Tile Drainage in Wisconsin:

Understanding and Locating Tile Drainage Systems

University of Wisconsin–Extension
DISCOVERY FARMS
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Subsurface drainage is used for agricultural, residential and industrial purposes to remove excess water from poorly drained land. An important feature statewide, drainage enhances Wisconsin agricultural systems, especially in years with high precipitation. Drainage systems improve timeliness of field operations, enhance growing conditions for crop production, increase crop yields on poorly drained soils and reduce yield variability. In addition to agronomic benefits, subsurface drainage can improve soil quality by decreasing soil erosion and compaction.

To maintain agricultural productivity and protect water quality, producers, consultants and agency personnel must understand tile drainage, locate drainage systems and properly maintain them.

The purpose of this publication is to:

- ✓ provide information on tile drainage systems throughout Wisconsin and
- ✓ describe methods to locate tile drains in the field.

"Once the tiles are located, producers or consultants should develop accurate maps and keep copies (both electronic and paper) in a secure file system. Modifications to existing systems or the installation of new tiles should also be identified. Your local Land Conservation Departments should be able to provide copies of aerial photos or base maps."

Tile Drainage Systems in Wisconsin

Subsurface drainage is not a new management practice. Evidence of these systems dates as far back as ancient Rome. In Wisconsin, drainage systems were originally constructed using short (1-foot) segments of clay or cylindrical concrete "tiles." Tiles were initially installed manually, requiring hand excavation. Modern drain tiles are corrugated, perforated plastic pipes typically installed mechanically using a trencher. These plastic pipes are available in a variety of diameters to accommodate different flow rates. They are typically installed at a depth of 3 to 6 feet below the soil surface and discharge into drainage ditches, streams or wetlands.

The majority of tile-drained land in Wisconsin is located in the eastern and southern portions of the state (**Figure 1**), although county records indicate that tile drainage is prevalent statewide. Tile drainage systems in Wisconsin differ from systems in other eastern corn-belt states, such as Indiana, Ohio, Illinois and Iowa. Tile drained soils in these states are often large, flat, poorly drained areas where tiles are installed in a uniform or grid pattern. In Wisconsin's rolling landscape, tile drains are often installed in a random pattern, following depressional areas.

Two primary factors influencing tile system design in Wisconsin are soil type and topography. In eastern Wisconsin, medium-textured silt (loess) soils overlay fine-textured glacial material (**Figure 2**). In these soils water drains freely through the upper part of the soil profile (typically 3 to 8 inches), but the more restrictive sub-soil impedes downward water movement. This results in saturation of the upper portion of the soil profile. Tile drainage is needed in these soils to eliminate seasonally high water tables. In the unglaciated, or "Driftless" region of southwest Wisconsin, tiles are used to drain springs and sidehill seeps that saturate upland portions of the landscape. Tile drains are also installed to drain closed depressional areas throughout the state. And they are used to drain areas with perched water tables or sand lenses causing seasonally high water tables. In addition, producers use tiles to drain organic "muck" soils for improved agricultural production.

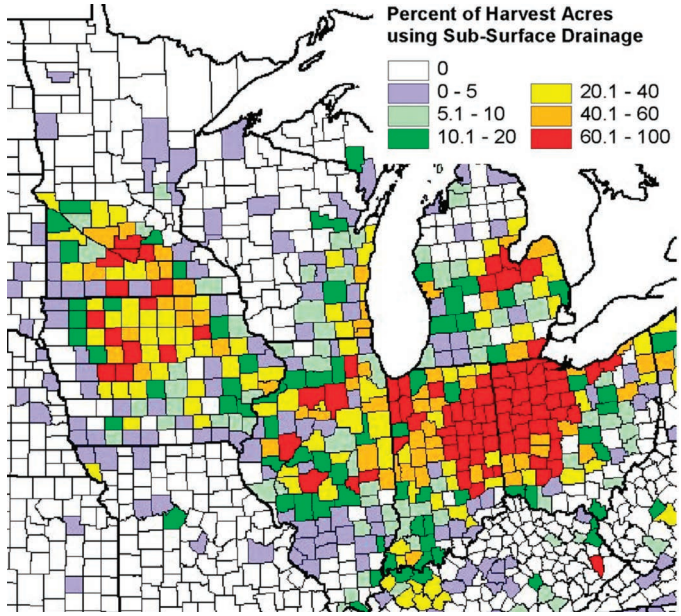


Figure 1: Extent of subsurface drainage (1992).

Source: 1992 NRI: 1992 Census of Agriculture; Gary Sands, Agricultural Drainage 101.

Figure 2: Typical eastern Wisconsin soil profile.

Locating Tile Drains

Knowing the location and extent of tile drains is a challenge facing producers, consultants and agency personnel. Records of main, lateral and outlet tile locations are often lacking. To properly use and maintain an existing tile drainage system, producers must be able to locate tile lines and outlets. Although it is often hard to identify old tile systems in agricultural settings, there are a number of resources available to help. The local Natural Resources Conservation Service (NRCS) or Land Conservation Department (LCD) offices may have maps or other materials if a previous land owner worked with these agencies. Information from these maps should be field-verified.

There are also three readily identifiable drainage features that can indicate the presence of tiles: vents, surface inlets and outlets. Modern tile systems often include vents to increase water removal efficiency and maintain atmospheric pressure within the drain system. Air vents consist of a perforated orange or white pipe protruding a few feet above the ground (**Figure 3**). Surface water inlets look similar to air vents and are typically installed in low areas lacking a surface outlet. Surface inlets are designed with aboveground openings to allow surface water to directly enter tiles. Producers must take special care when applying manure, fertilizers and chemicals close to inlets, given the high potential for direct entry into the system and into surface waters.

Figure 3: Typical tile vents/surface inlets.

Another identifiable feature is a tile outlet, where the tile system discharges to drainage ditches, waterways, streams and/or wetlands (**Figure 4**). Tile outlets should be located and marked in the field for future reference. Producers should inspect outlets and clear debris that could impede flow. A sink hole can occur when a tile outlet is blocked. Blockage creates back pressure within the tile, and the surrounding soil becomes saturated. When the pressure within the drain drops, the saturated soil next to the pipe will get sucked into the tile, resulting in a sink hole. Sink holes can also result from large (> 10x) changes in tile line grade or when the flow velocity exceeds approximately 4 feet per second.

Newer technologies, such as monochrome and color infrared aerial photographs (**Figure 5**), can be useful in mapping tile lines. Aerial maps from NRCS soil surveys may show tile line locations by differences in soil color. There is a period of time shortly after spring frost-out where drain locations will appear lighter in color than the surrounding soil because drained soils dry more quickly. Advances in ground penetrating radar, geomagnetic surveying, electromagnetic induction, resistivity and other emerging technologies will likely result in more effective and efficient methods of locating subsurface drains.

There are less scientific methods used by drainage professionals to locate existing tile drains. Observing soil moisture and crop growth patterns at various periods and conditions can be useful in identifying existing tile lines. In most instances, growth and yield of crops are enhanced directly over tile lines in both dry and wet years due to improved soil aeration, moisture conditions, biological activity and chemical factors. The following conditions may be used to help to identify existing tiles:

1. During and just after snowmelt, water will pond in fields. As these localized ponds begin to disappear, drier soil conditions will appear over tile compared to the surrounding soils. This condition may last from a few hours to a few days.
2. From April to June, drier soil conditions will appear over tiles compared to the rest of the field immediately after a significant precipitation event (usually over 0.5 inches of rain). This will last only 2 to 3 hours after the precipitation event.
3. If June conditions are wet and cool, knee-high corn will often be a deeper green color over tile lines due to improved moisture environment and nutrient availability.

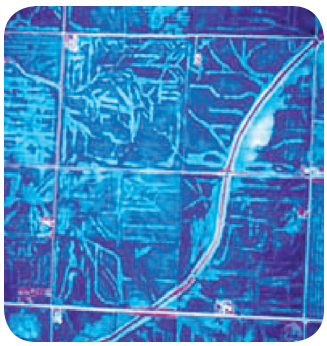
Figure 4: Typical tile outlet for discharge into soil or water.

4. Watch the dew on the alfalfa at sunrise (facing east). Tile line locations will reflect more sunlight, attributed to greater leaf density over tiles.
5. During moisture deficient conditions, deep-rooted crops such as alfalfa will be taller over tile lines than in the rest of the field. This is due to extended moisture availability closer to tiles.
6. When soybeans first start blossoming, the plants over tile lines will flower up to a week earlier due to accelerated plant growth and maturity.
7. In fields with foxtail, the weed will be absent over tiles since foxtail favors conditions with compacted soils and excess moisture.
8. Review of GPS yield monitoring data can indicate yield increases on short, localized areas over tile lines in corn and soybeans during both wet and dry years.

If you are having trouble locating tile drains using standard methods, contact your local drainage professional for assistance. Once tiles have been located, develop accurate maps and keep them in electronic and paper formats. Always record modifications to existing systems or the installation of new tiles.

Figure 5: Monochrome and color infrared aerial photos showing tile locations.

Source: USDA-NRCS Web Soil Survey



Source: Verma, A., R. Cooke and L. Wendte. 1996. Mapping subsurface drainage systems with color infrared aerial photographs. *In Proc. of the America Water Resources Association Symposium on GIS and Water Resources.* AWRA. Ft. Lauderdale, Fl.

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Fact sheet NO. 1

The *Tile Drainage in Wisconsin* series includes this fact sheet and *Maintaining Tile Drainage Systems* (GWQ056).

For more information on system maintenance, visit the Cooperative Extension Tile Drainage Resources website:

http://fyi.uwex.edu/drainage

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