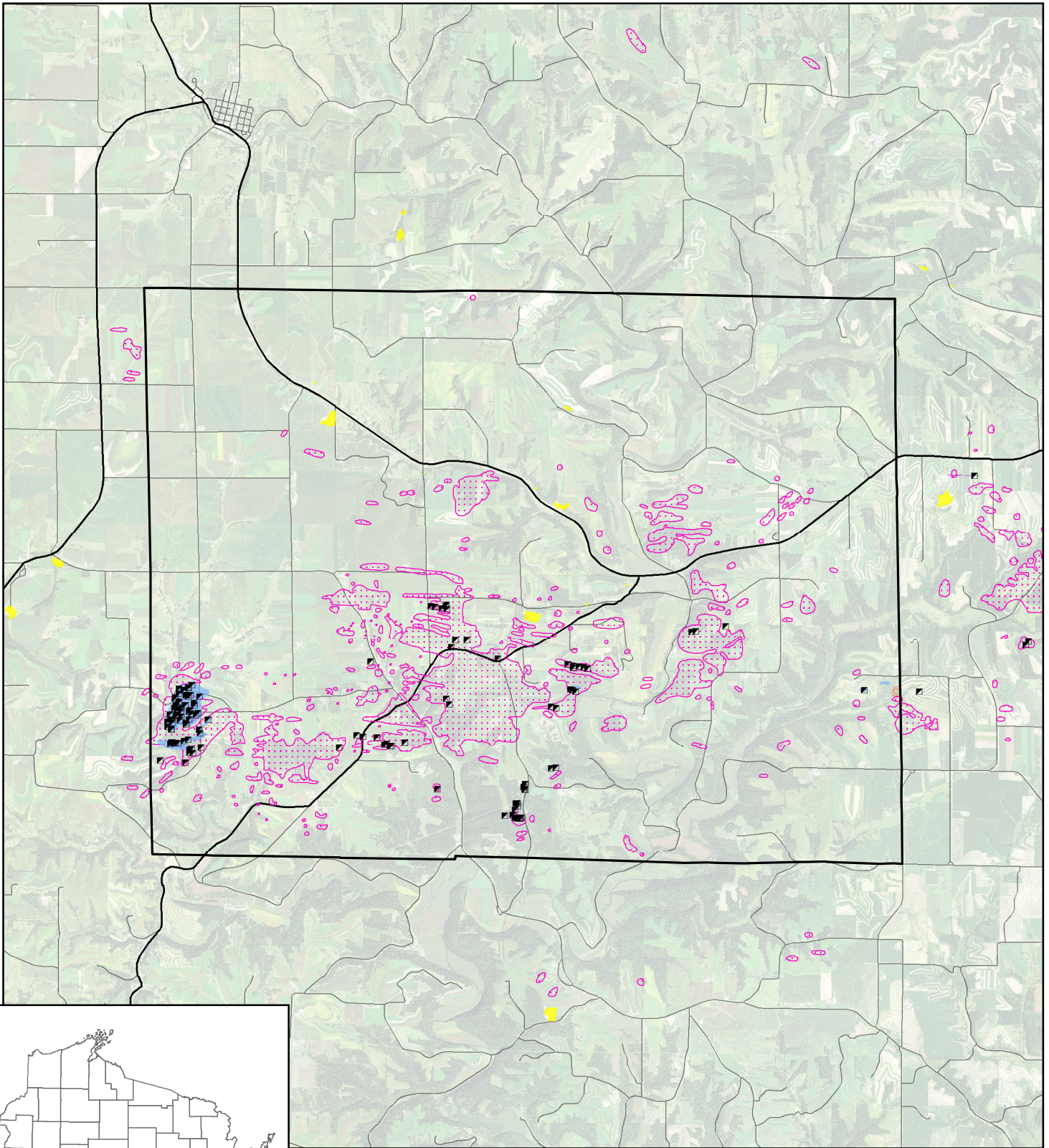













Contamination

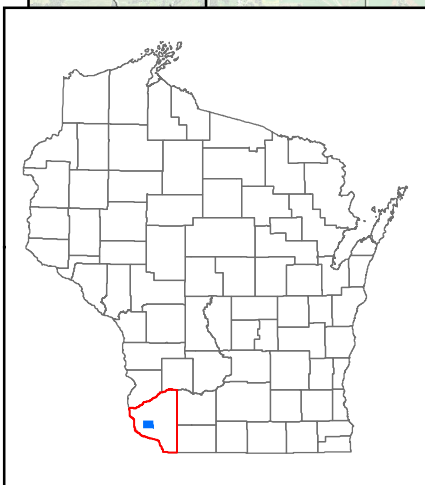


— Highway
— Road

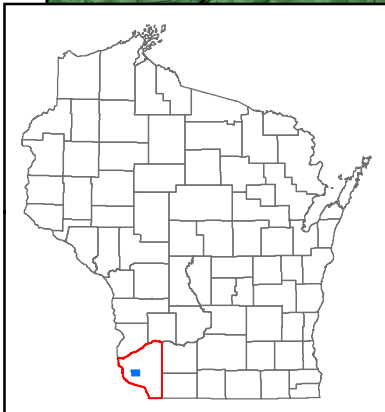
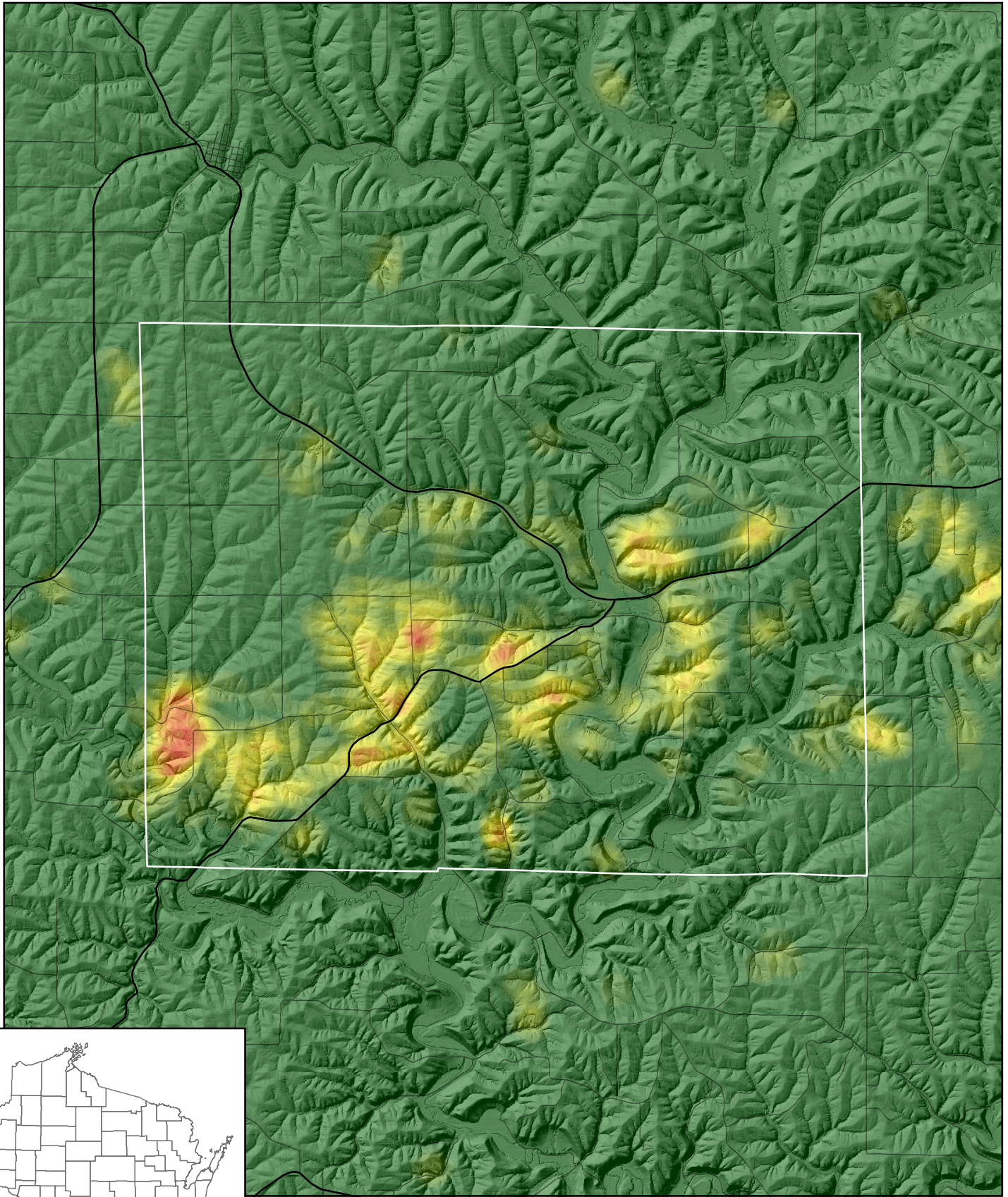
Beetown



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|  Surveved Workings |  Hazard |  Civil Division |
|  Unsurveved Workings |  Abandoned Railroad |  Highway |
|  Surface Lead Mining |  Mine Shaft |  Road |
|  Open Activity |  Borehole | |



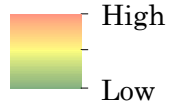
Beetown



0 0.5 1 2 Miles

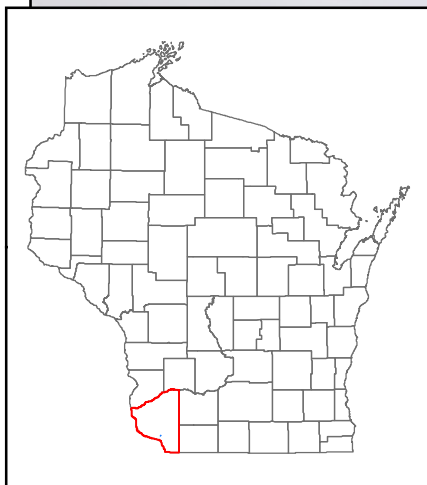
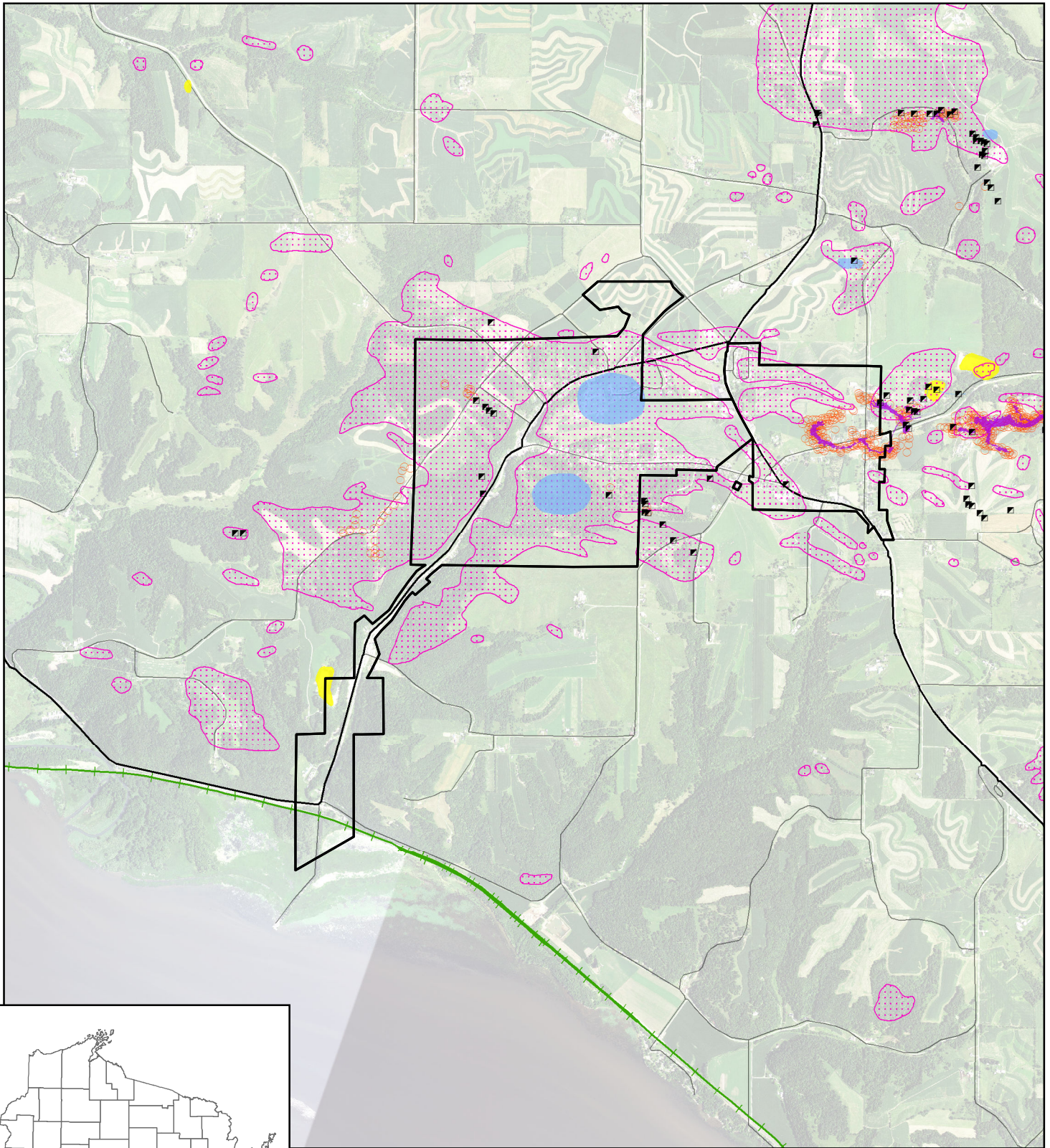


Contamination














- Highway
- Road

Potosi

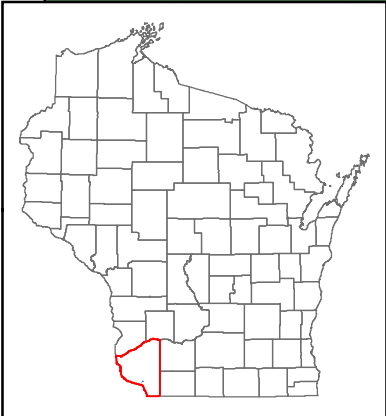
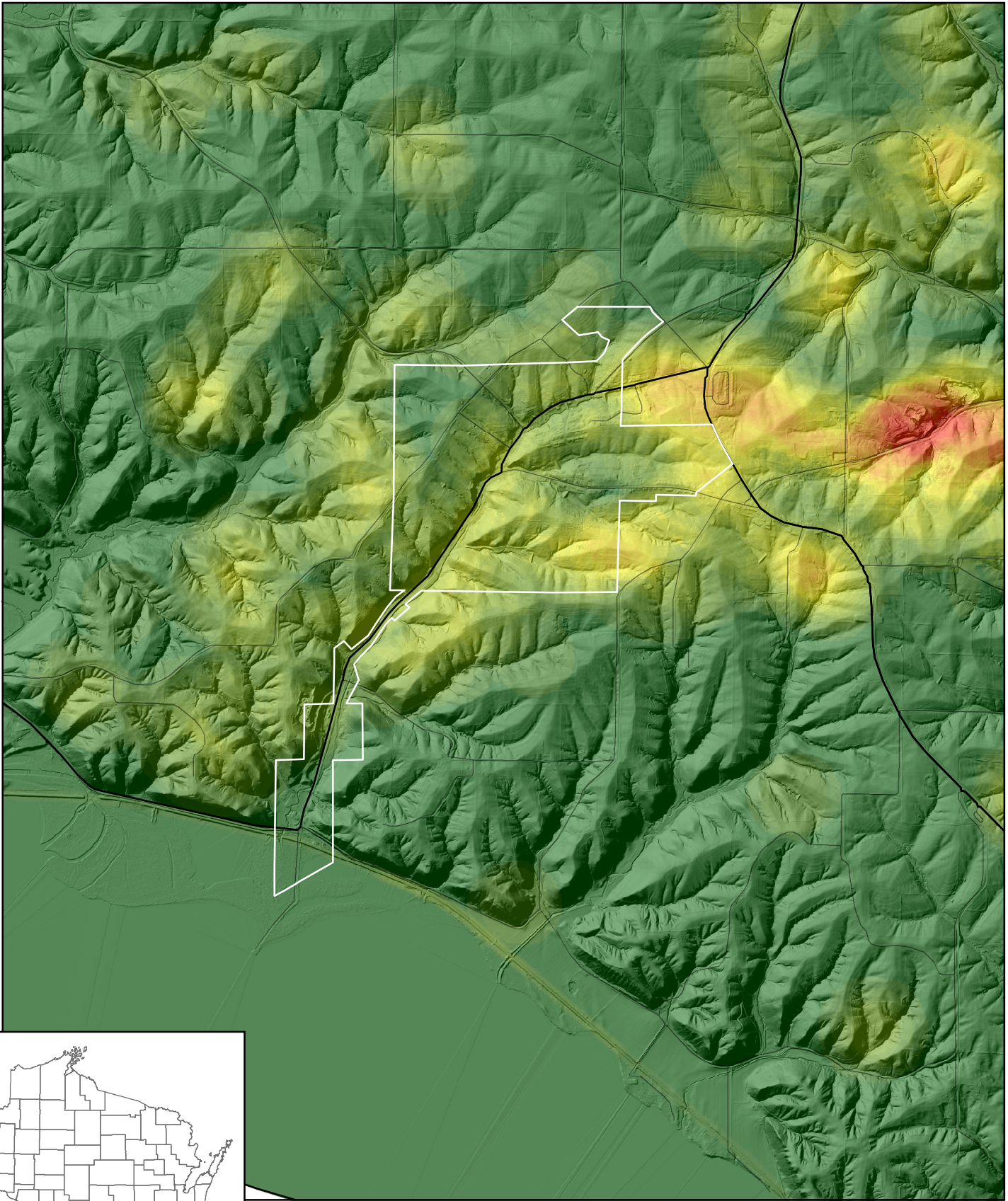


0 0.325 0.65 1.3 Miles



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|  Unsurveved Workings |  Abandoned Railroad |  Highway |
|  Surface Lead Mining |  Mine Shaft |  Road |
|  Open Activity |  Borehole | |

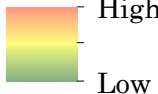
Potosi



0 0.25 0.5 1 Miles

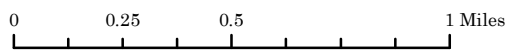
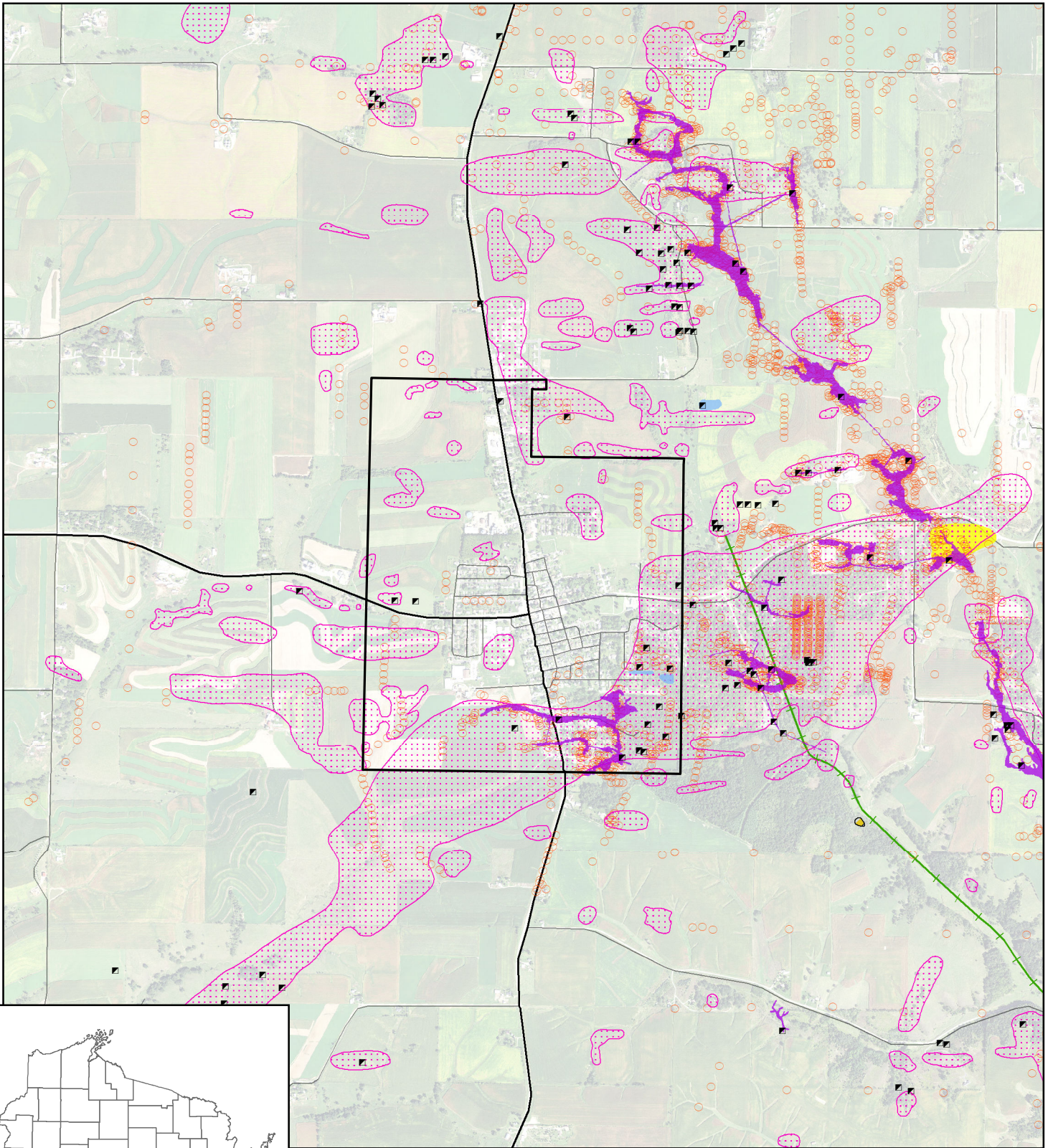













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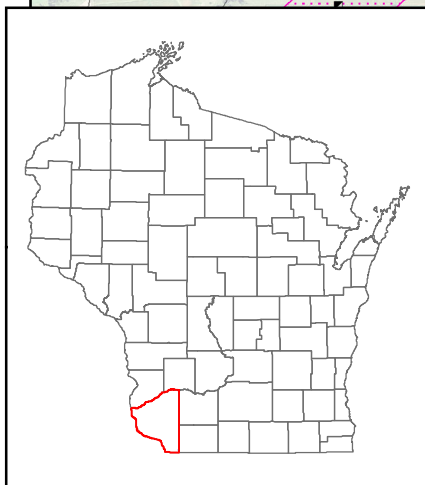


— Highway
— Road

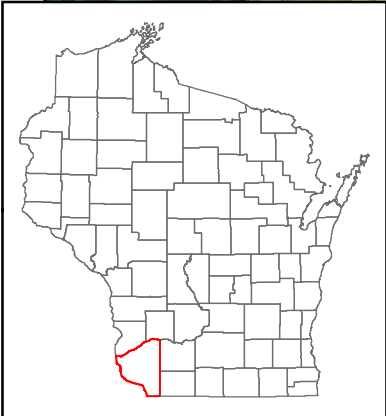
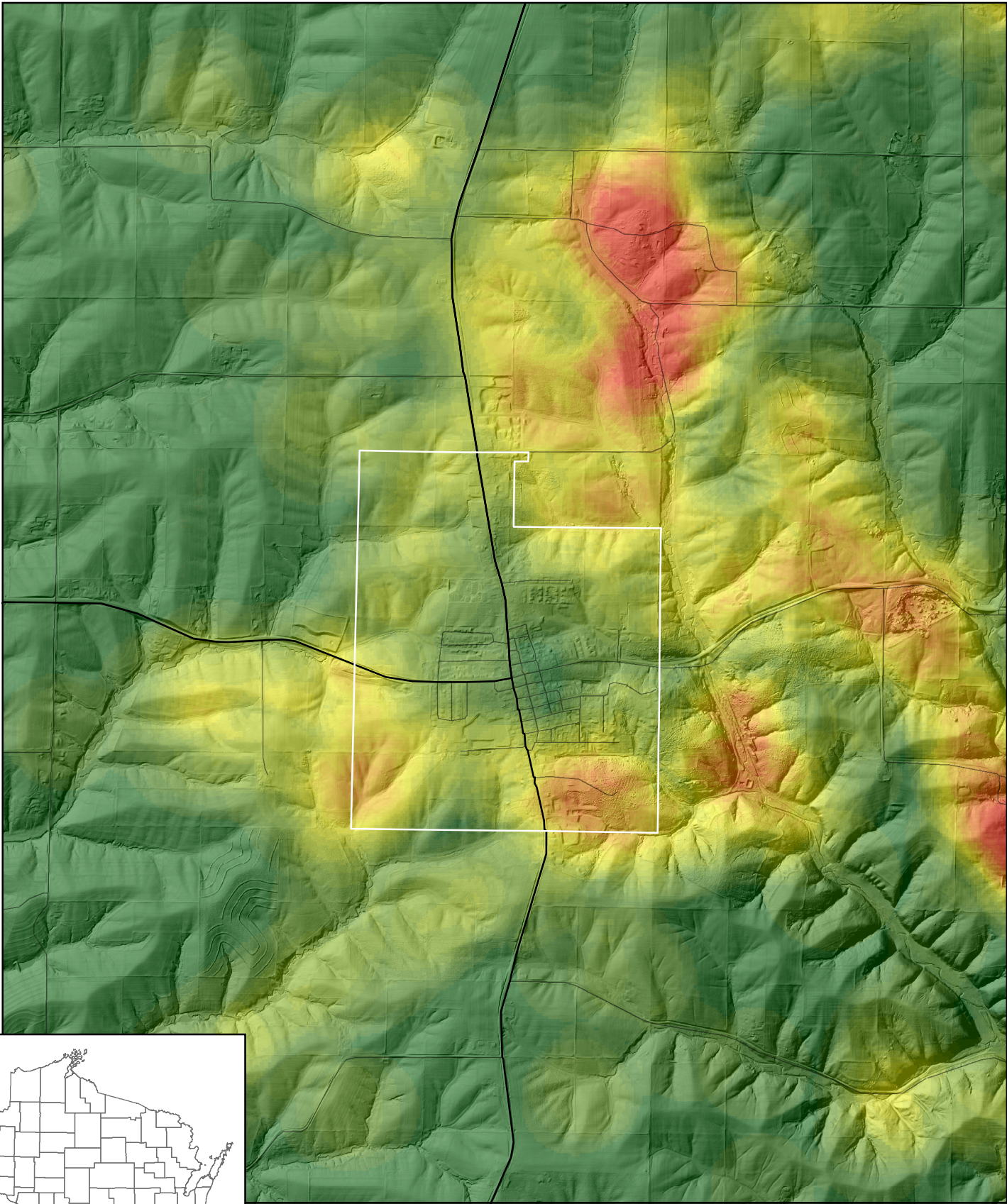
Hazel Green



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|  Unsurveved Workings |  Abandoned Railroad |  Highway |
|  Surface Lead Mining |  Mine Shaft |  Road |
|  Open Activity |  Borehole | |



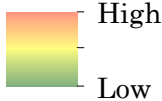
Hazel Green



0 0.2 0.4 0.8 Miles



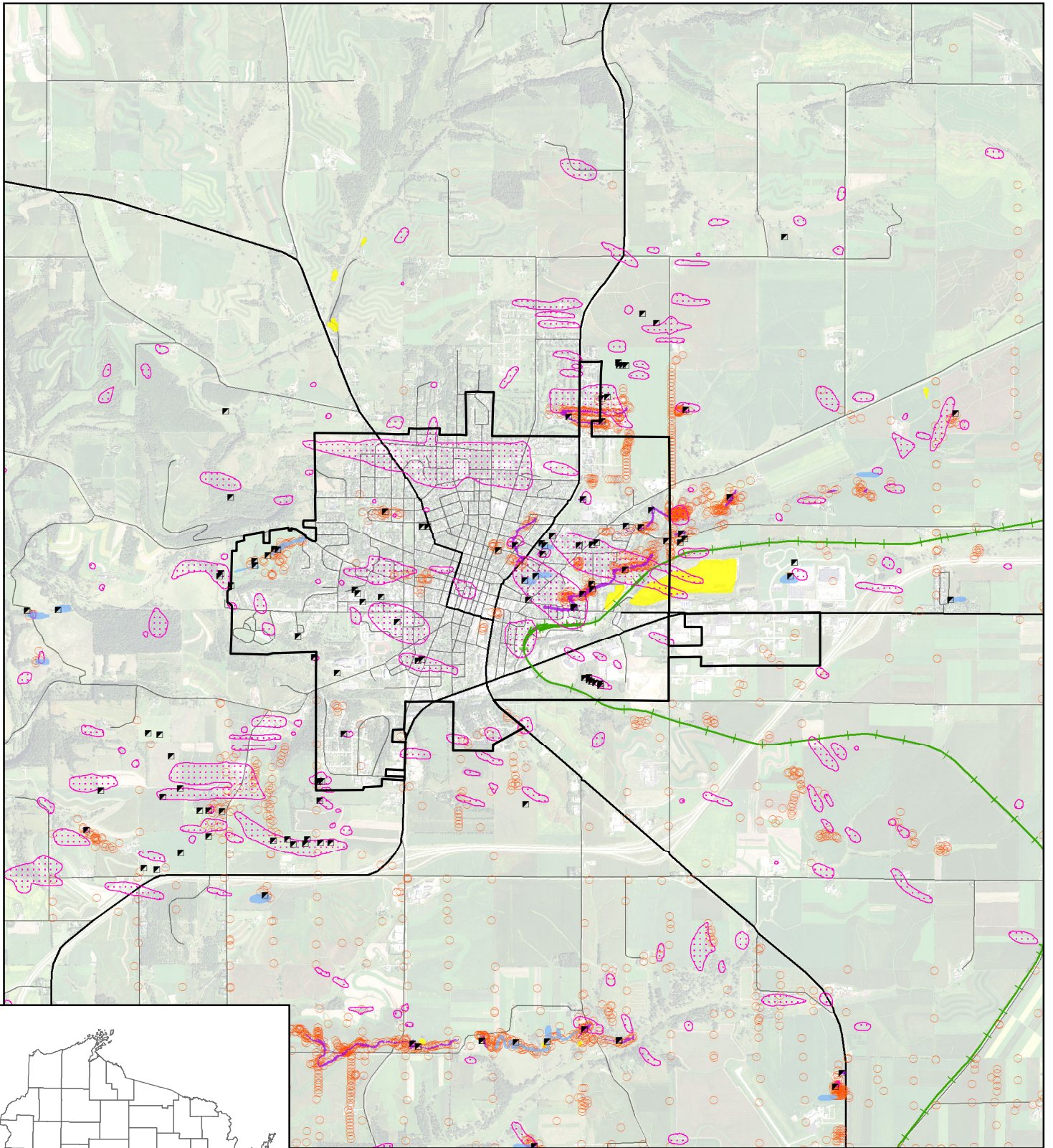
Contamination



— Highway












— Road

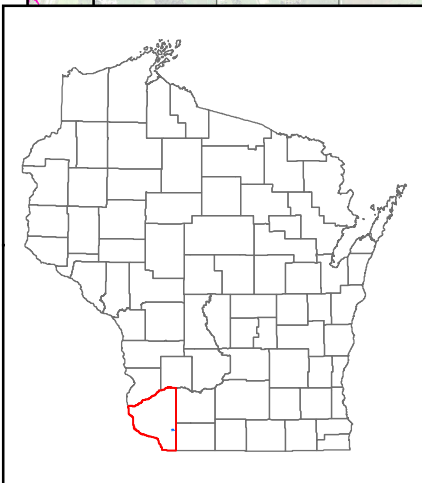
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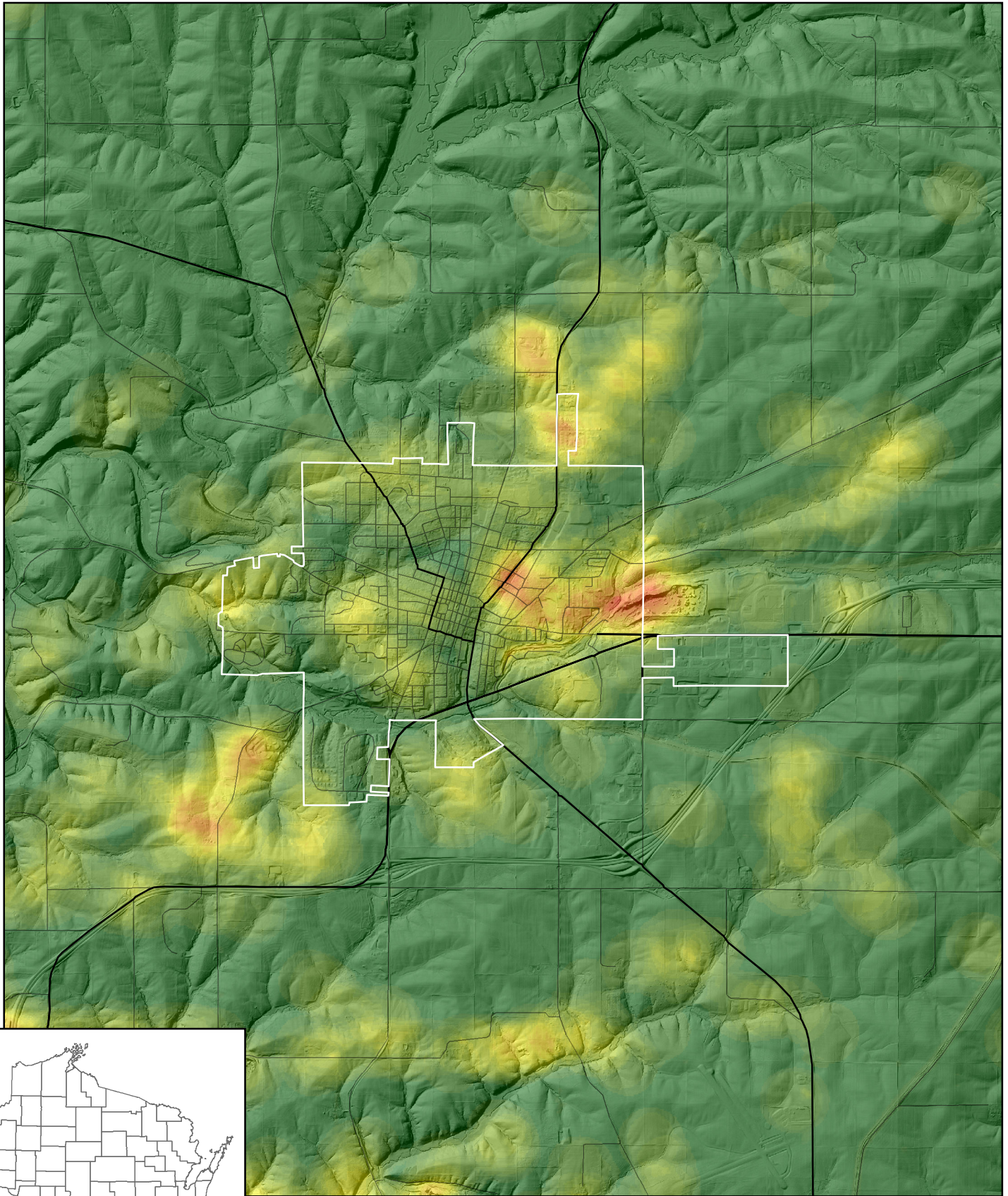
0 0.4 0.8 1.6 Miles



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|  Open Activity |  Borehole | |



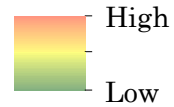
Platteville



0 0.35 0.7 1.4 Miles

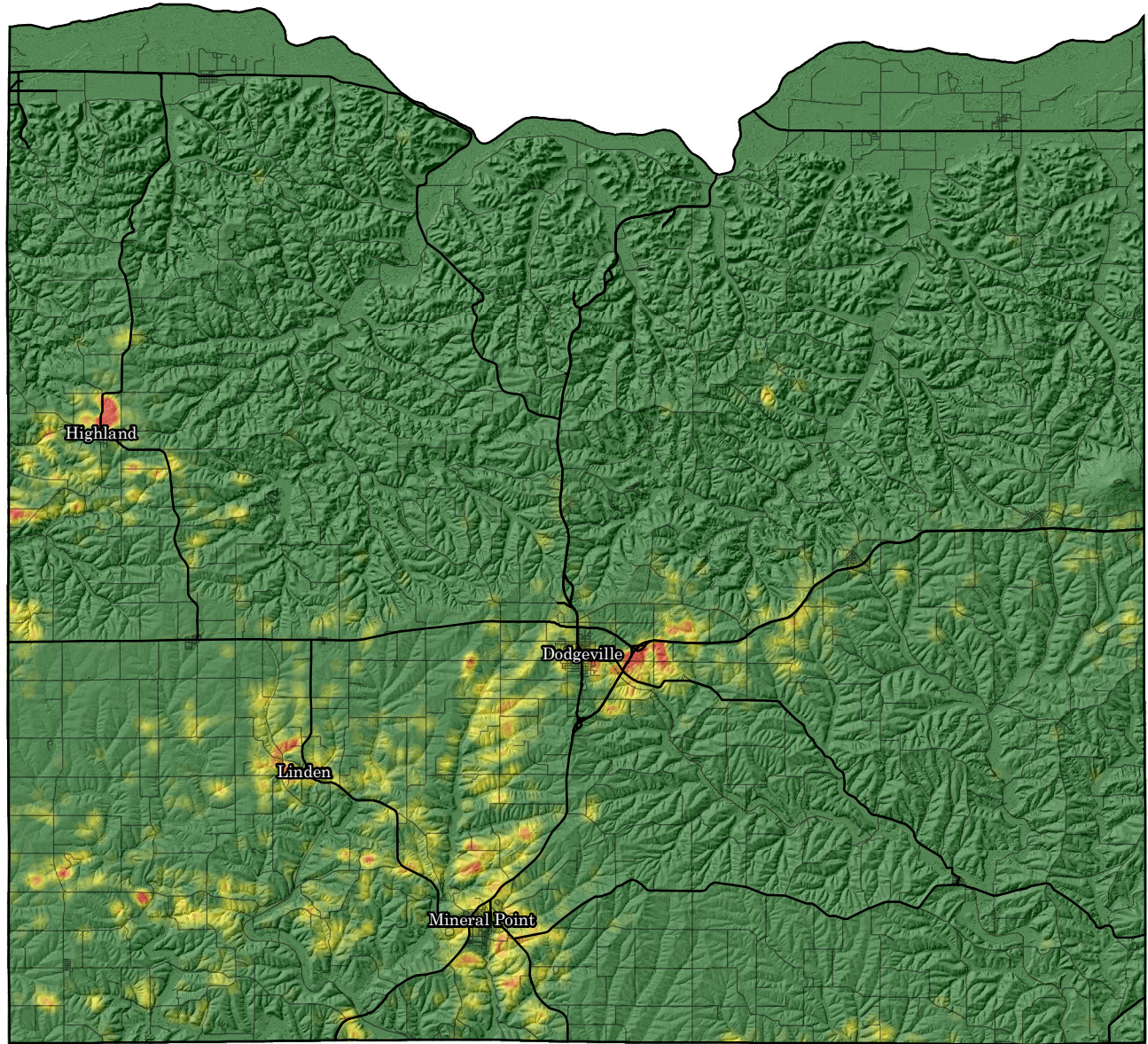


Contamination



— Highway
— Road

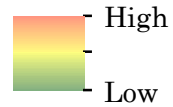
Iowa County



0 1.75 3.5 7 Miles

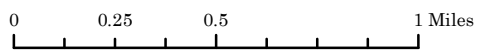
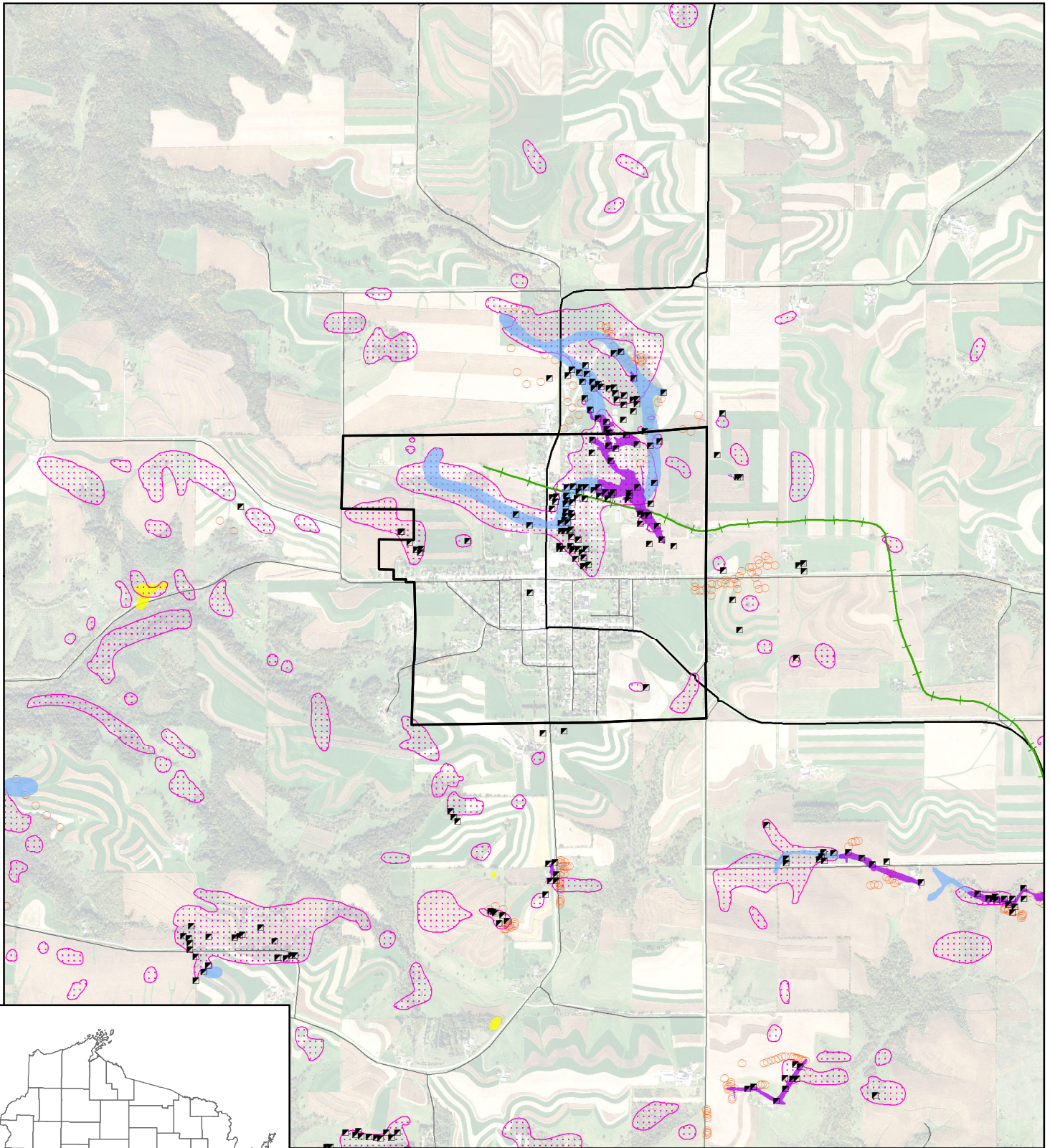







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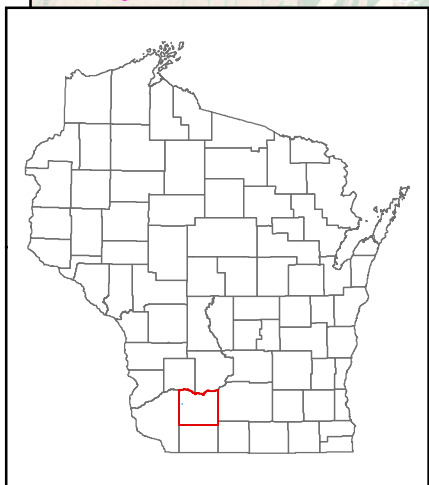


— Highway
— Road

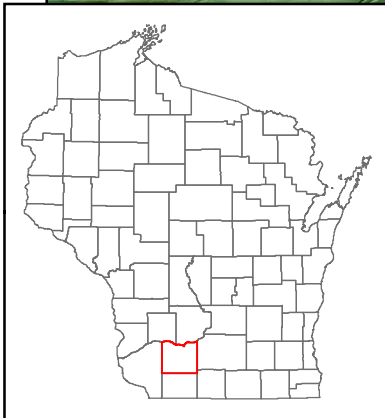
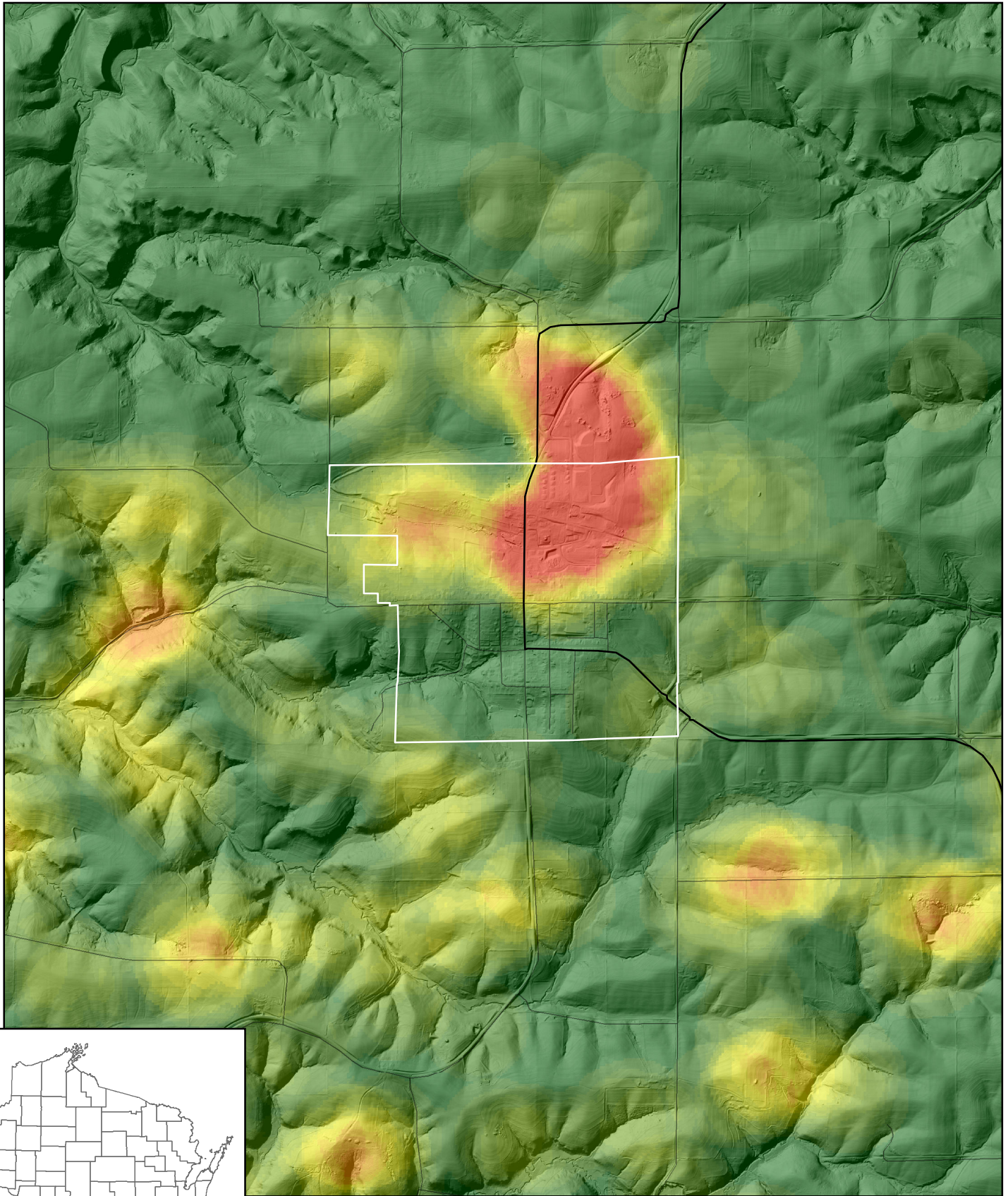
Highland



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|  Survejed Workings |  Hazard |  Civil Division |
|  Unsurvejed Workings |  Abandoned Railroad |  Highway |
|  Surface Lead Mining |  Mine Shaft |  Road |
|  Open Activity |  Borehole | |



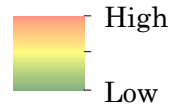
Highland



0 0.2 0.4 0.8 Miles

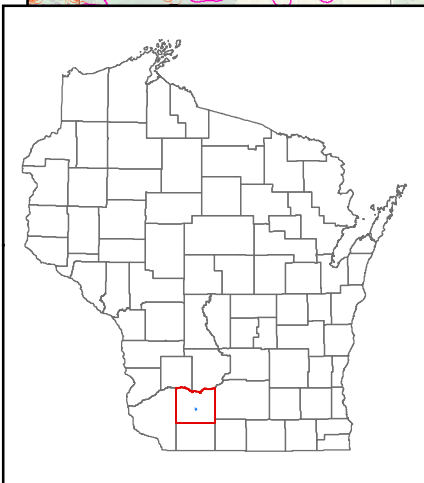
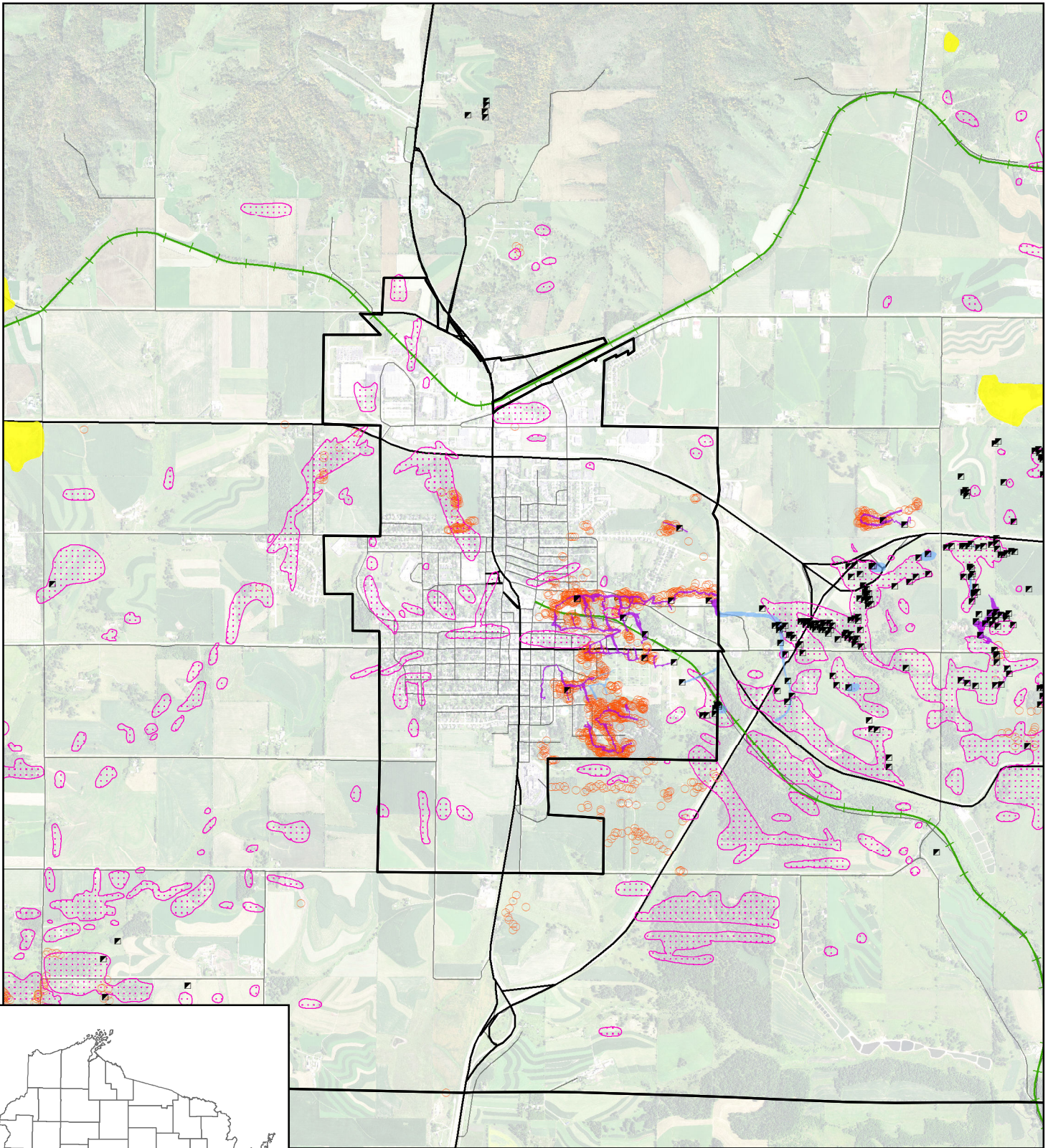


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







— Highway
— Road

Dodgeville

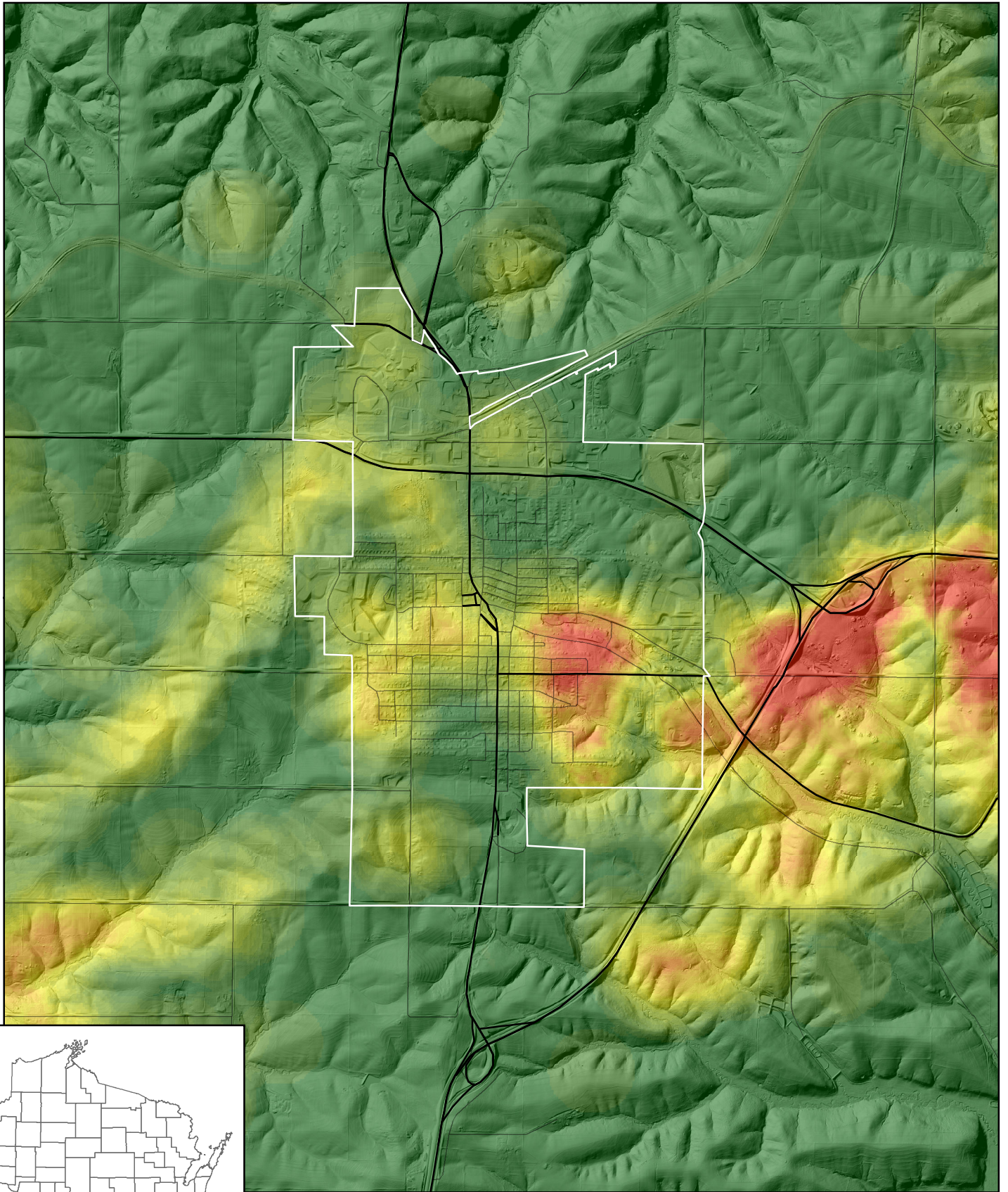


0 0.375 0.75 1.5 Miles



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|  Open Activity |  Borehole | |

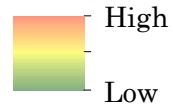
Dodgeville



0 0.25 0.5 1 Miles

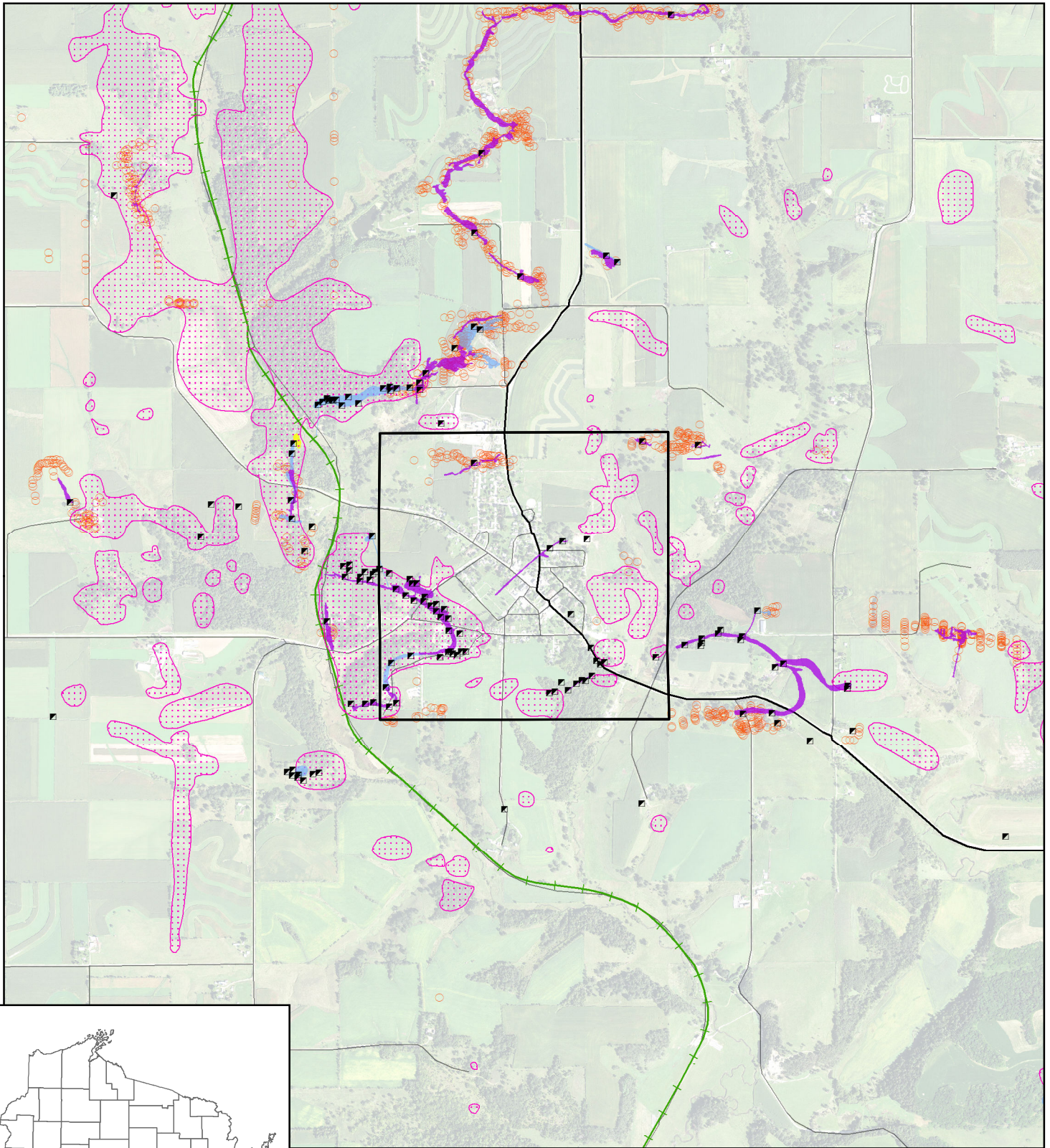


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





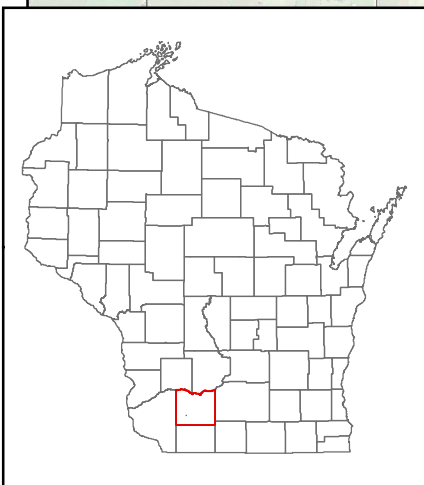
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— Road

Linden

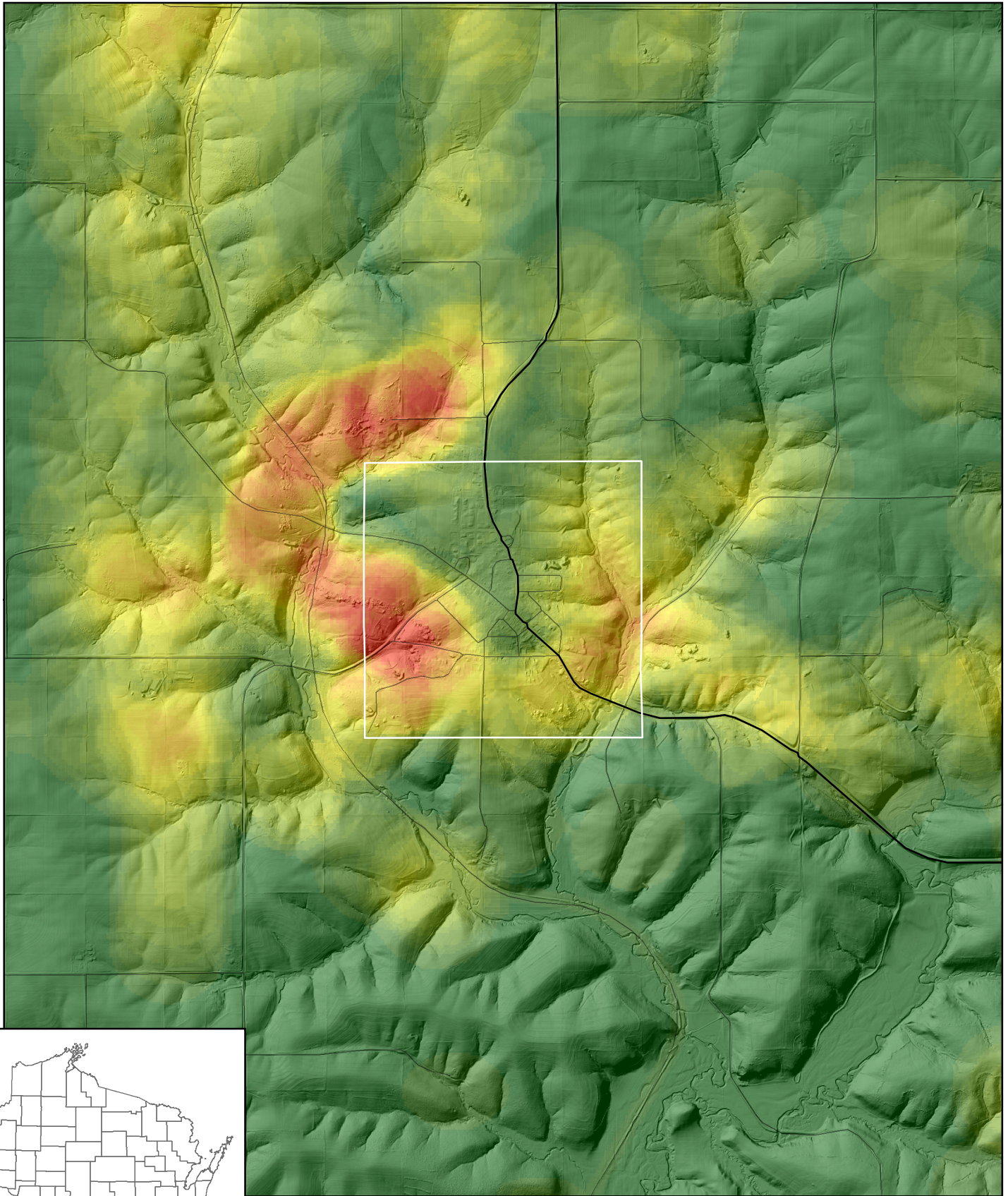


0 0.25 0.5 1 Miles

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|---|---|--|
|  Surveved Workings |  Hazard |  Civil Division |
|  Unsurveved Workings |  Abandoned Railroad |  Highway |
|  Surface Lead Mining |  Mine Shaft |  Road |
|  Open Activity |  Borehole | |



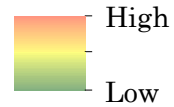
Linden



0 0.175 0.35 0.7 Miles

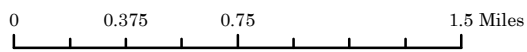
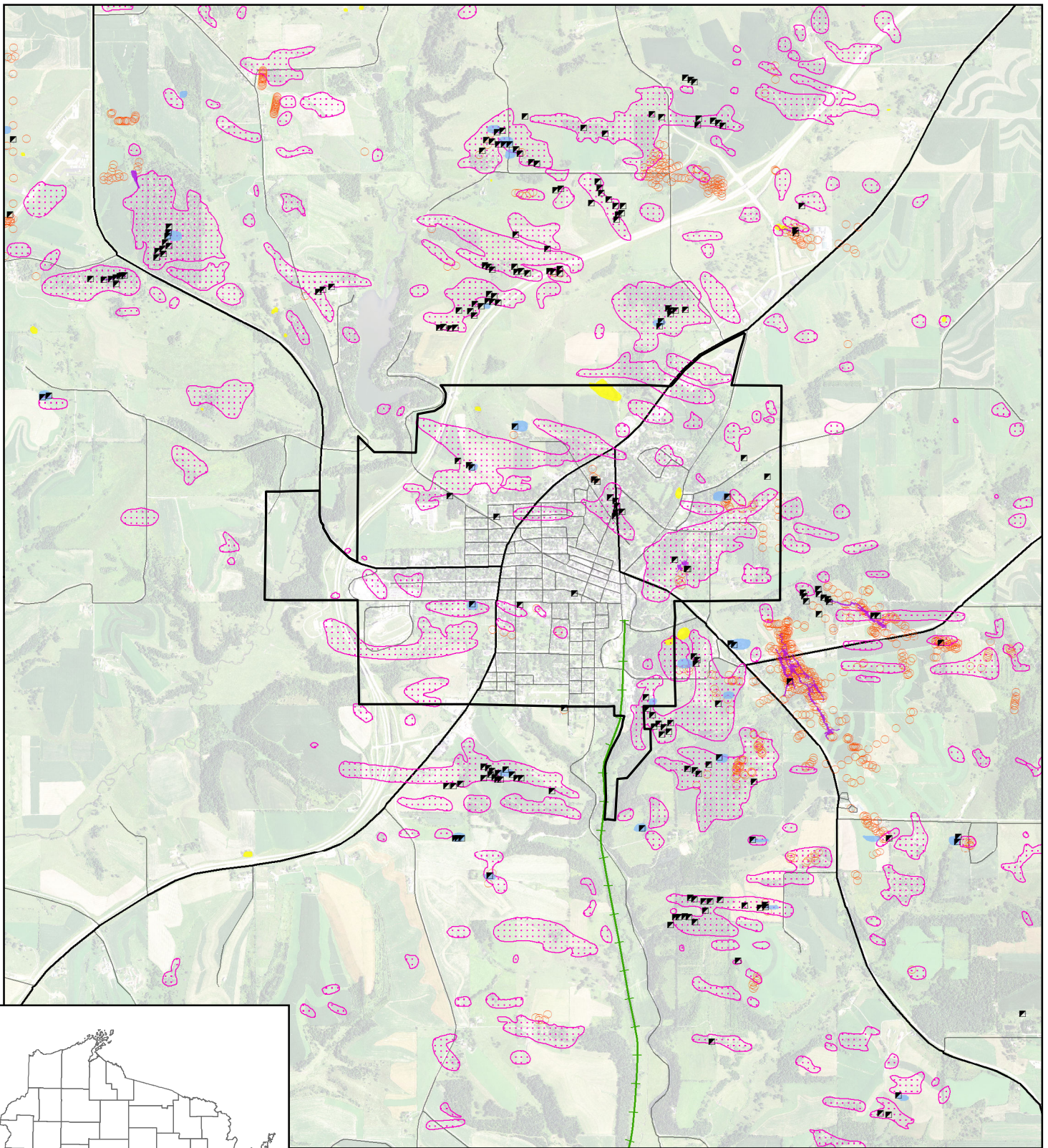













Contamination

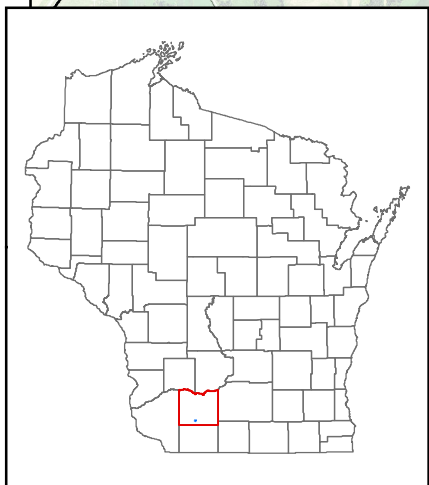


— Highway
— Road

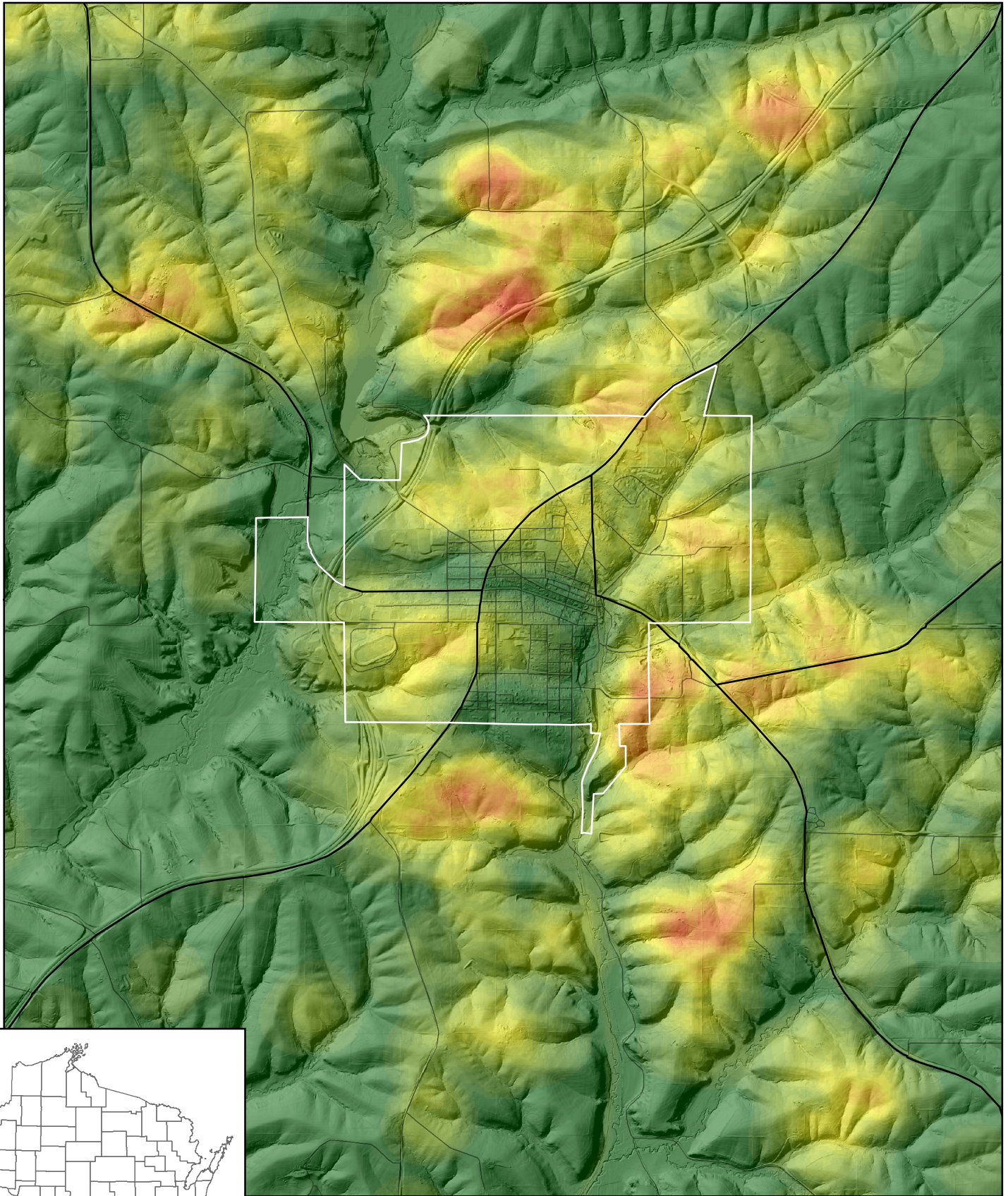
Mineral Point



- | | | |
|---|---|--|
|  Surveved Workings |  Hazard |  Civil Division |
|  Unsurveved Workings |  Abandoned Railroad |  Highway |
|  Surface Lead Mining |  Mine Shaft |  Road |
|  Open Activity |  Borehole | |



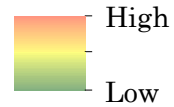
Mineral Point



0 0.25 0.5 1 Miles



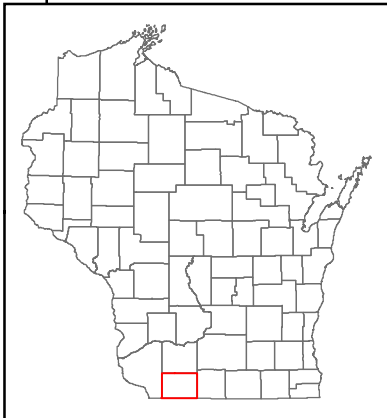
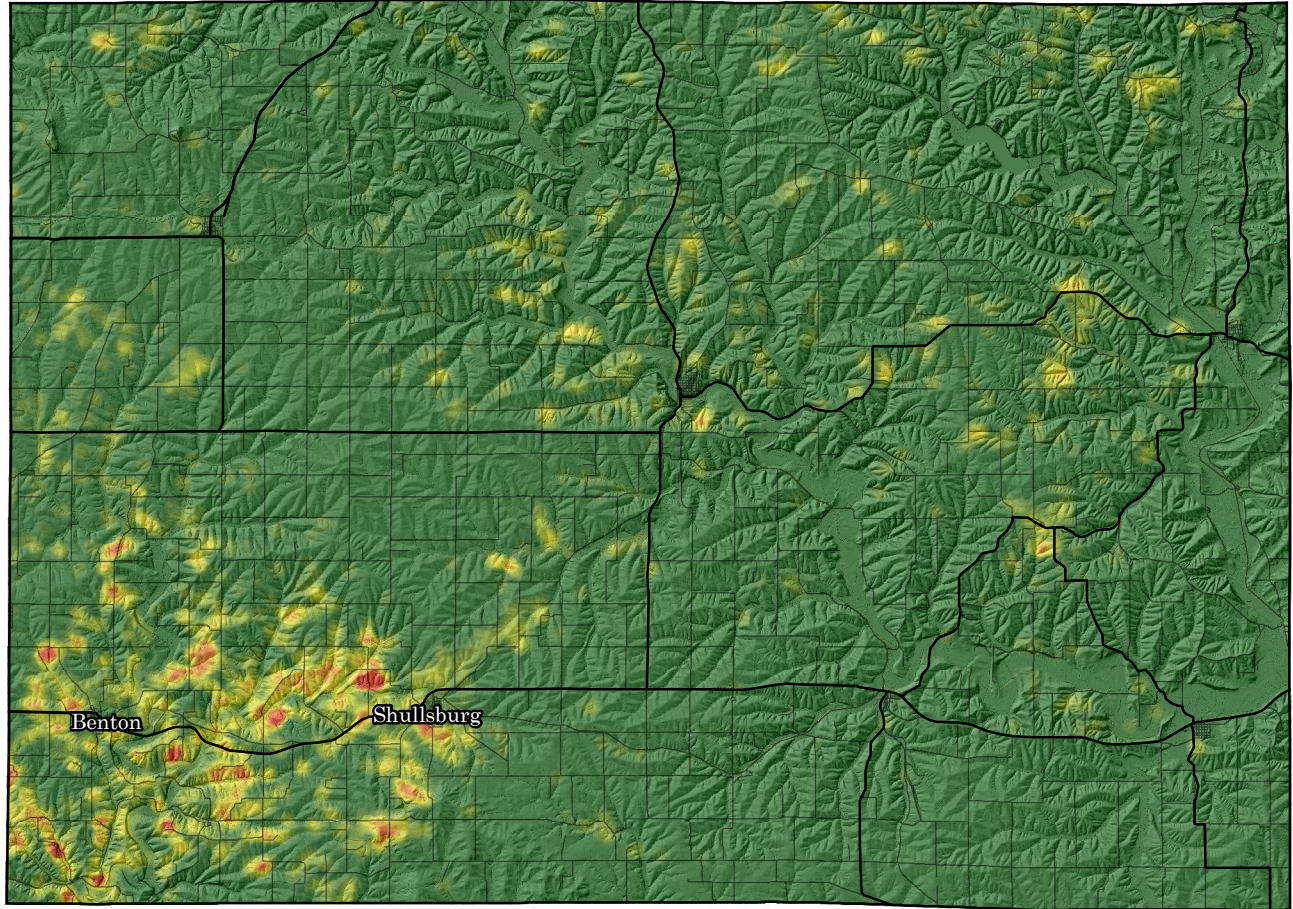
Contamination



— Highway

— Road

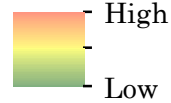
Lafayette County



0 1.75 3.5 7 Miles

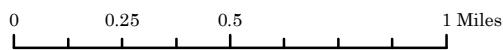
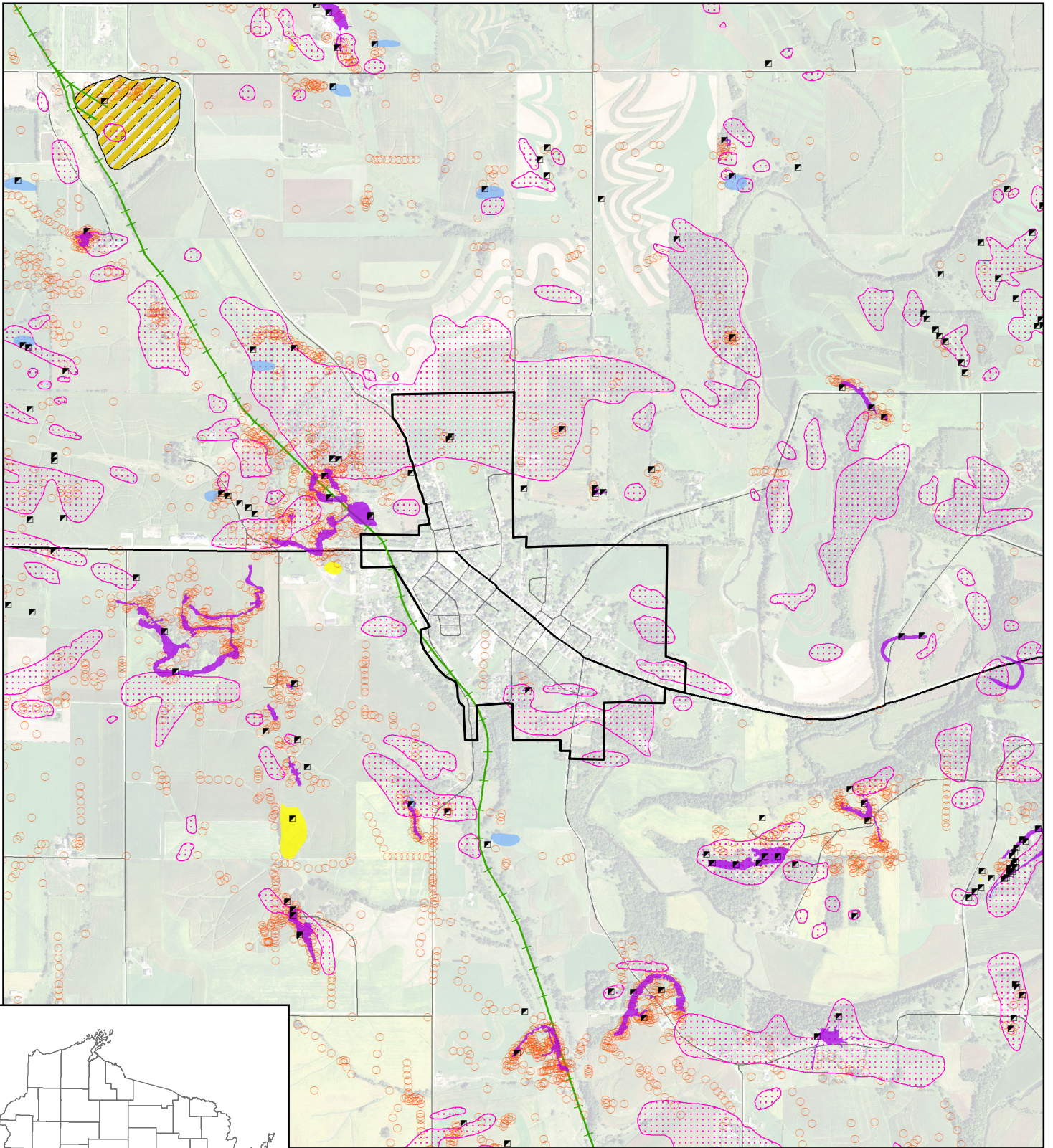













Contamination

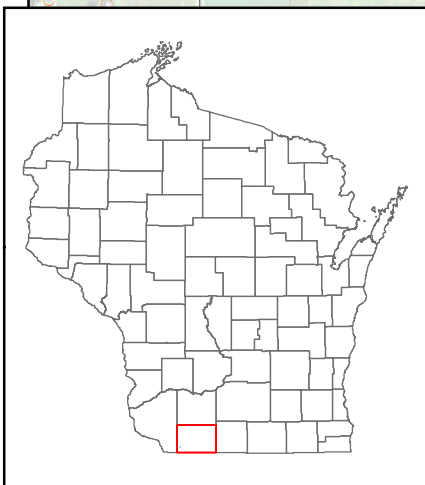


— Highway
— Road

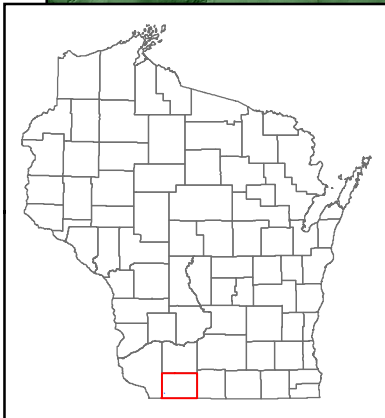
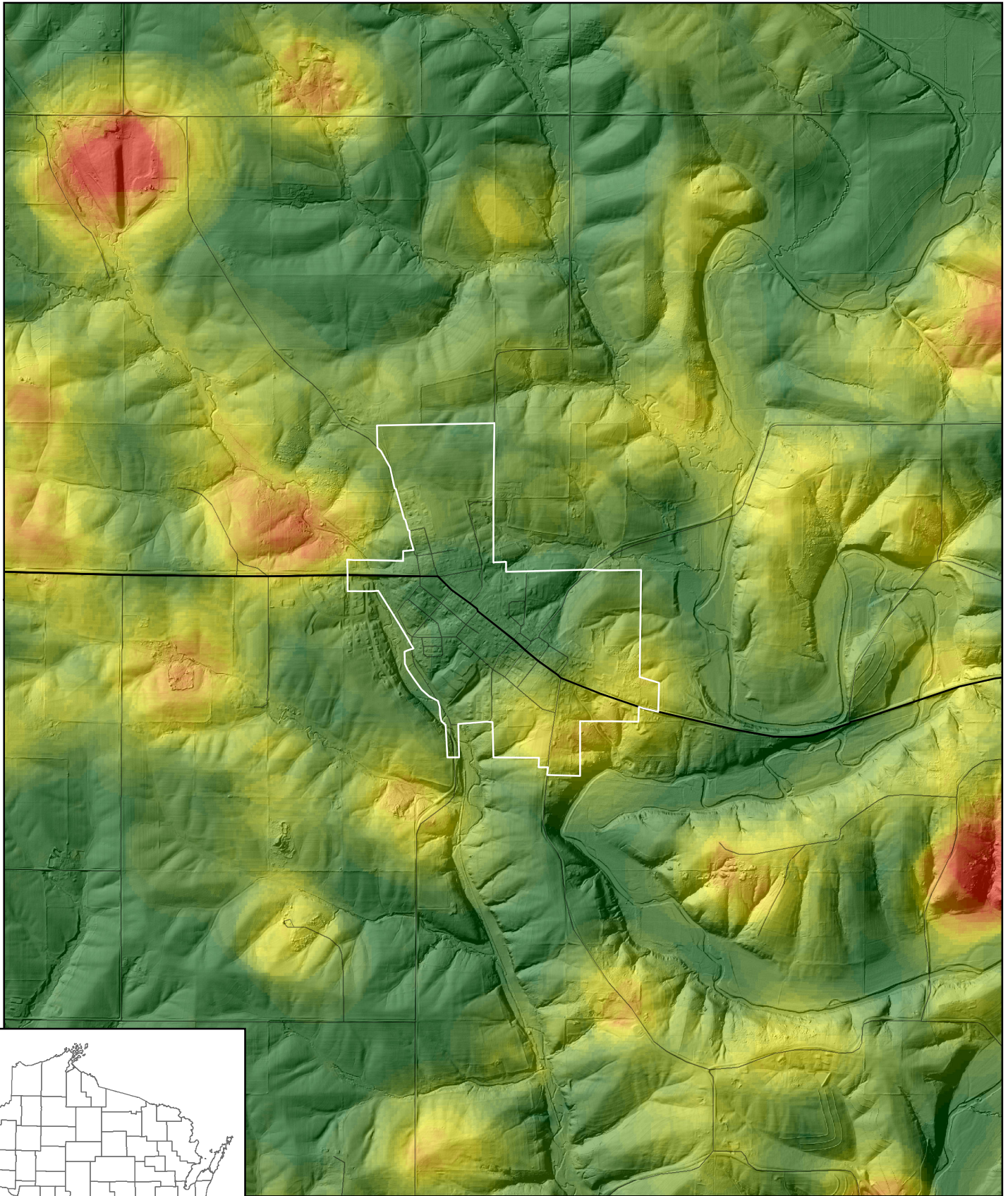
Benton



- | | | |
|---|---|--|
|  Surveyed Workings |  Hazard |  Civil Division |
|  Unsurveyed Workings |  Abandoned Railroad |  Highway |
|  Surface Lead Mining |  Mine Shaft |  Road |
|  Open Activity |  Borehole | |



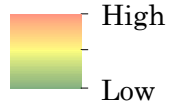
Benton



0 0.175 0.35 0.7 Miles

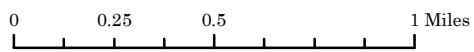
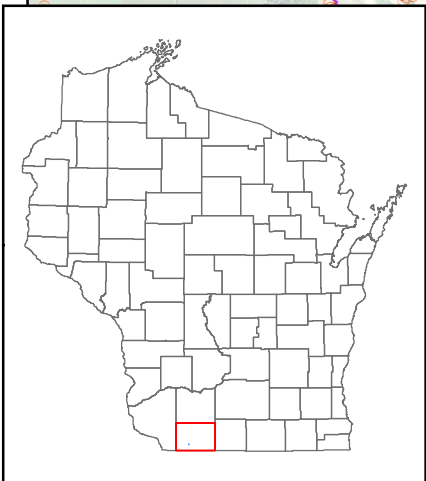
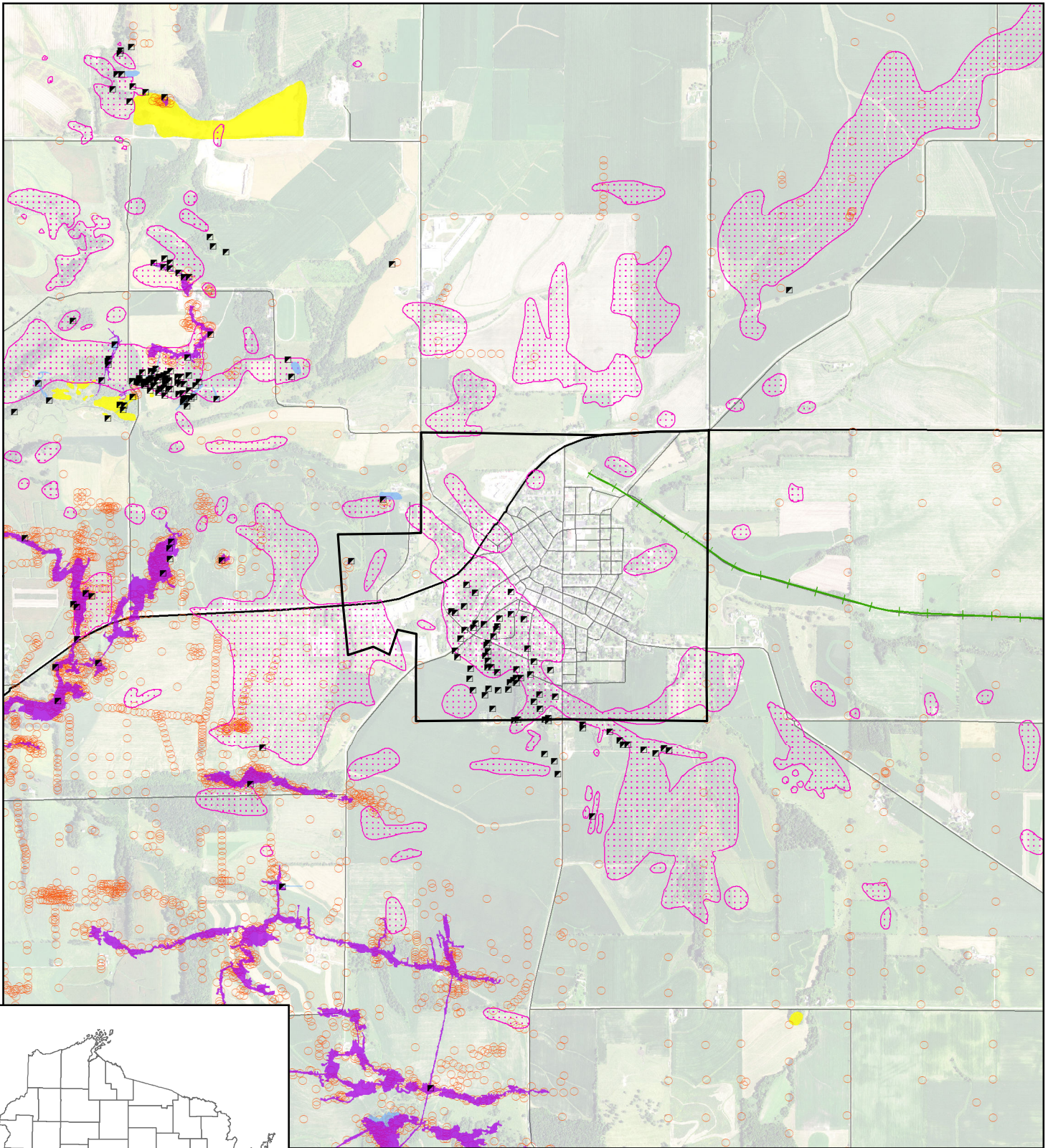













Contamination



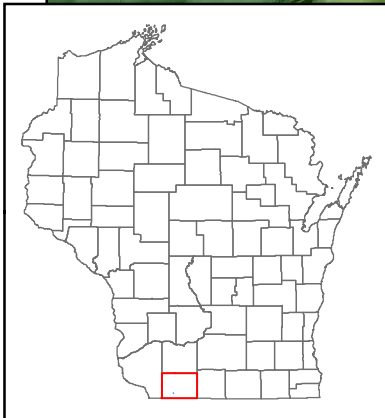
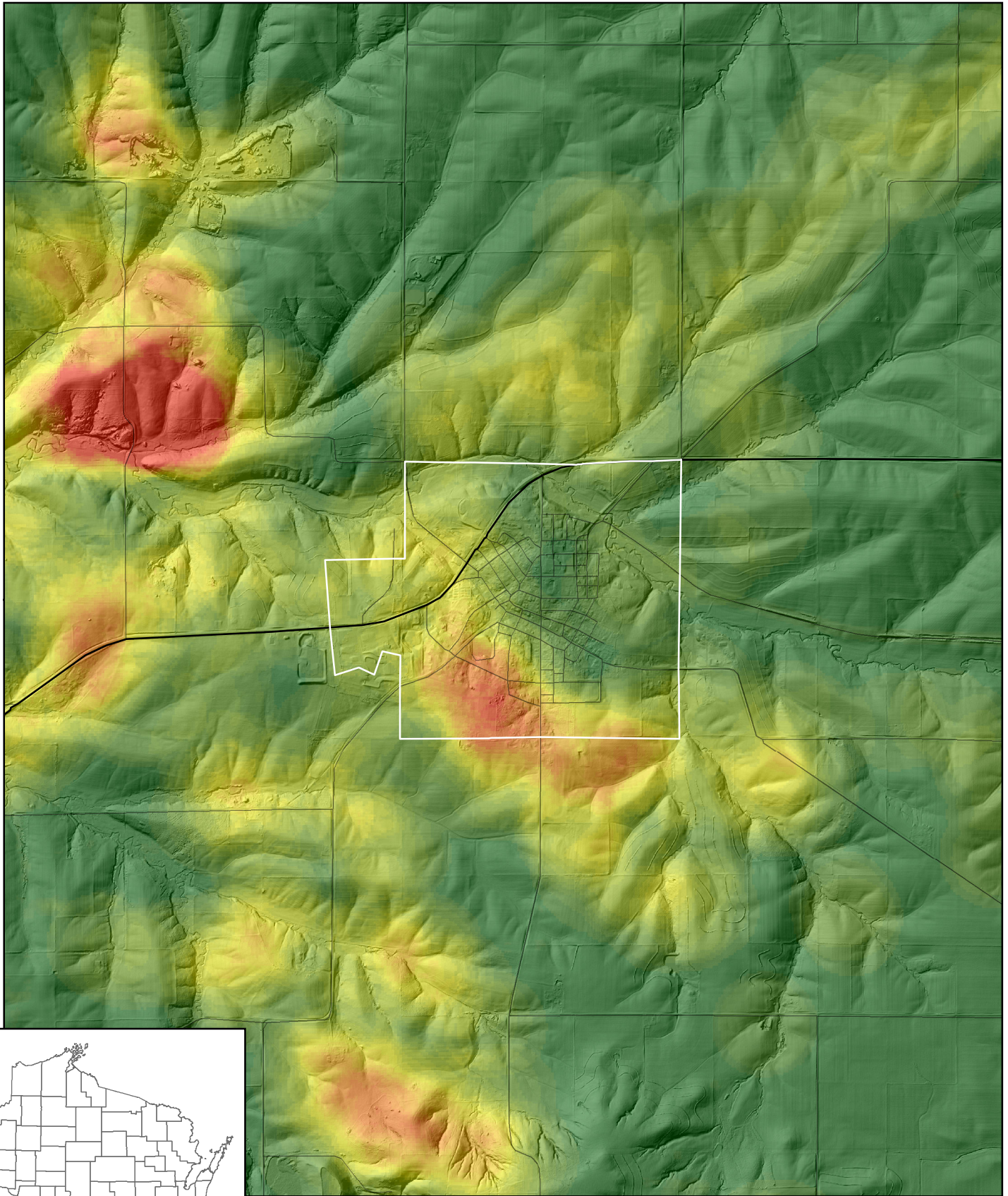
- Highway
- Road

Shullsburg



- | | | |
|---|---|--|
|  Surveved Workings |  Hazard |  Civil Division |
|  Unsurveved Workings |  Abandoned Railroad |  Highway |
|  Surface Lead Mining |  Mine Shaft |  Road |
|  Open Activity |  Borehole | |

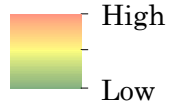
Shullsburg



0 0.2 0.4 0.8 Miles

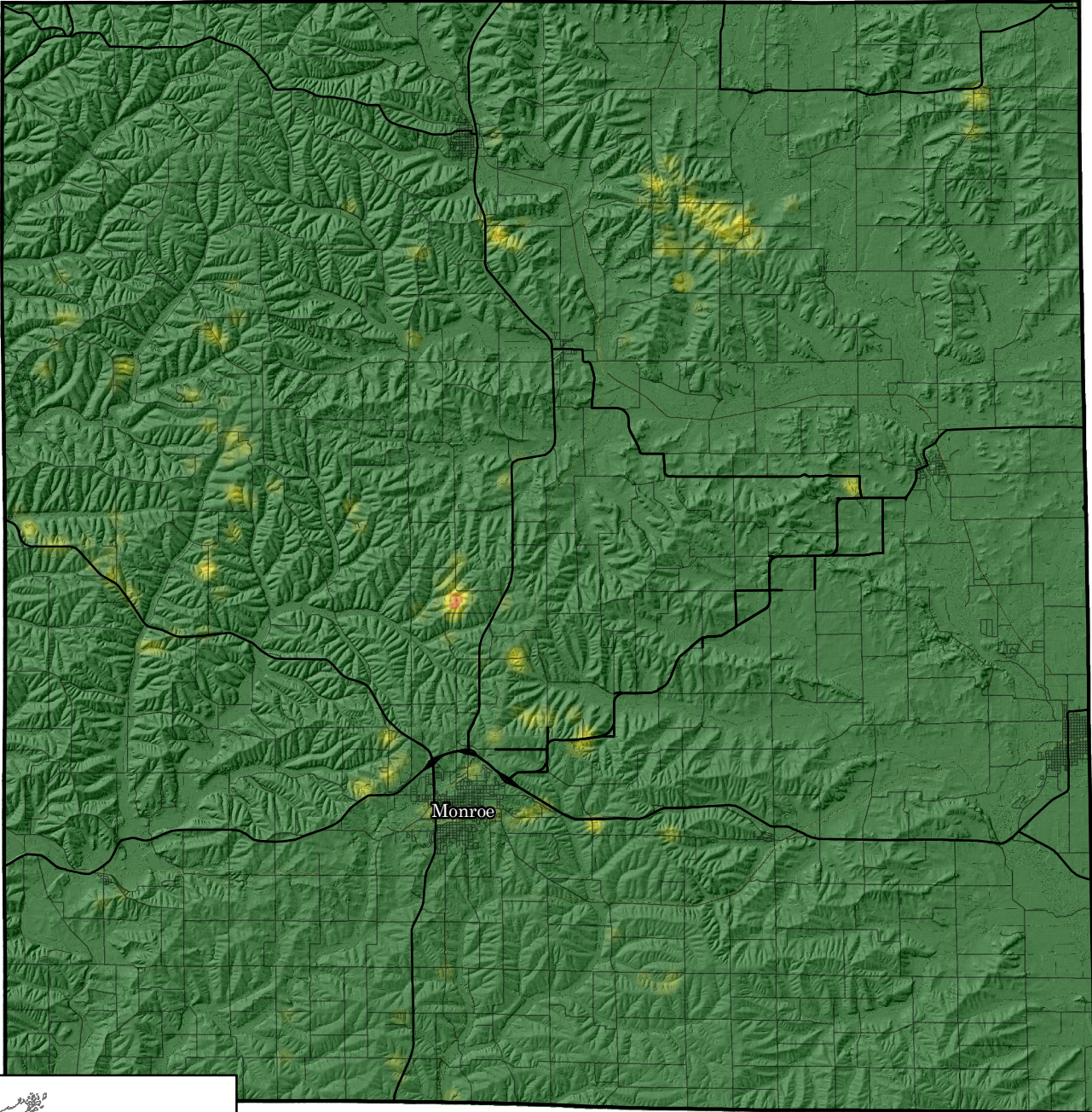


Contamination

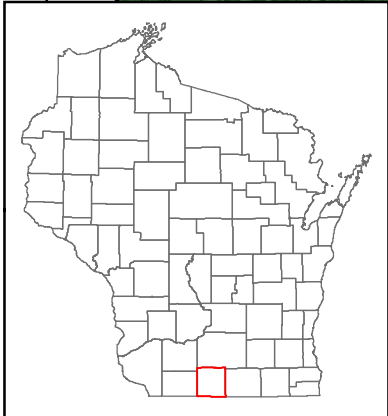


— Highway
— Road

Green County



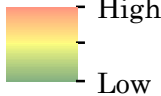
Monroe



0 1.5 3 6 Miles

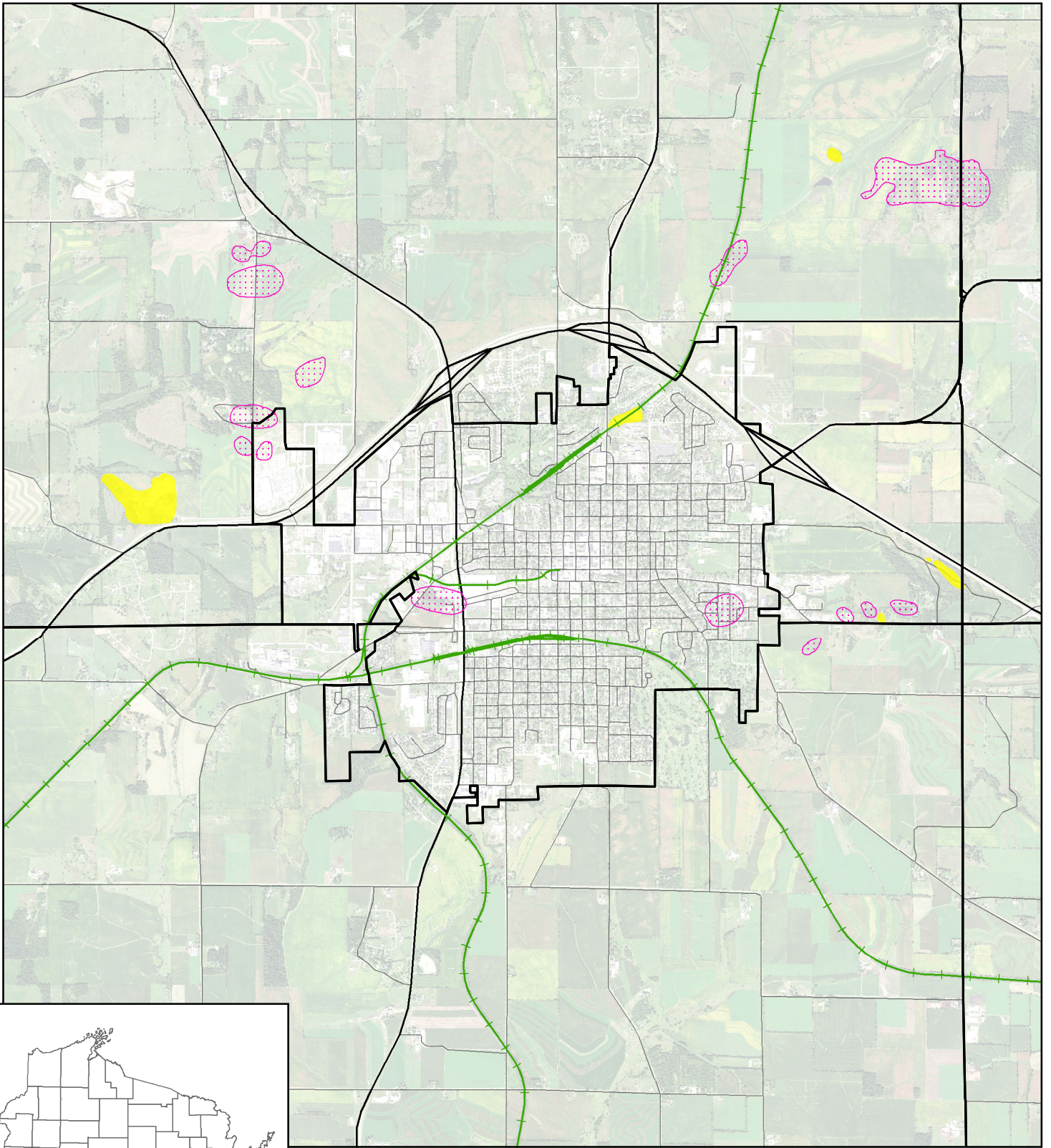


Contamination











— Highway
— Road

Monroe

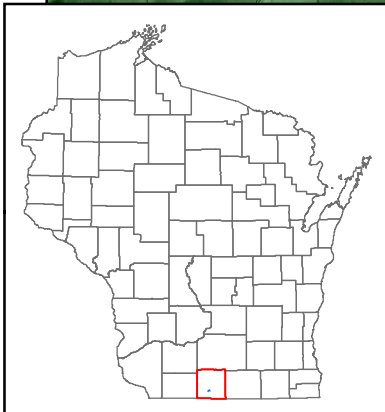
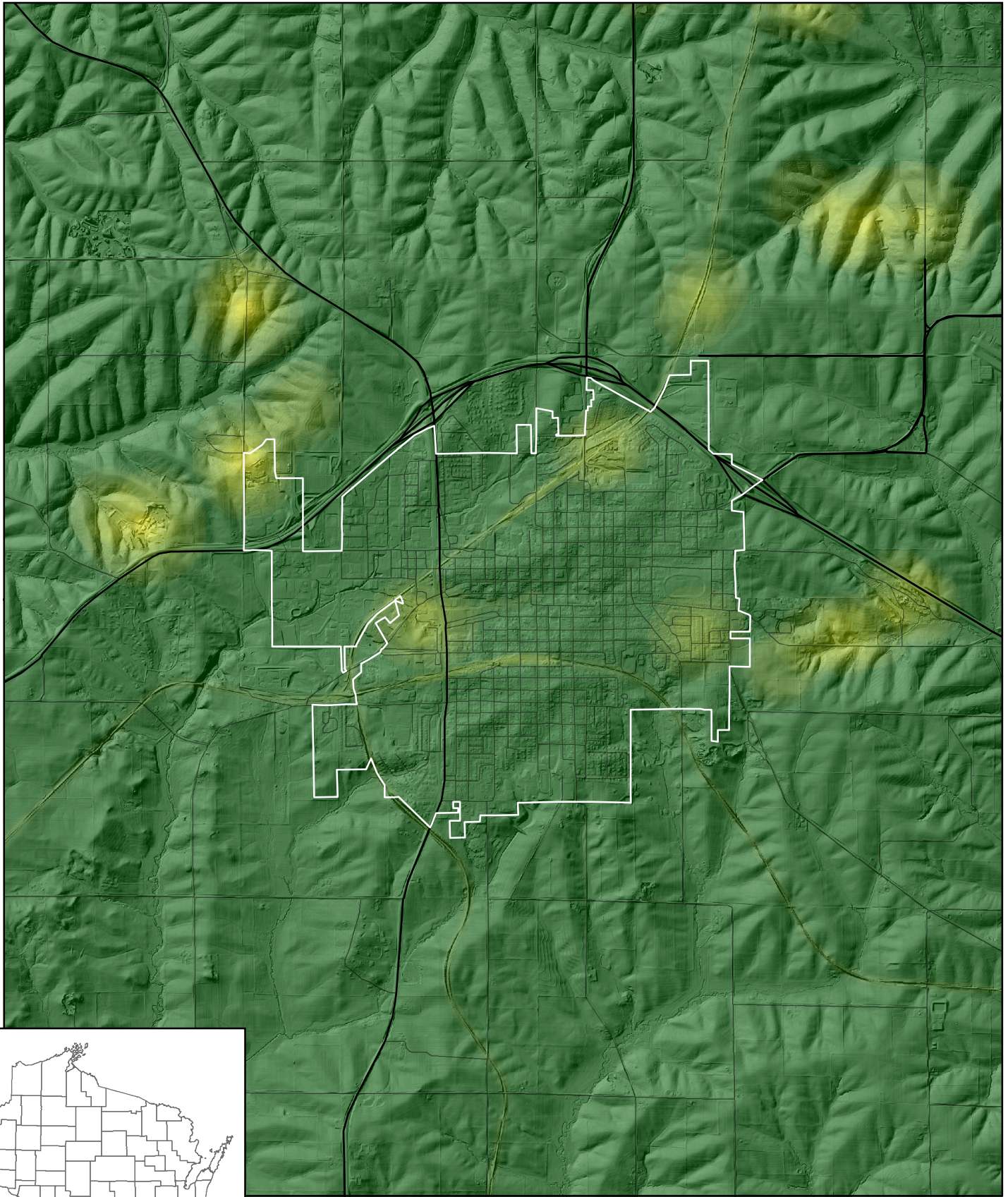


0 0.375 0.75 1.5 Miles



- | | | |
|---|---|--|
|  Surveved Workings |  Hazard |  Civil Division |
|  Unsurveved Workings |  Abandoned Railroad |  Highway |
|  Surface Lead Mining |  Mine Shaft |  Road |
|  Open Activity |  Borehole | |

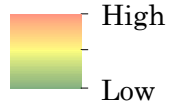
Monroe



0 0.25 0.5 1 Miles



Contamination



- Highway
- Road