A bioreactor is a subsurface trench with a carbon source installed to reduce the nitrate concentration in tile discharge and groundwater. This carbon source is usually woodchips that act as a substrate for bacteria that break down the nitrates in the water flow and converts it into nitrogen gas.

This practice is applied to sites where there is a need to reduce the concentration of nitrate-nitrogen of subsurface drain flow or groundwater. The system can treat drainage from 40 to 60 acres of farmland. The nitrate load reduction ranges from about 15 percent to greater than 90 percent, depending on the site, drainage system, and weather patterns.

**Benefits of Bioreactors**

The benefits of installing a bioreactor are:

- Reduce nitrate loadings
- Minimum lifespan of 10 years
- Installation requires no modification to current practices
- Minimal land taken out of production
- Minimal maintenance after installation
- In-field yields will not be affected
- Improved water quality
Implementation
There are two control structures in the bioreactor, and each plays a different role. The structure controlling the inflow reroutes the water into the bioreactor and allows the excess water to bypass the bioreactor in case of a high-flow event. The structure controlling the outflow remains in the bioreactor so the water will remain there long enough for bacteria to remove the nitrates. These control structures are adjustable to let more inflow and less outflow or vice versa, depending on the circumstances.

A common bioreactor that treats 40 to 60 acres is approximately 100 to 120 feet long and 10 to 25 feet wide. Bioreactors are best placed on the edge-of-field in the buffer strip or grassed area.

It is recommended to use woodchips that are untreated/unpreserved and that are without any fine materials, dirt, or gravel. Chips can be 1/4 inch to 1 inch in length, providing for a sustainable carbon source that will last longer. The cost share for bioreactors is for 50 percent of the costs associated with installation.

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Prairie Rivers of Iowa
(515) 232-0048
www.prrcd.org
Benefits of Buffer Strips

The benefits of installing a buffer strip are:

- Slow water runoff
- Traps sediment, pesticides, and fertilizers
- Increased infiltration
- Source of food and shelter for wildlife
- Reduction of flooding
- Protection of livestock
- Protection from streambank erosion
- Improved stream habitat for fish
Implementation

In designing buffer systems, the flow of either surface water or ground water through the buffer should be maximized, and the integrity of the vegetation should be maintained. While buffers have the potential to provide significant water quality improvement, in-field management must also be considered. Specific practice implementation resources are available online through Iowa State University Extension and Outreach.

Buffer strips are most effective when combined with other conservation practices, such as nutrient management, residue management, and cover crops.

The Squaw Creek Watershed Nutrient Management Initiative is providing a cost-share benefit program to help with the expenses associated with buffer strip usage. The cost-share rate is 50 percent of the costs associated with installation.

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Benefits of Cover Crops

The benefits of incorporating cover crops into your operation are:

- Reduced soil erosion
- Decrease soil compaction (only in some species)
- Absorb unused fertilizer to make available for next cash crop
- Reduction of needed nitrogen application on cash crop
- Improve water quality of drainage water
- Increased organic matter
- Increased infiltration rate
- Increased porosity of soil
- Can be a forage source for livestock
Implementation

There are a variety of options for planting cover crops, and the method use depends on personal preference. A flight service can use a plane or a helicopter to fly-on seed while your row crops are still in the ground. You could also use a high-clearance tractor to broadcast seed the cover crops in while the row crops are still standing. If seeding after harvest, you can no-till plant or broadcast seed into the row crop residue.

Terminating cover crops depends on the crop you chose to use. Crops like oats, spring wheat, turnips, and radishes will not need to be terminated because they do not survive the winter. Harvesting, crimping, mowing, tilling, or herbicides compatible with the following row crop can be used to terminate other cover crops. Termination should be done at least two weeks prior to planting to minimize the risk of reducing yields.

The Squaw Creek Watershed Nutrient Management Initiative is providing a cost-share benefit program to help with expenses of using cover crops. Our cost share is available for $25/acre for planting.

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In-Field Conservation Practice: No-Till

Tillage of the soil causes the soil and the chemicals in the soil to become vulnerable to erosion. No-till is a system in which the soil is not disturbed before planting, except for injecting fertilizer nutrients (liquid manure or anhydrous ammonia). The entire residue from the previous crop remains on the soil’s surface to protect it from erosion.

No-till systems work best in well-drained soil conditions. It is recommended that this practice be used in conjunction with crop rotation, nutrient management, and edge-of field practices on your land based on the natural resources concerns.

Benefits of No-Till

The benefits of a no-till operation instead of conventional tillage are:

- Reduced soil loss
- Reduced phosphorus loss
- Improves soil structure over time
- Increased water infiltration rate
- Improved water quality
- Increased soil porosity
- Increased water availability to plants
- Increased organic matter
- Reduction of soil crusting
- Reduction of compaction
- Reduced fuel and labor costs
Implementation

The equipment required for no-till is a coulter, or disk seed-furrow, to open the narrow strip for planting. A no-till planter must have depth-gauging wheels that firmly contact the soil surface.

Selecting a corn hybrid with good seedling disease resistance and insect resistance ratings is important, as many pathogens can overwinter in crop residue.

Usually, the yield of no-till planted corn is competitive with corn planted into a tilled seedbed. Per-acre net revenue differences between no-till and tilled corn are general minimal. This is especially true of corn rotated with soybeans.

The yield difference in no-till soybeans is generally less than five percent. However, no-till soybean net revenue per-acre is often higher due to fuel and tillage equipment cost savings. When no-till planting beans after corn, use row cleaners to clear enough residue for seedling establishment.

The Squaw Creek Watershed Nutrient Management Initiative is providing a cost share benefit program to help with your expenses of using this selected best management practice. The cost share for no-till is for the amount of $10/acre.

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A saturated buffer is a buffer area intercepting the tile lines between the edge of a row crop field and a body of water. A saturated buffer, compared to an unsaturated buffer, is used when a till outfit is present underground. Instead of flowing straight into the body of water, the tile drainage water is redirected to flow through the buffer. This practice is intended to make further use of the buffer’s ability to improve water quality.

In a saturated buffer, prairie grasses, shrubs, and trees can absorb about 50 percent of the water flow from the field. Combining the bacteria in soil converting soluble nitrogen to nitrogen gas, through denitrification, and uptake by the perennial plants, nitrates will be removed and in turn keep them out of the adjacent stream.

Benefits of Saturated Buffers
The benefits of installing a saturated buffer are:

- Improved water quality from tile and surface water
- Reduction of flooding
- Protection from streambank erosion
- Improved water table recharge
- Source of food and shelter for wildlife
- In-field yields will not be affected
- Minimal maintenance after installation
Implementation

The components required for a saturated buffer are an established buffer strip (with native grasses, shrubs, and trees), a tile main to intercept, and adequate downstream drainage. The buffer needs to extend at least 30 feet from and 300 feet along the stream with well-established vegetation.

The saturated buffer will absorb all nitrogen in the normal flow events, but will be bypassed in large rain events.

The Squaw Creek Watershed Nutrient Management Initiative is providing a cost share benefit program to help with your expenses of using this selected best management practice. The cost share for saturated buffer is for 50 percent of the costs associated with installation.

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Benefits of Strip-Till

The benefits of a strip-till operation instead of conventional tillage are:

- Reduction of water erosion
- Reduction of soil erosion
- Improvement of soil organic matter content
- Reduction of CO₂ loss from the soil
- Manages snow and water to increase available moisture
- Provide food and shelter for wildlife
- Allows for injection of nutrients directly into the row space
- Improved germination due to increased soil temperatures
- Comparable early season plant growth
- Conserves labor and energy costs

Conventional tillage accelerates the breakdown of soil organic matter, makes soil more susceptible to erosion, and may create a plow pan or compaction layer. Strip-till is a system in which residue-free strips of soil are tilled ahead of planting, either in fall after harvest or in spring. The remaining strips of land are undisturbed and left with residue that protects the soil from being eroded.

This practice is a good component for a nutrient management system. It is recommended that this practice be used in conjunction with crop rotation, nutrient management, and edge-of-field practices on your land based on the natural resources concerns. Where soil moisture conditions are suitable, strip-till creates narrow-width tilled strips, traditionally in the fall, to increase early spring soil moisture evaporation and increase the topsoil temperature.
Implementation

The strips tilled are approximately six inches wide (or about 1/3 of the row width) and four to eight inches deep. The seeds are planted directly into the strip of soil that has been tilled.

The equipment needed for strip-till is a heavy tool bar that has row markers, coulters, knives, and covering discs attached. The coulter must be large enough to cut through the residue without plugging. The injection knife for fertilizer application follows immediately behind the coulter. This knife is designed to till an area about six to eight inches wide. The covering discs are designed to flank each side of the knife and prevent the tilled soil from spilling into the inter-row area. There are a variety of systems available on the market for purchase and/or modification.

The Squaw Creek Watershed Nutrient Management Initiative is providing a cost share benefit program to help with the expenses that come with using this best management practice. The cost share for strip-till is for the amount of $10/acre.

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