# Beneficial Management Practices (BMPs) for Manure Application on Tile-Drained Land

Manitoba Livestock Manure Management Initiative Inc.

## Introduction

Most agricultural soils must be artificially drained for optimal crop production. Excess water in the root zone can delay seeding and other field activities, stifle root growth, hamper plant respiration and reduce crop yields. Historically, in Manitoba, the most commonly used method to remove excess water from fields has been surface drainage.

Sub-surface or tile drainage is increasingly viewed by farmers as a viable water management option. The benefits of tile drainage include earlier planting, quicker and more uniform soil drying and warming, deeper crop rooting, reduced soil erosion, reduced yield losses and lower yield variability. The application of livestock manure on tile-drained land, however, has raised concerns about the risk of nutrients and pathogens entering surface waterways via tile drains. The ability of producers to manage water and protect water quality has implications for the sustainability of Manitoba's agriculture industry.

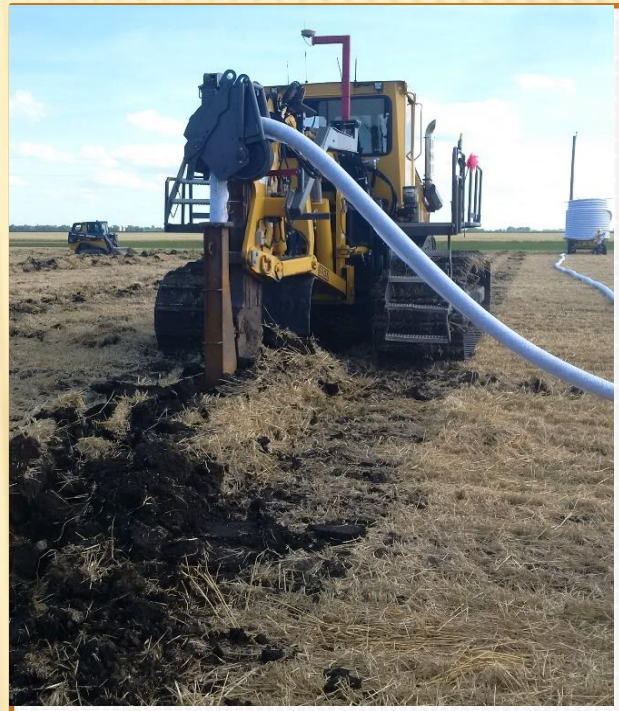
**Field showing excess moisture after a heavy rain**
**Photo Credit: M.D. Timmerman, Manitoba Agriculture**

Beneficial Management Practices (BMPs) that mitigate the transport of nutrients and pathogens to and through tile drains have been extensively researched elsewhere in North America. To determine whether or not some of these BMPs could be applicable to Manitoba, the Manitoba Livestock Manure Management Initiative (MLMMI) commissioned two reviews of tile drainage research and practices.

The goal of the reviews was to provide the Government of Manitoba, producers and municipal leaders with a solid understanding of how tile drainage works, the risks associated with tile drainage and potential beneficial management practices that could mitigate these risks.

## What is Tile Drainage?

Tile drainage is the practice of placing perforated pipes in the ground to remove excess water from the soil profile and lower the water table below the root zone. A tile drainage system typically includes a number of smaller diameter lateral pipes that empty into a larger main pipe. The water in the pipes flows by gravity to the edge of an agricultural field where it is released, via gravity or pumped using a lift station, to a ditch, municipal drain, collection pond or natural watercourse. Thus for tile drainage to be effective, a properly designed and maintained surface drainage network must also be in place to conduct drainage water downstream.



**Tile Installation**
**Photo Credit: V. Doan, Manitoba Agriculture**

## What is the Environmental Risk?

Under certain circumstances, nutrients and pathogens can reach tile drains. Current science indicates that the risk of nutrients or pathogens reaching tiles is greatest in the presence of soil *macropores,* such as cracks, wormholes and root channels. These pathways enable water to flow freely. If macropores extend from the soil surface to the tiles at the time of manure application, the risk of nutrients and pathogens entering the tiles increases.

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## Soil Management

Tilling the soil before manure application can destroy the connectivity of a macropore network near the soil surface and disrupt the flow of nutrients and pathogens that could occur through these pathways to tile drains.

Tilling the land, Photo Credit: M.D. Timmerman, Manitoba Agriculture

## *4R* Nutrient Stewardship

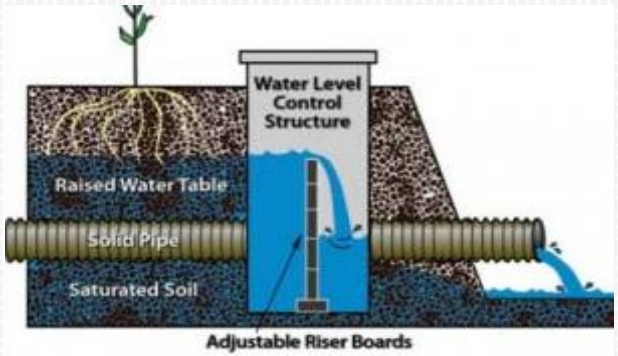
Nutrients from synthetic fertilizers and livestock manure are similarly susceptible to loss through tile drainage. The 4Rs of nutrient management – the Right *Source* of nutrient at the Right *Rate*, *Time* and *Place* – should be followed when applying nutrients to tile-drained land. For example:

- Nutrient applications, whether from manure or synthetic fertilizer, should be based on soil testing and crop requirements.
- Nutrients should not be applied when the land is saturated or tile water is running, or prior to a rain event.
- Nutrients should be placed beneath the soil surface, as regularly as possible, to maximize nutrient use efficiency and, in principle, minimize the risk of nutrient loss.

## Technologies

### Controlled Drainage

A controlled drainage system involves the placement of one or more control structures along the tiles or at the tile outlet in order to manage the water table elevation and drainage flow. Standard control structures are comprised of panels which can be inserted or removed to adjust the water level within and above the tiles. Having the ability to hold back tile water, and any nutrients in it, provides the crop access to this water later in the growing season. Control structures are most effective on nearly level lands with 0.5% slope or less.




Control structure, Photo Credit: USDA NRSC

### End-of-pipe treatment

The main objective of end-of-pipe treatment is to remove nutrients from tile drainage outflow before the water enters a surface watercourse. Treatment systems such as wetlands, bioreactors and vegetative buffers have been effective in reducing nitrates in some regions. The effectiveness of phosphorus removal from tile water needs further study.

Such treatment systems require dedicated land and must be biologically active as the water passes through in order for this BMP to work.

## Looking Ahead

Research is needed to validate the most promising BMPs under Manitoba's unique combination of climate, topography, soils and cropping systems. Similarly, because the combination of soil types, crop rotations, nutrient sources and land management practices varies by farm operation, there is no "one size fits all" approach to drainage design or BMP adoption. Cost and practicality remain critical factors in assessing the suitability of BMPs for Manitoba.

Woodchip bioreactor being researched at Agriculture and Agri-Food Canada, Morden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