Targeted Sampling Summary Report, 2017

Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP)
Agricultural Resource Management Division, Environmental Quality Unit
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Background

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 or enforcement standards have been exceeded at points of standards application. The Statute further specifies that agencies develop monitoring plans that include provisions for conducting four types of monitoring: problem assessment, regulatory, at-risk and management practice monitoring (§160.27; §160.05).

Purpose of Targeted Sampling

It is estimated that agriculture contributes an annual $88-billion to Wisconsin's economy. Growers use millions of pounds of pesticides, and millions of tons of fertilizers annually, to grow a wide variety of crops typically produced in one Wisconsin growing season. DATCP's Targeted Sampling Program is one form of monitoring the agency performs to meet its statutory obligation to protect groundwater. The agency utilizes a targeted approach to monitor drinking water wells that are at an elevated risk of being impacted by agricultural chemicals. The Targeted Sampling Program tests private wells located in or near agricultural areas of the state for the occurrence of pesticides and nitrate-nitrogen (nitrate).

Targeted Sampling Area Selection

Selection Criteria

Many criteria are considered when determining areas to include in Targeted Sampling. Criteria are primarily based on local geology or environmental conditions, predominant crop types, or characteristics of the predominant pesticides used on crops in a given area. Criteria may vary from year to year. Some examples of criteria used for area selection in the past are listed below:

- Area has susceptible geologic conditions like sandy soils with shallow groundwater, shallow depth to bedrock or karst features.
- Prior testing by others (county government, university, private owner, etc.) shows elevated nitrate, pesticides or other unusual test results.
- Area is within or near an existing atrazine prohibition area (PA) or has other restrictions on pesticide use as a result of concerns over groundwater contamination.

- Same crops grown year after year on same area (e.g. corn, cranberry, ginseng) increasing the likelihood of repetitive pesticide-use in area.
- Crops grown in area typically require extensive chemical or fertilizer inputs and/or irrigation.
- Pesticides used in area have characteristics of high mobility and resistance to degradation.

Staff review and plan areas to sample early in the year with sampling occurring in summer. Upon selecting an area to undergo sampling, staff drive to the area and go door-to-door seeking homeowners who are willing to have their well sampled. Samples are collected under standard sampling protocols and hand delivered to the DATCP Bureau of Laboratory Services (BLS) for analysis of pesticides and nitrate. Testing is free of charge to homeowners and a copy of the analytical results are provided to homeowners typically within 10-days of Program receipt of the data from BLS.

2017 Targeted Sampling Well Locations

In 2017, staff administered some significant changes to the Targeted Sampling Program. In prior years, numerous agricultural areas had been sampled over many years, with new areas selected and tested each successive year. It was typical that staff would not return to sample the same wells in an area, unless testing revealed the need for a groundwater investigation due to an enforcement standards exceedance. Using this approach, valuable observations of water quality were being made, but little could be said about changes in water quality in areas over time, because wells in these areas had not been revisited to collect follow-up samples.

In 2017, staff added a resampling component to the Targeted Sampling Program. A sampling goal of 100 wells was set, with about half coming from wells tested five to seven years earlier, and half coming from new areas that had not been sampled before. The plan was to include repeat sampling in future years, so that half of the wells tested in any given year would be "repeats" of wells that were sampled five years earlier. Using this new approach, over time staff will be able to assess both water quality in agricultural areas, and be able to see if water quality is getting better or worse.

A second change made to the program in 2017 involved staff recording known well construction information, and taking active efforts to select wells for sampling that have known well construction information. By doing this, staff hope to be able to make water quality observations that are linked to known well information like well depth, casing depth, well age or other construction characteristics. For example, in a given area, comparisons might be drawn between wells that are 80 to 100 feet deep, versus wells that are 60 to 80 feet deep. Or between wells in an area that are cased to the bedrock surface versus others that may be cased some greater depth into bedrock.

In 2017, staff established a program goal of testing 100 private wells. From June through August, a total of 107 samples were collected from agricultural areas located in 13 counties. Of this total, 56 samples were collected from private wells that had been sampled once before (five to seven years earlier) while 51 wells were sampled for the first time. Figure 1 shows locations of private wells sampled in 2017. Figure 2 shows locations of all wells sampled under the program dating back to 2010. The criteria used to select targeted sampling areas in 2017 and the number of samples collected in each area is shown in Table 1.

Figure 1: 2017 Targeted Sampling Well Locations
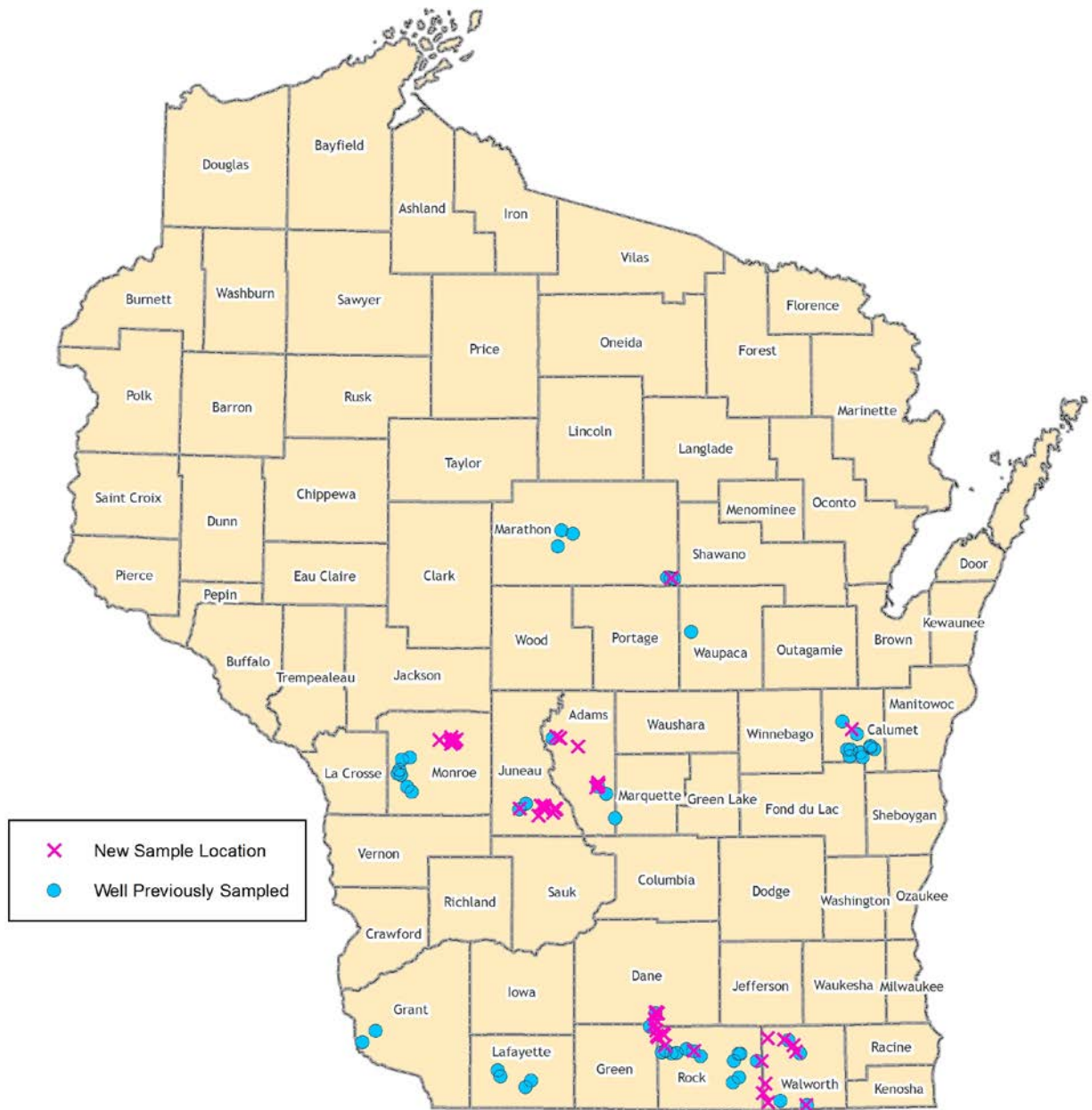
Figure 1 shows locations of 51 private wells sampled for the first time in 2017, while 56 wells sampled were repeats of wells sampled in a prior program year.

Figure 2: Targeted Sampling Well Locations since 2010
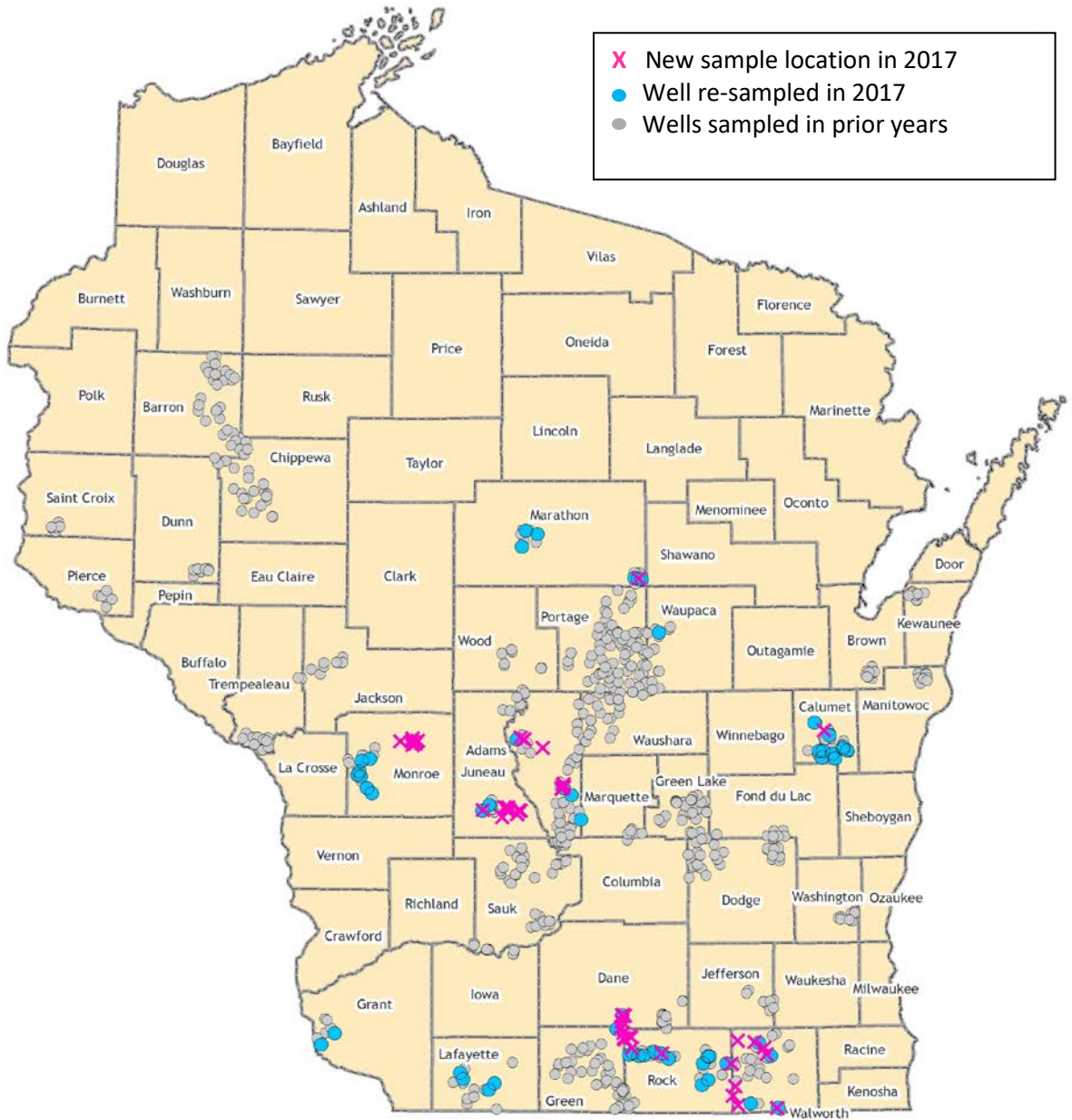
Figure 2 shows locations of wells sampled once during a prior year (grey dots), wells sampled for the first time in 2017 (red **X**), and wells sampled a second time in 2017 after five to seven years (blue dots). Grey dots show history of Targeted Sampling locations dating back to 2010. Grey dots give the reader a sense of where follow-up sampling is likely to occur in future years.

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Table 1: Targeted Sampling Criteria for 2017

| Targeted Area	Counties	Selection Criteria	Number of Samples
Arkdale, Friendship, Grand Marsh, Oxford	Adams / Marquette	Mixture of new wells and repeats from 2012, vulnerable soils, irrigation, shallow groundwater	12
Lyndon Station, Mauston	Juneau	Near existing PA, mixture of new wells and repeats from 2010, vulnerable soil, shallow groundwater	12
Cashton, Sparta	Monroe	Repeats from 2011, vulnerable soils, shallow bedrock, repeated cropping patterns	7
Tomah	Monroe	New area, vulnerable soils, shallow bedrock, repeated cropping patterns, near existing PA	10
Chilton, Hilbert, New Holstein	Calumet	Repeats from 2010, 2011 and 2012, shallow bedrock, repeated cropping patterns, concerns of local health dep.	11
Oregon, Brooklyn, Evansville	Dane / Green	Mixture of new wells and repeats from 2011 and 2012, nearby PA, repeated cropping patterns	10
Janesville, Milton, Avalon	Rock	Mixture of new wells and repeats from 2011 and 2012, nearby PA, repeated cropping patterns	19
Cassville, Darlington, Shullsburg	Grant / Lafayette	Repeats from 2011 and 2012, near existing PA, little available groundwater data, repeated cropping patterns, bedrock wells	6
Whitewater, Elkhorn, Sharon, Darien, Walworth	Walworth	Mixture of new wells and repeats from 2012, vulnerable soils, repeated cropping patterns	12
Marathon City, Franzen Township / Scandinavia	Marathon / Waupaca	Mix of new wells and repeats from 2011, unusual nearby agriculture (ginseng), vulnerable geology, repeated cropping, near existing PA	8

Groundwater Analytical List

In 2015, DATCP's Bureau of Laboratory Services (BLS) introduced new analytical equipment and methods to extract and analyze groundwater samples. BLS is capable of analyzing and reporting concentrations on 100 pesticides, plus nitrate. A link to the full BLS analyte list used during the 2017 sampling is included here (BLS Analytes).

Groundwater Standards

A summary of compounds detected in at least one sample, plus their respective ch. NR 140 Admin. Code, Preventive Action Limits (PAL) and Enforcement Standards (ES) is presented in Table 2.

Targeted Sampling Results

A total of 107 groundwater samples were collected from private drinking water wells as a part of the Targeted Sampling effort in 2017. Summaries of nitrate and pesticide results are provided below. All well owners were mailed a copy of their test results upon receipt of the data from BLS.

Nitrate

Of the 107 wells that were sampled, nitrate nitrogen was quantified above the detection limit in 87 samples, or in 81% of the wells tested. Nitrate was detected above the ES in 35 samples, or 32.7% of the wells sampled. This number contrasts sharply with results from the most recent random sampling survey, which estimated 8.2% of wells exceed the ES for nitrate statewide (Wisconsin DATCP, 2017).

Of the 107 wells sampled, 56 wells were sampled a second time in 2017. Interestingly, there were 10 wells sampled 5-7 years earlier that were, at the time, non-detect for nitrate, and all 10 of those wells remained non-detect for nitrate in 2017. It would not be valid to conduct trend analysis on these 56 wells until more sampling events have occurred, so little can be said about the changes in nitrate results across the two sample events. In the long term, these wells will be sampled again in the summer of 2022. Table 3 below provides a brief summary of the number of samples showing an increase or decrease, as well as those that were non-detect.

Table 3: Numbers of Samples Showing an Increase, No Change, and a Decrease in Nitrate Concentration

Nitrate Results: Out of 56 wells sampled twice or more...							
No. of increases		22	11	increased 1 ppm or more since previous sample	18	decreased 1 ppm or more since prior sample	
No. with no changes	(all ND)	10	7	increased 2 ppm or more since prior test	14	decreased 2 ppm or more since prior sample	
No. of decreases		24	3	increased 5 ppm or more		2	decreased 5 ppm or more

A summary of the nitrate occurrence data for all wells sampled in the Targeted Sampling Program in 2017 is included below. The occurrence data broken into sub-tables, Tables 4A, 4B, 4C and 4D. Each sub-table provides a breakdown of percentages of samples having nitrate relative to the NR 140 PAL (2 mg/l) and the NR 140 ES (10 mg/l). The sub-tables further breakdown the percentage of wells that range in concentration from 2 to 5 mg/l and 5 to 10 mg/l to help illustrate the numbers of wells that are approaching the ES. The percent occurrence categories are provided to help show comparisons across groups of wells represented in each sub-table. For example, Table 4A shows that nearly 33% of the 107 wells tested in agricultural areas in 2017 exceeded 10 mg/l nitrate.

Tables 4A, B and C provide different ways to summarize the data collected in 2017. Table D summarizes data for the same wells as Table C, except that D summarizes data from samples collected five to seven years earlier.

Table 2: Summary of compounds detected in 107 samples in 2017, relative to PAL and ES

Compound Detected	Range Detected*	Detections			NR 140 PAL / ES
		Total	>=PAL	>=ES	
NITROGEN (NO3+NO2 as N)	0.556 – 37.1 mg/l	87	81	35	2 / 10 mg/l
ATRAZINE	0.053 – 1.06 *	20	**	**	**
DE-ETHYL ATRAZINE	0.057 – 1.04	52	**	**	**
DEISOPROPYL ATRAZINE	0.052 – 0.17	10	**	**	**
DIAMINO ATRAZINE	0.225 – 1.26	32	**	**	**
ATRAZINE (TOTAL)	0.057 – 2.05	**	36	0	0.3 / 3.0
ACETOCHLOR	1.61	1	1	0	0.7 / 7
ACETOCHLOR ESA	0.069 – 1.3	12	***	***	***
ACETOCHLOR OA	0.602	1	0	0	46 / 230
ALACHLOR	0.259	1	1	0	0.2 / 2
ALACHLOR ESA	0.084 – 11	41	4	0	4 / 20
ALACHLOR OA	0.354 – 2.25	2			Not Established
BENTAZON	0.285	1	0	0	60 / 300
BROMACIL	0.197	1			Not Established
CLOPYRALID	0.143	1			Not Established
CLOTHIANIDIN	0.059 – 0.422	5			Not Established
DICAMBA	0.065	1	0	0	60 / 300
DIMETHENAMID ESA	0.056 – 0.121	2			Not Established
DINOTEFURAN	0.014	1			Not Established
FLUMETSULAM	0.13 – 0.19	2			Not Established
IMIDACLOPRID	0.061 – 0.115	2			Not Established
MCPP	0.592	1			Not Established
METALAXYL	0.079	1			Not Established
METOLACHLOR	0.051 - 0.242	2	0	0	10 / 100
METOLACHLOR ESA	0.053 – 17.6	76	****	****	****
METOLACHLOR OA	0.314 – 3.46	9	0	0	260 / 1300
METRIBUZIN	0.086 - 0.096	2	0	0	14 / 70
METRIBUZIN DADK	0.123 – 0.521	6			Not Established
THIAMETHOXAM	0.159 – 0.215	2			Not Established
TRICLOPYR	0.343	1			Not Established

* <u>Units</u>: Nitrate = mg/l (milligrams per liter, equivalent to parts per million) while pesticide = ug/l
  (micrograms per liter, equivalent to parts per billion).
 ** The NR 140 PAL and ES for the sum of parent atrazine and three breakdown products is 0.3 and 3 ug/l.
 *** The NR 140 PAL and ES for the sum of acetochlor ESA + OA is 46 and 230 ug/l.
**** The NR 140 PAL and ES for the sum of metolachlor ESA + OA is 260 and 1,300 ug/l.

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Table 4A summarizes nitrate data from all 107 private wells sampled in 2017. The table shows that nitrate concentrations were 10 mg/l or more in 32.7% of wells tested (35 wells). Nitrate exceeded 20 mg/l in 9.3% of samples collected.

Tables 4A – 4C: 2017 Nitrate Summary

Table 4A: Nitrate Occurrence Data for All 107 Wells Sampled in 2017			
26	wells sampled had from 0 to <=2 mg/L	24.3%	
21	wells sampled had from >2 to <=5 mg/L	19.6%	
25	wells sampled had from >5 to <=10 mg/L	23.4%	67.3% <= 10 mg/L
25	wells sampled had from >10 to <= 20 mg/L	23.4%	
10	wells sampled that had > 20 mg/L	9.3%	32.7% > 10 mg/L

Table 4B: Nitrate Occurrence Data for 51 Wells Sampled in New Areas in 2017			
13	wells sampled had from 0 to <=2 mg/L	25.5%	
8	wells sampled had from >2 to <=5 mg/L	15.7%	
14	wells sampled had from >5 to <=10 mg/L	27.4%	68.6% <= 10 mg/L
12	wells sampled had from >10 to <= 20 mg/L	23.6%	
4	wells sampled that had > 20 mg/L	7.8%	31.4% > 10 mg/L

Table 4C: Nitrate Occurrence Data for 56 Wells Sampled a 2nd Time in 2017			
13	wells sampled had from 0 to <=2 mg/L	23.2%	
13	wells sampled had from >2 to <=5 mg/L	23.2%	
11	wells sampled had from >5 to <=10 mg/L	19.7%	66.1% <= 10 mg/L
13	wells sampled had from >10 to <= 20 mg/L	23.2%	
6	wells sampled that had > 20 mg/L	10.7%	33.9% > 10 mg/L

Table 4B provides a breakout of results for the 51 samples collected from newly sampled wells. Table 4C shows results for 56 wells tested in 2017 that were also sampled 5 to 7 years earlier. The nitrate data for both subsets of wells is very similar.

Tables 4C and 4D below provide a summary of nitrate occurrence data for the 56 wells that were sampled two times, once five to seven years ago, and again in 2017. Upon comparing the data from the same wells over time, the most significant (and encouraging) change appears to be that in 2017, fewer wells contained nitrate exceeding the ES (33.9%) than when they were sampled years earlier (37.5%). Another encouraging observation is the fact that 10 wells were non-detect for nitrate when sampled years earlier, and they remained non-detect in 2017. Although these are encouraging observations for these wells, it is discouraging to see that the 2017 results showed a higher percentage of wells exceeding 20 mg/l nitrate (10.7 % versus 7.1%) than was observed in the earlier data. It also appears that recent sampling shows a higher overall percentage of samples falling between the PAL and ES (2 to 10 mg/l) rather than dropping below the PAL.

Tables 4C and 4D: Nitrate Occurrence Comparison for 56 Wells Sampled Two Times

Table 4C: Nitrate Occurrence Data for <u>56 Wells</u> Sampled a 2nd Time in 2017			
13	wells sampled had from 0 to <=2 mg/L	23.2%	
13	wells sampled had from >2 to <=5 mg/L	23.2%	
11	wells sampled had from >5 to <=10 mg/L	19.7%	66.1% <= 10 mg/L
13	wells sampled had from >10 to <= 20 mg/L	23.2%	
6	wells sampled that had > 20 mg/L	10.7%	33.9% > 10 mg/L

Table 4D: Nitrate Occurrence Data for Same <u>56 Wells</u> Sampled 5 to 7 Years Earlier			
15	wells sampled had from 0 to <=2 mg/L	26.8%	
8	wells sampled had from >2 to <=5 mg/L	14.3%	
12	wells sampled had from >5 to <=10 mg/L	21.4%	62.5% <= 10 mg/L
17	wells sampled had from >10 to <= 20 mg/L	30.4%	
4	wells sampled had > 20 mg/L	7.1%	37.5% > 10 mg/L

Pesticides:

A total of 28 different pesticide compounds and/or metabolites were detected in one or more of the 107 wells sampled in 2017. Atrazine was the most frequently detected pesticide (20 times), followed by clothianidin (five times), and metolachlor and thiamethoxam (twice each). Metolachlor ESA, de-ethyl atrazine and alachlor ESA were the top three pesticide metabolites detected (76, 52 and 41 times, respectively). None of the pesticides detected exceeded their respective ES. Atrazine Total Chlorinated Residues (atrazine TCR--includes the sum of atrazine plus its metabolites de-ethyl atrazine, deisopropyl atrazine, and diamino atrazine), acetochlor, alachlor and alachor ESA were detected above their respective PALs in 36, 1, 1 and 4 samples each. Thirteen of the compounds detected do not have established NR 140 water quality standards.

The neonicotinoid class of insecticides have been the subject of increased scrutiny for their potential role in decreased pollinator populations worldwide. Four neonicotinoids, clothianidin, dinotefuran, imidacloprid and thiamethoxam were detected in samples collected in 2017. All detects were less than 0.5 ug/l. Clothianidin was detected in five wells, while imidacloprid and thiamethoxam were detected two times each. The neonicotinoid, dinotefuran was detected once, representing the first time this compound has been detected in groundwater samples collected by DATCP. With the exception of dinotefuran, these compounds have been observed at similar concentrations in groundwater and surface water monitoring programs conducted by DATCP.

The neonicotinoid detections occurred in wells located in Adams, Calumet, Juneau, Lafayette, and Monroe Counties. Just two wells had multiple neonicotinoids present: a well in Adams County and a well in Calumet County both had clothianidin and thiamethoxam. In samples from each well, clothianidin was present at about half the concentration of thiamethoxam. It is possible that at least some of the clothianidin is present as a result of thiamethoxam use, as studies have shown that clothianidin formation can occur as a result of normal degradation of the compound thiamethoxam (U.S.

EPA, 2017). Regardless, considering the popularity of neonicotinoid insecticides as seed treatments for corn, soy and other crops, it is likely that both insecticides have been used in nearby agriculture.

Three wells that had neonicotinoid detections in 2017 were also sampled 5-7 years earlier, but only one of these three, well PX239 (Grand Marsh - Adams County) had a repeat detection of a neonicotinoid. In 2012, clothianidin was present in PX239 at 0.317 ug/l, while in 2017 it was present at 0.422 ug/l. Other pesticides were detected in both sampling events at this well, including atrazine and its chlorinated residues, alachlor ESA, and metolachlor ESA and metolachlor OA. Nitrate in samples from PX239 went from 13.7 mg/l (2012) to 37.1 mg/l nitrate. Four other newly sampled wells in 2017 were located within two miles of PX239. These include wells CO525, MD571, VR833 and VR834. Each well had elevated nitrate and multiple pesticide detects. Three of the four also had detections of clothianidin, imidacloprid and/or thiamethoxam. The area surrounding these wells is marked by sandy soils, irrigated agricultural fields, and relatively shallow groundwater. A brief summary for this area and all others sampled in 2017 is provided below, along with any staff recommendations for future actions to take in each area.

Area Summaries and Staff Recommendations

1. *Arkdale, Grand Marsh, Friendship, Oxford – Adams & Marquette Counties*

County	WUWN	Well Depth	Casing Depth	Static Water Depth	Bedrock Depth Description	Installation Date	Sample Date	ALACHLOR	ALACHLOR ESA	ALACHLOR OA	ATRAZINE TCR	BENTAZON	CLOTHIANIDIN	DICAMBA	IMIDACLOPRID	METALAXYL	METOL. ESA	METOL. OA	METRIBUZIN	METRIBUZIN DADK	THIAMETHOXAM	NITRATE
Adams	BA698	45	42		SAND	8/22/1989	8/1/2017	0	5.44	0	0.598	0	0	0.645	0	0	2.34	0	0	0.123	0	11.6
Adams	XE299	62	60	37	SAND	4/21/2013	8/1/2017	0.26	4.28	2.25	1.721	0	0	0	0	0	1.65	0	0	0	0	13.1
Adams	YB645	63	58	20	SAND	5/22/2017	8/1/2017	0	0	0	0.272	0	0	0	0	0	0.0628	0	0	0	0	9.46
Adams	ON685	46	42	22	SAND	9/7/2001	8/1/2017	0	0.084	0	0.0605	0	0	0	0	0	0.109	0	0	0	0	8.9
Adams	ON685	46	42	22	SAND	9/7/2001	9/11/2012	0	0	0	0		0				0	0	0		0	7.61
Adams	CO525	104	94	63	SAND	1/30/1990	8/1/2017	0	0	0	1.1076	0	0	0	0.0614	0	2.86	0.349	0.0959	0.521	0	31
Adams	MD571	114	110	59	SAND	7/27/1998	8/1/2017	0	0	0	0.105	0	0.123	0	0	0	1.09	0	0	0.242	0.215	27.3
Adams	VR833						8/1/2017	0	0	0	0.0856	0.285	0	0	0	0	0.989	0	0.0864	0.344	0	14.8
Adams	VR834						8/1/2017	0	0	0	0.0732	0	0.102	0	0	0	2.6	0.419	0	0.373	0	29.7
Adams	PX239						8/1/2017	0	0	0	1.8987	0	0.422	0	0	0.0787	8.25	3.46	0	0	0	37.1
Adams	PX239						9/4/2012	0	0.103	0	0.737		0.317		0		5.98	0.958	0		0	13.7
Adams	VR832						8/1/2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Adams	FN930	45	42	22	SAND	10/5/1992	8/1/2017	0	0	0	0.0974	0	0	0	0	0	0.263	0	0	0	0	10.8
Adams	FN930	45	42	22	SAND	10/5/1992	9/4/2012	0	0.13	0	0		0		0		0.166	0	0		0	6.35
Marquette	PX235						8/1/2017	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Marquette	PX235						9/5/2012	0	0	0	0		0		0		0	0	0		0	0

Shaded rows are data for the same well as row above, but from a prior sampling year.
Notes: Depths shown are in feet, pesticide concentrations are ug/l and nitrate is mg/l.

A total of 12 wells were sampled in the vicinity of Arkdale (4), Grand Marsh (5), Friendship (1) and Oxford (2). All are located within the central sands region. Well construction information was found for seven (58%) of the wells. Well age seemed to have no bearing on contaminant type or concentration, but several of the wells had no well construction information or known age. Wells in the middle-third of the above table (between lines) are located in Grand Marsh, within 2 miles of each other.

- 66% of the wells (8 of 12) contained nitrate nitrogen concentrations at or above the ES of 10 mg/l, with a maximum concentration of 37.1 mg/l. The average nitrate concentration was 16.1 mg/l.

- 83 % of wells sampled contained at least one pesticide or pesticide metabolite.
- A total of 14 pesticides or pesticide metabolites were detected: 83% of the wells contained atrazine TCR, none of them exceeded the 3.0 ug/l ES.
- For wells having well construction documentation, all were cased (42-110 ft) to about twice the depth of their static water levels (22-63 ft).
- For wells having well construction documentation, the deeper wells tend to have more elevated nitrate concentrations.
- Four wells were tested in 2012 (shaded rows) and again in 2017. Nitrate and pesticide concentrations generally increased in three of the four, two of which had significant increases. The fourth well was non-detect for all analytes in 2012, and remained non-detect in 2017. This well (PX235) is many miles from all other wells, and is near the edge (if not outside) of the Central Sand Plain.

Staff recommendations: Resample area wells in five years. For wells in Grand Marsh (those near PX239), staff recommends reaching out to homeowners and growers in the immediate area in an attempt to inform them of area results, about the apparent susceptibility of groundwater wells in the area, and to make additional efforts to obtain samples from other wells in the area, including irrigation wells.

2. *Cashton, Sparta – Monroe County*

County	Well														
Monroe	IH036	39	34	12	32	SANDSTONE	1/1/1996	6/6/2017	0	0	0.0634	0.38	0.621	0	4.3
Monroe	IH036	39	34	12	32	SANDSTONE	1/1/1996	7/19/2011	0.175	0	0.165	0.681	0.655	0	8.81
Monroe	UO887	69	63	23		SAND & GRVL	5/29/2008	6/6/2017	0	0	0	0	0	0	2.89
Monroe	UO887	69	63	23		SAND & GRVL	5/29/2008	7/19/2011	0	0	0	0	0	0	3.96
Monroe	RJ931	77	68	34	65	SANDSTONE	1/1/2003	6/6/2017	0	0	0	0	0	0	1.18
Monroe	RJ931	77	68	34	65	SANDSTONE	1/1/2003	7/19/2011	0	0	0	0	0	0	1.9
Monroe	MN078	96	86	20	34	SANDSTONE	1/1/1998	6/6/2017	0	0	0	0	0	0	2.86
Monroe	MN078	96	86	20	34	SANDSTONE	1/1/1998	7/19/2011	0	0	0	0	0	0	3.57
Monroe	PX177	140	97	32		SANDSTONE	1/1/1973	6/6/2017	0	0	0	0	0	0	2.3
Monroe	PX177	140	97	32		SANDSTONE	1/1/1973	7/19/2011	0	0	0	0	0	0	2.22
Monroe	PX171							6/6/2017	0	0.309	0.382	0.552	3.31	0.418	8
Monroe	PX171							7/11/2011	0	2.36	0	0	1.95	0.296	7.38
Monroe	PX180							6/6/2017	0.0694	0.591	0.084	0.25	17.6	2.3	29
Monroe	PX180							7/11/2011	0.389	2.38	0	0	19.8	2.47	31.4

Shaded rows are data for the same well as row above, but from a prior sampling year.
Notes: Depths shown are in feet, pesticide concentrations are ug/l and nitrate is mg/l.

A total of 7 wells were sampled in agricultural areas near Cashton and Sparta. Each well was initially sampled in 2011 (shaded rows) and again in 2017. Well construction information was found for five (71%) of the wells. Well age seemed to have no bearing on contaminant type or concentration.

- Just one well contained nitrate nitrogen at or above the ES of 10 mg/l. The well had a concentration of 31.4 mg/l in 2011 and 29 mg/l in 2017. This well's construction is not known. The average nitrate concentration for all seven wells was 7.8 mg/l.
- 43% of wells sampled (3 of 7) contained one or more pesticides or pesticide metabolites.

- A total of 6 pesticides or pesticide metabolites were detected, but no ES exceedances were observed.
- Atrazine, atrazine metabolites and metolachlor ESA were the pesticides most frequently detected (3 of 7 wells). Four wells were non-detect for pesticides during both sample events.
- Well construction data shows most wells are cased down into sandstone. Age of well did not seem to correlate to overall well depth or depth of casing into sandstone. Some older wells were drilled and cased deeper into rock than the newer wells.
- Contaminant concentrations remained fairly constant or decreased in most samples collected the second time in 2017.

Staff Recommendations: Resample these wells in five years.

3. Tomah – Monroe County

County	WUWN	WellDepth	CasingDepth	StaticWaterDepth	BedrockDepth	Description	Install Date	Sample Date	ACETOCHLOR ESA	ALACHLOR ESA	ATRAZINE (ATZ)	ATRAZINE TCR	METOL-ESA	METOL-OA	NITRATE
Monroe	MP866	60	31	19	18	SANDSTONE	10/16/1996	6/13/2017	0	0	0	0	0	0	6.85
Monroe	UH700	62	42	11	10	SANDSTONE	10/17/2008	6/13/2017	0	0.271	0	0.164	2.93	0	21
Monroe	qx552	65	36	24	23	SANDSTONE	2/28/2003	6/13/2017	0	0	0.0564	0.188	2.37	0.424	16.7
Monroe	PS296	75	42	25		SANDSTONE	6/2/1977	6/15/2017	0	0	0.0988	0.383	0.573	0	13.4
Monroe	VR816	75		35			8/6/1974	6/15/2017	0	11	0	0.072	0	0	5.39
Monroe	CR910	78	45	35	12	SANDSTONE	11/13/1989	6/13/2017	0	0	0.0573	0.788	0.739	0	4.52
Monroe	XM997	85	58	19	11	SANDSTONE	10/29/2014	6/13/2017	0	2.3	0.0708	0.24	2.37	0	8.42
Monroe	TA173	97	75	66	6	SANDSTONE	6/15/2005	6/15/2017	0	0	0	0	0	0	4.62
Monroe	TI512	140	33	90	4	SANDSTONE	11/11/2006	6/13/2017	0	0	0	0	0	0	0.807
Monroe	VR814							6/13/2017	0	0	0	0	0	0	7.25

Notes: Depths shown are in feet, pesticide concentrations are ug/l and nitrate is mg/l.

A total of 10 wells were sampled in agricultural areas near Tomah for the first time in 2017. Well construction information was located for eight (80%) of the wells. Well age seems to have no bearing on contaminant type or concentration. Of the wells having construction data, the shallowest wells (60-75 ft. deep) tended to have higher concentrations of contaminants.

- Three of 10 wells (30%) sampled contained nitrate nitrogen at or above the ES of 10 mg/l. The average nitrate concentration was 8.9 mg/l.
- 60% of wells sampled (6 of 10) contained one or more pesticides or pesticide metabolites.
- Five pesticides or pesticide metabolites were detected: no ES exceedances were observed.
- Atrazine, atrazine metabolites and metolachlor ESA were the most frequently detected pesticides (3 of 7 wells). Alachlor ESA was the pesticide detected at the highest concentration, present at 11 ug/l in well VR816. Four wells were non-detect for pesticides.
- Sandstone bedrock exists in wells sampled at depths ranging from as little as four feet to 23 feet deep. Construction data shows that wells are cased into sandstone from 13 to as much as 29 feet. Well age does not tend to correlate with well depth or depth of casing into sandstone. Some older wells were drilled and cased deeper into rock than the newer wells.
- Contaminant concentrations remained fairly constant or decreased in most samples collected the second time in 2017.

Staff Recommendations: Resample these wells in five years.

4. Lyndon Station, Mauston – Juneau County

County	WUWN	WellDepth	CasingDepth	StaticWaterDepth	BedrockDepth	Description	InstallationDate	SampleDate	ACETOCHLOR ESA	ALACHLOR ESA	ALACHLOR OA	ATRAZINE TCR	BROMACIL	DIMETHENAMID ESA	DINOTEFURAN	MCPP	METOLACHLOR - ESA	METOLACHLOR - OA	TRICLOPYR	NITRATE
Juneau	GM209	77	41	40	12	SANDSTONE	11/15/1993	8/22/2017	0	0.17	0	0	0	0	0	0	0.176	0	0	2
Juneau	GM209	77	41	40	12	SANDSTONE	11/15/1993	6/3/2010	0	0	0	0					0	0		1.78
Juneau	VR859	95	32	35	7	SANDSTONE	7/9/1984	8/22/2017	0	0.198	0	0	0.197	0	0	0	0.498	0	0	2.32
Juneau	XA285	125	39	55	5	SANDSTONE	6/14/2013	8/22/2017	0	0.173	0	0	0	0	0	0	0.116	0	0	0.69
Juneau	QW732	125	44	12	5	SANDSTONE	7/17/2002	8/22/2017	0	0.496	0	0	0	0	0	0	0.351	0	0	3.37
Juneau	PS157							8/22/2017	0.07	0.512	0	0.458	0	0.121	0	0.592	0.549	0	0	4.74
Juneau	PS157							9/20/2010	0	2.03	0.339	1.749					0.128	0		6.53
Juneau	VZ352							8/22/2017	0	0	0	0	0	0	0	0	6.22	0	0	14.9
Juneau	VZ352							6/3/2010	0	0	0	0					0	0		7.5
Juneau	JD136							8/22/2017	0	0	0	0	0	0.0563	0.145	0	0.0598	0	0.343	4.69
Juneau	VR854							8/22/2017	0	0	0	0	0	0	0	0	0	0	0	0
Juneau	VR855							8/22/2017	0	0	0	0	0	0	0	0	0	0	0	0
Juneau	VR856							8/22/2017	0.19	0.435	0	0	0	0	0	0	4.32	0.644	0	7.32
Juneau	VR857							8/22/2017	0.62	5.76	0	0.299	0	0	0	0	2.29	0	0	7.91
Juneau	VR858							8/22/2017	0.36	0.922	0	0.0955	0	0	0	0	5.47	0	0	10.2

Shaded rows are data for the same well as row above, but from a prior sampling year.
Notes: Depths shown are in feet, pesticide concentrations are ug/l and nitrate is mg/l.

A total of 12 wells were sampled in agricultural areas near Lyndon Station and Mauston. Three wells had been sampled in 2010 (shaded rows) and were sampled a second time in 2017. Well construction information was located for just four (33%) of the wells. Data for well age and construction is not sufficient for drawing any comparisons to concentrations detected.

- Just two of 12 wells sampled (17%) contained nitrate nitrogen at or above the ES of 10 mg/l. The average nitrate concentration in the 12 samples collected in 2017 was 4.8 mg/l.
- 83% of wells sampled (10 of 12) contained one or more pesticides or pesticide metabolites.
- Eleven pesticides or pesticide metabolites were detected: no ES exceedances were observed.
- Alachlor ESA and metolachlor ESA were the most frequently detected pesticides. Metolachlor ESA was the pesticide detected at the highest concentration, present at 6.22 ug/l in well VZ352. Just two wells had samples that did not detect pesticides.
- Sandstone bedrock exists in wells sampled at depths ranging from as little as five feet to 12 feet deep. Construction data shows that wells are cased down into sandstone 25 to as much as 39 feet.
- In the three wells that were resampled in 2017, nitrate nearly doubled in concentration in one well (VZ352 went from 7.5 to 14.9 mg/l), while the other two had minor decreases in nitrate.

Staff Recommendations: Resample these wells in five years.

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5. *Chilton, Hilbert, New Holstein – Calumet County*

County	WUWN	Well Depth	Casing Depth	Static Water Depth	Bedrock Depth	Description	Install Date	Sample Date	ACETOCHLOR ESA	ALACHLOR ESA	ATRAZINE TCR	CLOTHIANIDIN	FLUMETSULAM	METOLACHLOR	METOLACHLOR ESA	METOLACHLOR OA	THIAMETHOXAM	NITRATE
Calumet	RM297	100	63	20	21	DOLOMITE	7/21/2003	6/20/2017	0	0	0.0571	0	0	0	0.393	0	0	8.56
Calumet	IG723	200	42	40	21	DOLOMITE	9/5/1995	6/20/2017	0	0	0	0	0	0	0.139	0	0	2.47
Calumet	IG723	200	42	40	21	DOLOMITE	9/5/1995	8/7/2012	0	0	0	0		0	0	0	0	3.67
Calumet	LG230	140	44	12	16	DOLOMITE	4/1/1997	6/20/2017	0	0	0	0	0	0	0	0	0	10.5
Calumet	LG230	140	44	12	16	DOLOMITE	4/1/1997	10/6/2011	0	0	0	0		0	0	0	0	10.4
Calumet	TF676	200	105	67	22	DOLOMITE	4/21/2006	6/20/2017	0	0	0	0	0	0	0.161	0	0	5.08
Calumet	TF676	200	105	67	22	DOLOMITE	4/21/2006	10/6/2011	0	0	0	0		0	0	0	0	3.62
Calumet	MW157							6/20/2017	0	0	0.351	0.071	0.13	0.242	3.2	0.359	0.159	22.2
Calumet	MW157							10/6/2011	0	0.177	0.534	0		0	0.334	0	0	26.3
Calumet	PX259							6/20/2017	0	0	0	0	0	0	0.0531	0	0	4.77
Calumet	PX259							8/7/2012	0	0	0	0		0	0	0	0	1.57
Calumet	PX261							6/20/2017	0	0	0.651	0	0	0	1.27	0	0	10.5
Calumet	PX261							8/7/2012	0	0	0.555	0		0	0.59	0	0	11.5
Calumet	PX262							6/20/2017	0	0	0.523	0	0	0	0.897	0	0	21.2
Calumet	PX262							8/7/2012	0	0	0.309	0		0	0	0	0	19.2
Calumet	PX293							6/20/2017	0	0	0.0592	0	0	0	1.8	0	0	12.3
Calumet	PX293							10/6/2011	0	0	0	0		0	0.237	0	0	13
Calumet	US914							6/20/2017	0	0	0.647	0	0	0	1.09	0	0	17.1
Calumet	US914							10/6/2011	0	0	0	0		0	0.337	0	0	12.1
Calumet	VZ365							6/20/2017	0.226	0	0	0	0	0	1.03	0	0	22.7
Calumet	VZ365							7/15/2010	0	0.113	0			0	1.02	0		26.9

Shaded rows are data for the same well as row above, but from a prior sampling year.
Notes: Depths shown are in feet, pesticide concentrations are ug/l and nitrate is mg/l.

Eleven wells were sampled in agricultural areas near Chilton, Hilbert and New Holstein. Each well was initially sampled in either 2010, 2011 or 2012 (shaded rows) and was sampled a second time in 2017. Well construction information was found for four (36%) wells. Construction data is not sufficient for drawing meaningful comparisons between well age or construction and concentrations detected.

- Seven wells (64%) contained nitrate nitrogen at or above the ES of 10 mg/l.
- 91% of wells (10 of 11) contained one or more pesticides or pesticide metabolites in 2017.
- A total of 9 pesticides or pesticide metabolites were detected, but no ES exceedances were observed.
- Metolachlor ESA was the pesticide most frequently detected (10 of 7 wells) in 2017.
- One well was non-detect for pesticides during both sample events. This well exceeded 10 mg/l nitrate in both sample events.
- Four wells have construction records. Dolomite was recorded at depths from 16 to 22 feet. Casing depths varied from 42 to 105 feet, and overall well depths were between 100 to 200 feet.
- Ten wells were sampled a second time in 2017. Between the first and second sampling, nitrate concentrations changed less than 1 mg/l in two wells, had increased by 1 mg/l or more in samples from four wells, and had decreased by 1 mg/l or more in samples from four wells. The largest change observed was a 4.2 mg/l decrease in nitrate at well VZ365.

Staff Recommendations: Resample these wells in five years.

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6. *Oregon, Brooklyn – Dane & Green Counties*

County	WUWN	Well Depth	Casing Depth	Static Water Depth	Bedrock Depth	Description	Install Date	Sample Date	ACETOCHLOR	ACETOCHLOR ESA	ACETOCHLOR OA	ALACHLOR ESA	ATRAZINE TCR	CLOPYRALID	FLUMETSULAM	METOLACHLOR ESA	NITRATE
Dane	CX265	152	42	60	30	SANDSTONE	12/17/1990	7/5/2017	1.61	1.3	0.602	0.211	2.049	0.143	0.19	0.2	4.79
Dane	EQ478	152	63	61	42	SANDSTONE	1/9/1992	7/5/2017	0	0	0	0	0	0	0	0	3.23
Dane	SD310	200	100	100	10	SANDSTONE	1/4/2004	7/5/2017	0	0	0	0.394	0.514	0	0	0	8.57
Dane	VR824	216	184	84	184	SANDSTONE	7/17/1987	7/7/2017	0	0	0	0	0	0	0	0	0
Dane	VR822							7/5/2017	0	0	0	0	0	0	0	0	4.25
Dane	VR823							7/6/2017	0	0	0	0	0.104	0	0	0.175	5.54
Green	YE350	132	95	15	91	SANDSTONE	7/12/2010	7/7/2017	0	0	0	0	0.589	0	0	0	2.79
Green	YE350	132	95	15	91	SANDSTONE	7/12/2010	7/12/2010									1.69
Green	RX396	198	160	40	55	SANDSTONE	11/21/2001	7/7/2017	0	0	0	0	0	0	0	0	0.556
Green	VR825							7/7/2017	0	0	0	0.854	0	0	0	0.894	6.69
Green	VR826							7/6/2017	0	0	0	0.996	1.017	0	0	0	8.61

Shaded rows are data for the same well as row above, but from a prior sampling year.

Notes: Depths shown are in feet, pesticide concentrations are ug/l and nitrate is mg/l.

A total of 10 wells were sampled in agricultural areas near Oregon and Brooklyn. Well YE350 had been sampled in 2010 (shaded row) and a second time in 2017. Well construction information was located for six (60%) of the wells. Well age and construction data is not sufficient for drawing comparisons between age or construction and concentrations of agrichemicals detected.

- None of the wells sampled contained nitrate nitrogen at or above the ES of 10 mg/l. The average nitrate concentration in the 10 samples collected in 2017 was 4.5 mg/l.
- 60% of wells sampled (6 of 10) contained one or more pesticides or pesticide metabolites.
- Eight pesticides or pesticide metabolites were detected: no ES exceedances were observed.
- Alachlor ESA, atrazine TCR and metolachlor ESA were the most frequently detected pesticides. Four wells had samples that did not detect pesticides.
- For the six wells with construction records, sandstone bedrock exists at depths ranging from 10 to 184 feet deep. Casing depths range from 42 to 184 feet.
- In the one well that was resampled in 2017, nitrate increased in concentration just 1.1 mg/l. Pesticides had not been tested in this well during earlier testing in 2010.

Staff Recommendations: Resample these wells in five years.

7. *Evansville, Milton, Janesville, Avalon – Rock County*

County	WUWN	Well Depth	Casing Depth	Static Water Depth	Bedrock Depth	Description	Install Date	Sample Date	ACETOCHLOR ESA	ALACHLOR ESA	ALACHLOR OA	ATRAZINE TCR	METOLACHLOR ESA	METOLACHLOR OA	NITRATE
Rock	AV874	100	42	50	42	DOLOMITE	11/21/1988	6/27/2017	0	0	0	0.5375	0.27	0	5.52
Rock	AV874	100	42	50	42	DOLOMITE	11/21/1988	8/30/2011	0	0.119	0	0	0.729	0	5.19
Rock	DV286	125	42	30	39	DOLOMITE	8/28/1991	6/27/2017	0	0	0	0.783	0.98	0	10.7
Rock	MO309	125	62	20	3	SANDSTONE	6/1/1998	6/27/2017	0	0	0	0.236	0.0593	0	7.56
Rock	MO309	125	62	20	3	SANDSTONE	6/1/1998	8/22/2011	0	0.121	0	0	1.04	0	10.8
Rock	VD115	255	185	40	183	DOLOMITE	10/6/2010	6/27/2017	0.11	2.95	0	0	0.579	0	0
Rock	VD115	255	185	40	183	DOLOMITE	10/6/2010	8/22/2011	0	1.84	0.153	0	0.477	0	0
Rock	VR853							6/27/2017	0	0.259	0	0.44	0.37	0	10.5
Rock	LW648	188	185	21		SAND & GRVL	4/24/1998	6/27/2017	0	0	0	0.8115	0.623	0	8.97
Rock	LW648	188	185	21		SAND & GRVL	4/24/1998	8/30/2011	0	0.111	0	0.302	0.948	0	15.7
Rock	PX193							6/27/2017	0	1.45	0	0.843	0.498	0	7.64
Rock	PX193							8/30/2011	0	1.83	0	0.152	0.935	0	8.57
Rock	px188							6/27/2017	0	0	0	0	0	0	0
Rock	px188							8/22/2011	0	0	0	0	0	0	0
Rock	KZ674	55	52	20		SAND & GRVL	9/6/1996	6/29/2017	0	0	0	0.466	0.499	0	10.1
Rock	KZ674	55	52	20		SAND & GRVL	9/6/1996	8/23/2011	0	0	0	0	2.13	0	9.52
Rock	TW818	120	78	70	78	DOLOMITE	9/14/2006	6/29/2017	0	0.201	0	0	0.111	0	0
Rock	TW818	120	78	70	78	DOLOMITE	9/14/2006	6/5/2012	0	0.173	0	0	0	0	0
Rock	SH178	140	95	50	95	DOLOMITE	8/3/2004	6/29/2017	0	1.66	0	0.81	3.96	0	12.9
Rock	SH178	140	95	50	95	DOLOMITE	8/3/2004	6/5/2012	0	2.1	0	0	4.02	0.16	13.7
Rock	QZ019	180	63	120	7	DOLOMITE	7/8/2002	6/29/2017	0	0.821	0	0.383	0.508	0	9.2
Rock	QZ019	180	63	120	7	DOLOMITE	7/8/2002	8/2/2012	0	2.23	0	0	0	0	12.8
Rock	IG141	210	63	130	8	DOLOMITE	4/13/1995	6/29/2017	0	3.86	0	0.793	0	0	13.5
Rock	IG141	210	63	130	8	DOLOMITE	4/13/1995	6/5/2012	0	4.92	0	0.637	0	0	16.5
Rock	DH539							6/29/2017	0	0.193	0	0.812	0.846	0	19.2
Rock	DH539							5/29/2012	0	0.853	0	0.979	0.602	0	18.7
Rock	PX232							6/29/2017	0.21	0.772	0	1.5974	1.49	0	13.6
Rock	PX232							5/29/2012	0.19	1.48	0	0.795	2.02	0	17.7
Rock	VR821							6/29/2017	0	0.531	0	0.388	3.36	0	14
Rock	VR828	86	64	33	63	SANDSTONE	9/6/1958	7/6/2017	0	0	0	0	0	0	6
Rock	SY158	100	70	30	70	SANDSTONE	4/26/2005	7/6/2017	0	0.212	0	0.4542	2.01	0	14.2
Rock	VR827							7/6/2017	0	0.285	0	0	0.588	0	0

Shaded rows are data for the same well as row above, but from a prior sampling year.

Notes: Depths shown are in feet, pesticide concentrations are ug/l and nitrate is mg/l.

A total of 19 wells were sampled in agricultural areas near Evansville, Milton, Janesville and Avalon. Thirteen wells (68%) were sampled in either 2011 or 2012 (shaded rows) and were sampled for the second time in 2017. Attempts to correlate well depth and well age to concentrations of nitrate were made and are discussed in Chart 7A and Chart 7B below.

- 47% of the wells (9 of 19) contained nitrate nitrogen concentrations at or above the ES of 10 mg/l, with a maximum concentration of 19.2 mg/l. Nitrate was not detected in four wells, three of which were also non-detect five or six years earlier. In 2017, the average nitrate concentration was 8.6 mg/l.
- 89% of wells (17 of 19) contained one or more pesticides or pesticide metabolites in 2017.

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- Six pesticides or pesticide metabolites were detected, but no ES exceedances were observed.
- Metolachlor ESA was the pesticide most frequently detected (16 of 19 wells) in 2017, followed by atrazine TCR, then alachlor ESA. Well PX188 was non-detect for both pesticides and nitrate during both sample events. Well VR828 was non-detect for pesticides in 2017.
- Twelve wells (63%) have construction records. Water was reportedly from dolomite in seven wells and sandstone in three wells. Casing lengths and open bedrock intervals varied widely from well to well. Bedrock wells varied in total depth from 86 to 255 feet. Two wells had three-foot screens in sand and gravel at depths of 52-55 feet and 182-185 feet each. Static water depths at well construction varied widely in all 12 wells, from 20 to 130 feet.
- Thirteen wells were sampled a second time in 2017. Nitrate concentrations were either stable or decreasing in all wells sampled for the second time. Eight wells showed no appreciable change in nitrate concentrations (defined as a change of 1 mg/l or less). Samples from five wells showed decreases in nitrate concentrations of 1 mg/l or more. None of the wells sampled a second time showed an increase in nitrate of 1 mg/l or more. The largest observed change was a 6.7 mg/l decrease in nitrate at well LW648: a sand and gravel well screened from 185 to 188 feet deep with static water at just 21-feet below ground surface.

Considering the number of Rock County wells with known well construction data (12 out of 19 wells), attempts were made to show any correlations between well depth, well age, and nitrate concentration. Given that the set of wells sampled are all close to agricultural areas, one might assume that deeper wells might have lower concentrations of nitrate than shallow wells, or that older wells are built to less stringent standards than newer wells, and are therefore more likely to allow contamination to migrate into the well. Charts 7A and 7B are mathematical attempts to show the closeness of the relationship that well depth (7A) has to nitrate concentration, and that well age (7B) has to nitrate concentration. Good correlations between these parameters would be indicated by R-squared values close to one. As the charts below show, there is not a good correlation between well depth or well age and nitrate concentration in the wells in Rock County where this information was known.
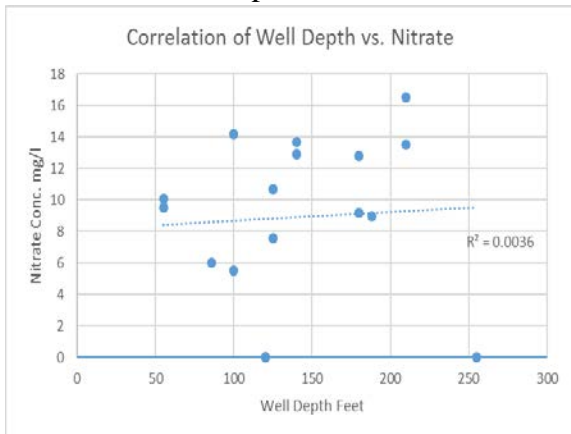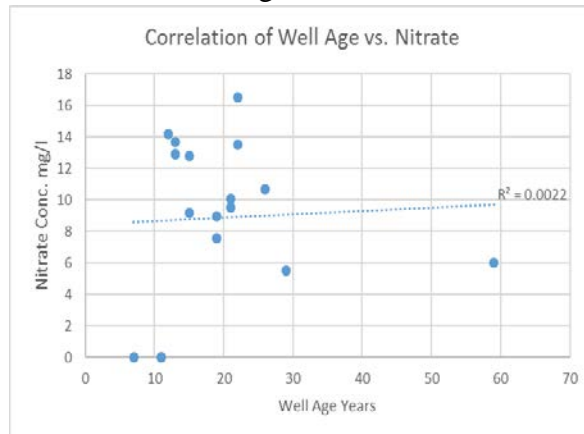
Chart 7A   Well Depth vs Nitrate   Chart 7B   Well Age vs. Nitrate

Staff Recommendations: Resample these wells in five years.

8. *Cassville, Darlington, Shullsburg – Grant & Lafayette Counties*

County	WUWN	Well Depth	Casing Depth	Static Water Depth	Bedrock Depth	Description	Install Date	Sample Date	ACETOCHLOR ESA	ALACHLOR	ALACHLOR ESA	ALACHLOR OA	ATRAZINE TCR	CLOTHIANIDIN	METOLACHLOR	METOLACHLOR ESA	METOLACHLOR OA	NITRATE
Grant	HB161	180	112	90	25	DOLOMITE	8/1/1995	7/25/2017	0	0	0.607	0	0	0	0	2.51	0	2.61
Grant	HB161	180	112	90	25	DOLOMITE	8/1/1995	8/23/2011	0	0	2.05	0	0	0	0	2.68	0	7.11
Grant	LB790	220	84	140	30	DOLOMITE	11/2/1999	7/25/2017	0	0	0	0	0	0	0	0.245	0	1.54
Grant	LB790	220	84	140	30	DOLOMITE	11/2/1999	8/23/2011	0	0	0	0	0	0	0	0.537	0	1.11
Lafayette	MK701	154	80	36	9	DOLOMITE	10/24/1998	7/25/2017	0	0	0	0	0	0	0	0	0	0
Lafayette	MK701	154	80	36	9	DOLOMITE	10/24/1998	5/21/2012	0	0	0	0	0	0	0	0	0	0
Lafayette	SZ757	236	147	160	12	SANDSTONE	7/22/2005	7/25/2017	0	0	0.404	0.354	0.427	0.0592	0.051	3.66	0.314	20.5
Lafayette	SZ757	236	147	160	12	SANDSTONE	7/22/2005	5/21/2012	0.14	0.22	0.706	0.363	0.38	0	0	3.77	0.388	16.5
Lafayette	UT093	270	122	180	7.5	SANDSTONE	6/10/2009	7/25/2017	0	0	0	0	0	0	0	0	0	0
Lafayette	UT093	270	122	180	7.5	SANDSTONE	6/10/2009	5/21/2012	0	0	0	0	0	0	0	0	0	0
Lafayette	PX229							7/25/2017	0	0	0.209	0	0.9402	0	0	3.08	0	16.8
Lafayette	PX229							5/21/2012	0	0	0.363	0	0.601	0	0	3.38	0.243	17.8

Shaded rows are data for the same well as row above, but from a prior sampling year.
Notes: Depths shown are in feet, pesticide concentrations are ug/l and nitrate is mg/l.

A total of 6 wells were sampled in agricultural areas near Cassville (Grant County), and near Darlington and Shullsburg (Lafayette County).   All six wells had been sampled first in 2011 or 2012 (shaded row) and a second time in 2017. Well construction information was located for five (83%) of the wells. Well age and construction data is not sufficient for drawing meaningful comparisons between well age or construction parameters and concentrations of agrichemicals detected.

- Nitrate was detected in four of the six wells. In 2017, two of the wells sampled contained nitrate at or above the ES of 10 mg/l. The average concentration in the six samples collected in 2017 was 6.9 mg/l.
- 67% of wells sampled (four of six) contained one or more pesticides or pesticide metabolites.
- Nine pesticides or pesticide metabolites were detected: no ES exceedances were observed.
- Metolachlor ESA was the most frequently detected pesticide (four wells). Two wells had no detections of nitrate or pesticides.
- Construction records show water coming from dolomite in three wells, and from sandstone bedrock in two wells.
- Well SZ757 had a detection of clothianidin (0.0592 ug/l) in 2017, which was not detected in the 2012 sample.
- Six wells were sampled a second time in 2017. Between the 2011/2012 and the 2017 sampling events, pesticide concentrations were very similar. Nitrate concentrations showed no appreciable change (1 mg/l or less) in four wells, while one well (HB161) had a 4.5 mg/l decrease in nitrate, and another well (SZ757) had a 4.0 mg/l increase in nitrate concentration.

Staff Recommendations: Resample these wells in five years.

9. *Whitewater, Clinton, Sharon, Darien – Walworth County*

County		Well Depth	Casing Depth	Static Water Depth	Bedrock Depth		Install Date				
Walworth	VR835						8/8/2017	0	0.327	0.146	2.46
Walworth	VR836						8/8/2017	2.49	0	0.591	0
Walworth	VR837						8/8/2017	0	0	0.264	0
Walworth	VR838						8/8/2017	0.128	0.316	7.49	15.1
Walworth	VR839	191	187	86	SAND & GRVL	9/25/1981	8/8/2017	0	0	0	0
Walworth	VR850	27			SAND & GRVL		8/8/2017	0.167	1.382	2.85	11.2
Walworth	VR851						8/8/2017	0	0	0	0
Walworth	VR852						8/8/2017	0	0	0	0
Walworth	PX199						8/8/2017	0	0.294	0.548	5.43
Walworth	PX199						6/19/2012	0.291	0	0.818	13.3
Walworth	PX244						8/8/2017	0	0	0	0
Walworth	PX244						6/19/2012	0	0	0	0
Walworth	PX251						8/8/2017	0.295	0	0.125	0
Walworth	PX251						7/10/2012	0.396	0	0	0
Walworth	PX257						8/8/2017	0	0.097	0.399	18.1
Walworth	PX257						7/10/2012	0	0	0	20.3

Shaded rows are data for the same well as row above, but from a prior sampling year.
Notes: Depths shown are in feet, pesticide concentrations are ug/l and nitrate is mg/l.

A total of 12 wells were sampled in agricultural areas near Whitewater, Clinton, Sharon and Darien in Walworth County.   Four of these wells (33%) had been sampled first in 2012 (shaded row) and a second time in 2017. Well construction information was located for just one well (VR839), while depth information was also available for one additional well (VR850), which is a driven point well that was installed by the owner.

- Nitrate was detected in five of the 12 wells. In 2017, three of the wells sampled contained nitrate at or above the ES of 10 mg/l. The average concentration in the 12 samples collected in 2017 was 4.4 mg/l.
- 67% of wells sampled (eight of 12) contained one or more pesticides or pesticide metabolites.
- Three pesticides or pesticide metabolites were detected: no ES exceedances were observed.
- Metolachlor ESA was the most frequently detected pesticide (eight wells). Four wells had no detections of nitrate or pesticides.
- The construction record for one well shows water coming from sand and gravel. The owner of well VR850 stated he had installed the well himself to a depth of just 27 feet deep in sand.
- Four wells were sampled for a second time in 2017. Between the 2012 and 2017 sampling events, pesticide concentrations were similar. Nitrate concentrations remained not-detectable in two wells, while two wells showed a decrease in nitrate concentrations of 2.2 mg/l (PX257) and 7.87 mg/l (PX199).

Staff Recommendations: Resample these wells in five years

10. Marathon City and Franzen Twp., Scandinavia – Marathon & Waupaca Counties

County	WUWN	Well Depth	Casing Depth	Static Water Depth	Bedrock Depth	Description	Install Date	Sample Date	ACETOCHLOR ESA	ALACHLOR ESA	ATRAZINE TCR	METOLACHLOR ESA	METRIBUZIN DADK	NITRATE
Marathon	RA700	33	25	13		SAND & GRVL	6/7/2003	7/11/2017	0	0	0	0.0879	0	0
Marathon	RA700	33	25	13		SAND & GRVL	6/7/2003	6/28/2011	0	0	0	0		0
Marathon	WK350	38	34	15		SAND & GRVL	8/15/2007	7/11/2017	0	0	0.182	1.99	0	9.99
Marathon	WK350	38	34	15		SAND & GRVL	8/15/2007	6/28/2011	0	0	0	0.713		9.37
Marathon	GD717	88	40	22	6	CRYSTLNE BR	10/10/1994	7/11/2017	0.113	0	0	0.189	0	0
Marathon	GD717	88	40	22	6	CRYSTLNE BR	10/10/1994	7/25/2011	0.171	0	0	0.288		0
Marathon	QV942	306	40	21	6	CRYSTLNE BR	8/28/2003	7/11/2017	0	0	0	0	0	4.5
Marathon	QV942	306	40	21	6	CRYSTLNE BR	8/28/2003	7/25/2011	0	0	0	0		8.36
Marathon	RA695	51	47	25		SAND & GRVL	4/21/2003	7/11/2017	0	0	0	0.33	0	4.4
Marathon	RA695	51	47	25		SAND & GRVL	4/21/2003	6/28/2011	0	0.192	0	0.247		3.22
Marathon	PX182	120				CRYSTLNE BR		7/11/2017	0.125	0	0	0.592	0	3.45
Marathon	PX182	120				CRYSTLNE BR		7/25/2011	0.109	0	0	0.38		2.88
Marathon	VR831							7/11/2017	0	0.0904	0	0.781	0.127	7.95
Waupaca	OH928	80	75	26		SAND & GRVL	12/5/2000	7/11/2017	0.0807	0.298	0.895	0.867	0	9.53
Waupaca	OH928	80	75	26		SAND & GRVL	12/5/2000	6/14/2011	0.209	0.279	0.394	0.197		12.5

Shaded rows are data for the same well as row above, but from a prior sampling year.

Notes: Depths shown are in feet, pesticide concentrations are ug/l and nitrate is mg/l.

Eight wells were sampled in agricultural areas near Marathon City and in Franzen Township in Marathon County, and near Scandinavia in Waupaca County. Seven wells were sampled in 2011 (shaded rows) and were sampled for the second time in 2017.

- None of the wells sampled in 2017 contained nitrate concentrations exceeding the ES of 10 mg/l. In two wells (RA700 and GD717), nitrate was not-detected in either sample year.
- 88% of wells (7 of 8) tested in 2017 contained one or more pesticides.
- Five pesticides or pesticide metabolites were detected, but no ES exceedances were observed.
- Metolachlor ESA was the pesticide most frequently detected (7 of 8 wells). Well QV942 was non-detect for pesticides during both sample events.
- Six wells (75%) have construction records showing four draw water from sand and gravel, and three from crystalline bedrock (note that one bedrock well, PX182 was also reported by the well owner to be 120 feet deep and drawing water from granite). The depths of the sand and gravel wells varies from 33 to 80 feet deep and have static water depths from 13 to 26 feet at time of construction. The two granite wells varied from 88 to 306 feet deep: each had 40 feet of casing, six feet to bedrock, and a static water depth of about 21 feet.
- Between 2012 and 2017, nitrate concentrations did not change greatly in samples from four wells (less than 1 mg/l change in nitrate concentration). Two wells decreased in concentration 1 mg/l or more nitrate, and one well increased by 1 mg/l or more.   The largest observed change was a decrease of 3.86 mg/l nitrate at well QV942, a well cased to 40 feet with 266-feet of open borehole in granite.

Staff Recommendations: Resample these wells in five years

Reference Cited:

Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP). April 2017. *Wisconsin Groundwater Quality: Agricultural Chemicals in Wisconsin Groundwater.* Agricultural Resource Management Division publication 264.

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