

Ohio Controlled Drainage

(OH-AUGLAIZE1, OH-AUGLAIZE2, OH-CRAWFORD, OH-DEFIANCE1, OH-HARDIN1, OH-HARDIN2, OH-HENRY)
Controlled Drainage

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SITE SUMMARY

Controlled drainage was installed on seven private farms in northwest Ohio through a Conservation Innovation Grant in 2007. At each site, controlled drainage was compared to conventional free drainage in adjacent zones that were monitored independently. There was no physical barrier between the zones, which ranged in size from 17 to 49 acres. The two zones at each site were farmed as a single field, using the same management practices (cropping, tillage and fertilization).

All sites are flat, with average slopes ranging from 0.2% to 1.6% slopes. Soils are fine textured and slowly permeable, and require subsurface drainage for economically viable crop production.

Drain flow was monitored using the depth in the control structure, with a V-notch weir. Rating curves were developed in a lab experiment conducted to derive relationships between water depth and flow rate for different sizes of in-line water level control structures. Flow rate datasets include numerous gaps due to equipment failure and other reasons.

Ghane et al. (2012) studied crop yield impacts of controlled drainage at these seven sites, Gunn et al. (2015) used data from six of the seven sites to assess drain flow impacts of controlled drainage, and Pease (2016) examined flow and nutrient concentrations. They used slightly different site names than in the database, so Table 1 is provided to allow data users to understand the sites across these different studies.

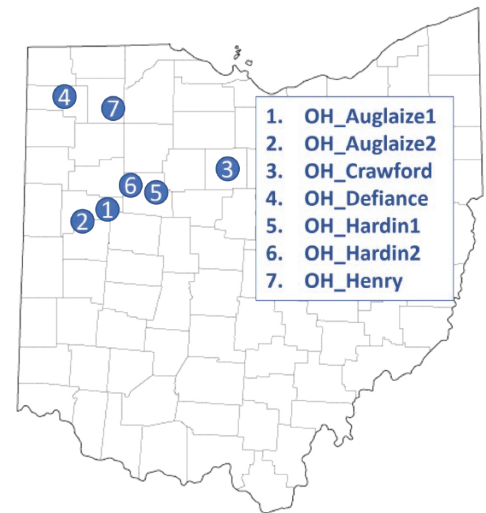


Table 1. Site names used in various studies

Site Name in Transforming Drainage Database	Site Name in Ghane et al. (2012) and Gunn et al. (2015)	Site Name in Pease (2016)
OH_Auglaize1	Auglaize E	Lakeview
OH_Auglaize2	Auglaize SE	St. Johns
OH_Crawford	Crawford	Crawford
OH_Defiance1	Defiance	Defiance
OH_Hardin1	Hardin N	Blanchard
OH_Hardin2	Hardin NW*	Dunkirk
OH_Henry	Henry	Henry

* Not included in Gunn et al. (2015)



Box 1. Site info

WATER MANAGEMENT PRACTICES

- Conventional Drainage (depth 2.5-3.5 feet, spacing 30-50 feet)
- Controlled Drainage (depth 2.5-3.5 feet, spacing 30-50 feet)

SITE CHARACTERISTICS

OH-AUGLAIZE1

- Soil: Millford Silty clay loam
- Rotation: Popcorn-Corn-Soybean

OH-AUGLAIZE2

- Soil: Minster silty clay loam, Blount silt loam
- Rotation: Corn-Soybean, occasionally wheat

OH-CRAWFORD

- Soil: Luray silty clay loam
- Rotation: Corn-Soybean, occasionally wheat

OH-DEFIANCE1

- Soil: Paulding clay, Roselms silty clay
- Rotation: Corn-Soybean

OH-HARDIN1

- Soil: Blount silt loam and Pewamo silty clay loam
- Rotation: Corn-Soybean

OH-HARDIN2

- Soil: Blount silt loam and Pewamo silty clay loam
- Rotation: Corn-Soybean

OH-HENRY

- Soil: Mermill loam
- Rotation: Popcorn-Corn-Soybean

MEASUREMENTS IN DATABASE

OH-AUGLAIZE1

- Tile Flow (2008-2014; 99% of days*)
- Tile N Load (2010-2014; 71% of days*)
- Tile Water Quality: Nitrate-N, Ortho-P (2010-2014; 80 samples)
- Crop Yield (2008-2012), Grain Moisture (2010-2012)
- On-Site Weather (2008-2011)

OH-AUGLAIZE2

- Tile Flow (2009-2015; 71% of days)
- Tile N Load (2010-2015; 76% of days)
- Tile Water Quality: Nitrate-N, Ortho-P (2010-2015; 173 samples)
- Water Table Depth (2011-2015)
- Crop Yield (2008-2015)
- Grain Moisture (2008-2010, 2013, 2015)
- Final Plant Population, Biomass/Total Nitrogen/Total Carbon (Vegetative, Grain, Cob) (2013, 2015)
- Soil Texture (2011)
- Soil Bulk Density, Soil Water Retention (0-15 bars) (2011, 2013, 2015)
- Soil Nitrate, pH, CEC (2011-2015)
- Soil Organic Carbon, Total N (2011, 2013, 2015)
- Soil Moisture and Temperature (2012-2015)
- On-Site Weather (2008-2014)

OH-CRAWFORD

- Tile Flow (2008-2014; 69% of days)
- Tile Water Quality: Nitrate-N, Ortho-P (2011-2014; 72 samples)
- On-Site Weather (2008-2010)

OH-DEFIANCE1

- Tile Flow (2008-2014; 88% of days)
- Tile N Load (2011-2014; 53% of days)
- Tile Water Quality: Nitrate-N, Ortho-P (2011-2014; 61 samples)
- Crop Yield, Grain Moisture (2006-2012)
- On-Site Weather (2008-2011)

OH-HARDIN1

- Tile Flow (2008-2014; 60% of days)
- Tile Water Quality: Nitrate-N, Ortho-P (2011-2014; 68 samples)
- Crop Yield, Grain Moisture (2007-2012)
- On-Site Weather (2008-2010)

OH-HARDIN2

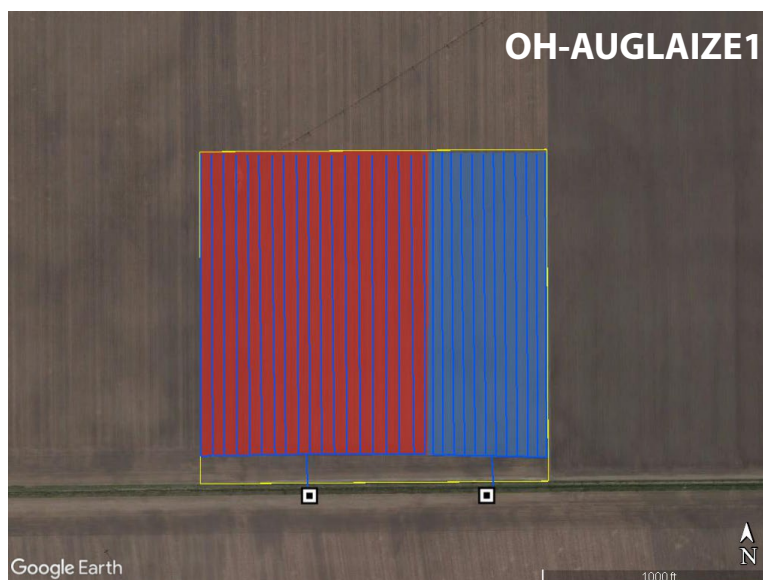
- Tile Flow (2008-2014; 100% of days)
- Crop Yield (2008-2011)
- On-Site Weather (2008-2009)

OH-HENRY

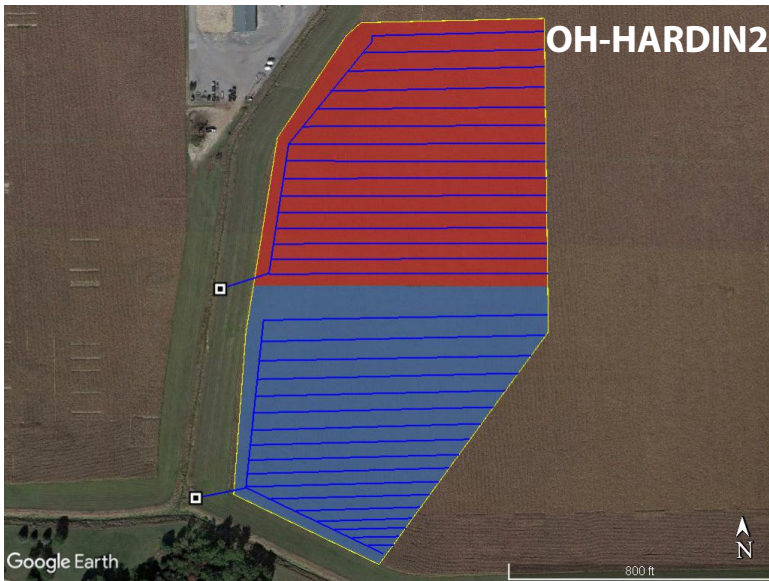
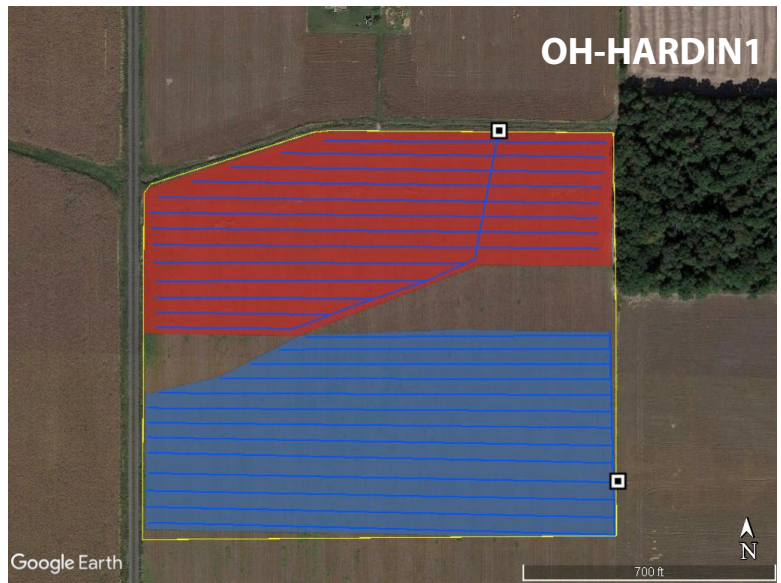
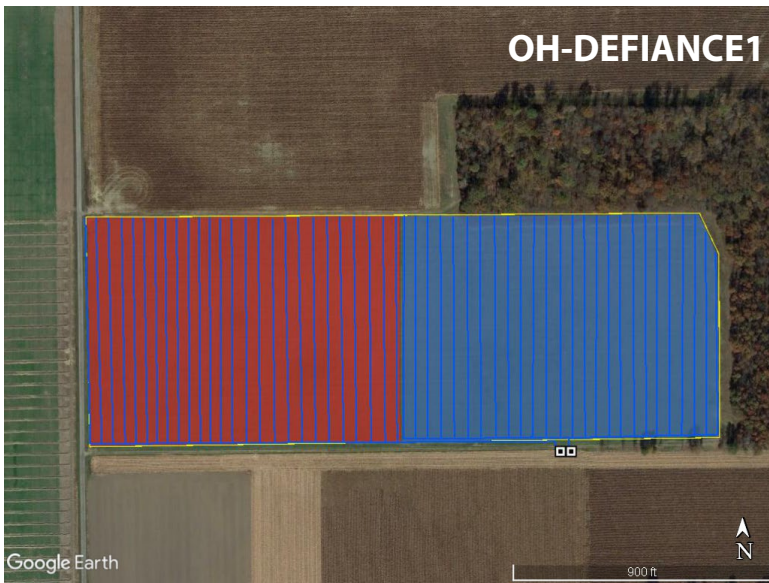
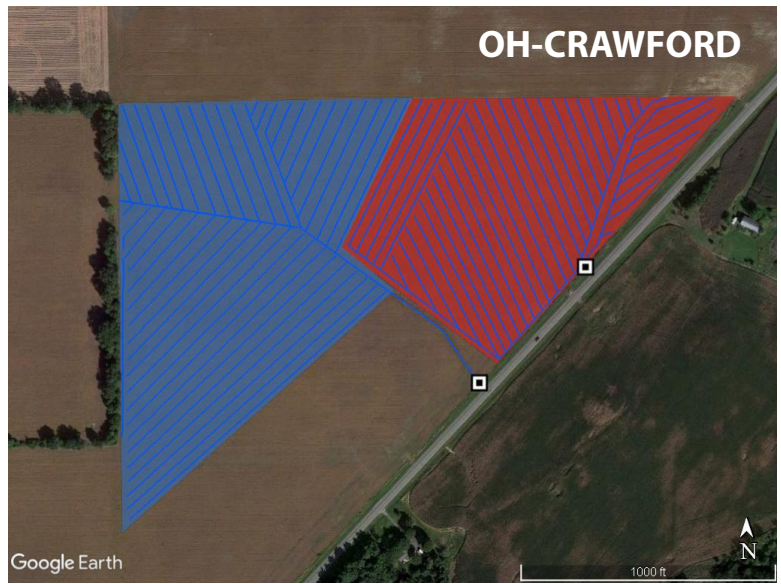
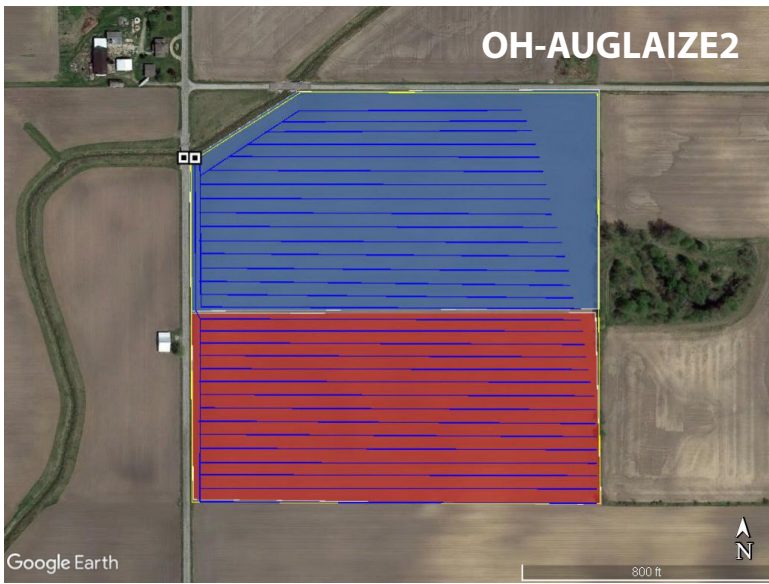
- Tile Flow (2008-2014; 89% of days)
- Crop Yield, Grain Moisture (2008-2011)
- On-Site Weather (2008-2010)

* These percentages include days for which drain flow gaps were filled based on algorithms described in Abendroth et al. (2022). Both original measured data and filled data are provided in the database.

RESEARCH SITE MAPS



- Controlled Drainage
- Conventional Drainage
- Tile Line
- Control Structure



■ Controlled Drainage — Tile Line
■ Conventional Drainage Control Structure

SUMMARY OF RESULTS

FLOW

Controlled drainage led to significant reductions in the daily frequency of subsurface drainage discharge during winter, spring, and summer, but not autumn. Based on the results of the study, the authors found that controlled drainage could reduce daily subsurface drainage volume and nitrate-N load by 40% to 100%, depending on soil type and precipitation timing. They concluded that reduced drain flow may increase water uptake by crops, but most of the flow contributes to increases in runoff and seepage.

CONCENTRATION

An analysis of nitrate-N and dissolved P concentration found that the seasonal pattern is different between the two nutrients. Nitrate concentrations were highest in spring, while soluble phosphorus concentrations were highest in late summer (Figure 2).

LOAD

Controlled drainage reduced both nitrate and dissolved reactive phosphorus (DRP) loads to tile drains. Figure 3 shows loads by month averaged across all sites for which data were available, for both free and controlled drainage.

CROP YIELD

Within the area of influence, defined as an elevation increase equal to the difference of the water table depth in the CD control structure from the maximum effective root depth, the controlled drainage fields had a yield advantage of 6% for corn and 3.5% for soybeans (Ghane et al., 2012). The water table of CD was within 1.3 m of the soil surface for a longer period of the growing season than for FD, which is an indication of a raised water table in the field resulting in an increased crop yield.

PUBLISHED WORKS FROM THE SITE

- Gunn, K.M., Fausey, N.R., Shang, Y., Shedekar, V.S., Ghane, E., Wahl, M.D. and Brown, L.C., 2015. Subsurface drainage volume reduction with drainage water management: Case studies in Ohio, USA. *Agricultural Water Management*, 149, pp.131-142. <https://doi.org/10.1016/j.agwat.2014.10.014>
- Ghane, E., Fausey, N.R., Shedekar, V.S., Piepho, H.P., Shang, Y. and Brown, L.C., 2012. Crop yield evaluation under controlled drainage in Ohio, United States. *Journal of Soil and Water Conservation*, 67(6), pp.465-473. <https://doi.org/10.2489/jswc.67.6.465>
- Pease, L.A., 2016. Characterization of agricultural subsurface drainage water quality and controlled drainage in the Western Lake Erie Basin (Doctoral dissertation, The Ohio State University).
- Pease, L.A., Fausey, N.R., Martin, J.F., and Brown, L.C. 2017. Projected climate change effects on subsurface drainage and the performance of controlled drainage in the Western Lake Erie Basin. *Journal of Soil and Water Conservation*, 72(3), pp.240-250. <https://doi.org/10.2489/jswc.72.3.240>
- Pease, L.A., Fausey, N.R., Martin, J.F., and Brown, L.C. 2018. Weather, landscape, and management effects on nitrate and soluble phosphorus concentrations in subsurface drainage in the Western Lake Erie Basin. *Transactions of the ASABE*, 61(1), pp.223-232. <https://doi.org/10.13031/trans.12287>

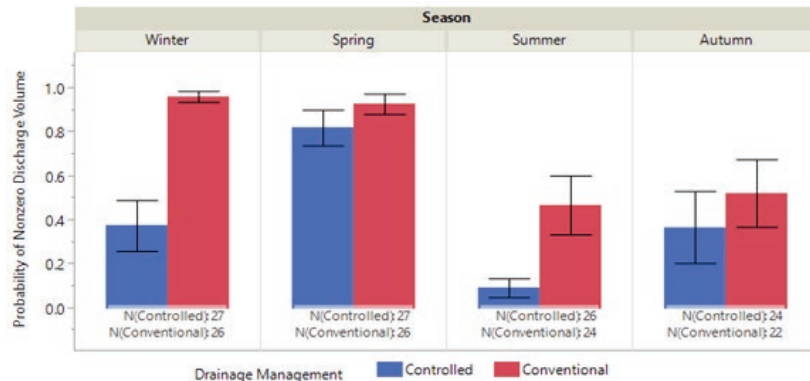


Figure 1. Mean probability of total subsurface discharge rate exceeding 0 mm day⁻¹ during each season for controlled drainage and conventionally drained systems. Each error bar represents a 95% confidence interval of the mean. (Figure from Pease, 2016)

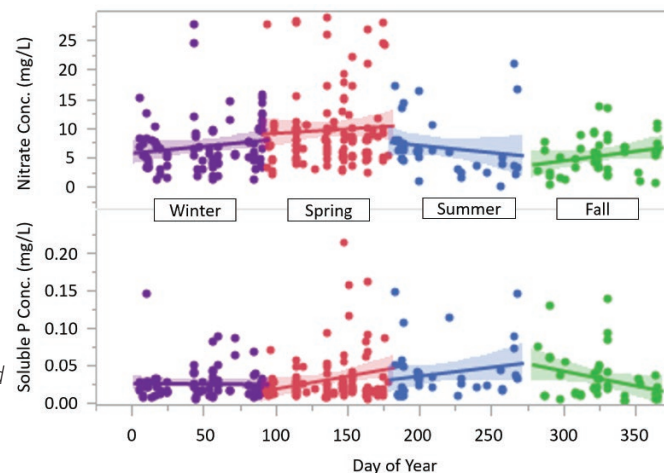


Figure 2. Concentration across sites and seasons.

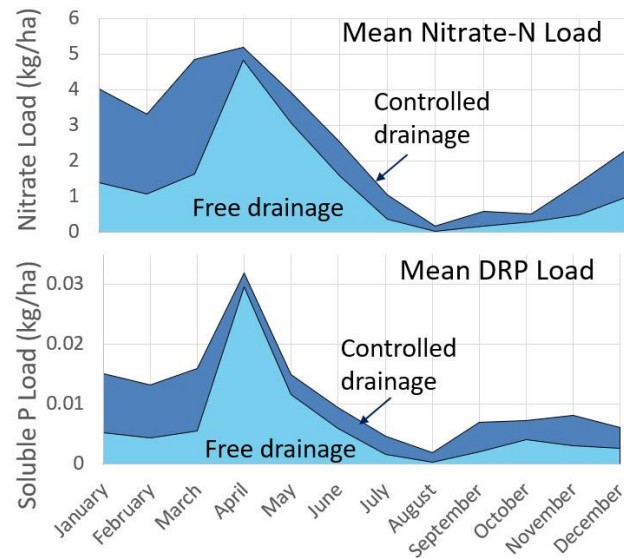


Figure 3. Monthly nitrate and dissolved reactive phosphorus loads for free and controlled drainage averaged across all years for the seven Ohio sites.

Data Access

Data from this site are available through the USDA National Ag Library Ag Data Commons repository (<https://doi.org/10.15482/USDA.ADC/1521092>) or the interactive website at Iowa State University with visualization and querying capabilities (<https://drainagedata.org>).

ACKNOWLEDGEMENTS

TRANSFORMING DRAINAGE PROJECT

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