

Core Ideas: Tile Drainage and Phosphorus

- Tile drainage is an essential water management practice on many agricultural fields in the Lake Champlain Basin, providing better growing conditions, improved soil structure, enhanced trafficability, more timely planting and harvest, and increased yields.
- It is estimated that about 5% of Vermont's cropland is tile drained. In some agriculturally-intensive subwatersheds within the Lake Champlain Basin, cropland drainage is estimated to be as high as 70%.
- In agricultural fields with subsurface (tile) drainage, much of the tile drainflow is conveyed directly to ditches or other surface waters.
- Once dismissed as negligible, phosphorus levels in subsurface tile drainflow are now recognized as significant. Tile drainflow has been clearly shown to influence both hydrology and phosphorus loading at the field and watershed scales.
- Use of tile drainage significantly alters the hydrology of the field and the landscape. Compared to an undrained condition, the use of tile drainage:
 - Increases total annual water output from a field, but reduces surface runoff;
 - Delivers the majority (50 to >90%) of field water loss as tile drainflow; and
 - Can sometimes contribute the majority of streamflow in small watersheds.
- Phosphorus concentrations measured in tile drainflow vary significantly due to soil characteristics, tile layout, agricultural management and cropping systems, and weather. Significant phosphorus concentrations have been found in tile drainflow across a variety of conditions. High phosphorus concentrations in tile drainflow have been observed in the Lake Champlain Basin.
- Significant phosphorus export from agricultural fields occurs via tile drainflow, and can equal or exceed phosphorus losses via surface transport. Quebec researchers have reported that 40 – 80% of annual phosphorus loss from crop fields occurred via tile drainflow.
- Most research indicates that phosphorus loads from tile drainflow are small during the growing season. The majority of the annual load is reported to occur outside the growing season, and some researchers have identified the spring snowmelt period as the most critical.
- Factors such as soil cracking, reduced tillage, high manure/fertilizer application, high soil test phosphorus levels, and wet weather contribute to higher phosphorus losses via tile drainflow.
- Tile drainflow has been shown to be a significant source of phosphorus at the watershed scale. A modeling study estimated that 13% of the agricultural phosphorus load to St. Albans Bay could be attributed to tile drainflow. However, other estimates based on monitoring data suggest that tile drainflow can contribute as much as 40 – 80% of annual phosphorus load in agricultural watersheds.
- Watershed management efforts must consider the potential contributions of tile drainflow in watershed phosphorus budgets. Researchers in the U.S. Great Lakes region and in Europe have identified significant basin-scale phosphorus loading and eutrophication impacts from the discharge of tile drainflow.
- Management measures to reduce phosphorus loads delivered via tile drainflow – including field nutrient management, drainage water management, and end-of-tile treatment – offer some promise, but their effectiveness is not yet fully proven.