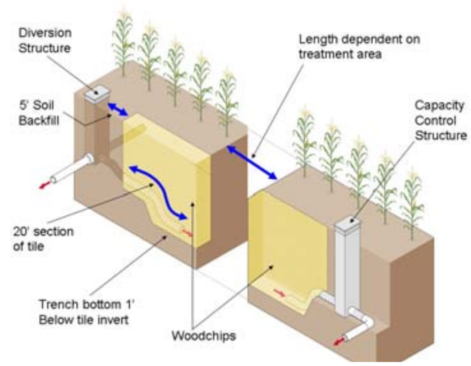
Woodchip Bioreactors

Subsurface drainage water from agricultural land often appears to be clean and free of particulate contaminants. However, one of the environmental concerns with subsurface drainage water is the amount of nitrate it contains. Nitrate in drainage water may be a problem if concentrations are high and it reaches a river that is used as a source of drinking water. Nitrate in drainage water is also a concern because of its potential contribution to hypoxia in the Gulf of Mexico. As nitrate is carried by river systems to the Gulf, it is thought to increase the growth of algae – the algae die and decompose, thereby consuming dissolved oxygen. The low levels of dissolved oxygen are not adequate for many aquatic species that are important for commercial fishing. The loss of nitrate through drainage water also represents the loss of a valuable resource that could have been used by growing crops.

Several methods of reducing the amount of nitrate in drainage water are being explored. The primary methods are good management of nitrogen fertilizer and the use of improved drainage system designs. However, edge of field treatment of drainage water is a strategy that may be needed to reach goals for decreasing the amount of nitrate in drainage water.

The use of a woodchip bioreactor is one method for removing nitrate from large volumes of drainage water. Drainage water is diverted into a trench filled with woodchips. Nitrate is removed from the drainage water by denitrification in which nitrate is converted to nitrous oxide and nitrogen gas.

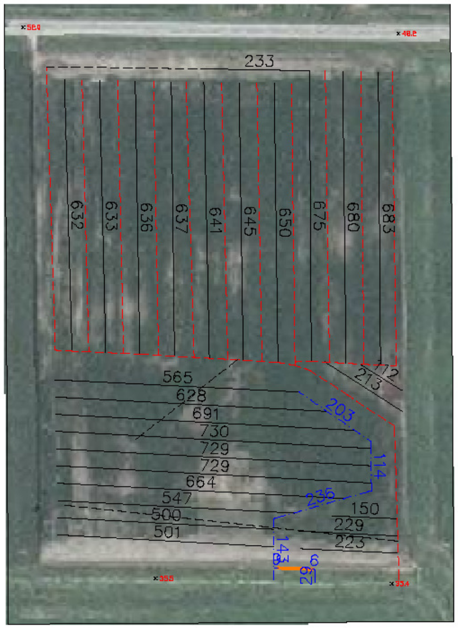


Design by Richard Cooke, University of Illinois

A woodchip bioreactor can be made by digging a trench about six feet deep and 2 to 3 feet wide. The length of the trench is dependent on the amount of water being treated. It is estimated that about 10 feet of trench is needed per acre of drained land. The trench is filled nearly full of woodchips and then covered with topsoil. Drainage water is directed to the bottom of the trench with plastic drainage pipe. Water is removed from the downstream end of the bioreactor with another section of perforated plastic tile that then directs the water into a drainage main or ditch.

Bioreactors have been studied in Illinois and have been shown to effectively reduce nitrate levels in drainage water. Bioreactors have been installed in the last year to determine their effectiveness in removing nitrate from drainage water in Minnesota with its cooler soil conditions and different seasonal drainage flow patterns. The cost effectiveness and practicality of bioreactors will depend considerably on the topography and cost of digging the trench and obtaining woodchips.

The bioreactor at this site was made by digging a trench approximately 125 feet long and about six feet deep. The trench was lined with a plastic film to reduce the amount of water movement in and/or out of the bioreactor to help with studying it effectiveness in removing nitrate. The trench was filled with woodchips and covered with top soil.



The bioreactor was placed in the lowest part of the field between the drainage main and the outlet – a typical in a drained field. Water that passes through the bioreactor or bypasses the reactor will be measured as it enters the drainage ditch. Amounts of nitrate entering and exiting the bioreactor will be determined to study its efficiency in removing nitrate from drainage water.

Approximate costs of construction were $1500 for the control structures, $600 for the woodchips, and $1100 for the trenching, for a total of about $3200. This reactor treats the water from 8 acres so the cost per acre would be $400. Life expectancy of the reactor is at least 20 years.

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