

Byron Township Water Quality Study: Managed Timber to Row Crop Agriculture

Monitoring soil nitrate movement in a field from the point of land use conversion

A multi-partner effort to study nitrate nitrogen movement that occurs below an agricultural field recently transitioned from managed timber production to irrigated row crop production has now been underway for two cropping seasons. The landowner, R.D. Offutt Company, has made the property and their staff available to better understand the movement of water and nitrate-nitrogen through the soil following this type of land use transition.

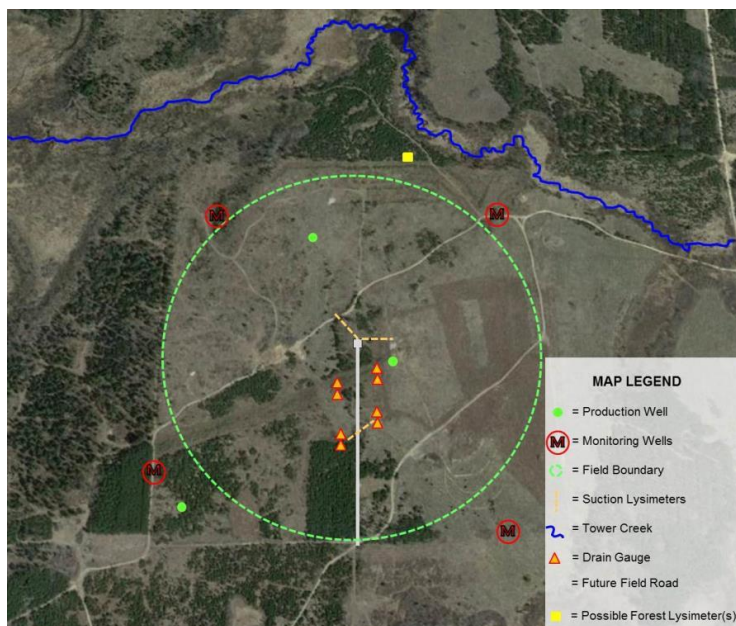
This study is unique. It is the first instance in the state, and perhaps nationally, where groundwater impacts from irrigated agriculture have been studied from the first year of production. Findings from the study will be valuable as additional timber land in Minnesota's Central Sands region is transitioned for other purposes—a trend that has started and likely will continue as Potlatch Corporation sells off its land holdings in Minnesota. The study will help researchers, ag industry, and government better understand the potential groundwater quality impact of such land use transitions.

The study is also unique in its team of talented and dedicated partners:

- R.D. Offutt Company (RDO)
- Central Lakes College, Staples (CLC)
- Minnesota Department of Agriculture (MDA)
- University of Minnesota Extension (U of M)
- Northwest AquaTek Solutions (NWATS)
- Sustainable Farming Association of Minnesota (SFA)

The 160 acre site known as "Byron #1" is located in Byron Township, Cass County, 12 miles north of Staples, Minnesota. The soil is loamy sand, and groundwater occurs at depths of 10 to 20 feet. RDO plans to grow seed potatoes and peas as part of a four-year rotation, and Central Lakes College will grow barley, soybeans, or possibly edible beans during the other two rotational years. The land was cleared in 2013, soybeans were planted in 2014 in the first crop production year, corn was grown in 2015, and soybeans are planned for 2016.

If not utilized by plants or retained in soil organic material, nitrate from nitrogen fertilizer or breakdown of organic matter is moved by water down through the soil and into groundwater. Since water moves quickly through sandy soil, the potential for nitrate contamination of groundwater in much of Minnesota's Central Sands region is high. Because of this potential, RDO and CLC are using innovative cropping practices to reduce nitrate loss on this site, including the use of nitrogen fertilizer best management practices, planning a crop rotation that will include only low-nitrogen demanding crops—seed potatoes, peas, barley, soybeans, and edible beans—also using slow release nitrogen fertilizers, and using cover crops to capture and hold excess nitrate in the rooting zone until the following season.



Byron Township Study Site

This aerial photo was taken before clearing operations were completed.

The site known as "Byron 1" is located 12 miles north of Staples, Minnesota in Byron Township, Cass County.

The photo shows the locations of monitoring equipment and irrigation water wells.

Bordering the site to the north is Tower Creek. Possible impacts on the flow of Tower Creek from the pumping of irrigation water is being monitored by RDO/NWATS with oversight by the DNR.

Key components of the study:

Collection of soil water samples with suction tube lysimeters

During growing seasons, soil water is being collected weekly from 15 suction tube lysimeters, and samples are analyzed for nitrate-nitrogen. The lysimeters were installed at a 4-foot depth to collect soil water that has moved past crop rooting depth and could potentially move down to groundwater. The tips of the lysimeters are made of a porous ceramic material that water flows through when suction is placed on the tubes (diagrams below).

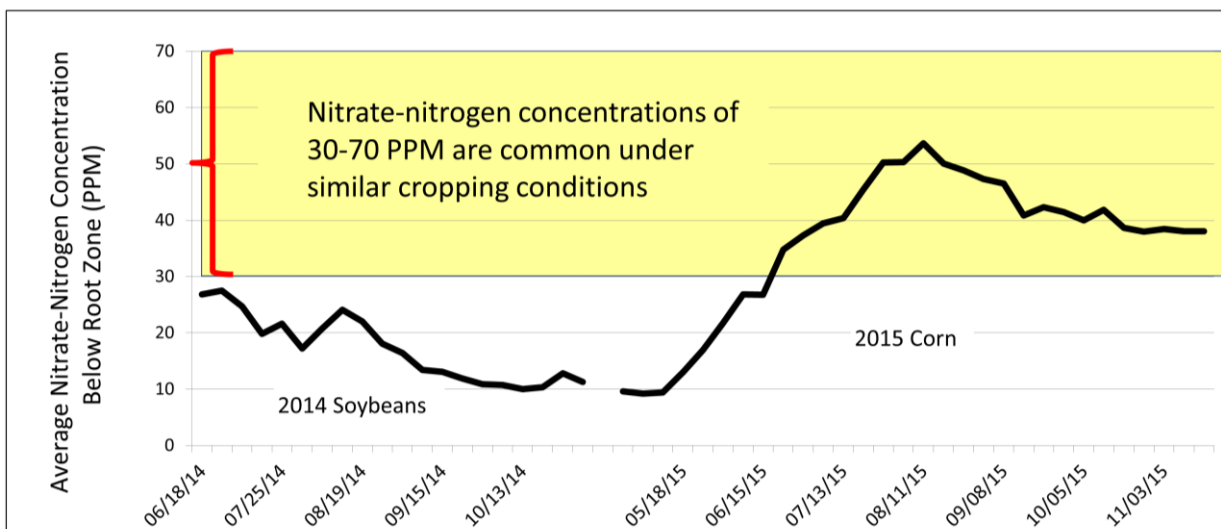


Far left: Installation of lysimeters at Byron Township site. Lysimeters are installed in holes at the bottom of the trench. PVC pipe protects plastic sampling lines from rodents.

Immediate left: “See-through” diagram of a suction tube lysimeter.

Below: Graph of 2014 & 2015 nitrate-nitrogen concentrations from soil water collected from lysimeters.

Soil Water Nitrate-Nitrogen Concentration Byron #1 2014-2015



This graph shows the average soil water nitrate-nitrogen concentrations observed under Byron #1 in 2014 under soybeans and 2015 under corn. Soil water data from other similarly managed fields in Central MN have shown nitrate-nitrogen concentrations that range from 30-70 ppm throughout a corn/russet/bean rotation. This preliminary data shows soil water nitrate-nitrogen concentrations at Byron #1 measuring in a range comparable to other locations.

Drain gauges

Installed below the crop rooting zone, at a depth of four feet, drain gauges measure the volume of water that moves through the soil profile. This information combined with nitrate-nitrogen concentration data from lysimeters can provide an estimate of groundwater loading in terms of pounds of nitrate-nitrogen per acre.

Monitoring wells

As part of this field study, seven shallow monitoring wells were installed around the field perimeter in early November 2014. Over time, these wells will enable us to better understand the movement of shallow groundwater below this field and also provide access to measure the nitrate concentration of this water throughout the year.

For more information, please contact: Ryan Perish, MDA, 218-898-0002, ryan.perish@state.mn.us