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OTT Hydromet

OTT Hydromet Application Notes / Success Stories

HYDROLAB University of Iowa

Background

As a heavily agricultural state, Iowa has implemented various policy initiatives in an attempt to reduce farm pollution, including the Nutrient Reduction Strategy, which uses a science- and technology-based approach to address nitrate contamination. Monitoring of nitrate loads is an essential means of assessing the amount of nitrate entering streams from farm fields, which is a substantial issue throughout Iowa[i]. The data captured by these methods are required by models used to evaluate water quality and volume (e.g., MIKE SHE model) and perform End Member analysis to infer the sources of high nitrate water.

In Iowa, constructed drainage, also known as tiling, is a common practice that lowers the water table, drains wet spots, and promotes the quick drainage of hydric soils after rain. This is important for optimizing crop yields, as rainfall within Iowa exceeds the water requirements for crop production. After a rain event, water from the fields, i.e., tile water, flows through constructed drainage, typically consisting of a network of porous 6” diameter pipes, and enters the stream. Tile water generally has higher nitrate concentrations and is thus a primary source of nitrate in streams.

Identifying water sources with higher nitrate concentrations—including tile water, surface water runoff, and groundwater—is critical for assessing how nitrates are processed in streams.

What is monitored and why?

Iowa state agencies have outlined a nutrient reduction strategy that directly addresses nitrates[iii]. Such initiatives aim to improve water quality and identify best practices that reduce nutrients and flooding.

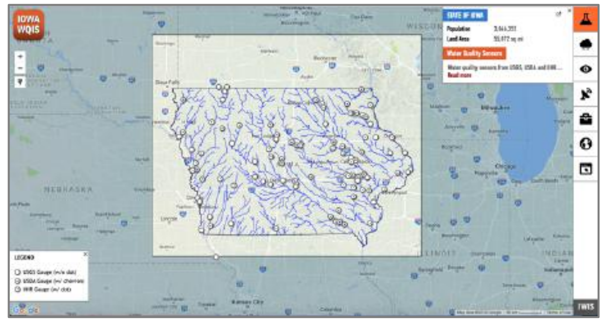
IIHR—Hydroscience & Engineering, a research institute at the University of Iowa College of Engineering, established and manages the IIHR Water Quality Network, which focuses on tracking statewide water quality conditions in real-time, including nitrate loading. In collaboration with its affiliates, the program has grown from a handful of nitrate sensors to span 80 water quality monitoring stations over the past decade[iii] . Most sites have a Hach Nitratax deployed for measuring nitrate in the form of nitrate- and nitrite-nitrogen (NOx). Continuous measurement of NOx is critical, as elevated NOx in streams and lakes can disrupt ecosystem processes[iv], leading to harmful algae blooms[v] and low biodiversity[vi].

In addition, twenty sites are equipped with HYDROLAB DataSonde 5X (DS5X) multiparameter sondes for long-term continuous water quality monitoring. The HYDROLAB sonde measures and records conductivity, which is a conservative metric in a stream as it is expected to be relatively stable. Additionally, the DS5X sonde measures pH, dissolved oxygen (DO), and temperature. These data inform interpretations of nitrate estimates and support watershed monitoring. For example, HYDROLAB data are used in conjunction with HACH Nitritax data to identify water sources within a stream.

Members of the IIHR water quality team gather at Clear Creek near one of the water quality sensors. (Photo courtesy of IIHR)

Monitoring Solution

In order to monitor seasonal changes in nitrates, sensor sites are located in streams, with instrumentation removed during the winter to prevent damage[vii]. These sites have been carefully selected to capture nitrate levels across streams with uses varying from recreation to municipal water supplies. These sensor sites utilize HYDROLAB sondes and HACH Nitratax sensors, which are powered by deep-cycle batteries recharged via solar panels. They send data collected by on-site dataloggers back to Iowa City via a cell modem every 15 minutes, with new data posted in near-real-time via the Iowa Water-Quality Information System (IWQIS) https://iwqis.iowawis.org/) using the Google Earth platform. Short-term data cover the past 2 weeks, with long-term data sets available by contacting IIHR research staff.



Iowa Water Quality Information System (WQIS) for Real-time access to water quality data

Available water quality data:

- HYDROLAB Sondes:
  - Conductivity
  - Temperature
  - Dissolved Oxygen
  - pH
  - Water Temperature
- HACH Nitratax:
  - Nitrate NOx (or NO3-N)

All equipment is continually checked, calibrated, and maintained according to the manufacturers' recommendations.

HYDROLAB multi-parameter sonde for long-term continuous water quality monitoring

Advantages

HYDROLAB data have helped identify how nitrate is processed in streams. Additionally, changes driven by precipitation can be observed in the collected data. For example, the following patterns clearly emerge.

- Surface water runoff has low conductivity.
- Winter road salting results in increased conductivity during melting and precipitation events.
- Nitrate-consuming organisms in the streams effect DO. Combined analyses of DO levels and nitrate allow the mechanism for nitrate processing to be determined. Plants and other organisms may consume and retain nitrate, which could be permanently removed from streams. With long-term continuous water quality data, annual and diurnal patterns may be inferred.

In short, HYDROLAB data inform interpretations of nitrate data and support watershed modeling.

Summary

Nitrate-loading data are essential for assessing amounts of nitrate entering streams from farm fields. This vital information is used for research purposes to populate models to evaluate water quality and volume, while enabling End Member analyses to identify nitrate-rich water sources.

For more information please visit ott.com

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[i] Spalding, R. F., & Exner, M. E. (1993). Occurrence of nitrate in groundwater—a review. *Journal of environmental quality*, 22(3), 392-402.

[ii] Weber, L., Jones, C., and Davis, C. (2017). *IIHR 2016 Water Monitoring Report*. IIHR — Hydroscience and Engineering, College of Engineering, The University of Iowa, Iowa City.

[iii] ibid., p. 5

[iv] Vitousek, P. M., Aber, J. D., Howarth, R. W., Likens, G. E., Matson, P. A., Schindler, D. W., ... & Tilman, D. G. (1997). Human alteration of the global nitrogen cycle: sources and consequences. *Ecological applications*, 7(3), 737-750.

[v] Heisler, J., Glibert, P. M., Burkholder, J. M., Anderson, D. M., Cochlan, W., Dennison, W. C., ... & Lewitus, A. (2008). Eutrophication and harmful algal blooms: a scientific consensus. *Harmful algae*, 8(1), 3-13.

[vi] Weber et al., (2017), p. 7

[vii] Ibid., p. 10