Minimizing Manure & Nutrient Transport to Tile Systems

Aaron Pape
UW Discovery Farms
At our core: A farmer-led water quality research and educational program
Traditional Discovery Farms monitoring: credible edge-of-field research

- Weather ● Soil
- Runoff ● Sediment
- Nitrogen ● Phosphorus
Benefits of Tile drainage

- Increase crop yields
- Improve field access and reduce compaction
- Reduce runoff and soil erosion
- Raises soil temperature
Proper management in tile drained landscapes is key to reducing losses.

Tile adds additional management concerns.
Twelve key elements for managing tile-drained land to minimize the potential to transmit manure & nutrients to tiles
1. Understand and locate tile features
2. Maintain tile drainage systems

- Routine inspection and maintenance to ensure proper function
- Annual inspection to identify outlet blockages and tile blowouts
Tile blowouts

1. Weak point in tile drain
2. Pressure causes drain to rupture
3. Soil is drawn in to ruptured drain
4. Void left in the soil during low-flow periods
5. Surface soil collapses to form blowout
Tile blowout/sinkhole development in agricultural landscapes can occur from a variety of means:

- Collapse of clay or concrete tiles from degradation over time
- Inadequate venting
- Expansion of tile system without adequately resizing main or sub-mains
- Outlet blockages
- Improper joint connections or junctions between old/new tile lines
- Contact of deep tillage equipment with shallow tile lines
3. Assess soil conditions prior to liquid manure applications

- Both high and low soil moisture contents can be problematic for liquid manure applications to tile-drained land
  - High – tiles flowing
  - Low – soil cracking
4. Review forecasted weather prior to liquid manure applications

- Avoid applications when rainfall is predicted to occur after application
- Soil moisture levels are increased by liquid manure applications
- 7,000 gal = ¼” rain
- Can the soil take it?

www.manureadvisorysystem.wi.gov
5. Monitor tile outlets when applying liquid manure

- Tiles should be monitored before, during, and after liquid manure applications for potential discharge of manure
- In most circumstances, applications should be avoided when tiles are flowing
6. Restrict tile discharge prior to manure application if possible

• If water level control structures are installed in tile systems, insert stop-logs to prevent flow from tile drains before application

• Tile plugs can also be used but often fail

Source: Mark Dittrich - Minnesota Dept. of Agriculture
7. Take precautions when surface applying liquid manure to land under no-till or perennial crops

Preferential flow paths are well developed:

- Earthworm burrows
- Root channels
- Shrinkage cracks
- Structural porosity

*(Shipitalo et al., 2004)*
Soil crack preferential flow
Earthworm preferential flow
Earthworm preferential flow
Efficiency of tile water removal

Surface versus Tile Discharge

Tiles flowing at capacity

Surface
Tile
Rain

8/21/07 0:00 8/21/07 12:00 8/22/07 0:00 8/22/07 12:00 8/23/07 0:00 8/23/07 12:00 8/24/07 0:00 8/24/07 12:00

Surface & tile discharge, in gallons/second (5-minute interval)

Hourly precipitation, in inches
8. Use tillage to break up preferential flow paths prior to or concurrent with application

- If performed improperly, knife injection or horizontal sweep injection can force manure through macropores
9. Ensure precautions are taken for manure and nutrient applications in fields with tile surface inlets

• Surface inlets are commonly used in fields with closed depressions - areas without an outlet for surface water

• Extra precautions need to be taken in proximity of surface tile inlets because they are a direct conduit to tile drainage systems

• Buffer
10. Use best management practices for fertilizer and manure management

- Apply nutrients based on University recommendations
- Fine tune nitrogen
- Waiting to apply manure in the fall until soil temperatures are less than 50°F (or use nitrification inhibitors or cover crops)

(Laboski and Peters, 2012)
11. Use conservation management practices such as cover crops, conservation tillage, and grassed waterways

- Capture nitrogen
- Reduce erosion
- Reduce soil loss and sediment-attached nutrient movement on the soil surface and will also help to reduce the potential of loss to tile drains
12. Have an emergency plan in place

• If manure enters tile drains, take immediate steps to stop the flow and prevent discharge to fresh water systems
  ✓ block or divert the tile outlet
  ✓ intersect the tile system, and dig a pit directly downstream of the spill site to collect manure

• Contact the South Dakota DENR at (605) 773-3296 to report the spill and get assistance with subsequent remedial actions.
Proper management in tile drained landscapes is key to reducing losses

Measures to prevent nutrient loss to tiles are much less expensive and are more effective than treatment

Tile Drainage in Wisconsin: Managing Tile-Drained Landscapes to Prevent Nutrient Loss

Subsurface drainage of agricultural land has the ability to improve yields and reduce surface runoff and erosion losses. However, with a reduction in surface runoff, more water infiltrates the soil and percolates through the soil profile. This is of particular importance to farmers, as this water can also transport essential plant nutrients, specifically nitrogen and phosphorus, out of the root zone. Once nutrients reach the tile drain, they have a direct conduit to surface waters.

Tile-drained agricultural land must be well-managed to reduce the loss of nutrients to surface waters. Nutrient management practices must be carefully followed to minimize the risk of nutrient loss and to maximize fertilizer use efficiency. Additional considerations need to be taken with manure applications on tile-drained land to both minimize nutrient loss and prevent manure entry into tile drains.

The purpose of this publication is to:

- provide information on nutrient management concerns in tile-drained agricultural landscapes, and
- present management and treatment practices to reduce the loss of nutrients from tile systems to surface water.

“Proper management of crop nutrients on tile-drained landscapes is key to reducing nutrient loss and maximizing nitrogen use efficiency.”
Discovery Farms in WI and MN are expanding tile monitoring network with new CIG project.

Intensively monitored tile sites surrounded by satellite locations

Provide tools for farmers and advisors to diagnose and treat fields with high nutrient losses through tile drains

Understand the link between soil health and tile drainage
Basic
Tile Study

4 counties in MN, 5 in WI
48 total sites
Results from first year this winter.
Takeaway

The soil surface and tile drains are closely connected. What gets applied to the surface potentially finds a way to the tile. Take extra care in managing manure on tile lands. We want “Goldilocks” conditions - moisture, precipitation. Adjust manure rates accordingly.
1. Understanding and Locating Tile Drainage Systems

2. Maintaining Tile Drainage Systems

3. Managing Tile-Drained Landscapes to Prevent Nutrient Loss
   • Fixing tile blowouts: What you need to know
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