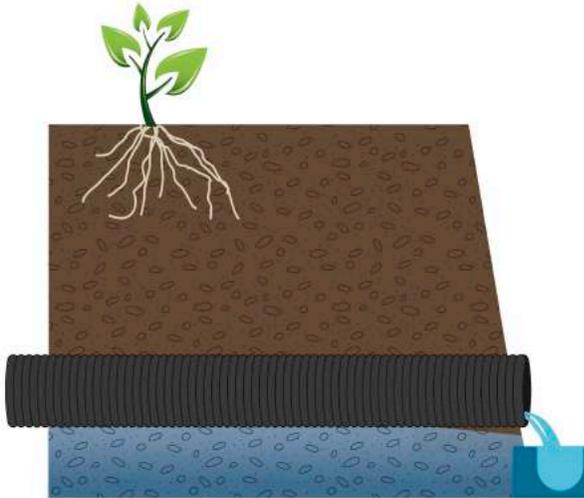


Controlled Tile Drainage: Calculate Your Benefits

Under conventional, or uncontrolled, tile drainage, water flows directly from the outlet into the surface water. Controlled tile drainage (CTD) involves simple flow control systems installed at tile drain outlets. Control structures are opened from harvest to spring, permitting free drainage to improve aeration and assist spring field operations. In the summer, control structures are used to raise the water table and create a potential to store water for crops. The control structures use an adjustable-height stop log system that allows drainage once the desired water level (height of water table) is achieved. This system restricts outflow and sometimes eliminates it completely.



Uncontrolled Drainage



Controlled Drainage

Benefits of Controlled Tile Drainage

Crop Yield

CTD reduces loss of water and nutrients from crop fields, providing increased resilience to drought events. Yield benefits are dependent on crop type as well as timing and amount of rainfall in relation to the stage of crop growth.

Under dry conditions, CTD can result in up to 25% yield increases compared to conventional tile drainage. However, in extreme drought years, when rainfall is not sufficient to raise the water table above the tile depth, yield benefits will not occur.

Long-term comparisons demonstrate a 3 to 5% average yield increase in corn and soybean yields under CTD. An Agriculture and Agri-Food Canada (AAFC) study in eastern Ontario estimated average annual yield benefits for soybeans and corn to be \$48/ha and \$78/ha, respectively, in 2006 dollars. However, some studies in the American Midwest have concluded that yield benefits are less significant.

Water Quality

CTD significantly reduces nutrient loss from tile drainage systems. Research by AAFC and South Nation Conservation has shown significant reductions in the export of ammonium (57%), nitrate (65%) and phosphorus (63%) during the growing season. On a subwatershed scale, mass load of total nitrogen in waterways was reduced by 50 to 100% compared to conventional tile drainage.

However, CTD has been tied to increases in surface runoff and deep percolation as a result of the higher water table. Conservation measures to control risk of sediment and nutrient loss to surface waterways should be considered, including timing of fertilizer application. Adjustment to water levels may be required during periods of high rainfall.

Greenhouse Gases

In wetter soils, there is an increased risk of denitrification, a process where nitrogen is converted to the greenhouse gas nitrous oxide. However, monitoring of AAFC study sites indicates that CTD may not significantly impact greenhouse gas flux (exchange) compared to conventionally drained soils. This may be due to more efficient use of nitrogen and water in CTD fields.

Costs of Implementation

If systematic tile drainage is already in place, the cost of installing control systems is relatively minimal. A single control structure can typically manage 4 to 8 ha – assuming slopes are flat enough to be controlled by one structure – with cost effectiveness increasing as the area that can be controlled with a single structure increases. Control structures cost between \$500 and \$3,000 per structure. Using a typical structure cost of \$1,000 each, the estimated installation cost ranges from \$125/ha to \$250/ha. Structures have a lifespan of ~25 years, with a payback period estimated at 3 to 4 years.

In Ontario, control of water levels is typically done only in the summer, with drains allowed to run freely the rest of the year. Management is reasonable, requiring at minimum a visit in the spring and fall to adjust water levels. Monitoring throughout the growing season to adjust for periods of high rainfall may be required. Allowing free drainage in the winter minimizes the risk of damage caused by freezing of the structures. The only recommended annual maintenance is lubrication of the control structures.

Suitability for Controlled Drainage

Controlled drainage systems require flat landscapes with ideal slopes of less than 1%, and less permeable subsurface soils. There is potential for controlled drainage on greater slopes if a stair-step system is used to accommodate elevation changes, although more control structures will be required.

Producers should consider if higher water tables due to CTD could impact neighbouring landowners or septic systems. Producers should also consider field traffic impacts – control structures must be opened for a sufficient period before field operations to prevent increased soil compaction due to the higher water table.

Ongoing Research

Research shows the benefits of CTD vary based on the crop, amount of rainfall, and timing of rainfall in relation to the stage of crop growth. In 2016, OSCIA partnered with University of Ottawa scientists to develop a tool for farmers and extension personnel to calculate the crop yield benefits of controlled tile drainage under varying conditions. The tool is expected to be available in spring 2018.



Top: Installation of a control structure. Middle: Adding stop logs to raise the water table. Bottom: The interior of the control structure, showing the raised water table controlling drainage. Photos: UTRCA.

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