2020 Field-Edge Groundwater Monitoring Program

Wisconsin Department of Agriculture, Trade and Consumer Protection
Agricultural Resource Management Division
Environmental Quality Unit
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Introduction

In 2020, the Wisconsin Department of Agriculture, Trade and Consumer Protection's (DATCP) Agrichemical Management (ACM) Bureau continued the Field-Edge Groundwater Monitoring Program to monitor groundwater quality at strategic geographic locations within agricultural areas to characterize agrichemical migration to underlying aquifers. Groundwater monitoring was performed by DATCP staff across a network of 73 monitoring wells at 24 established locations. At each location, depth to groundwater was measured, and groundwater samples were collected in the spring and the fall to evaluate seasonal variations. Collected samples are submitted to DATCP's Bureau of Laboratory Services (BLS) for chemical analysis. This report has been prepared to document 2020 program activities, and includes a summary of groundwater level measurements and analytical data results. Recommendations for the 2021 Field-Edge Groundwater Monitoring Program plan based on historic trend results are also presented in this report.

Purpose of Field-Edge Groundwater Monitoring

It is estimated that agriculture contributes $104.8-billion[1] annually to Wisconsin's economy. Growers in Wisconsin use several million pounds of pesticides and tons of fertilizers annually to grow a wide variety of crops. DATCP's Field-Edge Groundwater Monitoring Program is one form of monitoring the agency performs to meet its statutory obligation to assess groundwater quality. Wisconsin's groundwater law, Chapter 160, Wis. Stats., requires agencies to sample and monitor groundwater for substances related to facilities, activities, and practices under their jurisdiction that have a reasonable probability of entering the groundwater resources of the state, and to determine whether preventive action limits (PAL) or enforcement standards (ES) have been exceeded at points of standard application. The statute further specifies that agencies should develop monitoring plans that include provisions for conducting four types of monitoring (Wis. Stats., Ch. §160.05 and §160.27):

1. **Problem assessment monitoring,** *to detect substances in the groundwater and to assess the significance of the concentrations of the detected substances*;
2. **Regulatory monitoring,** *to determine if preventive action limits or enforcement standards are attained or exceeded and to obtain information necessary for the implementation of responses with respect to specific sites;*
3. **At-risk monitoring,** *to define and sample at-risk potable wells in areas where substances are detected in the groundwater or where preventive action limits or enforcement standards are attained or exceeded*, and
4. **Management practice monitoring,** *to assure practices are within compliance regulations*.

The purpose of the Field-Edge Groundwater Monitoring Program (Program) is to evaluate agricultural practices and chemical uses on groundwater quality (problem assessment and regulatory monitoring). Depth to groundwater measurements and groundwater sample results are used to measure affects from agrichemical practices and use within and adjacent to agricultural fields. Affects to groundwater quality from agrichemical use is dependent on conditions at each location. Results are used to measure both localized and regional impacts to aquifers over time at each field-edge sampling site. Goals of the Program include:

- Provide an early warning system to detect new agrichemical compounds in groundwater before widespread contamination can occur in underlying aquifers;
- Identify and measure pesticide concentrations that may have a potential to migrate to groundwater and exceed groundwater quality standards;
- Identify which environmental conditions (e.g., depth to groundwater, soil type, and geologic setting) are most vulnerable to impacts from routine agrichemical use;

[1] Contribution-of-Ag-to-WI-Econ-4-Update.pdf (wisc.edu)

- Gather and compile data regarding the occurrence and persistence of pesticide and metabolites in groundwater that may impact drinking water wells so that health based groundwater quality standards can be established;
- Study the dissipation of restricted use pesticides (e.g., atrazine) in groundwater after prohibition areas are established or use is restricted, and the dissipation of pesticides no longer in use (e.g., aldicarb);
- Gather and compile long-term data on nitrate contamination in groundwater and its relationship to application practices; and
- Evaluate affects to groundwater quality from various land uses and related pesticide use (i.e tree nurseries, infiltration basins, golf courses).

Program Approach

The Program's groundwater monitoring network consists of 73 wells installed at 24 strategic locations throughout the state. DATCP typically has access agreements with the property owners, allowing DATCP to install and access wells for sample collection. Typically, a monitoring well nest consists of a shallow well intersecting the water table and adjacent deeper wells (piezometers) installed with well screens placed at deeper depths within the underlying aquifer. These well nests are installed at the edge of an agricultural field to measure potential impacts from routine agrichemical use. Well locations were carefully selected to avoid interference from other potential sources (i.e. septic systems).

Over time, monitoring well nests have been installed within a variety of geologic settings, often in areas prone to groundwater contamination, such as areas with sandy soil, shallow depths to bedrock, or shallow groundwater. Nested well locations have two to five monitoring wells. The shallowest well intersects the water table with piezometers installed at deeper intervals. Table 1 in Appendix A provides construction specifications for each well in the program's groundwater monitoring well network. Figure 1 in Appendix B depicts the program's monitoring locations relative to State of Wisconsin and county boundaries.

Program data collection and documentation are completed in accordance with established protocols and guidance. Depth to water measurements and sample collection procedures are designed to collect reliable data consistently and in an unbiased fashion to ensure that localized conditions and regional impacts to aquifers over time can be evaluated. Field sampling observations and water level measurements are recorded in field notebooks. The compiled field information, along with laboratory results, are retained in databases maintained by DATCP.

Standard operating procedures for groundwater sampling followed DNR and DATCP protocols (Groundwater Sampling Field Manual, PUBL-DG-038 96 and Groundwater Sample Collection-Monitoring Well 1/21, respectively), which include the following:

- After unlocking the protective casing, remove the well cap to allow the water level to equilibrate with atmospheric pressure before measuring and recording the water level at each well.
- Each well is then properly purged to remove a minimum of four well casing volumes. Purging is performed either by using dedicated bailers and rope, peristatic pumps (low flow) with dedicated tubing, or submersible electric pumps (i.e. whale pumps) with dedicated tubing. The volume of water removed is measured and recorded in the field log book.
- Samples are then collected and placed in laboratory-provided containers using either sampling equipment dedicated to the well, or equipment that is decontaminated prior to use.
- Samples are placed into coolers and held on ice while in transport to the laboratory.
- Water purged from the wells and any rinse water used for cleaning is discarded on the ground surface.
- Field information is recorded in logbooks and maintained by ACM staff.

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Groundwater samples are collected using the same equipment used for purging. Samples are collected in one-liter amber glass bottles provided by BLS. Fifty-millimeter plastic containers were used for select glyphosate sampling. Bottles and containers are then placed in a cooler and held on ice along with a properly completed sample collection record and hand-delivered to BLS within 48 hours. During 2020, the program did not experience any issues with shipping or bottle breakage.

Bureau of Laboratory Services performed all groundwater analytical testing using GC/MS/MS and LC/MS/MS methods in accordance with ISO 17025 accreditation standards. All samples were tested for 106 pesticide analytes and nitrogen as nitrate plus nitrite (reported as nitrogen). Pesticide analytes are listed in Table 2 of Appendix A, along with corresponding reporting limits. Two new metabolites were added to the 2020 testing: dacthal DI-acid and dacthal mono-acid. A summary of the 2020 program analytical data results is listed in Table 3 of Appendix A. Individual monitoring well or piezometer analytical reports are available upon request.

DATCP provides annual results for each site to the respective property owner or grower, including water level data, analytical results, and a brief discussion of data trends over time. Growers are asked to reply with information regarding crops grown, pesticide use, and the amount of nitrogen applied to the fields near monitoring wells.

Program Assets and Infrastructure

The groundwater-monitoring network for the 2020 Field Edge Monitoring Program is comprised 31 water table observation wells and 42 piezometers around the state. Table 1 in Appendix A lists well construction specifications associated with these Program assets. Figure 1 in Appendix B depicts the Program's monitoring sites relative to State of Wisconsin and county boundaries. Construction logs, well development forms, and abandonment forms associated with the groundwater monitoring wells and piezometers are available upon request. The following is a summary of the history of the program.

1985-1989 ORIGINAL MONITORING WELLS AND PIEZOMETERS

The DATCP Field-Edge Groundwater Monitoring Program began in 1985. Initially, arrangements with growers and landowners at 50 sites were established in areas highly susceptible to groundwater contamination. Groundwater monitoring nests with three to four wells were installed at each site. Nested wells were constructed with well screens placed at various depths in the underlying aquifer. Nested wells were constructed adjacent to agricultural fields in the central sands region, Lower Wisconsin River Valley, and at other sandy soil areas throughout the state. The original Field-Edge Study was designed to collect groundwater samples from the uppermost shallow aquifer. Samples were tested for a limited number of agrichemicals and fertilizer to evaluate potential impacts to shallow groundwater from routine agricultural practices performed at nearby fields.

Data from the program's initial years led to the establishment of statewide pesticide management plans for both atrazine and aldicarb. Over the years, many of the wells installed for the initial study have been abandoned due to changes in land ownership, urban encroachment, or damage. Of the original 50 sites, 16 sites still exist and were included in the 2020 monitoring program.

2005 MONITORING PROGRAM EXPANSION

In the fall of 2005, DATCP expanded its groundwater monitoring network with funding from a United States Environmental Protection Agency (US EPA) grant. Each of the six sites selected for program expansion were used for a prior groundwater monitoring study, (Evaluation of Renewed Use of Atrazine in Atrazine Prohibition Areas) completed by DATCP in 2005. That study (also known as the Atrazine Reuse Study) was performed to gather information to evaluate the potential to repeal atrazine prohibition areas.

The groundwater flow direction was determined as part of the Atrazine Reuse Study. Using that information, two new monitoring wells were installed hydraulically down gradient adjacent to agricultural fields at the six sites. All six of these sites still were included in the 2020 monitoring program.

2010 UNIVERSITY WISCONSIN – OSHKOSH MONITORING WELLS

In the spring of 2010, DATCP became aware of a study to be performed by a University of Wisconsin-Oshkosh graduate student and the Wisconsin Geological and Natural History Survey (WGNHS). The study included installation of shallow bedrock monitoring wells at the edge of agricultural fields in a karst geological setting. It included monitoring wells at sites in Brown, Calumet, Kewaunee, and Manitowoc counties. Bedrock fractures at each well were identified by the study team. Groundwater samples were collected by the study team and DATCP, and tested annually as part of this Program between 2010 and 2014. The study was completed and all monitoring wells were subsequently abandoned in 2014.

2011 MONITORING PROGRAM EXPANSION

In the summer and fall of 2011, DATCP expanded its groundwater monitoring network again with additional funding from a US EPA grant. Monitoring wells were constructed at two new stations in La Crosse and Trempealeau Counties. These wells were installed along an elevated terrace adjacent to the Mississippi River. Since the groundwater flow direction was known at each site (both locations were part of the Atrazine Reuse Study), DATCP installed two groundwater monitoring wells at the hydraulically down gradient edge of agricultural fields at both sites. Both sites are still accessible today and were included in the 2020 monitoring program.

2017 MONITORING PROGRAM EXPANSION

In the summer and fall of 2017, DATCP expanded the groundwater monitoring network again with additional funding from a US EPA grant. Piezometers were constructed at three existing sites (two sites in Adams County and one in Portage County) and at one new site, the Hancock Agricultural Research Station (HARS). At each of these sites, two piezometers were installed near the existing groundwater monitoring nest with five-foot screens located at depths greater than 50 feet and 80 feet. The purpose was to evaluate groundwater quality relative to agrichemical uses at deeper aquifer intervals and compare data to shallower aquifer depths. A water table observations well (screen placed to intersect the water table) was also constructed at HARS. The HARS site and nested wells at the Adams and Portage County sites were included in the 2020 Program.

2020 Results

A total of 91 water level measurements and 80 groundwater samples were collected as a part of DATCP's 2020 Field-Edge Groundwater Monitoring Program, which is a decrease from previous years. In response to the COVID-19 pandemic, the 2020 spring sampling was delayed several months and started in early summer 2020. Due to the compressed time frame, the program still visited all of the stations, but collected water level information from all the groundwater monitoring wells and water samples for chemical analysis from approximately half of the locations. The groundwater locations selected for sampling were locations where prior data indicated greatest quality concerns. All of the stations were visited during the fall sampling time frame and samples were collected at that time.

All groundwater samples were submitted to BLS for chemical analysis. Table 3 in Appendix A summarizes 2020 Program analytical results and provides comparative risk values. The analytical data is compared to groundwater/drinking water standards to assess potential risk to human health and the environment. The risk values are sourced from the Wisc. Admin. Code, Ch. NR 140 for groundwater qualitative health standard limits and Wisconsin Department of Health Services (DHS) drinking water health advisories.

Key findings for 2020 include:

- Only ten responses were received for the 24 sites where field pesticide- and fertilizer-use information was requested from growers.
- Water level measurements continue to be measured at higher than normal water table elevations. Higher water table conditions have been observed over the past several years, and correlates with greater than

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average statewide precipitation. In 2020, according to National Oceanic and Atmospheric Administration (NOAA), the state received on average one inch of precipitation greater than normal conditions.

- Laboratory analysis included 106 pesticide analytes for the laboratory testing methods. During 2020, 28 pesticide analytes were detected in excess of reporting limits in numerous groundwater samples, which is similar to previous years.
- Pesticides detected in excess of laboratory reporting limits in 2020 samples include nine herbicides, 12 herbicide metabolites, six insecticides, and one fungicide.
- It appears the pesticides were detected at slightly greater concentrations during the fall sampling event compared to spring results.
- Overall, analytical data indicates that greater pesticide and nitrogen concentrations are present at depth at the nested monitoring well network locations. These results indicate that pesticides migrate vertically and laterally within the underlying aquifers. This is consistent with prior year's findings.
- Metolachlor ethanesulfonic acid (ESA) was detected in excess of laboratory reporting limits in 95% of all samples collected, the most frequently detected pesticide. Additionally, with the exception of one site in Langlade County (LN1-1), metolachlor ESA was detected at each groundwater monitoring site. This is consistent with prior year's findings.
- Alachlor ESA was the second most frequently detected compound. It was detected in excess of laboratory reporting limits in 76% of the samples collected and at 18 of the 24 groundwater monitoring sites.
- Clothianidin was the third most frequently detected compound. It was detected in excess of laboratory reporting limits in 75% of the samples collected and at 19 of the 24 groundwater monitoring sites. This is an increase from previous years, and increasing frequency of detection continues.
- Atrazine or one of its breakdown products (de-ethyl atrazine, de-isopropyl atrazine, and diamino atrazine) was detected in excess of laboratory reporting limits in 44% of the samples collected.
- Neonicotinoid compounds clothianidin, imidacloprid and thiamethoxam were detected in excess of laboratory reporting limits in 75%, 59% and 50%, respectively, of the samples collected in 2020. The frequency of detection is an increase from previous years.
- There were no Wisc. Admin. Code ch. NR 140 Exceedance Standard (ES) exceedances for established groundwater quality health standards. Only 30 of the 107 pesticides tested for have established groundwater quality health standard levels. However, there were exceedances of Wisc. Admin. Code, Ch. NR 140 Preventive Action Limits (PAL) for alachlor ESA, de-ethyl atrazine, di-amino atrazine, and atrazine total chlorinated residuals (TCR).
- The DHS has drinking water quality advisories for several pesticides. Imidacloprid was detected at 14 out of 24 sites at concentrations equal or exceeding the proposed ES of 0.2 micrograms per liter (µg/L) or parts per billion (ppb).

GROWER RESPONSES

DATCP obtained limited information regarding 2020 crops grown, pesticide use, and the amount of nitrogen applied to the fields adjacent to the monitoring nests. A request for this information was included with each summary letter sent to nearby property owners and growers. Responses to the information request is voluntary. DATCP received replies from ten of the 23 sites. No information was requested from HARS for site WS7 since the site is used for research and uses many different active ingredients. Table 4 in Appendix A summarizes information provided by the growers along with available information from the previous four years. The following Figure 2 is a summary of crops grown adjacent to the monitoring well nests and nitrogen use data for 2020.

Figure 1. Crops Grown and Nitrogen Applied on Fields Adjacent to Field Edge Stations.

Crop	Number of Sites with Crop	Percent of Sites (reported)	Range of Nitrogen Applied (lbs / acre)
Corn	2	20%	70.78 – 97.90
Carrots	1	10%	241.30
Field Corn	1	10%	167.17
Kidney Beans	2	20%	91.98
Potatoes	1	10%	225.93
Seed Corn	2	20%	201.95 – 223.2

Irrigation systems are present at 19 of the 24 monitoring sites. Of the 19 sites with irrigation systems, eight sites provided water usage data for 2020. Growers reported that the range of irrigation water applied to the fields in 2020 ranged from 2.5 to 21 inches per acre, with an average of 8.59 inches.

Growers were also asked if they have state-approved Nutrient Management Plans for the adjacent fields. Of the ten respondents, only four indicated they have approved plans.

A wide variety of pesticides used on fields adjacent to field edge monitoring wells was reported by the growers. Metolachlor was the most widely used active ingredient pesticide, followed by pendimethalin. A total of 47 different active pesticide compounds were reported to be applied to the fields. Table 4 in Appendix A identifies the complete list of pesticides used in 2020 as reported by the growers.

WATER LEVEL MEASUREMENTS

Depth to water level measurements are recorded for each well prior to collecting groundwater samples for laboratory analysis. Water level data is incorporated into a DATCP database for evaluation of historic trends. Water level data for 2020 was measured in the early summer (June) and fall (October or November). Overall, water level measurements indicate a stable or slightly higher water table conditions compared to recent years.

Higher water table conditions usually correlate well with above normal precipitation, which was recorded throughout the state during 2020. Wisconsin averages about 33.5 inches of precipitation annually. In 2020, the majority of the state accumulated between 30 and 40 inches of precipitation. Figure 3 depicts the accumulated precipitation in inches for Wisconsin.

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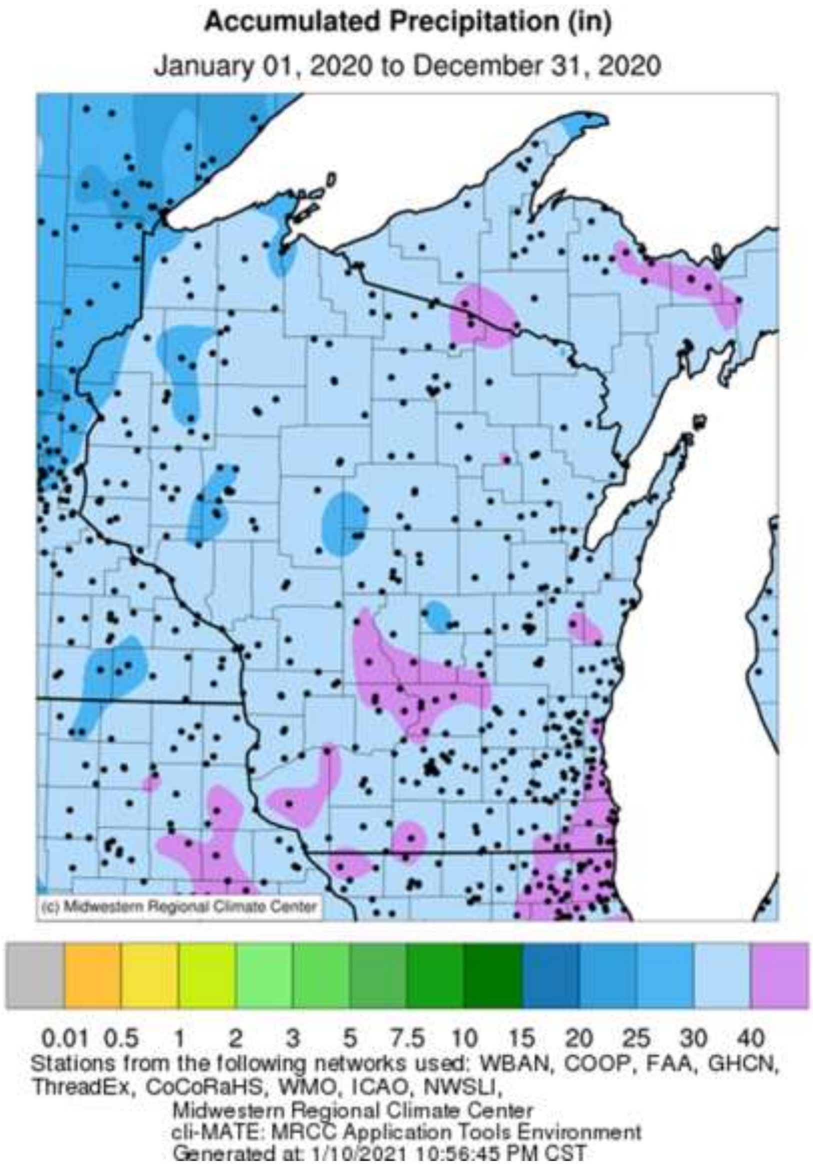
Figure 3. Accumulated Precipitation from Monthly Climate Watch Archive.

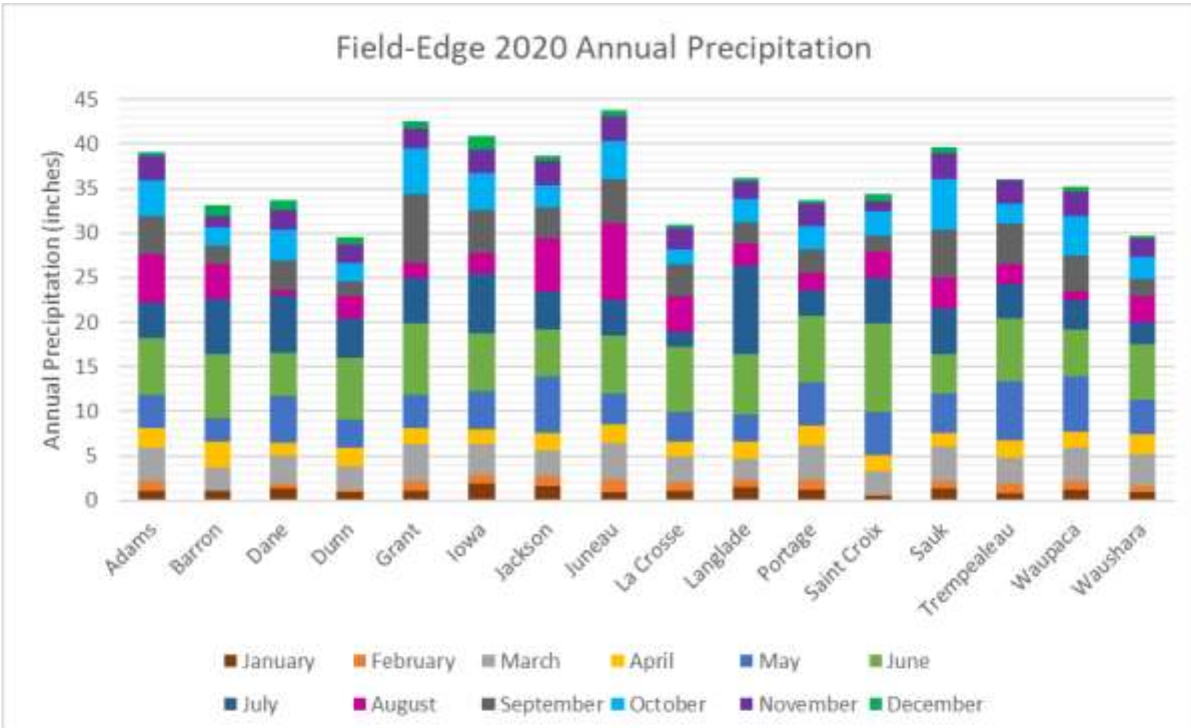


As reported by the National Centers for Environmental Information and their *National Climate Report – Annual 2020*[2], from January through April, Wisconsin experienced numerous winter storm and heavy snow events. In early February, a winter snowstorm produced four to ten inches of snow across the western region. As the snow melted, it produced a flooding event in early April along portions of the Mississippi and Yellow Rivers. This event caused the rivers to crest over 0.5 ft. above the flood stage. Thunderstorm events with strong winds primarily occurred throughout the year from April through August. In early June, Wisconsin experienced the remnants of Hurricane Cristobal in the western region of the state, which caused flash flooding events across Trempealeau, Taylor, and Buffalo Counties. In late June, another flash flood event occurred in central Wisconsin. This event produced 1.5 to two times above the normal flash flood guidance value. In late August, a heavy rain event produced three to five inches of precipitation in Juneau and Adams Counties, which caused flash flooding to occur. The remainder of the year from October through December primarily consisted of strong wind and winter weather storm events.

[2] National Centers for Environmental Information, Wisconsin Location, 2020. Past Weather | National Centers for Environmental Information (NCEI) (noaa.gov)

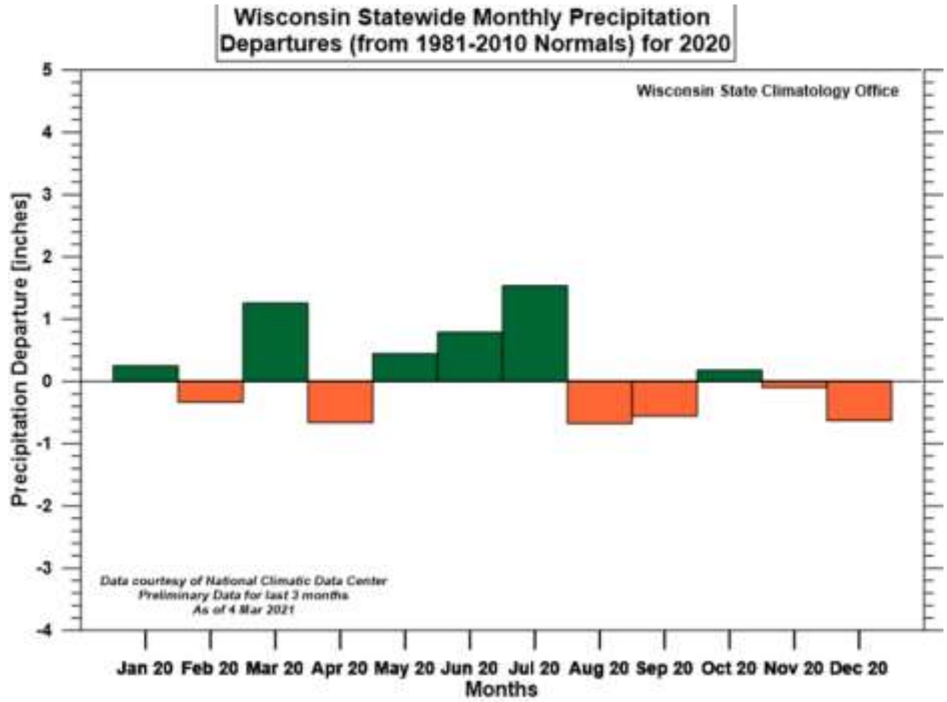
As recorded by NOAA, Figure 4 summarizes the total annual precipitation in the counties where Program groundwater monitoring stations are located. The various colors indicate the monthly precipitation data at each location.

Figure 4: 2020 Monthly Precipitation Totals Near Field-Edge Monitoring Program Locations.



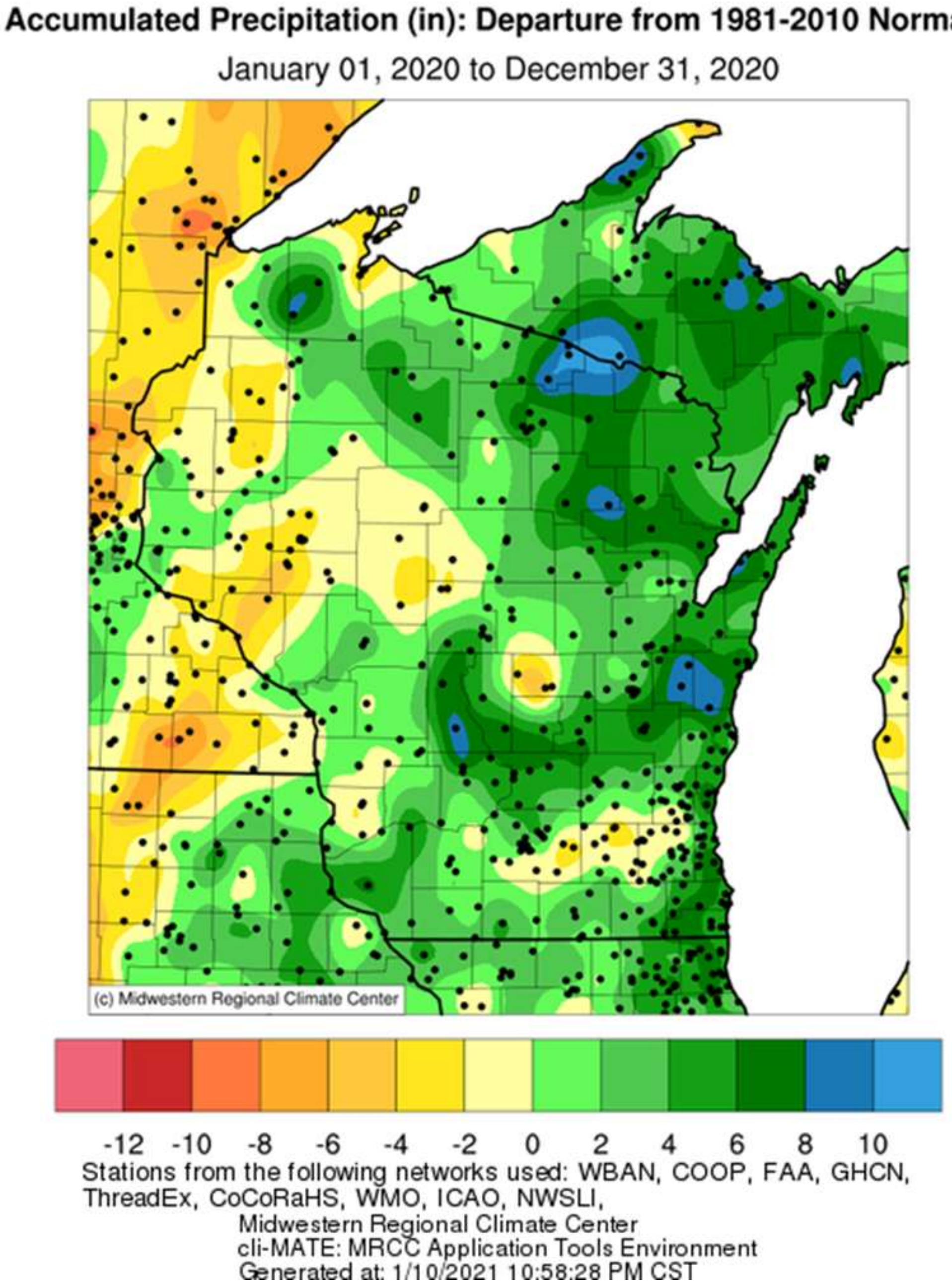
Monthly statewide precipitation departure from the historical normal was obtained from the Wisconsin State Climatology Office and is displayed on Figure 5. During 2020, January, March, May through July, and October showed a positive departure from normal, meaning that there was an increase in precipitation. These range from 0.2 to 1.4 inches above normal. Conversely, February, April, August through September, November, and December showed a negative departure from normal, meaning there was a decrease in precipitation. These values are less than one inch.

Figure 5: Monthly Precipitation Departures from Average.



Similarly, Figure 6 depicts the departure from normal for the accumulated precipitation regarding 2020 data. Positive values, indicated by the green and blue colors, show that the total precipitation was greater than normal. Negative values, indicated by the yellows and orange colors, show that the total precipitation was less than normal for 2020. Overall, this Figure also indicates that Wisconsin experienced greater than average precipitation levels. According to NOAA's *Annual 2020 National Climate Report*, Wisconsin accrued greater than one inch in excess of normal conditions. This is the eighth consecutive year Wisconsin has experienced greater than normal precipitation conditions.

Figure 6: Statewide Map of the Accumulated Precipitation Departure from Normal.



The following figures (7 – 9) provide examples of measured water level fluctuations over time for three wells in the groundwater-monitoring network. The three provided have the infrastructure to irrigate. However, it is unknown the volume of water that was applied in 2020 to the fields since growers did not provide that information. Graphs showing water level measurement trends for all other wells in the groundwater monitoring network are available upon request.

2020 water level data for an Adams County station indicate a continued rise in water levels from 2016 extending into 2020. This would be expected based on the amount of 2020 precipitation compared to average. The overall trend appears to be highly variable with a slight increase over the past several years.

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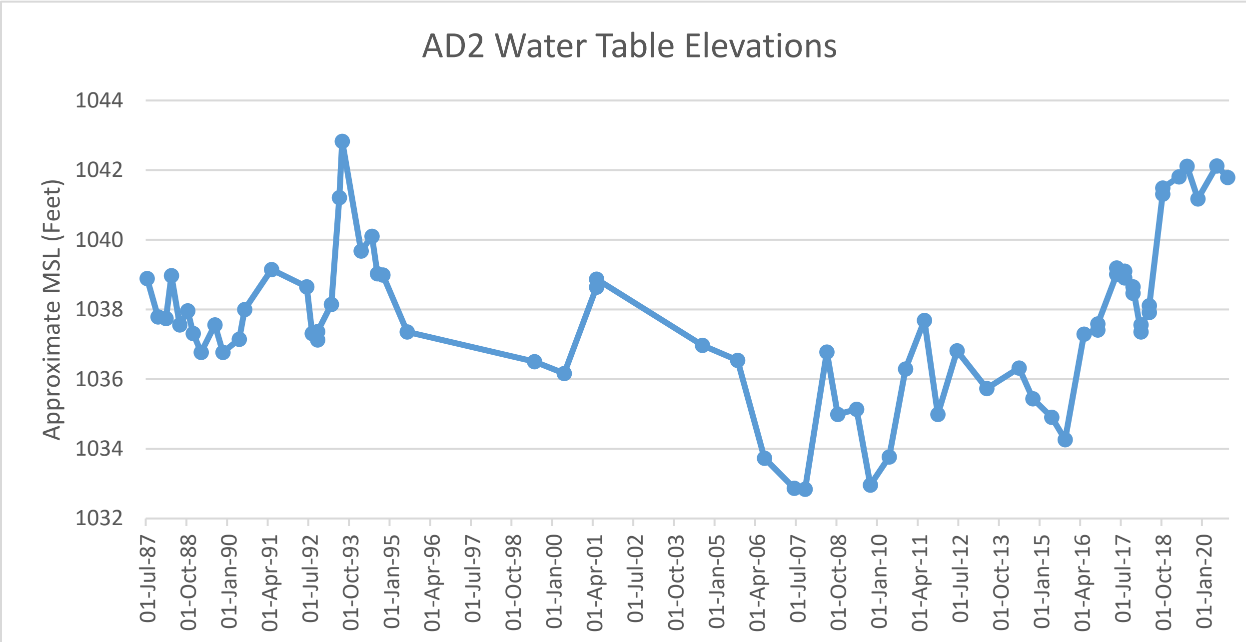
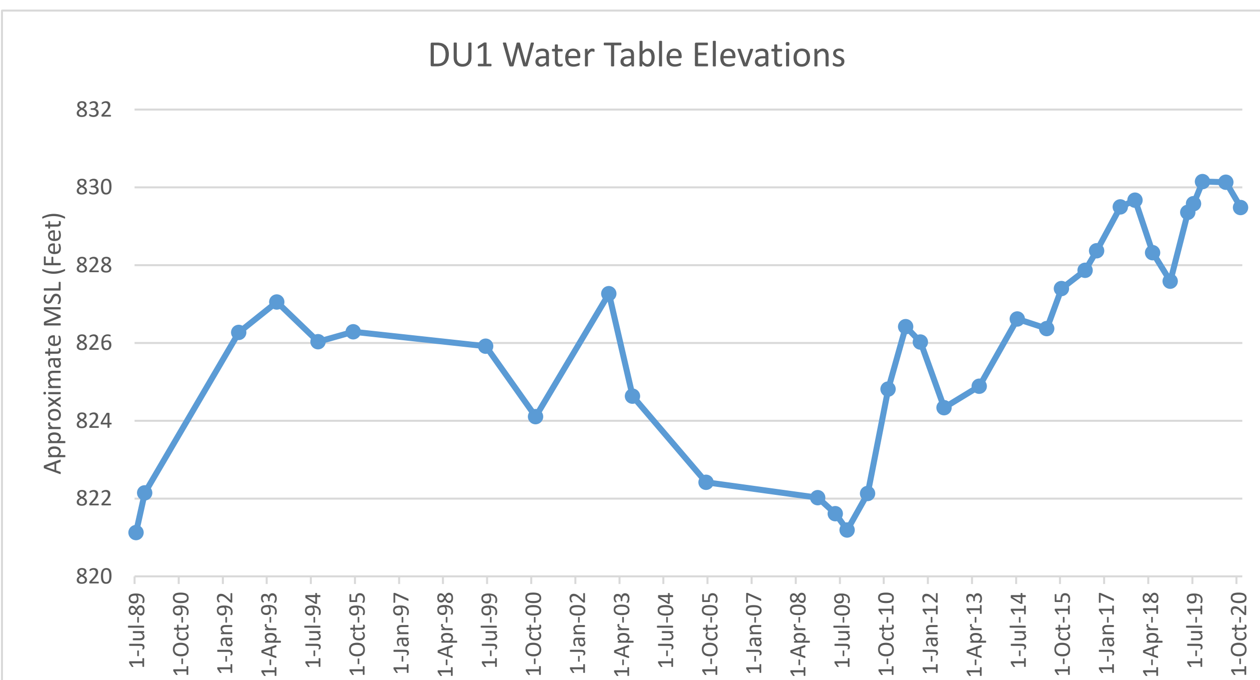
Figure 7: Historic Water Level Data for a Field-Edge Monitoring Station in Adams County.



2020 water level data for a Dunn County station indicates a slight decrease compared to the previous year. This likely reflects the slightly less than average precipitation measured for the immediate area during the year. In 2019, the water level measured in the fall was the highest water level observed for the last 30 years of monitoring at this location. Overall, the data shows that the water table continues to rise at this location, rising almost nine feet since 2008.

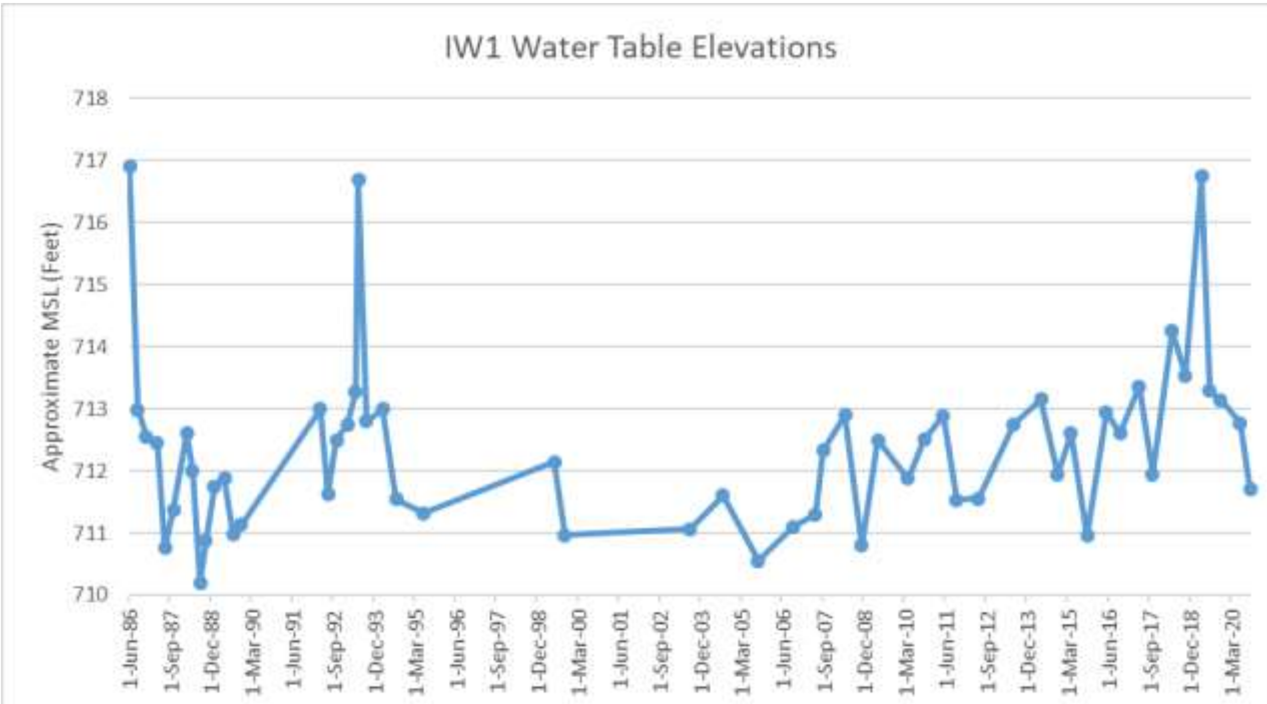
Figure 8: Historic Water Level Data for a Field-Edge Monitoring Station in Dunn County.



2020 water level data for an Iowa County station indicates stable water table conditions, more consistent with historical measurements. This site is near and likely highly influenced by the Wisconsin River water levels.

The 2020 spring water level is likely influenced by high river levels from heavy snow melts. High water table conditions in spring have been observed several times at this locations over the course of the monitoring program. The overall trend continues to indicate a stable to slightly increasing trend over the past 20 years, which likely correlates to nearby river elevations.

Figure 9: Historic Water Level Data for a Field-Edge Monitoring Station in Iowa County.



DATCP is planning to complete additional evaluation of groundwater elevation data for each individual monitoring site as part of a detailed study. Historical water level monitoring data will be evaluated for each site and results will be documented in a separate report prepared for each site (*Historical Field-Edge Site Data Analysis*). This evaluation will include a comparison of water level trends to precipitation records. These reports will be completed over a three-year period with the first group available in 2022.

PESTICIDE DETECTED FREQUENCY

Only 28 of the 106 analytes tested for in DATCP's 2020 Field-Edge Groundwater Monitoring Program were detected in excess of laboratory reporting limits. The number of compounds detected in 2020 is similar to the number detected in prior years. A pesticide analyte, or nitrogen, was detected in all samples collected with the exception of one groundwater sample collected in June from a shallow monitoring well in Portage County (PR1-1).

The most frequently detected pesticide compounds detected in 2020 are listed in Table 5. This includes all pesticide analytes detected at a concentration greater than the laboratory reporting limit at a frequency greater than 20%. This number of compounds detected at this rate is an increase compared to prior years. New to this table in 2020 compared to previous years are acetochlor ESA, bentazon and metribuzin des-amino (DA).

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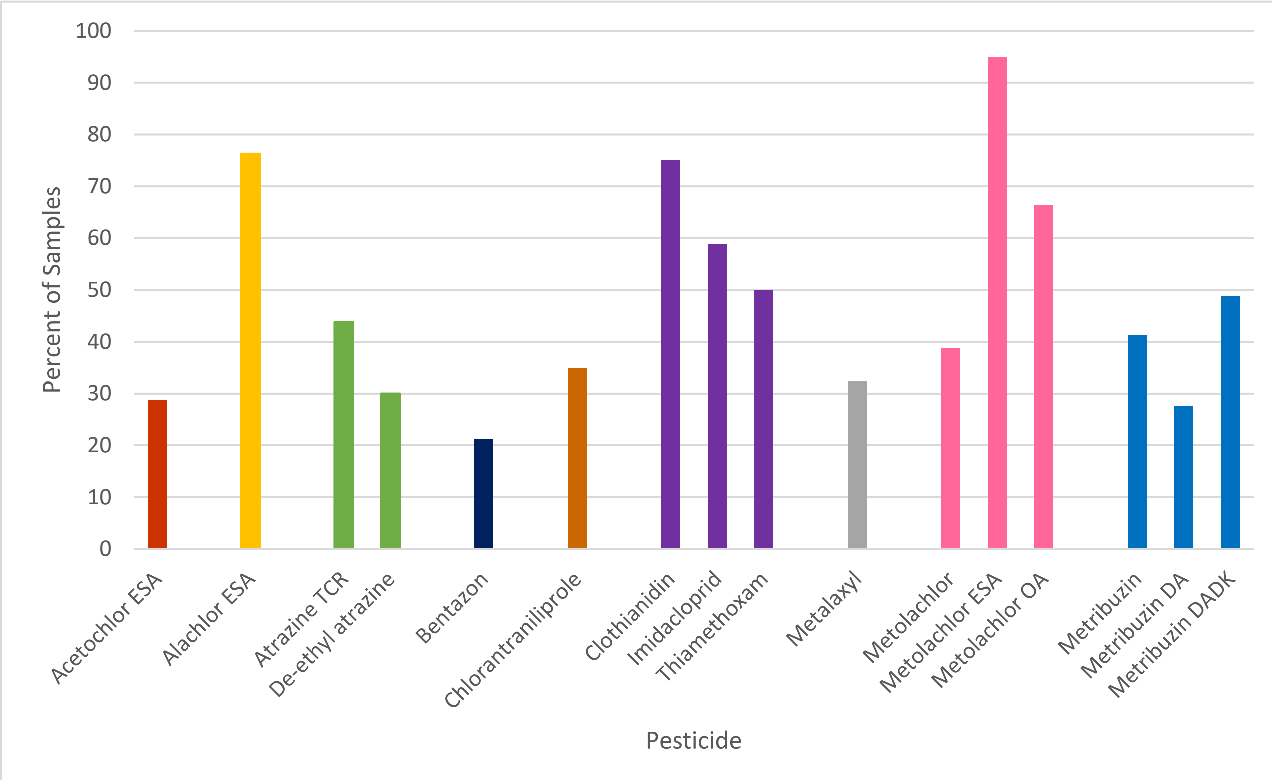
Table 5: Percentage of 2020 Samples with Detectable Pesticide Concentrations (Includes all analytes detected in 20% or more of all samples collected).



Notes: *Atrazine TCR is total chlorinated residues of atrazine; which includes the sum of atrazine plus its metabolites de-ethyl atrazine, de-isopropyl atrazine, and di-amino atrazine*

Metolachlor ESA was the most frequently detected analyte in excessive of laboratory reporting limits. It is a breakdown product of metolachlor, which is an active ingredient in corn herbicides. Metolachlor ESA was detected at 23 sites and in 95% of all samples collected.

Alachlor ESA was the second most frequently detected compound in 2020. It was detected in excess of laboratory reporting limits at 18 of the 24 sites and in 76% of the samples collected. This is an increase compared to historical observations.

The third most frequently detected analyte for the 2020 program was clothianidin. It was detected in excess of laboratory reporting limits at 19 of 24 sites and in 75% of the samples collected. This represents an increase in the amount of detections compared to 2019, and a continual increase in detections since clothianidin testing began. Results for 2020 also indicate clothianidin detections at sites throughout the State. During previous years, clothianidin detections were frequent within the Central Sands Agricultural Region, but not as frequently as observed elsewhere.

2020 results are consistent with the detection frequency observed in prior years. As described in the 2016 Statewide Groundwater Survey, metolachlor ESA was also the most widely reported pesticide metabolite observed in drinking water wells (32% of all wells sampled in 2016), which was followed by alachlor ESA (21.5% of all wells).

COMPARISON TO STANDARDS

The Wisconsin Department of Natural Resources (DNR) sets groundwater quality standards in Wisc. Admin. Code ch. NR 140, which includes substances of public health concern based on recommendations from WDHS. These standards have two parts, the ES and the PAL. The ES is a level that, if exceeded, requires intervention from the appropriate authority. In the case of pesticides in drinking water, DATCP is required to intervene if levels exceed the ES. The PAL is a percentage of the ES: 10% of the ES for carcinogenic, mutagenic, or teratogenic properties and 20% of the ES for all other substances. The intention of the PAL is to act as a trigger for intervention by the appropriate authority before the pollutant becomes a serious risk to public health. Pesticide concentrations identified during DATCP's 2020 program were compared to Wisc. Admin. Code ch. NR 140 Groundwater Quality standards. DHS has also established drinking water quality advisories for 15 different pesticides. Table 3 in Appendix A lists the existing standards alongside the range of concentrations for the pesticide compounds detected in 2020 samples

No ES standards were exceeded in any samples collected in 2020. However, imidacloprid concentrations exceeded the DHS drinking water health advisory of 0.2 µg/L in 17 groundwater samples collected from sites in Adams, Iowa, Sauk, and Waushara counties. These sites include those in the Lower Wisconsin River Valley or the Central Sands Agricultural Region. Concentrations ranged from 1.5 to 0.201 µg/L. No other DHS drinking water health advisories were exceeded in 2020.

As depicted in Table 3 in Appendix A, concentrations of alachlor ESA, atrazine, de-ethyl atrazine, de-isopropyl atrazine, di-amino atrazine, atrazine TCR (total chlorinated residues, which are the sum of atrazine plus its metabolites de-ethyl atrazine, de-isopropyl atrazine, and di-amino atrazine), and metolachlor were detected in excess of the Wisc. Admin. Code ch. NR 140 PAL standards. The locations of wells with PAL exceedances and detected concentrations are consistent with results from prior years.

Table 3 in Appendix A also includes results for pesticides and their metabolites with no established ES or PAL. 77 out of 107 pesticides compounds tested have no established standard. A review of all 2020 data indicates that 28 different pesticides compounds were detected in excess of laboratory reporting limits, and 16 of these 28 compounds have no Wisc. Admin. Code ch. NR 140 established standard. However, nine of the 16 compounds with no established standard have a DHS drinking water health advisory (clothianidin, imidacloprid, sulfentrazone, thiamethoxam, chlorantraniliprole, flumetsulam, fomesafen, metalaxyl, and saflufenacil). Four of the 16 compounds with no established standards or advisories are metabolites for compounds with standards (alachlor, dimethenamid, or metribuzin). The remaining three detected compounds with no existing standard or advisory are bicycloprone, bromacil, and cyantraniliprole. Table 6 includes a detection summary of these remaining three compounds that are not metabolites and have no standard or advisory.

Table 6:
Detected Compounds that have No Established or Proposed Wisc. Admin. Code ch. NR 140 Standard.

Analyte	Sites with Detects (out of 24)	Number of Detects (out of 80)	% of Samples Detected	Concentration Range (in µg/L)
Bicyclopyrone	1	2	2.5%	0.12 – 0.14
Bromacil	1	2	2.5%	0.0536 – 0.0592
Cyantraniliprole	3	5	6.3%	0.0623 - 0.424

This is the first time bicyclopyrone has been detected in excess of laboratory reporting limits in any of the groundwater samples associated with the Program. It is a herbicide to control grass and broadleaf weeds, blocking their function to produce essential compounds for carotenoid pigments. It is one of the active ingredients in Acuron, a corn herbicide.

Bromacil was detected for the first time in Field-Edge Monitoring Program samples in 2019. It was first registered in the United States in 1961 and is used for brush control and non-cropland areas in Wisconsin. Cyantraniliprole was also detected for the first time in Field-Edge Monitoring Program samples in 2019. It is an active ingredient in Fortenza or Minecto Pro, an insecticide of the ryanoid class that is applied on corn and soybean crops.

It is important to note that comparisons of detected pesticides and their metabolite concentrations to established groundwater quality standards and drinking water advisories are based on exposure to a single compound. These comparisons do not fully evaluate the risk to human health when two or more compounds are present. Currently, there are no calculations to predict potential risk when multiple compounds are present. Since the current approach does not account for potential synergistic effects, potential toxicity may be underestimated when two or more compounds are present.

OTHER NOTABLE OBSERVATIONS

Glyphosate:

According to USDA - National Agricultural Statistics Service, in 2020[3], glyphosate was the most widely used pesticide on Wisconsin fields planted with soybean and second most pesticide used on fields planted with corn. Until 2019, glyphosate and its metabolites were not included in the DATCP pesticide analysis. DATCP added limited testing for glyphosate and two of its metabolites, AMPA (aminomethylphosphonic acid) and glyphosate ammonium, to the 2019 testing program. Limited sampling continued in 2020.

For 2020, glyphosate sampling was limited to 13 samples collected in June from monitoring wells at five different locations (AD5, IW1, PR1, SK6, and WS7). In addition to the full pesticides scan, these samples were also tested for glyphosate and its metabolites. Based on the crops grown or as reported by the growers in their Response Reports, glyphosate could have been applied to these adjacent fields either in 2019 or 2020. No detections in excess of laboratory reporting limits for any of the glyphosate family of pesticides were reported in these groundwater samples collected in 2020.

Neonicotinoids:

Interest in the neonicotinoid class of insecticides has increased greatly in recent years due to concerns over possible effects on pollinators. DATCP began testing for these compounds in 2008 with thiamethoxam. Bureau of Laboratory Services now analyzes for six neonicotinoid compounds. Three of these compounds, clothianidin, imidacloprid and thiamethoxam (CIT), were detected in field-edge groundwater samples collected in 2020. The other three neonicotinoid compounds, acetamiprid, dinotefuran, and thiacloprid, were not detected in excess of laboratory reporting limits in any groundwater samples. The presence of the three CIT compounds in groundwater is expected, as these compounds are known to readily leach when applied to crops grown in sandy soils, and are used in many insecticide products. CIT compounds are labeled for use on most crops grown in the state including corn, soybeans, potatoes, many other vegetables, fruit crops, and most small grains.

Field edge monitoring results indicate that CIT compounds are becoming more prevalent in groundwater over time. CIT compounds were observed at more locations in 2020 compared to prior years, but in areas of known impacts, concentrations appear to be stable or slightly decreasing. Since testing for neonicotinoid compounds began, thiamethoxam and imidacloprid have always been detected in field-edge samples, primarily at sites within the Central Sands Agricultural Region and Lower Wisconsin River Valley.

One observation regarding the 2020 data suggests that the imidacloprid and thiamethoxam are migrating vertically and horizontally within Central Sands Agricultural Region aquifers. Concentrations do not fluctuate seasonally, but greater concentrations have been detected in the deeper screened wells (AD2-5, AD3-3, AD5-5, and WS7-3) compared to shallow wells. Additionally, imidacloprid and thiamethoxam have also been detected in nearby surface water samples indicating that groundwater is discharging to surface water year-round as base flow (see DATCP's *2020 Surface Water Sampling Report*).

The 2020 results are consistent with historical data. No Wis. Admin. Code Ch. NR 140 ES or PAL groundwater quality standards have been established for the CIT compounds in Wisconsin. However, DHS has identified drinking water health advisories for the CIT compounds. Clothianidin and thiamethoxam were detected in 75% and 50%, respectively, of all 2020 samples collected from field edge monitoring wells. Clothianidin concentrations ranged from 0.0122 to 1.74 µg/L, and thiamethoxam concentrations ranged from 0.015 to 4.74 µg/L. These detected concentrations do not exceed any of the respective DHS drinking water health advisories for clothianidin or thiamethoxam.

Imidacloprid concentrations exceeding laboratory reporting limits were detected in 59% of the 2020 groundwater samples collected. It was detected in samples collected from 14 of 24 sites at concentrations

[3] Wisconsin AG News – Chemical Use, May 14, 2021; United States Department of Agriculture National Agricultural Statistics Service. http://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Chemical_Use/

ranging from 0.0109 to 0.854 µg/L. Imidacloprid exceeded the DHS drinking water health advisory of 0.2 µg/L in 17 samples. These groundwater samples were collected from sites within the Central Sands Agricultural Region and Lower Wisconsin River Valley (Adams, Iowa, Sauk, and Waushara Counties). The imidacloprid data relative to each monitoring location is presented in Table 7 in Appendix A.

Results from DATCP's Field-Edge Groundwater Monitoring Program can also be compared to nearby historical Surface Water Sampling Program results. This data can then be used to further evaluate mobility, persistence, and discharge to surface water. DATCP intends to report findings of the evaluation along with an evaluation of historical results as part of DATCP's upcoming detailed comprehensive report for each field edge site.

Alachlor:

As noted previously, alachlor ESA was the second most frequently detected compound in 2020 samples. It was detected in excess of laboratory reporting limits in more than 76% of the samples collected and at 18 of the 24 field edge monitoring sites. The alachlor ESA data relative to each monitoring location is presented in Table 8 in Appendix A.

Alachlor ESA concentrations ranged from 0.06 to 11.4 µg/L in 2020 samples. As observed since 2017, groundwater samples collected from deeper wells AD5-5 and WS7-3 exhibited concentrations in excess of the Wis. Admin. Code ch. NR 140 PAL of 4.0 µg/L. No PAL exceedances were observed in samples collected from wells screened at shallower depths at these same sites in 2018, 2019 or 2020. Although alachlor ESA remains at concentrations in excess of the PAL, it cannot be attributed to current use at nearby fields. Alachlor ESA is a breakdown product of alachlor. Alachlor production ceased in December 2014 and field application was not allowed in Wisconsin after August 2018. The parent alachlor was not detected in excess of laboratory reporting limits in any samples collected in 2020. These results were also observed with 2018 and 2019 samples.

Alachlor ESA was widely detected in surface water and groundwater samples collected throughout the state. It is expected that these metabolite concentrations will decline over time since field application of the parent compound is no longer allowed. Additional data collection and evaluation of data from multiple years is needed to validate these observations.

Atrazine:

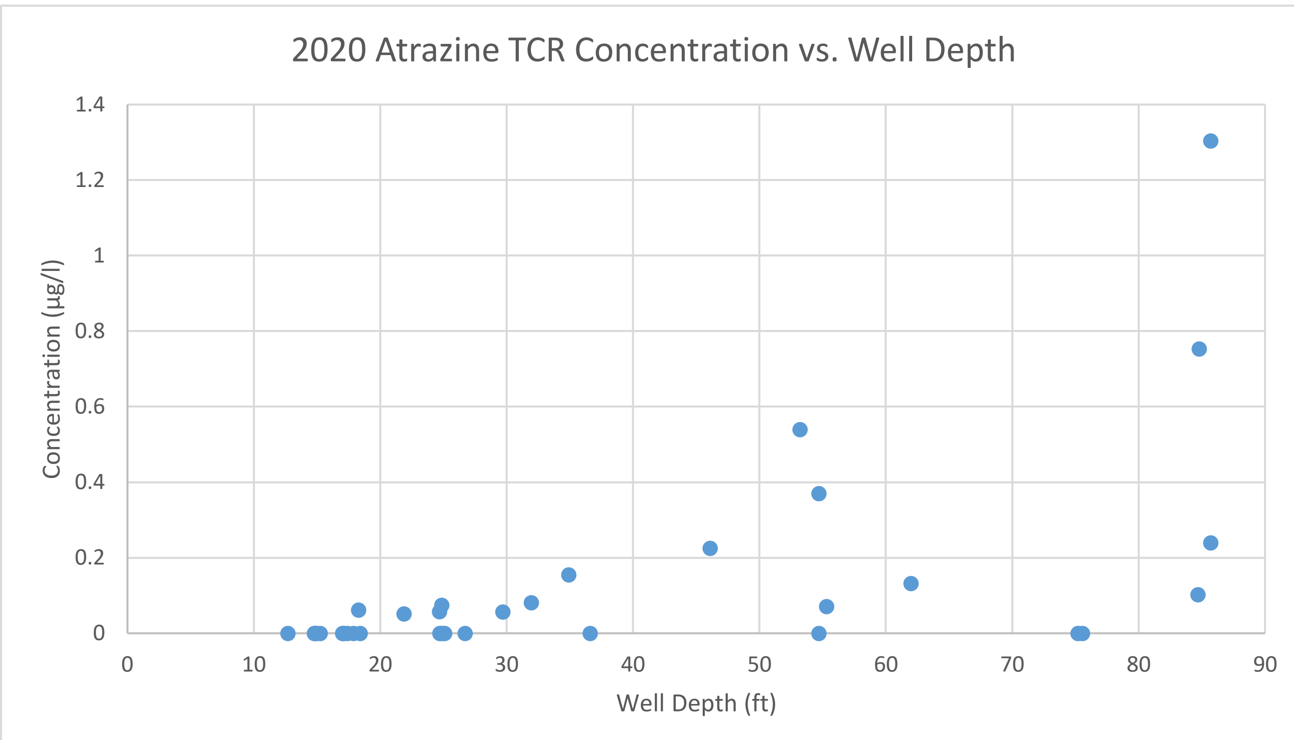
There are currently 101 atrazine Prohibition Areas (PAs) covering approximately 1.2 million acres within Wisconsin. It is illegal to apply any pesticide containing the active ingredient atrazine within an atrazine PA. In non-PAs, atrazine use is restricted but not prohibited. Since PAs have been in place for ten years or more, it is anticipated that atrazine and its metabolite concentrations in groundwater would be limited, or not present at all. Of the 24 field-edge sites in the Program, 11 are located within a PA. No Growers self-reported atrazine use on adjacent fields within the PAs.

Atrazine or one of its breakdown products (de-ethyl atrazine, de-isopropyl atrazine and di-amino atrazine) was detected in excess of laboratory reporting limits in almost 44% of the groundwater samples collected in 2020. No atrazine was detected at concentrations exceeding the Wis. Admin. Code Ch. NR 140 ES of 3.0 µg/L. However, atrazine or one of its metabolites was detected in 11 groundwater samples at concentration greater than the Wisc. Admin. Code ch. NR 140 PAL of 0.3 µg/L. Concentration for atrazine TCR ranged from 0.0503 to 1.304 µg/L. Parent atrazine and metabolite data for each monitoring site is presented in Table 9 in Appendix A

During 2020 atrazine or one of its metabolites was detected in groundwater samples collected from 14 of the 24 sites. Groundwater samples with detections in excess of the Wis. Admin. Code ch. NR 140 PAL were collected from monitoring well networks located at six of the 24 sites: three locations in Adams County, two locations in Waushara County, and one in La Crosse County. Of those six sites, one is located in a PA; in Waushara County (WS4). From the groundwater samples collected from the WS4 location, there were no detections in excess of laboratory reporting limits of the parent material atrazine. Based on grower self-reporting, atrazine has not been used on the adjacent WS4 fields for more than 20 years. These results indicate that the source for atrazine may be older.

As observed during previous years, the greatest concentrations of atrazine TCR were detected in 2020 samples collected from deeper screened wells. Figure 10 depicts atrazine TCR concentrations relative to groundwater sample well depth. As indicated, elevated concentrations of atrazine TCR were detected in samples collected from monitoring wells screened between 50 and 60 feet below ground surface (bgs), and at deeper wells screened between 80 and 90 feet bgs. Shallow wells screened between 10 and 40 feet bgs detected atrazine TCR and lesser concentrations. Based on atrazine TCR concentrations observed across the aquifer depth, it is possible that atrazine is applied at nearby agricultural fields at rates that are not affecting shallow groundwater quality. The greater atrazine concentrations are being observed at depth that likely reflects historic impacts to groundwater quality rather than an on-going source from the surface. A trend analysis is needed to show all historical groundwater data to determine if the atrazine TCR concentrations are decreasing within PAs as intended. DATCP intends to report these finding along with an evaluation of historical results as part of DATCP's detailed comprehensive report for each field edge site.

Figure 10: Atrazine Concentrations relative to Groundwater Sample Well Depth.



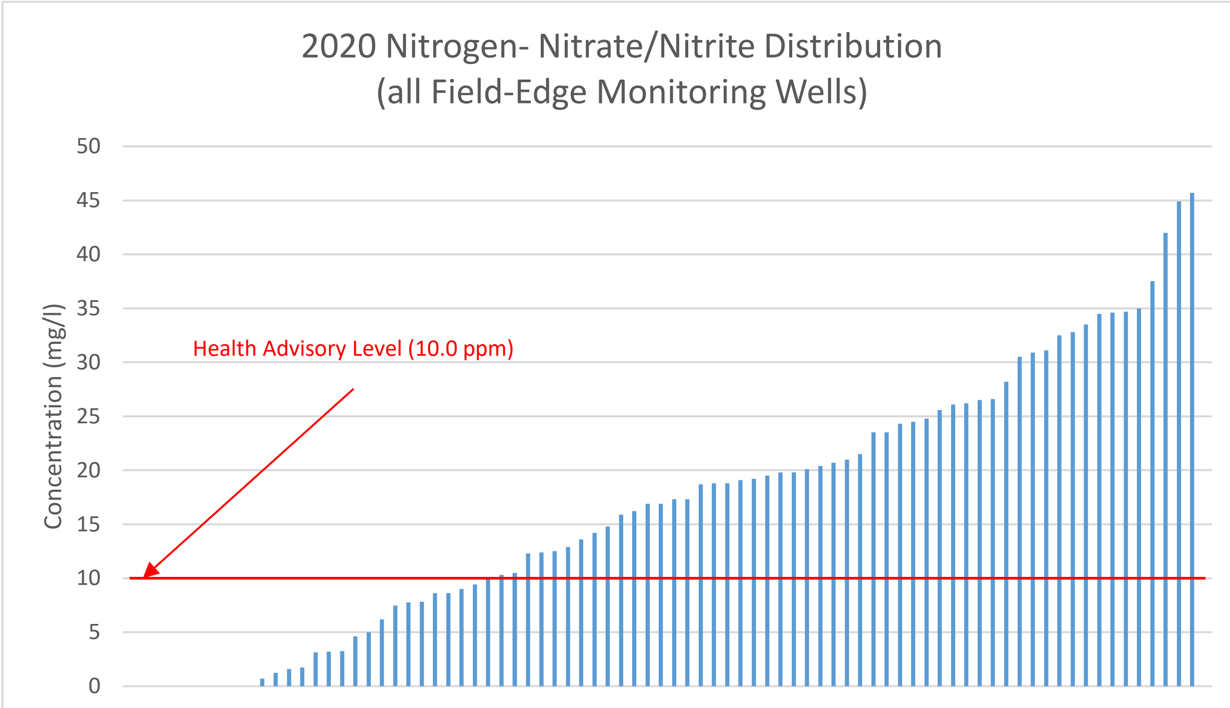
Nitrogen:

DATCP's Field-Edge Groundwater Monitoring Program primary focus is on pesticide affects to groundwater quality. In addition to pesticides, BLS includes nitrogen as nitrate/nitrite analyses. Nitrogen impacts in groundwater and drinking water are the responsibility of Wisconsin DNR. However, BLS includes nitrogen as nitrate/nitrite analyses as part of this program, and that data is shared with DNR.

Nitrogen was detected in excess of laboratory reporting limits in 67 of the 80 field edge groundwater samples collected in 2020. The average nitrogen concentration for all 2020 samples is 16.88 milligram per liter (mg/L or parts per million [ppm]). The average nitrogen concentration for 2020 is slightly greater than last year's average of 16.06 ppm, but slightly lower than that in 2018 of 17.72 ppm.

The Wis. Admin. Code ch. NR 140 ES of 10 mg/L for total nitrogen was exceeded in 54 of the 80 groundwater samples. An additional 13 samples exceeded the Wis. Admin. Code ch. NR 140 PAL of 2.0 mg/L. The greatest concentration of nitrogen (45.7 mg/L) was detected in the WS4-1 sample collected at a Waushara County station. All nitrogen data relative to each monitoring location is summarized in Table 10 in Appendix A Figure 11 depicts the 2020 nitrogen concentration distribution.

Figure 11: Nitrogen as Nitrate plus Nitrite Results Distribution in Groundwater Samples



Nitrogen concentrations were also compared to wells screened at different depths. Figure 12 depicts nitrogen concentrations for all wells by depth. As indicated, nitrogen was detected over a wide range of concentrations in groundwater samples collected from wells screened at shallow depths (between ten and 40 feet bgs) compared to deeper wells. Groundwater samples collected from deeper wells typically detected nitrogen at greater concentrations. As indicted, nitrogen exceeded the 10 mg/L ES in samples collected from all the monitoring wells screened across the aquifer at a depth greater than 40 feet, and in more than half the wells less than 40-feet deep.

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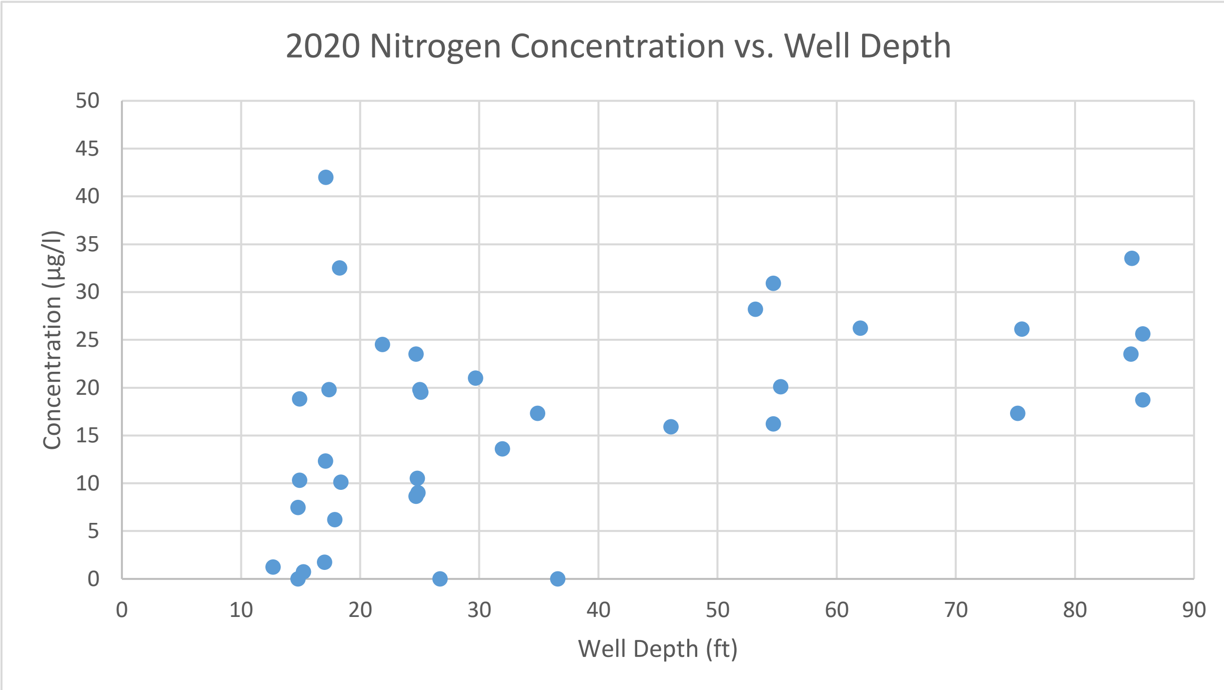
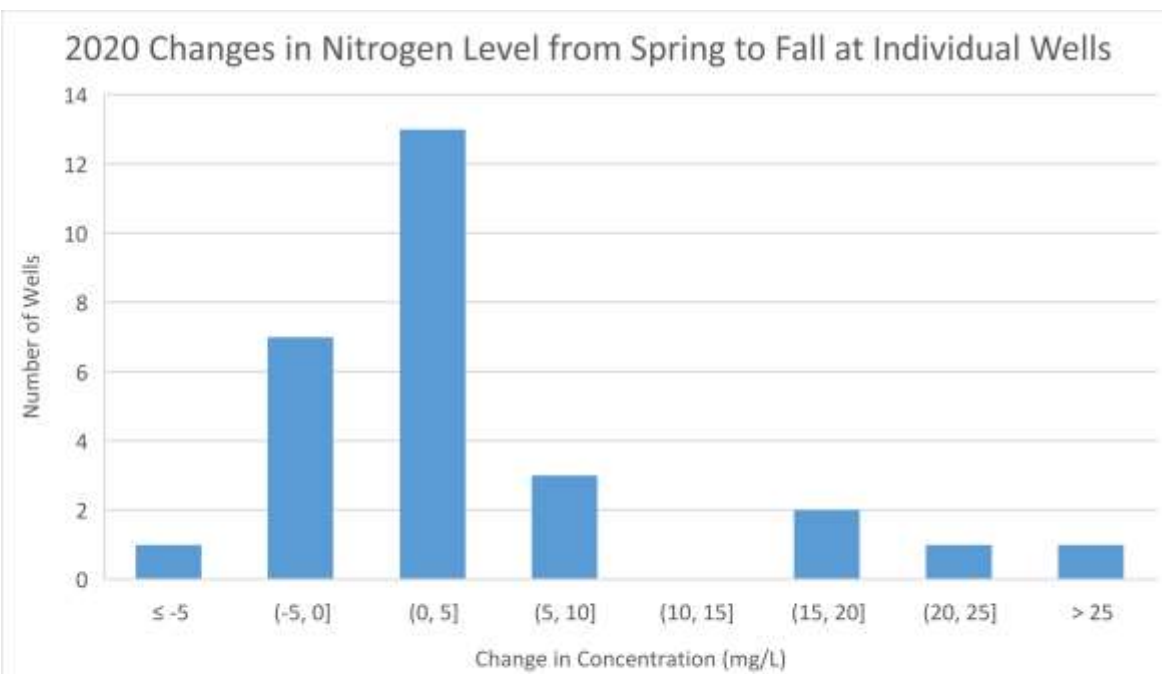
Figure 12:
Nitrogen as Nitrate plus Nitrite Concentrations relative to Groundwater Sample Well Depth.



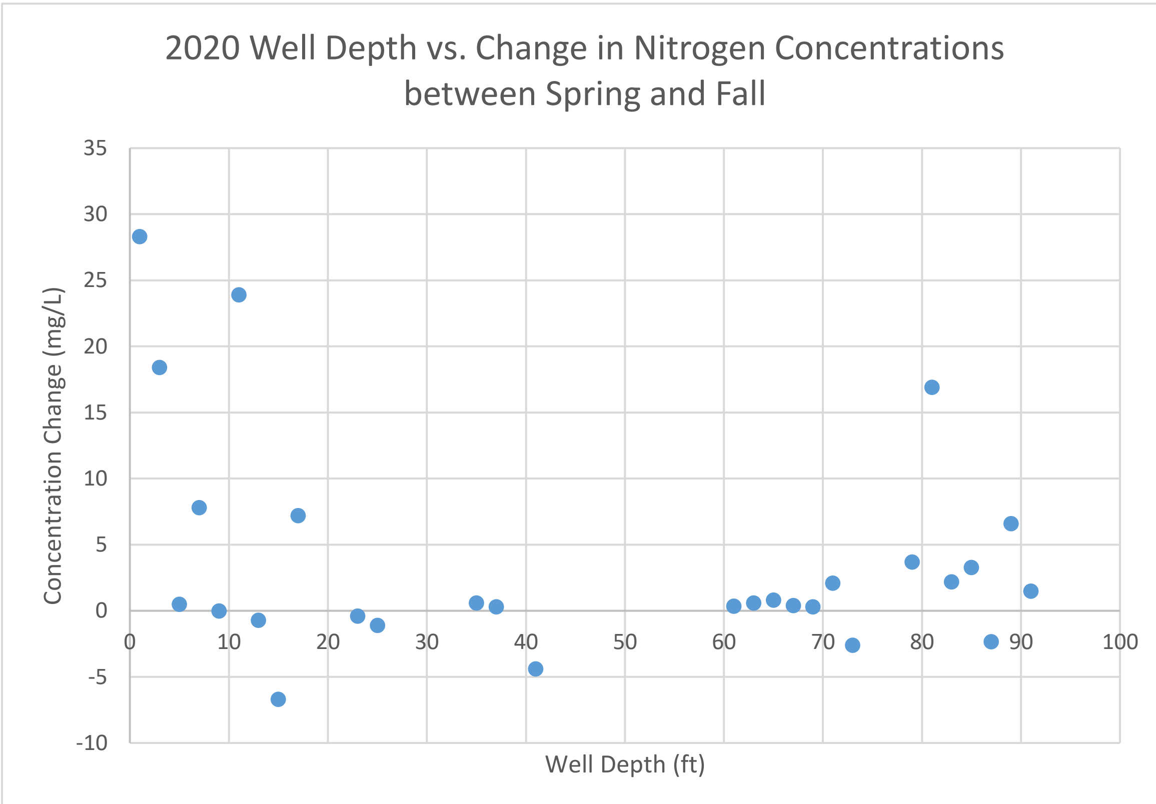
Groundwater samples collected from deeper screened wells also show less seasonal variation in nitrogen concentrations compared to shallow wells. As depicted on Figure 13 below, nitrogen concentrations fluctuated between -5 mg/L to + 5 mg/L in samples collected between spring and fall 2020 at the majority of monitoring well locations. On average, nitrogen concentrations increased by 0.6 mg/L between spring and fall. Overall, this suggests that nitrogen concentrations for the majority of wells indicate little seasonal variation.

Figure 13: Nitrogen as Nitrate plus Nitrite Concentrations Variability



However, when the data is graphed based on nitrogen concentrations relative to groundwater depths, seasonal variation becomes more pronounced. This likely indicates nitrogen applications at the surface influence groundwater quality seasonally. As depicted on the Figure 14 below, groundwater samples collected from shallower wells have a wider range of variability in nitrogen concentrations. Nitrogen concentrations in samples collected from deeper screened wells show less variability indicting little seasonal variation.

Figure 14: Nitrogen as Nitrate plus Nitrite Concentrations relative to Seasonal Variation



2021 Program Goals and Objectives

The Field-Edge Groundwater Monitoring Program's mission is to monitor groundwater quality at strategic geographic locations within agricultural areas to characterize agrichemical migration to underlying aquifers, and act as an early warning signal for nearby drinking water wells.

Program goals for 2021 include:

- Collaborate with BLS and develop a *2021 Field-Edge Groundwater Monitoring Program Sampling Plan*.
- Conduct a groundwater sampling event in the spring and fall from the Program's groundwater monitoring network. This will include continuing to analyze a certain set of samples for glyphosate.
- Document annual activities completed and summarize results for each site in a letter sent to each grower.
- Document the annual activities completed and summarize results in a *2021 Field-Edge Groundwater Monitoring Program Summary Report*.

2021 data will be added to the existing database to ensure that long-term water level and groundwater monitoring data can be used to identify trends in groundwater quality over time. Long-term groundwater quality trends may be used to further evaluate the effectiveness of atrazine PAs. Long-term groundwater data will also be compared to surface water data from within the same watershed to identify potential relationships between surface water and groundwater quality. This evaluation may also be used to evaluate seasonal surface water flow variations and base flow groundwater discharge to surface water. DATCP intends to report finding along with an evaluation of historical results as part of DATCP's detailed comprehensive report for each field edge site.

ADDITIONAL PROGRAM ACTIVITIES

In 2021, additional effort and focus beyond routine annual activities includes expanding the groundwater monitoring well network. DATCP requested and received additional funding from US EPA to construct additional piezometers at existing groundwater monitoring well nests. The proposed project objective is to install deeper wells adjacent to existing wells, because historic data indicates that agrichemicals are migrating vertically beyond the deepest depth of our existing piezometers. This work will be will be described in the next annual report.

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Appendix A

Table 1
Field-Edge Groundwater Monitoring Program
Monitoring Wells and Piezometers Construction Specifications

County	Site (Grower)	Well Identification	WUWN	Year Constructed	Prohibition Area	Irrigation Available	Ground Elevation (MSL)	TPVC Elevation (MSL)	Well Depth (ft)	Bottom of Well (MSL)	Screen Length (ft)	Top of Screen (ft)	Sampling Method
Adams	AD2	AD2-1	BH954	1987	No	Yes	1,051.7	1,053.96	17.87	1,036.09	5	1,053.96	Peristolic Pump
		AD2-2	BH953	1987				1,054.14	22.83	1,031.31	5	1,054.14	
		AD2-3	BH952	1987				1,054.17	27.62	1,026.55	5	1,054.17	
		AD2-4	VR844	2017				1,054.44	54.70	999.74	5	1,054.44	Dedicated Bailer
		AD2-5	VR845	2017				1,054.35	85.70	968.65	5	1,054.35	
	AD3	AD3-1	BH999	1987	No	Yes	1,008.0	1,010.48	14.93	995.55	5	1,010.48	Peristolic Pump
		AD3-2	BI000	1987				1,010.34	19.64	990.70	5	1,010.34	
		AD3-3	BI001	1987				1,010.44	24.69	985.75	5	1,010.44	
	AD4	AD4-1[1]	BH996	1987				1,017.38	24.71	992.67	5	1,017.38	
		AD4-2	BH997	1987	No	Yes	1,013.9	1,017.26	29.69	987.57	5	1,017.26	Dedicated Bailer
		AD4-3	BH998	1987				1,016.56	34.57	981.99	5	1,016.56	
	AD5	AD5-1	CL461	1988	No	Yes	1,051.1	1,053.18	15.24	1,037.94	5	1,053.18	Peristolic Pump
		AD5-2	CL455	1988				1,053.31	19.91	1,033.40	5	1,053.31	
		AD5-3	CL456	1988				1,053.27	25.23	1,028.04	5	1,053.27	
		AD5-4	VR846	2017				1,053.63	53.20	1,000.43	5	1,053.63	Whale Pump and Dedicated Tubing
		AD5-5	VR847	2017				1,053.68	85.70	967.98	5	1,053.68	
Barron	BR3	BR3-1	BR279	1987	No	Yes	1,052.7	1,055.79	15.03	1,040.76	5	1,055.79	Peristolic Pump
		BR3-2	BR280	1987				1,055.37	20.02	1,035.35	5	1,055.37	
		BR3-3	BR281	1987				1,054.93	25.02	1,029.91	5	1,054.93	
Dane	DN1	DN1-1[2]	BR250	1985				744.38	12.10	732.28	5	744.38	
		DN1-2	BR251	1985	93-57-04	Yes	741.9	744.22	17.40	726.82	5	744.22	Peristolic Pump
		DN1-3	BR252	1985				744.97	22.20	722.77	5	744.97	
Dunn	DU1	DU1-1	AO384	1989	No	Yes	852.5	853.92	34.90	819.02	5	853.92	Dedicated Bailer
		DU1-2	AO385	1989				854.87	40.80	814.07	5	854.87	
		DU1-3	AO386	1989				855.12	46.10	809.02	5	855.12	
	DU2	DU2-1	AO387	1989	No	Yes	856.2	858.05	26.70	831.35	5	858.05	Peristolic Pump
		DU2-2	AO388	1989				858.17	31.30	826.87	5	858.17	
		DU2-3	AO389	1989				858.48	36.60	821.88	5	858.48	
Grant	GR1	GR1-1	BR255	1985	93-57-04	No	683.8	686.32	12.50	673.82	5	686.32	Peristolic Pump
		GR1-2	BR256	1985				686.48	17.30	669.18	5	686.48	
		GR1-3	BR257	1985				686.12	21.60	664.52	5	686.12	
Iowa	IW1	IW1-1[3]	BH955	1986					14.90		5		
		IW1-2[3]	BH956	1986					19.90		5		
		IW1-3[3]	BH957	1986					24.90		5		
		IW1-4	BR259	1986	93-57-04	Yes	724.7	726.35	17.10	709.25	5	726.35	Peristolic Pump
		IW1-5	BR260	1986				726.47	21.30	705.17	5	726.47	
		IW1-6	BR261	1986				726.49	26.70	699.79	5	726.49	
		IW1-7	BH967	1987				726.60	61.99	664.61	5	726.60	Whale Pump and Dedicated Tubing
	IW2	IW2-1	BR036	1986	93-57-04	Yes	725.0	727.52	14.80	712.72	5	727.52	Peristolic Pump
		IW2-2	BR037	1986				727.42	19.70	707.72	5	727.42	
		IW2-3	BR038	1986				727.13	24.70	702.43	5	727.13	
Jackson	JK3	JK3-1	JH991	2005	94-27-04	No	1,025.3	1,028.06	27.33	1,000.73	10	1,028.06	Peristolic Pump
		JK3-2	JH981	2005			1,023.7	1,026.44	25.77	1,000.67	10	1,026.44	
Juneau	JN1	JN1-1	BR046	1985	No	Yes	939.7	941.26	11.70	929.56	5	941.26	Peristolic Pump
		JN1-2	BR047	1985				941.21	16.70	924.51	5	941.21	
		JN1-3	BR048	1985				941.34	21.50	919.84	5	941.34	
	JN3	JN3-1	JH937	2005	94-29-01	No	901.5	903.84	20.42	883.42	10	903.84	Peristolic Pump
		JN3-2	JH936	2005			902.0	905.20	18.14	887.06	10	905.20	
La Crosse	LC2	LC2-1	VZ391	2011	No	Yes	684.1	686.40	49.22	637.18	10	686.40	Dedicated Bailer
		LC2-2	VZ392	2011			687.8	681.91	43.98	637.93	10	681.91	
Langlade	LN1	LN1-1	BH964	1986	No	No	1,471.6	1,473.85	14.80	1,459.05	5	1,473.85	Peristolic Pump
		LN1-2	BH965	1986				1,474.44	19.70	1,454.74	5	1,474.44	
		LN1-3	BH966	1986				1,473.74	24.80	1,448.94	5	1,473.74	
Portage	PR1	PR1-1	BR207	1986	No	Yes	1,079.7	1,082.01	12.70	1,069.31	5	1,082.01	Peristolic Pump
		PR1-2	BR208	1988				1,081.94	17.60	1,064.34	5	1,081.94	
		PR1-3	BR209	1988				1,081.72	22.50	1,059.22	5	1,081.72	
		PR1-4	VR848	2017				1,082.83	55.30	1,027.53	5	1,082.83	Whale Pump and Dedicated Tubing
		PR1-5	VR849	2017				1,082.77	84.70	998.07	5	1,082.77	
St. Croix	SC1	SC1-1	JH938	2005	94-56-02	Yes	1,006.8	1,010.14	24.87	985.27	10	1,010.14	Peristolic Pump
		SC1-1 (D)	VZ390	2011				1,009.16	30.10	979.06	10	1,009.16	
		SC1-2	JH939	2005			1,003.9	1,006.63	21.87	984.76	10	1,006.63	
		SC1-2(D)	VZ393	2011				1,006.40	30.17	976.23	10	1,006.40	
Sauk	SK6	SK6-1	BB246	1988	93-57-04	Yes	712.5	714.57	14.92	699.65	5	714.57	Peristolic Pump
		SK6-2	BB247	1988				714.84	20.04	694.80	5	714.84	
		SK6-3	BB248	1988				714.70	25.10	689.60	5	714.70	
Trempealeau	TR1	TR1-1	PX201	2005	No	Yes	730.4	733.29	75.55	657.74	10	733.29	Dedicated Bailer
		TR1-2	PX202	2005			731.1	733.83	75.20	658.63	10	733.83	
Waupaca	WP2	WP2-1	JH985	2005	94-69-01	No	908.4	911.03	20.45	890.58	10	911.03	Peristolic Pump
		WP2-2	JH984	2005			905.7	908.82	20.43	888.39	10	908.82	
Waushara	WS4	WS4-1	BB258	1988	93-70-01	Yes	1,082.4	1,084.97	17.13	1,067.84	5	1,084.97	Peristolic Pump
		WS4-2	BB259	1988				1,085.03	22.02	1,063.01	5	1,085.03	
		WS4-3	BB260	1988				1,084.98	27.16	1,057.82	5	1,084.98	
		WS4-4	BB261	1988				1,084.88	31.94	1,052.94	5	1,084.88	
	WS6	WS6-1	JH989	2005	93-70-01	Yes	1,076.8	1,080.90	18.27	1,062.63	10	1,080.90	Peristolic Pump
		WS6-2	JH990	2005				1,079.07	17.02	1,062.05	10	1,079.07	
	WS7	WS7-1	VR841	2017	No	Yes	1,075.7	1,078.65	18.40	1,060.25	10	1,078.65	Peristolic Pump
		WS7-2	VR842	2017				1,078.79	54.70	1,024.09	5	1,078.79	Whale Pump and Dedicated Tubing
		WS7-3	VR843	2017				1,078.78	84.80	993.98	5	1,078.78	

Notes:

1	Monitoring well was abandoned on May 30, 2019 because integrity of protective casing was compromised during spring 2019 sampling.
2	Monitoring well was abandoned on December 13, 2018 because integrity of protective casing was compromised by a vehicle prior to fall 2018 sampling.
3	Monitoring wells were abandoned June 11, 1993 because they were no longer needed for the monitoring program.
WUWN	Wisconsin Unique Well Number
MSL	Mean sea level
TPVC	Top of well casing (PVC)
(hatched)	Monitoring Well/Piezometer abandoned.
(blue)	Monitoring Well/Piezometer construction was financed by a 2017 U.S. EPA grant.
(green)	Monitoring Well/Piezometer construction was financed by a 2011 U.S. EPA grant.
(gray)	Monitoring Well/Piezometer construction was financed by a 2005 U.S. EPA grant.
(white)	Monitoring Wells/Piezometers assocaited with initial program activities and financed by State.

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Table 2

2020 Sample Analytes, Applicable Wis. Admin. Code ch. NR 140 PALs & ESs, Drinking Water Health Advisories, and Reporting Limits

Analyte Description	PAL (µg/l)	ES (µg/l)	Advisory*	Reporting Limit (µg/l)
2,4,5-T				0.050
2,4,5-TP	5	50		0.050
2,4-D	7	70		0.050
2,4-DB				0.80
2,4-DP				0.050
ACETAMIPRID				0.010
ACETOCHLOR	0.7	7		0.050
ACETOCHLOR ESA	46	230		0.050
ACETOCHLOR OA	46	230		0.30
ACIFLUORFEN				0.050
ALACHLOR	0.2	2		0.050
ALACHLOR ESA	4	20		0.053
ALACHLOR OA				0.25
ALDICARB SULFONE				0.050
ALDICARB SULFOXIDE				0.071
AMINOPYRALID				0.150
ATRAZINE	0.3	3		0.050
DE-ETHYL ATRAZINE	0.3	3		0.050
DEISOPROPYL ATRAZINE	0.3	3		0.050
DIAMINO ATRAZINE	0.3	3		0.20
ATRAZINE TCR (calculated)	0.3 [2]	3 [2]		0.050
AZOXYSTROBIN				0.050
BENFLURALIN				0.050
BENTAZON	60	300		0.050
BICYCLOPYRONE				0.050
BROMACIL				0.050
BIFENTHRIN				0.005
CARBARYL	4	40		0.050
CARBOFURAN	8	40		0.050
CHLORAMBEN	30	150		0.32
CHLORANTRANILIPROLE			16,000	0.050
CHLOROTHALONIL				0.10
CHLORPYRIFOS	0.4	2		0.050
CHLORPYRIFOS OXYGEN ANALOG				0.050
CLOMAZONE				0.050
CLOPYRALID				0.050
CLOTHIANIDIN			1,000	0.010
CYANTRANILIPROLE				0.050
CYCLANILIPROLE				0.20
CYFLUTHRIN				0.050
CYPERMETHRIN				0.10
CYPROSULFAMIDE				0.050
DACTHAL	14	70		0.050
DACTHAL DI-ACID	14 [1]	70 [1]		0.050
DACTHAL MONO-ACID	14 [1]	70 [1]		0.050
DIAZINON				0.050
DIAZINON OXYGEN ANALOG				0.050
DICAMBA	60	300		0.30
DICHLOBENIL				0.050
DIMETHENAMID	5	50		0.050
DIMETHENAMID ESA				0.050
DIMETHENAMID OA				0.050
DIMETHOATE	0.4	2		0.050
DINOTEFURAN				0.010
DIURON				0.050

Analyte Description	PAL (µg/l)	ES (µg/l)	Advisory*	Reporting Limit (µg/l)
EPTC	50	250		0.050
ESFENVALERATE				0.025
ETHALFLURALIN				0.050
ETHOFUMESATE				0.050
FLUMETSULAM			10,000	0.050
FLUPYRADIFURONE				0.050
FLUROXYPYR				0.070
FOMESAFEN			25	0.050
GLYPHOSATE			10,000	0.500
GLYPHOSATE AMMONIUM				0.500
AMPA			10,000	0.500
HALOSULFURON METHYL				0.050
HEXAZINONE			400	0.050
IMAZAPYR				0.050
IMAZETHAPYR				0.050
IMIDACLOPRID			0.2	0.010
ISOXAFLUTOLE			3	0.050
ISOXAFLUTOLE RPA202248 (DKN)			3	0.050
LAMBDA-CYHALOTHRIN				0.020
LINURON				0.050
MALATHION				0.050
MCPA				0.050
MCPB				0.10
MCPP				0.050
MESOTRIONE				0.10
METALAXYL			800	0.050
METHYL PARATHION				0.050
METOLACHLOR	10	100		0.050
METOLACHLOR ESA	260	1,300		0.050
METOLACHLOR OA	260	1,300		0.27
METRIBUZIN	14	70		0.050
METRIBUZIN DA				0.10
METRIBUZIN DADK				0.12
METSULFURON-METHYL				0.050
NICOSULFURON				0.050
NORFLURAZON				0.050
OXADIAZON				0.050
PENDIMETHALIN				0.050
PERMETHRIN				0.030
PICLORAM	100	500		0.050
PROMETONE	20	100		0.050
PROMETRYN				0.050
PROPICONAZOLE				0.050
PROTHIOCONAZOLE-DESTHIO				0.050
SAFLUFENACIL			460	0.050
SIMAZINE	0.4	4		0.050
SULFENTRAZONE			1,000	0.050
SULFOMETURON-METHYL				0.050
TEBUPIRIMPHOS				0.050
TEMBOTRIONE				0.10
THIACLOPRID				0.010
THIAMETHOXAM			100	0.010
THIENCARBAZONE-METHYL			800	0.050
TRICLOPYR				0.050
TRIFLURALIN	0.75	7.5		0.050
NITROGEN-NITRATE/NITRITE (mg/l)	2	10		0.50 mg/l

* Wisconsin Department of Health Services Drinking Water Health Advisory (June 2019, November 2020, Revised February 2022).

[1] Combined sum of metabolites (Di- and Mono-acid) and parent Dacthal.

[2] Total Chlorinated Residue for Atrazine. Combined sum of metabolites (De-ethyl, De-isopropyl and di-amino) and parent Atrazine.

Table 3
Field-Edge Groundwater Monitoring Program
2020 Groundwater Analytical Results

2020 Ground Water Project Results (all concentrations in ug/l)							Wisconsin Department of Health Services	Wisconsin Admin. Code Chapter NR 140	
Pesticide Name	Pesticide Class	Reporting Limit	Number of Sites with Detects[1]	Number of Total Detects[2]	Percent of Samples with Detects	Concentration Range	Drinking Water Health Advisory[3]	Enforcement Standard	Preventive Action Limit
2,4-D	Herbicide	0.05	0	0		--	--	70	7
2,4-DB	Herbicide	1.50	0	0		--	--	--	--
2,4-DP	Herbicide	0.05	0	0		--	--	--	--
2,4,5-T	Herbicide	0.05	0	0		--	--	--	--
2,4,5-TP	Herbicide	0.05	0	0		--	--	50	5
Acetamiprid	Insecticide	0.010	0	0		--	--	--	--
Acetochlor	Herbicide	0.05	0	0		--	--	7	0.7
Acetochlor ESA	Metabolite	0.05	11	23	28.8%	0.0552 - 3.92	--	230	46
Acetochlor OA	Metabolite	0.3	1	2	2.5%	0.563 - 0.5	--	230	46
Acifluorfen	Herbicide	0.05	0	0		--	--	--	--
Alachlor	Herbicide	0.05	0	0		--	--	2	0.2
Alachlor ESA	Metabolite	0.053	18	61	76.3%	0.06 - 11.4	--	20	4
Alachlor OA	Metabolite	0.25	3	7	8.8%	0.257 - 3.93	--	--	--
Aldicarb Sulfone	Insecticide	0.05	0	0		--	--	--	--
Aldicarb Sulfoxide	Insecticide	0.071	0	0		--	--	--	--
Aminopyralid	Herbicide	0.15	0	0		--	--	--	--
Atrazine	Herbicide	0.05	6	15	18.8%	0.0508 - 0.211	--	3	0.3
De-ethyl atrazine	Metabolite	0.05	10	24	30.0%	0.0534 - 0.891	--	3	0.3
De-isopropyl atrazine	Metabolite	0.05	8	15	18.8%	0.0503 - 0.242	--	3	0.3
Di-amino atrazine	Metabolite	0.2	3	4	5.0%	0.206 - 0.333	--	3	0.3
Atrazine (TCR)		0.05	14	35	43.8%	0.0503 - 1.304	--	3	0.3
Azoxystrobin	Fungicide	0.05	0	0		--	--	--	--
Benfluralin	Herbicide	0.05	0	0		--	--	--	--
Bentazon	Herbicide	0.05	6	17	21.3%	0.509 - 18.8	--	300	60
Bicyclopyrone	Herbicide	0.05	1	2	2.5%	0.12 - 0.14	--	--	--
Bifentrin	Herbicide	0.0050	0	0		--	--	--	--
Bromacil	Herbicide	0.05	1	2	2.5%	0.0536 - 0.0592	--	--	--
Carbaryl	Insecticide	0.05	0	0		--	--	40	4
Carbofuran	Insecticide	0.05	0	0		--	--	40	8
Chloramben	Herbicide	0.32	0	0		--	--	150	30
Chlorantraniliprole	Insecticide	0.050	9	28	35.0%	0.0593 - 1.09	16,000	--	--
Chlorothalonil	Fungicide	0.10	0	0		--	--	--	--
Chlorpyrifos	Insecticide	0.05	0	0		--	--	2	0.4
Chlorpyrifos Oxon	Metabolite	0.05	0	0		--	--	--	--
Clomazone	Herbicide	0.05	0	0		--	--	--	--
Clopyralid	Herbicide	0.05	0	0		--	--	--	--
Clothianidin	Insecticide	0.010	19	60	75.0%	0.0122 - 1.74	1,000	--	--
Cyantraniliprole	Insecticide	0.050	3	5	6.3%	0.0623 - 0.424	--	--	--
Cyclaniliprole	Insecticide	0.2	0	0		--	--	--	--
Cyfluthrin	Insecticide	0.050	0	0		--	--	--	--
lambda- Cyhalothrin	Insecticide	0.020	0	0		--	--	--	--
Cypermethrin	Insecticide	0.1	0	0		--	--	--	--
Cyprosulfamide	Safener	0.05	0	0		--	--	--	--
Dacthal	Herbicide	0.05	0	0		--	7	70	14
Dacthal Di-acid	Metabolite	0.05	0	0		--	--	70	14
Dacthal Mono-acid	Metabolite	0.05	0	0		--	--	70	14
Diazinon	Insecticide	0.05	0	0		--	--	--	--
Diazinon oxon	Metabolite	0.05	0	0		--	--	--	--
Dicamba	Herbicide	0.60	0	0		--	--	300	60
Dichlobenil	Herbicide	0.05	0	0		--	--	--	--
Dimethenamid	Herbicide	0.05	0	0		--	--	50	5

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Dimethenamid ESA	Metabolite	0.05	2	6	7.5%	0.135 - 1.24	--	--	--
Dimethenamid OA	Metabolite	0.05	0	0		--	--	--	--
Dimethoate	Insecticide	0.050	0	0		--	--	2	0.4
Dinotefuran	Insecticide	0.010	0	0		--	--	--	--
Diuron	Herbicide	0.05	0	0		--	--	--	--
EPTC	Herbicide	0.05	0	0		--	--	250	50
Esfenvalerate	Insecticide	0.025	0	0		--	--	--	--
Ethalfluralin	Herbicide	0.05	0	0		--	--	--	--
Ethofumesate	Herbicide	0.05	0	0		--	--	--	--
Flumetsulam	Herbicide	0.05	3	3	3.8%	0.0576 - 0.204	10,000	--	--
Flupyradifurone	Insecticide	0.05	0	0		--	--	--	--
Fluroxypyr	Insecticide	0.070	0	0		--	--	--	--
Fomesafen	Insecticide	0.05	1	1	1.3%	0.45	25	--	--
Glyphosate	Herbicide	0.5	0	0			10,000	--	--
Glyphosate Ammonium	Metabolite	0.5	0	0			--	--	--
AMPA	Metabolite	0.5	0	0			10,000	--	--
Halosulfuron methyl	Insecticide	0.05	0	0		--	--	--	--
Hexazinone	Herbicide	0.05	0	0		--	400	--	--
Imazapyr	Herbicide	0.05	0	0		--	--	--	--
Imazethapyr	Herbicide	0.05	0	0		--	--	--	--
Imidacloprid	Insecticide	0.010	14	47	58.8%	0.0109 - 0.854	0.2	--	--
Isoxaflutole	Herbicide	0.05	0	0		--	3	--	--
Isoxaflutole DKN	Metabolite	0.05	0	0		--	3	--	--
Linuron	Herbicide	0.05	0	0		--	--	--	--
MCPA	Herbicide	0.05	0	0		--	--	--	--
MCPB	Herbicide	0.1	0	0		--	--	--	--
MCPP	Herbicide	0.05	0	0		--	--	--	--
Malathion	Insecticide	0.05	0	0		--	--	--	--
Mesotrione	Herbicide	0.1	0	0		--	--	--	--
Metalaxyl	Fungicide	0.05	10	26	32.5%	0.0505 - 0.459	800	--	--
Methyl Parathion	Insecticide	0.05	0	0		--	--	--	--
Metolachlor	Herbicide	0.05	12	31	38.8%	0.0508 - 5.84	--	100	10
Metolachlor ESA	Metabolite	0.05	23	76	95.0%	0.0619 - 34.9	--	1,300	260
Metolachlor OA	Metabolite	0.27	15	53	66.3%	0.281 - 37.7	--	1,300	260
Metribuzin	Herbicide	0.05	11	33	41.3%	0.0859 - 6.27	--	70	14
Metribuzin DA	Metabolite	0.1	9	22	27.5%	0.1 - 0.756	--	--	--
Metribuzin DADK	Metabolite	0.12	12	39	48.8%	0.168 - 4.24	--	--	--
Metsulfuron methyl	Herbicide	0.05	0	0		--	--	--	--
Nicosulfuron	Herbicide	0.05	0	0		--	--	--	--
Norflurazon	Herbicide	0.05	0	0		--	--	--	--
Oxadiazon	Herbicide	0.05	0	0		--	--	--	--
Pendimethalin	Herbicide	0.05	0	0		--	--	--	--
Permethrin	Herbicide	0.030	0	0		--	--	--	--
Picloram	Herbicide	0.05	0	0		--	--	500	100
Prometone	Herbicide	0.05	0	0		--	--	100	20
Prometryn	Herbicide	0.05	0	0		--	--	--	--
Propiconazole	Fungicide	0.05	0	0		--	--	--	--
Prothioconazole-desthio	Metabolite	0.050	0	0		--	--	--	--
Saflufenacil	Herbicide	0.05	1	1	1.3%	0.133	460	--	--
Simazine	Herbicide	0.05	0	0		--	--	4	0.4
Sulfentrazone	Herbicide	0.05	3	6	7.5%	0.0508 - 0.395	1,000	--	--
Sulfometuron methyl	Herbicide	0.05	0	0		--	--	--	--
Tebupirimphos	Insecticide	0.05	0	0		--	--	--	--
Tembotrione	Herbicide	0.10	0	0		--	--	--	--
Thiacloprid	Insecticide	0.010	0	0		--	--	--	--
Thiamethoxam	Insecticide	0.010	14	40	50.0%	0.015 - 4.74	120	--	--
Thiencarbazone methyl	Herbicide	0.05	0	0		--	800	--	--
Triclopyr	Herbicide	0.05	0	0		--	--	--	--
Trifluralin	Herbicide	0.05	0	0		--	--	7.5	0.75

Notes:

1 Total number of sites were 24.
2 Total number of samples were 80.
3 Wisconsin Department of Health Services Drinking Water Health Advisory (June 2019, November 2020, revised February 2022).
'--- Indicates that Health Advisory Level value in Wisconsin not established.
μg/L micrograms per liter or parts per billion
TCR Total Chlorinated Residue for Atrazine. Reflects an additive quantity of atrazine (parent material) and its three metabolites (de-ethyl, de-isopropyl and di-amino atrazine).

Indicates no detects in excess of laboratory reporting limits.
Indicates detects in excess of laboratory reporting limits.
Indicates detects in excess of laboratory reporting limits and Wis. Admin. Code ch. NR 140 Preventive Action Limit.
Indicates detects in excess of laboratory reporting limits and either Wis. Admin. Code ch. NR 140 Enforcement Standard or DHS Drinking Water Health Advisory.

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Table 4

Table 4
Field-Edge Groundwater Monitoring Program
2020 Land-, Pesticide/Nitrogen- and Irrigation-Use (as Provided by Growers)

COUNTY	SITE (Grower)	YEAR	CROP	NUTRIENT MANAGEMENT PLAN	IRRIGATION APPLIED (in inches)	NITROGEN APPLIED (in lbs/acre)	PESTICIDE PRODUCT APPLIED
Adams	AD2	2016	corn silage	---	6.45	374.8	glyphosate
							N-serve
							atrazine
							dicamba
		2017 [1]	---	---	---	---	---
		2018 [1]	---	---	---	---	---
		2019 [1]	---	---	---	---	---
		2020 [1]	---	---	---	---	---
	AD3	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018	snap beans	yes	6.59	89.0	metolachlor
							halosulfuron-methyl
							sethoxydim
							imazamox, bentazon
							thiamethoxam
							bifenthrin
							glyphosate
		2019 [1]	---	---	---	---	---
		2020 [1]	---	---	---	---	---
	AD4	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018	soybeans	yes	7.66	14.0	metribuzin
							metolachlor
							Clethodim
							bentazon
							thiamethoxam
							chlothianidin
							glyphosate
		2019 [1]	---	---	---	---	---
		2020 [1]	---	---	---	---	---
	AD5	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018 [1]	---	---	---	---	---
		2019 [1]	---	---	---	---	---
		2020 [1]	---	---	---	---	---
Barron	BR3	2016 [1]	---	---	---	---	---
		2017 [1]	---	---	---	---	---
		2018 [1]	---	---	---	---	---
		2019	corn	no	2.24	300	Glyphosate
							diglycolamine salt
							topramezone, dimethenamid-P
							acetochlor, flumetsulam, clopyralid
		2020 [1]	---	---	---	---	---
Dane	DN1	2016	seed corn	---	3	216.7	simazine
							metolachlor
							mesotrione
							topramezone
							bifenthrin
							pyraclastrobin, metconazole
							2,4-D
							glyphosate
							sodium chlorate
		2017	soybeans	---	2	6.0	glyphosate
							clethodim
							lambda-cyhalothrin
							glufosinate
		2018 [1]	---	---	---	---	---
		2019	soybeans	yes	2	1.7	glyphosate
							metribuzin
							dimethenamid
							glufosinate
							clethodim
							lambda-cyhalothrin
		2020	seed corn	yes	4	201.95	s-metolachlor
							glycine, N-phosphonomethyl-potassium salt
							mesotrione
							simazine
							topramezone
							acetochlor
							simazine
							azoxystrobin, cyproconazole
							bifenthrin
							metaconazole, pyraclostrobin

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Dunn	DU1	2016	soybeans	---	3.43	100.0	dimethenamid
							flumioxazin
							clethodim
							benzoic acid
		2017	horseradish	---	0.8	140.5	peroxyacetic acid, hydrogen peroxide
							oxyfluorfen
							sulfentrazone
							glyphosate
							clethodim
							boscolid
							chlorothalonil
		2018	corn (grain)	no	3.97	193.3	glyphosate
							dicamba
							dimethenamid, saflufenacil
		2019 [1]	---	---	---	---	---
		2020	kidney beans	no	2.5	91.98	pendimethalin
							s-metolachlor
							imazamox
							sodium bentazon
							clethodim
							beta-cyfluthrin, imidacloprid
							saflufenacil
	DU2	2016	corn	---	8	241.0	glyphosate
							dimethenamid, saflufenacil
		2017	kidney beans	---	4	85.0	pendimethalin
							s-metolachlor
							bentazon
							fomesafen
							imazamox
							clethodim
							saflufenacil
							thiamethoxam, fludioxonil
		2018	corn	---	5	66.2	dimethenamid, saflufenacil
							glyphosate
							atrazine
		2019	kidney beans	yes	3.25	72.5	pendimethalin
							glyphosate
							s-metolachlor
							imazamox
							bentazon
							fomesafen
							clethodim
							imidacloprid
							saflufenacil
		2020	kidney beans	no	2.5	91.98	pendimethalin
							s-metolachlor
							imazamox
							sodium bentazon
							clethodim
							beta-cyfluthrin, imidacloprid
							saflufenacil
Grant	GR1	2016 [1]	---	---	na	---	---
		2017 [1]	---	---	na	---	---
		2018 [1]	---	---	na	---	---
		2019 [1]	---	---	na	---	---
		2020 [1]	---	---	na	---	---
	IW1	2016	potatoes	---	18.4	374.4	metam sodium
							azoxystrobib, difenoconazole
							metalaxyl
							imidacloprid
							azoxystrobin
							metribuzin
							novaluron
							spinosad
							beta-cyfluthrin
							rimsulfuron
							chlorothalonil
							pyraclostrobin
							boscolid
							abamectin
							pyrimethanil
							fentin hydroxide
							mancozeb
							diquat bromide
		2017	seed corn	---	8.9	198.5	glyphosate
							bifenthrin
							glufosinate
							MCPA, bromoxynil
							pendimethalin
							pyraclostrobin, metconazole

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Iowa							propiconazole, azoxystrobin
		2018	snap beans	no	5.7	77.0	thiamethoxam
							halosulfuron-methyl
							s-metolachlor
							imazamox, bentazon
							sethoxydim
		2019 [1]	---	---	---	---	---
		2020	potatoes	no	21	225.93	bifenthrin, pyraclostrobin
							metribuzin
							s-metolachlor
							indoxacarb
							acetamiprid
							chlorothalonil
							spinosad
							lambda-cyhalothrin
							mefentrifluconazole
							Abamectin
							zoxamide
							pyrimethanil
							mancozeb
							fentin hydroxide
							diquat dibromide
	IW2	2016	seed corn	---	12.8	195.5	glyphosate
							bifenthrin
							metolachlor
							pendimethalin
							tembotrione
							bromoxynil
							azoxystrobin
		2017	snap beans	---	6.6	72.2	glyphosate
							EPTC
							thiamethoxam
							bifenthrin
							imazamox, bentazon
							copper hydroxide and copper chloride
		2018	seed corn	no	12.1	256.0	bifenthrin
							bicyclopyrone, metolachlor, mesotrione
							pendimethalin
							thiamethoxam
							azoxystrobin
		2019 [1]	---	---	---	---	---
		2020	seed corn	no	10.6	223.2	bifenthrin
							glufosinate
							s-metolachlor
							nicosulfuron
							pyroxasulfone
							pendimethalin
							azoxystrobin, propiconazole, pydiflumetofen
Jackson	JK3	2016 [1]	---	---	na	---	---
		2017 [1]	---	---	na	---	---
		2018 [1]	---	---	na	---	---
		2019 [1]	---	---	na	---	---
		2020 [1]	---	---	na	---	---
Juneau	JN1	2016	sweet corn	---	8	211.0	atrazine
							s-metolachlor
		2017	snap beans	---	2.9	122.0	s-metolachlor
							halosulfuron-methyl
		2018	sweet corn	no	8	228.6	atrazine
							s-metolachlor
		2019	potatoes	no	12.5	65.05	azoxystrobin
							chlorothalonil
							esfenvalerate
							spinosad
							thiamethoxam
							diquat dibromide
							boscalid
							metribuzin
							cyantraniliprole, abamectin
							metam sodium
							potassum salt
							metalaxyl
		2020	sweet corn	no	9.5	212.37	atrazine
							metolachlor
	JN3	2016 [1]	---	---	na	---	---
		2017 [1]	---	---	na	---	---
		2018 [1]	---	---	na	---	---
		2019 [1]	---	---	na	---	---
		2020 [1]	---	---	na	---	---
		2016	corn silage	---	---	179.5	glyphosate
							lorsban
							acetochlor

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La Crosse	LC2						dicamba
		2017	soybeans	---	---	0.0	glyphosate
							2,4-D
							imazethapyr
		2018	corn	yes	2.5	705.7	glyphosate
							atrazine, acetochlor
							mesotrione
		2019	beans	---	---	0.0	glyphosate
							methansulfonamide
							metribuzin
							metolachlor
							glyphosate, imazethapyr
		2020[1]	---	---	---	---	---
Langlade	LN1	2016[1]	---	---	---	---	---
		2017[1]	---	---	---	---	---
		2018[1]	---	---	---	---	---
		2019[1]	---	---	---	---	---
		2020[1]	---	---	---	---	---
Portage	PR1	2016[1]	---	---	---	---	---
		2017[1]	---	---	---	---	---
		2018	sweet corn	yes	4.6	164.0	s-metolachlor
							atrazine
		2019	potatoes	yes	6.7	159	chlorothalonil
							azoxystrobin
							spinetram
							abamectin, cyantraniliprole
							imidacloprid
							novaluron
							diqust
		2020[1]	field corn	---	7.2	167.17	glyphosate
St. Croix	SC1	2016	soybeans	---	na	---	glyphosate
		2017	corn	---	na	250.0	glyphosate
							tembotrione
							acetochlor
		2018	soybeans	no	na	0.0	glyphosate
		2019[1]	---	---	na	---	---
		2020[1]	---	---	na	---	---
Sauk	SK6	2016[1]	---	---	na	---	---
		2017[1]	---	---	na	---	---
		2018[1]	---	---	na	---	---
		2019[1]	---	---	na	---	---
		2020[1]	---	---	na	---	---
Trempealeau	TR1	2016[1]	---	---	---	---	---
		2017[1]	---	---	---	---	---
		2018[1]	---	---	---	---	---
		2019[1]	---	---	---	---	---
		2020[1]	---	---	---	---	---
Waupaca	WP2	2016	corn	---	na	132.0	acetochlor
							clopyralid
							flumetsulam
		2017	soybeans	---	na	0.0	glyphosate
		2018	soybeans	yes	na	0.0	glyphosate
		2019	corn	yes	na	122.0	acetochlor, clopyralid, flumetsulam
		2020	corn	yes	na	97.9	glyphosate
							acetochlor, clopyralid, flumetsulam
	WS4	2016	carrots	---	9.08	176.0	glyphosate
							pendimethalin
							chlorothalonil
							esfenvalerate
							clethodim
							azoxystrobin
		2017	potatoes	---	13.62	115.1	glyphosate
							thiamethoxam, fludioxonil
							mancozeb
							azoxystrobin
							pentachloronitrobenzene
							s-metolachlor
							metribuzin
							rimsulfuron
							chlorothalonil
							novaluron
							metalaxyl
							copper hydroxide and copper chloride
							spinosad
							boscolid
							cyantraniliprole, abamectin
							pyraclostrobin
							oxathiapiprolin
							fentin hydroxide
							diquat bromide
							metolachlor

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Waushara		2018	corn	no	9.1	70.6	simazine
							glyphosate
							ammonium sulfamate
		2019	beans	no	2.42	24.96	metolachlor
							halosulfuron-methyl
		2020	carrots	no	12.12	241.3	pendimethalin
							clethodim
							prometryn
							carfentrazone-ethyl
							esfenvalerate
							chlorothalonil
							azoxystrobin
							boscalid
	WS6	2016	corn	---	8.35	70.4	glyphosate
							simazine
							metolachlor
		2017	beans	---	6	105.6	glyphosate
							ammonium sulfamate
							metolachlor
							phosphorus oxide
							halosulfuron-methyl
		2018	carrots	no	12.76	254.1	clethodim
							carfentrazone-ethyl
							cypermethrin-S
							azoxystrobin
		2019	potatoes	no	10.9	200.16	pendimethalin
							metribuzin
							novaluron
							phosmet
							chlorothalonil
							boscolid
							cyantraniliprole, abamectin
							metalaxyl
							fentin hydroxide
							diquat dibromide
		2020	corn	no	7.93	70.78	glyphosate-isopropylammonium
							metolachlor
							simazine
							tembotrione
	WS7	2016					
		2017					
		2018					
		2019					
		2020					

Notes:

1 Grower did not provide information in Annual Reporting Form.

(green) Site is located within an atrazine Prohibition Area.

--- Information not provided by Grower.

na Fields are not equipped to irrigate.

(hatched) Site is a research location with multiple crops and herbicide types and application rates.

Table 7
Field-Edge Groundwater Monitoring Program
2020 Imidacloprid Concentrations in Groundwater Samples

COUNTY	SITE (Grower)	WELL IDENTIFICATION	WUWN	SAMPLE DATE (2020)	IMIDACLOPRID (in µg/L)
Adams	AD2	AD2-1	BH954	6/3	0.0128
				10/27	0.0472
		AD2-4	VR844	6/3	0.475
				10/27	1.5
		AD2-5	VR845	6/3	0.263
				10/27	0.326
	AD3	AD3-1	BH999	6/30	0.138
				11/18	0.0951
		AD3-3	BI001	6/30	0.144
				11/18	0.094
	AD4	AD4-2	BH997	6/30	0.0703
				11/18	0.0786
	AD5	AD5-1	CL461	6/3	0
				10/27	0
		AD5-4	VR846	6/3	0.188
				10/27	0.158
		AD5-5	VR847	6/3	0.0936
				10/27	0.355
Barron	BR3	BR3-1	BR279	11/4	0
		BR3-3	BR281	11/4	0
Dane	DN1	DN1-2	BR251	10/15	0
Dunn	DU1	DU1-1	AO384	6/24	0
				11/4	0
		DU1-3	AO386	6/24	0
				11/4	0
	DU2	DU2-1	AO387	6/24	0.0109
				11/4	0
		DU2-3	AO389	6/24	0
				11/4	0
Grant	GR1	GR1-1	BR255	10/21	0
		GR1-3	BR257	10/21	0
Iowa	IW1	IW1-4	BR259	6/9	0.119
				10/15	0.0908
		IW1-7	BH967	6/9	0.296
				10/15	0.269
	IW2	IW2-1	BR036	6/9	0
				10/15	0
		IW2-3	BR038	6/9	0.262
				10/15	0.0759
Jackson	JK3	JK3-1	JH982	10/29	0
		JK3-2	JH981	10/29	0
Juneau	JN1	JN1-1	BR046	10/27	0
		JN1-3	BR048	10/27	0.0741
	JN3	JN3-1	JH937	10/14	0
		JN3-2	JH936	10/14	0
La Crosse	LC2	LC2-1	VZ391	11/12	0
		LC2-2	VZ392	11/12	0
Langlade	LN1	LN1-1	BH964	10/20	0.0164
		LN1-3	BH966	10/20	0
Portage	PR1	PR1-1	BR207	6/11	0
				10/20	0.0773
		PR1-4	VR848	6/11	0.0507
				10/20	0.045
		PR1-5	VR849	6/11	0.048
				10/20	0.0446
St. Croix	SC1	SC1-1	JH938	6/23	0
				10/14	0
		SC1-2	JH939	6/23	0
				10/14	0
Sauk	SK6	SK6-1	BB246	6/9	0.205
				10/15	0.165
		SK6-3	BB248	6/9	0.457
				10/15	0.38
Trempealeau	TR1	TR1-1	PX201	11/12	0
		TR1-2	PX202	11/12	0
Waupaca	WP2	WP2-1	JH985	10/20	0
Waushara	WS4	WS4-1	BB258	6/30	0.287
				11/5	0.299
		WS4-4	BB261	6/30	0.0498
				11/5	0.0298
	WS6	WS6-1	JH989	6/18	0.0777
				11/5	0.0791
		WS6-2	JH990	6/18	0
				11/5	0.0168
	WS7	WS7-1	VR841	6/18	0.0553
				10/29	0.172
		WS7-2	VR842	6/18	0.201
				10/29	0.216
		WS7-3	VR843	6/18	0.854
				10/29	0.769

Notes:

WUWN	Wisconsin Unique Well Number
µg/L	Micrograms per liter or parts per billion
0	Concentration does not exceed laboratory reporting limit of 0.05 µg/L.
(yellow)	Wisconsin Department of Health Services Drinking Water Health Advisory (June 2019, November 2020, revised February 2022).

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Table 8
Field-Edge Groundwater Monitoring Program
2020 Alachlor ESA Concentrations in Groundwater Samples

COUNTY	SITE (Grower)	WELL IDENTIFICATION	WUWN	SAMPLE DATE (2020)	ALACHLOR ESA (in µg/L)
Adams	AD2	AD2-1	BH954	6/3	0.0841
				10/27	0.245
		AD2-4	VR844	6/3	0.524
				10/27	0.575
		AD2-5	VR845	6/3	0.473
				10/27	0.69
	AD3	AD3-1	BH999	6/30	0.348
				11/18	0.079
		AD3-3	BI001	6/30	0.315
				11/18	0.196
	AD4	AD4-2	BH997	6/30	0.12
				11/18	0.326
	AD5	AD5-1	CL461	6/3	0
				10/27	0
		AD5-4	VR846	6/3	1.58
				10/27	1.42
		AD5-5	VR847	6/3	9.4
				10/27	11.4
Barron	BR3	BR3-1	BR279	11/4	0
		BR3-3	BR281	11/4	0
Dane	DN1	DN1-2	BR251	10/15	0
Dunn	DU1	DU1-1	AO384	6/24	0.227
				11/4	0.205
		DU1-3	AO386	6/24	0.132
				11/4	0.134
	DU2	DU2-1	AO387	6/24	0.148
				11/4	0.0859
		DU2-3	AO389	6/24	0.0891
				11/4	0.0725
Grant	GR1	GR1-1	BR255	10/21	0
		GR1-3	BR257	10/21	0.0712
Iowa	IW1	IW1-4	BR259	6/9	0.714
				10/15	0.359
		IW1-7	BH967	6/9	1.19
				10/15	1.17
	IW2	IW2-1	BR036	6/9	0.221
				10/15	0.481
		IW2-3	BR038	6/9	0.713
				10/15	0.419
Jackson	JK3	JK3-1	JH982	10/29	0
		JK3-2	JH981	10/29	0
Juneau	JN1	JN1-1	BR046	10/27	0
		JN1-3	BR048	10/27	0.522
	JN3	JN3-1	JH937	10/14	11.4
		JN3-2	JH936	10/14	0.0777
La Crosse	LC2	LC2-1	VZ391	11/12	0
		LC2-2	VZ392	11/12	0
Langlade	LN1	LN1-1	BH964	10/20	0
		LN1-3	BH966	10/20	0
Portage	PR1	PR1-1	BR207	6/11	0
				10/20	0
		PR1-4	VR848	6/11	0.798
				10/20	0.779
		PR1-5	VR849	6/11	0.727
				10/20	0.745
St. Croix	SC1	SC1-1	JH938	6/23	0.304
				10/14	0.242
		SC1-2	JH939	6/23	0.0766
				10/14	0.0866
Sauk	SK6	SK6-1	BB246	6/9	0.296
				10/15	0.139
		SK6-3	BB248	6/9	0.715
				10/15	0.487
Trempealeau	TR1	TR1-1	PX201	11/12	0
		TR1-2	PX202	11/12	0
Waupaca	WP2	WP2-1	JH985	10/20	0.06
Waushara	WS4	WS4-1	BB258	6/30	0.232
				11/5	0.323
		WS4-4	BB261	6/30	0.298
				11/5	0.608
	WS6	WS6-1	JH989	6/18	0.212
				11/5	0.242
		WS6-2	JH990	6/18	0
				11/5	0
	WS7	WS7-1	VR841	6/18	0.116
				10/29	0.192
		WS7-2	VR842	6/18	0.929
				10/29	1.05
		WS7-3	VR843	6/18	2.55
				10/29	2.07

Notes:

WUWN	Wisconsin Unique Well Number
Alachlor ESA	Alachlor Ethanesulfonic Acid
µg/L	Micrograms per liter or parts per billion
0	Concentration does not exceed laboratory reporting limit of 0.05 µg/L.
(yellow highlight)	Detected concentration exceeds the Wisconsin Administrative Code Ch. NR 140 Preventive Action Limit of 4.0 µg/L.

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Table 9
Field-Edge Groundwater Monitoring Program
2020 Atrazine and Metabolite Concentrations in Groundwater Samples

COUNTY	SITE (Grower)	WELL IDENTIFICATION	WUWN	SAMPLE DATE (2020)	Atrazine	De-ethyl Atrazine	De-isopropyl Atrazine	Di-amino Atrazine	Atrazine TCR
Adams	AD2	AD2-1	BH954	6/3	0	0	0	0	0
				10/27	0	0	0	0	0
		AD2-4	VR844	6/3	0.187	0.183	0	0	0.37
				10/27	0.211	0.161	0	0	0.372
		AD2-5	VR845	6/3	0.0653	0.174	0	0	0.2393
				10/27	0.0712	0.158	0	0	0.2292
	AD3	AD3-1	BH999	6/30	0	0	0	0	0
				11/18	0	0.0684	0	0	0.0684
		AD3-3	BI001	6/30	0	0.0573	0	0	0.0573
				11/18	0	0	0	0	0
	AD4	AD4-2	BH997	6/30	0	0.0568	0	0	0.0568
				11/18	0	0.0603	0	0	0.0603
	AD5	AD5-1	CL461	6/3	0	0	0	0	0
				10/27	0	0	0	0	0
		AD5-4	VR846	6/3	0.162	0.32	0.0571	0	0.5391
				10/27	0.123	0.14	0	0	0.263
		AD5-5	VR847	6/3	0.098	0.891	0	0.315	1.304
				10/27	0.152	0.774	0	0.223	1.149
Barron	BR3	BR3-1	BR279	11/4	0	0	0	0	0
		BR3-3	BR281	11/4	0	0	0	0	0
Dane	DN1	DN1-2	BR251	10/15	0	0	0	0	0
Dunn	DU1	DU1-1	AO384	6/24	0	0	0.155	0	0.155
				11/4	0	0	0.15	0	0.15
		DU1-3	AO386	6/24	0	0	0.225	0	0.225
				11/4	0	0	0.242	0	0.242
	DU2	DU2-1	AO387	6/24	0	0	0	0	0
				11/4	0	0	0	0	0
		DU2-3	AO389	6/24	0	0	0	0	0
				11/4	0	0	0	0	0
Grant	GR1	GR1-1	BR255	10/21	0	0	0.0659	0	0.0659
		GR1-3	BR257	10/21	0	0	0	0	0
Iowa	IW1	IW1-4	BR259	6/9	0	0	0	0	0
				10/15	0	0	0	0	0
		IW1-7	BH967	6/9	0.0512	0	0.081	0	0.1322
				10/15	0.0508	0.0534	0.0822	0	0.1864
	IW2	IW2-1	BR036	6/9	0	0	0	0	0
				10/15	0	0	0	0	0
		IW2-3	BR038	6/9	0	0	0	0	0
				10/15	0	0	0	0	0
Jackson	JK3	JK3-1	JH982	10/29	0	0	0	0	0
		JK3-2	JH981	10/29	0	0	0	0	0
Juneau	JN1	JN1-1	BR046	10/27	0	0	0	0	0
		JN1-3	BR048	10/27	0	0	0	0	0
	JN3	JN3-1	JH937	10/14	0	0	0	0	0
		JN3-2	JH936	10/14	0	0	0	0	0
La Crosse	LC2	LC2-1	VZ391	11/12	0.0589	0.21	0.0646	0	0.3335
		LC2-2	VZ392	11/12	0.0895	0.165	0	0	0.2545
Langlade	LN1	LN1-1	BH964	10/20	0	0	0	0	0
		LN1-3	BH966	10/20	0	0	0	0	0
Portage	PR1	PR1-1	BR207	6/11	0	0	0	0	0
				10/20	0	0	0	0	0
		PR1-4	VR848	6/11	0	0.071	0	0	0.071
				10/20	0	0.0727	0	0	0.0727
		PR1-5	VR849	6/11	0	0.102	0	0	0.102
				10/20	0	0.1	0	0	0.1
St. Croix	SC1	SC1-1	JH938	6/23	0	0.0741	0	0	0.0741
				10/14	0	0.0687	0	0.206	0.2747

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St. Croix	SC1	SC1-2	JH939	6/23	0.0512	0	0	0	0.0512
				10/14	0	0	0	0	0
Sauk	SK6	SK6-1	BB246	6/9	0	0	0	0	0
				10/15	0	0	0	0	0
		SK6-3	BB248	6/9	0	0	0	0	0
				10/15	0	0	0	0	0
Trempealeau	TR1	TR1-1	PX201	11/12	0	0	0	0	0
		TR1-2	PX202	11/12	0	0	0	0	0
Waupaca	WP2	WP2-1	JH985	10/20	0	0.0675	0	0	0.0675
Waushara	WS4	WS4-1	BB258	6/30	0	0	0	0	0
				11/5	0	0	0	0	0
		WS4-4	BB261	6/30	0	0	0.0809	0	0.0809
				11/5	0	0	0.14	0.333	0.473
	WS6	WS6-1	JH989	6/18	0	0	0.0614	0	0.0614
				11/5	0	0	0.0503	0	0.0503
		WS6-2	JH990	6/18	0	0	0	0	0
				11/5	0	0	0	0	0
	WS7	WS7-1	VR841	6/18	0	0	0	0	0
				10/29	0	0	0	0	0
		WS7-2	VR842	6/18	0	0	0	0	0
				10/29	0	0	0	0	0
		WS7-3	VR843	6/18	0.101	0.426	0.226	0	0.753
				10/29	0.0876	0.35	0.197	0	0.6346

Notes:

Concentrations identified as micrograms per liter or parts per billion.

TCR Total Chlorinated Residue for Atrazine. Reflects an additive quantity of atrazine and its three metabolites (de-ethyl, de-isopropyl and di-amino atrazine).

WUWN Wisconsin Unique Well Number

µg/L Micrograms per liter or parts per billion.

0 Concentration does not exceed laboratory reporting limit of 0.05 µg/L.

(green) Site is located within an atrazine Prohibition Area.

(yellow) Detected concentration exceeds the Wisconsin Administrative Code Ch. NR 140 Preventive Action Limit of 0.3 µg/L.

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Table 10
Field-Edge Groundwater Monitoring Program
2020 Nitrogen - Nitrate/Nitrite Concentrations in Groundwater Samples

COUNTY	SITE (Grower)	WELL IDENTIFICATION	WUWN	SAMPLE DATE (2020)	TOTAL NITROGEN (in mg/L)
Adams	AD2	AD2-1	BH954	6/3	6.18
				10/27	34.5
		AD2-4	VR844	6/3	16.2
				10/27	34.6
		AD2-5	VR845	6/3	18.7
				10/27	19.2
	AD3	AD3-1	BH999	6/30	18.8
				11/18	26.6
		AD3-3	BI001	6/30	8.63
				11/18	8.62
	AD4	AD4-2	BH997	6/30	21
				11/18	44.9
	AD5	AD5-1	CL461	6/3	0.715
				10/27	0
		AD5-4	VR846	6/3	28.2
				10/27	21.5
		AD5-5	VR847	6/3	25.6
				10/27	32.8
Barron	BR3	BR3-1	BR279	11/4	0
		BR3-3	BR281	11/4	19.8
Dane	DN1	DN1-2	BR251	10/15	19.8
Dunn	DU1	DU1-1	AO384	6/24	17.3
				11/4	16.9
		DU1-3	AO386	6/24	15.9
				11/4	14.8
	DU2	DU2-1	AO387	6/24	0
				11/4	0
		DU2-3	AO389	6/24	0
				11/4	0
Grant	GR1	GR1-1	BR255	10/21	12.5
		GR1-3	BR257	10/21	14.2
Iowa	IW1	IW1-4	BR259	6/9	12.3
				10/15	12.9
		IW1-7	BH967	6/9	26.2
				10/15	26.5
	IW2	IW2-1	BR036	6/9	0
				10/15	0
		IW2-3	BR038	6/9	23.5
				10/15	19.1
Jackson	JK3	JK3-1	JH982	10/29	3.19
		JK3-2	JH981	10/29	3.26
Juneau	JN1	JN1-1	BR046	10/27	3.14
		JN1-3	BR048	10/27	31.1
	JN3	JN3-1	JH937	10/14	4.61
		JN3-2	JH936	10/14	0
La Crosse	LC2	LC2-1	VZ391	11/12	20.4
		LC2-2	VZ392	11/12	18.8
Langlade	LN1	LN1-1	BH964	10/20	7.45
		LN1-3	BH966	10/20	10.5
Portage	PR1	PR1-1	BR207	6/11	1.23
				10/20	1.59
		PR1-4	VR848	6/11	20.1
				10/20	20.7
		PR1-5	VR849	6/11	23.5
				10/20	24.3
St. Croix	SC1	SC1-1	JH938	6/23	9.01
				10/14	9.41
		SC1-2	JH939	6/23	24.5
				10/14	24.8
Sauk	SK6	SK6-1	BB246	6/9	10.3
				10/15	12.4
		SK6-3	BB248	6/9	19.5
				10/15	16.9
Trempealeau	TR1	TR1-1	PX201	11/12	26.1
		TR1-2	PX202	11/12	17.3
Waupaca	WP2	WP2-1	JH985	10/20	7.82
Waushara	WS4	WS4-1	BB258	6/30	42
				11/5	45.7
		WS4-4	BB261	6/30	13.6
				11/5	30.5
	WS6	WS6-1	JH989	6/18	32.5
				11/5	34.7
		WS6-2	JH990	6/18	1.73
				11/5	5
	WS7	WS7-1	VR841	6/18	10.1
				10/29	7.77
		WS7-2	VR842	6/18	30.9
				10/29	37.5
		WS7-3	VR843	6/18	33.5
				10/29	35

Notes:

WUWN	Wisconsin Unique Well Number
mg/L	Milligrams per liter or parts per million
0	Concentration does not exceed laboratory reporting limit of 0.5 mg/L.
(yellow)	Detected concentration exceeds the Wisconsin Administrative Code Ch. NR 140 Preventive Action Limit of 2.0 mg/L.
(orange)	Detected concentration exceeds the Wisconsin Administrative Code Ch. NR 140 Enforcement Standard of 10.0 mg/L.

2020 Monitoring Well Sites